Gross

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OF THE
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ACADEMY
OF
SURGERY

VOL. XX.

1918

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OF THE

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ACADEMY OF SURGERY

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NOTICE

The present volume of *Transactions* contains the papers read before the Academy from January, 1917, to December, 1917, 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	1904	HENRY R. WHARTON
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VICE-PRESIDENTS.

ELECTED		ELECTED	
1880	D. HAYES AGNEW	1902	JOHN B. DEAVER
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1884	SAMUEL W. GROSS	1905	WILLIAM J. TAYLOR
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1900	HENRY R. WHARTON	1916	GEORGE G. ROSS

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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

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ELECTED

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

ELECTED

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1891 LEWIS W. STEINBACH
1902 JOHN H. GIBBON
1905 JOHN H. JOPSON
1915 JOHN SPEESE

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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.

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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.

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ELECTED

1895 WILLIAM J. TAYLOR
1895 DEFORREST WILLARD
1896 RICHARD H. HARTE
1897 ROBERT G. LECONTE
1900 G. G. DAVIS

ELECTED

1902 JOHN H. JOPSON
1905 GEORGE G. ROSS
1908 FRANCIS T. STEWART
1914 JOHN SPEESE
1915 A. P. C. ASHHURST
1916 D. B. PFEIFFER

COMMITTEE ON SAMUEL D. GROSS PRIZE FUND AND LIBRARY.

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; Surgeon to the Presbyterian Hospital; Dispensary Surgeon to the 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 Episcopal Hospital; Surgeon to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases.

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; Instructor in Surgery in the Jefferson Medical College.

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

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.

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.

1916. CLARK, JOHN G., M.D., 2017 Walnut Street. Professor of Gynæcology in the University of Pennsylvania; Gynæcologist-in-Chief to the University Hospital; Consultant to the Women's College Hospital, Bryn Mawr, Chestnut Hill, Abington, and Jewish Hospitals.

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., University of Pennsylvania, Goett. 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.

1916. DORRANCE, GEORGE M., M.D., 2025 Walnut Street. Surgeon to the St. Agnes Hospital; Professor of Oral Surgery in the Evans Institute of Dentistry and Department of Dentistry of University of Pennsylvania.

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 and Philadelphia Hospitals.

‡ Non-Resident Fellow.

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 Orthopædic Hospital; Assistant Surgeon to the Widener Memorial Industrial School for Crippled Children; Surgeon to the Orthopædic Department of the Episcopal Hospital.

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

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.

1913. HEARN, WILLIAM P., M.D., 334 South 42d Street. Surgeon to the Philadelphia General Hospital.

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.

1916. HIRST, BARTON C., M.D., 1821 Spruce Street. Professor of Obstetrics in the University Hospital; Gynæcologist to the Howard and Orthopædic Hospitals; Consulting Surgeon to the Lying-in Hospital, Newport, R. I., Hospital, and Pottstown, Pa., 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; Associate Surgeon to the Widener Training School.

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; 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.

1914. KEENE, F. E., M.D., 116 South 19th Street. Instructor in Gynæcology in the University of Pennsylvania; Gynæcologist to the Chestnut Hill Hospital; Consulting Gynæcologist to the Abington Hospital; 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; Assistant Surgeon to the Jefferson Hospital; Surgeon to the Out-Patient Gynæcological Department of the Pennsylvania Hospital.

1916. LANDON, L. H., M.D., Carnegie Steel Company, Pittsburg, Pa.

1914. LAWS, GEORGE M., M.D., 2033 Locust Street. 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; Assistant Surgeon American Stomach 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; Surgeon to the Out-Patient Department of the Pennsylvania Hospital; Surgeon to the Dispensaries of the Episcopal, Orthopædic, and Children's Hospitals; Assistant Surgeon to the Bryn Mawr Hospital.

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, Howard, and Mt. Sinai 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. MULLER, 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. Consulting Surgeon to the Pottstown Hospital.

1890. NEILSON, THOMAS R., M.D., 1937 Chestnut Street. Professor of Genito-Urinary Surgery 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., 319 South 16th 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; Surgeon to the Abington Memorial Hospital; Assistant Surgeon to the University Hospital; Assistant Surgeon to the Out-Patient Department of the German Hospital.

1916. RANDALL, ALEXANDER, M.D., 1831 Chestnut Street. Assistant Surgeon to Out-Patient Department University Hospital; Assistant Surgeon to the Genito-Urinary Service Philadelphia General Hospital; Consulting Surgeon to the Germantown Hospital; Assistant Instructor in Surgery in the University of Pennsylvania.

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 Surgeon to the Presbyterian Hospital.

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; Clinical Professor of Orthopædic Surgery in the Women's Medical College.

1894. SHOEMAKER, GEORGE ERETY, A.M., M.D., 1831 Chestnut Street. Gynæcologist to the Presbyterian Hospital; Consulting Surgeon to the Woman's 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 in the University of Pennsylvania; Instructor in Surgery in the Philadelphia Polyclinic; Surgeon, Polyclinic Hospital; Surgeon to Douglas 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., 317 South 15th Street. Orthopædic Surgeon to St. Joseph's Hospital; Physician in Charge of Photo A Department in the University Hospital; Orthopædic Surgeon to St. Edmund's Home for Crippled Children.

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; Assistant Genito-Urinary Surgeon to the Jefferson 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 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. Professor of Genito-Urinary Surgery in Temple University; Genito-Urinary Surgeon to the Samaritan and Garretson Hospitals.

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. 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; 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; 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; 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.
1916. EDWARD B. HODGE.
1917. J. EDWIN SWEET.

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 Lewis Stephen Pilcher....Brooklyn, N. Y.
1916 Wm. W. Keen.....Philadelphia, Pa.

CONTENTS

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING, HELD JANUARY 8, 1917

The President, DR. CHARLES H. FRAZIER, in the Chair

MULTIPLE MOVABLE BODIES IN KNEE-JOINT

DR. T. TURNER THOMAS reported the following case: Man, fifty-one years old. Health has always been good except for trouble in right knee of about thirty years' duration. At twenty-one years of age had scarlet fever which left him with a severe inflammation of the right knee. This kept him in bed or on crutches for about eighteen months or two years. At twelve years of age had a severe injury of the soft tissues about the left knee, but he has never had any trouble with this knee since then. The right knee was very stiff after the crutches were given up, but normal motion gradually returned and for many years he experienced no trouble in the use of the limb. About four years ago, this knee suddenly became fixed in flexion, with severe pain and a sense of a giving way of the limb under him. This kind of attack has recurred many times since, sometimes as often as once in every block walked, sometimes not for several days. Frequently, following an attack, the knee swells and then cannot be fully extended. On palpation numerous bodies can be felt moving about in the joint and the femur, tibia and patella are considerably deformed (Fig. 1).

Operation (December 15, 1916).—At the Stetson Hospital. An incision was made on each side of the joint, running vertically alongside of the patella and turning backward along the joint line to its posterior limit. It extended through all layers into the joint. This was essentially the Jones incision for the removal of the semilunar cartilages. Twenty foreign bodies were removed. Most of them were completely detached. Two large, irregular ones were attached. Just below the patella, under the synovial membrane, were two small bodies which were cut away. Above the patella, under the synovial membrane, in the roof of the suprapatellar bursa, were two other small bodies, which were seized with forceps and pulled away. Another was attached back of the external condyle and was pulled away with some difficulty. The wound was closed in layers by catgut, a dressing and plaster case applied. Primary healing. Was out of bed in ten days and left the hospital in three weeks, wearing a split case for sup-

port and using crutches. As the lateral ligaments of the knee on both sides were completely divided, it is intended to allow them to unite strongly before the case is put aside entirely, which will be done about six weeks after operation.

Dr. Charles H. Frazier reports also a case in which he removed from the knee two unusually large foreign bodies (Fig. 2). The patient was admitted to the University Hospital September 21, 1916, with the following history: That he had sustained an injury to the knee cap thirty years ago, which gave him, however, very little trouble. Last winter he noticed some pain and swelling in the joint, which has continued to the present time, and he was treated for rheumatism. He also had had pain in both elbow- and both wrist-joints. In other respects the history is practically negative. An examination reveals apparent enlargement of the bones entering into the formation of the knee-joint and two movable masses can be detected in the joint on either side of the patella. The presence of these foreign bodies was confirmed by the X-ray plates (Fig. 3). At the operation an incision was made above the patella through the middle of the quadriceps extensor tendon. The joint cavity was opened and the loose foreign bodies found and removed. No others could be felt. The capsule of the joint appeared to be thick and rather œdematous. The margins of the patella presented the appearance rather characteristic of hypertrophied arthritis. The wound was closed with tier sutures and convalescence was uneventful. The diagnosis returned from the Pathological Laboratory was chondroma.

STRICTURE OF THE ŒSOPHAGUS

Dr. Henry R. Wharton reported the following case: Robert T., two years of age, was admitted to the Presbyterian Hospital, November 21, 1915, having a few hours before swallowed a solution of concentrated lye. At this time his condition was urgent, temperature 104.2, pulse 150, respiration very rapid. His condition improved in a few days, but he was unable to swallow semisolids, although he could swallow liquids. Numerous attempts were made to pass œsophageal bougies without success. He took food readily, but it accumulated in the œsophagus and was regurgitated. Under ether anæsthesia attempts were made to pass bougies without success. A bismuth X-ray showed that the stricture was located at the gastric end of the œsophagus. As the patient was rapidly becoming emaciated, in spite of rectal feeding, his weight at this time being twenty-three pounds, on August 19 a gastrostomy was done and a No. 16 Fr. flexible bougie was passed,[1] from the stomach through the stricture and brought out through the anterior nares, and allowed to remain in position twenty-four hours. This was replaced by a soft rubber catheter which had a fenestrum a few

[1] Retrograde catheterization easier and more successful than catheterization from above.

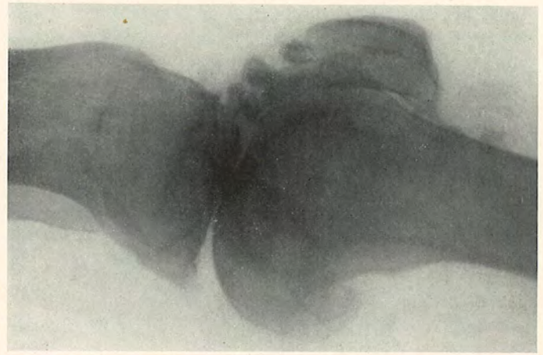

Fig. 1.—Movable bodies in knee. Lateral view.

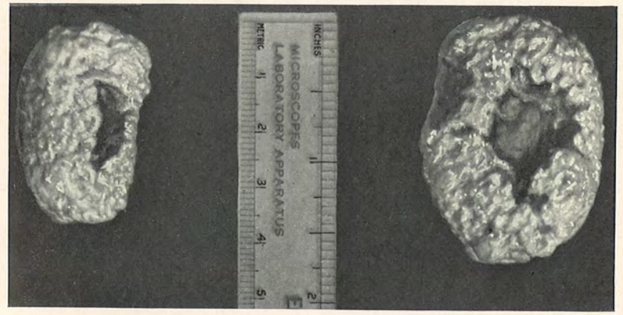

Fig. 2.—Photograph of specimen removed from knee-joint.

Fig. 3.—Röntgenogram of same specimen as Fig. 2.

inches inside the stomach wall, through this liquid nourishment was administered every three or four hours. A shot clamped upon a silk ligature was swallowed and brought out of the gastrostomy wound. By means of this ligature bougies were passed at intervals through the stricture and also a strong silk ligature was passed with which Abbe's operation was done on two occasions. Gradual dilatation was practised with bougies until a No. 30 could be passed. The gastrostomy wound healed promptly and the patient can now swallow solid food. He is now in good condition, weighing thirty-three pounds. On account of the tendency to recontraction of the stricture, bougies should be passed for some time.

CYST OF THE TIBIA

Dr. James K. Young reported the case of a white girl, of Russian birth, thirteen years old, who came under observation at the Polyclinic Hospital in May 22, 1916, suffering from osteitis fibrosa cysticus, of three years' duration, of the lower end of the tibia (Fig. 4). There was a large mass, 5 cm. in each diameter, occupying the outer malleolus and including the entire lower portion of the tibia, there was also a longitudinal scar over this region from a previous operation performed two years ago by Dr. D. L. Despard, who incised the cyst which was found to contain a soft sanguineous mass which was thoroughly cauterized with carbolic acid and treated with alcohol, and the wound closed. After this some improvement was noticed. The examination had shown that the walls of the cyst were thin; it was sensitive to pressure and had been increasing in size. The condition was differentiated from giant-celled sarcoma, which was the condition it most resembled, by the length of time it had existed, the slow growth, and the X-ray appearance. Three methods of treatment were presented. First, a conservative treatment; second, excision and bone transplantation; third, curettement and bone transplantation.

1. Under the use of a weight sustaining apparatus and alterative treatment with local and X-ray treatments, the X-ray pictures showed a distinct change in character, becoming more dense, the cyst diminished in size and lost its sensitiveness. 2. The second method is not to be recommended, as better results are obtained by curettement. 3. The third method of treatment consists of curettement and bone transplantation. If the bone cyst increases in size and becomes more sensitive, it is proposed to curette the cavity, crush the walls and transplant the fragment of bone in order to retain the shape of the cavity and prevent deformity.

Dr. Ginsburg said that two bone cyst cases have been encountered during the past three years in the Fracture Clinic at the Mt. Sinai Hospital. One occurred in the lower extremity of the radius, and the other in the upper extremity of the humerus. Spontaneous fracture occurred in both cases, and during the process of bone repair both

cavities were largely obliterated. The bone cyst in the radius appeared to be multilocular, and before union was complete the entire cavity was still not completely obliterated. Pathological fracture appears to be a certain means of obliterating a bone cyst, and is far superior to any surgical method employed.

We know little about the real underlying pathology of bone cysts, and in our cases X-ray plates of other long bones in the body fail to show the presence of cystic degeneration.

G. P. MÜLLER said that he, in 1904, reported a case of benign bone cyst, and wrote one of the first papers published in this country upon this disease, although a number of cases had been previously reported. Since then many more cases have been reported and several good papers, notably those of Bloodgood, Silver and Landon, have been written. Some eighty cases in all have been reported. Dr. Young states that it is his intention to remove most of the wall of the cyst and to transplant bone to take the place of the defect. The simple crushing of the wall of the cyst is sufficient, and is followed by prompt bone formation. Bloodgood has shown this in all of his reports and there does not seem to be any necessity for extensive bone transplants in these cases. In one case reported by Dr. Landon and operated on by Dr. Müller, the patient had a large cyst of the femur surrounded by a mere shell of bone. Crushing part of the walls of this cyst sufficed to bring about a cure. There was entire regeneration of the bone some months later. In looking over the records of Dr. Frazier's service in the University Hospital, the following case has been found which has never been reported:

Elizabeth H., aged fifteen. The trouble began one year previously as a swelling in the hand, without pain, and without history of injury, and with no other symptoms. Examination revealed a spindle-shaped swelling on the fourth left metacarpal, firm but not of bony hardness, and capable of indentation. An X-ray plate revealed a bone cyst.

At operation the shell of bone was partly removed, the interior curetted, and the wound closed without drainage. Two years later the patient was perfectly well and he had not been able to trace her at the present time. The tissue removed from the interior of the bone was typical of granulation tissue with a few giant-cells, and at one place the pathologist reports the presence of cartilage, but on looking at the plate now, they are inclined to believe that the cartilage is not present.

DR. A. P. C. ASHHURST said that these bone cysts in children are practically always benign, but in a patient of eighteen to twenty-five years one must be cautious in regarding them as benign. He had operated on four cases of bone cyst—three in children and one in a girl of twenty-one years. In the latter case the tumor recurred after the first operation. When he did an incision of the bone subsequently

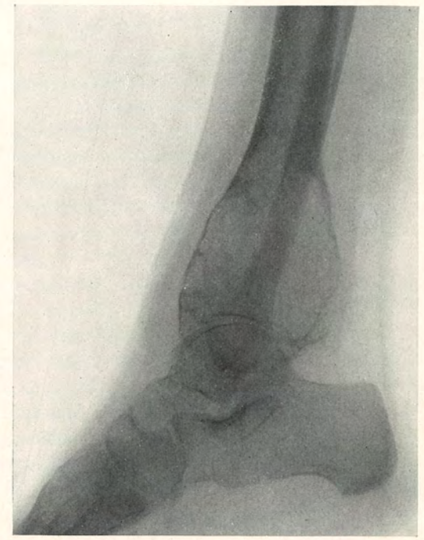

FIG. 4.—Cyst of the lower end of the tibia.

all the pathologists to whom he submitted specimens reported the tumor to be a much more malignant type than ordinarily seen in these cases; the stroma was sarcomatous, and did not resemble granulation tissue, as is the case in benign growths.

Dr. Gwilym G. Davis had operated on a case of this character six or eight years ago in a child of four or five years of age with a cyst of the lower end of the ulna. He simply broke away the outer wall and curetted the cavity, in which there was some granulation material, found to be sarcomatous in structure, and depressed the sides. The wound healed nicely and has remained healed ever since.

ILEOCÆCAL INFANTILE STENOSIS

Dr. Astley P. C. Ashhurst reported the following case: Thomas B., aged two years, was admitted to the Episcopal Hospital, November 25, 1915, with symptoms of acute intestinal obstruction. The illness began November 22, with recurrent attacks of abdominal pain; during the attacks the baby gripped his belly with both fists. As he had suffered with similar attacks all during his life, no great alarm was felt. Vomiting set in, however, and on the third day of what was now seen to be the severest attack he ever had suffered, he was sent to the hospital.

Examination at 1.30 P.M., soon after admission: The child lies quietly on his back, apparently exhausted. His eyes are hollow, his tongue and skin very dry. He has just vomited some bile. Since admission there have been several attacks of sudden abdominal pain, the child crying out, and clutching at his belly. There is violent peristalsis. There is no rigidity, except during the attacks of pain. Above the umbilicus, a transversely placed, sausage shaped tumor is present, which is slightly movable, and not very tender. A diagnosis of intussusception was made, and the child was prepared for operation.

Operation.—Under the anæsthetic 3 P.M. (gas-oxygen, preceded by morphin sulphate grain $\frac{1}{48}$ and atropin sulphate grain $\frac{1}{400}$) no such tumor as above described could be palpated. It was nevertheless determined to proceed with the operation. A right paramedian incision was made downward for three inches from the umbilicus. There was no peritonitis. The lymphatic vessels of the small and large bowels were distended. The transverse colon was normal. The small bowel was not distended. A movable mass, the size of a guinea-hen's eggs, was felt in the ileocæcal region. The small intestines were then packed off with pads, and the ileocæcal coil was delivered through the incision. No intussusception was now present, but there was a tumor in the ileum just above the ileocæcal valve, about 4 cm. in length, precisely resembling the tumor seen at the pylorus in cases of infantile stenosis. There were several inflamed epiploic appendages on the cæcum and ascending colon, but no enlarged mesenteric lymph-nodes were detected.

The wall of the ileum felt thick, and the lumen appeared to be almost obliterated by the tumor which involved the whole circumference equally (Fig. 5). Apparently there had been an intussusception of this mass into the cæcum and ascending colon. A lateral anastomosis (Fig. 6) was made by suture between the ileum just proximal to the mass and the ascending colon (into the anterior longitudinal band, not as shown in the diagram into the median side of the colon). The appendix was not removed, owing to the precarious condition of the patient. The time of the operation was thirty minutes.

Recovery was entirely uneventful. The child was taken home one

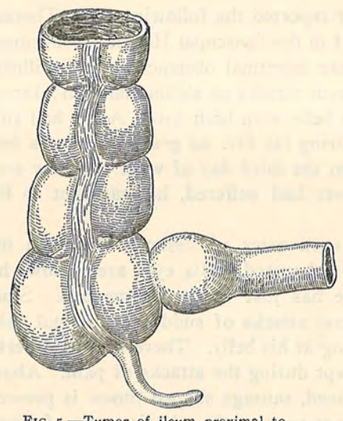

FIG. 5.—Tumor of ileum proximal to ileocæcal opening, causing stenosis.

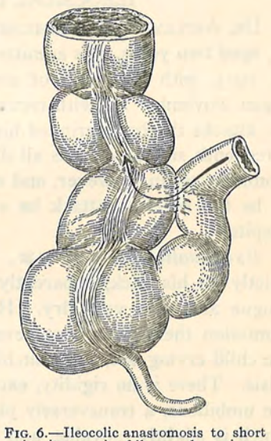

FIG. 6.—Ileocolic anastomosis to short circuit stenosis of ileocæcal opening.

month later, December 25, 1915; and was seen at first at rather frequent intervals. The child is now in perfect health. No attacks of abdominal pain have occurred since operation.

It was not until after the operation, with its rather disconcerting findings, that it was learned from the parents that the child had been subject since earliest infancy to precisely similar attacks, none of which however had been so severe or had lasted so long as that which finally compelled them to seek hospital treatment.

The question of most interest is whether the tumor caused the intussusception, or whether the intussusception caused the tumor. The former supposition is more reasonable, in view of the fact that repeated but milder attacks had occurred more or less constantly throughout life, and that the tumor had not the least evidence of being due to œdema or swelling. It was as like the tumors seen in infantile pyloric stenosis as one pea is like another.

STAB WOUND OF THE DEEP EPIGASTRIC ARTERY*

WITH COMMENTS UPON THE SURGERY OF THAT VESSEL

BY PENN G. SKILLERN, JR., M.D.
OF PHILADELPHIA

J. B., schoolgirl, white, fifteen years of age, was admitted to the Polyclinic Hospital on October 31, 1916, at 9.40 P.M., and discharged, cured, on November 26th.

History of Present Injury.—During a Hallowe'en frolic at 9.30 on the evening of admission—ten minutes before reaching hospital—the patient was stabbed in the abdomen by a fifteen-year-old boy, who wielded a new penknife with a blade 1½ inches by ⅜ inch. The patient experienced pain only when the knife was withdrawn.

Physical examination reveals an incised wound of the abdominal wall which involves the middle of the left rectus muscle just below the level of the navel. The direction of the wound is oblique, and the length is 1¼ inches. There is no protrusion of the omentum or of a viscus. On admission there was no undue amount of external bleeding from the wound, but after etherization was begun a smart amount of blood began to well up from the wound. The patient was not greatly shocked and there was no unusual abdominal rigidity previous to operation.

Operation.[1]—Ether anæsthesia. The stomach was washed out, and many masticated nuts were removed. A vertical incision, 4 inches in length, was made through the middle of the left rectus muscle, incorporating the stab wound. There was active bleeding from the stab wound, and the tissues bordering upon the latter were suffused with blood. On retracting the outer portion of the rectus muscle and inspecting its posterior surface the deep epigastric artery was found to have been severed in the stab wound and was still bleeding, though with diminished force. Both ends of the artery, together with its accompanying vein, were ligated. On incising the peritoneum blood-clots welled up, followed by the thin omentum. Evisceration of the movable intestines was rapidly performed, the coils being covered by hot, moist compresses. The blood-clots led down into the pelvic cavity, from which at least one pint of blood-clots was removed. Careful inspection of iliac arteries and veins and of vessels of mesentery and meso-sigmoid and omentum revealed no other source of hemorrhage; nor was gross injury to any viscus found; there were no fecal contents free in the abdominal cavity, nor was the gut collapsed at any point. Masticated nuts were felt along the course of the

*Read before the Philadelphia Academy of Surgery, January 8, 1917.

[1] By Dr. Skillern in the absence of Professor Morris Booth Miller, upon whose service the patient was admitted.

bowel and in the appendix. The eviscerated intestines were replaced. One pint of normal saline solution was placed and left in the abdomen. The wound was closed by tier sutures of chromic gut. No drainage was employed. Intravenous saline of 750 c.c. was given on the table.

With the exception of superficial infection of the stab wound convalescence was uninterrupted. On the sixth day after operation the patient passed a few old blood clots *per anum*. This suggested that the angular point of the penknife (Fig. 1) had inflicted a small incised wound in the wall of a coil of gut. This wound, however, must have been immediately closed by contraction of the muscular wall of the bowel aided by prolapse of the mucosa into the mural wound, for at the time of operation there were no signs of an unsealed perforation of the intestine.

The salient feature in this case was the concealed hemorrhage. Writing upon punctured wounds of the arteries of the abdominal wall Lidell [2] says: "When these arteries are opened by wounds which penetrate the abdominal cavity, and the apertures in the integuments are closed without first securing the wounded vessels, the blood may flow inwardly and collect in great quantity in that cavity; *this concealed hemorrhage may be so abundant as to prove fatal.*" That such a hemorrhage may prove rapidly fatal is shown in a case of perforation of the deep epigastric artery in the course of paracentesis for ascites.[3] In this case puncture was made at a point equidistant from the navel and anterior superior iliac spine. On withdrawing the trochar a small drop of blood appeared at the puncture orifice. Two and one-half hours after puncture the patient began to manifest signs of internal hemorrhage and died shortly afterward while waiting for a priest. At necropsy a large quantity of red and almost pure blood escaped from the abdomen —*about 4 litres. A great clot occupied the left iliac fossa.* The epigastric artery itself, and not one of its branches, was injured. Our patient was upon the operating table one hour after the stabbing. Concealed hemorrhage from such a wound may be checked and even prevented when, by a fortuitous circumstance, the omentum prolapses into the wound and acts as a natural hæmostatic packing. Such a case is reported by Hunter.[4]

W. S., white man, age ——, in a fight a few hours ago, was stabbed with a short dirk in the abdomen. The knife entered about 1¼ inches to the left of the median line, a little below the level of the anterior superior process of the ilium. Cutting inward and upward diagonally across the fibres of the rectus muscle, the knife divided a branch of the deep epigastric artery and entered the abdominal cavity. The withdrawal of the knife was

[2] Ashhurst's "International Encyclopædia of Surgery," 1883, iii, 129.
[3] Merle: Bull. et mém. de la Soc. anat. de Paris, 1907, 6 S, 9, 522.
[4] Maryland and Virg. M. J., Richmond, 1860, xv, 136.

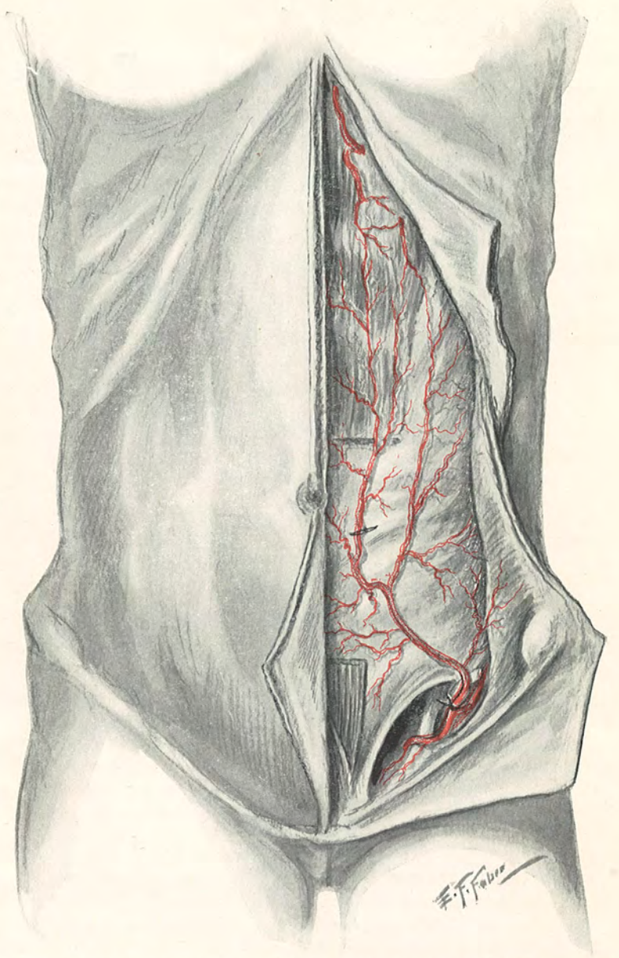

Fig. 1.—Sketch from dissection by author of deep epigastric artery, showing its course, division into two trunks, branches of distribution and anastomoses. Below and to left of navel is shown the portion divided by the stab wound. The site of election for the application of a ligature is shown close to the origin of the vessel from the external iliac. The anomalous obturator vessel is shown better in Fig. 2.

followed by considerable hemorrhage, but this was soon arrested by a piece of the omentum as large as the hand, being forced through the wound during the efforts at vomiting and coughing, which immediately succeeded the injury.

In our case the appearance of the usual signs upon which exploratory cœliotomy for perforating wounds is based was anticipated by immediate operation, which was based solely upon the surgical axiom that, given a penetrating incised, lacerated or punctured wound—especially in the region of important vessels, nerves, tendons, or viscera—the extent of damage done by the vulnerating agent can be accurately determined by exploratory operation alone. *In this case it was just as important to find out what the knife did not do, as it was to find out what it did do.* Thus, when the patient was first seen all that could be learned by inspection was that there was a penetrating wound which had divided the skin over the known course of the deep epigastric vessels; in order to inspect further we had to explore, and by exploring we found the deep epigastric vessels divided, the peritoneum opened, and hemorrhage taking place from the vessels through the rent in the peritoneum into the pelvic cavity. As to what the knife did not do we assured ourselves that it did not make a gross wound in the bowel, nor injure the vessels of the omentum or mesentery. Without exploration the true situation would have been but a matter of conjecture.

In the Medical and Surgical History of the War of the Rebellion, Part II, surgical volume ii, p. 9, Otis reports seven cases of secondary hemorrhage from gunshot wound of the deep epigastric vessels, of which five cases were fatal. He states, "Here, as in the management of bleeding from the wounded internal mammary and intercostal arteries, timid, inefficient, temporizing treatment appears to have been followed by lamentable loss of life. *The instances to be cited teach emphatically that wounds of the epigastric, circumflex, mammary, and lumbar arteries are not to be regarded as trivial, but demand the rigorous application of the rules for the management of wounded arteries, the exposure of the bleeding point, and a proximal and a distal ligature.*"

Had operative interference been delayed in this case the concealed nature of the hemorrhage would, of course, have been indicated by pallor, by cold, clammy sweats, and by feeble pulse, along with sighing, thirst and restlessness. The accumulating blood gravitating to the pelvic cavity would have produced sensible enlargement of the hypogastric region, soft at first, and solid afterwards, and would have been detected by rectal palpation.

Boyer[5] speaks forcibly of the importance of ligation for hemorrhage from these wounds, and gives particulars of an instructive case of wound of the deep epigastric artery, that proved fatal, in which this

[5] Cited by Lidell, *loc. cit.*

measure had been neglected. Guthrie[6] several times saw this artery tied with success. In the case of a Portuguese soldier stabbed in the belly with a sabre, there was profuse hemorrhage from a small wound made by the point of the weapon. This wound Guthrie enlarged until the wounded but undivided artery became visible; upon this two ligatures were placed, and the external wound was sewed up. The man recovered.

SURGERY OF THE DEEP EPIGASTRIC ARTERY

According to Cunningham's description, the deep epigastric artery (Fig. 1) arises immediately above Poupart's ligament from the front of the external iliac. Curving forward from its origin it lies in the extraperitoneal fat, it turns round the lower border of the peritoneal sac, and runs upward and inward along the inner side of the internal abdominal ring and along the outer border of Hesselbach's triangle; it then pierces the transversalis fascia, passes over the semilunar fold of Douglas, and enters the sheath of the rectus abdominis. For a short distance it ascends behind the rectus, but it soon penetrates the substances of the muscle, and breaks up into branches which anastomose with terminal offsets of the superior epigastric branch of the internal mammary artery and with the lower intercostal arteries. At the internal abdominal ring in the male the vas deferens, the spermatic vessels, and the genital branch of the genitocrural nerve hook round the front and outer side of the artery, the vas deferens turning inward behind it; whilst in the female the round ligament of the uterus and the genital branch of the genitocrural nerve occupy the corresponding positions. The branches are muscular, cutaneous, cremasteric and pubic. The *pubic branch* descends on the outer or the inner side of or across the crural ring to anastomose with the pubic branch of the obturator artery. Sometimes when the obturator branch of the internal iliac artery is absent, the pubic branch of the deep epigastric artery enlarges and becomes the obturator artery (Fig. 2), which descends to the obturator foramen, according to observations made by Jastschinski, along the outer border of the crural ring in 60 per cent. of the cases, this arrangement being more frequent in females; across the ring in about 22.5 per cent. of cases, again more frequent in females; and along the free edge of Gimbernat's ligament in only 17.5 per cent. of cases, this being more common in males. In the last two instances the artery may be injured in the operation for the relief of a strangulated femoral hernia.

The deep epigastric artery may be mapped out by drawing a line from a point midway between the anterior superior iliac spine and the symphysis pubis towards the navel. According to the dissection made by the writer (Fig. 1) the trunk of the deep epigastric artery, on reaching the outer border of the rectus, divides into two large branches, a mesial, which continues the course of the trunk upward through the

[6] Commentaries, etc., p. 510. Am. ed.

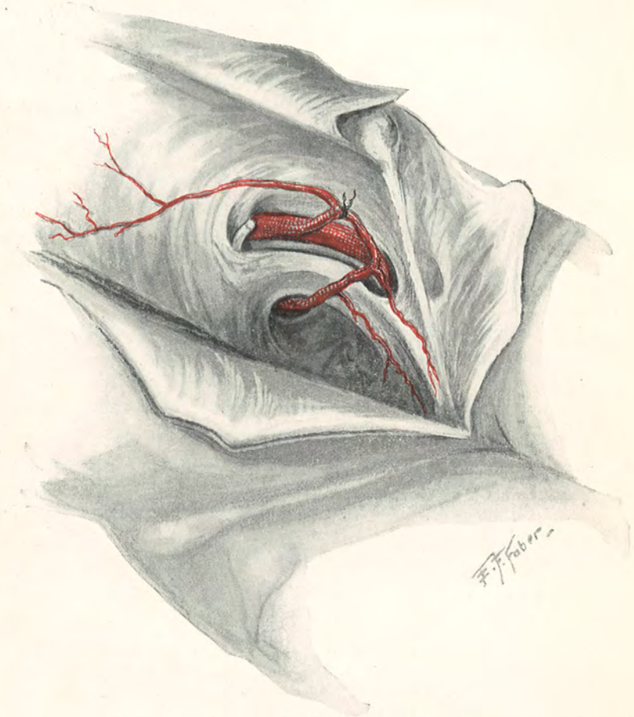

FIG. 2.—Sketch from same cadaver as Fig. 1. The obturator is seen arising anomalously from the deep epigastric and descending in dangerous relation with crural ring to obturator foramen. The application of a ligature to this vessel at its origin is shown.

rectus muscle, and a lateral, which bends laterally as it inclines upward, to supply the flat muscles of the flank. Both are shown in the cut anastomosing with the superior epigastric and lower intercostals.

The deep epigastric artery is but one of a series of what we shall term parietal vessels of the trunk, the others being the internal mammary with its perforating branches, the intercostals, the lumbar, the iliolumbar, the circumflex iliacs, and the superficial epigastric. Practically all these vessels are of surgical significance, the first in the operation of removal of the breast, the second in punctured wounds of the thorax and rib resection, and the last in herniotomy. All must be dealt with with wholesome respect, for practically all when opened and not tied are capable of terminating life by hemorrhage.

The deep epigastric artery is larger than it is commonly conceived to be. In the specimen from which the sketch (Fig. 1) was made the trunk was the size of the ulnar. It is accompanied by a single vein, although in some cases there are two veins. When the artery has been injured the hemorrhage may be checked by packing with iodoform gauze or by ligation. It is very easy to ligate the vessel close to its origin, as the writer found by investigations upon a series of cadavers. All that is necessary is to make a ¾-inch incision above and parallel with Poupart's ligament, and midway between the anterior superior iliac spine and the symphysis pubis. Cutting down through skin, both layers of superficial fascia (ligating the superficial epigastric), deep fascia and external oblique aponeurosis, the cremaster and arching fibres of the internal oblique are pushed upward and the transversalis fascia is incised, exposing the deep epigastric vessels in their first stage, and the ligature is applied as shown in the cut (Fig. 2).

The deep epigastric artery is involved in the following surgical conditions:

(1) Stab or gunshot wounds, already considered.

(2) Spontaneous hæmatoma of the rectus muscle, a case of which was presented before this Academy by Dr. John Speese.[7]

(3) Injury in paracentesis abdominis. This subject has been thoroughly worked up by Trzebicky.[8]

(4) Division during a cœliotomy incision. Here the conditions are the same as when the artery is divided by a stab wound, and they must be dealt with accordingly, remembering to ligate both ends.

(5) Postoperative secondary hemorrhage, especially in drainage cases. Here it is the custom to pack, but ligation of the vessel at its origin is both surer and safer, and prevents recurrence of secondary hemorrhage with possibly fatal results.

(6) Division of anomalous obturator artery when cutting Gimbernat's ligament to relieve the constriction of a strangulated femoral

[7] Annals of Surgery, February, 1916, 245.
[8] Archiv f. klin. Chirurg., 1890–1891, xli, 850–65.

hernia. Since this accident cannot be foreseen when working from below, it may be avoided to some extent by dulling the blade of the herniotome, so that while it is sharp enough to divide the dense Gimbernat ligament, yet it is so dull that it pushes the artery before it. It should be borne in mind, also, that the merest nick of the constricting tissue is usually all that is necessary to enable the strangulation to be overcome. In case of uncontrollable hemorrhage from the vessel it must be ligated close to its orgin from the deep epigastric artery in the manner already described for the latter vessel, and as shown in the sketch (Fig. 2).

STAB WOUND OF MESENTERIC VEIN

Dr. George P. Müller reported the case of a butcher, age twenty-five years, who, while at work, slipped and fell against a long, sharp meat knife which he was using at the time. It entered the abdomen. He became faint, and had some abdominal pain, and a few hours later was brought to the University Hospital on the service of Dr. Charles F. Frazier.

The history of the injury, general abdominal rigidity, some dulness in the flanks, and a leucocytosis of 17,000 were suggestive of intra-abdominal hemorrhage, possibly also of peritonitis. Operation was immediately performed (July 14, 1916). On opening the abdomen it was found to contain a considerable amount of fluid blood, and investigation revealed three punctures of the mesentery through which blood was oozing, and a nick in the serous coat only of the intestine, just above the mesenteric wounds. The knife had evidently nicked the bowel, and penetrated the mesentery twice, just as a pin is passed through a coat lapel. Between the leaves of the mesentery there was considerable bleeding, and this extended for six or eight inches on either side of the wounds. The punctured areas were caught *en masse* and ligatures applied. The blood clots were removed from the abdomen and the abdomen washed out with salt solution. The patient was discharged nine days after the operation and recovery was uneventful.

Dr. Gwilym G. Davis said that before exploratory operations were as common as they are now he had a case of stab wound of the deep epigastric artery rather high up, just below the lower edge of the ribs. The wound was enlarged slightly but it was so difficult to control the bleeding that he made an incision about an inch below the wound and placed his index finger in underneath and compressed the deep epigastric artery against the abdominal wall. That controlled the hemorrhage and enabled him with the other hand to enlarge the wound sufficiently to control the bleeding vessel without further difficulty. He did not recommend that technic to-day, but it answered well in that case. In that instance there were no such symptoms as mentioned in the paper. In many of these cases of stab wound, although the abdominal wall is perforated, the intestine may not be seriously damaged.

THE GROSS PATHOLOGY OF MEDIAN BAR FORMATION IN THE URINARY BLADDER*

By Alexander Randall, M.D.
of Philadelphia

In 1830 G. J. Guthrie, of England, first described median bar formation as a cause of vesical obstruction. His contribution was read before the Royal College of London under title of "Bar at the Neck of the Bladder." During the sixty years that followed the subject received but scant attention from surgeons, with the possible exception of the work of Mercier. For the past two decades this form of obstruction to urination has been studied anew from many points of view, so that we now have a very complete understanding of the character of such obstructive formation. This knowledge includes the clinical symptomatology and diagnosis, the cystoscopic appearance and examination, and the various operative procedures devised for its relief. Again, the tissue removed in the cases of true bar formation by operative means has been subjected to microscopic section as to its minute pathology, so that one might to-day say that the only chapter of median bar formation left unexplored is the gross pathological picture of the condition.

It does seem strange that isolated gross specimens of median bar formation have not been recognized and recorded previously by investigators, either surgeons or pathologists, and I am afraid that it is due to the neglect to investigate these parts routinely at the post-mortem table. There are to my knowledge to-day, after a comprehensive review of the literature, but three illustrations of what we designate as median bar formation; the first by Mercier in 1850, the second by Englisch in 1901—both rough wood cuts—and the third by Watson.

Appreciating that the ideal way would be to trace clinical cases through their post-mortem examination in order to obtain such gross specimens of median bar formation, it was found that the rarity of such opportunities, and the lack of the appreciation of its clinical symptomatology, forbade such a course, and it seemed the wiser procedure to cast aside the detail of the many failures that were bound to occur, and to examine a long series of bladders, urethras, and prostates, as they came to the autopsy table, irrespective of age or clinical diagnosis, hoping thereby to obtain a few specimens in the series which presented the gross changes of median bar formation, trusting to *other* than clinical means to determine the diagnosis, and to have illustrations made of the findings so obtained.

During post-mortem examination of patients, who have died of various diseases in the wards of our large city hospital, there can be frequently observed, in male subjects over forty years, indications of a

*Read before the Philadelphia Academy of Surgery, January 8, 1917.

mild degree of chronic prostatic disease with associated damage to the urinary tract above. It is generally found that no complaint has been made of this by the patient, it is usually unsuspected, unrecorded on the history, and has virtually never received treatment. In these cases, however, one finds at autopsy beginning trabeculation of the bladder, the presence of a slight bas-fond indicative of retention and back pressure, the ureters and renal pelves are dilated to a mild extent, and there is present a recent interstitial nephritis throughout both kidneys, and the renal parenchyma shows indications of pressure atrophy through its substance. When this pathology is viewed by one with a surgically trained mind, it is impossible to avoid the conclusion that the renal destruction, as the result of the partial retention of urine from the prostatic condition, has contributed to a certain extent to the lowering of the patient's power of resistance to a general infection, or has poisoned the heart muscle by the retained products of metabolism which should normally be excreted by the healthy kidneys. These patients succumb to other lethal affections, and their clinical and anatomico-pathological diagnoses rarely take into account the part played by the urinary obstruction, in fact it is the exception if any attention, either at the bedside or the post-mortem table, is directed toward such a diagnosis unless very marked changes are present. Clinically we know that frequently a patient bordering on uræmia and its fatal outcome is born anew to years of useful livelihood by the removal of the obstruction caused by an hypertrophied prostate, and the time is now ripe that *other* forms of vesical obstruction of equal danger should be similarly appreciated and appropriately treated, before the patient, handicapped and poisoned by his own faulty bladder function, succumbs to the first trial his bodily resistance is tested against.

There have now been examined a total of 200 autopsy specimens in this series with ages varying from nineteen to seventy-nine years. Studying them by decades we find that:

From	10	to	20	years	there	were	3 cases.
From	21	to	30	years	there	were	21 cases.
From	31	to	40	years	there	were	37 cases.
From	41	to	50	years	there	were	51 cases.
From	51	to	60	years	there	were	42 cases.
From	61	to	70	years	there	were	33 cases.
From	71	to	80	years	there	were	9 cases.
From	81	to	90	years	there	were	0 cases.
And of age unknown					there	were	4 cases.

It is interesting to note that in this series of 200 cases 46 (23 per cent.) have shown gross pathological changes of one kind or another in either the bladder, the prostate, the posterior urethra, or the seminal vesicles, and the returns from this mode of study have been most lucrative and interesting in all branches of urological pathology.

There have been found 28 specimens of median bar formation, 14 per cent. of the total number of specimens examined showing changes of this type.

Of these 28 median bar cases 8 specimens are recorded as large, by which I mean that there is no doubt that the condition as found must have caused some urinary obstruction and retention, and that the size of the bar and the visible damage to the urinary tract above stood out as a marked abnormality on examination of the specimen. They represent 4 per cent. of the total series and occurred at the ages of forty-six, fifty, fifty-four, fifty-eight, sixty, sixty-seven, and seventy-nine years.

In the remaining 20 cases (10 per cent.), the bar is recorded as small, meaning thereby that though the abnormality was unmistakable on macroscopic examination, the condition was not of so pronounced a degree, nor was it associated with other changes that would make me feel positive that urinary obstruction, of importance or degree sufficient to cause retention, had yet occurred. They are simply the early cases, where development had not reached such a degree as in the previous group. In these the ages are recorded as from twenty-six to seventy-four years. The average age for the cases classified as large bars is 57.7 years and for the small bars 47.5 years, a difference in figures that was to be expected, but not to be considered weighty, except from a clinical and diagnostic standpoint, for with but few omissions they are all within the age when hypertrophy of the prostate may be expected to be the cause of the condition.

In studying these specimens grossly it has been possible to group them into four types which may be described as follows:

1. A type of abrupt bar or dam, rising from, or better stretched across, the posterior lip of the vesical orifice, formed of firm, dense, sclerotic tissue, whose edge is sharp and narrow, and whose lateral terminations form an abrupt angle with the lateral walls of the vesical outlet. In these cases one is apt to find that the so-called urethral trigone—that fan-shaped, striated area, which normally spreads downward from the posterior vesical orifice to converge upon the formation of the verumontanum—has been distinctly shortened, and in marked cases the verumontanum is drawn up directly under the abrupt rise that forms the median bar. This type of bar on cross section is macroscopically composed of fibrous tissue and is definitely sclerotic from connective tissue proliferation. It is always associated with small, non-hypertrophied lateral prostatic lobes, and has been present in three of the eight cases classified as "large" bar formation.

2. In the second type the bar has an upward tendency of growth, and seems to encroach upon, or draw upon, the vesical trigone more than upon the urethral surface. This type is characterized by an infolding, or creasing, of the vesical trigone transversely, and is the type more readily appreciated cystoscopically by reason of the above characteristic and by the proximity of the ureteral orifices to the vesical outlet. This

type has been least frequently found in this series of cases and likewise shows less tendency to obstructive changes. There were found in all three specimens of this type of bar in the entire series. On cross-section it is composed of fibrous tissue similar to that found in Type 1, and has simply expended its efforts in a different direction and is not associated with the urethral shortening so characteristic of the former.

3. In the third type there is formed a bar due to glandular hypertrophy which has its origin in the true median lobe glands, under the sphincter muscle and within the prostatic capsule. This is often the most prominent feature of a beginning general hypertrophy and the early cause of obstruction to the emptying of the bladder. Slight hypertrophy at this point will cause the formation of a thick, broad, rounded-edged bar of quite different character from that of the other two types, and will cause an obstruction at the orifice, long before a correlative amount of hypertrophy in the lateral lobes assumes any importance whatever. On section there will be found a definite layer of uninvolved tissue three to four millimetres in thickness composed of the mucous and submucous layers, under which will be found definitely hypertrophic glandular tissue occupying the situation of the median lobe acini in the posterior prostatic commissure, with a well-marked encapsulation. This type of obstructive bar is without question the most frequent variety, and seems to be the prevalent location where hypertrophic changes are most apt to start.

4. The fourth type of bar formation is that due to an hypertrophy of the subcervical glands of Albarran[1] alone. These hypertrophies have proven to be quite frequent and rarely develop as a definite bar, but rapidly assume the shape of a perfectly rounded lobe with deep lateral cleftings, and, though often causing marked evidences of urinary obstruction, even when quite small, are seldom in the class of true bar formation. Several beautiful specimens of such isolated hypertrophies have been encountered in this series, and it has been a matter of difficulty to decide whether to group them with the bar cases where clinically they belong, or under prostatic hypertrophy which anatomically they are.

Clinically both these types of glandular hypertrophies cause urinary obstruction, and the size will often obliterate the anatomical origin. Moderate-sized enlargements form a borderline group where personal opinion alone can be used in deciding the anatomical origin as between the glandular bar and the solitary hypertrophied subcervical glands.

If one bears in mind the close similarity of the symptomatology of all vesical neck obstructions and the four types here differentiated, one can then readily appreciate that first of all (*a*) the surgical treatment

[1] The simultaneous association of hypertrophic changes in both the posterior commissure and the subcervical glands of Albarran are now under investigation by microscopic study.

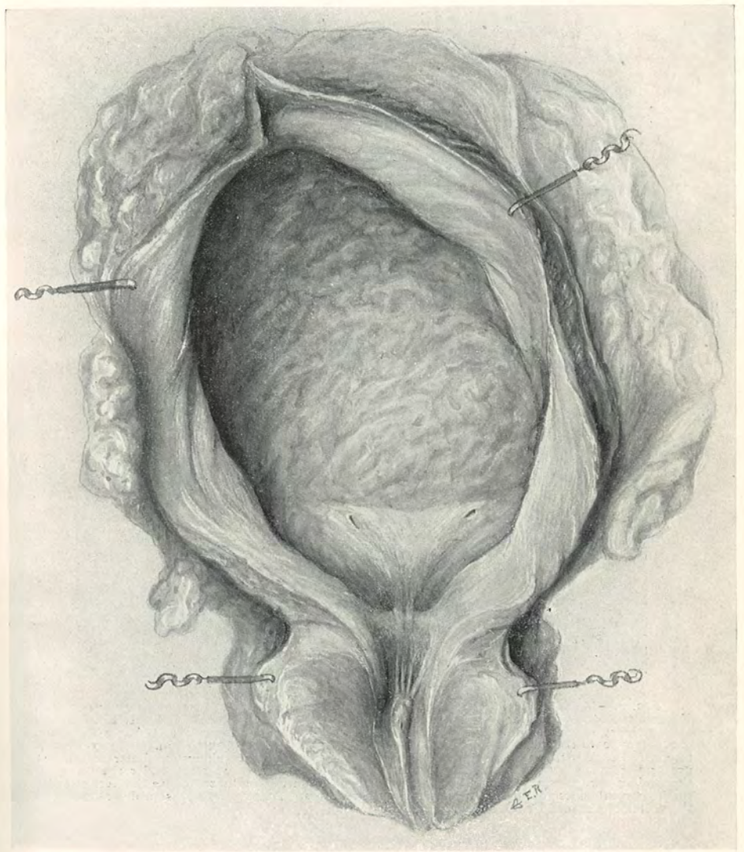

FIG. 1.—Specimen No. 3927. Shows the normal bladder cavity, trigone, vesical orifice, urethra, and prostate of a male, dying at the age of forty-two years, as viewed when opened along the ventral or anterior surface. Note size and relative positions of ureteral orifices, trigone, uvula vesicæ, urethral trigone, verumontanum, and size of prostate. The proportions are drawn to the scale of life size, to which all the following illustrations may be compared, as the same scale has been maintained throughout.

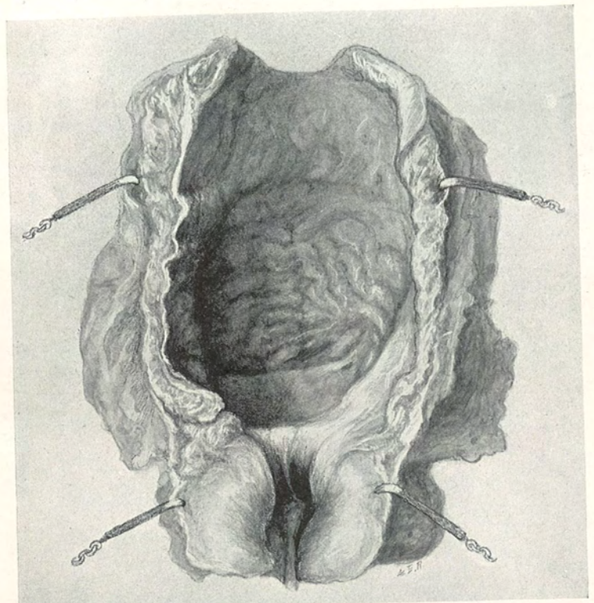

FIG. 2.—Median bar; fibrous; Type 1. Specimen No. 3850. F. H., aged sixty-seven years. Entered the Men's Medical Ward on December 21, 1915. Profoundly toxic, catheterization necessary, urinary output small. Died December 27, 1915. Clinical diagnosis: Lobar pneumonia, chronic myocarditis, chronic nephritis. Anatomical diagnosis: Lobar pneumonia, pleurisy, chronic interstitial nephritis, hypertrophy and dilatation of heart. Specimen shows good bar formation: urethral trigone very much shortened with verumontanum drawn up close under the breast of the median bar. Vesical trigone and prostate normal in outline and size. Note the abrupt angle to the normal course of the urethra where the bar occurs. There was likewise a diverticulum in the vertex of the bladder not shown in this illustration.

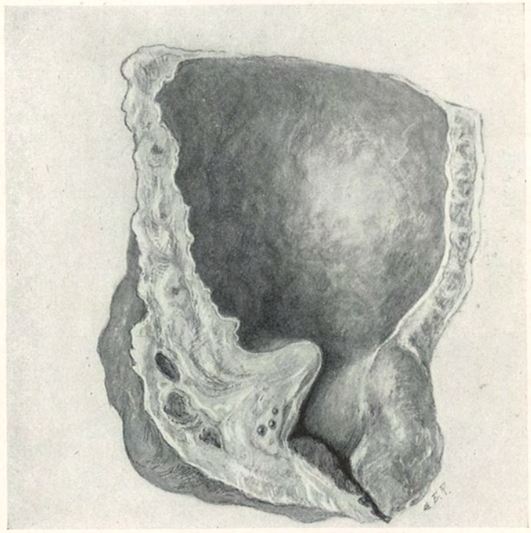

FIG. 3.—Median bar; fibrous; Type 1. Specimen No. 3850. Same as Fig. 2, drawn after sagittal section of the specimen, giving in clear detail the position of the bar, character of tissue, location of verumontanum, and abrupt angle to the normal urethral course.

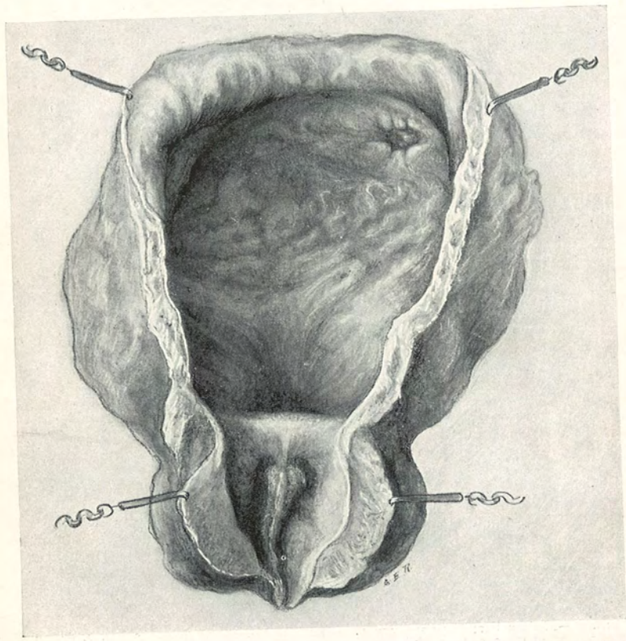

FIG. 4.—Median bar; fibrous; Type 1. Specimen No. 3871. M. G., aged sixty. Entered Medical Ward, January 14, 1916. Suffering with an acute attack of influenza. Died January 20, 1916. Clinical diagnosis: Lobular pneumonia. Anatomical diagnosis: Lobular pneumonia, pleurisy, parenchymatous nephritis, early interstitial nephritis. Specimen shows a thick, short bar, with marked shortening of the urethral trigone, verumontanum being drawn up directly under the base of the median bar formation. Prostate of normal size, vesical trigone of the Y-shaped variety. Evidence of urinary obstruction seen in the formation of the small diverticulum in the vertex of the bladder.

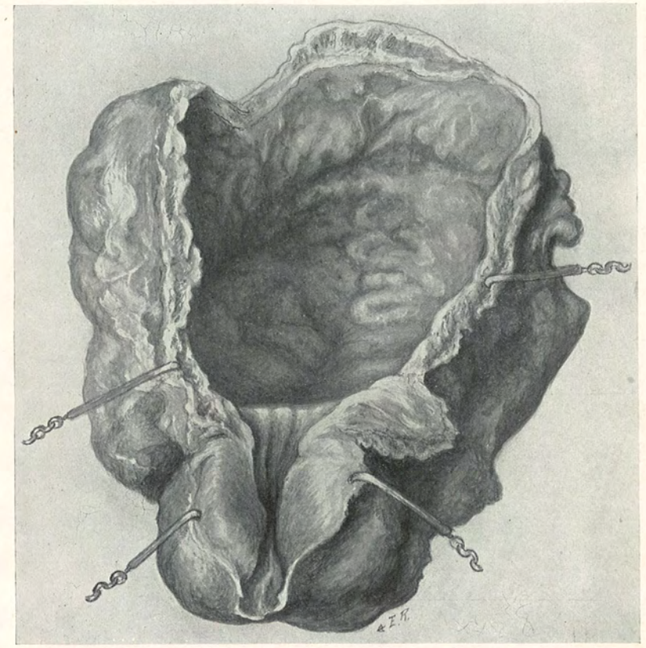

FIG. 5.—Median bar; fibrous; Type 2. Specimen No. 3834. C. T., aged seventy-six. Entered the hospital July 17, 1914. History highly suggestive of carcinoma of the œsophagus, and after a protracted confinement the patient died December 10, 1915. Clinical diagnosis: Carcinoma of the œsophagus, chronic myocarditis, arteriosclerosis. Anatomical diagnosis: Carcinoma of the œsophagus, stomach, and liver; chronic diffuse nephritis. Specimen a good illustration of bar formation and of the second type which is characterized by encroachment on the vesical trigone, with shortening and transverse creasing of it, rather than on the urethral surface. There is a well-marked bas-fond and beginning trabeculation and thinning in the bladder walls. No prostatic enlargement.

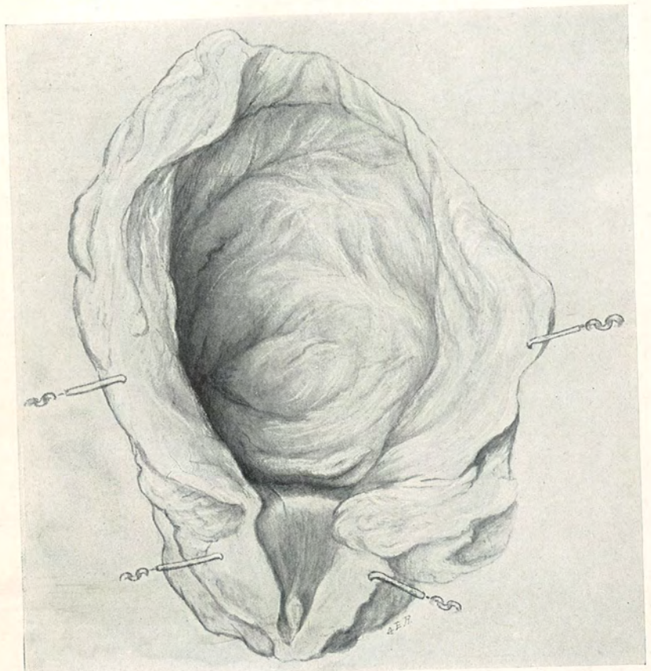

FIG. 6.—Median bar; fibrous; Type 2. Specimen No. 3959. A. F., aged fifty-five. Entered Tuberculous Ward December 21, 1915. History gives no note on any genito-urinary complaint. Died March 30, 1916. Clinical diagnosis: Pulmonary tuberculosis. Anatomical diagnosis: Ulcerative and conglomerative pulmonary tuberculosis, chronic parenchymatous nephritis, slight dilatation of right ureter. Specimen shows the second variety of bar where the encroachment is upward and upon the vesical trigone. The urethral surface is but little if any shortened, but the bar is definitely present and there is a deep transverse clefting or creasing of the vesical trigone that brings the ureteral orifices in close approximation to the vesical orifice. The bladder wall is as yet undamaged except for the presence of a decided bas-fond.

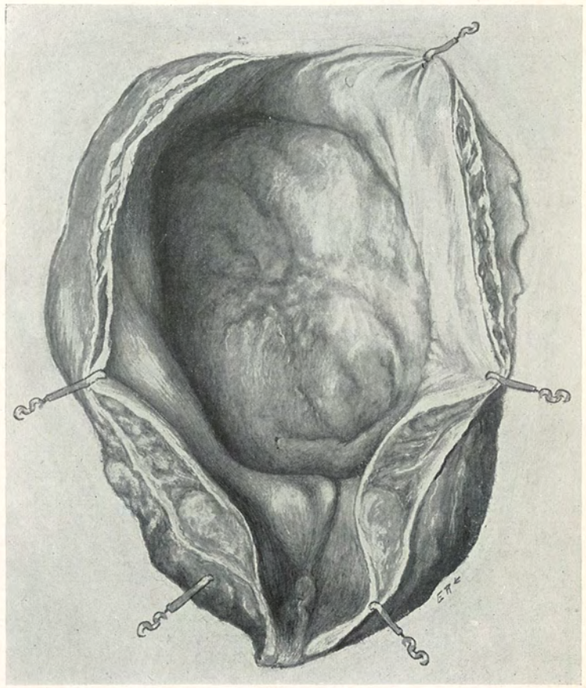

FIG. 7.—Median bar; glandular; Type 3. Specimen No. 4123. G. F. H., aged fifty-six. Entered the Men's Medical Ward May 17, 1916, complaining of shortness of breath and general cardiac symptoms of eighteen months' duration. History of a specific urethritis in youth. Physical examination reveals general symptoms of broken compensation and Cheyne-Stokes respiration. History notes urinary output as small, urine examination shows low specific gravity, trace of albumin, and a few hyaline casts. Patient died October 1, 1916. Clinical diagnosis: Myocarditis, decompensation, chronic interstitial nephritis. Anatomical diagnosis: General anasarca, dilatation of heart, chronic fibroid myocarditis, multiple pulmonary infarcts, chronic diffuse nephritis. The specimen is one of glandular bar formation due to hypertrophic glandular changes in the posterior prostatic commissure. The bar is thick, rounded, and firm. The bar has an upward tendency of growth causing, as is characteristic of Type 2, a transverse creasing of the vesical trigone: however, grossly, it in no wise resembles a fibrous type of bar. The lateral prostatic lobes are slightly enlarged. The bladder wall decidedly hypertrophied.

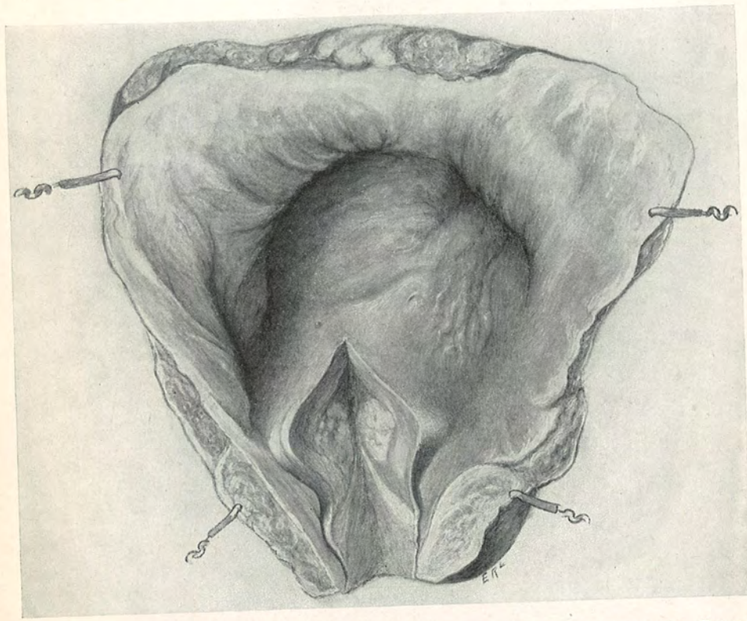

FIG. 8.—Median bar; glandular; Type 3. Specimen No. 4071. W. I. L., aged twenty-six. Entered the Medical Ward July 14, 1916, with acute pulmonary symptoms. He gave a history of having had a Neisserian infection fifteen years ago. There are no genito-urinary symptoms recorded on the history. He died a typical pulmonary death July 16, 1916. Clinical diagnosis: Lobar pneumonia. Anatomical diagnosis: Lobar pneumonia, cloudy swelling of kidneys. The specimen shows a small bladder with thick (hypertrophied) walls. There is a definite bar at the vesical orifice of the thick glandular type. The hypertrophy of the bladder musculature has been in an effort to overcome the beginning obstruction, and helped by youth the compensation has apparently been complete to the time of death. Section of the bar in the midline demonstrated an increase in the prostatic glandular tissue of the posterior commissure, early hypertrophy at this point having been responsible for the bar formation.

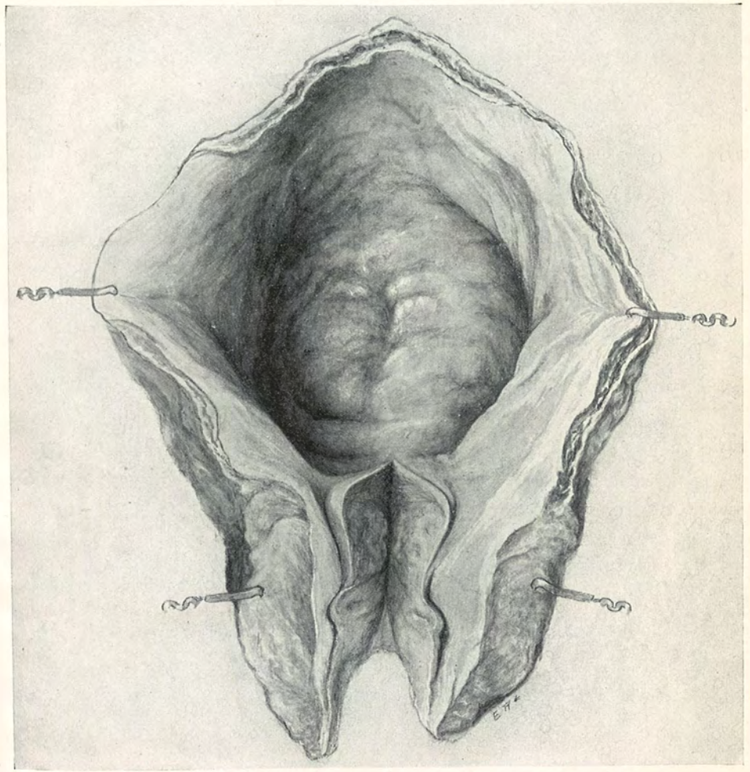

FIG. 9.—Median bar; glandular; Type 3. Specimen No. 4039. F. K. B., aged fifty. Entered the Neurological Ward, May 30, 1916, complaining of pains in his legs and head, and an unsteady gait. Only genito-urinary note in the history is the occurrence of a specific urethritis six years previously. Patient died in an apoplectic stroke on June 9, 1916. Clinical diagnosis: Cerebral hemorrhage. Anatomical diagnosis: Intracranial tumor, bronchopneumonia, cloudy swelling of kidneys. Specimen is one of the thick median bars which has been incised in the midline to again demonstrate the hypertrophic glandular tissue in the posterior prostatic commissure as the cause of the bar formation. There is a very slight amount of lateral hypertrophy, and the bladder wall is beginning to give way and to dilate its walls being considerably thinned

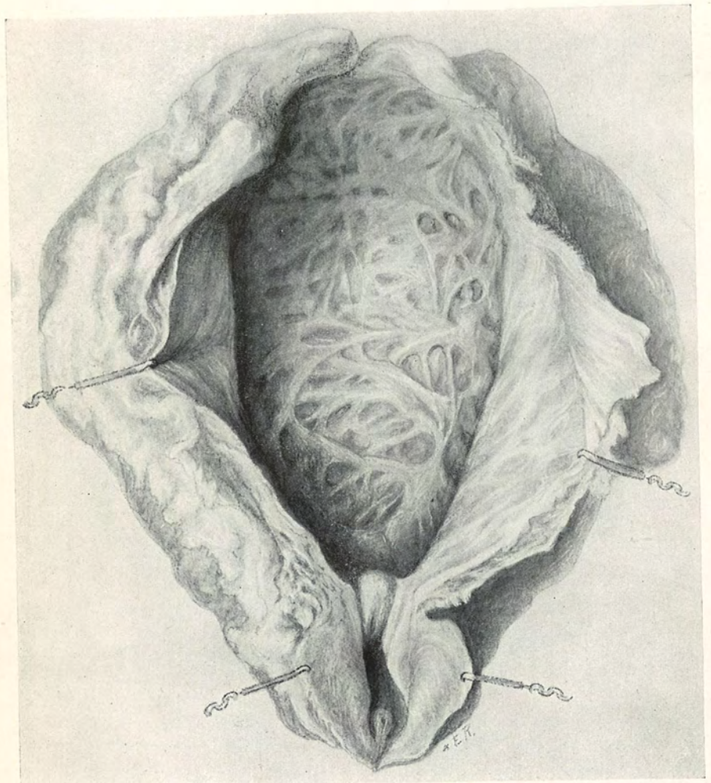

FIG. 10.—Median bar; glandular; Type 4. Specimen No. 3963. G. S., aged fifty. Entered the Insane Wards, February 2, 1916. He had been picked up on the street by the police, gave evidences of having lived a tramp's life, could give no coherent statement as to his past and lacked any knowledge of the present. His history notes general lessening of mental faculties, restlessness, senility, and dementia. He is incontinent. Wassermann is negative. Died March 30, 1916. Clinical diagnosis: Senile dementia, arteriosclerosis, dry gangrene of right foot. Anatomical diagnosis: Bronchopneumonia, chronic interstitial nephritis, obliterative arteritis of right posterior tibial artery. Specimen shows a small nodular hypertrophy at the vesical orifice. Behind this is a highly trabeculated bladder wall giving all the necessary evidence of having worked against a gradually increasing degree of obstruction. This nodular hypertrophy is situated just under the mucous membrane, is not associated with any hypertrophy of the prostatic lobes, nor was there any stricture of the urethra present. This type of obstruction is due to an isolated hypertrophy of the subcervical group of glands of Albarran.

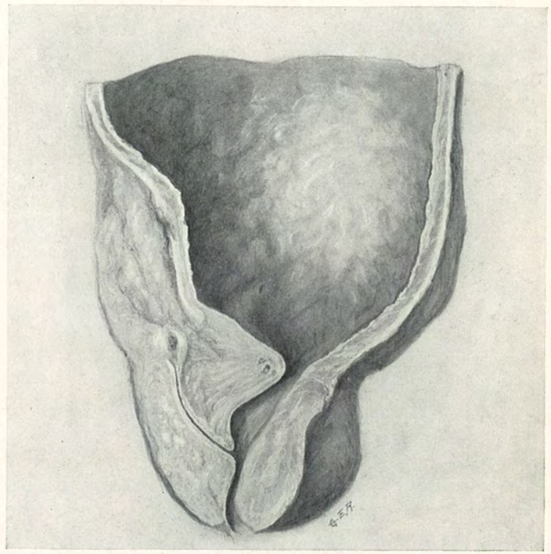

FIG. 11.—Median bar; glandular; Type 4. Specimen No. 3824. H. A. R., aged fifty-four. Entered the Genito-urinary Ward, November 27, 1915, in a semiconscious condition. Incontinence of urine. A very large hydrocele was aspirated on December 1, 1915, and the patient transferred to the Neurological Department with the diagnosis of gumma of the brain. Wassermann positive. Died December 3, 1915. Clinical diagnosis: Cerebrospinal lues, chronic interstitial nephritis. Anatomical diagnosis: Multiple gummata of the brain, œdema of the lungs, chronic diffuse nephritis. Specimen shows in the gross a slight median bar formation which mesial section demonstrates to be due to a small cluster of gland acini, visible to the naked eye, situated immediately in the edge of the bar. The bar in this case was so small that not until sectioned and the above noted, was it considered worthy of preservation. It is undoubtedly a very early hypertrophy of the subcervical glands of Albarran, further enlargement of which produces the isolated median lobe hypertrophies.

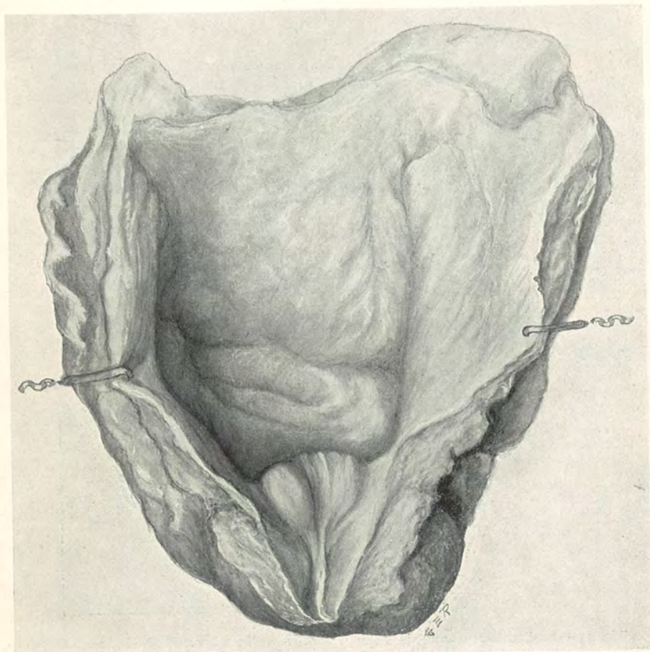

FIG. 12.—Median bar; glandular; Type 4. Specimen No. 3967. A. B., aged sixty-seven. Entered the Medical Ward, March 20, 1916, complaining of abdominal pain, dizziness, and paralysis of right leg. Patient found to be very weak, pain in abdomen of five days' duration and of shooting character. Inability to use right leg of four days' duration and gradually increasing in its extent. No venereal history. Patient very emaciated, semicomatose, incontinence of urine and fæces. Heart sounds weak, chest negative, abdomen rigid, but with no localizing tenderness. He became progressively weaker and right-sided hemiplegia developed, and he died March 31, 1916. Clinical diagnosis: Cerebral thrombosis. Anatomical diagnosis: Bronchopneumonia, chronic fibrous pleurisy, chronic interstitial myocarditis, chronic valvulitis, arteriosclerosis, chronic interstitial nephritis. Specimen shows a lobular median obstruction with deep lateral cleftings. It is superficial and covered only by the mucous membrane. Bas-fond well developed, bladder walls hypertrophied, prostate normal in size. Like the two preceding specimens it represents an isolated hypertrophy of the subcervical glands of Albarran.

must of necessity be different as between the median bar formation and generalized prostatic hypertrophy; (*b*) that, second, the mode of treating the various types of bars will differ according to the variety present; (*c*) and, third, that the differential diagnosis in the living must depend entirely upon an accurate cystoscopic study of the vesical orifice.

DR. CHARLES H. FRAZIER had under observation a case which might be interpreted as illustrating the type of obstruction which Dr. Randall has referred to in his classification as congenital.

The patient was three years of age. His mother said he was always more or less feverish and urinated frequently. What was thought to be incontinence proved later to be retention with overflow. Owing to an existing cystitis the child complained at times of great pain. The urine contained large quantities of pus and the phthalein test showed but 15 per cent. elimination in two hours on one occasion, 25 per cent. on another. There were occasional rises in temperature, and a provisional diagnosis of pyelitis was made as a complication of the vesical obstruction.

An exploratory suprapubic cystotomy was performed. The bladder was found to be distended, extending up to and above the umbilicus. A careful inspection failed to reveal the cause of obstruction, although in the absence of any form of obstruction in the urethra there must have been some congenital lesion at the urinary meatus which interfered so consistently with the evacuation of the bladder. Although ample drainage was provided the patient subsequently succumbed to the pyelitis. While the findings were negative, there would seem to be no explanation of the dysuria other than the pressure of some such congenital form of obstruction as Dr. Randall has referred to.

DR. H. L. CECIL, of Baltimore, said that the condition of median bar may be divided into two forms: congenital and acquired. The congenital forms date from birth or early childhood and give symptoms of small stream, weak force, straining on urination, etc., with the symptoms of obstruction as manifested by the patient's general condition. The acquired form usually dates back to middle life or early manhood. The symptoms are essentially the same as in the congenital form, except that the patients are seen earlier in the disease and usually do not show such grave general symptoms. The cause of this form is probably anything that may cause a chronic prostatitis or cystitis; namely, gonorrhœa, sexual excess, sexual excitement without gratification, masturbation, etc. However, many of the patients did not give a history of anything that might have caused the condition, so far as we know.

The symptoms produced by median bar may be divided into (1) urinary, (2) painful, and (3) sexual. Among the cases observed in

the clinic of Dr. Hugh Young, at the Johns Hopkins Hospital in Baltimore:

(1) *Urinary Symptoms:* 16 had retention; 11 had incomplete urination; 14 had sudden stoppage; 18 had urgency; 47 had hesitancy; 92 had frequency; 35 had small stream; 28 had weak force; 7 had hæmaturia; 11 had pyuria.

(2) The symptoms of pain may be divided into local and referred: *Local pain:* 12 patients had pain at the end of urination; 24 patients had pain during urination; 6 patients had pain before urination; 5 patients had pain constantly in the region of the bladder; 26 patients had pain at the vesical orifice. *Referred pain:* 18 patients had pain throughout the urethra; 24 patients had pain at the end of the penis; 21 patients had pain in the perineum; 11 patients had pain in the rectum; 7 patients had pain in the back.

(3) *Sexual symptoms: Desire:* Lost, 6 patients; impaired, 19 patients. Erections: Absent, 6 patients; impaired, 11 patients; painful, 1 patient. Ejaculation: Absent, 7 patients; precocious, 5 patients; painful, 4 patients. General symptoms: 4 patients were uræmic; 7 showed definite septic symptoms.

Age: Before 20 years of age, 1 case; 20 to 30, 3 cases; 30 to 40, 8 cases; 40 to 50, 36 cases; 50 to 60, 35 cases; 60 to 70, 30 cases; 70 to 80, 17 cases; 80 to 90, 3 cases.

The cytoscopic findings were as follows: 114 cases had median bar; 36 cases had lateral enlargement; 18 cases had an anterior lobe; 4 cases had polyp at the vesical orifice; 3 cases had hypertrophied trigone; 19 cases had diverticulum; 42 cases had marked trabeculation; 14 cases had vesical calculus.

Residual urine: 3 patients had complete retention; 14 patients had over 200 c.c.; 36 patients had between 50 and 200 c.c.; 74 patients had below 50 c.c.; 6 patients had no residual.

The number of cuts made at the time of operation was judged entirely by cystoscopic findings, three being the usual number and these usually directed posterior, right and left posterior.

Every effort has been made to ascertain the results in these cases by having the patients return for examination and when it was not possible to do this have the patients fill out a circular letter. When patients returned if they had any of the old symptoms, or if on examination residual urine was found, the case was not regarded as cured. Seventy patients were cured; 13 patients were 90 per cent. improved; 16 patients were 75 per cent. improved; 13 patients were 50 per cent. improved; 3 patients were 25 per cent. improved; 13 patients were not improved.

The 13 patients that were not improved were cases in which the principal symptoms were pain, irritation or frequent urination due to contracted or painful bladder, although before operation cystoscopic

examination showed a definite median bar. The punch operation was done in these cases in the hope it might relieve the symptoms. These cases may be classified as follows: 3 patients had definite hypertrophy of the prostate; 5 patients had cystitis; 2 patients had pain in posterior urethra; 3 patients had greatly contracted bladder.

A study of these cases shows that the punch operation will do all that it is intended to do, viz.: completely remove obstruction at the vesical neck due to a bar, valve, or circular contraction. It also generally cures the irritation, pain and frequency as well. But in some cases these painful symptoms are due to other lesions in the posterior urethra or bladder, and require appropriate additional measures.

The congenital bars are due, as we have seen them, to hypertrophied muscle of the internal sphincter or a great increase in the connective tissue between these muscle bundles. This type usually shows but little if any inflammatory change. The acquired form may be either inflammatory, which is by far the most frequent, or a definite hypertrophy of the gland tissue.

The inflammatory type shows usually an inflammation, either submucous, muscular or periacinous or a combination of these. This inflammatory change may be either acute or chronic, though usually chronic and of long-standing. The most frequent location of this chronic change is just beneath the mucous membrane at the vesical orifice. This chronic inflammatory process causes the formation of connective tissue which is piled up at the vesical orifice and subsequently leads to median bar.

The inflammatory change may, however, be deep-seated instead of superficial, in which case microscopic examination shows the muscle bundles widely separated by connective tissue throughout which there is an active chronic process.

Of about equal frequency as the submucous type is the periacinous. Here the most marked inflammatory process is just beneath the mucous membrane of the glands. Further from the glands there is a great increase in connective tissue. In this way there is a great increase in the tissue of the subcervical or subtrigonal group of glands which leads to median bar.

The acquired form of hypertrophy is identical with hypertrophy of the prostate and needs no comment.

From a pathological point of view the cases that have not been relieved show either an acute inflammatory process or a hypertrophy.

The one objection to the punch operation—that of hemorrhage—has been to a large extent obviated by the use of a cephalin-coated catheter. The cephalin is dissolved in as small amount of ether as possible and this concentrated solution of cephalin is allowed to drop on the rotating catheter; the ether quickly evaporates and leaves a smooth coat of cephalin. The coating extends from the eye for about three

inches back. Thus, when the catheter is in place, pure cephalin is brought in direct contact with the cut surface at the vesical orifice. This local hæmostatic, recently described by Dr. Howell, has been used on all the punch cases during the past six months at the Brady Urological Institute, with the result that practically none of these cases bleed.

Dr. Edward Martin said that this discussion is limited to obstruction at the neck of the bladder, the part of the prostate palpable through the rectum bend and the urethral length not being largely increased. It is true that obstruction thus placed and conditioned may be due to a median bar, but not always, since there may be a fibrosis of the internal vesical sphincter producing a ring-like constriction. Although there are no completely convincing microscopic studies of this type clinically, there is a hard annular obstruction which can be felt by the finger, which obstructs the passing instrument and which can be relieved only by section or wide dilatation or both. Obstruction in practically all cases is largely influenced in its degree by spasm and congestion, as this obstruction in the ring cases is more inveterate and lethal than that due to the ordinary hypertrophied prostate which we take out.

The operative attack, of course, is at the site of the obstruction. This we have carried out by fulguration, by the punch—which has not been entirely satisfactory; but most successfully and safely by a suprapubic opening, inspection, palpation and the meeting of the indications, either by removal of adenomatous growth or section of an obstructive fibrous bar always followed by very wide dilatation of the internal sphincter or by multiple sections of a localizing ring.

Dr. Randall spoke of the renal degeneration and atrophy which always accompany obstruction low down and which are factors in hastening the fatal ending, whatever the disease from which the patient suffers. The difficulty in treating many of these cases is that they have never been catheterized, and are not infected. There is no known method, no human skill by which can surely be avoided infecting these cases on the first catheterization. The infection when it occurs travels up into the kidney by the lymphatics with a resulting pyelitis and pyelonephritis to which these congested and damaged kidneys are peculiarly susceptible and from which some of these patients promptly perish. For that reason the cases which have survived their first infection may be better risks than those who have never been infected. And it therefore follows that in the case of a fairly comfortable and able-bodied person there is a perfectly justifiable hesitation in instrumentation of any kind, even gentle catheterization, since this in spite of every precaution may be followed by an ascending and fatal infection. When the obstructive symptoms become urgent this risk must of course be taken.

Dr. John B. Deaver said that he had operated on these cases in years gone by, exposing by the suprapubic method and removing the enlarged portion with the rongeur forceps. He had used the Sir Henry Thompson instrument. He had found that the ordinary rongeur forceps, such as is used in other operations, answers very well. He agreed with Dr. Randall that in these fibrotic prostates or median bar enlargements, one cannot do a total enucleation with the same degree of ease and safety as one can the above mentioned operation. We know how much more grave from the operative standpoint removal of a small hard prostate is in comparison to a large prostate. He had had no experience with the punch operation. It is doubtless satisfactory in the hands of Randall and Young and in the hands of men who are experts in cystoscopy, and the operation should be confined largely to the practice of those men. The safer method rather than the one proposed by Dr. Randall would be that of suprapubic exposure by which one can actually see the condition and deal with it with less liability of complications.

Dr. B. A. Thomas called attention to a paper in the *Ohio State Medical Journal,* April, 1915, by E. O. Smith of Cincinnati, who discussed the subject of "median bar formation" or obstruction. Smith cited a number of cases and showed excellent pictures of two or three gross specimens similar to some shown by Dr. Randall, in which enlargement of Albarran's glands, causing obstruction, was beautifully shown. Contrary to Dr. Randall's conception, it has been his custom to regard "median bar formation" not as one involving the median lobe of the prostate, a premise which is not generally admitted, but which the essayist this evening states should be considered, including everything obtructive at the vesical neck "with the exception of the lateral lobes." Personally, he did not think that simple hypertrophy of the median lobe of the prostate belongs in the caption of so-called "median bar formation."

He had been accustomed to recognize five types of "median bar formation" or obstruction at the neck of the bladder. They are: (1) glandular; (2) fibrotic inflammatory; (3) fibrotic non-inflammatory; (4) muscular contracture; (5) congenital mucosal fold.

The glandular type of this disease has its origin in Albarran's subcervical or Home's subtrigonal group of glands, but should not include hyperplasia of the median lobe of the prostate. The second and third types are fibrotic in character, and may or may not be associated with inflammatory changes associated with the underlying prostate. The fourth type is that which clinically we are accustomed to consider as a muscular contracture of the vesical neck, possibly the result of neurological or inflammatory affections. This opinion is also held by a number of renowned authorities—Guyon, Marion, Bazy, Frankel-Hochwart, Chetwood and others.

The work of Young with respect to the microscopic study of sections in about 100 cases did not show that the muscular element entered into the condition at all. However, it is possible that by the punch operation enough glandular or fibrotic tissue is not removed to catch the underlying muscle or fibrés of the sphincter. The last is the congenital obstruction. This he had never seen but he had no doubt it may occur, simply as a fold of the mucosa at the vesical orifice.

The German urologists in recent years have regarded atrophy of the prostate as a cause of median bar formation or contracture of the neck of the bladder. In a recent article Dr. Randall also seemed to attribute atrophy of the prostate as a cause of this condition. He could not see by any thought of histopathology how atrophy of the prostate can possibly cause such a state of affairs at the vesical orifice. He did not believe it is the cause, although not infrequently atrophy of the prostate is present. Why cannot prostatic atrophy be associated with or the counterpart of the same condition that causes contracture of the neck of the bladder? The importance of "median bar formation" will be realized when it is remembered that approximately 10 per cent. of patients complaining of symptoms of prostatism are cases of *prostatisme sans prostate,* and do not belong to the well recognized group of simple prostatic hypertrophy, in which the treatment is essentially and frequently radically different.

In the proper treatment of the conditions, two thoughts should be borne in mind primarily by the surgeon: First, whether or not syphilis may be present. The second is that to which Dr. Randall alluded, spermatocystitis, as a gonorrhœal sequel. It has been shown by Belfield, of Chicago, that, as a result of seminal vesiculitis with inflammation and infiltration of the base and neck of the bladder, symptoms may arise such as median bar formation causes. Within the past eighteen months he had seen three cases with considerable amounts of residual urine, one with fifteen ounces, with no other possible cause than a definite chronic periseminal vesiculitis. The cysto-urethroscope, although not always all sufficient diagnostically in all cases, is invaluable in differential diagnosis.

He agreed with Dr. Randall that as to treatment each case is a study unto itself. Rectal palpation, to determine if possible the state of the seminal vesicles and lateral prostatic lobes, and in conjunction with the use of the cysto-urethroscope to learn the thickness of tissue intervening between the rectum and vesical neck, is important. Just as in prostatectomy for simple hypertrophy either suprapubically, or perineally, so here with "median bar formation" or obstruction at the vesical neck it is paramount to determine, first, the operability of the patient by any method, and, second, operative procedure best fitted for the particular patient. For the first he recommended more strongly than ever, the index elimination of indigocarmin, than which there is no better,

or more reliable test for the determination of kidney function. Reliance mainly upon this and discrimination as to route has obviated a prostatectomy death now for two years and eight months and a mortality rate of barely 3 per cent.

The operative procedures directed to the relief of median bar formation or obstruction resolve themselves into the following: (1) suprapubic cystotomy, followed by removal of obstruction at orifice, either with ordinary cranial rongeur or with Young's punch. (2) Young's median bar excisor or punch operated per urethram, as designed. (3) Chetwood's galvanocautery, through perineal incision. (4) Destruction by high frequency spark (so-called fulguration).

He agreed with Dr. Deaver regarding the method of operation in the majority of cases, that is as described under (1). In those cases where a fibrotic bar exists at the vesical orifice, Young's punch will be of service when the rongeur fails. Used in conjunction with cystotomy, the danger from hemorrhage and infection incident to the punch operation is reduced to a minimum. Employed only per urethram as designed, he believed the danger following the punch operation is greater than that from the open operation, either by the suprapubic or perineal route. He had used Young's punch in a number of cases and in one case was unfortunate enough to have the patient die of embolism within a week after having been considered out of danger. Of course, one cannot say that embolism might not have occurred had the operation been of another kind. However, a number of urologists have reported serious hemorrhages, even deaths, following this operation.

Chetwood's galvanocautery incision of the vesical neck through the perineum has permanently supplanted the Bottini-Freudenberg procedure per urethram, but it too enjoys a rather restricted field of utility, and should be reserved for only the most advanced and intractable forms of contracture of the vesical orifice.

Fulguration or the high frequency spark may be applicable to a limited number of cases, but should not substitute more rational and better procedures. As a rule, even in the glandular type of obstruction, this method is likely to prove unsatisfactory because of the necessarily prolonged and painful course of treatment.

DR. RANDALL, in closing, said that he feared he had been rather vague in describing the median bar, and he confessed he was still a little vague in his own mind regarding exactly what it means. He started out in this work thinking that he had a very definite picture of what he would find. As time has gone on he had had to modify and modify that picture, for as the specimens increased he had found more borderline conditions, and specimens in which, with the naked eye only, it was impossible to say the origin of the tissue causing the obstruction. The work has continually pointed to the need of microscopic study in

order to distinguish the true underlying pathology, and this phase of the subject was started some months ago and is being carried on as fast as the material is obtained.

He had continued to use the term " median bar " because it was the one employed by the man who first recognized and described the condition, but he used it in a very broad sense, covering with it all obstructions situated at the posterior vesical orifice unassociated with hypertrophy of the lateral lobes.

He felt that he had touched rock-bottom in but two places. He had presented four types of obstruction. He had found two types of obstruction at the posterior vesical orifice, the first is fibrous, the second glandular. Each allows of a second subdivision; the fibrous into bars that point (*a*) urethraward, and those that have an (*b*) upward-vesicalward-tendency of growth; while the glandular obstructions (call them bars if one will) may either be the (*c*) hypertrophic nodule or lobe from the subcervical glands, or the (*d*) thick, rounded bar from the glandular hyperplasia in the posterior prostatic commissure.

Dr. Martin's remarks in regard to the muscular ring contracture are pertinent. One sees them clinically but what they are from the gross pathological standpoint he was not ready to say.

Dr. Thomas had brought out a fair criticism as to why he included the glandular hypertrophies at all. He had done so because, first, they form a definite type of median obstruction, second, because clinically in certain cases it is impossible to say whether the obstruction is of one variety or the other, and, third, because there are borderline cases in which even with the bladder and prostate in one's hand, one cannot determine the character of the obstructing tissue. It was because of such embarrassments that the microscopic study became an essential.

It had been a great pleasure to hear both Dr. Deaver and Dr. Martin sanction the death knell of suprapubic prostatectomy in the cases of so-called " small fibrous prostates." They are not hypertrophies and unquestionably should not be treated as such. They *are* the bar cases, the cases of *prostatisme sans prostate:* the obstruction is definite but in actuality small, and other surgical procedures than prostatectomy can secure complete relief of symptoms.

STATED MEETING, HELD FEBRUARY 5, 1917

The President, Dr. Charles H. Frazier, in the Chair

SCAPULOHUMERAL AMPUTATION FOR GAS BACILLUS INFECTION

Dr. Nathaniel Ginsburg presented a patient who was admitted into the Mt. Sinai Hospital, March 22, 1916, with a traumatic amputation of the left arm about 7 cm. from the shoulder-joint. The extremity had been accidentally introduced into a knitting machine, which caused the injury. Upon admission the patient was immediately taken to the operating room, and disarticulation of the left shoulder-joint was performed. Extensive laceration of the soft tissue about the remains of the shaft of the humerus precluded any attempt to save much of the extremity. The wound was thoroughly disinfected by mechanical cleansing, and by the application of iodine to the lacerated tissues. The shoulder flaps were loosely sutured and a rubber drainage tube, introduced into the glenoid cavity, emerged at the lower angle of the wound.

Thirty-six hours after the amputation, the patient's temperature rose to 105°, accompanied by a rapid and thready pulse of 132. The wound discharge was foul, of the characteristic odor of gas infection, and the flaps were discolored by beginning gangrene. On the following day the shoulder flaps were black, with foul odor and profuse discharge from the wound. The wound was completely opened, exposing the glenoid cavity, bubbles of gas discharging freely at this time. The skin over the entire left chest was discolored and crepitant. Cultures from the wound showed the presence of the *bacillus aerogenes capsulatus* and the tetanus bacillus.

Irrigation of the wound with a fifty per cent. hydrogen peroxide solution alternating every two hours with a 1-4000 bichloride solution was begun. Extensive necrosis took place, resulting in total loss of the flaps enclosing the glenoid cavity, and spread dorsally until the entire surface of the scapula was exposed, as though it had been cleared by a dissecting-room scalpel.

On April 10, nineteen days following the injury, excision of the scapula was performed, employing nitrous oxide and ether anæsthesia, with practically no bleeding in the wound. He received daily injections of 10 c.c. of antistreptococcic serum, on April 11, 12 and 14. The wound continued to discharge profusely—however, healing over sufficiently to allow the patient to be discharged from the hospital on April 27, when he was referred to the Out-Patient Department for

further treatment. Now the denuded surface has completely healed, and the patient has returned to work.

GUNSHOT WOUND OF THE THIGH: GAS BACILLUS INFECTION

Dr. Nathaniel Ginsburg presented a patient who had received a load of bird shot, at close range, into the femoral region of the right thigh, on October 12, 1916. He was admitted into the Jewish Hospital one hour later with a large, punched-out wound, corresponding to the saphenous opening, about four inches in diameter and involving the entire thickness of the thigh in this region. The patient was considerably shocked, with rapid and feeble pulse, and presented evidence of the loss of considerable blood. He was bleeding freely upon admission, the hemorrhage being controllable only by gauze packing introduced into the wound. Fifteen hundred units of tetanus antitoxin were injected and the wound was thoroughly cleansed with pure tincture of iodine. The femoral sheath, with the visible pulsating femoral artery, was thoroughly exposed and had miraculously escaped penetration by the shot. The long saphenous vein and the superficial and deep external pudic arteries and the obturator vessels had apparently been opened by the wound inflicted. The X-ray examination the following day (October 13) showed a great number of small shot embedded in the thigh against and surrounding the obturator foramen. There were numerous shot scattered in the lower gluteal region. In the evening of this day, the foul odor, characteristic of gas bacillus infection, attracted attention and an examination of the wound revealed gas bubbles with crepitation of the surrounding tissue. Dr. David Riesman, who saw the patient, concurred in the diagnosis of gas bacillus infection.

Under nitrous oxide anæsthesia, a fenestrated rubber tube was introduced into the wound, passing completely through the adductor region of the thigh, and irrigation was begun, employing a fifty per cent. hydrogen peroxide solution, alternating with a solution of Bulgarian bacilli every two hours. The infection was apparently confined by the intermuscular septa of the thigh, which enclose the muscles of the median osteofascial compartment, and did not spread beyond this region. Extensive necrosis of the muscles corresponding to this area took place.

On October 14, two days after admission, continuous irrigation of the wound with Dakin's solution was begun, the hydrogen peroxide solution being discontinued. The patient was extremely toxic, and intravenous injections of sodium bicarbonate solution were administered daily. Multiple incisions were made over the internal and posterior surfaces of the thigh, opening up the muscular spaces through which drainage was established.

Improvement slowly took place, large masses of necrotic material

being removed from the wound and counter openings. On October 21, close application of electric light to the wound, without dressings, was maintained. In view of the fact that the process was now limited, and the patient's condition much improved, irrigation of the wound with a fifty per cent. peroxide of hydrogen, followed by a 1-8000 solution of nitrate of silver, was substituted for Dakin's solution.

The patient was discharged from the hospital November 6, 1916, with loss of the upper portions of the adductor and gracilis and pectineus muscles, and with slight discharge from the wound corresponding to the site of his injury. Numerous shot have been discharged from his gluteal wound since he left the hospital, but most of the bird shot still remain in his body.

Recovery in these two cases can be attributed to early and free drainage which was established, with the continuous irrigation of the wounds.

COMPOUND FRACTURE OF THE PATELLA

Dr. John H. Jopson presented a stout woman, fifty-six years of age, who was admitted to the Presbyterian Hospital in September, 1916, with a bad laceration of the face and a compound fracture of the patella, the result of having been struck by a street car. She was transferred to the operating room almost immediately. Examination of the knee disclosed an irregular wound over the patella, about one inch in length, running transversely. Through this could be palpated a comminuted fracture of the bone, which was broken into many fragments, and the finger passed directly through it into the knee-joint. The patient was etherized, and the entire region of the knee prepared for operation. The preparation consisted in cleaning the skin with benzene, alcohol and tincture of iodine. The wound was enlarged by lateral incisions, which were carried downward and outward to the condyles of the femur. The joint, when opened, was thoroughly washed out with a sherry-colored solution of tincture of iodine in water. The patella was broken into probably a dozen fragments, and two or three small detached fragments were removed. The aponeurosis had been lacerated over the bone and torn down toward the external condyle. It was brought together with mattress and interrupted sutures of chromic catgut. Two rubber drainage tubes were inserted in the outer angle of the wound, one extending into the joint, the other to the opening in the joint capsule. The skin wound was sutured except for the drainage track and the traumatic wound, which latter was drained by a piece of rubber tissue. The leg was dressed on a posterior splint and the patient given antitetanic serum.

The convalescence was uneventful. An X-ray taken after operation showed good approximation of the fragments. The splint was re-

moved after four weeks and the patient left the hospital on November 1. There was then about one-third the normal amount of flexion present in the knee and she was able to walk on crutches. She has now regained very fair use of her knee, is able to bear her weight on it, and has good range of motion, flexion being possible to a right angle, and still improving.

This case illustrates among other things the method of treatment of compound fractures of any variety which Dr. Jopson has found most efficacious, namely, immediate transference to the operating room, etherization, sterilization as if for primary operation, followed by cleansing of the wound—sterilization, the introduction of drainage and whatever other measures may seem indicated. Since adopting this plan his results in the treatment of compound fractures have been vastly improved, and severe infections are a rarity.

Compound fracture of the patella is an unusual injury in civil practice. Of twenty-six recent fractures of the patella operated upon by him, this was the only instance in which the fracture was compound. This series was operated without mortality and without joint infection. Stimson has emphasized the fact that patellar fractures are generally compound by reason of external violence, except in those instances where refracture occurs after operation, and where the scar or the skin is tightly adherent to the surface of the bone. In such instances indirect violence may result in simultaneous fracture of the patella and tear of the soft parts covering the bone.

Dr. Nathaniel Ginsburg gave the history of a compound fracture of the patella which was operated upon by him on August 22, 1912, in the Philadelphia Polyclinic Hospital.

The patient was a fireman on a railroad engine, who fell from the tender, striking on the right patella. He was operated upon immediately on his admission to the hospital, and the patella was found to have been fragmented into four pieces, with a wound communicating with the interior of the joint. At operation, one fragment was found lying free in the joint cavity, which was removed, and another small fragment, which could not be satisfactorily placed in relation to the other pieces of the patella, was excised. The joint was irrigated with a 2 per cent. formalin solution, followed by sterile water, and the remaining fragments were apposed by a bronze wire passed through the ligamentum patellæ below the quadriceps extensor tendon above. The capsule was sutured as well as the lateral ligaments, the joint being closed without drainage. The leg was immobilized by a posterior splint, in addition to traction, employing twenty pounds of weight.

On the day following the operation, the knee-joint was aspirated and about 200 c.c. of serosanguineous fluid were removed, and 15 c.c. of a 2 per cent. formalin-glycerin solution were injected. The patient was discharged from the hospital on September 28, with good union of the patella. The highest temperature during his stay in the hospital was 99°, and the pulse-rate never rose above 98.

He has been unable to trace the patient since his discharge from the hospital, but there is every reason to believe that he has a good functional knee-joint, since he had a satisfactory operative recovery, and no infection resulted following the injury.

OLD REFRACTURE OF THE PATELLA, WITH SUPPURATIVE ARTHRITIC EFFUSION, AND RESECTION AND TRANSPLANTATION OF THE LOWER FRAGMENT

Dr. Nathaniel Ginsburg presented a man who was admitted into the Jewish Hospital, September 7, 1916, and discharged December 22, 1916. Four months previous to his admission, the patient sustained a fracture of his right patella, which was sutured in another hospital, the fragments not having been wired. He tripped over a curbstone, and fell to the ground, striking his right knee, and sustaining a refracture of the patella, on September 7, 1916. Examination showed a transverse fracture of the right patella, with about five centimetres' separation of the fragments. On the following day a sudden rise of temperature occurred, which reached 103° September 10, seventy-two hours after admission.

On September 11, an examination of the knee-joint suggested the presence of a purulent effusion. The joint was aspirated, and 90 c.c. of pinkish purulent fluid were withdrawn; and 14 c.c. of a 2 per cent. formalin in glycerin solution were injected. The temperature immediately dropped to $99^{2}/_{5}°$.

The day following the aspiration of the joint, a large submuscular abscess of the lower third of the right thigh was incised, employing local anæsthesia. This infection was associated with the purulent joint effusion, and probably was an extension of the same. The temperature subsided to normal thirty-six hours following drainage of the thigh abscess.

Longitudinal traction was applied to the injured leg upon his admission into the hospital, and was maintained until the open operation upon the patella was performed. Drainage from the thigh wound and from the needle puncture wound into the joint continued for some weeks. On October 25, about seven weeks after his admission into the hospital, his wounds had completely healed. It was now deemed advisable to attempt to bring the patellar fragments together. The operation was performed during one of the clinics for the physicians attending the Clinical Congress of Surgeons then meeting in Philadelphia.

Under gas-ether anæsthesia, a vertical incision was made over the right patella extending from the quadriceps extensor tendon above to the tubercle of the tibia below, and the interior of the joint was exposed. There was considerable capsular and aponeurotic thickening with fibrous induration of the blood-clot which existed between the two fragments. Both fragments were immobile, and could not be apposed in the slightest degree. The joint cavity above the line of fracture was considerably diminished by the firm application of the upper fragment to the femoral surface, owing to the contraction of the quadriceps extensor muscles and the lateral ligaments.

The periosteal attachment of the ligament of the patella was chiselled off the tibia, carrying with it a small fragment of cortical bone. This did not lessen the difficulty, since the lower fragment remained immovable, owing to the induration and diminished elasticity of the patellar capsule and the lateral aponeurotic expansion. The lower fragment was completely excised and lifted out of the wound. The wound clot was dissected, and, after freshening the fracture surfaces, the excised fragment was brought in contact with the upper fragment and held there by a phospho-bronze wire suture passed through the patellar capsule. The lower fragment was fixed on a higher level by interrupted chromic catgut sutures to the aponeurotic expansion from which it had been dissected, and the lateral ligaments and patellar capsule of the knee-joint were also sutured by interrupted chromic catgut sutures. The joint was immobilized by a plaster casing extending from the upper thigh to the lower leg, which was worn for four weeks.

With the exception of some slight superficial wound discharge, convalescence was uninterrupted and the patient was dismissed from the hospital on December 22, 1916, with union of the patellar fragments and sufficient flexion and extension of the leg to allow him to act as an orderly in the hospital. The X-ray examination of both knee-joints shows the superior position with relation to the femoral condyles occupied by the injured patella.

Dr. John H. Jopson said that some time ago he showed before the Academy a case of old fracture of the patella in which there had been much difficulty in approximating the patellar fragments. A plastic operation on the quadriceps tendon was performed, and an elevation of the tubercle of the tibia after the method of von Bergmann, after which the fragments could be brought in apposition and wired. Firm union was secured. Dr. Ginsburg's method amounts to a free transplantation of the lower fragment and the result is excellent. He would much prefer this method to the use of a bone inlay as suggested by Albee, as he believes convalescence would be much shorter and the resulting union stronger.

CHRONIC PERFORATING ULCER OF THE SMALL INTESTINE, INVOLVING THE BLADDER WALL

Dr. Geo. Erety Shoemaker presented a woman fifty-three years of age, who had been operated upon by him December 4, 1916, for the relief of ulcer and partial obstruction of the small intestine, chronic appendicitis, chronic cholecystitis. The patient was very stout and for a number of years had had pain and abdominal distention with occasional nausea and vomiting without definite localization as to origin. She had been in the Medical Wards of the Presbyterian Hospital twice under suspicion of pyloric ulcer. Definite symptoms associated with that condition were, however, wanting. The obscure attacks continuing, she was admitted to the reporter's service for exploration on recommendation of her physician.

Patient had formerly weighed more than 200 pounds, but had lost 47 pounds, and claimed to be unable to eat general diet without bringing on attacks of severe abdominal cramp-like pain, with difficulty in moving the bowels. There was no history of jaundice; the pains never went to the right shoulder and were never located in the gall-bladder region. They had only lately been in the right lower quadrant, shifting to the umbilicus. Repeated previous gastric analysis had shown low total acidity, low free hydrochloric acid, contents usually alkaline; there was no food retention. The X-ray studies had resulted in a diagnosis of pyloric ulcer by the röntgenologist, but there was no food relief, no pain late after food ingestion. There was now no leucocytosis and no jaundice. Shortly after admission to the hospital, a sharp attack of generalized abdominal pain occurred with persistent vomiting. Lavage of the stomach brought brownish material with a fecal odor. The bowels moved freely immediately afterwards and there was no further vomiting. The condition was now evidently one of partial obstruction. No pelvic lesion was present except a very small movable nodular mass in the region of the right ovary, which was not accounted for. There was frequent urination and much bladder irritation. The thighs and vulva were inflamed and incrusted from urinary contact. There was no incontinence. Because it was necessary to explore both the upper and lower abdomen, the incision was made to the right of the navel and extended upward and downward as required. The gall-blader contained more than one ounce of bile; was compressible, moderately adherent, its walls a trifle thicker than normal and of a dull brown color, which indicated a low degree of chronic inflammation. No stones could be felt. The pylorus was thoroughly exposed and palpated, but no thickening or other evidence of disease could be demonstrated. There were no adhesions. The appendix was long, passed behind the cæcum, and had no meso. It was removed after splitting the outer mesocolon, cutting off the base first and gradually working down to the tip. Adhesions in the neighborhood had formed

a well-defined Lane's kink which was released. A congenital fold of peritoneum passed downward from the root of the appendix to the pelvic wall at the insertion of the infundibulopelvic ligament. That was ligated and incised. Further exploration revealed about two feet from the ileocæcal an angulated knuckle of small bowel, infiltrated over an area of an inch or more in diameter. There were no neighboring adhesions. The bowel was separated and brought into the wound which produced a fistulous opening. The intestine was larger above than below the site of partial obstruction. The mesentery was thickened, but not hard, near the insertion into the bowel. About 8 inches of small intestine was resected, the ends being burned off with the cautery and turned in with catgut, afterward being covered with Lembert suture of celluloid linen. Side-to-side anastomosis was then performed by suture. The infiltrated point of the bladder showed excavation which did not at this time perforate the mucous membrane, though it may at some time have done so. The diseased area was excised, the bladder wall sutured with two rows of chromic catgut. An abdominal cigarette drain was introduced near the site of the intestinal anastomosis. A retention catheter was placed in the urethra. There was no post-operative vomiting, no distention, intestinal gas passed freely. Bowels were moved by glycerin enema. There was a few drachms of purulent brown fluid at the drainage site by the third day; the drain was removed at this time and was not replaced. No gas and no fæces escaped at any time. The external irritation from the urine rapidly cleared up.

The convalescence was somewhat stormy due to the long-standing gastric catarrh with flatulence. The anastomosis never leaked; the wound healed solidly while in the hospital. Normal bowel movements were readily secured. The patient is now doing well, January 17, six weeks after operation. Cystoscopy by Dr. Laws shows bladder normal.

Laboratory Diagnosis.—Dr. Pfeiffer. Inflammatory infiltration and ulceration of bowel and bladder.

CONGENITAL PYLORIC STENOSIS

Dr. Damon B. Pfeiffer presented a specimen of congenital pyloric stenosis. The patient was a girl, aged four weeks, the only child of healthy parents. At birth the baby weighed 7 pounds 13 ounces, and was apparently normal. For the first week the child took the breast and showed no digestive disturbances. During the second week she began to vomit occasionally. Various milk formulas were tried without effect and the vomiting grew worse while the baby lost weight rapidly. The bowels moved scantily. In the fourth week Dr. Charles A. Fife was called in consultation by the attending physician, Dr. George A. Parker of Southampton. Visible gastric peristalsis could not be

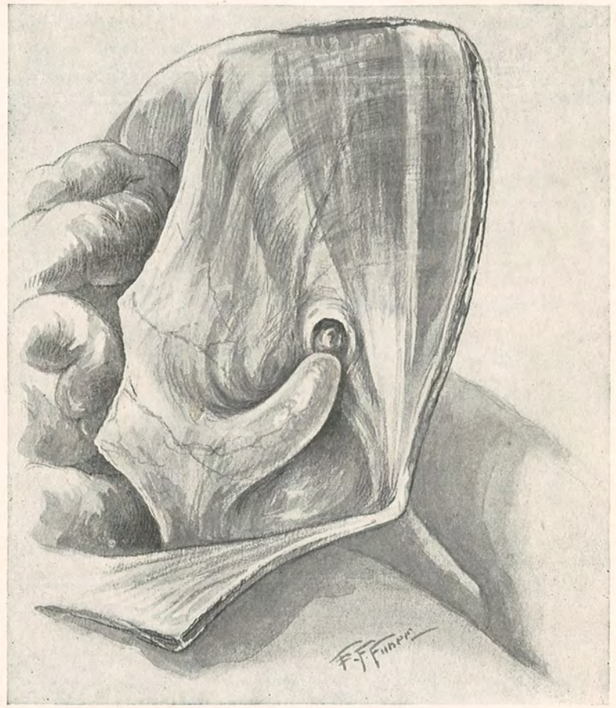

Fig. 1.—A unique exposé of direct inguinal hernia, chanced upon in the dissecting room of the University of Pennsylvania. On stripping the general layer of parietal peritoneum backward from the anterior abdominal wall in quest of the deep epigastric artery this finger-like hernial sac was revealed with its tip in the hernial orifice. Its connection with the general layer of parietal peritoneum was exactly like that of a finger of a glove to the rest of the glove. To show the hernial orifice the sac was drawn somewhat backward. Hesselbach's triangle is well shown, with the hernial orifice near its base.

observed at times, but no epigastric tumor was palpable. The child displayed evidence of ravenous hunger, taking food eagerly and sucking its thumbs. With the diagnosis of hypertrophic stenosis of the pylorus, the patient was referred to the Abington Memorial Hospital, for operation. The weight by this time was barely four pounds. The pulse was exceedingly thin and weak and the temperature subnormal.

Under ether anæsthesia, a posterior gastrojejunostomy was made without special difficulty. Hypodermoclysis was given during the operation and the patient left the table in good condition. She vomited once the following day and the stomach was washed out, a small quantity of biliary material being obtained. Feedings of whey were begun. The next day the baby showed evidence of excessive weakness and died a few hours later.

At postmortem the peritoneum was everywhere glistening and showed no evidence of peritonitis. The gastrojejunostomy was mechanically satisfactory. The pyloric canal for a distance of about an inch was tightly constricted, as had been observed at operation, by a thickened muscularis measuring 6 mm. in depth at its thickest part. There was no apparent œdema. The longitudinal incision through this part of the muscularis was made after removal of the specimen and shows beautifully the distinctness of the separation of the muscularis from the submucosa and the elasticity of the latter, thus illustrating the ease and effectiveness of a Rammstedt procedure which was considered but not practised in this case. It shows also the sharp limitation of the muscular thickening to the gastric side of the pylorus, an important point to observe in performing the Rammstedt operation, because of the ease with which the duodenum may be opened.

The case illustrates the fact which has been pointed out by Holt, Downes and others, that sudden collapse may occur in these weakened infants with or without relief of the obstruction, and shows the advisability of resorting to surgical measures at an early period.

ILLUSTRATION OF A DISSECTION SHOWING A UNIQUE CONCEPTION OF DIRECT INGUINAL HERNIA

Dr. P. G. Skillern, Jr., presented the specimen shown in Fig. 1.

SURGICAL EXPERIENCE AND SURGICAL KNOWLEDGE

THE ANNUAL ORATION BEFORE THE PHILADELPHIA ACADEMY OF SURGERY, FEBRUARY 5, 1917

By Joshua Edwin Sweet, M.D.

of Philadelphia

Assistant Professor of Surgical Research in the University of Pennsylvania

I have chosen for my text the last sentence of the seventh verse of the first chapter of the book of Dionis, entitled "A Course of Chirurgical Operations, demonstrated in the Royal Gardens at Paris," by "Monsieur Dionis, chief chirurgeon to the late Dauphiness and to the present Dutchess of Burgundy," translated from the Paris edition and printed in London in the year 1710:

"But it must be granted that the Chirurgeon, to whose lot no more than this practical Manual and Operative Chirurgery falls, will frequently run the risque of Killing and Laming his Patients, when without the Direction of a Physician; and, even in the Presence of the Physician himself, will he not be in danger of committing Faults, if his Hand be not guided by his Head? 'Tis certain, that to walk well good eyes and agile and pliant legs are requisite, and that the one without the other is insufficient for that purpose. A blind Man, for instance, provided with good Legs, and led by a quick sighted and faithful Guide, may stumble for want of Light. So, whatever Experience a Chirurgeon may have, if he have not the Knowledge which ought to direct him in his Operations, he will work in the dark; and if he be not a good Theorician, he will never prove an able Practitioner."

I have chosen this text because in conferring upon me the deeply appreciated honor of delivering this annual oration, it is to be assumed that I was supposed to have some message of interest to bring to you. If I have any such message, it is to be found in the advantageous position in which I find myself, standing midway between the theorists of the laboratory and the men of practice. This position offers me, perhaps, a slightly different point of view from that possessed by either group alone, and even makes it incumbent upon me to attempt to reconcile the opposing ideas of two, sometimes unfortunately hostile, forces. The position is not unlike that taken by the man who feels called upon to intervene in a family quarrel; and fortunate indeed the interventionist, upon whom both sides do not finally fall, to his eternal damnation!

Is there any wrong which needs righting? I feel that there is, because for many years now I have watched young men go out from the medical schools with ideals which are certainly broader because of the improvements in the laboratory courses now in force in our medical schools. They go into our hospitals, and the next time I see

them their ideals have been changed to the more narrow ideals of pure practice. The laboratory means little to them, the laboratory training in the art of acquiring knowledge has vanished, the use of books as tools seems to have been forgotten. If it be not a fact that something is wrong why does the committee of this academy find it needful to issue such an appeal as the one which we have all so recently received?

Now part of the trouble, which our committee thinks must exist, and I am sure exists, may be the fault of ourselves. We have allowed the academy to become a clearing-house of experience, rather than a clearing-house of knowledge. In part it may be due to that defect of human nature which compels men to follow a leader. If this is the case, I would fill these meetings by making the leaders of surgery promise to attend; the rest would then come. I know it does not seem to sound quite right, but my meaning may be clear to you if I say that if I wanted to catch fleas I would first catch a dog.

The chief trouble, I believe, lies elsewhere. Somewhere between the time of leaving the medical schools and leaving the years as hospital internes, someone, something, has undermined the efforts of the teachers of the medical schools to give to the students a broader point of view. Does the fault lie with the men who teach them in the hospitals, with you practical men of surgery, or does it lie with the conditions existing in our hospitals? If it is with the conditions as they exist, who shall remedy these conditions?

I have had many young surgeons come to me for special work along certain lines. They come with two desires, to do some dissecting of the human body, to learn surgical technic by practice on the living animal. Never yet has my heart been gladdened by the sight of the would-be abdominal surgeon coming to learn the physiology of the gastro-intestinal tract. Once in a while one appears with a glimmer of the value of pathology, yet without the realization that, since pathology is only physiology gone wrong, pathology cannot be understood without knowing the basal physiology. Why is this? Has no one pointed out to them that the "when" of pathology and the "why" of physiology are of far greater importance than the "how" of anatomy? Has no one pointed out that while anatomy is the foundation stone, one who has climbed to its very top is still unable to even reach the place where the builders of to-day are working? Is it because the teaching of the writer of our text is less true to-day than it was two centuries ago, "if he be not a good theorician he will never prove an able practitioner"?

The pure theorist is not entirely free from blame. The value of pure science taught for its own sake is unquestionable, but since we are training men for medicine and surgery, the laboratory which helps in that training need not be too proud of its purity. It would seem

too, as though these exponents of pure science might more often permit us to catch a glimpse of their beloved mistresses, minus some of the veils of language and technicality. But since I am talking to you practical men, I shall refuse you the further comfort of thinking of the faults of the pure theorists. You will recall that when the mountain refused to come to that great prophet of Islam, Mohammed did swallow his pride, gird up his loins and go to the mountain.

I firmly believe that something is not right, and I further believe that this something can be expressed best by pointing out the difference between surgical experience and surgical knowledge as it is seen in a consideration of certain surgical procedures of to-day. I am aware that there is perhaps no difference between the broad definitions of experience and of knowledge, since knowledge must be defined as the sum of experience. Yet over two hundred years ago our friend Dionis perceived a difference in the common acceptation of the terms, and this difference exists to-day as then; and there certainly will be a great difference in the effect on the aspiring candidate for surgical fitness, whether you continue to emphasize the necessity of gaining surgical experience or whether you begin to point out to him by example and by precept the greater importance of gaining surgical knowledge, the sum of all human experience, which bears immediately or remotely upon the art and science of surgery.

It is so self-evident that it is banal that one must know the anatomy of a part before he can operate, but why stop there? Think for a moment of the present status of gastric surgery. The anatomists have not yet taught us the position and shape of the stomach. The Röntgenologists have taught us further that it does not make much difference where it is, so long as it is working properly. Now physiology has as one of its fundamental precepts, the fact that Nature will have things go her way regardless of man's wishes in the matter; yet in spite of this fundamental fact, in spite of Kelling's [1] demonstration of this fact sixteen years ago and Cannon's elaboration of this fact eleven years ago [2]—that in the presence of a normal pylorus food will not pass out of the stomach through a gastro-enterostomy opening but through the pylorus as normally (see Figs. 1, 2, and 3)—in spite of the fact that men like our own great leaders of surgery have pointed this out and with sufficient force, I cite the paper read by our own President in December, 1914 [3]—how many simple gastro-enterostomies have been done this very day for gastric ulcer, and how many will still continue to be done for years to come, or, indeed, until our surgeons have learned to differentiate between, and rightly evaluate, experience and knowledge?

You may say that conditions are not normal in the presence of an ulcer; that a pylorospasm exists, that the operation does do good in many cases. But do you know, even, whether the operation or the

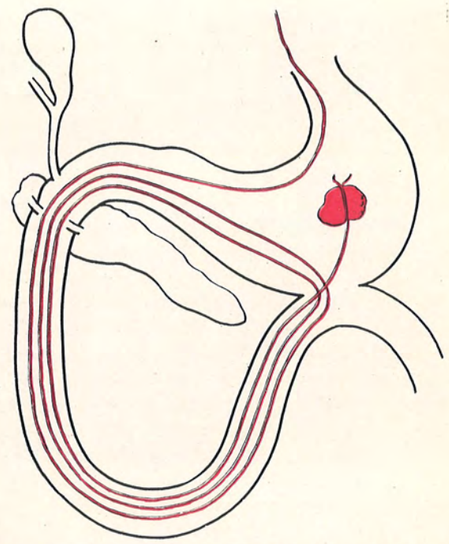

FIG. 1.—Draper's demonstration of the course followed by a bolus of food, to which a string has been attached, in an animal in which a gastro-enterostomy has previously been performed.

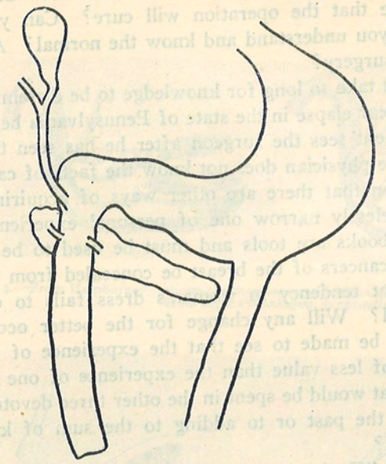

FIG. 2.—If the duodenum be cut and turned in at a point as indicated in this diagram, the lower end being anastomosed to the stomach by an end-to-side as shown, or by the ordinary lateral gastro-enterostomy, a certain number of these animals will die with all the symptoms of high intestinal obstruction.

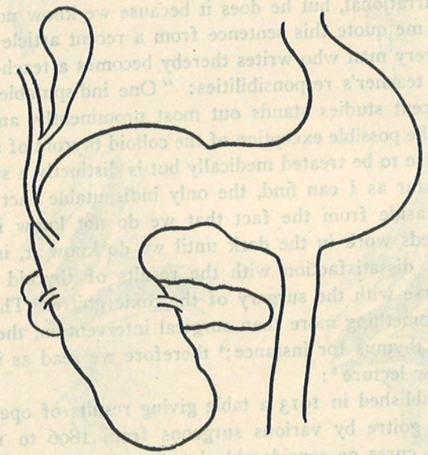

FIG. 3.—Some animals operated as in Fig. 2 will live, showing at autopsy an enormous dilatation of the blind end of the duodenum or else less dilatation but extreme hypertrophy of the muscularis of the duodenum. Therefore, while food has passed through the gastro-enterostomy opening as shown by the animal's living in good health, the autopsy nevertheless reveals that nature has been insisting upon having things go her way.

real surgical rest in bed accomplished the result? Can you assure any given case that the operation will cure? Can you restore to normal unless you understand and know the normal? Are you doing 100 per cent. surgery?

Why does it take so long for knowledge to be disseminated? Why must a whole year elapse in the state of Pennsylvania before the average cancer patient sees the surgeon after he has seen the physician? Is it because the physician does not know the facts of cancer, because he has forgotten that there are other ways of acquiring knowledge beside the hopelessly narrow one of personal experience? Has he forgotten that books are tools and must be used to be kept bright? Must so many cancers of the breast be concealed from the physician until the present tendency in woman's dress fails to conceal them from the world? Will any change for the better occur until our young men can be made to see that the experience of four surgical dispensaries is of less value than the experience of one appointment, with the time that would be spent in the other three devoted to reading the wisdom of the past or to adding to the sum of knowledge by laboratory work?

Part of this difficulty is due to the methods in vogue in surgical teaching and writing. Since surgery always presents a condition in which something must be done, a surgeon must act, and he does that which seems to him best. But how often, even to his audiences of surgeons, does he say that that which he is about to do may be useless, is certainly irrational, but he does it because we know nothing better to do? Let me quote this sentence from a recent article on the thyroid—and every man who writes thereby becomes a teacher and must remember a teacher's responsibilities: "One indisputable fact established by recent studies stands out most prominently, and it is that goitre, with the possible exception of the colloid thyroid of adolescence, is not a disease to be treated medically but is distinctly a surgical condition." So far as I can find, the only indisputable fact concerning the thyroid, aside from the fact that we do not know its function and must needs work in the dark until we do know it, is that there is a growing dissatisfaction with the results of thyroid surgery; I mean of course with the surgery of the toxic goitre. Therefore the attempts at something more than surgical intervention, the Röntgenization of the thymus for instance;[4] therefore we read as in Mackenzie's Bradshaw lecture[5]:

"Klose published in 1913 a table giving results of operations for exophthalmic goitre by various surgeons from 1896 to 1912. The percentage of cures or considerable improvement ranges from 50 to 98.7, Th. Kocher claiming 93.7 per cent. and Mayo 97.8 per cent. The percentage of deaths allowed by Th. Kocher was 1.3 and by

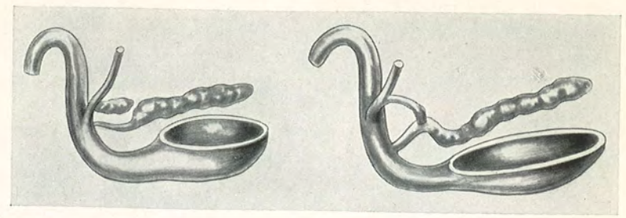

FIG. 4.—From Hamburger[7]—shows the manner in which the two portions of the pancreas, derived from separate anlagen, eventually fuse.

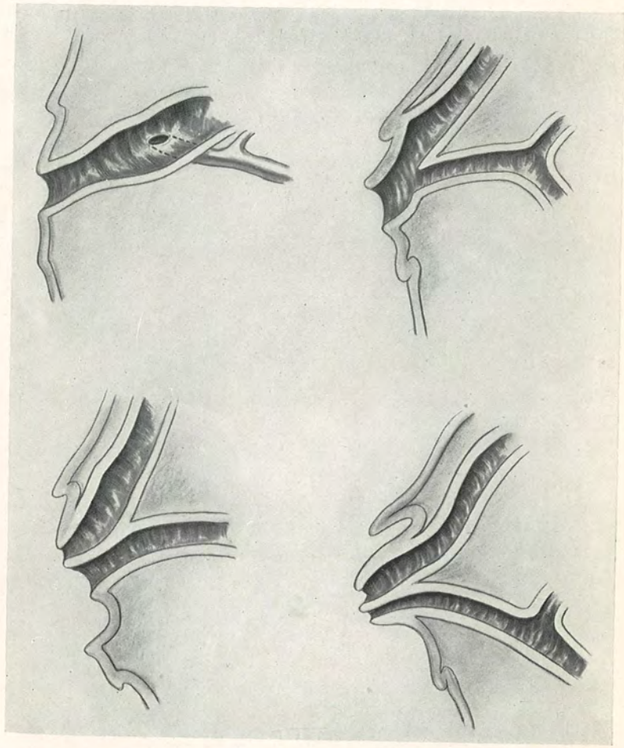

FIG. 6.—From Letulle et Nattan-Larrier[9]—the various types of the opening of the common and pancreatic ducts into the intestine.

Mayo 2.2. These figures, I have no hesitation in saying, should be received with great reservation."

"A more convincing report has recently been published by Judd and Pemberton . . . In this the 97.8 per cent. of cures or considerable improvement has fallen to 70 per cent., but even that is, I am sure, much too high if the cases operated upon are true cases of exophthalmic goitre."

It is idle to retort that Mackenzie is only a medical man. Our medical friends are as acute observers as are we. I regret to say that as a class they are better trained in the art of acquiring knowledge; and they doubtless see more of the unsatisfactory results of thyroid surgery than does the surgeon, because the patients, having tried surgery and found it wanting, can do naught else than seek the comfort

Opie's Statistics.

100 subjects examined.

10 cases, no anastomosis of the two duct systems.

4 additional cases, the two systems united only by a minute branch.

11 cases, the duct of Santorini equal in size to, or larger than the duct of Wirsung.

FIG. 5.

of medicine, small comfort though it may be. Mackenzie's refusal to accept surgical statistics need give no offence to the surgeon who in the past few years has been devising schemes and systems for following up his cases, since every such invention but proves anew either that he has just awakened to the necessity for finding out what he has been accomplishing, or at least, having awakened, finds his present system inadequate. We must permit others the pleasure of criticising things which we ourselves criticise in ourselves.

No student of the thyroid can ignore the opinion of the internist. Whenever there are two radically opposed points of view between surgeon and internist, it means at the very least that surgery is not convincing—it is not 100 per cent. surgery. Nor can the argument hold that if these views are presented, some patients will be held until too late by the general practitioner. If the seeking for patients conflicts

with the seeking for truth, we must do without the patients. We have long since emancipated surgery from the bondage of working under a physician as they worked in the days of the writer of our text. Surgery is no more the carpentry of medicine. But the habit of gently sneering at our medical colleagues, while known to be but a mild form of mental exercise to the big minds of the leaders of surgery, is too often taken seriously by the student, to his own detriment.

The surgery of the pancreas offers several splendid examples of what I would impress upon your minds. In one of our most recent text-books, Moynihan writes,[6] in relation to the treatment of chronic pancreatitis, "The majority of surgeons follow Robson in preferring cholecystostomy, or if permanent drainage is required, cystenterostomy, if the gall-bladder is sufficiently healthy." Now such a procedure must be based upon the assumption that the infection is duct-borne, otherwise mere drainage of the duct could serve no end. It also must assume that, granting the assertion that it is duct-borne, the ducts of the pancreas could be drained through the gall-bladder. Let us look into the matter. Fig. 4 is only twenty-five years old.[7] It shows the development of the pancreas. The surgeon who studies this picture with a thought to the vagaries of embryologic development should not be surprised to find irregularities in the pancreatic ducts. The results of Opie, Fig. 5, published in 1903,[8] are not surprising, nor need Fig. 6[9] surprise the surgeon. Yet in the ten out of one hundred cases of Opie, where the duct of Santorini drains the greater part of the pancreas, and in Fig. 6 in certain types of papillæ, there can be no doubt that neither cholecystostomy nor cystenterostomy would help. In view of these considerations alone, the drainage of the ducts could not give 100 per cent. surgery. Moynihan, in vol. iii, Keen's Surgery, reproduces Fig. 6, but fails to apply the lesson it carries to the question of treatment. Even granting that ascending infections are mucosal infections, which in any case of ascending infection they are most likely not, we might assume that chronic pancreatitis could not occur in these cases where the ducts of the pancreas enter separately from the bile-ducts, but this would need to be mere assumption.

You may say that it is easy to reason *post hoc propter hoc*, that hindsight is notoriously clearer than foresight; that since two of our own Fellows have so clearly demonstrated the true nature of chronic pancreatitis as have Deaver and Pfeiffer,[10] it is a simple matter to look backward and criticise. But the point I wish to make is that Opie's work was published in 1903, that the pictures I have shown you of the peculiarities of the openings of the ducts are from a paper of 1899, and that the peculiarities of the development of the organ, to which I drew your attention, are from a paper published in 1892. I would emphasize here what is a well-known fact to those who know books, that a text-book in any growing subject is behind the times before it

leaves the printer's hands, that the surgeon must keep in touch with the original sources, and that not only in the journals devoted to surgery.

Certainly this takes time, certainly it takes effort, certainly it is something each must do for himself. You cannot hire someone to think for you any more than you can hire someone to perform many other of your personal physiologic functions. He who embarks on the surgical cruise ships for no joy-ride. If we wish to raise the standard of surgery, if we would weed out undesirables, let us get this idea clear before the minds of the aspirants to surgical success, that the real surgeon must know as much as any man in any branch of medicine and then some, this "then some" being the whole field of surgical technic.

There is no doubt that the living pathology can teach some things that the dead pathology cannot teach, that it can teach many things better. There is no doubt that human vivisection—I use the term before a body of surgeons and do not care if over-zealous ladies wish to misinterpret it—is superior to animal experimentation, wherever it can be utilized; but living pathology does not supersede the basic pathology of the microscope. It cannot stand alone, nor is it intended by its most able exponent that it should stand alone.

The operating room teaches physiology, but not the whole subject. For instance, there can be no doubt that the whole picture of acute pancreatitis can only be explained by the activation of the proteolytic fermentogen of the pancreas, not in the intestine where the enterokinase normally activates trypsinogen into trypsin, but abnormally, in the gland itself or in the peritoneal cavity. This activation is brought about by the action of some unknown substance set free from the tissues under the conditions of autolysis. Therefore any process, infectious—though not all infections—embolic, mechanical, which can injure cells and permit autolysis may start the process of activation, and once started it is probable that the products of tryptic digestion themselves can in turn activate the fermentogen.[11] This fact is based on the evidence of painstaking researches, finished and published long before Körte wrote[12] in regard to acute pancreatitis:

"So now the majority of surgeons recommend the exposure of the inflamed pancreas; while some are satisfied with draining the surface of the pancreas by gauze and tube, others advise to go on into the diseased organ. As I have explained above, I join the latter and believe that by this means one lessens the inflammation and prevents more extensive necrosis."

Yet Körte grants but five lines to a discussion of all the work on pancreas poisoning, the understanding of which clears up so many of the problems of the surgery of acute pancreatitis. We know why injuries of the organ during digestion are more serious than at other

times, there is more zymogen present to be activated. There is no need for an elaborate classification of acute pancreatitis, since the various classes into which the disease has been divided are but degrees of the same process. The problem of the time of operation becomes clear. It is a progressive process, progressing under its own power, progressing more and more rapidly as it gains headway, therefore the sooner we operate the better. The question of drainage ceases to be a question; a means of escape for the infection, which may be present or so soon will appear from the neighboring intestines, and for this activated pancreatic secretion must be provided and must extend into the gland itself, where the trouble lies. Here more surely than Dionis ever dreamed, will the surgeon " not be in danger of committing faults if his hand be not guided by his head? "

The operating room cannot teach these facts of physiological chemistry; therefore as much as we may hate to do it we must go to the physiological chemist, begging him on bended knee to converse in words of one syllable.

Let us not forget that the greatest lesson which surgery will read out of the Great War promises to be the Dakin-Carrel treatment of infected wounds. Let us consider how this has come about. Certainly not out of the depths of the surgical experience of an experimental surgeon. It has come because Carrel possesses the genius of appropriating knowledge to the needs and purposes of surgery; and therefore he made use of the knowledge of the pure chemist Dakin. Not only that the ends of justice and fairness may be met, but that all may realize the importance of applying all knowledge to surgery, let us always think of and speak of the Dakin-Carrel treatment of infected wounds rather than the Carrel treatment. No better example of what I am trying to emphasize could be found.

Now let no one go from here thinking that I have minimized the importance of surgical experience or of surgical judgment, which can only come from a proper combination of common sense, experience and knowledge. Neither the writer of the text, nor I, nor any one in the two hundred years between us would divorce experience from knowledge. The point we would make is that the one without the other is just one-half a whole, and " if he be not a good theorician he will never prove an able practitioner."

You may tell me that the trouble lies with hospital conditions; that there is so much routine to be done that the spirit needed to encourage the search for knowledge is crushed, and all the young surgeon can hope to do is to learn what he may from experience. You may tell me that the blame for multiple hospital appointments in dispensaries and hospital services lies with the boards of managers. I will not venture into your own field, but I will point out to you that

you will either change these conditions or someone will change them for you.

We hear to-day a great deal about the full-time idea in schools and hospitals. Now do not be misled that this idea is being discussed because it has been started at the Johns Hopkins and at St. Louis and is being started in Chicago; nor is it being discussed because the Rockefeller Foundation is behind it. It is being discussed because of dissatisfaction with existing conditions, and unless these existing conditions are changed it will come here. This dissatisfaction is with the men who hold hospital appointments and give to the hospital nothing more than the gleanings of their own experience. The dissatisfaction is with the men who hold so many hospital appointments that they have not the time to give more than gleanings, even though they are capable of better things; with the men who, having ideas, have only time to pass them on to their assistants, who pass them on to the internes, who pass them on to the head nurses, who pass them on to the probationers, who pass them on to the orderlies, who pass them on to the bed-pan; dissatisfaction with the men who use the hospitals for gaining experience and never hand back to the hospital a quid pro quo in the form of crystallized experience or knowledge.

You give your time to the ward patients, you keep your appointments promptly, the wards are getting as good treatment as other hospitals, your mortality is as low, your operating staff is well trained? I should hope so—but is this enough? If you drop out to-morrow, will your hospital be any the better for your having worked there? Will the thousands who are to come be treated better because you treated the tens who were there?

These are the questions in men's minds which are leading to the discussion of the full-time idea. I do not know personally if it be the ideal; I do not know, if it were ideal in one place that it would necessarily be generally applicable. We are the servants of convention and custom in surgery as in life—even a musical comedy would fall flat among the naked natives of Africa. But I do know that something will be done to force from surgeons, in return for surgical experience, a commensurate quota of surgical knowledge.

If you do not believe that I am right, look around the country to-day, and I think you will find, without exception, that the men who are advancing the art and science of surgery are one-hospital men, that the hospitals whose names are associated with surgical progress are essentially one-man hospitals.

I do not represent any pessimism in regard to Philadelphia surgery. No city in the country, from the placid eastern coast over the western prairies to the Golden Gate, boasts as many great surgeons to the square inch as does Philadelphia. We would make it a post-graduate centre. Then remember that post-graduate centres are the

outgrowth of undergraduate centres, that they do not spring full-panoplied from the head of an oil well. The undergraduate school of surgery only begins with the diploma and it is up to you who teach in every hospital which has an interne, whether you will teach or not, to keep up the standards of the schools. You are the teachers of surgery!

I lay no claim to originality in this idea I have endeavored to present to you. I chose my text indeed from the writings of a surgeon of the long dead past. This is not the first time that this thought has been presented in this same place on this same occasion. What but this same idea prompted Ross to write in the annual oration of 1913:[13]

"Experience must set its seal deeply upon him who aspires to the heights of the surgical art. Each case must carry its lesson, however slight. The work and experience of others should be weighed in the balance.

"And granted that the surgeon has those qualifications which are so necessary to him, what is it that will enable him to further advance the science and art of surgery?

"Primarily it is the ability to profit by the experience of others, and the constant endeavor to add something new, seem it ever so trifling, to the fund of acquired knowledge."

And again, "And so the true surgeon cannot be too narrow a specialist. Specialism in modern surgery is necessary, but even more necessary is the well-grounded, thorough man who combines with his highly specialized vision openness to facts that lie beyond his immediate horizon, and an ability to interpret them."

Going back but two years more, we find the same thought underlying the annual oration of 1911, and summed up by Ashhurst in the last paragraph:[14]

"To know the wisdom and accomplishments of the past, and from them to gain a clearer vision of the needs and the possibilities of the future; to record and to study the experiences of the present, and compare them with the learning of others; to recognize the shortcomings and the disadvantages of current methods and theories, and to search for better; to let neither feeble health nor prosperity, neither the indolence of youth nor the procrastination of advancing years divert them from the path of learning and of progress; to prove all things and hold fast to that which is good: this is the patience of the saints, this is the patience of surgery."

I have ventured to presume upon this same topic to-night, because if I had any criticism of these two presentations from which I quote, it would be that they were too masterly, too scholarly, and slid softly and gently over our heads. Most of us are so constituted that the stars of heaven are not seen so clearly as are those stars perceived after a blow on the head with an ax. My hope is that I may have brought

close home to you, who are the teachers of surgery, though you may not have the title of professor, the truth of our text—"Whatever experience a surgeon may have, if he have not the knowledge which ought to direct him in his operations, he will work in the dark; and if he be not a good theorician he will never prove an able practitioner."

Coleridge says, "To most men experience is like the stern lights of a ship, which illumine only the track it has passed." Are you leaning over the stern rail, watching the turmoil of the waters raised by the propeller, not knowing whether the propeller is turning forward or backward? Get up on the bridge, steer by the stern lights of the ships that have gone before. From the bridge you can look back over your own track, seeing it perhaps the clearer if not too near. From the bridge alone can you see these stern lights of other ships. Only there can you follow the charted paths; only there can you keep your ship in line of battle.

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STATED MEETING, HELD MARCH 5, 1917

The President, Dr. Charles H. Frazier, in the Chair

X-RAY TREATMENT OF CARBUNCLE OF FACE

Dr. George G. Ross presented a woman, sixty-two years of age, who was admitted to the Stetson Hospital on December 23, 1916. Her history showed that on November 23, 1916, she had first noticed a "small pimple" in the right temporal region just anterior to the ear. This grew very hard and painful, enlarged rapidly, and spread to the cheek and side of the neck. The carbuncle was incised, but grew rapidly worse. On admission the patient showed on the right side the face a hard, deeply congested swelling, containing numerous small openings from which a little pus oozed, showing slough beneath. This swelling extended from just anterior to the ear around under the eye and down the neck to just above the clavicle, involving the whole side of the face and cheek over to the edge of the mouth and nose. This is well shown in the accompanying photograph (Fig. 1).

The patient's general condition was poor. Her previous history of polyuria and pruritus suggested diabetes, and there was also a history of glycosuria. Sugar was, however, not shown in the urine until January 4, 1917, and then in small quantity (.277 per cent.). Later it was more abundant and has been in evidence since her discharge from the hospital. The temperature on admission was 101 degrees and never ran above this, being practically normal after the third week. Pain was not marked and the carbuncle was markedly insensitive to handling. The process was exactly such a slow sloughing with subacute infection as is often seen in diabetic conditions.

The patient was placed upon liquid diet with milk and eggs freely given. Flaxseed poultices were applied and continued until January 18, 1917. Local treatment was from the first confined to cleansing, removal of detritus, and touching the openings with tincture of iodine. The first X-ray treatment was given on December 27, 1916, and three subsequent ones on January 1, January 5, and January 18, 1917, respectively. Each one was of ten minutes' duration and given without filtration. A five milliampere current backed up against a 4½-inch spark. After each treatment there was a marked reaction. Improvement was noted after the first treatment and each subsequent one (Fig. 2). The inflammatory swelling began to subside and the carbuncle literally dried up. The pictures show this better than it can be described. The local process made an uninterrupted recovery. In the second week the swelling below the angle of the jaw became so marked that it seemed that incision would be necessary, but improvement under the X-ray made this unnecessary. The patient's general condition rapidly

improved and she was able to be up on January 18, 1917. A troublesome diarrhœa and pains, probably phlebitic, in the lower extremities delayed her complete recovery.

GALL-STONE ILEUS

Dr. George G. Ross presented an elderly woman, who was admitted to hospital December 3, 1916, with the history that about twenty-four hours before admission she was seized with sudden cramp-like pain in central abdomen. There was no radiation and it increased in intensity. Nausea and vomiting started almost immediately and continued at very short intervals until admission. At first the vomitus was yellowish, but later it became dark brown and of a fecal odor. It was forcible in type. Patient's bowels moved twice after the onset of sickness without any medical agents. There were no cardiac, pulmonary or renal symptoms. According to her statements she had always been in good health except for an attack of severe upper abdominal pain about one year ago, lasting for two or three days and accompanied with nausea and vomiting. Has never been jaundiced. Has never noticed clay-colored stools. She has never been troubled with gastro-intestinal symptoms aside from the above, and occasional gaseous eructations. Physical examination reveals an elderly white female, apparently very acutely ill. Frequent vomiting of dark fluid material with intense fecal odor. Pulse is good in volume and regular. Heart and lungs negative to rapid examination. Abdomen pendulous. There is no point of special tenderness, but a general soreness. There are no palpable masses. Inguinal and femoral hernial orifices free.

The abdomen was opened by a right rectus incision just below the level of the umbilicus. Considerable free blood-stained fluid within the peritoneal cavity. Peritoneum slightly injected. Hernial orifices free. In the pouch of Douglas was a loop of ileum, in the lumen of the most dependent portion of which was a mass about the size of a walnut. Intestine slightly dilated above the obstruction. Bowel incised over the mass which was expressed through the incision. It appeared to be a gall-stone. The bowel was closed by fine catgut suture. Peritoneum stitched over the line of incision with linen thread. To palpation the gall-bladder was very much contracted and the lumen practically obliterated. There were old adhesions between the gall-bladder and bowel. The abdomen was closed without drainage.

Except for a moderate superficial infection her subsequent progress of recovery was uneventful and she was discharged at the end of five weeks.

The obstruction in this case was due to two conditions: First, the diminution of the lumen by the large stone; and second, to the sharp angulation of the gut caused by the weight of the stone.

SOME OF THE PROBLEMS OF PLASTIC SURGERY *

By John Staige Davis, M.D.

of Baltimore, Md.

By plastic and reconstructive surgery I mean that branch of surgery which deals with the repair of defects and malformations, either congenital or acquired, and with the restoration of function and improvement of appearance. This is accomplished chiefly by the transfer of tissue, either from the immediate neighborhood or from some distant part. The deformities dealt with in plastic surgery for the most part involve the skin or adjacent soft parts, rather than the bones and joints, the ligaments or tendons. The treatment of large denuded surfaces, requiring skin grafting, and of intractable wounds, should also come under the care of the plastic surgeon.

In reconstructive surgery on the jaws and palate the plastic surgeon should have the coöperation of a skilled dental surgeon. The plastic surgeon, with his special knowledge of tissue transplantation, can be of great use to the general surgeon and to the orthopedist in repairing the defects left by certain necessarily mutilating operations. This also applies to the gynæcologist and genito-urinary surgeon, when called on to perform more extensive transplantations than they are accustomed to undertake.

My experience has been that we seldom, if ever, find two plastic cases exactly alike, and thus no "cut and dried" methods can be employed. Each case should be carefully studied and the various methods of repair considered from every standpoint. This endless variety in itself brings a certain fascination to the operative treatment, and to the after-care of these patients. Keen surgical judgment is often necessary to determine what should be done; whether or not a plastic procedure should be finished at one operation; how far to go in the initial operation, and when to follow with the secondary procedures. The results in certain groups of cases are very slow, and in these the process is one of gradual building up. In such cases the entire series of operations should be planned with regard to the ultimate result, and not to the immediate relief of the condition. The post-operative treatment and dressings should be done by the surgeon himself, or directly under his eye, as successful results in a great measure depend on skilful and judicious after-treatment.

The simpler the operation the more likely it is to succeed, and this is especially exemplified in the operations for the relief of

* Read before the Philadelphia Academy of Surgery, March 5, 1917.

harelip. It is wise to make haste slowly in plastic surgery, and to underdo, rather than overdo. Thorough familiarity with the free transplantation of skin, fat, fascia, bone and cartilage is essential, as all of these tissues are constantly utilized in reconstructive work. The principles of tissue shifting, and of the use of pedunculated flaps, must be understood, and also the possibilities of combinations with the above mentioned free transplants.

A few words concerning these transplantations may be of interest.

Transplantation of Skin.—The use of skin grafts is absolutely essential in plastic surgery. There is seldom a case of any magnitude in reconstructive work in which some form of skin grafting is not used at one time or another during the process.

Skin grafts may be divided in general into *thin grafts* where only the superficial layers are utilized, as obtained by the methods of Reverdin and of Ollier-Thiersch; and *thick grafts* where the whole thickness or nearly the whole thickness of the skin is used. This latter division includes *small deep grafts,* secured in much the same manner as Reverdin grafts, but often including the whole thickness of the skin; also the so-called Wolfe-Krause grafts, which include the full thickness of the skin.

Grafts may be further classified into auto-grafts, where the graft is obtained from the same individual; *iso-grafts* where the graft is obtained from another individual of the same species, and *zöo-grafts* where the graft is obtained from a lower species.

I will not go into the technic of obtaining these grafts, but will only say that both thin and thick grafts may be successfully transplanted on healthy granulating surfaces, as well as on fresh wounds.

Iso-Grafts.—There is much difference of opinion as to the advisability of utilizing iso-grafts, and many surgeons insist that only auto-grafts should be used. Of course, auto-grafts are more likely to succeed, but I feel convinced, when it is not possible to utilize auto-grafts, that iso-grafts are well worth trying, and that very good lasting results may be secured if the grafts are obtained and transplanted with the proper technic. The success or failure of iso-grafts may be dependent on the similarity of blood groups of the host and donor, and a subsequent report will be made on this point.

Zöo-Grafts.—Many successes have been reported following the use of zöo-grafts from various animals. My own experience is that these grafts take readily and receive their blood supply as promptly as ordinary grafts. They also have the power of stimulating wound as do other grafts. However, in every case which has been under my observation these grafts, after doing well and often when the wound is entirely healed, will suddenly with no apparent cause begin to melt away, and will soon disappear.

Transplantation of Fat.—Free fat grafts are used principally for filling in depressions. They can be successfully transplanted and enough of the tissue will survive to accomplish the desired purpose. Some surgeons prefer small bits and others pieces of considerable size and thickness. This tissue must be most carefully handled to prevent bruising. The defect into which it is placed must be perfectly dry and asepsis must be maintained. Fat is also used in plastic surgery to prevent adhesions around tendons and nerves. Often a pedunculated flap of skin with a very large mass of fat is transplanted, and in this way better circulation is assured.

Subcutaneous fat is the usual source of supply, and this is ordinarily abundant on the abdominal wall, or on the thigh. Omental fat has been used successfully, but one would hardly feel justified in opening the abdomen for the sole purpose of obtaining fat.

Transplantation of Fascia.—Fascia is used in plastic surgery for a number of purposes. It is valuable for reinforcing weakened or defective tissues. New tendons may be constructed of it. It may be used for the relief of ptosis. It may be used either alone or with fat in joints. Fascia lata is the favorite source of supply, but the deep fascia obtained almost anywhere is very satisfactory.

Transplantation of Bone and Cartilage.—Bone and cartilage are normally the supporting framework for the soft parts, and both are used for this purpose in reconstructive surgery. When bone is chosen for the supporting substance, it is advisable to leave the periosteum intact. It must be borne in mind that free grafts of bone, either with or without periosteum, when transplanted into soft parts will eventually absorb. I have found experimentally and clinically that a bone graft in contact with bone at one end and extending into the soft parts, without special function, will become thin and eventually lose its power to act as a support. However, if the bone transplant is placed in contact with living bone at each end, it will become a permanent supporting framework. Whether the graft lives or whether it is replaced is still a matter of dispute, the pros and cons of which we will not consider here.

Cartilage, on the other hand, is an ideal supporting substance for transplantation, and will live and not shrink when transplanted free, either with or without its perichondrium, into soft parts. It will also live when in contact with bone at one or both ends. Rib cartilage is the usual source of supply. Cartilage is flexible and thus less liable to subsequent fracture; it can be easily cut and shaped into any desired form; it is no more difficult to obtain than bone, and a large supply is always available. Any one of these advantages, it seems to me, would suggest the use of cartilage rather than of bone for the supporting material in transplantation for the correction of saddle nose, the filling out of sunken areas on the face, and also for the framework in rhinoplastic operations.

Mucous Membrane Transplantation.—Free grafts of mucous membrane are of little value either when transplanted to the eyelids or into the mouth. Mucous membrane offers little if any advantage in these situations over very thin Thiersch grafts, and the results are usually unsatisfactory. Pedunculated flaps of mucous membrane in the mouth are often successful, and if mucous membrane is not available, pedunculated skin flaps can be used with equal success, and with very good permanent results.

Subcutaneous Hydrocarbon Prosthesis.—The injection of paraffin has been advocated by a number of men, and is principally used for correcting certain deformities about the face. This can be done with a little practice by anyone who is able to purchase the equipment, and gives immediate results which are, at first, very satisfactory to the patient. This method is the sheet-anchor of the "quack" facial specialist. However, paraffin often shifts its position gradually, and trickles down the tissue planes, or, perhaps, the infiltrated tissues may thicken and cause deformities which are much worse than the original defect. For a number of years I have felt that the injection of paraffin, and similar substances, is bad surgery, and have spent much time in trying to remove the paraffin injected by others, and in correcting the deformities caused by these injections.

Definition of Terms.—By a *flap* we mean a mass of tissue attached at some portion of its circumference by a pedicle, which can be shifted at once or later as far as the pedicle will allow.

By a *graft* we mean a mass of tissue which is cut free to be transplanted wherever necessary.

A surface defect may be closed in one of four ways:

First, by skin grafting.

Second, by sliding the edges together and suturing, called the French method. In those instances where there is tension the skin may be mobilized to a very great extent by undercutting, and in this way large areas of skin may be shifted in without impairing its vitality. If direct union is impossible in a wound, even after undercutting, then lateral liberating incisions may be made, either on one or both sides, and the edges closed, leaving one or two smaller defects in place of a large one.

Third, by pedunculated flaps from tissue in the immediate neighborhood, called the Indian method. In some instances healthy flaps from adjacent tissue are impossible to get, especially in finger contractures, or where a defect is situated in the midst of scar tissue.

Fourth, by pedunculated flaps from distant parts, called the Italian method. This may be done either by a single or double transfer. It is usually easy to secure sufficient tissue by using flaps from distant parts, but the constrained position necessary in order to utilize these flaps is

exceedingly irksome to the patient, and many are unwilling to endure the discomfort.

In all sorts of plastic operations it is advantageous that the patient should be in the best possible physical condition, and no plastic operation should be undertaken on those with active local disease still present. Asepsis rather than antisepsis should be maintained throughout the operation, and during convalescence. The tissues should be treated with the greatest consideration. Sharp cutting instruments must be used to avoid unnecessary injury to the tissues. The flaps should be handled with special forceps or small sharp hooks. The area into which the flap or graft is to be transferred should be perfectly dry, and all hemorrhage checked, as many failures are due to a blood clot collecting beneath the transplant, which prevents the early formation of a new blood supply. An accurate estimate of immediate and subsequent tissue shrinkage must be planned for. Accurate apposition is desirable as prompt healing minimizes scar tissue.

One of the most important points in plastic surgery when tissue of any kind is transferred, is that there be no tension either on flaps or on free grafts. Never leave a suture in place which blanches the transplanted tissues, as it is better to gain only a portion of the necessary distance than to jeopardize the whole flap. The use of pedunculated flaps is especially valuable when a pad of fat is required in addition to the whole thickness of the skin. The shape of the flap must correspond fairly accurately to the defect which it is to cover. Thin flaps are so pliable that they can easily be adjusted to fit a defect of almost any shape, but, especially in rhinoplastic operations, it is advisable to outline the flap from a carefully calculated pattern.

The skin of pedunculated flaps, as well as of whole thickness grafts, must be chosen with some regard to the area into which it is to be placed. The flap should be cut at least one-third larger than the area it is to fill, and this equally applies to grafts of whole thickness skin. The shrinkage of both flap and graft is in the direction of the elastic fibres. Normal skin is necessary for a successful flap, as any scar on the edge of a flap will usually slough, and a scar running across a flap will completely cut off the circulation beyond it. Always excise the scar if possible along the edges to be sutured, as the healing will be much more satisfactory.

The pedicle should be as broad as possible. Always aim to have the pedicle very close to the loss of substance. The long axis of the pedicle should be in the same direction as the axis of the flap in the new situation. The pedicle of a flap should be in the same line as the area to be filled. The elasticity of the skin will allow a curved flap to assume a straight position without difficulty.

As a general rule the flap should not be longer than two and a half or three times the width of the pedicle. The pedicle should not be twisted enough to interfere with the circulation of the flap. The flap

FIG. 1.—Carbuncle of cheek.

FIG. 2.—Carbuncle of face. Condition after two applications of the X-ray.

should be made of the skin and subcutaneous fat, and in some large wounds the deep fascia may be included. The amount of fat should be somewhat thicker than is actually necessary to fill the defect, as the excess is taken care of by subsequent shrinkage. It is unwise to include muscle with the skin and fat flap to be shifted. The shifting of muscle, etc., should be done separately. A flap may be cut much thinner if its pedicle contains a main artery, and it is of advantage to have the artery. However, a main artery is not essential if the flap is thick and includes enough smaller vessels for its proper nutrition.

Twisting or too much tension on a pedicle may cause the shutting off of circulation and subsequent death of the flap. There is sometimes death of a pedunculated flap which has an excellent blood supply due to the lack of drainage from the flap. In other words, the flap is choked by the blood entering it and being unable to get out promptly. This is especially to be feared if the pedicle contains a main artery. This danger is overcome by scarifying the flap to allow surface drainage until the proper vessel drainage is established. Scarifying for drainage is not necessary in whole thickness free grafts. Perforation of the grafts is essential, however, to allow the escape of blood or serum which may collect beneath the graft.

When there is doubt about the circulation in a long narrow flap, it is advisable to separate it from the deeper structures but to leave it attached at each end. Keep it separated from its bed by rubber protective, or by covering the bed with Thiersch grafts, and then after two or three weeks cut one pedicle and transfer the flap. As a rule it is best to wait from 10 days to two weeks before amputating the pedicle of a flap. This may be done by notching on each side of the base and thus gradually cutting off the circulation of the pedicle or the amputation may be done at one time, and after the pedicle is cut through it should at once be fitted into its proper position, as in this way a better result can be obtained with little, if any, loss of the tissue in the pedicle. The area from which the pedunculated flap is taken may be closed with sutures if the skin is lax, or after undercutting and sliding. If closure is not possible on account of the size of the area, then the defect may be covered with skin grafts, preferably of the Thiersch variety. Immobilization of the part with plaster, crinolin, or splint is essential, and the dressings next to the transplanted tissue should be soft and very carefully applied.

Flaps of normal tissue are often successfully shifted into the midst of scar tissue, but the circulation of these flaps should be especially good. A graft of whole thickness skin may also be placed successfully in the midst of movable scar tissue, and accomplish its purpose. The result in these cases being that the graft is more stable than the tissue which surrounds it, and it also follows that the scar becomes more resistant as the tension is relieved.

On a part completely covered with scar, as is often seen on the face, much can be done by the gradual shifting of the scar tissue itself, but this must be done very slowly, and with the greatest care, sometimes only a fraction of an inch being gained at one operation. It is a waste of time to attempt to shift pedunculated flaps of scar tissue.

In plastic work I prefer to use small cervical needles for the deep sutures when they are necessary, and catgut for the suture material. For the skin I find the corneal needle satisfactory, and use horse-hair, very fine silk, silkworm gut, or silver wire, depending on the indications. In cleft palate work I find that silkworm gut and horse-hair for the hard and soft palates and fine silk for the uvula are most satisfactory. Special small curved needles are used for this work. Very fine catgut should be used for ligatures. It is rare in plastic surgery that we encounter a deformity which cannot be helped by logical surgical methods. At best we can only accomplish a certain amount, trusting in nature to complete our work.

Dr. John B. Roberts said that of late years he had been more interested in what might be called cosmetic constructive and reconstructive surgery than in strategic and substitutive plastic surgery. The last two are often valuable in obtaining access to deeper organs and in supplying physiologic substitutes for structures put out of commission by operation or disease. Cosmetic surgery affords operative relief in congenital deformities and deformities due to loss of tissue. To illustrate some of the results he had brought a patient and a few photographs of other patients to give an idea of what he considered good plans of treatment. This boy, now eleven years old, had been under his care for successive operations since he was about five years old. He lost, by cicatricial contraction after deep burns, the use of his left thumb, which is shown by the photographs (Figs. 3 and 4). In addition his left ear was deformed in its lower portion by being buried in cicatricial tissue close against the lower part of his skull. He had no chin, because the deep sloughing and scarring of the neck had drawn the lower jaw close to the front of the laryngeal region. His lower lip was attached to the mental region so that it was dragged outward allowing saliva to flow over. His mouth, therefore, could not be closed and he could not lift his head from his chest (Fig. 5). The thumb, which was extended and abducted and attached to the front of the wrist by contraction, was by a succession of operations liberated by sliding tissue from the dorsal and palmar surfaces of the forearm into the gap left when the flexed wrist and the movable thumb were after incisions put in proper position. A portion of the gap was closed by a large flap obtained by attaching the hand and forearm to the abdomen for a couple of weeks. He now has a fairly movable thumb and a straight wrist (Fig. 4). By sliding and transferring pedunculated

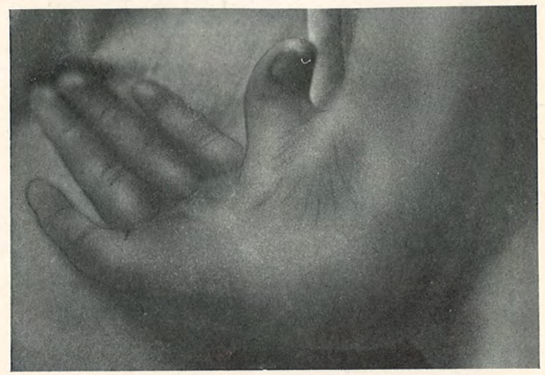

Fig. 3.—Deformity of thumb and wrist from scar of burn in child of six years, due to accident one year before.

Fig. 4.—Plastic operation on thumb, showing condition three months after operation (see Fig. 3). Notice flap swung from back of wrist and forearm to release thumb.

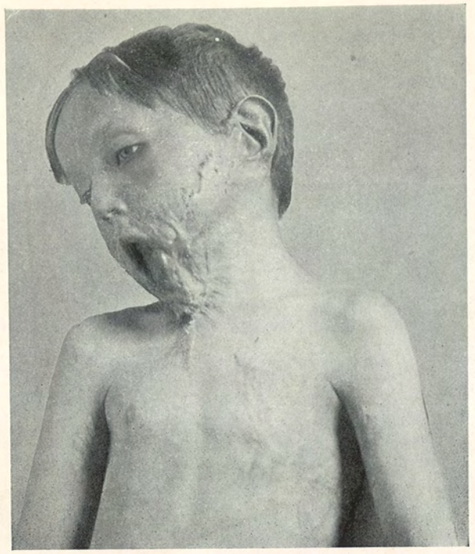

FIG. 5.—Deformity of mouth, chin and ear from burn one year previously.

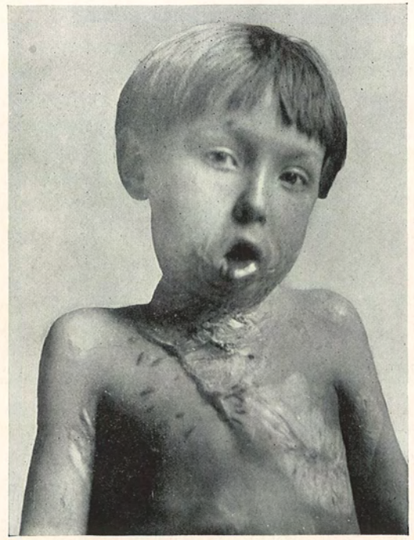

FIG. 6.—Showing improvement in face three months after operation.

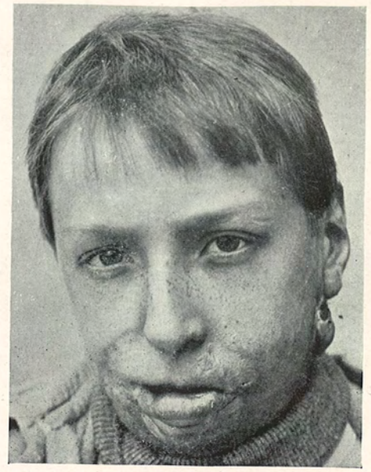

FIG. 7.—Showing condition of patient of Figs. 5 and 6, six years after operations. Boy now twelve years old.

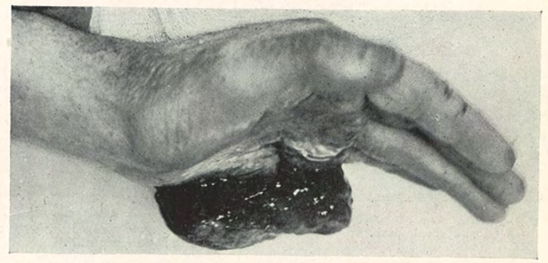

FIG. 8.—Mass obtained from thigh attached to edge of hand to be transferred to nose as a rhinoplastic procedure.

FIG. 9.—Rhinophyma.

FIG. 10.—Result of graft after removal of rhinophyma.

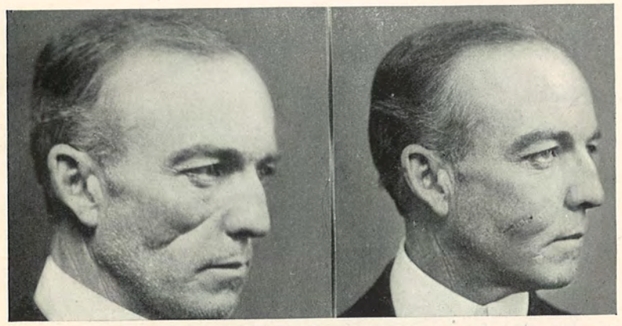

FIG. 11.—Furrow scar of cheek attached to subjacent bone.

FIG. 12.—Scar freed from bone and cheek filled out by a free transplant of fat taken from abdominal wall.

flaps from the sides of the neck, the head was liberated and a chin made. The everted lower lip shown in the original photograph was freed and replaced so that he could close the mouth; and a new external portion made to the lip by utilizing flaps from the outer portions of the upper lip and some of the flap taken from the anterior belly wall to fill in the space left when the thumb was liberated. Sliding flaps were used to make a new lobe to the ear. This was accomplished by using a folded flap with penetrating mattress sutures to form a lobe. The final result obtained is shown in Fig. 7.

The method of transporting a flap from abdomen or thigh is shown in Fig. 8, which shows a large piece of skin and superficial fascia removed from the thigh of a patient and attached to the left hand to be carried to the face to make the lower part of the nose, lost by syphilis. Figs. 9 and 10 show how the ponderous nose due to rhinophyma or hypertrophic acne may be relieved. This man's nose was shaved down to a proper shape by a razor and a large Thiersch epithelial skin graft from the thigh was placed upon the end of the nose. The photograph was taken very shortly after the skin graft was placed in position. The cure was very satisfactory.

Figs. 11 and 12 show the value of adipose tissue grafts to restore the contour of the cheek. The patient had had, since early manhood, a deeply attached furrow scar of the cheek, due to a kick by a horse. By splitting open the tissues, incising the scar tissue latterly beneath the skin and inserting a free flap of fatty tissue from the front of the abdomen, he was able to fill out the cheek as shown in the picture. This, it will be seen, was made a little over-full because shrinkage is sure to take place later. The second photograph was made about three weeks after the operation.

DR. FRANCIS T. STEWART said, in regard to æsthetic surgery, that one of the principles which should be emphasized is the taking of the tissue from the immediate neighborhood of the defect whenever that is possible. The secondary changes which take place in a graft taken from a distance sometimes make the repair as unsightly as the defect. The Italian method of transplantation was until recently the only method of bringing parts from a distance, but this has fallen into increasing disuse because of the employment of the free transplantations. In the correction of defects especially of the face which is the only part, at least in man, which can always be seen, tissue from the scalp can be used to advantage. Fortunately the hair follicles are preserved and the hair grows and covers up whatever irregularities the surgeon may not have had the skill or the opportunity to correct.

ACUTE PERFORATION OF GASTRIC AND DUODENAL ULCERS*

WITH A REPORT OF 36 CASES

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of Philadelphia

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This paper comprises a study of 28 cases of acute perforation of duodenal and 8 cases of acute perforation of gastric ulcers admitted to the Episcopal Hospital since 1908. Through the kindness of Dr. H. C. Deaver and Dr. R. Neilson, I was permitted to operate upon eight of these cases. The stimulus that prompted me to study and report these cases was the wonderful immediate operative results of the cases reported by Dr. John B. Deaver of this city, and a careful study of cases operated upon and reported by Dr. Gibson of New York.

Perforation of a duodenal ulcer is the most frequent, serious upper abdominal catastrophe we are called upon to treat. Notwithstanding this or the fact that so much has been written within the past few years on their experimental production, diagnosis and operative treatment, very few of our cases were referred to the hospital with the correct diagnosis. In the majority of instances, however, a surgical diagnosis had been made.

Since 1908, 157 cases of duodenal and gastric ulcer have been treated in the Episcopal Hospital; as 36 of this number were admitted with acute perforations, the chance, according to these statistics, of a simple ulcer perforating is 22 per cent.

Innumerable pathologic conditions have been mentioned as possible causes of duodenal ulcer, and in many ways have they been produced experimentally. Durante, in an article entitled "The Trophic Element in the Origin of Gastric Ulcer," mentions no less than seventeen ways in which they have been produced experimentally. The great majority of duodenal ulcers occur in men, and almost every case of the perforated ones; in fact, in every case in this series, man is the one affected. This seems to occur with too great a regularity to be a coincident. Is there an anatomic, histologic or physiochemical difference in the alimentary tracts of the two sexes, or does the abdominal type of respiration in the male favor the production of, or, when once formed, the perforation of a duodenal ulcer? In perforations of typhoid ulcer the proportion is almost, though not quite, as great in favor of the male sex.

* Read before the Philadelphia Academy of Surgery, March 5, 1917

The diagnosis of a perforation of a duodenal ulcer is, as a rule, not difficult. The previous history of indigestion, the sudden, severe and excruciating pain in the epigastric region, sometimes followed by nausea and vomiting and the board-like rigidity of the upper abdominal muscles are usually present in every case. In a few of the cases, before the operation, we were unable to get a history of previous stomach trouble, but on closely questioning them after the operation we were able in all cases to elicit the fact that at times the stomach had given them some trouble.

It is surprising how infrequently patients suffering from an acute perforation of a duodenal ulcer exhibit symptoms of shock. Occasionally, however, it is a most serious factor. In one case of this series, a man sixty-two years of age who walked into the Receiving Ward, giving a history of a perforation a few hours previously, died an hour or two after admission from shock.

The absence of liver dulness is not regarded as a valuable sign. I am aware that its absence may be due to several causes, and also, for the sign to be of exact scientific importance, one should know the normal liver dulness of the patient in question. I believe, however, that it is of some value. In a case of acute hemorrhagic pancreatitis which I operated upon recently, with all the symptoms of an upper abdominal perforation, but having normal liver dulness, I made a diagnosis of probable duodenal perforation, but was not greatly surprised on opening the abdomen to find some other condition the cause.

To differentiate acute pancreatitis, perforation of the gall-bladder or that of a gastric ulcer from a perforation of the duodenum is often impossible. In some cases of appendicitis and in other inflammatory conditions within the abdomen that lead to a peritonitis, it may be impossible in the absence of a clear-cut history to make a correct diagnosis. Also in duodenal cases that have been perforated for several hours and have a diffuse peritonitis, unless you can obtain a clear history, it is only by the shrewdest guess that you are able to say other than that you are dealing with a perforative peritonitis. Besides the conditions mentioned above, the other causes we have encountered which atypically simulated an acute perforation of a duodenal ulcer were internal strangulated hernia, pneumonia, subdiaphragmatic pleurisy, visceral crises of tabes, gastritis, lead and ptomaine poisoning.

In the treatment of a perforation of a duodenal ulcer, all surgeons agree, with the exception of a few minor points in the technic, that the ulcer should be closed; whether or not a primary gastro-enterostomy should be performed is still a debatable question.

The best reasons advanced why a primary gastro-enterostomy should be performed are: To remedy any possible obstruction at

the pylorus resulting from encroachment upon the lumen of the duodenum, due to infolding of the ulcer; to obstructive œdema, that might follow shortly after operation; to late cicatrization; to place the duodenum and stomach at rest by dependent drainage and to bring about a cure by changing the chemistry of the stomach. Also, in cases of multiple ulcers, it acts as a cure and prevents complications incident to them.

The arguments against the performance of a primary gastro-enterostomy are: That it adds several minutes to the operation, it opens up the lesser peritoneal cavity to infection, and that a gastro-enterostomy does not always work the wonders it is supposed to, being very much like the little girl who "when she was good she was very, very good, but when she was bad she was horrid."

Primary gastro-enterostomy has nothing to do with the immediate results other than to forestall the possibility of pyloric stenosis. It, however, does render the patients more comfortable immediately following the operation, reducing the tendency to spit up or vomit. They are able to take substantial nourishment at an earlier date and thus hasten their convalescence.

Gibson, after a study of the end-results of fourteen cases, rejects primary gastro-enterostomy. He says, "I consider it unwise to do a gastro-enterostomy for a condition which is going to be cured anyhow." Case VII of my series is quite interesting and seems to bear this statement out.

> C. I., aged twenty-seven, diagnosis acute perforation of a duodenal ulcer, of six hours' duration. At operation a large chronic callous ulcer, nearly the size of a quarter, was found. This was closed by three layers of sutures. Cultures taken from the ulcer were negative, but from the upper and lower abdominal cavities diplococci were found. The patient, four weeks after the operation, developed a subdiaphragmatic abscess, for which he was operated by the transthoracic route with fatal result.
>
> *Post-mortem.*—Entire stomach and duodenum removed and showed nothing macroscopically, the duodenum appeared normal and there was no occlusion.

Our immediate results in cases where primary gastro-enterostomy was performed have been excellent and in those cases in which a gastro-enterostomy was not performed the mortality could in no way have been influenced by so doing, as these cases died of pneumonia, peritonitis and subdiaphragmatic abscess. Dr. John B. Deaver has had a most wonderful experience in acute perforations of duodenal ulcer and has operated upon 46 cases with but one death. In all but three of these cases he performed a primary gastro-enterostomy, truly a wonderful record and one that proves beyond doubt that the addition of a gastro-enterostomy does not increase

the mortality. Dr. Deaver's great skill and dexterity, however, make it possible for him to get results in a procedure of this kind far better than statistics usually show.

Our own experience in these cases with primary gastro-enterostomy has been excellent, having had ten without a death. I feel as if these cases were more or less picked ones, so hesitate to offer them, other than to show that primary gastro-enterostomy does not add to the mortality. Certainly two of the arguments against gastro-enterostomy, namely, the prolongation of the operation and the danger of spreading the infection, can be eliminated. If there is danger of immediate or late pyloric obstruction, or if there are other ulcers present, then certainly a primary gastro-enterostomy should be performed.

In gastric ulcers Balfour has suggested that the act of perforation has a curative feature, and on this basis has advised the use of the cautery on simple ulcers. The post-mortem findings in Case VII of my series certainly add weight to this suggestion.

In thirteen of our cases cultures were taken with the following results: In four a smear and culture both proved negative; in three, the smear showed pus cells, but a culture failed to show a growth; cultures in the remaining six showed diplococci in three, streptococci in one, diplococci and bacilli in one and bacilli in one.

In indurated ulcers where it is impossible to satisfactorily infold, I think it wise to place a small cigarette drain at this site. Regardless of laboratory results I believe it good practice to drain the pelvis, as one cannot tell at the time of the operation whether or not organisms are present in the soiled peritoneal cavity, and if they are, their number and degree of virulency. In early operations it is considered by some unnecessary to drain. I have been unable to convince myself of this, as in one case upon whom I operated four hours after the perforation, the culture showed diplococci. Drainage also permits the escape of the discharged gastric and duodenal contents which it was impossible to mop away at the time of the operation. Flushing of the abdominal cavity is, as a rule, not to be advised. It may, however, be necessary in early cases, where the peritoneal cavity has been flooded by a large quantity, and I may add, with large pieces of undigested food.

A study of the end-results has been gratifying but not convincing. I have seen twelve of the duodenal cases and two of the gastric ones who had had perforations. Seven of the duodenal cases had had an enterorrhaphy and a primary gastro-enterostomy performed and the remaining five an enterorrhaphy.

In questioning these cases (duodenal) most carefully, in only one, a case of simple enterorrhaphy, did I find a perfect cure. This patient had had absolutely no trouble with his stomach since the operation. In the other cases all had had some gastric disturbance. In the great majority of instances, however, it was due to specific

TABLE III

CASES OF ACUTE PERFORATION OF DUODENAL ULCER ADMITTED TO THE HOSPITAL IN A MORIBUND CONDITION AND NOT OPERATED UPON

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
J. C.....	34	Male	.....	30 hours	.....	Death	Peritonitis.
S. McC.....	41	Male	.....	48 hours	.....	Death	Peritonitis.
A. S.....	62	Male	.....	5 hours	.....	Death	Shock.
P. H.....	35	Male	.....	36 hours	.....	Death	Peritonitis.
H. K.....	29	Male	.....	72 hours	.....	Death	Peritonitis.

TABLE IV

ACUTE PERFORATION OF GASTRIC ULCERS

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
H. S.....	37	Male	4 years	12 hours	Gastrorrhaphy	Death	Peritonitis.
J. M.....	53	Male	1 year	6 hours	Gastrorrhaphy	Recovered.	
M. G.....	21	Male	9 months	4 hours	Gastrorrhaphy	Recovered.	
E. E.....	25	Male	2 weeks	8 hours	Gastrorrhaphy	Recovered.	
W. F.....	53	Male	3 weeks	72 hours	Gastrorrhaphy	Death.	Peritonitis.
W. D.....	27	Male	4 years	6 hours	Gastrorrhaphy	Recovered.	
W. K.....	35	Male	2 years	8 hours	Gastrorrhaphy	Recovered.	

NOTE.—In three of these cases the ulcer was situated very close to the pylorus.

TABLE V

ACUTE PERFORATION OF GASTRIC ULCERS NOT OPERATED, ADMITTED TO THE HOSPITAL IN A MORIBUND CONDITION

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
S. C.....	25	Female	.....	48 hours	.....	Death	Peritonitis.

TABLE I

AUTHOR'S CASES OF ACUTE PERFORATION OF DUODENAL ULCERS

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
J. H.....	53	Male	1 year	6 hours	Enterorrhaphy	Recovered.	
H. S.....	28	Male	2 years	4 hours	Gastro-enterostomy and enterorrhaphy	Recovered.	
J. M.....	38	Male	6 weeks	20 hours	Gastro-enterostomy and enterorrhaphy	Recovered.	
I. C.....	62	Male	5 years	13 hours	Enterorrhaphy	Recovered.	
S. S.....	23	Male	1½ years	8½ hours	Gastro-enterostomy and enterorrhaphy	Recovered.	
W. B.....	24	Male	6 months	9 hours	Gastro-enterostomy and enterorrhaphy	Recovered.	
C. I.....	27	Male	8 months	6 hours	Enterorrhaphy	Death	Subdiaphragmatic abscess.
J. A.....	49	Male	7 years	8 hours	Gastro-enterostomy and enterorrhaphy	Recovered.	

TABLE II

OTHER CASES OF ACUTE PERFORATION OF DUODENAL ULCER

Name	Age	Sex	Duration	Hours Perforated	Operation	Result	Cause of death
C. S.....	44	Male	1 year	48 hours	Enterorrhaphy	Death	Peritonitis.
J. W.....	35	Male	1 year	8 hours	Enterorrhaphy	Recovered.	
C. J.....	35	Male	2 years	6 hours	Enterorrhaphy	Recovered.	
S. N.....	40	Male	4 years	12 hours	Enterorrhaphy	Death	Peritonitis.
M. F.....	24	Male	1 year	8 hours	Enterorrhaphy	Recovered.	
G. F.....	27	Male	1 year	7 hours	Enterorrhaphy and gastro-enterostomy	Recovered.	
W. K.....	52	Male	1 year	10 hours	Enterorrhaphy and gastro-enterostomy	Recovered.	
W. H.....	29	Male	8 months	48 hours	Enterorrhaphy	Death	Peritonitis.
T. K.....	26	Male	3 months	18 hours	Enterorrhaphy	Recovered.	
J. T.....	35	Male	3 years	6 hours	Enterorrhaphy and gastro-enterostomy	Recovered.	
J. McC....	50	Male	8 months	27 hours	Enterorrhaphy	Death	Shock.
R. W.....	45	Male	2 years	8 hours	Enterorrhaphy	Death	Pneumonia.
I. B.....	22	Male	2 weeks	9 hours	Enterorrhaphy and gastro-enterostomy	Recovered.	
B. M.....	38	Male	5 years	6 hours	Enterorrhaphy	Death	Pneumonia.
W. S.....	35	Male	2 years	3 hours	Enterorrhaphy and gastro-enterostomy	Recovered.	

causes, such as eating indigestible food, alcoholism, tobacco, etc. Several, and it was almost equally divided between the two types of operation, said they had to be very careful what they ate, and in two cases sodium bicarbonate was required to relieve attacks of hyperacidity. I selected four cases, two of enterorrhaphy and two of enterorrhaphy and primary gastro-enterostomy, for laboratory study. Only one, a gastro-enterostomy case, showed a normal acidity. The other three were above normal. An X-ray study showed one case, a simple enterorrhaphy, with slight gastric retention.

The post-operative advice is most important. Their mouths should be put in order, many of them have bad teeth; and they should be instructed what to, and especially what not to eat. Hot liquids, tobacco and alcohol should be forbidden. These instructions were given to nearly all of the cases on their discharge from the hospital. I was surprised, however, in making a study of the end-results, to find that only one or two had heeded the advice consistently.

To really know the true end-results these patients should be placed on the proper diet and they should live up to the instructions. They should also be carefully studied, as other conditions might be the cause for persistent or periodic gastric symptoms.

On the whole, the end-results of the cases studied in this series were quite good. It was, however, impossible after questioning them to say, "This is a case of simple closure," or "this is one on whom a primary gastro-enterostomy was performed."

HISTOLOGICAL EVIDENCES OF GROWTH CHANGES IN TRANSPLANTS

Dr. Dean Lewis, of Chicago, read by invitation a paper with the above title, of which the following is an abstract:

There is still considerable discussion as to the histological changes occurring in transplanted tissue of different types and their significance. We know that certain rules must be followed and certain technical errors avoided if the transplantation is to be successful, but we do not as yet know positively upon what the life of transplanted tissue depends. A number of different conclusions have been drawn from the study of much the same material by different men.

Various views have been expressed concerning the fate of the different elements in bone transplants, and in many instances much the same type of experiment has been made and the preparations have been stained in much the same way. One observer comes to the conclusion that periosteum is markedly osteogenetic, while another observer believes that the transplanted tissue acts merely as a scaffolding for developing osteoblasts and that therefore boiled bone, homo- and heterotransplants do as well as an autotransplant. It is difficult to reconcile the different views which have been expressed. The difficulties of interpretation of histological preparations are indicated by the diversity of conclusions arrived at in the study of preparations of much the same kind. It is almost impossible in some cases to correlate histological appearances with function and growth potentialities.

In considering transplants of bone, tendon, fascia and nerves, we find that degenerative and regenerative changes occur in all.

The regressive changes occurring in a bone transplant are dependent upon the physical properties of compact bone which does not permit of early and extensive permeation of serum. The unossified portion of a transplanted segment of bone and the periosteum and contents of the medullary canal, porous spaces and Haversian canals, are readily permeable to lymph and consequently are more apt to live. The compact bone is apt to die. As far as can be determined by histological examination of transplanted bone, the greater part of the compact bone dies, and this is replaced slowly by the so-called "creeping substitution" by bone cells of the compact bone which have not died and by cells from the periosteum and endosteum.

Ivory pegs or dead boiled bone may be used as intramedullary splints, the ends of the fragments being placed in immediate contact or somewhat separated over such a splint. In these cases the peg or dead bone may be replaced by the newly formed bone. Such material cannot be used to bridge a long defect, for substitution, in my experience does not take place in dead tissue used to bridge a long defect.

Degenerative and regenerative changes occur in transplanted tendon. The degenerative fibrillæ in a tendon transplant are replaced by tissue formed by proliferation of the peritendineum externum and internum. The regenerative changes in the transplanted tendon are dependent upon the early assumption of functional activity. Segments of tendon, transplanted into subcutaneous fat roll up and become shrunken, the fibrillæ becoming distinctly smaller in size and staining poorly, while segments of a tendon transplanted into a defect in a tendon which is made to functionate early undergoes distinct regenerative changes as indicated by an increase in size and distinct histological evidences of growth.

All transplants must assume function early. William Roux several years ago stated that the fate of transplanted tissue was dependent upon whether or not the transplant was made to assume functional activity.

Tissue such as fascia and cartilage which physiologically may be placed rather low in the scale perform a number of different functions, and may be transplanted in different ways and places and still survive. Cartilage as shown by Davis transplanted into subcutaneous tissues will survive, while bone transplanted in this way will be gradually absorbed. Fascia does not tend to undergo the same changes as tendon. The degenerative changes occurring in transplanted fascia, which are mostly fatty, are apparently directly proportionate to the size of the transplant. In large fascial transplants transplanted into dural defects fatty changes have occurred in the center with subsequent cicatricial substitution. These changes are due

to failure of serum to permeate to the center or delayed reëstablishment of vascular circulation at this point.

Fascia and cartilage may be successfully transplanted into places and under conditions which would result in gradual absorption of tendon and bone transplants.

In nerve regeneration the degenerative changes occurring in the distal end of the proximal end and throughout the distal segment are followed by regenerative changes which are very important. Degeneration of the axis cylinders and myelin sheaths are followed by proliferative changes in the neurilemma sheaths which lead to the formation of the so-called protoplasmic bands. These bands form the conduits down which the regenerating axis cylinders of the proximal stump pass, and are the essential determining factor in nerve regeneration. Axis cylinders reform after section of the spinal cord, but do not pass the point of section because no bands are formed and the regenerated axis cylinders form a network at the level of section.

Experimental work would indicate that the hyperplastic nuclei of the developing protoplasmic band can grow in vitro, while the resting nuclei die. This experiment would indicate that a nerve graft to be successful should be transplanted after Wallerian degeneration has commenced.

After the neurilemmal nuclei has passed back to the resting stage it is doubtful whether the protoplasmic band stage can be reproduced again, and this may account for the number of failures of secondary nerve suture after the lapse of considerable time.

Roux's law has much to do with the fate of a transplant and failure to keep it in mind accounts for the many different conclusions which have been drawn concerning the fate of transplanted tissue. Interpretations of the histological findings often differ because of the difficulty of correlating structure and function.

STATED MEETING, HELD APRIL 2, 1917

The President, Dr. Charles H. Frazier, in the Chair

RESULT OF TREPHINING FOR COMPOUND FRACTURE OF FRONTAL BONE

Dr. P. G. Skillern, Jr., presented a man, aged thirty-five years, who was admitted to the Polyclinic Hospital, service of Professor G. P. Müller, on January 18, 1917, at 12.01 A.M., and was discharged cured on January 27, 1917. Shortly before admission to hospital he was attacked by a man who struck him a blow upon the right side of the forehead with an ordinary hatchet. When admitted the patient was perfectly conscious and talkative, but somewhat under the influence of liquor. Physical examination revealed a vertical wound on right side of forehead three-quarters inch from median line and with its lower angle at the supra-orbital eminence, whence it extended upward one and one-quarter inches. Beneath the cut scalp edges the skull was laid open, the outer edge projecting forward, while the inner was depressed. Pulsations of the underlying dura were plainly visible. Dark blood flowed from the wound. Under ether anæsthesia and iodine preparation the wound was enlarged downward to the orbital margin, revealing extension of the line of fracture below the limits of the trauma wound. The outer table was bitten away with rongeur forceps, revealing more extensive splintering of the vitreous than of the outer lamina of the skull. Adjoining the deep margin of the hatchet cut these splintered vitreous fragments were depressed upon the dura, which was not, however, lacerated. To gain more room a horizontal incision was added, beginning at the lower angle of the vertical incision and extending two inches outward just above orbital margin and parallel with it. The fracture in its lower portion had opened the frontal sinus. All splinters of vitreous were removed. While withdrawing a splinter from the inner side of wound bleeding arose from the superior sagittal sinus, which was controlled by two strips of iodoform gauze packing, to prevent infection of meninges from nose. There was now a gap in the skull with rounded, even margins; the dura was still unopened. Over this gap the scalp was sutured lightly. Dr. Skillern remarked that this case emphasized the importance of performing exploratory operations upon skull injuries. This patient when admitted was conscious and talkative in spite of the gaping wound made by the hatchet, and there was but a moderate amount of bleeding from the wound; yet the vitreous table was extensively shattered and depressed upon the dura. One of these vitreous splinters had penetrated the wall of the superior sagittal

sinus; it plugged the hole it had made in the sinus, as was shown by the profuse hemorrhage ensuing upon its removal under gentle manipulation. The opening of the frontal sinus developed a source of infection from the nasal cavity to the meninges. The advantages of the operation, therefore, were that it revealed the extent of injury, permitted relief from the pressure of the inner table upon the dura, prevented secondary hemorrhage from spontaneous dislodgement of the splinter which plugged the sagittal sinus, and facilitated disinfection of the frontal air space, which, although not harboring bacteria when not diseased, yet at operation must be considered diseased until proven healthy, and which, even when healthy, for a path for the transmission of infection from the nasal chamber to the meninges.

INTUSSUSCEPTION IN AN INFANT : RESECTION : RECOVERY

Dr. John H. Jopson presented an infant, aged seven months, who was admitted to the Children's Hospital May 12, 1916, being referred by Dr. A. G. Mitchell, with a diagnosis of intussusception. He was breast fed up until three months of age and then bottle fed on cow's milk mixture. He was well until thirty-six hours before admission, when after a bowel movement he developed colic followed by vomiting, and had continued to vomit everything taken, including milk, water and barley water. The vomitus was expelled with considerable force and was at first green and later somewhat brown, containing some mucus, but was not of a fecal odor. There had been no bowel movement since pain began, and no attempt to cause any by enema had been made. When first seen (by Dr. Mitchell shortly before admission) the child was quite sick. He had a strong cry, the skin was loose, showing evidence of rapid loss of weight and fluids. The throat, heart and lungs were normal. The abdomen was soft and scaphoid, not tender, and presented in the lower portion, median line below the umbilicus, a visible and palpable sausage-shaped tumor 2 inches by 3½ inches, apparently in the region of the small intestine. Rectal examination revealed no tumor, but blood and mucus were voided. There was no history of frequent bloody and mucus stools, the bowels being closed since the development of the pain and vomiting. This is significant in view of the operative findings.

On admission to the hospital the temperature was $100^{3}/_{5}^{\circ}$; pulse 152; respirations 38. Operation the same evening under ether anæsthesia. A right rectus incision downward from the umbilicus exposed an intussusception immediately beneath the wound, which when delivered was found to be entirely in the small intestine. The exact location was not sought for or determined. The peritoneum was smooth and shining over the bowel, the deeper layers of which were dark and congested. There was marked constriction at the upper end of the tumor, the entering point of the bowel. All attempts at reduction failed, the peritoneum splitting on slight pressure when attempts were made to express the bowel from below upward. Resection was at once performed, the mesentery being cut close to the edge

of the intussusception and a small-sized Murphy button used to perform end-to-end anastomosis. The snug closure was then reinforced by the Cushing suture, interrupted at one point. The abdominal wall was closed by through-and-through sutures of silkworm gut. The time of operation was forty minutes, and the condition on the table at times was poor, and strychnia and camphorated oil were used hypodermatically. After the operation proctoclysis with glucose and soda solution was used and small amounts of nourishment given by mouth the following day. The patient vomited at intervals for the first thirty-six hours, and there were several movements which contained blood, or mucus, or both, for forty-eight hours after operation. The movements became fecal on the second day, when several dark brown liquid stools were obtained, and the vomiting practically stopped. Attempts at feeding by peptonized milk were not very successful and it was later rendered possible to obtain breast milk from one of the wet nurses employed by the hospital, which agreed well with the infant. The temperature rose sharply after operation, as is usual in these cases, reaching 105°, and declined gradually, touching the normal in six days. The promising convalescence was suddenly interrupted by an accident which threatened for a time to result fatally. This complication was due to failure of union in the abdominal wound which opened up when dressed on the seventh day, and a couple of loops of small intestine protruded from the abdominal cavity. The child was taken to the operating room and given a little chloroform, the intestines replaced, a cigarette drain inserted in the peritoneal cavity, and the wound re-sutured. It healed thereafter by granulation. The button was passed on May 20. The child was transferred to the Medical Ward for treatment by Dr. Hand on June 4, where, with the aid of breast milk, the weight chart showed a steady gain, and the patient was later sent to the country branch of the hospital from whence he was discharged June 21.

The patient was readmitted to the medical wards in Dr. Hand's service in July, with symptoms of gastro-intestinal indigestion, marked by diarrhœa, vomiting and loss of weight. Improvement was prompt, and under proper feeding the child gained 2 pounds or more in the course of a month, when he was again discharged to his home as cured. At the time of his readmission the child weighed 10 pounds 3 ounces, and at the time of his discharge 12 pounds 4 ounces. This illness was apparently the ordinary gastro-intestinal disorder of the summer months.

The length of the entire specimen removed was 23 cm. measured along the border opposite the mesentery. Of this length 7 cm. was accounted for by the collapsed section of the ileum below the tumor, extending to the point of resection of the bowel. There was a short portion of ileum resected above the point of the entrances of the intussuscipiens. The diameter of the intussusception was 9 cm. It will be seen from these measurements that between 15 and 18 inches if intestine were resected. The child, now eighteen months old, is in good condition and well nourished in spite of unhygienic surroundings and poor maternal care.

The case adds another recovery to the very small number of infants who have survived intestinal resection for irreducible intussusception. Dowd, writing in 1913, referred to eight cases besides his own remarkable case of recovery in an infant five days old. Reference may be made to two other cases reported by J. Fraser and Clubbe, without attempting a complete review of recent literature. In view of the rarity of recovery after resection, one might consider with favor the practice of short-circuiting the bowel by an anastomosis around the irreducible intussusception as successfully practised in two cases in children by Rutherford and Parry. The present case also illustrates the value of the Murphy button for emergency work even in infants. In four of the previously reported recoveries, a Murphy button or Mayo Robson button was used. Twice the Paul tubes were used; for a two-stage operation Dowd favors the use of needle and thread.

CHRONIC INTUSSUSCEPTION OF THE LARGE INTESTINE IN AN ADULT

Dr. John H. Jopson reported the history of a man, aged thirty-six years, who was admitted to the Presbyterian Hospital with a history of illness of two months' standing. It began as slight soreness below and to the left of the umbilicus and was associated with cramp-like pains in the same region, coming on about one hour after meals and also present and more intense at bed time. Vomiting began a few weeks previous to admission and matter vomited consisted of stomach contents and bile. Pain was not relieved by eating or medication. There was some relief from pain while lying upon the left side. The bowels at first were regular and later diarrhœa developed; sometimes eight or ten movements a day. The movements were usually greenish and liquid and never contained blood. Along with these symptoms he lost weight. When admitted abdominal distention was marked; the abdomen was tympanitic, with a tender area below and to the left of the umbilicus. No mass could be felt. The abdomen was very tense, so that examination was unsatisfactory and there was no evidence of fluid. The white blood count was 6250. The patient was not acutely ill on admission. Diarrhœa was still present. No diagnosis had been arrived at during the time the patient was in the hospital but he was undergoing a systematic examination and on the third day after admission and while being prepared for X-ray examination, he developed an unusually severe attack of abdominal pain, being an exaggeration of the same type of cramps to which he was subject. He went into collapse almost at once and died within a few hours and without any sign of reaction.

At autopsy there was found a chronic intussusception in the descending colon. Probably as a result of the chronic, incomplete obstruction, a perforation had occurred, not at the site of the intussusception, but in the first portion of the ascending colon. The abdomen was full of fecal contents and death was due to shock and peritonitis. When the intussusception was opened, there was found at the apex of the intussuscepted bowel what was at first thought to be a pedunculated growth. It was only on microscopic section of the same and after a study of several sections that Dr. Pfeiffer, pathologist to the hospital, pronounced this mass to be a portion of the parietal wall of the inverted bowel.

LARGE FIBRONEUROMA OF THE MEDIAN NERVE

Dr. John H. Jopson presented a male negro, aged forty-five years, who was admitted to the Bryn Mawr Hospital in January, 1917, with the history that about thirty years ago he had noted a small swelling on the inner side of the left arm following a slight traumatism, which gave him no pain and was not tender on pressure. It underwent a very gradual enlargement. He paid little attention to it until about three months ago, when he began to have pain in the arm and a stinging, tingling sensation in the ring and little fingers. The patient was an exceptionally well-developed and well-nourished negro, otherwise in good health. There was a large, hard, round, symmetrical tumor the size of a small fist on the inner side of the left arm overlying the vessels midway between the axilla and the elbow. It was slightly movable and lay to the inner side of the biceps muscle and apparently was not attached to it. It was not tender on pressure nor did examination cause any pain in the distribution.

At operation the outer portion, or what might be designated the capsule of the tumor, was found to be made up of many layers of what appeared to be smooth, fibrous tissue. The tumor was situated in the course of the median nerve which entered it at its upper and left it at its lower pole. Each layer of the above-mentioned capsule was split and dissected back with care to avoid injuring the nerve fibres. Examination showed that the fibres of the nerve spread out after reaching the growth, and when the innermost layer was divided the tumor could be peeled out entire without cross-sectioning any nerve tissue. The sac that remained bore very much the same relationship to the unaffected portion of the median nerve that the sac of an aneurism does to the artery after incision. The layers of the sac were then infolded so as to obliterate it, using small catgut sutures, and the arm was dressed upon a splint.

Following the operation the patient was found to have a loss of sensation on the palmar surface of the index and middle fingers and the first phalanx of the dorsal surface. There was also loss of flexion of the thumb and index finger. He was discharged from the hospital February 4, 1917.

When he reported for examination five weeks later there was a soft swelling four inches long and two inches wide in the site of the tumor. He has still what he describes as "a sore feeling" along the course of the median nerve from the elbow to three inches above the wrist. Anæsthesia persists on the flexor surfaces of the thumb and index finger, across the palm to a point about one inch above the base of the third finger, the palmar surface of which is also anæsthetic. The dorsal surface of the index and of the middle finger is affected as far as the first joint. There is a small

area of anæsthesia on the radial side of the last phalanx of the fourth finger. Muscular power in the thumb is largely regained. There is still some loss of flexion of the proximal phalanx and flexion is lost in the index finger. The patient is receiving electrical treatment at the present time.

The pathological report of the tumor is as follows:

Microscopic examination of sections taken from the wall of the tumor shows a dense connective-tissue stroma which contains relatively few cells and has undergone hyaline degeneration. The tissue is well vascularized and in a few places rather large blood-spaces are noted. There are areas in which lime salts have been deposited, minute areas containing blood pigment are seen, and considerable amounts of blood extravasation are present. Small foci of necrosis appear; these areas are found toward the innermost degenerated portion of the tumor. The major portion of the growth is composed of the dense fibrous stroma noted. Microscopic examination suggests a fibroma which has undergone the various degenerations noted.

This specimen represents a rare type of tumor, namely, a solitary neurofibroma of unusual size, originating from the endoneurium. Solitary neurofibromata of this type present the picture of a slowly-growing benign tumor which, according to Woolsey, not infrequently undergoes either myxomatous, cystic or fatty degeneration, and less commonly sarcomatous change. The multiple type of neurofibroma is more common than the solitary variety. Neurofibromata may reach the size of a grape fruit. They are sometimes hereditary, and more often congenital; the plexiform variety almost always so.

The appropriate treatment of endoneural tumor of the solitary type is incision of the enveloping nerve sheath along the course of the nerve fibres, carefully avoiding division of the same, until the adventitious capsule of the tumor is passed and the tumor itself is reached and can be enucleated. This was the procedure practised as far as possible in this case, but, as is evident, there was some disturbance of function of the nerve despite the care which was exercised. This condition is improving and if no recurrence of the tumor takes place, will probably be almost, if not entirely, overcome.

ULTIMATE RESULTS FOLLOWING NEPHROPEXY IN CASES OF SYMPTOMATIC NEPHROPTOSIS*

By John G. Clark, M.D.
and
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of Philadelphia

Knowledge concerning the anatomy of organs obtained at autopsy and in the dissecting room has within recent years led to serious errors in symptomatic deductions made in office or bedside studies. Before Schultze began his investigation of the anatomy of the pelvic organs in living women, the view generally held by anatomists was that the uterus normally occupied a retroposed position. This belief was due to the fact that after death the general relaxation of the supporting ligamentary structures permits the uterus to fall backward. Schultze, through the bimanual method of pelvic examination in a series of normal women, was able to prove the contrary position *in vivo*.

Before Glenard published his epoch-making paper in 1885, autopsy protocols seldom recorded the kidney in any other than a fixed lumbar position. Even with wide range of mobility the kidney after death settles back into its lumbar fossa, and with the congealing of the suprarenal fat the organ is left more or less fixed in articulo mortis, and what was an abnormal position in life becomes a normal one in death. In both instances adherence to classic anatomic standards led to a confusion of theories as to the symptomatic manifestations of these organs, and, as a consequence, both organs have been subjected to gross surgical insults. In every instance in which some form of fixation operation has been devised to fit a certain anatomic pattern these errors have been vividly demonstrated.

From 1890 to 1900, when, through eager but ill-tempered enthusiasm, many surgeons began a most energetic operative propaganda in cases of nephroptosis, too often the chief indication for surgical intervention was the mere presence of a movable kidney in a neurotic woman. Since the majority of women who have movable or floating kidneys are thin-chested, the subjects of enteroptosis, and are poorly developed in many other directions—in other words, are physical defectives from birth—they furnish the worst possible operative risks so far as restoration to a normal standard of health is concerned. Because of this very injudicious selection of cases, in the earlier phases of this work the greatest opprobrium was cast upon all operations for nephroptosis. So long as the anatomic rule was followed and was sustained by a blanket symptomatology covering all possible phases of gastro-intestinal and neurotic disorders, the beneficial result attained was indeed slender, as the final surgical inventory proved. Like the old-fashioned

* Read before the Philadelphia Academy of Surgery, April 2, 1917.

shot-gun prescription, it was potentially harmful oftener than it was beneficial.

It is not surprising, therefore, that many surgeons who from the first had been conservatively skeptical became radically antagonistic to any further surgical activity in this field. The effects of such antipodal positions in medicine are usually salutary, for time tends to dampen the ardor of the enthusiast and holds in leash the pseudo-surgeon, while the judicious practitioner, who occupies a position midway between an irrational optimism and a stubborn pessimism, may take stock, as it were, and from a careful balancing of equations usually gathers valuable practical conclusions that are applicable to an occasional case.

In the study of our series of 50 cases the evolutionary limitations of operative indications as our own experience has grown has come from the recognition of our own failures in the neurotic type of women. That vast and prolific domain of neuroses and of gastro-intestinal functional deviations that previously furnished so large a number of cases has of recent years been excluded by all discerning surgeons, for the final demand is that the kidney itself must, through manifest symptoms directly referable to the organ, furnish the indication for an operation. In our series of cases we find that, during the earlier years covering a much smaller clinical service in the University Hospital, the proportionate number of nephropexies was much larger than with the present greatly increased departmental census. This numeric shrinkage during the last seventeen years is indicated by the following figures:

During the years 1900 to 1905 there were 1385 ward admissions; among this number 18 nephropexies occurred; between 1905 and 1910 there were 1765 admissions, with 15 operations; from 1910 to 1915 there were 2422 admissions, with only 17 operations: in other words, the figures show a steady diminution in the percentage of elective cases.

If one adheres to the rule that surgical intervention is indicated only when the kidney or the bladder gives expression to symptoms, the ratio of cures will compare satisfactorily with that following other approved operative procedures. To define our attitude I may say that we have settled upon three cardinal indications for possible surgical intervention in movable or floating kidneys. These are *fixed pain in the renal area, Dietl's crisis, and marked vesical distress referred from the renal area.* Even these symptoms, however clear, must be supplemented and confirmed by a rigid clinical investigation, which should include a cystoscopic examination, catheterization of the ureter on the affected side, and, in the majority of cases, an injection of thorium and an X-ray examination to ascertain the degree of dilatation of the renal pelvis. Any apparent surgical indication not confirmed by these latter diagnostic measures is, in our opinion, open to criticism.

Every possible source of obstruction from lesions of the pelvic organs and from ureteral stricture must be excluded, and when these conditions have been fully complied with and an accurately defined bill of clinical particulars has been established, one is warranted in anticipating, with

considerable optimism, a favorable outcome from a properly executed nephropexy.

In no case is the diagnosis of symptomatic nephroptosis permissible unless a thorough cystoscopic and skiagraphic study of the case has been made. Such a procedure is necessary not only because it affords additional evidence on which to base the diagnosis, but also because it eliminates the possibility of a renal lesion, such as calculus or tuberculosis, or of an ureteral stricture being present, which conditions may produce symptoms closely simulating those of movable kidney.

As a means of corroborating the diagnosis, pyelography has proved a valuable aid. In the more advanced cases of pelvic dilatation retention can be demonstrated by the ureteral catheter, but dependence should not be placed upon this alone, or erroneous conclusions may be the result. The picture of the renal pelvis and ureter shown in the pyelogram affords indisputable evidence, and often furnishes information concerning other lesions that would escape detection by simpler methods of diagnosis. By pyelograph it is possible to demonstrate not only the earliest stages of pelvic dilatation, but also the point of angulation which is often found to exist in the upper portion of the ureter or at the ureteropelvic junction.

My associate, Dr. Floyd E. Keene, who has charge of the cystoscopic investigations in our department at the University Hospital, has until recently used a 10 per cent. collargol solution for the injections, with satisfactory results; more recently, however, he has employed thorium nitrate method, as described by Burns, and has found it superior to collargol in that it gives a clearer picture, is a cleaner medium to work with, and is apparently free from the dangers that have been reported as following the collargol injection. The ureteral catheter is passed into the renal pelvis, and the character of the urinary flow is noted, to determine the presence and the degree of retention. The catheter is then withdrawn for 15 centimetres, and with the patient in the half-sitting posture, the thorium solution is injected slowly by the gravity method. When the solution ceases to flow or the patient experiences the slightest sensation of fullness in the kidney region, the injection should be discontinued and the picture taken. By this limitation of the symptomatology and the accurate checking up of anatomic defects neuroses of all types and cases of gastro-intestinal disturbances are excluded.

The advances made in the surgery of the upper abdomen have in large measure exploded the pelvic reflex fallacies, for it has been amply proved that lesions of the pelvic organs that do not manifest direct symptoms seldom indeed give rise to gastric reflexes. This is true also of gastro-intestinal reflexes of renal origin. Because of the close anatomic relationship between the right kidney, the duodenum, and the pylorus, it is probable that an unduly movable kidney may occasionally be responsible for gastric disturbance. This statement is borne out by the occasional cure of these disorders that follows an operation for nephroptosis with a direct renal symptomatology. On the contrary, however, when the digestive disturbances are

the sole symptoms, but few patients are cured by anchorage of a movable kidney. The occasional issue in which the gastric symptoms have been made the pretext for an operation is so rare, and the record of failures is so frequent, as to strengthen the conviction that such disorders should never, alone, serve as a surgical finger-board merely because a palpable movable kidney is present. By following this policy of absolute limitation we may fail to cure an occasional deserving dyspeptic, but, on the other hand, we will also certainly escape the ridicule and just criticism of the internist or neurologist because of many surgical wrecks in which proper discrimination was not made. For years we have measured the range of the renal mobility in all abdominal sections by slipping the kidney under direct touch to its lowest point of excursus, and we have found repeatedly the most extreme mobility of the right kidney without a single attendant renal or gastric symptom.

Notwithstanding the more rigid selection of cases within recent years, we find, on reviewing the results, that the percentage of cures among the cases traced appears to be about the same. This at first sight is apparently at variance with the belief that a more rigid selective policy will yield better results. We believe that this uniformity of cures in our cases, however, is more apparent than real, and is due to the fact that a large percentage of women whom we have failed to trace were operated upon in the earlier days of our hospital service, when we were less discriminating in our surgical endeavors.

One cause of failure to effect a cure by nephropexy in a symptomatic nephroptosis may occur when there is chronic dilatation of the renal pelvis, with secondary renal changes, such as pyelitis or nephritis, and even though, as the result of the operation the kidney is placed in a better functionating position, the pathologic changes are too far advanced to permit a perfect physiologic restoration to take place.

As to the method of operation, we have found Edebohls's plan, with slight technical modifications, to be the most satisfactory. In our earlier series of cases we employed the Brodel stitch successfully, but we were always under the impression that in sinking a triangular stitch into the renal substance we increased the hazard of an untoward operative result.

In operating according to Edebohls's plan the usual straight dorsal incision is made, and the kidney is reached through the renal triangle, with a minimal amount of injury to the muscular structures. Great care must be exercised to avoid injury or ligation of the lumbar nerves. In one or two instances in our earlier experience this latter accident occurred, and a slow and painful convalescence was the result; in one case this distressing sequel dragged painfully on into months. The perirenal envelope is pulled well up and any redundancy is excised so that when the suspension stitches are applied this tissue also secures the kidney through its hammock-like adjustment. In effecting decapsulation of the kidney we depart from the extensive method of Edebohls. Our right plan is to split the capsule back on a grooved director to each pole of the kidney, but it is only slightly dissected loose from the organ, leaving a narrow band of exposed kidney substance about one-half

inch wide. The extent of the decapsulation has thus been limited because experimental investigations and clinical experience have proved that the fibrous capsule that reforms after a total decapsulation is frequently the source of serious pathologic changes. Three mattress sutures of silk or linen thread are inserted in the capsule on each side of the exposed dorsal surface of the kidney, and the perirenal fascial hammock, which is pulled up snugly about the kidney, is transfixed. With a long curved needle these sutures are carried through the lumbar wall to the surface and tied over small gauze bolsters. Because of the tension upon these sutures the denuded renal surface is brought up into snug contact with the incision, thus creating a strong bond of fixation between these two surfaces, where adhesions occur. The incision is closed in the usual manner, and at the end of ten days the suspension sutures are removed.

About 50 per cent. of our cases have been examined at intervals varying from one to ten years after the operation, and in no case has a recurrence taken place. In one of our earlier cases in which a nephropexy was attempted by using the Brodel stitch, the hemorrhage from one of the triangular stitches in the kidney was so severe that a nephrectomy was necessary to save the patient's life. This was the only immediate surgical complication of noteworthy importance occurring in this series of cases. One patient died of a pulmonary embolus ten days after operation. From what has been said it will be seen that the dangers of a nephropexy are slight and should not deter the surgeon from undertaking the operation provided his intervention is based upon a valid renal symptomatology.

Analysis of Fifty Cases of Nephroptosis in which Nephropexy has been Performed.—In following up the cases which have been operated upon between 1900 and 1915 we have been able to secure full data from 36 of the 50 cases operated upon during this time. Divided into five-year epochs, at first glance it would appear that the percentage of cures is about the same in all three groups regardless of the greater refinement of diagnosis and the more accurate restriction of the symptomatology to actual renal or vesical manifestations in the later series. This conclusion, however, is fallacious, for much the larger proportion of untraced cases falls within the first and second five-year periods than in the last. Thus, in 18 of the first group, only 10 could be located; of the second 15 there were 11, and in the last 17 there were 14. As we review the first and second groups, we observe, first, that the indications for operations were at times at best rather vague, and not infrequently the nephropexy was performed as an incidental part of a combined operation, consisting of various pelvic, appendiceal, and other procedures. Since 1910 the operations have largely been for the correction of a pathologic nephroptosis *per se*, and the only additional operation has been as a rule the coincident removal of an appendix as a matter of precaution rather than of necessity. We may, therefore, attribute a curative ratio of 70 per cent. in this group directly to the kidney suspension rather than to some one of three or four other coincident operations.

In other words, one might say that in our earlier experiences, a nephro-

pexy was thrown in with the pelvic operations on the principle of giving good measure rather than because the kidney was the subject of direct pathologic manifestations. In several of our earlier cures we may feel reasonably sure that this additional operation did neither harm nor good, whereas in some of our failures we are inclined to feel that the prolonged surgical manipulation in a neurotic individual has done positive harm. We particularly are impressed with this fact in the final summary of results. It is always salutary to review the bad results of our work in order to correct such faults in the future and to lay down fixed rules for a routine procedure applicable to a chosen group of cases.

First, as an example of a surgical error, I would cite Case 810, admitted to the hospital in 1903. The patient's chief symptoms were—sharp pains in both ovarian regions, radiating down the left leg, headache, backache, no renal symptoms. The examination revealed a prolapsed left ovary, prolapsus uteri partialis, lacerated cervix and perineum, and movable right kidney. For these conditions the following operations were performed: Repair of cervix and perineum, suspension of uterus, and right nephrorrhaphy. This case could not be traced, but regardless of the result so far as any benefit to the patient's health was concerned, in the light of our present knowledge one may feel assured that no benefit was derived from the additional nephrorrhaphy. In other words, this part of our operation was performed to meet an anatomic rather than a pathologic indication. In such an instance if a bad result were to follow, the ill-chosen operation might easily have to bear the burden of a bad recovery. According to our present attitude we view such a procedure as meddlesome surgery much more likely to be provocative of harm than of good.

Our table of earlier cases reveals instances of misapplied surgery, but we believe that errors have been less and less frequent during the last ten years. An operation without a clearly defined indication in a neurotic patient can only result in an untoward issue in the vast majority of cases, and it is for this very reason that we so urgently condemn the application of surgery to any organ unless a pathologic state directly amenable to surgical measures is found.

We shall relate the brief summary of one more case of misapplied operation before passing to our later series which stands upon a more equitable basis. Case 1230, admitted May 9, 1904. Chief symptoms were pain in lower abdomen, especially in inguinal regions and right renal area, increasing weakness, general nervous breakdown, seven or eight years ago. Diagnosis: Bilateral hydrosalpinx and right nephroptosis. The combined operation consisted of a right salpingo-oöphorectomy, left salpingectomy, partial left oöphorectomy, appendectomy and right nephropexy. Again, in this instance, the patient could not be located, but we do not hesitate to hazard the opinion that whatever the ultimate outcome in this case may have been the nephropexy added no beneficial effect but possibly helped to topple the patient further over into the domain of chronic neurasthenia. We may refer to such cases

CASES OF NEPHROPTOSIS OPERATED UPON DURING THE LAST FIVE YEARS

Gynecological number, date of admission	Symptoms	Diagnosis	Operation	Condition on discharge	Result
3462 10-6-10	Constipation, flatulence. Colicky pains in lower abdomen. Lump in right side of abdomen. "Knife-like" pain in kidney. Cannot lie on left side. Nausea when on her feet.	Right hydronephrosis from nephroptosis.	Suspension of right kidney. Appendectomy.	Surgical convalescence satisfactory.	Growing better each day. Doing housework and gaining strength. Gained 12 pounds. Numbness in right hip. Never sick except occasional headache.
2510 11-2-10	Backache. Frequency and urgency of urination. Pain in side.	Right nephroptosis. Retroflexion of uterus.	Appendectomy. Suspension right kidney and ovary. Coffey suspension.	Surgical convalescence satisfactory.	Greatly improved. Constant desire to void has passed. Pains across back, especially morning, but wears off later in the day. Worse at periods.
3518 11-10-10	Paroxysmal pain left side following pregnancy, relieved by voiding. Mass in left side during attacks.	Movable left kidney.	Suspension left kidney.	Surgical convalescence satisfactory.	Could not be located.
3746 5-20-11	Pain in sacral region. Weakness. Basily tired. Frequency of urination.	Nephroptosis. Peri-appendicitis.	Suspension of kidney. Appendectomy.	Died suddenly from pulmonary embolus 10 days after operation.	
3806 7-3-11	Pain in left kidney, radiating to bladder. Slight hæmaturia after attacks.	Hydronephrosis, due to aberrant artery. Nephroptosis.	Pyelotomy. Nephropexy.	Surgical convalescence satisfactory.	Complete cure. No urinary trouble except 2 attacks of cystitis. Does not gain in weight.
4130 3-21-12	Attacks of "indigestion." Pain in right iliac fossa. Urinary frequency. Flatulence.	Chronic appendicitis. Movable right kidney.	Appendectomy. Suspension right kidney (Edebohls).	Surgical convalescence satisfactory.	Cured.
4161 4-13-12	Lump in right side since a fall, 1 year ago. Tenderness in both regions.	Right nephroptosis.	Nephropexy.	Surgical convalescence satisfactory.	Cured. Slight œdema of feet since 1 year after operation. Headache at periods.
4308 8-20-12	Hæmaturia. Pain right side. Nausea. Nervousness. Menorrhagia.	Hæmaturia. Uterine fibroids.	Supravaginal hysterectomy. Suspension right kidney.	Surgical convalescence satisfactory.	Patient better and stronger in every way. Tires easily.
4582 2-12-13	Nausea after meals. Epigastric distress.	Cholelithiasis. Movable kidney.	Nephropexy. Removal of gall-stones.	Surgical convalescence satisfactory.	"Intestinal trouble" and occasionally frequency of urination. More or less nervous—due to onset of menopause.
4692½ 5-13-13	Pain and soreness in right iliac region and loin. Nausea and vomiting. Frequent urination. Epigastric distress after eating.	Chronic appendicitis. Cæcum mobile. Movable right kidney.	Appendectomy. Suspension right kidney.	Pain in kidney region.	One year ago pain left side, lasting 4 weeks, diagnosed congestion of kidney. Last summer attack of pain right side with fever, lasting 12 days, diagnosed gall-stones. Occipital headaches with nausea and vomiting. Nocturia but not as much as before operation. Gained 14 pounds.

CASES OF NEPHROPTOSIS OPERATED UPON DURING THE LAST FIVE YEARS—*Continued*

Gynecological number, date of admission	Symptoms	Diagnosis	Operation	Condition on discharge	Result
4920 10-17-13	Sharp pain, left costovertebral angle, referred downward and forward; backache; frequency, pain and burning on urination.	Ptosis of left kidney. Perinephritis.	Suspension left kidney. Freeing of adhesions.	Surgical convalescence satisfactory.	Unimproved—says she is in constant pain. Very garrulous concerning multiplicity of symptoms. Extremely neurotic.
5019 12-22-13	Constant pain in lumbar region, radiating downward. Nervousness.	Left hydronephrosis.	Nephropexy.	Backache.	Patient felt better and backache was hardly perceptible until pregnancy 1 year ago. Constant severe headaches during entire pregnancy. Backache worse since confinement. Also constipated, never having a natural movement.
5108 2-12-14	Dragging pain in right side for 2 years, worse when standing.	Right hydronephrosis.	Edebohls nephropexy.	Surgical convalescence satisfactory.	Much improved but at times feels weak. Pain in left side and back. Menstruated twice each month for past 4 months.
5509 11-17-14	Sharp pain right side of pelvis. Frequent desire to urinate. Pain intermittent and involving loin.	Chronic appendicitis. Floating kidney.	Appendectomy. Right nephropexy.	Surgical convalescence satisfactory.	No further sharp attacks of pain, but occasionally pain on bending or twisting. Excellent health generally except somewhat nervous.
5698 2-17-15	Bladder irritability. Pain lower abdomen.	Movable kidney.	Nephropexy.	Surgical convalescence satisfactory.	Marked improvement.
5751½ 4-21-15	Lumbar pain right side, 4 years. Indigestion. Dysmenorrhœa.	Movable kidney.	Nephropexy.	Surgical convalescence satisfactory.	Kidney excellent position. Menorrhagia—seat of fibroid. Rectal tenesmus at periods.

as markers in the line of surgical progression, teaching the unerring lesson of what not to do.

In the evolution of this phase of surgery these cases stand as milestones or perhaps turning points in our experience and have served a valuable purpose in limiting our endeavors to cases which offer a large percentage of curative possibilities with a minimum probability of untoward results and disastrous nervous sequelæ. All too frequently we find still this same class of individuals being advised by physicians of limited experience to undergo these unnecessary, and therefore harmful operations, and quite as frequently surgeons who are willing to act as aiders and abettors of this unwarranted procedure.

The paramount value of an accurate follow-up system is to detect the great as well as the lesser flaws in surgical work, so that those who follow may not fall into similar error. From our observations the one chief warning is clearly apparent—a nephropexy in a neurotic woman, unless the renal symptomatology is clearly defined, cannot be deprecated too urgently.

In concluding, we append a table of cases operated upon since 1910, the period during which we have endeavored to select only those of a true pathologic nephroptosis. A summary of symptoms with diagnosis, operation, and ultimate results is given. While the results are by no means perfect, they nevertheless present a 70 per cent. restoration to active efficiency of the women operated upon, a degree of restoration which compares favorably with many other operations generally accepted by representative surgeons.

Conclusions.—1. The kidney, particularly the right, is not a fixed organ, and even an excessive range of mobility is no certain index of a reflex gastric or nervous disability unless direct renal symptoms referable to the kidney itself are present.

2. The three cardinal symptoms of disturbed renal function are pain in the renal area; a urinary or Dietl's crisis, due to kinking of the ureter; or vesical irritability directly referable to the kidney of the affected side.

3. No diagnosis should rest solely upon palpation of even an unduly movable kidney or upon a definite symptomatology unless this is confirmed by a cystoscopic examination, catheterization of the ureters, and a pyelograph to define the point of kinking in the ureter and the degree of dilatation of the renal pelvis.

4. With this rigid method of exclusion and clear symptomatic definition the surgeon may confidently count upon securing 70 per cent. of cures and from 10 to 15 per cent. of improvements as the result of the operation.

5. The dangers arising from the injection of radiographic substances into the renal pelvis are great if piston or excessive gravity pressure is employed during the injection. With slight gravity pressure no untoward symptom has been observed in our series of cases.

6. In our hands, the Edebohls method, with slight modification, has proved satisfactory as a permanent means of anchorage.

DR. GEORGE ERETY SHOEMAKER said that one of the essential conditions in dealing with kidney prolapse is that the operation be undertaken for definite symptoms due to the kidney mobility and not because the kidney moves. Many of his patients had been treated satisfactorily with the corset alone. In several instances other operations have been done; for example, repair of lacerations or Coffey operation, but it has been possible in nearly all instances to separate symptoms due to the other conditions.

The operation has a somewhat limited place but a definite one; it will relieve certain very definite distress from dislocation of the kidney which produces in its aggravated form the Dietl's crisis and certain indefinable sensations of unrest which appear only in the upright position and which disappear with kidney support. The situation in life of some women prevents their wearing through the day an efficient corset.

In 1906 he published in the *Journal of the American Medical Association* a suggestion for the modification of the technic of kidney-fixation which was intended to be added to suture methods and all other methods of sup-

port which might be advised. It consists essentially in delivering the kidney as usual through the torn fascias and fatty capsule, then closing the opening from which the kidney emerged by catgut sutures of the fat and fascia below. It will now be found that the kidney cannot be put back into the body; a new bed for it is made by blunt dissection close to the muscles of the back and above the incision, after which the usual method of suture of the kidney to the parietes is carried out and the external wound is closed. Where this technic can be carried out he believed that a better support is obtained and a better cushion of fat formed below the kidney. This does not interfere with any other technic, but is an addition to it.

He had notes on 21 cases of suspension of the kidney within the last seventeen years. Within the short time since receiving notice as to this discussion, he had been able to hear from and examine several of these and the condition of all except 5 is known. All recovered from the operation. One, performed seventeen years ago, is known to have relapsed; she, however, had a greatly relaxed and pendulous abdomen; has had 4 children since the operation. She was relieved of very severe attacks of dislocation with kidney prominence, extreme pain accompanied on one occasion by bloody urine; eleven years later there was but little descent of the kidney, but at present it has a large range of motion, although there are no crises.

One patient, with no other trouble, operated eleven years ago, writes: "I have no discomfort; have since married, and have two children, and attribute present well-being to the operation."

Another examined a few days ago was operated in 1903 (fourteen years ago); she has had 3 children since; does more work than ever before and is "feeling splendid"; present weight 145 pounds. Before operation the left kidney was below the navel; she had crises of abdominal pain usually produced by exertion; several attacks with a palpable lump over the kidney and severe pain. She was symptomatically cured and remains so to date. In this case part of the fatty capsule was removed.

Another extremely grateful patient has regained her health completely, but in addition to the kidney suspension she had a Coffey operation for viceroptosis. The right kidney was 2 inches below the navel. She has regained her health and capacity to work as a foreign missionary. She remains well; kidney was examined more than a year after fixation and found in good position.

In his general experience there has been little occasion to regret the operation largely because the cases have been selected. As far as known there has been only one absolute failure to secure improvement beyond a few months; this was in a young working woman of a highly neurotic temperament and probably many other elements entered into the condition. At the present time probably this operation would not be done.

In conclusion one might say that it is an operation to be undertaken only after careful study and where other measures have failed to afford relief; but in the selected cases it is well worth while.

A NEW METHOD OF EXCISING THE HEAD OF THE HUMERUS*

By T. Turner Thomas
of Philadelphia

The purpose of this paper is not to discuss the general subject of excisions of the shoulder-joint, but to report briefly what is believed to be a new operation and to report two cases on which it was done. By the operation which seems to be generally taught the upper end of the humerus is removed a variable distance below the tuberosities. All four of the rotator tendons, those of the supra- and infraspinatus, teres minor and subscapularis, are divided at their attachments to the tuberosities, their bony attachments removed and the long tendon of the biceps is dissected out of its groove in the humerus, to be later returned to what is left of this groove. The removal of so much bone and the detachment of so many important muscles lead to a serious disturbance of the function of the shoulder-joint, often to that very crippling condition, a flail shoulder. The operation offered here was performed on one case of recurrent dislocation of the shoulder and on one of old unreduced dislocation. It is, therefore, considered only in connection with these conditions. Any value it may have in connection with other conditions calling for excision of the shoulder-joint, such as tuberculous disease, must be determined later. It does not disturb any of the muscles except the subscapularis, which is divided, but later is reunited. Only the cartilage-covered portion of the humeral head is removed.

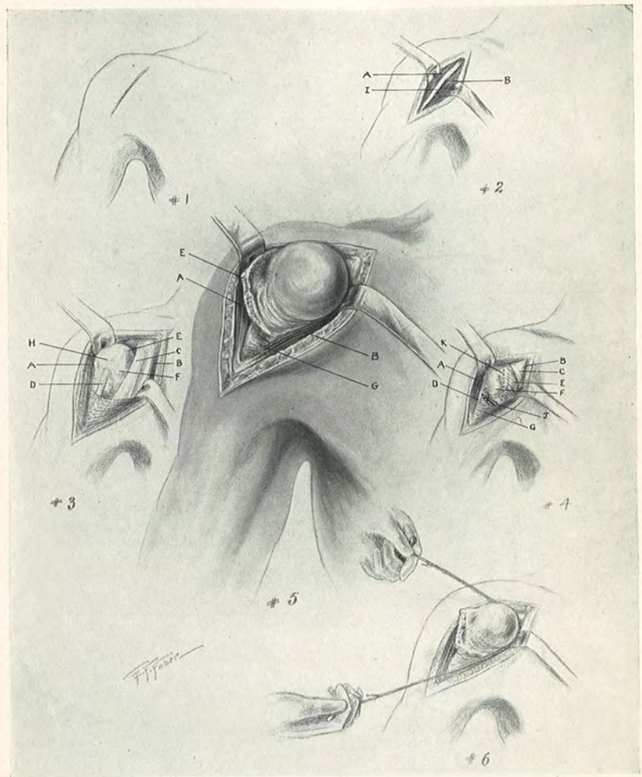
It is probably not generally appreciated that in the common anterior dislocation of the shoulder, recent and old, the only portion of the humerus protruding in front or outside of the glenoid cavity, is that covered with cartilage and not all of that. I have operated on between thirty and forty old dislocations of the shoulder, recurrent and old unreduced, in which I have nearly always found when I looked for it a typical groove of varying depth in the posterior part of the cartilage-covered portion of the humeral head. This resulted from the pressure against it of the anterior margin of the glenoid cavity, and the constancy of its presence and its situation shows just how much of the humeral head projects in front of the glenoid cavity in the ordinary dislocation of this joint. This groove corresponds to the site of contact between the two bones in the ordinary cadaver dislocation of this joint produced by hyperabduction. The removal, therefore, of the cartilage-covered portion of the head by sawing through at the anatomical neck will prevent recurrences of the dislocation, because it removes the only portion which can be dislocated, while it does not disturb any of the muscle attachments except that of the subscapularis which reunites closely later.

* Read before the Philadelphia Academy of Surgery, April 2, 1917.

In the old unreduced dislocation this operation removes the bony obstruction to the ascent of the remaining portion of the humerus to its normal level just below the acromion process. But this ascent following the operation in my case was incomplete, probably because of the resistance of the surrounding soft structures which had grown into their abnormal position around the long dislocated head. It did, however, remove the bony resistance to movement, so that with increasing movement of the joint and use of this movement it is not unlikely that the humerus will later slowly work its way almost if not quite up to its normal level. In any case the result should be a better one than after removal of the humerus down to the surgical neck as in the usual excision of the shoulder. One can exclude the possibility of flail shoulder, but limitation of movement will be marked unless vigorous exercises are maintained for a long time afterwards. Very little effort was made in either of my two cases to obtain movement, in the epileptic because he did not greatly need it and because he would or could not keep up the exercises. In the other patient the hand of the affected side was helpless for the carrying out of the necessary exercises because he could not grasp anything with it. The degree of movement obtained in the first case, practically without effort, indicates that much better movement could have been obtained in a man who was determined to get it. The second patient was such a man but was crippled with an almost useless hand.

CASE I.—Man, 26 years old, epileptic. Admitted to the Philadelphia General Hospital and the capsule operation for recurrent dislocation was done by myself, January 10, 1914. The dislocation recurred March 24, 1915, during an epileptic attack. He is a large and very powerful man and during such an attack it is said by the physicians who have been in charge that five or six men are necessary to hold him in order that he does no damage to himself or anybody else. During the fourteen months following the operation he had many convulsions without a dislocation. Soon after the operation he was removed to the insane department where he has remained since. I did a second capsule operation, September 20, 1915, and recurrence of the dislocation followed this on April 24, 1916, eight months later. In view of his great strength and violent convulsions and his failing mentality, because of which he will never be called upon to earn his living, it was considered advisable to excise the head of the humerus. This was done before the Clinical Congress of Surgeons, October 28, 1916, as follows:

The usual incision for excision of this joint was employed, *i.e.*, one about six inches long between the deltoid and pectoralis major from just above the coracoid process downward. After retracting the margins of the wound and exposing the upper end of the humerus the bicipital groove was located by palpation. The bony prominence in front of it is the lesser tuberosity and marks the insertion of the subscapularis. This tendon was divided parallel with the bicipital groove and about a half inch in front of or internal to it. This opened the



FIGS. 1–6.—*A*, deltoid; *B*, pectoralis major; *C*, short head of biceps and coracobrachialis; *D*, long head of biceps; *E*, subscapularis; *F*, lesser tuberosity; *G*, tendon of pectoralis major; *H*, greater tuberosity; *I*, cephalic vein; *J*, anterior circumflex vessels; *K*, line of division of subscapularis and capsule. 1, skin incision; 2, cephalic vein in interval between deltoid and pectoralis major; 3, upper end of humerus exposed in almost full internal rotation; 4, humerus in full normal external rotation, dotted line indicates where subscapularis and underlying capsule are divided into joint; 5, division of subscapularis and capsule permitted abnormal external rotation and turning of humeral head out of wound; 6, application of Gigli saw.

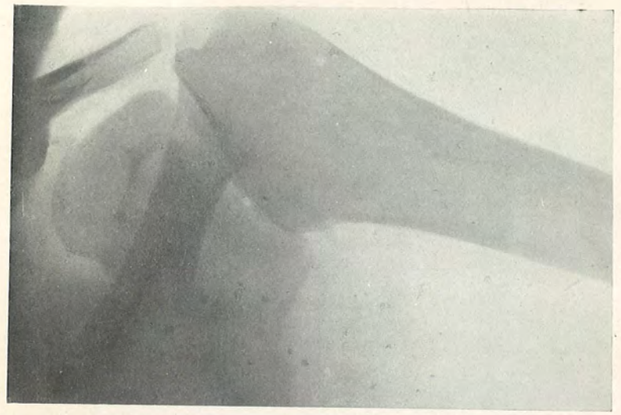
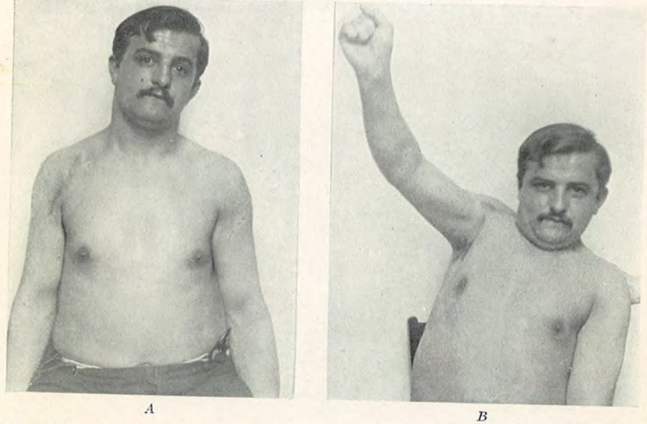


FIG. 7.—Case I. Right shoulder after operation with arm in partial abduction and external rotation. Line of excision could not be shown with arm at side and in internal rotation.



A *B*

FIG. 8.—Case I. *A*, showing nearly normal contour of right shoulder after operation. *B*, showing degree of abduction now possible.

shoulder-joint and permitted external rotation beyond the normal limit. This tends to turn the humeral head out of the wound, the degree to which this can be accomplished depending upon the extent of the division of the subscapularis tendon and underlying capsule upward and downward. That shown in Fig. 5 was obtained in the cadaver but not in operation on my patient. Enough was obtained in both cases, however, to make passing of the Gigli saw around the head at the anatomical neck comparatively easy, so that no difficulty was experienced in removing the head. In both, strong external rotation tended to tear the attachment of the capsule and tendon, after the cutting had been carried as far as could be seen, and thus to increase the external rotation and turning out of the head. The internal rotation of the Velpeau position, in which the limb was afterward dressed, brought the cut margins of the subscapularis tendon together without sutures, which may be used if desired. The skin wound was closed by plain catgut without drainage. The patient has had no dislocations since the operation although he has had many of his usual powerful epileptic convulsions. He seems to have full use of the limb except for the limitation of movement shown in Fig. 7.

CASE II.—Well-nourished, heavily-built man, 64 years old, fell down a flight of stairs on July 15, 1915, sustaining a painful injury of the left shoulder. He went to work on the following day, but his hand became so numb that he was compelled to give it up and come home. The hand felt as if it was "asleep". The whole limb has been very helpless ever since. A dislocation of the shoulder was not discovered for some time after the accident and then it could not be reduced. He was admitted to the University Hospital, May 24, 1916, and I attempted reduction without operation, unsuccessfully. He refused another attempt by operation at this time, but returned to the hospital in the following November for this purpose. The middle finger and the terminal phalanx of the ring finger of the affected hand, had been amputated years ago, but the remaining fingers had good movement and perfect function. Since the injury to the shoulder, these fingers and the thumb have been useless because of stiffness and atrophy which involve the whole hand as well. The patient wears a glove on this hand constantly because of numbness and coldness in it. Operation was done November 10, 1916. After exposure of the dislocated humeral head by the same incision as in the preceding case, the subscapularis was located and divided in essentially the same way. Many attempts were then made to pull or pry the head into the socket, with the aid of retractors for pulling and chisels to lever the head in, but without success. Then after some effort the head was rotated out of the wound as in the preceding case and a similar portion removed by the Gigli saw. It was more difficult to rotate the head out than in Case I, but with a little persistence in careful cutting of the capsule and tendon above and below, especially below, where the circumflex vessels had to be avoided, with strong rotation on the forearm to tear what could not be divided, enough exposure of the head was obtained to permit the passing of the wire saw around the anatomical neck

and then the working of the saw through the bone. No effort was made to force the head upward and backward to its normal level except by forcing the arm into full Velpeau position, and fixing it there. A small drainage opening was made into the axilla and a rubber tube introduced. There was no infection, but a hæmatoma developed in the inner part of the wound and was drained. The patient was discharged December 16, 1916, with a small sinus persisting. To-day, April 2, 1917, the tuberosities of the humerus operated on, on inspection and palpation, appear to have returned almost to their normal height under the acromion. Abduction can be corrected to a right angle with the body. External rotation is limited. The patient says the arm has been much more useful and comfortable "since the shoulder is back in place." The movements of the fingers, while still very limited, have shown distinct improvement since the operation.

STATED MEETING, HELD MAY 7, 1917

The President, Dr. CHARLES H. FRAZIER, in the Chair

SPLENECTOMY FOR PERNICIOUS ANÆMIA

DR. J. STEWART RODMAN reported the history of a man, aged thirty-nine years, who was admitted to Dr. Sailer's service August 13, 1916, suffering from asthenia. He had been well until five weeks before admission when he began to have daily attacks of abdominal pain, with chills and sweats, and an attack of vomiting every other day. No blood in the vomitus nor in the stools. Lost weight rapidly—thirty pounds during the period. He was markedly pale and anæmic; eyes prominent, skin icteroid; tender under right costal margin; spleen not palpable; no adenopathy—urine albuminous but free from casts and sugar; on admission red blood-corpuscles were 2,580,000; hæmoglobin, 30 per cent. Two weeks later the red count had fallen to 1,050,000 with hæmoglobin 20 per cent. A blood transfusion of 150 c.c. was done September 17, which raised the red count to 3,420,000, with hæmoglobin 30 per cent. October 18, the red count had fallen to 3,100,000 with hæmoglobin 35 per cent. A splenectomy was resorted to October 19, being done by Drs. Allen and Rodman.

The removed spleen was one and one-half times its normal size; was adherent to stomach, pancreas, colon and diaphragm. Moderate hemorrhage. Pedicle clamped and double ligated. Gauze packing to diaphragmatic surface. The gauze was removed five days later. The postoperative course was uneventful. On October 24, five days after the removal of the spleen, the red count had risen to 3,250,000, hæmoglobin 44 per cent.; three weeks later the red count had risen to the normal level of 4,470,000 with hæmoglobin 45 per cent. The patient was discharged home November 15, 1916.

GUNSHOT WOUND OF THE SPINAL CORD

DR. J. STEWART RODMAN reported the history of a man aged thirty-four years, who was admitted to the Presbyterian Hospital, in the service of Dr. F. O. Allen, December 17, 1916, on account of a gunshot wound of the neck.

The bullet had entered posteriorly on the right side at the base of the neck. He was unconscious when admitted but regained consciousness shortly after admission. Temperature 100 degrees. Pulse 80. Complete paralysis of upper and lower limbs. Loss of sensation to upper third of chest. Loss of bladder and rectal control. An X-ray plate showed a bullet in the spinal cord about the level of the fifth cervical vertebra.

Operation.—(Gas and oxygen.) Drs. J. S. Rodman and F. O. Allen. Laminectomy; spines and laminæ of fifth, sixth, and seventh vertebræ

removed. Fourth and fifth vertebræ fractured by bullet, 38 caliber bullet removed from spinal canal at level of fourth cervical vertebra. After lifting bullet from its bed it was seen that the spinal cord was completely divided at this level; wound closed with gauze drainage.

TRAUMATIC BRACHIAL PARALYSIS.

Dr. Astley P. C. Ashhurst presented a man, aged fifty-four years, who was referred by Dr. J. H. Baldwin to his service at the Orthopædic Hospital, June 10, 1916. On March, 1916, this man had fallen and injured his left shoulder. One week after the injury the man applied to Dr. Baldwin, who sent him to the Methodist Hospital. Paralysis was present at this time. Dr. Baldwin found the whole limb much swollen, and recognized the presence of an unreduced dislocation of the shoulder (subcoracoid); this was reduced at the hospital under primary anæsthesia by Dr. L. J. Hammond. The patient went home eight days after the dislocation was reduced, in good condition. Two weeks after leaving the hospital he says his arm began to swell; he had considerable constant pain like pins and needles radiating from the shoulder to the fingers. He then returned to the Methodist Hospital, where he remained six weeks, receiving massage and electricity.

Examination, June 10, 1916, three months after the injury, when first seen at the Orthopædic Hospital, showed a healthy looking man, with the left upper extremity hanging helpless at the side of the body. There was no *voluntary motion* below the shoulder except very slight power in the triceps, sufficient merely to extend the elbow a trifle, and very questionable power of pronating the forearm. The arm could be elevated from the side by means of the trapezius acting on the scapula. There was good power in the pectoralis major. There was noticeable atrophy of the deltoid. There was no power to flex the elbow, nor to move the hand or fingers. The hand was slightly swollen. *Passive motion:* at the shoulder external rotation was limited at the sagittal plane, abduction at 35 to 40 degrees (without causing rotation of the scapula); other passive movements were normal except slight loss of full extension of the elbow. There was some grating in the shoulder on motion, and some thickening of the bones.

Electrical examination by Dr. H. P. Boyer, June 12, 1916, showed reaction of degeneration in the deltoid, biceps, triceps and the flexors and extensors of the carpus and fingers. The response was very poor to the galvanic current, and there was practically no response at all to the faradic current.

Treatment consisted in massage and electricity three times weekly. The question of exploratory operation was discussed with the patient, but not urged very enthusiastically, and was not accepted by him.

July 1, 1916. The elbow and hand swell at times. He thinks he has more power in the shoulder and elbow, but none is apparent on examination.

September 16, 1916. The patient says that sensation, which was absent below the elbow when he first came to the hospital three months ago, has returned very gradually and now is about normal from the wrist up. In the hand hypæsthesia (no anæsthesia) persists. The patient was seen at this time by Dr. Francis W. Sinkler, who believes the lesion to have been a laceration of the nerves in the axilla. Examination to-day (September 16) shows no power to flex the elbow, though the biceps can be felt to contract voluntarily; there is doubtful voluntary power in the brachialis anticus; but he is unable to flex the elbow even when the forearm is hanging vertical like a pendulum with the arm held horizontal. There is fair power in the triceps. The elbow cannot be fully extended passively. He is able to abduct his shoulder to about half the normal extent, and the deltoid can be felt contracting. There is almost normal active flexion and extension of the shoulder. There is good pronation and weaker supination of the forearm, the latter being accomplished mainly by the biceps, which can be felt to contract though it is not strong enough to flex the elbow.

September 25, 1916. *Electrical examination* by Dr. Boyer shows no change from that of June 12, except that the deltoid no longer shows reaction of degeneration.

April 14, 1917. The patient, who still comes three times weekly for massage and electrical treatments, says that up to about two months ago he could not feel hot water in the hand; he could put it in "boiling water" he says, and not know it. Now, however, sensation is normal. *Active motion:* shoulder can be abducted to 60 degrees, the deltoid seems normally active; flexion and extension of the shoulder are almost normal; internal and external rotation are good, but the latter is limited at the sagittal plane. Flexion and extension of the elbow are good, but flexion is still a little weak. Flexion of the wrist is *very* weak, but there is fair power of extension. There is full supination, and pronation to the mid-position, both of fair strength. There is very little movement in the fingers, consisting only in very feeble flexion and extension; there is no power to separate the fingers. The thumb can be moved slightly in flexion and extension. *Passive motions:* at the shoulder there is no more passive than there is active motion. At the elbow the range of passive motion is from 60 to 160 degrees. Rotation in the forearm is normal. The wrist extends almost normally, flexes two-thirds normal. The fingers and thumb can be flexed half the normal extent, and can be fully extended.

May 4, 1917. *Electrical examination* by Dr. H. P. Boyer: There is marked improvement shown. The deltoid, biceps, triceps, and extensors of fingers do not show reaction of degeneration, and respond fairly well to the Faradic current. The flexors of the fingers still show reaction of degeneration and do not respond to the Faradic current.

Dr. Ashhurst added that he thought the diagnosis in this patient was correctly given by Dr. Sinkler as a laceration of the nerves in the axilla. The laceration probably was slight, consisting rather in stretching than any actual solution of continuity. The effusion of blood, lymph, and synovial fluid no doubt also was in some measure responsible for the disability. The

prognosis probably is good in this case for ultimate recovery even of the hand; though when the patient was first seen, and especially when it was found that reactions of degeneration were so complete, there seemed little hope of ultimate recovery.

Dr. Ashhurst recalled that Duval and Quillain (1898) maintained that all nerve lesions accompanying injuries by indirect violence at the shoulder were either *radicular* or *terminal,* there being no such clinical entities as ruptures of the brachial plexus. Also that Delbet and Cauchoid (1910) had collected 36 cases of paralyses, complicating dislocations of the shoulder: 25 were *terminal,* and were caused by the dislocation; 11 were *radicular,* and were caused *not* by the dislocation, but by the same cause which produced the dislocation. In this series there were no lesions of the brachial plexus proper.

The present case, therefore, supports these investigations.

Dr. T. Turner Thomas said that it has long been the tendency to attribute all traumatic brachial paralyses of a diffuse character to injuries of the brachial plexus because a nerve rupture involving so many muscles could not be located anywhere else. The late results, according to his experience, show that almost every case recovers completely from the paralysis. The sensation is rarely disturbed seriously, and in almost every case the shoulder-joint is stiff and painful, indicating that it was injured.

For six years he had been trying to show that the paralyses in most of these cases is secondary to the shoulder-joint injury and disappears with the complete recovery from this joint injury, sometimes before. The greatest difficulty is in deciding what cases may properly be included under the traumatic brachial paralyses. Some surgeons believe that the Duchenne-Erb paralysis (C V, and C VI) is common in adults and serious, while most surgeons ignore it entirely in their practice, and it is given no place in surgical text-books. Yet few surgeons, probably, would deny that traumatic brachial palsy of varying degree from injury in the shoulder region is frequent but rarely permanent. The fact of the matter is that discussion of the subject is being avoided.

He recognized two main classes of these cases. In the first, by far the most common, the shoulder-joint becomes stiff and painful, but is in no sense flail. These recover completely with the restoration of normal function in the shoulder-joint or even in the presence of a considerable permanent ankylosis. In the second the causal force dropped a half inch or inch below its normal level under the acromion, and later the joint became flail when the pain and muscle rigidity disappeared, and especially when the resulting atrophy became marked. Early removal of the flail condition of the joint and then of motion, the operative stiffness is followed by a complete cure. In other words, the operation puts the joint into the condition found in the first class, which is then overcome.

Not infrequently there will be found in both groups, from the shoulder to the ends of the fingers, marked pain and tenderness in all of the structures, with pain and stiffness in all of the joints, much worse in the hand than elsewhere. This condition is present in Dr. Ashhurst's case and is now the only condition to be reckoned with. It is not peculiar to shoulder injuries. LeBreton has reported a series of cases following Colles's fracture. In all of his cases with flail shoulder, four in number, except the first seen five years ago, there was more or less swelling in the hand, extending a variable distance upward. It may have been present in his first case before he saw it, nearly five weeks after the accident. He had had at least as many cases without flail shoulder. He doubted if a patient with a marked case of this condition can ever again have a normal hand, because adhesions have developed between all of the tendons and their sheaths, in addition to the trouble in the joints, and he could not believe that the adhesions would disappear and the tendons work freely in their sheaths again.

CANCER OF THE PENIS

Dr. B. A. Thomas reported the history of a man, aged thirty-seven years, who was admitted to the Polyclinic Hospital on January 4, 1917, with the following history: He had had a phimosis all his life, and had never been able to retract the prepuce. One year ago he noticed a slight discharge from the penis, but did not pay any attention to it at the time. The condition grew worse for a while, and a few months later the glans penis began to recede from the margins of the prepuce, and to swell at the same time. There has been a bloody discharge from the ulcerated area for most of the time during the past year. At the time of admission the end of the penis presented a huge cauliflower growth, which, together with the œdematous loose connective tissue, measured about four inches in diameter. The growth apparently had its origin in the region of the coronal sulcus on the dorsal aspect of the organ, but at the present time by contiguity has involved three-fourths of the circumference of the infiltrated organ, merely a portion of the glans in the region of the meatus being free. The inguinal lymph-nodes on both sides were palpable. The Wassermann reaction resulted negatively.

On January 5th patient underwent operation, consisting of bilateral inguinal lymphadenectomy and total extirpation of the penis, the incision extending downward from both inguinal regions, meeting and encircling the root of the penis, thence downward, dividing the scrotum to the middle of the perineum, after which the corpora cavernosa were freed from their attachments to the rami of the ischium. The bulb of the penis was then divided, the urethra severed and anastomosed in the perineum at the lower angle of the incision, after which the wound was closed. The histopathological report stated growth to be a squamous-celled carcinoma of the penis, with very early metastasis to the inguinal lymph-nodes.

A few days after the operation, X-ray treatment was begun as follows: For three days, each day, he was given six exposures of ten minutes each, at different sites. This was repeated in three weeks, and again in four

weeks, the last treatment being given after he was discharged from the hospital, which was on February 5. The patient's convalescence was remarkable in the fact that a week after his discharge from the hospital he was employed as a chair-pusher on the boardwalk at Atlantic City. Seen two months after he left the hospital, he was still at this occupation, experiencing no discomfort and had not any incontinence of urine, difficulty on urination, or evidence of contracture of his new external urinary orifice.

HYDROCELE OF EXTREME SIZE

Dr. Thomas presented a man, aged seventy-three years, who was first seen on March 26, 1917, at the Surgical Out-patient Department of the University Hospital, complaining of a huge rupture. He stated he had been the victim of herniæ on both sides for twenty years. Eleven months ago he fell, striking his herniæ, after which swelling began on the left side, and increased rapidly. At the present time the mass is so large that the patient is obliged to carry it in a hammock, suspended from his shoulders, by improvised suspenders. The penis is almost lost to view, becoming invaginated in the tumor, and appears as an inconspicuous dimple on the right side. The act of urination is accomplished by pressing a funnel against the skin below this dimple, which diverts the urine to a receptacle. The tumor is cystic in character, and fluctuates, and seems to be about two-thirds fluid, transmitting light in the lower two-thirds. This swelling, complicating the hernia on the left side, is remarkable chiefly because of its size, measuring 41 centimetres on its vertical diameter, and 81 centimetres in circumference. The hydrocele was tapped, any other form of treatment being out of the question, and sixteen pints of fluid were removed.

MYOSITIS OSSIFICANS PROGRESSIVA

Dr. B. A. Thomas and (by invitation) Dr. F. G. Harrison presented a little girl, four years of age, with the history that about February, 1916, the mother noticed a lump in the child's back in the lumbo-thoracic region, which she says appeared after a fall while at play. This grew larger, and other lumps appeared, and her neck became stiff. She has grown progressively worse. She has never complained of pain. There is no history of any lumps disappearing. There is limitation of motion of the spine, shoulders, and hips. There is a loose body in the right axilla, the others are all immovable.

There is an evening rise of temperature, no cough. Wassermann is negative. She plays around with other children.

Family History.—Father living and well. Mother has pulmonary tuberculosis. She has been deaf for seven years and has grown progressively worse lately. Has had eight children, three dead of causes uncertain, four others, besides patient, well.

Previous Medical History of This Child.—Normal birth. The mother says

there was a congenital malformation of the great toe, hallux valgus. The child was breast fed for three months. Had measles prior to her trouble, whooping cough when she fell, and chicken-pox afterward.

INDICATIONS AND TECHNIC FOR REMOVAL OF THE SPLEEN

A paper with the above title was presented by Drs. George P. Müller and Charles H. Frazier.

Dr. P. G. Skillern, Jr., called attention to the very excellent method of controlling the blood-supply in splenectomy which the essayists did not mention; this was suggested by J. C. A. Gerster (*Jour. Am. Med. Assoc.*, August 7, 1915), who believes that ligation of the arterial supply of the spleen at certain points which are more accessible than the deeply situated pedicle will greatly facilitate difficult splenectomies. These points are (1) the splenic artery close to the cœliac axis; (2) the gastro-epiploica sinistra where it reaches the stomach from the splenic. The cœliac axis is readily exposed through the lesser omentum just above the lesser curvature of the stomach and border of the pancreas, and may be made to come within one inch or so of the anterior abdominal wall by hyperextending the spinal column as for gall-bladder operations. This method should be applicable in certain cases of Dr. Müller's Group I, namely, in certain cases of traumatic rupture of the spleen, especially those cases where there is already severe traumatic shock, to which the addition of the surgical shock attendant upon splenectomy might surpass the margin of safety and kill the patient; in these cases mere ligation of the splenic artery with, if thought necessary, stuffing of the great omentum in the splenic rent, should suffice to bring about the immediate recovery of the patient. In cases of removal of the spleen for disease, in which there are numerous vascular adhesions conveying a vicarious exotic circulation to the spleen, ligation at these two points would serve to diminish the hemorrhage, but not to control it entirely.

By ligating the splenic artery at its origin a "safety first" principle is observed, precautionary against hemorrhage due to unforeseen accidents during or after operation; thus, after mobilization and delivery of the spleen its pedicle might be found to be very short and hard to clamp and ligate; and Dr. Frazier mentioned the possibility of the ligature slipping off the pedicle—a catastrophe for which there is no excuse, and one which can be prevented by anchoring the pedicle ligatures with two or three additional small ligatures.

As to the incision, Dr. Müller stated that he employs a long, vertical cut through the left rectus. For upper abdominal work the transverse incision, advocated last year by Moschcowitz, seems advantageous upon anatomic grounds. This incision divides one or both recti transversely two inches above the navel and is continued transversely outward through the flat muscles of the flank as far as conditions warrant. The advantages of this transverse incision are freer exposure and less damage to the abdominal wall. With the exception of the rectus the muscles and congeries of minute

tendons into which they insert are cut parallel with their fibres, instead of at right angles, as with all vertical incisions; for the same reason, the motor nerves, too, escape division. As regards dividing the rectus muscle transversely, the ultimate result is but the addition of another transverse cicatricial intersection to the three or more tendinous ones normally present. The scar resulting from the wound is stronger and its cutaneous portion eventually almost invisible. The transverse incision, however, takes more time, and when time is an important element, the linea alba incision, as advocated by Percy, could be employed.

TRAUMATIC BRACHIAL PARALYSIS WITH FLAIL SHOULDER JOINT *

WITH A REPORT OF THREE OLD AND ELEVEN NEW CASES

By T. Turner Thomas, M.D.

of Philadelphia

In a series of papers, published during the past five years, the effort has been made to show that traumatic brachial paralysis may be due to injury of the shoulder joint without actual trauma to the nerves supplying the limb involved. The chief evidence offered consists in the recovery of normal power merely from restoring normal function to the shoulder joint. If the shoulder joint relations are normal, the treatment consists in measures to overcome the limitation of movement always present in the shoulder joint. If the shoulder joint relations are abnormal, the treatment consists first in restoring them to the normal and then restoring the normal motion. The abnormal relations are due to dislocations. In the adult we have to deal usually with the ordinary anterior, subcoracoid dislocation, in the new-born with the posterior subluxation. In adults there occurs, not infrequently, a dislocation in which the humeral head drops below its normal level and the joint usually becomes flail. The purpose of this paper is to confirm, by further clinical experience, the conclusion reached in the first paper[1] on this phase of traumatic brachial paralysis, *i.e.*, that the flail shoulder joint is the result of such a dislocation and is essentially the cause and not the result of the paralysis. This is shown by the fact that the early operative removal of the flail shoulder results in a cure of the paralysis.

While the degree of paralysis and pain has varied considerably in my fourteen cases, one feature has been constant, the falling of the upper end of the humerus from a half to an inch below its normal level under the acromion. One type is more common than the others, although this varies in the degree of paralysis associated. The fingers can be pressed between the head of the humerus and the acromion, but this separation is easily removed by pressure upward under the elbow. As soon as the pressure is removed, however, the relaxed condition of the joint recurs. The patient can, usually, lift the humerus up to its normal level by a little muscular effort, but as soon as this effort is relaxed the humerus falls again. The muscles progressively atrophy until finally the upper end of the humerus may become almost subcutaneous. Usually, the movements and power of the hand are very good and may be almost normal. But the power decreases as the shoulder is approached and there it may be almost nil. In two cases the shoulder joint was tensely filled with effusion and not flail. I have had one case with complete paralysis of the whole limb and one with almost complete paralysis, in both of which

* Read before the Philadelphia Academy of Surgery, May 7, 1917.

[1] The Journ. Nerv. and Ment. Dis., vol. 38, No. 4, April, 1911, p. 193.

there developed a painful stiffness of all the joints of the limb involved. There is reason to suspect that much of the apparent paralysis was due to this pain and limitation of movement of the muscles and joints. Both died within a year and a half after the injury, and at the time of death the paralysis had disappeared in both; the stiffness and pain had improved very much but had not entirely disappeared and was still very severe in the hand.

As already stated the purpose now is not to discuss further the probable mechanism of the joint injury, but to support it by the results of treatment based upon it, and to outline that treatment. A very brief reference to the mechanism is necessary to properly appreciate the purpose of the operation. The most common cause of injury to the shoulder joint is hyperabduction from excessive force in a fall on the hand or grasping some object with the hand to prevent the fall. Rarely the force is sufficient to tear away the capsule and tendinous attachments from the neck of the humerus all around, when from this loss of support the humerus and the rest of the limb may sink downwards until the surrounding attached structures take up the support. The gap intervening between the lacerated surfaces later fills in by cicatricial tissue. While this is taking place this gap is maintained on the upper outer side of the joint where the capsule is under tension, but is not maintained on the axillary side where the torn edges of capsule come together because on this side the capsule is relaxed. This results in a lengthening of the capsule on the upper outer side and a contraction on the inner side. The outer lengthening permits the humeral head to drop when the arm is at the side. Because of the axillary contraction when the arm is carried into abduction the humeral head is forced up firmly to its normal level under the acromion. For the same reason complete abduction is prevented, notwithstanding the flail point. The humeral head probably can never go back to its normal level under the acromion against gravity with the arm at the side, and the patient ever afterwards suffers from the abnormality in the joint. To show the separation between the acromion and upper end of the humerus, the X-ray must be taken with the patient in the upright position. That this joint condition is the cause of the paralysis is proven in recent cases by the fact that when the joint is restored to its normal condition and is used long enough the power returns in the muscles. The normal joint conditions have been restored merely by shortening the upper and outer abnormally lengthened portion of the capsule by means of an operation and afterwards removing the operative stiffening of the joint by proper exercises.

In the shoulder as in most joints, a satisfactory exposure of the capsule without excessive division of muscles is very difficult and will, probably, deter many from trying this method of treatment. I have varied the operation in minor details in the effort to discover the easiest and simplest method, and I am not yet prepared to describe a single operation and exclude the other variations. I have presented a brief outline of each one in the case reports. Unless the surgeon is unusually familiar with the anatomy of the

part, I would advise the operation described in connection with Case IX. The incision follows the McBurney principle and gives a limited exposure of the capsule, but with a little patience and care it is sufficient for the purpose. As no capsule sutures (they are very difficult to introduce) are employed, it will be well to fix the arm after operation in the position shown in Fig. 7 and maintain it there for about five weeks. Unless the patient is willing to persist for a long time after the operation in exercises to force the arm into full abduction and external rotation, as by hanging by the hands, there will be much danger of permanent stiffness of the shoulder joint. Upon the rapidity with which the motion returns and the frequency with which it is used, depends in a large measure the rapidity and completeness with which the power of the muscles return. Yet complete or almost complete return of power seems to be possible when a considerable stiffness of the shoulder becomes permanent, as in Case IX.

CASES PREVIOUSLY REPORTED

Case I.—Man, thirty-nine years old. April 9, 1909, fell on board ship, a height of 8 ft., on his left side, while under the influence of liquor. Did not notice anything wrong with his shoulder until the following morning when it was stiff and painful. Admitted to the Philadelphia General Hospital April 10, 1909, on the service of Dr. J. Chalmers DaCosta who kindly turned the case over to me. I examined the patient for the first time about six weeks after the accident and found a severe brachial paralysis with flail shoulder, the paralysis being most severe at the shoulder and gradually becoming less toward the hand which was normal. Operation June 4, 1909. Incision along the posterior margin of the deltoid. Distinct evidence of old fractures of greater tuberosity found. Posterior scapular muscles lifted from the capsule, which was incised midway between its glenoid and humeral attachments with overlapping of these margins by catgut sutures. External rotator muscles also shortened by a tuck in each with catgut sutures. Wound closed with temporary drainage for oozing, and arm fixed on splint at right angles with body and in full external rotation. Primary healing. Arm brought to side in two weeks and supported for another week. Massage and exercises to improve motion at shoulder. In three months power of limb and motion at shoulder practically normal, and these have remained normal ever since. This patient has been available for observation almost continuously since the operation, as a fireman at the Philadelphia Hospital. The foreman says this patient is his best workman.

Case II.—Woman, twenty-five years of age. On December 2, 1910, on taking her seat in a rocking chair, she raised her arms above her head in the act of "stretching," when the chair suddenly tilted backward, necessitating a sudden and vigorous effort to recover her balance. This produced a severe pain which she located in the middle of the arm about over the insertion of the deltoid. A little later she tried flexion and extension of the forearm to "take the catch out of the arm," but without success. She went to the theatre the same

evening, but came home early on account of pain. Swelling appeared on the following day and the pain and tenderness became so severe that she could not tolerate any handling of the part. The arm hung at the side helpless, except for the ability to make slight abduction. She went to bed on the day following the accident and remained there three weeks, but could not lie down on account of the pain. Twenty days after the accident she was etherized and a persistent effort was made by her physician to reduce what seemed to be a dislocation, but without success. I saw the patient for the first time at the University Hospital, on the thirty-fourth day after the accident, when she was compelled to sit up in bed most of the time and was unable to move the arm, except for a few degrees, in any direction. The head of the humerus was distinctly below its normal level with an abnormal depression between it and the acromion. Pressure upward caused severe pain at the shoulder. Measurement from the acromion to the external condyle showed lengthening of five-eighths of an inch on the affected side, and the X-ray showed a decided downward displacement of the humeral head, but no fracture of the greater tuberosity. Operation January 6, 1910. Incision through posterior fibres and not along posterior margin of deltoid as in preceding case, and capsule alone shortened. The most prominent symptom in this case was the pain, which was explained by the marked tension of the capsule before it was opened, and the escape of much dark grumous blood as soon as it was opened. Eight months after operation the patient reported that the arm was perfect except that she still could not hook up her skirt in the back. This difficulty disappeared later and she has engaged much in tennis and other athletic games, without the slightest trouble ever since.

CASE III.—Corpulent man, sixty-five years of age, subject to severe cardiac weakness and, therefore, not suitable for operation. On October 28, 1909, while attempting to catch a street car, he tripped and fell against the curb, striking on his right shoulder. When he got up the arm seemed helpless and felt as though it was asleep. He went home and lay on a sofa, soon falling asleep. When he awoke both arms were raised above his head, causing him to think there could not be much wrong with his injured shoulder. On the following day it was stiff and painful and he went to a hospital, where the shoulder was said to be dislocated and reduction accomplished, the arm being bound to the side and the wrist supported by a sling. He was an orderly at the Philadelphia Hospital, and on his return there the dressing was reapplied and the limb maintained in this position for a month. He says that for a long time after this the arm hung helpless at his side. He could flex the forearm slightly but required the aid of the other hand to complete the movement. The hand movements were always best and he could always write with it, provided the forearm were first brought to a resting position. He had had electrical treatments at different times but thinks they never did him any good. Examination, August 30, 1910, shows that he has good movement and power in the hand. The forearm can be flexed much better now than

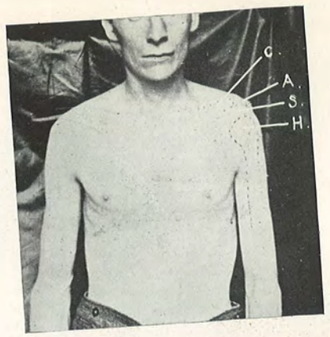


FIG. 1.—Case I. Before operation. Paralyzed left arm shows some atrophy and a slight notch on the point of the shoulder indicating the dropping of the humerus from its normal level under the acromion. Compare with normal right shoulder, and with same shoulder in Fig. 2. *C*, clavicle; *A*, acromion; *S*, abnormal space between humerus and acromion; *H*, head of humerus.

FIG. 2.—Case I. Picture taken in 1914, showing good muscular development of left upper extremity, which is as good to-day.

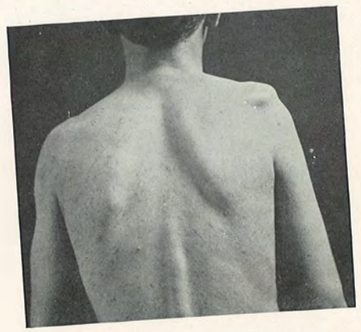


FIG. 3.—Case V. Posterior aspect of shoulder in a typical case of traumatic brachial paralysis with flail shoulder-joint.

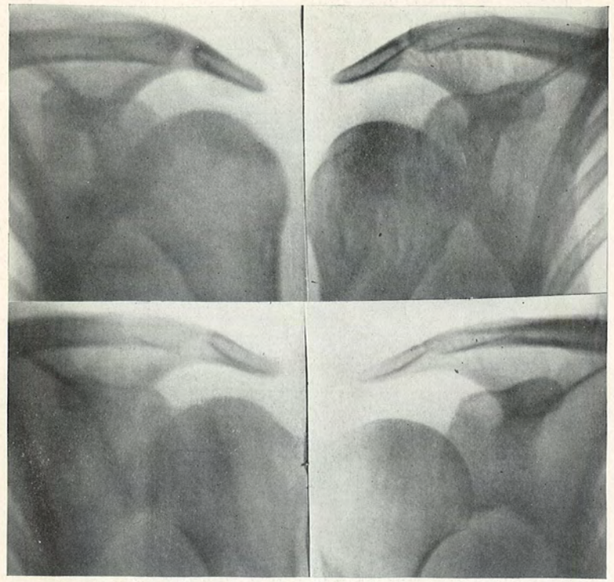


FIG. 4.—Shows that a flail shoulder-joint, once developed, however slight, probably never can fully recover, because the humeral head cannot go back to its normal level against gravity. *A* and *C*, normal right shoulder; *B* and *D*, affected left shoulder. *A* and *B* taken March 4, 1916, about seven and a half months after beginning of trouble. By directing the X-rays in the plane of the acromion process the widest possible space was obtained between the acromion and humeral head, thus emphasizing the difference between the two shoulders. *C* and *D* were taken May 5, 1917, fourteen months after *A* and *B*, the X-rays being directed in the same plane in all four pictures. The left shoulder has lost none of its laxity, which is, probably, permanent.

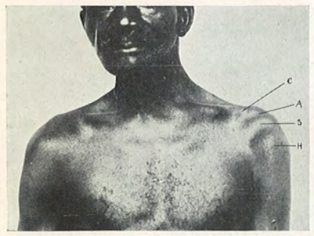


FIG. 5.—Case XII. Falling of humerus and consequent hollow between the acromion and head of the humerus shown in the left shoulder. *C*, clavicle; *A*, acromion; *S*, abnormal space between humerus and acromion; *H*, head of humerus.

FIG. 6.—Case XII. Before operation. Degree of active abduction possible. This slight degree appears to be due to fixation of the shoulder-joint and turning of scapula by muscles of neck and trunk, and not to any action of the deltoid. Note that the hollow between the acromion and humeral head has disappeared. This usually happens on any movement or attempted movement of the arm. Cannot flex elbow in slightest degree.

FIG. 7.—Case XII. A very good position in which to dress the arm after operation. It should never be dressed at the side. Tightening of the axillary portion of capsule from abduction forces upward head of humerus, while the portion operated is relaxed and shortened by cicatrization.

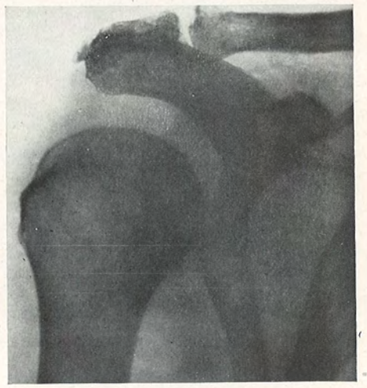


FIG. 8.—Case XII. Shows abdominal space between acromion and humeral head. X-rays directed anteroposteriorly not in plane of acromion as in Fig. 4. Fracture of greater tuberosity found at operation not found in this X-ray. Long tendon of biceps detached from upper glenoid margin in this case, but falling of humerus no greater than usual on that account.

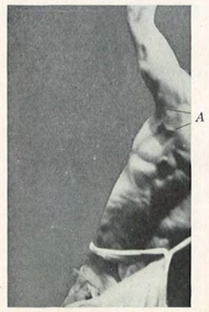


FIG. 9.—Case XII. Taken May 20, 1917, about a half minute after releasing his grasp of a tree limb by means of which he forced the arm into its full limit of abduction. He could keep it there against the pull of the contracted axillary tissues about a full minute. *A*, posterior operation scar, undergoing keloidal change.

some months ago, but not nearly as well as on the normal side. The arm by a strong effort could be abducted about 20 or 30 degrees, but with a considerable elevation of the shoulder (as in Fig. 6), and it was held there with some effort and pain at the shoulder. There is marked atrophy of the deltoid and posterior scapular muscles. Passive abduction is nearly normal. There is a distinct hollow between the acromion and head of the humerus, into which the fingers can be inserted. By pressure upward under the elbow, the humerus can be pushed up to its normal level and the patient can produce the same effect by muscular effort, but as soon as he relaxes, the humerus drops again. Measurements on both sides show a half-inch lengthening on the affected side. There is crepitation in the joint on movement but the X-ray is not clear as to the existence of a fracture of the greater tuberosity. Electrical examination by Dr. J. W. McConnell: On the right or affected side, the trapezius, biceps, extensors and flexors of the hand, the supinator longus and pronator teres, react normally to faradic stimulation. A current sufficiently strong to provoke contraction in the muscles by diffusion of the current, fails to cause any contraction of the deltoid. The muscles of the left shoulder and arm respond normally to faradic stimulation. This patient died of heart disease June 10, 1911.

NEW CASES

CASE IV.—Woman, single, fifty-eight years old, house servant. Admitted to the Philadelphia General Hospital, May 27, 1911, in the nervous wards, on the service of Dr. J. Hendrie Lloyd. Her chief complaint was of loss of power with tingling sensations in the whole left upper extremity. The patient was perfectly well when, several days before admission, she fell from a chair, on which she was standing, and struck on her left elbow, arm and shoulder. The tingling sensation is most marked in the fingers. She says that immediately after the fall the left arm lay under her body and that she could not move it except by grasping it with the right hand and pulling on it. She says "it felt as if it were dead" at that time.

Summary of examination by Dr. Lloyd: Gait and station good. Eyes negative. Pupils and cranial nerves good. Tongue protrudes in median line. Has slight tremor. *Right upper extremity* showed grip, power and motion unimpaired. Slight tremor in hand. *Left upper extremity* showed complete loss of power and motion and absolute flaccidity. Reflexes in biceps, triceps and pectoralis major absent. Tingling sensations in left arm, forearm and hand. Sense of touch and pain diminished, but not entirely lost in any part of the limb.

Dr. Lloyd asked me to see the case and to operate on it if in my judgment it was advisable. I found a distinct relaxation of the shoulder joint and the sensation unexpectedly good throughout the whole limb, and in view of the remarkable results obtained in the two preceding cases from simply restoring the normal shoulder joint relations and forced movements afterwards, I concluded to do the same operation in this case. I had not dealt with a complete paralysis

before. There was in addition in this case marked pain on movement of all the joints and a certain degree of cyanosis of the affected hand as it hung at the side.

Operation done July 1, 1911. Incision about five inches long along posterior margin of the deltoid, which was freed from the underlying external rotator muscles and retracted strongly upward, while the humerus was rotated strongly outward. The infraspinatus muscle, the first below the spine of the scapula, was separated from the shoulder joint capsule underneath, and the supraspinatus as far upward as possible. The capsule was then divided parallel with the glenoid margin and about midway between the glenoid and humeral attachments of the capsule. No signs of fracture or other injury discovered in the joint, except that capsule was abnormally long above. The circumflex nerve was exposed in the lower part of the wound, including a few of its branches. It was pinched with a tissue forceps several times without any response in the deltoid. With the arm held in abduction to about a right angle and external rotation, the capsule wound edges were overlapped by several catgut mattress sutures. Silkworm gut for skin sutures. Small rubber dam drain in upper angle of wound for uncontrollable oozing (most dependent position with patient lying on her back). Right-angled splint applied to inner side of arm and side of body, firmly, by adhesive plaster and bandages with arm in full external rotation. Primary healing. Drain removed in 48 hours. All support of arm and shoulder removed July 19, and arm gradually brought to side in a few days, after which it was supported by an adhesive strip under the elbow and over the acromion, with a sling for the forearm from the neck.

The return of power was very slow in this case and was associated with a very troublesome painful stiffness in all the joints. July 19, with the forearm resting on the patient's knee, there was very slight power to pronate and supinate the forearm. July 23, index finger could be moved slighly. Very slight dorsal flexion at the wrist. Pronation slightly improved. Can abduct elbow about four inches from the side. Some stiffness observed in all joints of the limb for the first time. (It may have been, and probably was, there before operation.) September 1, abducts arm about 25 degrees. Elbow cannot be passively extended more than about 140 degrees and in this position the arm hangs at the side. From this position she can flex the elbow to slightly more than a right angle. Can pronate and supinate forearm through a range of 10 to 15 degrees, and this with some force, supination being stronger than pronation. Has considerable flexion at wrist but less extension. Can touch side of index finger with thumb and can approximate thumb to within a half inch of litle finger. Has considerable movement of all fingers but cannot begin to make a fist.

Left hospital September 9, 1911, because she would not tolerate the pain induced by attempts at massage and passive motion to improve the very crippling stiffness and pain in all the joints of the limb.

By May 21, 1912, she had made remarkable improvement. She could actively abduct the arm at the shoulder to somewhat beyond a

right angle with the body and with the aid of the other hand could force it almost into full abduction. She had almost full flexion and extension at the elbow, and almost full pronation and supination of the forearm. The wrist movements had improved much, but she still lacked any considerable movement in the finger joints, and had most in the metacarpophalangeal joints. She was very anxious to go back to her work as a house servant, but the condition of her fingers would not permit her to do so. She was found dead in bed July 1, 1912. There was some reason to suspect suicide.

This is one of the most interesting cases I have had. The complete paralysis from the moment of the fall and the feeling as if it were then "dead," suggested very strongly the presence of a severe rupture of the brachial plexus. The preservation of sensation throughout the limb and the later complete disappearance of the paralysis, prove that a plexus rupture had not occurred. This patient was shown before the Clinical Congress of Surgeons, at the University Hospital in 1911, and at that time there was no suggestion of a brachial paralysis, only the evidence of a multiple joint condition.

Case V.—Sailor, admitted to service of Dr. H. Siter at University Hospital, March 2, 1911. He had sustained on board ship a fracture of the neck of the left femur and a dislocation of the right shoulder which had been reduced soon after its occurrence. The shoulder became very stiff and painful and the arm very weak and helpless. Dr. Siter asked me to take charge of the affected shoulder and arm. On June 8, 1911, under ether, the arm was forced into nearly full abduction and external rotation and held in this position for three weeks. The cast was then removed and the arm allowed to come down to the side of the body gradually, after which exercises were employed to restore normal motion to the shoulder joint. For a time he seemed to be making satisfactory improvement and was discharged to return to the hospital for the exercises. A short time later he reported that the arm was not improving but losing in power. He was readmitted to the hospital August 3, 1911, when the following notes were taken: There is still considerable atrophy of the whole right upper extremity, the shoulder region and hand being most affected. Can abduct the arm at the shoulder about 30 degrees. Can flex and extend elbow and rotate forearm. Can close fist only to about a quarter of the normal, and must have the wrist in dorsal flexion to do this. There is a considerable depression between the acromion and head of the humerus (see Fig. 3), which can be made to disappear by pressure upward at the elbow. Measurement from the edge of the acromion to the external condyle shows on the left side 12¼ in. and on the right side 13 in. There is much atrophy of the hand and considerable atrophy of the rest of the limb.

Before my manipulations under ether he had the common type of traumatic brachial palsy without flail shoulder. He afterwards developed, evidently as a result of my manipulations, a typical case with flail shoulder. On August 5, 1911, I did the operation described in connection with Case IV. Primary healing. Right-angled splint re-

moved August 20, and arm allowed to work gradually to side in the following few days. Arm supported by adhesive strip under elbow and over acromion, and arm bound to side from August 26, when he was allowed out of bed, until September 1, when he was discharged from the hospital. At that time he showed considerable improvement in power of the limb since the operation and could close the fist of the affected side almost completely. I found it unusually difficult to keep in touch with this case afterwards. He refused to keep up treatment at the orthopædic gymnasium, for the stiffness of the shoulder which always results from the operation. He had a prospective suit for damages against the ship company on his hands and there was some reason to suspect that his arm was recovering too rapidly without special treatment. I was concerned now only about the stiffness of the shoulder and repeatedly urged him to force the shoulder movements before it was too late. His reply was: "The arm is coming around all right, now." After the successful termination of his suit for damages, he left the city for his home in Germany, where he has since remained.

Case VI.—Man, seventy years old, huckster. While helping to "break in" a pair of horses May 14, 1913, he was thrown violently against the pole of a wagon, striking against the left arm. He was admitted to the Philadelphia Hospital, the same day, on the service of Dr. A. C. Wood, with whose permission I operated on and am reporting the case. There was a laceration of the right eyebrow and one on the left side of the nose. On the following day the whole left upper extremity was swollen, the shoulder region excessively, and there was much pain in all the joints. A dislocation of the shoulder was reduced by Dr. Wood. The X-ray showed a fracture of the external condyle and a possible fracture of the head of the radius. Flexion of the elbow was distressing because of the swelling and pain an l the arm was bound to the side with the elbow in extension on an anterior splint. The swelling of the hand which was not included in the bandages continued to be severe. The bandages and splint were not removed until May 23, when the whole limb was observed to be almost completely paralyzed. On June 11 it was noted "that paralysis continues but there is slight movement in his fingers and slight rotation of the forearm. The humeral head drops slightly below its normal level, which is shown by the X-ray, and the shoulder joint is somewhat lax."

Neurological examination by Dr. Charles Potts, June 17: Arm can be abducted by force to angle of about 20 degrees. Forearm can be supinated only to midway between full supination and pronation, from the fully pronated position in which it usually lies. Voluntarily the arm cannot be elevated at all in any direction. Can rotate arm at shoulder slightly. No winging of scapula is present. Unable to flex forearm on arm, and attempt to do so with force, passively, results in flexion scarcely to a right angle. Can extend pronated hand to little above line of forearm. Can extend first phalanges on hand but not second and third. Can flex hand on wrist, but no power of deviation to either radial or ulnar side. Can flex first phalanges but not second and third. Some power of abduction of fingers but not of adduction. End of thumb cannot be approximated to any of fingers.

Unable to flex or extend end of thumb. No biceps jerk. Triceps jerk is slightly present. Wrist jerks are absent. Muscles of forearm and arm are atrophied. Hand is swollen and œdematous. Impossible to see whether intrinsic muscles of hand are atrophied. On little and ring fingers there is loss of pain sense. On dorsum of hand as far as wrist, on line with little and ring fingers, pain sense is diminished. Otherwise pain sense is everywhere intact. Electrical examination by Dr. Potts, June 23, 1913: Infra- and supraspinatus of left side respond slightly to a strong faradic current. Pectoral response O. K. Latissimus dorsi responds faintly. None of other muscles of arm respond at all to faradism. Absence of faradic contractility shows impairment in the nerve supply of these muscles. On the basis of these findings Dr. Potts's diagnosis was, *brachial nerve paralysis.*

The same operation as in Case IV was done on the left shoulder on June 24, 1913, and arm fixed at right angles with body on splint. Patient says two days later, June 26, "the left hand now seems alive," and that before operation it felt "numb and dead." There is already a slight but distinct improvement in the movements of the hand, but it is general and, therefore, not easily described. Swelling of hand distinctly less and impaired sensation over dorsum of hand also lessened. Patient says he has now normal sensations on the left as on the right side. July 14, for past few days had been allowing his arm to fall from the splint and to come to an angle of about forty-five degrees with the body. To-day it is fixed in this position with a suitable splint. Hand and forearm still show some swelling. Moves all fingers actively at the first joints much more freely than before operation, and slightly at the second joints, but not at all at the third.

The stiffness and pain in all the joints of the limb seen in Case IV were characteristic of this case also, and were also much worse in the hands than elsewhere. In Case IV, the paralysis was complete, while in this one it was almost complete. The recovery from the paralysis was likewise very slow in this case, and when this patient died, January 9, 1915, it had completely disappeared, the limb at that time being in practically the same condition as the affected limb in Case IV at the time of her death. In neither of the two cases could death have been due to the operation on the affected limb.

Le Breton[1] calls attention to what appears to be the same condition affecting the hand after Colles's fracture. In his last paper[2] he includes among his case reports a reference to this patient whom he saw when I exhibited him before the members of the American Orthopædic Association, at the University Hospital, June 17, 1914. Two of my later cases were more mildly affected than this one and Case IV, and I have seen it several times in shoulder injuries without flail shoulder joint. Le Breton attributes the condition to a multiple arthritis of the hand in his cases, although he says there was a dense œdema and a low-grade cellulitis. I am confident that in my shoulder cases all the tissues from the shoulder to the ends of the

[1] Amer. Jour. Orthoped. Surg., November, 1911.
[2] Surg., Gynec. and Obst., 1915, xx, 450.

fingers were involved in the pathological process, as shown by a marked tenderness in all parts pressed on. Restricted motion in the joints was the most evident sign of the condition. It slowly becomes less acute and finally the pain and tenderness disappear, but leave a serious restriction of movement in all the joints of the part involved. I have not yet seen perfect movement recovered in any of the joints, although the larger joints have recovered much. But the hands, in both of my cases that died about a year after the accident, were at that time practically useless. I have no idea of the cause of the pathological process at the bottom of this condition, but I suspect that there is from the site of injury to the ends of the fingers a low grade of inflammation with exudate which affects the muscles and other soft tissues, but the synovial cavities most seriously. The numerous joints of the hand and the more extensive synovial lined tendon sheaths may become the seat of infiltration and adhesions which could account for the very troublesome involvement of the hand. Le Breton refers to some formation of adhesions in the tendon sheaths. There is room for question as to whether well developed adhesions between the tendons and their sheaths in the fingers will ever disappear and permit free movement of the tendons in their sheaths again.

Case VII.—Man, physician, referred September 12, 1913, by Dr. T. H. Weisenberg. Strong and healthy except for trouble in right upper extremity. In October, 1905, he was riding on a railway train, being seated near the window and the only passenger in the seat. His train was going westward and was being passed by an east-bound train. Both engines were taking up water at the time from troughs between the tracks underneath. The water thus disturbed was thrown through the window into the patient's face. This startled and confused him and during the excitement he was injured in some manner, becoming unconscious. He did not recover consciousness until 18 hours afterward when he was in the Altoona Hospital. His neck was stiff and he had slight swelling at the base of the skull in the occipital region. His chief trouble was in the right upper extremity. The whole limb was very painful but showed little swelling. Sensation was not tested and he does not know whether it was disturbed or not. The limb was paralyzed but not completely, and as far as he can recall about the same parts of the limb were involved as now. About five or six days after the accident a dislocation of the shoulder was recognized but he does not recall that any attempt was made to reduce it. The arm was bandaged in the Velpeau position for six or seven weeks. He then came to Philadelphia and a surgeon took the arm from this position and said that there was no dislocation. The probability is that the subluxation or relaxed joint was present from the time of the accident. An X-ray showed a cervical rib on this side which was removed.

My findings were as follows: The general picture presented by the brachial paralysis was very similar to that seen in Cases I, II, III, and V, which seem to be far the most common type. His greatest

power was shown in the hand and wrist and these seemed to be about normal, indicating that the muscles which move the hand, most of which come from and make up most of the forearm, were practically normal. Pronation and supination of the forearm could be made but their power was considerably below the normal. The action of the biceps is very weak, but that of the triceps is very good, almost normal. All the muscles in the shoulder region are very much atrophied and the upper end of the humerus is almost subcutaneous. Sensation is good throughout the whole limb, except about the shoulder, where it is much disturbed but not lost. The shoulder joint is flail, the humeral head falling about a half inch below the acromion. The doctor was so anxious to return to his home that he could not give the time for an electrical examination. I did not advise in this case the operation done on the others, because of the eight years which had passed since the causal injury. In the absence of an electrical examination, and in the presence of the profound atrophy and impaired sensation of the shoulder region, I think that the affected muscles must have undergone degeneration beyond ability to recover as in the preceding cases operated on. Probably, only an arthrodesis or the transplantation of a portion of the trapezius into the deltoid could improve conditions in this case.

Although the limb was swung flail at the shoulder and was very much crippled, it was far from being a useless one. The grip of the hand was about as good as on the normal side. In a severe forceps delivery, after placing the right forearm in a suitable position, he found the hand very serviceable. The profound paralysis is distinctly localized to the muscles surrounding the shoulder joint, and grows progressively less the further we go down the limb away from the shoulder, until we find practically if not the normal power at the wrist and hand. I think it doubtful that any injury of the brachial plexus could produce such a severe paralysis and atrophy in the shoulder region without affecting any of the numerous muscles which move the wrist and hand, and which include almost all the whole mass of muscles of the forearm.

Case VIII.—In this case the shoulder condition and brachial paralysis were overshadowed by the fracture of the humerus, pain, general distress and breaking down, which continued until the fatal termination and for which I have no explanation. No opportunity was afforded afterward to observe the effect of the operation on the movement of the shoulder joint and power of the limb, so that the report of the case might be omitted so far as its influence on the subject under discussion is concerned. It suggests why the shoulder joint condition is sometimes overlooked at the time of the accident.

Woman, forty-six years old, looks as if she might be 60 years old. Weight a short time before the accident 140 lbs., now 99 lbs. My first examination December 8, 1913. Referred by Dr. B. A. McDermott. August 30, 1913, tripped and fell to the floor in her home and injured the right arm. Two days later went to a hospital where a double fracture of this arm was diagnosed, and arm bandaged in Velpeau position. After three weeks plaster cast applied with arm in same position. At the end of seven weeks the cast was removed and non-

union discovered. She complained of much pain and this was accounted for by the statement that a nerve had been caught between the fragments. She was then etherized and the arm "broke over again" and a Velpeau bandage applied. For the past two weeks the arm has been at her side in right angle flexion, being supported by a sling from the neck under the forearm from the elbow to the wrist. She still complains of much pain in the arm.

On examination I found an ununited fracture about the middle of the humerus. The head of the humerus was much below its normal level under the acromion and could be pushed upward somewhat by pressure under the elbow, but not to its normal level on account of the pain produced at the fracture and shoulder joint. The joint is not flail as usual in this condition, but the head is more movable than normal from direct pressure on it. There seems to be considerable inflammatory infiltration in and around the joint. Sensation is present throughout the whole limb, but is best in the hand. Can move the hand weakly, pronate and supinate the forearm weakly and has slight power of flexion and extension at the elbow. Has not enough power, however, to lift her hand from her lap. Arm movements cannot be made on account of pain but she seems to have a little power in it. Patient looks weak, pale and distressed. Complains of almost constant pain in the affected arm.

Operation December 18, 1913, at University Hospital. Incision along posterior margin of deltoid which was retracted upward and outward and the arm was rotated backward. Tendon of the infraspinatus divided and dissected backward from the capsule, which was divided parallel with and midway between the glenoid and humeral attachments. Abduction of the arm was difficult because of the axillary inflammation but this forced the humeral head to its normal level under the acromion. The edges of the capsule wound were overlapped by catgut mattress sutures. In passing the needle for one of these sutures, it was observed that the needle passed with some difficulty and was seen emerging from the cartilaginous covered portion of the humeral head. It had passed through the bone for the distance of about an inch and about a half inch below the cartilage. This indicated a profound disturbance of nutrition.

The wound was then extended downward on the outer side of the arm almost to the elbow, passing over the circumflex nerve above and below the musculospiral below. The latter was lifted from its bed and retracted backward as much as possible. The middle of the humeral shaft for about three inches was broken up into small fragments, and the bone appeared to be soft when handled with forceps. Because of the weak condition of the patient, the desire to avoid hemorrhage as much as possible, and the hope that they might aid in making union more rigid, these numerous small fragments were not removed. The rough edges of the two main fragments were sawed off and brought together, the small fragments being pushed aside. A long Lane plate reaching from the surgical neck to the external condyle was applied and fixed by screws. Capsule sutures then tied, infraspinatus sutured,

muscles brought together and skin wound closed without drainage. An attempt was made to dress the arm at right angles with the body, but the screws had a poor hold on the soft bone and it was, therefore, brought to the side and fixed in this position with a light plaster cast, the forearm being placed across the chest and pressure being made under the elbow to keep the humeral head as far up as possible. Primary healing took place except for a very small opening at the lower angle of the wound which drained a serous discharge. An X-ray taken five days after operation showed that the screws had given way and the fragments separated. A week later the screws were removed. During the next four weeks the cast was renewed three times in the effort to relieve her distressing pain but without success. Discharged January 25, 1914.

May 13, 1914. In office to-day. Complains of much pain in right arm and back. Since leaving the hospital has developed a persistent cough, expectorates a purulent sputum and sweats profusely at night. Died July 16, 1914.

CASE IX.—Man, colored, 53 years old, laborer. Admitted to Philadelphia Hospital August 3, 1914. About the latter part of the preceding June, he was compelled to give up his work on account of the pain in the left shoulder and helplessness of the left arm. He does not recall any severe injury to the shoulder or arm, although he thought his trouble began with and was due to a heavy strain of this arm and shoulder from shovelling stones while engaged in "concrete" work. He seems to recall the particular time at which it occurred, and referred to a particular shovelful and the way he threw it over his head. His statements, however, appear to be unreliable. He says that soon after this incident, or about the third of July, he sought relief at a hospital dispensary, where his condition was diagnosed as rheumatism, for which he was given medicine. He continued treatment there for about a month and on finding that he was not getting better and was unable to work, he came to the Philadelphia Hospital. On examination I found slight atrophy of the whole limb, most marked in the arm. The shoulder was tender on pressure and the pain was much aggravated on passive movement which was about fifteen degrees and passive abduction was not much better. The movements of the hand, wrist and elbow are not mechanically restricted, but it is difficult to determine how much power he has. Except for some weakness, the hand and wrist are normal, but the limb as a whole is almost useless. He says that it has improved a good deal since the beginning of the trouble. The head of the humerus has fallen about three-quarters of an inch below the acromion as shown by the X-ray and palpation. Efforts to push the head up to its normal level are only slightly successful and cause much pain. Because of the resemblance of these symptoms to those which preceded operation in Case II, it was suspected that the joint would be found filled by a similar material.

Operation August 13, 1914. Because the patient objected to taking ether, he was given hyoscine gr. 1/50 and morphine gr. 1/2, divided into three doses. An attempt was also made to anæsthetize the brachial

plexus by the Kulenkampf method, and the skin in the line of the incision was injected with the same novocaine solution (2 per cent.). He was then turned on his right side and an incision made in the line of the deltoid fibres from the posterior edge of the acromion about four inches downward, care being observed to avoid the circumflex nerve. After going through the deltoid the infraspinatus was exposed and divided in the line of its fibres, *i.e.*, almost at right angles with those of the deltoid. This exposed the posterior part of the capsule, but only a small part of it with the widest possible separation of the infraspinatus wound. By strong traction on the margins of the wound, however, and rotating the humerus, first in one direction and then the other, the capsule could be freed a considerable distance above and below with the aid of the finger and a blunt pair of scissors closed. There was much less hemorrhage than usual. The joint was opened by the usual capsule incision, parallel with the glenoid and humeral attachments, which was extended upward and downward with the scissors aided by the guidance of the finger where the capsule could not be seen. Particular care is necessary to avoid cutting the circumflex nerve in the lower part of the wound and the long tendon of the biceps above which can be felt free in the upper anterior part of the joint. Before the joint was opened the capsule was observed to be under tension and as soon as the capsule was divided, a considerable quantity of a grumous, jelly-like substance escaped. Much of it had to be removed by the fingers. The small visible portion of the cartilage of the humerus was normal to sight and this as well as all the cartilage of the humerus and glenoid that could be felt had a normal feel, indicating that the jelly-like substance was not the result of an infection. It has always been difficult to introduce the capsule sutures and it was especially so in this case so that they were not used. The arm was abducted to just beyond a right angle, which forced the head up to its normal level by tension on the axillary portion of capsule. No sutures were necessary in the infraspinatus wound. Catgut for the deltoid incision. Silkworm gut for the skin. Small rubber drainage tube to the capsule. Dressing. Right angle splint and light plaster cast fixed arm in this position and nearly full abduction. Drainage tube removed in 48 hours hours, skin sutures in ten days and cast and splint in four weeks. Whole limb completely paralyzed, then, except for slight movements in fingers. September 29, 1914, gradual improvement in movement and power of hand and forearm. Shoulder still stiff and painful.

Persistent efforts were made to induce this patient to use forceful exercises to overcome the stiffness from the original injury and the operation, but he would have none of it. Once he paid a visit to the surgical dispensary of the University Hospital where he could have the services of a masseuse, but he complained of the pain and would go no more. I did not see him again until February 13, 1916, when he appeared to have full power and development of all the muscles of the affected limb, although he could abduct the arm only to the level of the shoulder and had corresponding limitation of external rotation. He was earning his living as a laborer.

CASE X.—Man, printer, 42 years old. Admitted to the Philadelphia Hospital July 17, 1914, on the service of Dr. H. R. Loux, with a fracture of the lower end of the radius, comminuted fracture of the surgical neck and upper third of the humerus and subluxation of the shoulder joint on the left side. About one week before he had fallen down a flight of stairs, injuring his left forearm, arm and shoulder. When union had been obtained in the fractured humerus and radius, Dr. Loux kindly turned the case over to me for treatment of the shoulder condition. The whole limb was then very weak but had most power in the hand and wrist as usual, the power at the shoulder being practically nil. As my service ended October 1 at the Philadelphia Hospital, I had the patient transferred to the University Hospital and operated on the shoulder October 15, 1914. Incision along posterior margin of the deltoid. Fibres of the infraspinatus separated as in last case, exposing the capsule. Edges of the wound retracted as far as possible, and by rotating the humerus as far as possible, first in one direction and then in the other, the capsule was freed from the overlying muscle well upward and downward. Capsule divided as in preceding cases, and, as more room was available than in the last case, three mattress catgut sutures were employed to overlap the capsule margins, while the arm was held in abduction to about a right angle and external rotation. No abnormality was detected in the joint in this case. Very small drainage tube to the infraspinatus. Catgut suture of the skin wound. Dressing. Light plaster cast with arm at right angle abduction and nearly full external rotation. Drainage tube left in five days. Primary healing. Cast removed November 5, 1914, the patient remaining in bed to allow the arm to come to the side gradually, which it did in four days. As usual, the humeral head was now held firmly up under the acromion but the shoulder region was painful and tender because of the tension on the shortened structures. Massage daily. Left the hospital November 13. February 8, 1915, in my office. Abducts arm easily and quickly to angle of 160 degrees and has almost normal external rotation. There still remains slight mechanical restriction of shoulder movement which he promises to work out by more vigorous exercises. The power of the whole limb is practically normal.

CASE XI.—Married woman, Italian, 21 years old, admitted to the Philadelphia Hospital August 21, 1915. About a month before admission, she woke one morning to find that she was not able to lift her left arm from her side. She says that she could move her fingers but they were very weak. She could not move her forearm except by picking it up with the other hand. The day before she had been working hard cleaning her two rooms, and this included the moving of her furniture, the heaviest of which was a brass bed. When she went to bed the night before she had not noticed any trouble with the left arm. On the following morning when the arm was paralyzed, the shoulder and arm were very painful and the muscles very tender. She has not noticed any ecchymosis at any time. About two days after the beginning of the trouble, she went to a doctor who told her the condition was due to a cold. A man, who has been a hospital attendant at the Philadelphia Hospital for, at least, thirteen years, and is unusu-

ally reliable, saw her within a week after the beginning of the trouble and he says that her shoulder and arm at that time were "swollen and red." The redness suggested inflammation to him but evidently was not of the infectious variety. At the time of admission, the power of the hand and forearm was good but below normal. She could abduct the arm from the side only about 20 degrees, while passive abduction was almost but not quite normal and caused considerable pain. She left the hospital September 3, 1915. About a week before Dr. J. W. McConnell made an electrical examination with the following results.

Galvanic current; Right deltoid, with the cathode, shows normal response, good volume, to 35 cells.

On left side, same position, gives no response. Biceps on right side, normal. On left shows good prompt response but not quite as good as on right. Triceps on right normal, on left not obtained. Supraspinatus on right normal. On left normal. Over left deltoid there is no response to anode or cathode, using a current strength which gives a very positive reaction on the right side. Same is true of the triceps on the left side. An area of hypalgesia on the left side, commencing about an inch above the tip of the acromion process, about an inch and a half broad tapering extending down over the shoulder 2½ to 3 inches. Otherwise the sensation of the arm is normal.

The power of the arm at the shoulder showed marked improvement every day until when she was leaving the hospital she could raise it straight up alongside her head. She could raise an ordinary kitchen chair with the right or normal arm, but could not raise it from the floor with the left arm.

Two days after the patient left the hospital, Dr. McConnell made the following examination at his office:

Faradic current: Right side; Deltoid, ant. mot. point, normal response. Post. mot. point, normal response. Pect. maj., mot. point, normal response. Trapez., mot. point, normal response. Infrsp., mot. point, normal response.

Left side: Same current and strength; Deltoid, ant. mot. point, much less than normal response. Post. mot. point, slightly less than normal response. Prot. maj., mot. point, much less than normal response. Trapez., mot. point, normal response. Infrasp., mot. point, much less than normal response. In all these tests the current strength was equivalent to four sections of a Fleming coil, the iron core being entirely covered.

Galvanic current: Dry cell battery, forty-five cells.

Right side: Normal response at all motor points previously examined by faradic current.

Left side: Deltoid, post. mot. point, normal response, *i.e.,* identical with response obtained on right side. Ant. mot. point, with cathode as active pole, application is not followed by immediate response. Quite some time is required to overcome the resistance. The response at first small, increases in volume until a very violent muscular action is obtained. This action, however, is not limited to the muscle under examination, but is diffused to other muscles constituting the shoulder

group; with the anode, some time is required to overcome resistance and the response is fairly large, but is confined to the portion of muscle under the electrode and there is not the same sharp contraction which is obtained on the normal side. The same is true as to the other points examined which were found by the faradic current to differ from the normal side. Dr. McConnell's conclusions: This patient has had a neuritis from which she is recovering. The peculiar response which is obtained is due to the subsidence of the neuritis and the restoration of electrical conductivity. That this has not been fully restored is evidenced by the qualitative change to galvanism, serial and modal.

Patient examined at Philadelphia Hospital March 4, 1916. Left arm has recovered much of its normal power, so that it can be used very well in doing her housework. There is, however, a small distinct difference in power of the two limbs. This difference is more distinctly manifested by the rapidity with which the left arm tires and that shoulder begins to ache, when the arm is used. The patient finds herself unconsciously using the right arm to save exhaustion and pain. When lifting a weight with the left hand she is conscious of a peculiar giving way or dropping of something in the shoulder of that side.

Patient seen again at Philadelphia Hospital May 5, 1917. The mild relaxation of the left shoulder joint still persists (see Fig. 4) although the power of the shoulder muscles has improved slightly but distinctly since the last examination. The patient uses this arm in all her work without special difficulty, except that it tires easily, is weaker than the right and after being used for a time begins to ache. An effort was made to determine the difference in strength of the two arms. The testing could not be applied directly to the shoulder muscles, but special apparatus in the gymnasium of the University of Pennsylvania was employed. The following results were obtained: Grip of both hands was the same. Pulling by grip of hand with arm held forward level with shoulder and counter-support against front of chest (flexors): Right side 45 kilograms and left 30 kilograms. Arms at same level and back supported, pushing object away by hands (extensors): Right 52 kilograms and left 50 kilograms. Lifting by hands in standing position: Right 145 kilograms, and left 125 kilograms. When hanging by the right hand she readily suspended her whole weight, but when using the left hand could not take her feet from the floor because of weakness in that arm and some pain at the shoulder. A number of dumb-bells were tied together by a piece of rope, a loop at the other end for the hand and long enough to reach above the level of her shoulder. The whole weight was 36 pounds. On the first trial she lifted this weight from the floor with the right hand and held it for 12 seconds, and with the left hand for six seconds. After several other trials without timing, a second test showed that she held up this weight with the right hand 24 seconds, and with the left one second. In other words she barely lifted the weight from the floor for a moment with the left hand. She said the left shoulder felt exhausted and was aching and had the sensation of giving way when she tried to lift.

It will be recalled that the history does not show a traumatic origin in this case. I have assumed that it was traumatic as I believe the origin was traumatic in case IX, and as it evidently was, although very slight, in case II. One would hardly expect as severe a condition from the degree of trauma in cases I and III, yet there can be no doubt of a traumatic origin in these two. A mild original injury agrees with the mildly flail joint, slight dropping of the humeral head shown by the X-ray, and mild permanent impairment of function of the shoulder muscles, in this case. The skiagraphs in Fig. 4 indicate that the mildly flail shoulder joint is probably permanent and that the patient will never recover perfect function in it.

CASE XII.—Colored man, 58 years old, laborer. Admitted from the neurological dispensary to the surgical service of Dr. C. H. Frazier in the University Hospital January 17, 1916. The following history was taken by the interne, Dr. W. Frank. Five weeks before, he was thrown from a wagon striking on his left arm, shoulder and head. He was unconscious for five or ten minutes. Since that time he has not been able to raise the left arm from his side nor flex his elbow. Otherwise he was perfectly well. He can move the arm only by swinging it from the shoulder. The acromion on this, the left side, is more prominent than on the right. Extension at the elbow is about normal in extent and power. The power of abduction is nil, but adduction is fairly good, almost as good as on the right side. Internal rotation is normal, but external rotation is slight. There is marked atrophy of the deltoid, supra- and infraspinatus and trapezius of that side. There is no weakness in the elevation of the left shoulder girdle. Lelt deltoid jerk is present but diminished as compared with the right. Left biceps jerk is present but very weak. Left triceps jerk is normal. No weakness of muscles of left forearm. Sensation is normal over the left shoulder region, chest, back and left arm. January 20th, the muscles and nerve reactions were tested to-day. No reactions of degeneration were found.

The following examinations were made in the neurological dispensary, January 3, 1916: "Complete paralysis of left deltoid, triceps, brachialis anticus, supraspinatus, infraspinatus. No disturbance of sensation. Triceps and muscles of forearm and hand good. No faradic response over following muscles in left arm: Biceps, deltoid, triceps (?), supinator longus. Slow response over extensors. Slower response of flexors of fingers on left as compared to the right." Second Examination, January 5, 1916: "No faradic response over supraspinatus and infraspinatus, biceps and deltoid. Good response over triceps, flexors and extensors, though slower than on right side." Third examination, January 20, 1916: Faradic response in deltoid and in biceps on left side obtained with current stronger than is used on right side, but the response is very prompt. Other muscles of arm and forearm respond in normal manner.

Operation January 25. Incision along posterior margin of deltoid. Infraspinatus muscles lifted from capsule which was further exposed upward and downward under the teres minor. Usual incision in capsule. Finger in joint failed to locate the long tendon of the biceps which is usually found easily. Second incision along anterior margin of pectoralis major and capsule opened over the bicipital groove. The long tendon of the biceps which normally occupies this groove, could not be found as it had torn from its attachment to the upper glenoid margin and had retracted downward from view. The greater tuberosity was unduly prominent and the bicipital groove obscured from a previous fracture. No sutures in capsule wound. Continuous No. 1 iodine catgut suture for anterior and posterior skin wounds. Small rubber drainage tube in lower angle of posterior wound for uncontrollable oozing. Dressing and bandage. Arm fixed by light plaster cast at an angle of about 130 degrees and nearly full external rotation (see Fig. 7). January 27, hole cut in cast and drainage tube removed. February 6, primary healing and patient sent home with arm in cast. Returned to hospital February 20 and on following day cast removed. Patient remained in bed for next four days to allow arm to work down to side slowly. There was then moderate swelling from the shoulder to the fingers. The whole limb was much weaker than before the operation. The triceps which was normal before operation now shows little or no power.

The return of power was unusually slow in this case. I did not see him again until April 18, 1916, when he could use the hand very well but in the standing position could not flex the elbow in the slightest degree. He could abduct the arm from the side about 20 degrees. In the recumbent position he could abduct it about 60 degrees and lift the whole limb forward from the shoulder. With the arm elevated a little he could flex the elbow weakly and carry the hand to his mouth. There was still a marked limitation of movement at the shoulder. It is evident that he has failed, almost entirely, to force the movements of the shoulder because of the pain involved. June 8, 1916, there was a marked improvement in the power of all the muscles but in the upright position he still was unable to make any flexion at the elbow. In the recumbent position he could carry his hand to his mouth rapidly. August 6, 1916, there was a decided improvement in power throughout the whole limb, but there is little or no improvement in motion at the shoulder and a decided crepitation is developed on passive movements of it. In the standing position he can flex the elbow and carry his hand to his mouth and top of his head easily. He can support his whole weight by the grasp of the hand of the affected arm. Examination October 16, 1916, by Dr. W. B. Cadwaladar, in the neurological dispensary of the University Hospital: "To-day all the muscles of the left shoulder girdle contract well and with considerable power but not quite so strongly as the corresponding muscles of the right side. It seems as if the only disability was entirely due to arthritis or adhesions about the shoulder joint. There are no changes of sensation for light touch, pain or temperature, *i.e.* sensation is normal. All movements, flexion, rotation, supination, abduction and adduction, can be well performed, except for limitation in the joint. There is positively good contraction of the left deltoid, biceps, brachialis anticus, supraspinatus, triceps and infraspinatus. There is possibly less power in

the infraspinatus proportionately than in the other muscles." While the return of power has been slow in this case, it has never ceased to progress and is as rapid now as at any time.

April 29, 1917, the patient reports that he has been at work as a laborer for a few months, working every day and doing a full day's work, earning fifteen dollars a week, an unusual amount for him. He seems to have full power in most of his muscles, but still can not elevate the arm above his head because of the limitation of movement in the shoulder. He was readmitted to the University Hospital February 26, 1917, for the removal of a keloid growth on the back of the right shoulder, and while under ether the left shoulder was manipulated as strongly as was felt to be safe in an effort to restore some of the restricted movement. This did not seem to be successful, but an opportunity was afforded while he was in the hospital to drill into him the kind of exercises that were necessary to restore motion. He is now able, after going through some preliminary exercises, to hold the arm up in the air for a short time by bending his shoulders backward (see Fig. 9). For six months after operation he probably made little or no effort to exercise the shoulder and until his last visit to the hospital showed marked indifference.

Case XIII.—Man, 52 years old, referred by Dr. J. Binder. About a week before Easter of 1916, while fixing an awning, he fell from a ladder from the level of the second story, injuring his left shoulder. It appears that there was a dislocation at the time which was reduced at a hospital on the following day. The arm was dressed in the Velpeau position and the patient discharged the same day to return to the dispensary daily. The bandages were removed in three weeks and massage and passive movements given for six weeks more. Immediately after the accident the whole limb became helpless and was very painful.

Examination June 20, 1916, about twelve weeks after the accident. Sensation is good throughout the whole limb. He can abduct the elbow from the side about four or five inches, and elevate it forward to about 45 degrees. Posterior elevation is nil. With his arm at his side he can flex the forearm to about an angle of about 45 degrees and can just touch the thumb to the mouth by bringing the mouth toward it as far as possible. In the recumbent position with his arm at his side and the hand touching the floor, he can flex the forearm at the elbow only very slightly, *i.e.*, he can lift the hand only about 3 inches from the floor. In this position he has practically no abduction. Rotation of the forearm is only slightly limited in range but is very weak. There is a considerable œdematous swelling of the hand and fingers which extends about halfway up to the forearm. He has passive abduction at the shoulder to about 45 degrees. There is a distinct dropping of the humeral head below the acromial process but by pressure under the elbow it can be forced up to its normal level only to drop again as soon as the pressure is removed.

The following neurological examination was made by Mr. Arnett, a fourth year medical student in the Neurological Dispensary of the University Hospital: Although left-handed the patient's left arm is smaller than the right (measured at biceps, L. 26 cm., R. 27.5 cm.). Left forearm 25 cm., right, 25.5 cm. There appears to be some dropping of the shoulder and the head of the humerus appears to be lower than the right. All movements can be performed with the left hand and forearm but they are very limited. The fingers can be moved only 30 degrees, the wrist 35 degrees, the forearm about 50 degrees. Heat, cold, touch and pain are normally perceived in the left hand, forearm and arm. The left hand, œdematous and shiny, measures 21 cm. across the knuckles, while the right measures 19.5 cm. The following electrical examination was made by Dr. J. W. McConnell: Right upper extremity shows no abnormality to either current, faradic or galvanic. In the left upper extremity there is no response to faradism in the deltoid muscle. All other muscles respond, but a slightly greater current strength is needed than is used on the right side. To galvanism all muscles respond normally save the deltoid which shows both serial and modal changes.

Operation was performed June 28, 1916, at the University Hospital. Same incision through deltoid and infraspinatus as in case IX, and same incision in capsule. With arm in full abduction and external rotation, the finger could be passed to the anterior part of the joint where the torn edge of the capsule could be felt and in it a fragment of bone torn from the anterior glenoid margin. This is the common ligamentous lesion of a dislocation. No sutures were introduced into the capsule. The deltoid incision was closed with No. 1 plain catgut. Same for skin. No drainage except between sutures. Plaster cast with arm in full abduction and external rotation. Primary healing. Cast removed in two weeks on account of distress it caused. Arm brought to right angle and fixed there by splint, which was removed a week later and the arm brought to the side. There was already a considerable improvement in the movement of the elbow and hand but the swelling which had largely disappeared with the arm elevated reappeared after it had been let down. On December 9, 1916, he could elevate the arm almost to the horizontal. The elbow movements were normal and the hand movements much stronger although still considerably limited in their movements. There is now very little swelling in the hands and fingers and above the wrist. Because of the pain at the shoulder the forearm sling was used until three weeks ago. April 25, 1917, all movements of the limb have improved very much. Can almost close fist as on normal side and uses the hand and arm in his work very well. There is a still slight swelling of hand and weakness of whole limb. Can elevate arm forward to about 110 degrees actively, and after lifting it up straight above his head with the other hand can hold it there by tilting his shoulders backward slightly. This is a recent accomplishment, but is an evidence of what has proven true of all the cases, *i.e.*, after the joint has been restored to its normal relations and firmness the improvement never seems to stop until the normal is reached or closely approached. Restriction of movement is the only obstacle to a return of normal function.

Case XIV.—Man, 65 years old. Particularly dull and slow mentally and physically. Admitted to the Philadelphia General Hospital,

November 29, 1916, to the service of Dr. H. R. Loux, who kindly turned the case over to my service. Ten days before admission he fell on a slippery pavement and sustained an injury to the left shoulder, was taken to a station house and did not believe until the following day that his left arm was hanging helpless at his side. He says that he went to a hospital the same day and had a dislocation of this shoulder reduced. On admission his hand was practically useless: he could not abduct the arm from the side and had only very slight power of flexion at the elbow. He had a little movement in the fingers. Passive movement at all the joints is painful and probably accounts for some of the failure to move the different parts of the limb. This applies particularly to the wrist drop which is present, as passive extension beyond the straight position in this joint is very slight because of the stiffness and pain. There is a distinct hollow to palpation under the acromion and consequent flail joint. This could not be shown by the X-ray because on repeated trials he would, when the machine was started, obliterate the interval between the acromion and upper end of the humerus by unconsciously contracting his shoulder muscles. There are areas of disturbed sensation especially in the hand. There is a tinge of cyanosis and slight swelling in the hand and the fingers can not be fully flexed, while efforts to force them cause pain.

Electrical examination by Dr. S. Leopold at the University Hospital:

No response to the galvanic current in the biceps or other muscles of the left arm, but with strong faradic current reactions were elicited in the biceps, long head of triceps and in the deltoid. These reactions were weak in all three muscles. In the other muscles about the shoulder (supraspinatus, infraspinatus, pectoralis major) no response was obtained. Considerable pain was complained of when the current was applied to the left shoulder region, while with the same current on the normal side there was no pain, showing, therefore, a very hyperæsthetic area about the injured shoulder. No reactions were elicited in the extensors of the forearm.

This case seemed to offer the opportunity of trying out an idea which had suggested itself some time ago. If, as I believe, these flail shoulder cases are ordinary anterior dislocations in which the hyperabduction has been extreme enough to tear the capsule from the humeral attachment all around, with consequent dropping of the humerus until other surrounding structures take up the support, it would hardly be good surgery to fix the arm in abduction at the time of the accident. This would force the humeral head into the dislocated position and keep it there. But three weeks had elapsed in this case, so that sufficient healing had occurred in the axilla to prevent dislocation when the arm was forced into full abduction. Enough tearing of the cicatricial axillary tissue would probably occur to cause considerable joint inflammation and shortening of the upper part of the capsule if it were kept relaxed by abduction and external rotation long enough. On December 12, 1916, under ether, the arm was forced into full abduction and external rotation with evident tearing of tissues in the axilla, and kept in this position by a plaster cast. This was removed January 30, 1917, six weeks later and patient kept in bed about a week later while the arm was gradually coming down to the side of the body. He was let out of bed a few days later with the forearm in a sling which was soon discarded. He was encouraged to force the arm back into the fully abducted and externally rotated position as often as possible. He did this fairly well and had almost all of these movements passively when he was sent to the City Home for the Indigent, February 15, 1917, but he had gained only slightly in power. He was readmitted to the hospital with croupous pneumonia March 15, 1917, and died of this condition five days later. The shoulder joint was still firm and not in the least flail when he was discharged from the hospital and probably did not become relaxed later.

Conclusion.—The effort here has been to show not how the flail shoulder produces the permanent paralysis so much as to show that it does. The only worth-while proof offered is that early removal of the flail joint and restoration of normal motion in it, results in the disappearance of the paralysis. It hardly seems necessary to argue that if the paralysis and flail shoulder had been caused by a rupture of the brachial plexus, recovery would not have followed, uniformly, treatment restricted to the shoulder joint. According to my experience, in most cases of traumatic brachial paralysis the shoulder joint is not in the least flail, but on the contrary exhibits limited movement and pain when movement is made. Is it not fair to ask those who account for these cases by an injury of the brachial plexus, to explain why the flail shoulder is found in only a few? The following observation made during the past six years seems worthy of some attention. I have read almost every paper on obstetrical paralysis published within recent years and many old ones, and have constantly been on the lookout for the report of an obstetrical palsy with flail shoulder but as yet without success. I found twice a vague reference to the condition but without any reference to a case. In view of the large number of cases of obstetrical palsy reported, hundreds of them in recent years, I am inclined to doubt its occurrence. If it does not occur it then becomes necessary for those who account for the obstetrical paralyses by an injury of the brachial plexus to explain the absence of flail shoulder in this class of cases.

Dr. Nathaniel Ginsburg said that he had observed and treated three cases of traumatic brachial paralysis in adults. The first patient (Figs. 1 and 2) was seen in July, 1912, and then presented a total paralysis of the shoulder girdle and arm, except for part of the supraspinatus and trapezius muscles. The intercostal humeral nerve was intact. There were marked trophic changes in the extremity, and he suffered from intense shooting pains in the forearm, hand, and fingers. On January 13, 1912, the injured extremity was caught in a heavy leather machinery belt. He remembered nothing of the injury until he awakened in the hospital, and was then told that his collar bone had been broken. The extremity was bandaged to his side for three weeks, at the end of which time it was discovered that a severe nerve injury

had taken place. A careful dissection of his brachial plexus was made in the Polyclinic Hospital, and the cords were found totally disorganized and beyond operative repair.

The second case (Figs. 3 and 4) was observed in the Jewish Hospital in August, 1916. The patient was a fireman, twenty-three years of age, whose left shoulder and lower cervical region were struck by a locomotive running in the opposite direction while he was leaning out of the cab in which he was riding. He suffered a traumatic avulsion of the cervical and brachial nerve trunks, resulting in total paralysis of the left upper extremity, with some sensation persisting corresponding to the distribution of the intercostal humeral nerve. He also sustained a fracture of both bones of the forearm of this extremity near the wrist joint and a fracture of the neck of the scapula. The inequality of his pupils at the time of his admission and also at the present time is marked. Operation, seven weeks after the injury, exposing the left cervical and brachial plexus with division of the outer third of the clavicle revealed the presence of intraspinal avulsion of some of the cervical nerve trunks entering into the formation of the brachial plexus, with complete division of some of the lower trunks. The dissociation of the cords entering into the formation of the brachial plexus was so marked and the perineuritic changes so extensive that it was not possible to satisfactorily make new nerve anastomosis, although a few of the trunks which seemed intact were brought together and sutured. The operation has apparently failed to restore any function in this extremity, for he seems to be hopelessly injured.

In both these cases the primary injury was apparently extreme traction exerted upon the cervical cords, plus direct trauma compressing the brachial plexus between the clavicle and the first rib.

The third patient (Figs. 5 and 6) was seen through the courtesy of Dr. Zion, of Wilmington. The man was injured in a street car altercation, being struck in the right supraclavicular region, and sustaining a partial fracture of the head of the humerus. A careful examination showed a paralysis typical of a traumatic brachial palsy, with some preservation of function corresponding to the motor and sensory distribution of the median nerve. The atrophy and the trophic changes, as shown in the photographs, are characteristic of paralysis of the type under discussion. He did not believe that there was division of all the nerve fibres in this case, but thought a considerable amount of his injury was the result of the trauma sustained by the controller which struck him in the supraclavicular region. With the application of massage and electricity, he has made considerable improvement, although the last examination a short time ago still shows extensive involvement of his musculospiral nerve.

He had been much interested in the surgical treatment of those cases where total division or extensive injury of the whole brachial plexus has taken place. On the cadaver he had found that it is anatomically impossible to successfully transplant cords from the opposite side, because the trunks are too short if carried across the pretracheal region, and also because the

FIG. 1. FIG. 2.

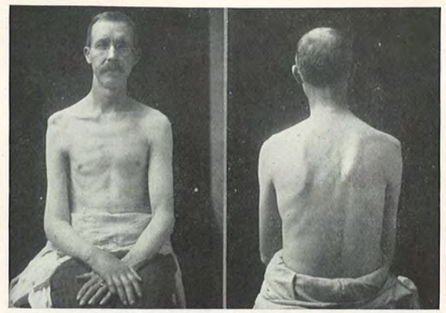


FIG. 1 and 2.—W. F. B., aged forty-four years. Traumatic rupture of brachial plexus. Injury January 13, 1912. Extremity caught in heavy leather belt of machinery. Remembered nothing until he awoke in the hospital, when he was told that his collar bone was broken; the arm being bandaged to the side for three weeks. July 27, 1912: Total paralysis of the shoulder girdle and arm, except for part of the supraspinatus and trapezius; intercostohumeral nerve intact; trophic changes in the extremity and intense shooting pain in the hand and fingers. Operation, July, 1912; disclosed rupture of the brachial plexus trunks.

FIG. 3. FIG. 4.

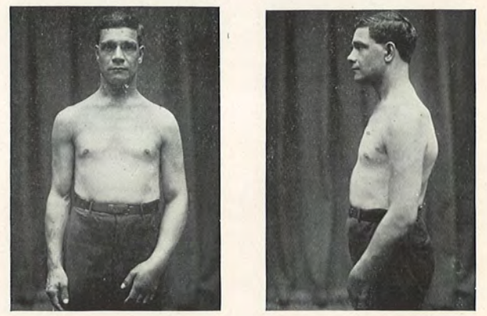


FIG. 3.—C. S., aged thirty-three years; fireman. Traumatic avulsion of the brachial plexus. Total paralysis of the left upper extremity with some sensation corresponding to the distribution of the intercostohumeral nerve. Operation: Partial anastomosis of intact cords. No result attained.

FIG. 4.—Same patient as Fig. 2. Lateral view, showing left upper extremity, following an injury to the cervical and brachial nerve trunks. Fractures of both bones of the forearm near the wrist and fracture of the neck of the scapula, complicating the injury to the nerve trunks.

FIG. 5.

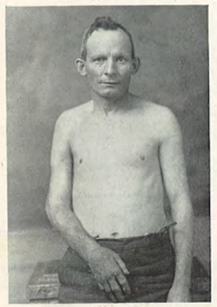


FIG. 6.

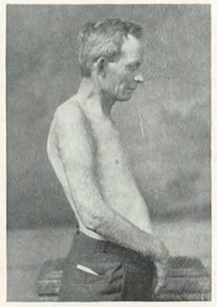


FIG. 5.—C. A. C. Traumatic brachial palsy of the right upper extremity, as result of being struck by a controller in the supraclavicular region, with coincident partial fracture of the head of the humerus. Note the atrophy of the shoulder and right pectoral region, with swelling of the extremity.

FIG. 6.—Same patient as Fig. 4. Lateral view. Note the suprascapular and deltoid and right pectoral atrophy. Some use of the muscles corresponding to the distribution of the median nerve is present. Marked involvement of the ulnar and musculospiral nerves. Decided improvement under massage and electricity.

shortest route across the neck, which is prevertebral, would necessitate an extensive dissection and expose the patient to grave injury. Again, where there is extensive or complete involvement of the whole plexus on one side, it would not seem wise to jeopardize the integrity of the sound side by longitudinal splitting of the nerve trunks.

It had occurred to him that if the upper intercostal nerves could be transplanted across the axilla into the trunks of the injured nerves, this operation would be indicated, since the intercostal nerves carry both motor and sensory fibres. Cadaver attempts to perform this operation have shown that the chief difficulties are first the danger of opening the thoracic cavity, since longitudinal resection of a number of ribs must be practised, and secondarily the intercostals are of surprisingly small size, even as far posteriorly as it is possible to reach them by the transaxillary route. One of these patients was exceedingly anxious to have this operation attempted, but he could not bring himself to believe that it would be justifiable to expose him to the risks of such an extensive procedure. All of these patients have bitterly complained of the intense neuritic pain in their hands and fingers from which they constantly suffer, and two have requested amputation of the injured extremity.

Dr. Ginsburg thought that Dr. Thomas had a little different conception of traumatic brachial paralysis from that which is generally held. The cases of traumatic brachial paralysis which appear in the literature largely consist of reports of serious injury to many or all of the cervical or brachial nerve trunks entering into the formation of this plexus. The term is generally employed to express a break in the continuity of the nerve trunks, either partial or total, the severance occurring intra- or extraspinally.

The cases reported by Bristow, Murphy, Frazier, and Skillern, as well as the three patients whose cases he had briefly presented, were instances of injury to the brachial cords, sustained as the result of trauma and confirmed by operative findings. The injury disclosed in this class of cases at the operating table has been one definite and severe injury to the nerve trunks, with coincident perineuritic changes. The class of cases reported by Dr. Thomas would suggest rather a primary shoulder injury without the brachial plexus participating to any great extent; or it may be that in a number of his cases the deltoid muscle has been partially or completely paralyzed by injury of the circumflex nerve, owing to its close proximity to the neck of the humerus. Certainly, relaxation of the capsule of the shoulder joint cannot occur in the absence of partial or complete paralysis of the deltoid muscle, and this at once implies injury to a nerve structure. The absence of operative investigation of the brachial plexus in most of his cases does not sustain the belief that they belong to the type generally termed traumatic brachial paralysis.

DR. PENN G. SKILLERN, JR., remarked that Dr. Ginsburg, in his discussion of Dr. Thomas's paper, said that for the relief of cases of traumatic brachial paralysis where the spinal rootlets themselves were torn asunder,

such as reported by Dr. Frazier and himself in 1911, he had conceived the idea of dividing the intercostal nerves and anastomosing their proximal ends with the distal portion of the brachial plexus. Such an anastomosis, even granting that it is practicable, would be but a drop in the bucket and quite like sending a liliputian on a giant's job, as far as concerns making up the loss of the great number of motor fibres possessed by the brachial plexus, especially when one considers that the upper six intercostal nerves carry only enough motor fibres for the supply of the small intercostal muscles alone; how far would these few motor fibres go when it comes to innervating the great muscular masses which move the upper limb?

Dr. T. T. Thomas quite agreed with Dr. Ginsburg that there are two kinds of traumatic brachial paralyses. What he was trying to show is that there are a great many in which there is probably no injury to the brachial plexus. No one who heard or read Dr. Frazier's paper of 1910 or 1911 on this subject, with its detailed report of a case in which the spinal canal was opened and an intraspinal rupture found, could fail to believe that real ruptures take place. On looking up the paper of Madame Klumpke on traumatic brachial paralysis of the lower arm type, he was struck by the number of cases that she collected which, with the one she reported, were almost exact counterparts of the one reported by Dr. Frazier. This type shows absolute loss of sensation and motion and never recovers. The cases he had been reporting have recovered fully from the paralysis and never had serious impairment of sensation. Moreover, they all had associated injury of the shoulder joint.

PARALYSIS OF BOTH TRAPEZII MUSCLES AFTER ABLATION OF CERVICAL LYMPH-NODES, WITH PROPOSAL OF A NERVE-ANASTOMOSIS OPERATION FOR CURE

Dr. Penn G. Skillern, Jr., presented a man, aged eighteen years, referred by Dr. Thomas Tigam, who was admitted to the Polyclinic Hospital (No. 31152) on April 24, 1917, for removal of recurrent tuberculous cervical lymph-nodes. He was discharged, cured, on May 3, 1917.

He had been operated upon one year before elsewhere, for on each side there was an operative scar four inches long along the posterior border of the sternomastoid muscle—diseased nodes evidently having been removed from the occipital triangle, and the trapezius branch of each spinal accessory nerve had been resected, for both trapezii were paralyzed and atrophied, bringing to the surface the deep anatomy of the shoulder girdle and base of the neck (Fig. 7). The patient stated that he noticed his shoulders drooping forward when he got up from bed after the operation.

The photograph shows beautifully the extent to which both shoulders droop forward. Both clavicles are prominent, and the supraclavicular fossæ are so deep that apical tuberculosis is suggested (Fig. 8). The upper border of the scapula with its notch can be plainly felt just beneath the skin: the vertebral border can likewise be felt. The spine of the scapula and

supraclavicular fossa are easily palpable. In other words, conditions are such as would be expected from a knowledge of the origin and insertion of the trapezius muscle, given the presence of atrophy of this muscle. The head, too, is inclined forward. The fresh operation incision was made by the author to remove recurrent tuberculosis of the lymph-nodes: when the upper limb of this incision was made the scar from the previous operation was excised, so that the situation of the latter is indicated. It was necessary to divide the sternomastoid to reach enlarged nodes beneath its upper third; during this manœuvre the sternal branch of the spinal accessory nerve was seen sinking into the sternomastoid muscle and was lifted up with the muscle without injury. The region of the old scar on the left side of the neck was not reoperated upon. The levator scapulæ muscles stand out prominently and subcutaneously on both sides. Loss of function of these muscles is well compensated.

A similar case was presented by Vosburgh before the New York Surgical Society on April 22, 1914 (Annals of Surgery, 1914, lx, 762). In the discussion which followed, Mathews said he had seen the spinal accessory nerve accidentally divided and the injury not followed by shoulder drop, and also when its division was necessary, neurorrhaphy could be performed with very good expectation of reunion. Dowd, referring to the relative importance of the spinal accessory nerve and the branches of the cervical plexus in the innervation of the trapezius muscle, stated that in a much used method of removing tuberculous lymphnodes the branches of the cervical plexus (III and IV) are sacrificed and the spinal accessory alone is preserved; and that while in many instances this is sufficient to provide good innervation to the trapezius, in other instances it might not be sufficient. Eliot found in a number of instances the development of these nerves differed very materially. In some cases the terminal branch of the spinal accessory passing to the trapezius was exceptionally well developed; in others it was not developed so well, while in rare instances it was entirely absent. Eliot also found that with a weak spinal accessory supply, the branches of the cervical plexus supplying the trapezius were exceptionally well developed, and *vice versa;* this might be accounted for by variations in the anastomosis between the spinal accessory nerve and the cervical plexus. In those cases where the spinal accessory supply of the trapezius was well developed, the degree of anastomosis between the cervical plexus and the spinal accessory was not well marked.

Reporting two cases of operative paralysis of the spinal accessory nerve, Bailey (Annals of Surgery, 1901, xxxiii, 558) states that serious disturbances of motion in both sternomastoid and trapezius immediately following operation, which obtained in his patients, contradicts the more common experience, for in most cases the paralysis which results from section of the nerve is not particularly disabling. Large pieces of the nerve are resected for spasmodic wry-neck without fear of serious loss of motor power; and in only a few of the reports of accidental section is any mention made of

paralytic results of consequence. This is explained by the additional supply to the trapezius from the cervical plexus. When the sternomastoid is totally paralyzed, freedom of movement of the head and neck is impaired, but it is not abolished; even when both muscles are entirely put out of service, the erect position of the head is not seriously interfered with. With the rare exception of penetrating wounds at the base of the skull, extracranial lesions of the spinal accessory are always confined to the external branch, and are nearly always traumatic. Neuritis of this nerve is rare.

Paralysis of the trapezius is indicated by great disability in raising the shoulder and in adducting the shoulder-blade. The arm cannot be elevated much above an angle of ninety degrees; the sufferer is practically deprived of the use of his arm for all heavy work. Complete trapezius paralysis is a serious calamity to any one, but especially to a laboring man. Forming, as it does, the most important support of the shoulder, the loss of the trapezius practically does away with the power of lifting weights which are at all heavy. The deltoid, in losing its support, loses much of its usefulness, and lifting must be done by the flexion of the forearm and by a bending of the whole body.

The assumption that occasionally there is a variation from the customary route by which the motor impulses pass from the spinal cord to the trapezius receives some support from the fact that the trapezius is not, in its anatomic relations, a fixed muscle. In man it may be congenitally absent in whole or in part; in the lower apes it is supplemented by another similar muscle called the spinocervicalis. Bailey takes this variation in the case of the trapezius to be as follows (Fig. 9):

The spinal centre situated between the first and fifth cervical segments of the cord is fixed and constant. As a general rule, the cells of this centre send their axons to the trapezius through both the spinal accessory and the cervical nerves. But sometimes there is a variation from this arrangement in that all the axons pass to the muscle in the spinal accessory, leaving the cervical nerves without function, as far as the trapezius is concerned. Under these circumstances, the motor impulses reach the trapezius exclusively through the spinal accessory, and section of it consequently means total palsy.

What can be done for operative paralysis of the spinal accessory nerve? We have seen that, according to Mathews, the spinal accessory nerve can be accidentally divided and the injury not followed by shoulder drop. At times the nerve is intentionally severed at operation for the purpose of thorough extirpation of diseased lymph-nodes; here immediate suture of the severed ends is, of course, indicated. In Bailey's second case neurorrhaphy was performed about six weeks after the original operation. The cut ends of the nerve were found to be considerably separated—an inch or more. Within a few weeks from the suturing, the electric reaction improved.

What is to be the treatment when the trapezius branch of the spinal accessory nerve has been extensively resected, and the distal portion of the

FIG. 7.—Oblique view of post-operative trapezius paralysis, showing forward droop of shoulders and of head. Note relative prominence of bones of shoulder girdle. Fresh scars due to reoperations for diseased nodes.

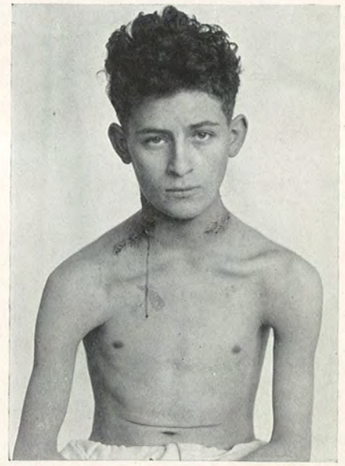


FIG. 8.—Anterior view of post-operative trapezius paralysis. Note depth of supraclavicular fossæ, simulating the depression produced by apical tuberculosis.

nerve, beneath the trapezius, can alone be found? The gap is too great for tubulization to be practicable, and nerve transplantation would be of doubtful utility. For such a case the author suggests the following nerve-anastomosis

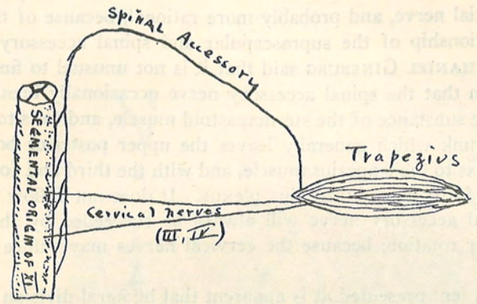


FIG. 9.—Scheme showing kindred segmental origin from cord of nerves supplying trapezius. The suprascapular nerve arises chiefly from the fifth cervical segment.

operation. He would have attempted it in the present case, but for the presence of pus in the operative field.

The suprascapular nerve, which supplies the supra- and infraspinatus muscles, is in close relationship with the trapezius branch of the spinal acces-

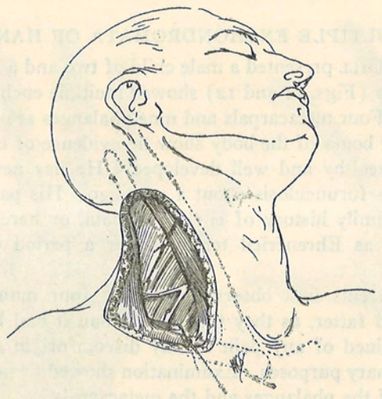


FIG. 10.—Sketch showing author's proposed nerve anastomosis operation when there is a wide gap between ends of resected spinal accessory nerve. The suprascapular nerve is seen split above the retracted omohyoid muscle and the split end has been anastomosed to the distal end of the spinal accessory close to the border of the trapezius. The missing portion of the spinal accessory nerve is indicated by shading. The proximal portion of the latter appears from beneath the sternomastoid.

sory nerve as it enters the trapezius muscle. The suprascapular nerve is derived from the fifth and sixth cervical segments; the spinal portion of the spinal accessory is derived in part from the fifth cervical segment. It is proposed, then, to isolate the trapezius branch of the spinal accessory and

the suprascapular nerve; to split the suprascapular nerve, and to anastomose the proximal stump of the split portion of the suprascapular nerve to the distal trapezius stump of the spinal accessory. This proposed nerve-anastomosis is at least as rational as the anastomosis of the spinal accessory with the facial nerve, and probably more rational, because of the close segmental relationship of the suprascapular and spinal accessory nerves.

Dr. Nathaniel Ginsburg said that it is not unusual to find in the dissecting room that the spinal accessory nerve occasionally breaks up into a plexus in the substance of the sternomastoid muscle, and fails to reform into the nerve trunk which generally leaves the upper posterior border of this muscle to pass to the trapezius muscle, and with the third and fourth cervical branches to form the subtrapezius plexus. It does not follow that division of the spinal accessory nerve will always be succeeded by shoulder drop, with anterior rotation, because the cervical nerves may suffice to innervate the muscle.

In the patient presented, it is apparent that bilateral division of the nerve supply of both trapezii muscles has taken place, and that the injury is not confined to the spinal accessory nerves alone. It is not unlikely that the nerve supply of the rhomboideus major and minor has likewise been cut, since there is evidence of relaxation of these muscles. The introduction of a firm interscapular ligament of fascia lata would perhaps be of assistance in this case in bringing and maintaining the normal position of the scapulæ.

MULTIPLE ENCHONDROMATA OF HAND

Dr. A. Bruce Gill presented a male child of two and a half years, whose X-ray photographs (Figs. 11 and 12) showed multiple enchondromata of the right hand only. Four metacarpals and nine phalanges are involved. X-ray plates of the other bones of the body show no evidence of enchondromata.

The child is healthy and well developed. He has never been ill with the exception of a furunculosis about a year ago. His parents are healthy and there is no family history of enchondromata, or hereditary deforming chondrodysplasia, as Ehrenfried terms it, for a period of at least three generations.

The child's parents first observed three or four months ago that his right hand seemed fatter, as they thought it, than it had been before. He has never complained of any pain or any discomfort in the hand, and he uses it for all ordinary purposes. Examination showed demonstrable enlargement of several of the phalanges and the metacarpals.

The subject of multiple enchondromata, or hereditary deforming chondrodysplasia, together with its literature, has been presented well in recent years by Boggs in the Transactions of the Association of American Physicians, Philadelphia, 1913, by Ehrenfried, Jour. A. M. A., May 15, 1915, by Ashhurst, Annals of Surgery, 1916, vol. 61, p. 167, by such others as Oberndorf, Clark and Atwood, Fragenheim, Schmidt, Lubarsch, Carman and Fisher, and others referred to in the above papers.

Fig. 11.

Fig. 12.

Various theories as to its etiology have been advanced, and many diseases such as syphilis, tuberculosis, and other infections, rhachitis, thyroid deficiency, trophic changes in the central nervous system have been suggested as causes. But the best opinion appears to be that it is a congenital condition due to abnormal *anlage* in the intermediary cartilage of the bones involved, and that frequently heredity plays a part. Certain cases said by Boggs to have been reported in the new-born, and the case here presented in a child two and a half years of age strongly indicate that the condition is truly a congenital one. The hereditary influence cannot always be traced, nor is the underlying cause of the congenital abnormality apparent.

STATED MEETING, HELD OCTOBER 1, 1917

The President, Dr. Charles H. Frazier, in the Chair

CONGENITAL CLEFTS OF THE FACE

Dr. John B. Roberts presented a boy, three years of age, who was born with a unilateral cleft of the mouth at the right side, with minor vertical clefts of the upper lip and lower eyelids (Fig. 1).

The lateral cleft of the cheek at mouth is now closed by two operations done during the last few weeks (Fig. 2). The scar has not as yet become entirely smooth because the last stitches were taken out only yesterday. In closing these fissures from the corner of the mouth he had found it very important to take deep sutures a considerable distance from the edge of the cleft, because it is almost impossible to prevent infection from the saliva; and feeding and crying tend to tear out the sutures.

The first operation was done by simply paring off the mucous membrane of the cleft and inserting copper wire sutures from skin into mouth. About two-thirds of the cleft healed, leaving the mouth still a little prolonged and its corner turned up, giving the appearance of risibility. By a second operation at the corner, the tissues were so displaced as to make the two ends of the mouth almost the same in appearance. When the scar fades, his mouth will be quite symmetrical. The partial clefts in jaw of right side, and in the upper lip on left side, and the clefts in the lower eyelids are conspicuous. The mouth on the right side showed a lateral cleft before operation about one-third of an inch long. There was a slight atrophy of the right side of the face. This caused the cleft at the right side of the mouth to be directed a little obliquely upward.

From the end of the right cleft there is a shallow groove running upward and outward toward the outer canthus. This corresponds to a want of development in the right maxilla, in which a groove can be felt by pressure through the cheek. Inspection of the mouth shows a corresponding groove in the alveolus in front of the first molar, which is just coming through the gum.

The upper jaw on left side has a nodule below the orbital ridge just outside the usual exit of the infra-orbital nerve. Just above this nodule and corresponding with the position of the imperfection of the upper jaw is a notch in the lower lid about one-sixth of an inch from the inner canthus. Here the skin lines the floor of the notch and is continued as a band over the mucosa until it reaches the conjunctiva covering the sclera. There is then an extension of the band, triangular in shape, running up to the cornea upon the conjunctiva and an attachment within the anterior chamber to the edge of the iris at the pupil. The jaw on the left side appears to be normal. The cleft on the right side gave the child a laughing expression because the lower lip extended around and upward and showed more mucous membrane than the upper lip. The two lips did not come quite together, exposing some of the

upper teeth, giving the child a snarling expression and the mouth an oblique appearance, partly due to a want of development of the right side. The roof of the mouth shows an anteroposterior elevation running from front to back, corresponding to the curious fissure in the right maxilla. There is no cleft of uvula or palate. The uncomely expression has been much improved by the mouth operation.

The upper lip shows on its edge to the left of the median line a slight notch in the vermilion border and a groove in the muscle under the skin which runs up to the left nostril. The skin is normal. This congenital condition is due to an imperfect coalescence of the tissues in the embryo, the same in nature as, but less complete than, harelip. The boy's ears, penis and skull are normal, except that as already stated the maxillæ have some peculiarities.

Dr. Roberts also showed a wet specimen from the Mütter Surgical Museum, being an infant with bilateral cleft of the mouth. In this case Dr. Roberts operated soon after birth, on the right side, but the sutures had not sufficient hold to prevent them being torn out when the infant cried, because the suppuration occurring softened the tissues. Thus a very great strain occurred, particularly as only one side was operated upon. The result was that no union occurred. He should have taken a larger grasp of tissue in the sutures and have operated on both sides at the same time. While he was waiting for the general condition of the baby to improve, it died from debility. The specimen shows the great gaping mouth stretching on both sides far out toward the ears (Figs. 3 and 4).

He also showed the photograph of a child, three months old, with a facial cleft involving the left side of nose and the inner end of the left lower eyelid. The left ala of nose, part, if not all, of the lachrymal bone, and the intervening structures are congenitally absent. The lower border of the lachrymal lake and its floor are absent, though the orifice of the inferior canaliculus is seen at the angle of the part of the lower eyelid which exists. The tears run directly down into the cavity of the nose, because there is no upper part of the nasal duct. The absence of a lachrymal bony wall, made normally by the lachrymal bone, deprives the child of a bony channel at the orbital end (Fig. 5).

To close this gap in the nose, he cut a flap from the left cheek with its pedicle just below the lower margin of the mandible, containing, he hoped, the facial artery uninjured. It was an error of judgment, perhaps, to try to close the whole opening at one operation, for the flap, which was slid toward the median line and stitched to the rawed edge of the cleft, sloughed. Had he transferred a shorter flap with its pedicle near the angle of the mouth and closed first only the lower two-thirds of the opening, possibly this anæmic gangrene would not have occurred.

Akin to these vertical fissures in the face, due to non-closure of the embryonic fronto-oral bud with the lateral buds, are the congenital clefts in the upper lip and palate. These may leave the lip incomplete on one or both sides of the median line, or divide alveolus and hard and soft palate. The

extent and combinations of these orolabial fissures vary greatly. He once saw the bony palate incomplete at suture in the middle line of the roof of the mouth, though the fissure was covered with normal mucous membrane. It showed plainly when the patient took a deep inhalation, through an open mouth, by the mucosa sinking into an anteroposterior furrow in the bone.

He has now under observation a girl of about ten years, who has the flattened nostril and a notch in the edge of the upper lip sometimes seen after imperfectly repaired complete harelip and cleft alveolus. There is even a little continuation of red mucosa running up the lip on one side of the notch, similar to that seen occasionally after inaccurate adjustment of the edge by the operator. The photograph of this girl (Fig. 6) looks as if she had complete cleft of hard and soft palate, but the deformity is caused by the deep triangular arch of the palate shutting out the light and giving a black shadow. The child has no opening through the palate for even a probe. There exists a coalescence of two incisors, a curious deformity of both clavicles and a duplex great toe on one foot. The impression of the mouth made by Dr. J. V. Mershon shows the curious anomaly (Fig. 7). The child keeps the mouth open constantly, due to mouth-breathing and the impossibility now of closing her mouth because the posterior teeth strike. The lower jaw is not contracted. She also has defective vision and some nystagmus. Adenoid tissue in the nasopharynx and the tonsils have recently been removed.

The wide nostril and flattened nose of complete cleft of palate, alveolus and lip before operation are well illustrated in Figs. 8 and 9, taken before treatment, when the babies were a few weeks old. The projection of the intermaxilla occurring in some patients with bilateral cleft of palate, alveolus, and lip is shown in Fig. 10.

The ten-year-old girl (Fig. 6) looks as though the early fetal structures of palate, lip and alveolus had failed to unite until much later than usual; and then Nature had found it too late to make a good repair of the separated bones and undeveloped parts. Dental and surgical methods will be required.

In Fig. 11 will be seen in a boy, 14 months old (who had cleft-lip and moderate cleft of palate) a notched appearance where the lip did not entirely unite, when operated upon a few weeks before the photograph was taken. The suture punctures have not yet become inconspicuous. This notch somewhat resembles the congenital deficiency in the upper lip of the little boy with bilateral cleft of the cheeks, shown in Fig. 1. The cleft palate has not yet been operated upon.

OPERATIVE SUGGESTION FOR WIDE BILATERAL CLEFT PALATE

Dr. John B. Roberts remarked that wide bilateral clefts of the hard palate, in mouths with low arch, present unusual operative difficulty. Mucoperiosteal flaps, to be united across the gap without dangerous tension, and yet with the necessary broad contact of raw surfaces, may be unobtainable by the usual procedures. He recently had employed, in a very troublesome instance of complete double palatolabial fissure in an infant, a modification of the usual methods, which, so far as he knew, had not been employed by

Fig. 1.—Lateral cleft of cheek and vertical cleft of upper lip and of lower eyelid.

Fig. 2.—Operative result in the case shown in Fig. 1.

Fig. 3.—Macrostoma bilateral cleft cheeks, congenital. Front view.

Fig. 4.—Bilateral cleft of cheeks. Lateral view of Fig. 3.

Fig. 5.—Facial cleft involving nose and eyelid. Outline of flap shown.

Fig. 6.—Congenital deformity with fused incisors and very high arch of palate.

FIG. 7.—Plastic cast of palate of case shown in Fig. 6.

FIG. 8.—Wide nostril and flattened nose in unilateral complete cleft of palate, alveolus and lip.

FIG. 9.—Wide nostrils and flattened nose in bilateral complete cleft of palate, alveolus and lip.

FIG. 10.—Projecting intermaxillary bone in cleft of palate, alveolus and lip (bilateral).

FIG. 11.—Notch in upper lip left after imperfect operation for closing a cleft of lip with cleft of palate on one side.

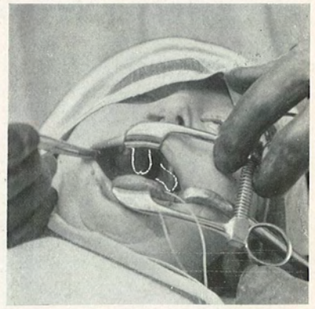


FIG. 12.—Diagrammatic illustration of method employed. (Photograph was not taken from patient who was treated by the method.) The flap outlined on the patient's left is upset towards the median line, the other flap is turned across the gap in the roof of the mouth and its end is sutured on top of the end of the upset flap.

FIG. 13.—Tie beams through cheeks to approximate the separated palatal masses in bilateral clefts of palate, alveolus and lip. Pads of gauze are shown under wires carried through cheeks.

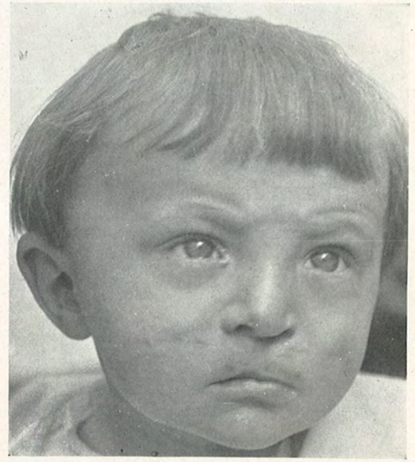


FIG. 14.—Showing result secured of lip in the case shown in Fig. 12.

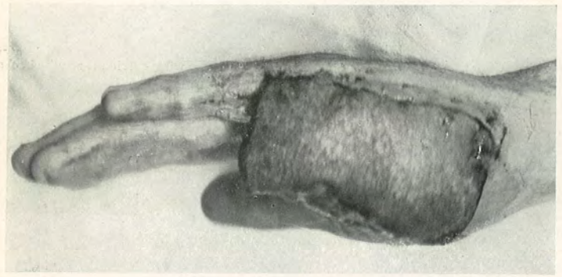


FIG. 15.—Plastic transplantation of cellulocutaneous flap from thigh or abdomen to face in plastic repair of nose, lips or chin. Hand showing skin surface of flap taken from thigh and satisfactorily used in rhinoplasty for syphilitic deformity of nose (Polyclinic patient). Note suture scars where flap has grown fast to ulnar side of hand. Opposite edge of flap shows thick pad of adipose tissue under skin. This border was sewed against raw surface of face, and the band cut loose from other border of flap two weeks later.

operators, with whose uranoplastic work he was familiar. It is a sort of combination of Lane's method with the Davies-Colley principle.

On the left side, he dissected up a tongue-shaped flap from the top of the alveolus and the adjoining palatal surface, with its pedicle containing the posterior palatine vessels. The median incision extended along the margin of the cleft backwards to a point a little beyond the posterior edge of the palate plate of the palate bone. The external incision, somewhat parallel to this, was made between the outer surface of the alveolus and the cheek. These two cuts were joined by a transverse cut across the gum and palate not far from the anterior end of the cleft alveolus on the same side. The long flap so outlined was raised by peeling, with a dull raspatory, the mucosa and periosteum from the top of the bony structures, leaving the unirrupted teeth and bared bone exposed. By carrying the buccal cut further backward than the median one, the mucoperiosteal flap torn up from the underlying bones was upset, as in Lane's operation, to present its mucous surface toward the cavity of the mouth. On the right side of the mouth a flap, similar in shape, was raised from alveolar and palatal structures, with its pedicle, however, in front, so as to include the blood supply from the anterior vessels of the palate external to the right side of the cleft. This flap, as was the left flap, was torn from the top of the alveolus and palate and included both mucosa and periosteum. Care was taken to lift both these flaps without using an edged tool under them. So-called palate knives with sharp edge or point are a delusion and a snare in raising flaps in uranoplasty. Curved or angular instruments without cutting edges are necessary to avoid dividing the vessels by which blood supply of the flaps is maintained (Fig. 12).

The end of the second flap was slipped or drawn obliquely across the bilateral cleft in the roof of the mouth and laid upon the upset flap from the other side of the gap. Four or five mattress sutures of silver wire brought the raw surfaces in close contact over a considerable extent of surface. The eversion of the posterior flap required the incision on its outer side to be carried further backward than the median cut. It may be carried inward a little at its back, to facilitate the turning over of the flap. The anterior flap may need its external incision carried forwards a little to permit rotation at its base. In both instances care must be observed to put no tension on the pedicle which may compress the vessels and cut off the circulation in the flaps. The free ends of both flaps should be made broad, to give wide contact when sutures are inserted in the overlapping ends of the flaps. An oblique bridge is made across the wide gap in the roof of the mouth by this operation, which gives a start for further operative plastic work.

The case in which he used this method a few weeks ago has now a substantial bridge. The child had double cleft of the soft and hard palate, alveolus and lip, with projection of the intermaxillary bone. When he was about two weeks old, Dr. Roberts had pushed back the intermaxillary protrusion, after excising a V-shaped piece of the nasal septum, and wired the alveolus on both sides to the intermaxilla. The tension caused the wires to cut out and the accompanying closure of the two clefts in the upper lip was

followed by suppuration and absolute failure. Twice more an endeavor was made to remedy the lip clefts by plastic operation. On one of these occasions the child developed erysipelas, which spread over head and back and was accompanied by double otitis media. The boy at the time of the final operation was about five months old.

His general condition is now good and it is Dr. Roberts' intention to operate for further closure of the anterior part of the palate in about two weeks. This he shall probably do by the method described to the Academy about a year ago; that is to carry wire sutures through the skin of the cheeks to perforate the two maxillæ and draw the soft bones together in front by twisting the wires on the cheek, much as Brophy does, with intra-oral tie-beams and lead plates within the cheeks (see Figs. 13 and 14).

In great absence of tissue in lips or nose the surgeon may obtain tissue from abdomen or thigh by using hand as transporting agent (see Fig. 15).

PEDICLED ABDOMINAL TRANSPLANT FOR CONTRACTURE OF FINGER

Dr. P. G. Skillern, Jr., presented a boy, aged twelve years, who was admitted to the Polyclinic Hospital (Case Record No. 31562), service of Dr. G. P. Müller, on June 26, 1917. Two months before admission he picked at a callus on the palmar aspect of the base of the right middle finger. Infection followed. The abscess was incised by another surgeon, the incision extending in the midline from the middle of the second phalanx across the two proximal flexion creases of the finger to its root. After healing had taken place contraction of the scar followed and went on until the finger was drawn down toward the palm, preventing forcible extension. This median scar was ridge-like and consisted of keloid cicatricial tissue.

June 27, 1917, under local novocaine anæsthesia, Dr. Skillern excised the scar in a rectangular manner, exposing unopened sheath of flexor tendons; the raw surface was covered by an abdominal flap which was stitched to the edges of the wound in the finger. Dressing applied. Limb bound to side.

July 9, 1917, the base of the flap was severed and the flap tacked down into the proximal portion of the skin wound. The abdominal wound was closed. The transplant healed soundly in place; at first redundant it is now growing smaller and adapting itself to the size of the finger. It forms a soft cushion covering the front of the proximal phalanx. It in no way incommodes the patient. The patient has recovered complete function, with the exception of the power of hyperextension.

Dr. Skillern remarked that this case illustrates the teaching of the late Dr. John B. Murphy, that an incision should never be made across a flexion crease. Progressive contraction is the inevitable result. It also shows the method of effectively correcting the deformity, namely, by a pedicled transplant. A copious blood-supply to this graft was insured by aiming to have the superficial epigastric artery in the middle of the pedicled transplant during the twelve days the latter was "taking."

Dr. A. Bruce Gill said that about four months ago he had a case somewhat similar to that reported by Dr. Skillern. A man, forty-seven years old, a leather-worker, had cut the middle finger on his left hand on a fence twelve years previously. The finger had become contracted so that it interfered seriously with his work. Dr. Gill excised the scar tissue which extended from the palmar crease to beyond the proximal interphalangeal joint. It was then found that the flexor tendons were contracted. They were lengthened. The proximal interphalangeal joint could now be extended and flexed by force, but it moved with a snap, as all the soft structures about the joint were contractured. Therefore, about three-eighths to one-half inch was removed from the distal end of the proximal phalanx to allow free motion in the joint.

The pouch of skin behind this joint was used in part to cover the joint in front. The remaining area of the wound was covered with a pedicled skin graft from the thigh. The hand was held to the thigh in a comfortable position by a light plaster case in which a window was cut for the dressing of the wound. Union had taken place at the end of two weeks and the graft was then cut loose from the thigh.

Contraction and thickening of such a graft always occurs. This makes a thick pad of skin on the hand which may interfere with the work of the patient and which is unsightly. In time the thickness of the graft becomes much less. In the case here reported he proposed to perform a second plastic operation to reduce the thickness of the graft.

Dr. John B. Roberts said that he had used the pedicled flap in the hand after excising Dupuytren's contraction. A cushion of skin and fascia remains somewhat as in this case. It would be easy to excise a piece and lessen the bulk as suggested by Dr. Gill. He had used in partial rhinoplasty the method of obtaining the flap described by Dr. Skillern. An abdominal or femoral flap is fastened to the ulnar edge of the hand, on which the surgeon has made an incision and laid the edges apart, so as to expose the underlying tissues for a half inch in width and two or three inches in length. After two weeks the thick flap of skin and superficial fascia is cut loose from the thigh or abdomen (Fig. 14). Then the hand is placed close to the face and the free edge of the cellulocutaneous flap stitched to the border of the rawed surface previously prepared in the nasal or oral region. Two weeks later the hand is cut loose from the flap which remains fastened to the face, and later is modelled to repair nose, lip, or chin. One can also obtain in this way tissue for plastic repair of the lip or chin by attaching a flap to hand and later applying it to face. Many amputations of fingers can be avoided by taking skin from the abdominal wall to cover the bones in the manner so well described by Dr. Skillern. He was convinced that many fingers have been needlessly sacrificed.

THE TRANSVERSE (DAVIS) INCISION FOR ACUTE APPENDICITIS, WITH SPECIAL REFERENCE TO THE APPENDIX CHAMBER

Dr. P. G. Skillern, Jr., reported the following cases:

Case I is a boy, twelve years of age, who had perforative appendicitis, for which the entire operation was done under novocaine anæsthesia, using a ½

per cent. solution without adrenalin. The boy had been sick for five days with pain (at first referred to navel, soon localizing in right iliac fossa) followed by nausea and vomiting, fever (99²/₅° F.) and leukocytosis (16,500). There were moderate rigidity of the right rectus and right flank muscles, acute tenderness on pressure between spinonavel line and Poupart's ligament, and induration in pelvis as revealed by rectal palpation. The incision began ¼ inch to inner side of anterior superior iliac spine and passed horizontally across to the midline—a distance of about 4 inches. The anterior sheath of the rectus muscle was cut across and the muscle retracted inward. The linea semilunaris and the posterior sheath of the rectus (close to Douglas's semilunar fold) were divided. The external oblique aponeurosis and the internal oblique and transversalis muscle aponuroses and muscular fibres were separated with the fingers out to the iliac spine. The transversalis fascia and peritoneum were divided transversely between forceps. The anterior wall of the cæcum presented itself and prolapsed through the wound. With the finger the appendix was traced to its tip, which lay in the pelvis amidst coils of ileum, which formed the left wall of the abscess cavity, as well as the upper wall, the right wall being formed by the cæcum and side of the pelvis. The appendix was perforated near its tip. The appendiceal vein was the seat of thrombophlebitis, feeling like a match-stick. Drainage consisted of one Mikulicz and one rubber tube: these drains were brought out through the lateral angle of the incision close to the anterior superior iliac spine, and between the pelvis and their point of emergence were bound above by the cæcum and below by the iliac fossa. Wound sutured in tiers up to drainage.

Owing to the thrombophlebitis of the appendiceal vein, which was found at operation, this patient was kept in bed until the danger of ascending infection of the portal venous system or detachment of an embolus from the thrombus had passed. This thrombophlebitis process maintained an irregular fever for three weeks, and when the fever finally abated and the leukocyte count fell to normal, it was presumed that the thrombus had become organized, so that the patient was allowed out of bed at the end of the fourth week. The wound is firmly healed; there is not the slightest suggestion of a weak spot in the scar.

In cases II and III, when relaxed by ether, a definite mass the size of a plum could be felt in both just above the outer half of Poupart's ligament. The transverse incision in its outer portion gave a very satisfactory free exposure of the mass, which in each instance proved to be the acutely inflamed and distended appendix surrounded by fresh plastic lymph exudate and wrapped by the acutely inflamed and hyperplastic omental edge. This mass was contained in a little chamber bounded in front by the anterior abdominal wall; behind by the iliac fossa; externally by the lateral abdominal wall; internally by the terminal coil of ileum and meso-appendix; below by Poupart's ligament; and above and in front by the towering cæcum, which is usually covered by the omentum.

This *appendix chamber* as it should be called—just as Birmingham in

Cunningham's "Anatomy" speaks of the "stomach chamber"—adds a very forceful argument in favor of the transverse incision for acute appendicitis. The danger zones of this appendix chamber are the upper wall and the inner wall. The upper wall is usually—except in children and in those with thin, short and poorly developed omental aprons—effectively sealed by the omentum, whose edge swells up with an army of phagocytes and offers an impenetrable front to the spread of infection in the upward and forward direction. The inner wall is the most vulnerable because unreliably sealed by the hyperplastic meso-appendix and the terminal and other coils of ileum: the pelvic cavity, too, forms a safety outlet or sewer for toxic exudates, and to this extent compensates for the deficiency of the inner wall. In the usual case of appendicitis with abscess, therefore, the safest approach to the appendix chamber is from below, in front, and externally, and this zone corresponds to the safest and most effective drainage outlet for the appendix chamber. This drainage track extends from the bottom of Douglas's cul-de-sac outward between the cæcum above and Poupart's ligament below to near the anterior superior iliac spine, just below and to the inner side of which it emerges. When operating under local anæsthesia one can see the internal oblique muscle by its contractions grasp the drainage material snugly with a soft pad of muscle tissue, and here at the very close of the operation one sees inaugurated that very effective mechanism that prevents post-operative hernia and that forms the principles upon which McBurney's gridiron incision is based, namely, to separate the muscles in the direction of their fibres and to push aside without injury the motor nerves.

The vertical incision through the right rectus is objectionable in the first instance because it necessitates approaching the appendix chamber from within outward, thus entering the chamber by breaking through its inner defensive wall, thereby exposing the general peritoneal cavity to diffuse infection. Drainage through a right rectus incision is by no means ideal: it occupies an undesirable relationship with both the appendix chamber and the general peritoneal cavity. Again, the vertical incision is objectionable because it violates McBurney incision principles: it cuts acrosss the muscles and cuts across the nerves. Strictly speaking, it does not divide the muscle fibres, but it divides the tendon fibres, which form the rectus sheaths. These aponeurotic tendon sheets are formed by minute tendon units which run transversely, and as a practical surgical proposition it is just as noxious to cut across tendons as it is to cut across muscle fibres. When the operator comes to sew up the vertical wound he may notice when closing the posterior rectus sheath that the sutures tend to cut through and pull toward the incision in the sheath. Post-operative intestinal distention puts an immediae strain upon the posterior rectus sheath, causing a little gap between every pair of suture holes, and forcing through each gap a pellet of subperitoneal fat—a condition that gives rise to much of the scar discomfort which is often erroneously attributed to the presence of adhesions. This undesirable feature of the vertical incision can be obviated by imbricating the posterior rectus

sheath, but this is technically difficult and time-consuming. With the vertical incision it is impossible to avoid contusing, lacerating, or even dividing the motor nerves, unless one can work through a very short vertical incision, in which case the nerve or two exposed in the field may be gently drawn aside. It must be acknowledged, however, that division of these nerves so close to their termination is not so damaging as their more external division, for in the former instance the inner strip of the rectus is all that can be paralyzed. Drainage through a vertical incision is more liable to result in post-operative ventral hernia than drainage through a transverse incision. From the cosmetic standpoint the vertical incision scar is liable to become unsightly, while on the other hand—unless keloid change supervenes—the transverse incision scar eventually becomes almost imperceptible, for the natural tendency of the superficial layers of the abdominal wall is to fall into transverse creases, just as is the case with the skin covering the neck.

In concluding these observations he again called attention to the appendix chamber which he had described, feeling that its consideration from the surgical standpoint forms a basis not only for the rational method of dealing with the usual case of acute appendicitis with abscess, but also for one of the arguments favoring the transverse incision. In addition, the transverse incision is anatomically, physiologically, pathologically and cosmetically far superior to the vertical incision. In closing up the transverse incision it will be noted that the undivided rectus muscle falls across the inner half of the wound, forming a perfect barrier against hernia through this portion. Finally, the treacherous deep epigastric artery can be freely exposed and retracted inward out of harm's way when the transverse incision is employed, whereas with the vertical incision it is neither so easily revealed nor so readily avoided, and when divided it is capable of giving rise to very troublesome bleeding and even to death from post-operative hemorrhage (see article by the reporter in ANNALS OF SURGERY, April, 1917, 451).

DR. GEORGE P. MÜLLER agreed with Dr. Skillern in objecting to the vertical right rectus incision in acute appendicitis, and for the same reason. He used the McBurney incision almost entirely and had no difficulty in handling the pathology within the abdomen. The opening can be made as small or as large as wished, and if the suggestion of Judd is followed and the rectus muscle exposed, it can be so pulled inwards as to give a very large exposure. He did not see that there was anything materially different in the transverse incision from the McBurney incision because it does not matter which way the skin is cut. He never used the McBurney incision in chronic cases where there might be duodenal ulcer above or pelvic disease below.

DR. GWILYM G. DAVIS said that he was interested at the time this incision was proposed to find out what was the favorite incision in appendicitis. From the fact that in this neighborhood the longitudinal incision alongside the rectus was used so much he assumed that that might be the favorite incision everywhere. He found, however, upon inquiry, that the favorite incision was that of McBurney. At a surgical meeting he once saw a demonstration of McBurney's operation in which a surgeon thought the case was not a suppurative one, but in which it turned out to be such. The exposure which he obtained on that occasion did not impress him favorably. He even yet could hardly see why the McBurney incision for suppurative cases is considered a really desirable one. He had always preferred the method which Dr. Skillern had described. The incision for the subacute cases can be made quite small. If, however, a supposedly mild appendicitis turn out to be otherwise, presenting adhesions or other difficulties, unless one has a good exposure one may perforate and tear the intestines. The small incision can then be enlarged by splitting the sheath of the rectus transversely over the muscle fibres clear across. It may be split to the median line, giving then an incision extending from the median line over to the anterior superior spine. If necessary it can be carried still along the crest of the ilium. With such an incision the surgeon can insert the hand and reach into the pelvis. If an operation on the gall-bladder is required, personally, he preferred to close the transverse incision opposite the anterior superior spine and make a separate incision above rather than to make one extremely long cut to expose both localities.

DR. EDWARD MARTIN said that this muscle-splitting operation which Dr. Skillern describes, he, together with many other surgeons, had been using for many years. The advantage of the transverse skin cut is, of course, incident to the fact that changes in custom are constantly occurring and there may come a day when a scar in this region may be conspicuously disfiguring. The method of approach is satisfactory in nearly all cases.

FACIAL CARBUNCLE, SINUS THROMBOSIS

DR. WM. J. RYAN said that the cavernous sinus, though less frequently affected with thrombosis than the other large sinuses, may become infected through the veins even though the seat of the trouble is apparently far removed. Such infection occurs by way of the extra-orbital connections of the ophthalmic veins, the superior and inferior, from cancrum oris, alveolodental periostitis, etc., which are also in communication with the facial veins.[1] Thus carbuncle of the face may be followed by cavernous sinus thrombosis. In the presence of thrombosis of the cavernous sinus two groups of pressure symptoms may be present: (*a*) venous, causing exophthalmos, œdema of the lids and of the corresponding side of the root of the nose, and chemosis; (*b*) nervous, causing ptosis, strabismus and variations of the pupil, pain, etc.

In illustration he reported a case taken from the records of the service of Dr. George P. Müller in the St. Agnes Hospital. The patient was a girl, nineteen years of age, who was admitted on February 7, 1917, with swelling and redness of the upper lip, swelling and œdema of both cheeks and of the right submaxillary region.

Five days before admission she noticed a pimple on the skin surface of

[1] Piersol: Human Anatomy.

the upper lip. She did not remember picking it. The lip became greatly swollen, but not very tender.

When admitted the upper lip was hard and swollen and was the seat of numerous pustules. Both eyes and lids were swollen. Both cheeks, especially the right, and the right submaxillary region were hard and brawny. There was also a moderate submaxillary lymphadenitis. Temperature was 102°; pulse 108; respiration 23.

Under ether anæsthesia an incision was made on each side of the midline of the skin surface, and corresponding incisions on the external mucous membrane. No free pus was seen, but the whole lip was a mass of sloughing tissue, with here and there a typical core. The lip was curetted through the four incisions and drained with rubber dam. A rubber coffer-dam was placed between the upper lip and the upper jaw, and allowed to extend over the lower lip so as to prevent any drainage running into the mouth. The whole face, except the eyes, was dressed with saturated magnesium sulphate dressings. The eyes were covered with wet boric acid compresses. The swelling of the face and submaxillary region was markedly reduced in twenty-four hours and had all disappeared the morning of the third day. The lip did not drain much but reduced in size daily until almost normal in contour. At the end of the second day she was somewhat restless. By this time there was some ptosis of the upper right eyelid, but no apparent exophthalmos. During the next day her restlessness did not abate, and that night she became very excitable, so much so as to necessitate the administration of morphine. On February 10, the second day after operation, all external swelling had practically gone, but the right eye was bulging considerably and the inferior palpebral conjunctiva began to avert. Ptosis of the upper lid was not very marked. She responded to conversation and had control of her sphincters (at this time). The next day the patient suddenly became very delirious; she vomited, and voided urine and fæces involuntarily. The dressings were removed from the face and the rubber dam removed from the mouth. The right exophthalmos was greatly increased. The eyelids could not be closed over the eyeballs. About 2 P.M. the patient became unconscious and died at 8.30 that evening.

It is to be regretted that autopsy was not allowed by her family.

THE USE OF DICHLORAMINE-T IN THE TREATMENT OF INFECTIONS AND INFECTED WOUNDS*

By Lieutenant Walter E. Lee, M. R. C.
and
Captain William P. Furness, M. R. C.

The experience of nearly two and a half years at the hospital of the American Ambulance in Paris has been in accord with that of the majority of surgeons who have served in the present war, namely, that the chlorine preparations have proven in our hands superior to all other germicidal agents. It was soon found, however, that all of the standard hypochlorite preparations, as eau de Javelle, Labarraque's and the eusol solutions, were very irritating to the skin if used for any length of time. In order to minimize this irritation, various modifications of the original formulæ were tried, the most successful of which was that of Dakin, a very dilute, neutral, Labarraque's solution. This neutral hypochlorite solution was found to have three inherent faults.

First: The neutral solution, unlike the original Labarraque's with its free alkali, was very unstable and it was necessary to prepare it almost daily.

Second: The dilute 0.48 per cent. solution contained such a very small mass of germicide, if the concentration was even slightly lowered, *e.g.*, to 0.4 per cent., the germicidal efficiency was very materially impaired, that it was necessary, in order to obtain a maximum effect, to have the solution all times in contact with the surface of the wound.

Third: The active chlorine was used up so rapidly from the solution when it came in contact with the wound exudate, from seven to fifteen minutes as estimated by Carrel, that it was necessary to frequently renew the supply of germicide, at least every two hours night and day.

Carrel, Dehelly and Depage gradually overcame all these inherent faults of the weak neutral hypochlorite solutions of Dakin and Daufresne by developing a beautiful but complicated technic for their application. And with this technic they were able to obtain wonderful results in the treatment of infected wounds.

It is generally conceded that they have demonstrated conclusively:

First: That if infected wounds are treated with the same aseptic surgical care that surgeons give to clean wounds, very unusual results can be obtained.

Second: That the primary dressing of infections and infected wounds should be made a formal aseptic operation in which all devitalized and infected tissue should be removed, with knife, forceps and scissors, that it is mechanically practical and anatomically justifiable to sacrifice.

Third: That infected wounds so treated can be sterilized if the wound

* Read before the Philadelphia Academy of Surgery, October 1, 1917.

surfaces are constantly bathed with even such a small mass of germicide as is contained in the aqueous hypochlorite solutions. This constant immersion can be accomplished by Carrel's complicated hydraulic system of reservoirs and tubes.

Fourth: That when the wound surfaces are practically clean, one bacterium per five microscopic fields on three successive counts made every third day, the wound edges may be approximated by sutures and union may be expected to take place without infection in about 80 per cent. of the cases.

Many have had the privilege of seeing the work of Carrel and Depage and can personally testify to the accuracy of their claims, but the indifferent success most of us have had in trying to obtain similar results, Carrel himself says, is because of our failure to grasp and apply the details of the technic. The Carrel technic demands an unusual degree of painstaking and time-consuming care, not peculiar skill, upon the part of the surgeons, nurses and chemist, and the unusual expense for both the apparatus and dressing material develops difficult problems for the entire personnel of even our civil hospitals.

Now it is essential in this technic of Carrel to so prepare the wounds at the primary operation that they will act as basins for retaining the hypochlorite solution during the period of repair. Thus the cardinal principle of surgery, dependent drainage of infected cavities, must be abandoned if this treatment is to be used. In spite of this, if the wounds are subsequently treated with the aqueous hypochlorites with the infinite care Carrel practises, the results will be far better than with any other treatment we have used in the past. But, if for any reason this perfect hydraulic system breaks down, and it is very vulnerable, these wounds prepared in this way act as pus pockets, and, as has been expressed by many military and civil surgeons, such wounds give unfortunate results.

We must not forget in our admiration for the Carrel technic, that it was because of the severe skin irritation produced by the standard hypochlorite preparations that Dakin first suggested his modified Labarraque's solution; and that because of the inherent faults of this Dakin's solution, instability, the very small mass of germicide contained, and the rapidity with which it liberated its chlorine, it was necessary to develop an unusual technic to make such a solution effective in the treatment of infected wounds.

Or this might be stated in another way, that the Dakin's solution and Carrel technic represent an effort to modify Labarraque's solution and the method of its application to infected wounds in such a way that there will be a minimum of the dreaded skin irritation produced by the original Labarraque's formula.

These facts were soon realized by Dakin, and he started a new search for a more effective germicide. If possible a chlorine compound which would be non-toxic and non-irritating to both the surface of the wound and to the skin and which could be placed in contact with the infection in a menstruum

that would be capable of containing not only the desired mass of germicide, but also of holding in solution a reserve mass over a long period of time.

In these investigations, he found that the various hypochlorite preparations used in the treatment of infected wounds react with proteins of any kind, and one of the first reactions consists in the amido-groups uniting with the active chlorine to form substances containing the NCl group.

These products, which belong to the group of chloramines, possess marked bactericidal properties, and are the active germicidal agents produced by the hypochlorites when they come in contact with the wound exudate. These chloramines are non-irritating to animal cells and this explains the absence of irritation in the wounds where the irritating active chlorine of the hypochlorite has been changed into chloramines and other non-irritating protein derivatives.

It is quite simple to produce many of these chloramines synthetically. The first one to be used was in the form of a sodium salt of toluene-para-sulphon-chloramide or Chloramine-T and sold in this country under the trade name of chlorazene. This synthetic chloramine was non-irritating to the skin and could be used in aqueous solutions in 2 to 4 per cent. strengths, but it had the same fault as the aqueous hypochlorite in that its active chlorine is liberated very rapidly, and though the difficulty of the skin irritation was obviated, it was still necessary to frequently renew the solution as with the aqueous hypochlorites.

Dr. Dakin entrusted to us the honor of testing the surgical value of another synthetic chloramine at the Pennsylvania Hospital, toluene-para-sulphon-dichloramine, which he called Dichloramine-T. This preparation was dissolved in chlorinated eucalyptol and could be used in strengths varying from 5 to 20 per cent. By using oil as a menstruum a large mass of germicide was brought to the infection and yet held so firmly in solution that it very slowly diffused into the surrounding medium for at least as long as eighteen to twenty-four hours, and during this period a mass of germicide was at all times active, which was equal to that given off during the first seven to fifteen minutes by the hypochlorite solution.

Theoretically then, this new chlorine compound eliminated at the start the chief indication or necessity for the Carrel technic, skin irritation. With such a solution, it should be possible to present to an infection an overwhelming mass of germicide, a 20 per cent. solution of dichloramine being approximately 80 times the germicidal mass of a 0.48 per cent. hypochlorite solution. There is a vital necessity, when using germicides in the treatment of infections, for the earliest possible application of an overwhelming mass of a rapidly acting agent, because infection develops in the tissues at the rate of a geometric progression and not by the slow process of addition, and therefore every minute counts in the end result. Dichloramine, with a phenol oil coefficient of about 50, can be presented in a larger mass without injury to the tissue cells than any other germicide we have used. Instead of having this chlorine given up with explosive rapidity and the consequent necessity of

frequent renewals of the solution, it would be slowly diffused into the surrounding media, making it unnecessary to renew the solution or to dress the wounds more frequently than once in every twenty-four hours.

Five months have elapsed since the writing of the first report upon the use of Dichloramine-T in the treatment of infections and infected wounds. We have now the records of 6028 civil cases in which the germicide has been used and of four months' work and 1200 cases reported by Captain Joshua Sweet with war wounds in the U. S. Base Hospital No. 10 in France. From this clinical experience the conclusions tentatively offered in our first report have developed into firm convictions.

Three thousand three hundred and eleven cases are reported by Dr. Robert P. Cummins from the surgical dispensary of the Midvale Steel Works.

Two thousand two hundred and seventy-one cases reported from the Pennsylvania Hospital from the surgical services of Dr. Robert G. LeConte, Francis T. Stewart and Walter E. Lee, and of the work of Dr. Robert C. McIver.

Two hundred and seven from the Germantown Hospital in the service of Dr. Walter E. Lee and the work of Dr. Robert Kelly and Dr. Robert Regester.

One hundred cases from the St. Agnes Hospital by Dr. G. M. Dorrance.

Fifty cases from the Children's Hospital in the service of Dr. Walter E. Lee and by Dr. Edgar Christy.

Eighty-nine cases from the Jefferson, Lankenau and Episcopal Hospitals.

From the records of 3311 cases at the Midvale Steel Works, it has been possible to make a comparison between the efficiency of tincture of iodine and Dichloramine-T. A period of four and a half months in 1916, when iodine was exclusively used, was compared with the same period of time in 1917 when Dichloramine-T was used. The results with Dichloramine-T were 60 per cent. better than with iodine.

An interesting comparative study was made at the Pennsylvania Hospital between the Carrel technic and Dakin solution and Dichloramine-T applied with the technic to be demonstrated on the screen. With the working factors as nearly the same as it is possible to have them, same surgeon, nurses and surgical asepsis and the same class of injuries, a total of 157 industrial injuries were treated by the Carrel technic and Dakin's hypochlorite solution with an average healing time of 14.4 days. The succeeding three months Dichloramine-T with a simplified technic was used in the treatment of 281 cases with an average healing time of 10.4 days.

At the Pennsylvania, Germantown and Children's Hospitals, there have been 2528 cases under our direct personal supervision. In the 825 cases of infection there was but one case in which a localized process was not controlled and in which there was a secondary involvement of tendon, bone or joint. In this group there were 60 cases of bone infection, and yet in no instance was it necessary to amputate because of infection. There is no doubt that the period required for healing has been considerably less than that with any other germicide we have used.

There has been a total of 1651 lacerated and infected wounds. When mechanically possible, we have routinely closed these wounds by suture up to six hours after the receipt of the injury, and frequently as late as twelve hours and always without drainage. The wound surfaces have been covered with a 20 per cent. solution of the oil before the sutures were inserted. Over 75 per cent. of the cases have healed without clinical signs of infections.

There have been 30 cases of extensive burns. The unusual comfort to the patient, together with the simplicity of the dressing, appeals to the patient and surgeon. The time required for healing has been decidedly less than required by any other means employed, and the resulting scars are soft and pliable, and very much better than obtained by us with ambrine.

With Dichloramine-T we have been able to obtain as good results as we have ever had when using the Dakin hypochlorite solutions with the complicated technic of Carrel. In addition, we have found:

1. That skin irritation will not occur if the wounds are not covered with thick occlusive dressings. This means the use of the smallest possible amount of gauze dressing and bandage.

2. The small amount of exudate from wounds treated with Dichloramine, makes it practical to use these thin dressings, and in our dispensary, at the Pennsylvania Hospital, there has been a saving of 75 per cent. of the gauze and bandages formerly used. Further, a still greater saving in dressing material and time results from the decrease in the number of dressings required for each wound during the period of healing. Rarely is it necessary to dress a wound, even during the first few days, more frequently than once in every twenty-four hours, and after that, intervals of forty-eight and seventy-two hours are usual.

3. Dichloramine, unlike the aqueous hypochlorite solution, has no effect upon the knots of catgut ligatures, and no disintegrating effect upon the catgut itself. The occurrence of secondary hemorrhages in wounds treated by the Carrel method was not uncommon in our experience at the American Ambulance. Captain Sweet reports that, in his 1200 cases of major infected military wounds, there was not one secondary hemorrhage.

4. Too great stress cannot be laid upon the value of Dichloramine as a deodorant dressing. The absence of the usual disagreeable odors in our wards, containing cases with fecal fistulæ, is a general observation. During the last two months, it has been used routinely in the wards of the Oncological Hospital in Philadelphia. Where formerly these putrid, sloughing, malignant tissues were irrigated every two hours with all kinds of solutions, with indifferent success in the control of infection and with a persistence of the offensive odor, now they are packed lightly every six hours with gauze saturated with a 5 per cent. solution of Dichloramine-T. Not only has the odor disappeared entirely, but the wound infections have been controlled.

That there may be no misunderstanding of our position as to the value of germicides in the treatment of infections and infected wounds, we wish to repeat the concluding statement of our first report. "One should not depend

upon a chemical agent to perform, in the treatment of suppurating wounds, that which can and should be done quickly and thoroughly by mechanical means. Neither chemistry nor bacteriology can, or should be expected to replace the mechanics of surgery. At the best, these chemical germicides can react only on the bacteria with which they come in contact, which means a very superficial process. Therefore, at the primary operation all foci of infection and all devitalized tissue must be removed when possible, by surgical procedures."

We wish to present in detail the methods used and results obtained in the treatment of infections and infected wounds in the Pennsylvania, Germantown and Children's Hospitals during the last five months—a total of 2213.

Accepting the results of the work of Carrel at Compeigne and Depage at LePan as demonstrating conclusively that infections and infected wounds must be treated with the same surgical asepsis as one follows in the care of sterile wounds, we have tried to consistently make of the primary dressing a formal aseptic operation, with the wearing of sterile gloves and the handling of the tissue with sterile instruments only. We continue this aseptic care of the wound during the entire period of treatment.

In the *preparation of the skin,* soap and water were first used for cleansing, care being taken to plug the wound with sterile oil soaked gauze. Of late we have found that the use of benzine for cleansing the skin is to be decidedly preferred. Neither water, alcohol nor hydrogen peroxide should be used, as they decompose Dichloramine-T.

In *infections* the focus has been excised when mechanically practical, but it has always been widely exposed so that the germicide may have an opportunity for a complete chemical contact with the bacteria. Adequate drainage has always been provided according to accepted surgical principles. After the completion of the mechanical procedures, the wound surfaces are thoroughly covered with the 20 per cent. solution of Dichloramine-T and then the wound edges are held apart by a generous gauze pack saturated with the same strength of oil. A very light gauze dressing is then applied, not more than four layers. If a bed patient, a clothing cradle is placed over the area to avoid displacement of the dressing, which may be held in place by a few strips of adhesive or a towel and safety pins. If the patient be ambulatory, the fewest possible turns of a lightly applied gauze bandage may be used to keep the dressing in place. Care is always taken in applying dressings not to make them impervious, for the solvent, eucalyptol oil, is an essential oil and acts like all essential oils when confined by air-tight dressings. If the discharge is unusual in quantity fresh gauze may be re-applied during the day, but in our experience it is rarely necessary to renew the dressing. The oil should be applied but once in every twenty-four hours. At the first dressing after the operation (and at all subsequent dressings) the same aseptic surgical technic is employed as at the time of the operation; and at this time, primary gauze drainage should be removed

and no more re-inserted unless the walls of the cavity or sinus collapse in such a way as to make it impossible to introduce the oil. A 5 per cent. solution of the oil is all that is required for secondary dressings with the possible exception of massive infections as in carbuncles or extensive bone lesions. Of course an opening in the surface of the wound must be maintained for the introduction of the oil until the infection is controlled. Of the 111 felons treated, it has never been necessary to remove bone or to amputate. During this same period, there have been 37 palmar abscesses and in no case has there been a spread of the infection to the forearm. In this group of 825 cases, amputation because of infection has never been required.

Our first use of the Dichloramine-T for *intra-abdominal infection* was limited to old, well walled-off sinuses following appendicial and tubal abscesses. The unusual rapidity with which these infections were controlled and the absence of any untoward symptoms gave to us the necessary confidence and we now use it routinely at the time of operation in intra-abdominal abscesses in exactly the same manner as described with superficial infections. There have been 13 cases of gangrenous, perforated appendicitis with abscess. Upon the removal of the appendix, the 20 per cent. solution has been dropped over all the visibly infected tissue. A medium sized gauze drain, saturated with the same strength of oil, has then been placed in the cavity and the wound closed in the usual way. The following daily dressings consist in applying 2 or 3 c.c. of the same strength of oil to the gauze wick and upon the edges of the wound. About the fourth day, the drain is loosened and removed when it has separated from the walls of the sinus. This is usually between the third and the seventh day. The cavity is then gently dried by means of gauze or cotton pledgets, and then filled with 5 per cent. oil. It has been our experience that it is rarely necessary to replace gauze drainage after the removal of the primary wick, but of course this may be necessary if the walls of the sinus collapse because of inadequate adhesions. The cavity of the wound is usually filled each day with the 5 per cent. oil until it closes by granulation from the bottom. In none of these cases have there been any unfavorable symptoms; and the average time of complete closure has been 15 days. There have been 9 cases of pelvic abscess of tube ovarian origin in which the oil was applied at the time of operation. Here again there have been no complications and the average time of closing of the wound has been 18 days.

There have been 30 cases of burns. In the treatment of burns it was possible from the start to control the infection with 5 per cent. solution of oil; but the sticky exudate resulting so infiltrated the gauze, that the dressing became adherent and impervious; and a layer of purulent fluid would collect beneath the dressing as with ambrine. We now employ one layer of a wide-meshed paraffined gauze, which is placed over the burned surface and then the oil is sprayed upon this film of paraffined gauze. The open mesh allows the oil to come in contact with the wound surface and

also for the wound exudate to escape. No other dressing should be applied and the usual technic of the open-air treatment of burns should be followed. Depending upon the amount of exudate, the paraffined dressing can be painlessly removed daily or less frequently as required.

For the preparation of an open-meshed gauze to be used in the treatment of burns we have found the following method of preparation the most satisfactory:

Ordinary mosquito netting of good quality with a mesh of about one thirty-second inch is cut in strips on the thread six inches wide and one yard long. It has a small amount of starch or stiffening in it which it is not necessary to wash out, in fact it can be handled and rolled more easily if this starch is not removed.

The ambrine, parawax, redintol J. & J. or cerelene, or similar preparation is melted on a water-bath in a flat tray and brought to the boiling point. When it is thoroughly melted one end of the strip of mosquito netting is folded over a glass rod as in starting a roller bandage. This is dipped in the melted wax and with the tips of the fingers protected by rubber gloves grasping the ends of the glass rod it is rolled up, letting the strip of mosquito net run through the melted wax as it is pulled towards the roll and the roll is wound up slowly as it rests on the bottom of the pan. When the strip is all rolled up, continue turning the roll over and over in the melted wax until it is thoroughly soaked, then quickly stand it on end in the pan of hot melted wax. The wax on the gauze quickly drains out of the meshes as it remains in the heat; the little excess that remains on the end of the roll can be shaken off. Allow the roll to cool slowly by standing it on end. Store in a sterile muslin container.

We have tested several combinations of paraffine and petrolatum, paraffine and liquid petrol, paraffine and beeswax, and plain beeswax—as to their solubility by Dichloramine-T in eucalyptol oil. In all combinations where petrolatum or liquid petrol or beeswax was used to make the paraffine flexible, these substances were dissolved out of the wax and made the dressing soft and rendered the paraffine thin and friable on the gauze. Pure paraffine, redintol and cerelene were unaffectd by prolonged soaking in Dichloramine.

Wounds.—(*a*) *Incised Wounds.*—Employing the same aseptic technic previously described, all bleeding vessels are ligated with catgut; the wound surfaces covered with the 20 per cent. solution of oil and then the edges closed with sutures and without drainage. We strongly advise against the use of drainage of any kind in the primary suture of wounds; it is unnecessary when employing Dichloramine-T and always provides a definite focus of infection. Dichloramine-T does not affect the tensile strength or the holding of the knots of catgut after an exposure of more than three weeks, so that the danger of secondary hemorrhage from the slipping or premature absorption of ligatures can be disregarded. The capillary ooze in the presence of Dichloramine-T and eucalyptol oil is decidedly less than with any other germicide we have used; and there will be no more oozing than the

tissues are normally able to care for, while you have placed in the tissues a mass of germicide that makes infection very improbable. Thus the two indications for draining incised wounds, hemorrhage and infection, are almost entirely eliminated when Dichloramine-T is used. In the subsequent dressings, the surfaces and wound edges may be sprayed daily, or even less frequently, with a 5 per cent. solution of oil until the wound is dry. If infections develop, it is only necessary to remove one or two stitches, to obtain a small opening through which the solution may be introduced into the depths of the wound. For us, the simplest method has consisted in the introduction of a grooved director through such an opening, to the bottom of the wound; and then when the coarse spray of an atomizer is directed against the groove, the oil flows into the wound. This also may be done with a glass hypodermic syringe and needle. It has been our experience that infection has been controlled on an average of 5½ days, when developing after the primary suture of incised wounds.

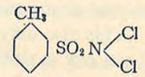
Wounds.—(*b*) *Lacerated Wounds.*—After the usual preparation of the skin, all the devitalized tissue is removed with a knife, scissors and forceps, that it is mechanically practical to take away; and in a like manner all foreign bodies and splinters of bone (if they be detached from the periosteum). If the primary operation takes place within three hours after the injury, the wound should be closed by suture after thoroughly covering the wound's surfaces with the 20 per cent. solution of the oil without drainage. When infection subsequently develops the previously described technic is followed, just enough of the stitches being removed to allow the introduction of the oil to the focus of the infection.

Wounds.—(*c*) *Crushed.*—When these involve the hands and feet, the treatment and results are not very different from the lacerated wounds. The time of healing, of course, is increased, tendons require more time than subcutaneous tissues; bone more than tendons; while the longest time required for healing is when there is joint involvement. We have had 10 compound fractures of the leg but none of the thigh. The treatment of these compound fractures, when involving these small bones, should be along the same lines described in the care of lacerated wounds. We have successfully closed one compound fracture of the tibia and fibula on the seventh day; and we have successfully closed a large compound fracture of the tibia and fibula with a 5-inch wound in the overlying soft tissue by primary suture six hours after the accident occurred. The question of secondary suture, which has not entered into the problem of the care of the incised, punctured, perforated and lacerated wounds, because of the rapidity with which they have closed of themselves, of course, enters into the problem of the care of the massive wounds, as compound fractures of the long bones. Our study of the bacterial counts of the wound has demonstrated that it is possible to bring the count to the point of clinical sterility, one bacterium per five microscopic fields, for three successive days, just as promptly as with hypochlorite.

Wounds.—(*d*) *Massive.*—In which it is mechanically impossible or surgically undesirable to close by sutures. Here the primary operation in

no way differs from that of the treatment of lacerated wounds, except in degree. In these wounds the question of dependent drainage is always to be considered, and provided, if surgically indicated. At the completion of the operation the surfaces of the wound are thoroughly covered with a 20 per cent. solution of oil and then wide-meshed paraffined gauze strips are placed directly in contact with the raw surfaces of the wounds to make the subsequent removal of the dressings painless. Over the paraffined gauze not more than 4 layers of gauze should be placed.

Dichloramine-T is prepared from toluol by a series of chemical reactions which lead to a substance having the following structural formula:



Its use as a disinfectant is dependent almost wholly on the reactions of the NCl_2 group in the side chain. In this group the chlorine (Cl) is very loosely held and is given off whenever the substance comes in contact with any other material having an affinity for chlorine. When detached from this compound chlorine it is in the free or nascent state and exerts all of its characteristic elementary reactions.

Free chlorine unites with nearly all common substances and materials to form chlorine compounds which are as a rule less stable than those substances from which they came. The well known action of bleaching powder depends upon this fact. It is the chlorine in the bleach which attacks the colored substances in cloth, forming chlorine compounds with them. These chlorine compounds are subsequently destroyed by the oxygen of the air or other agencies. The union of chlorine with other substances is greatly hastened by the presence of water or the moisture of the air, by the action of light, particularly direct sunlight, and by heat.

To return to Dichloramine-T; this substance is almost insoluble in water. It is soluble in a considerable number of organic solvents and oils. It is soluble, for example, in benzol, chloroform, carbon tetrachloride, alcohol and acetone. It is soluble in many essential oils, eucalyptol among them. Those solutions in which the solvent cannot be attacked by chlorine are stable. The compound carbon tetrachloride contains all the chlorine it is capable of taking up—it is saturated with chlorine, and therefore Dichloramine-T in such solution is stable. Alcohol on the other hand is broken down by free chlorine, it rapidly abstracts chlorine from the Dichloramine-T and is itself changed to other substances and the alcoholic solution of Dichloramine-T keeps but a very short time.

For the purpose of applying it to wounds the Dichloramine-T must be in solution. Carbon tetrachloride or chloroform would be good solvents because of the stability of the solutions, but are not suitable to apply to living tissues in quantity for a long time. Eucalyptol has been chosen after a very careful search as the best available solvent to use for the application of Dichloramine to the tissues.

Eucalyptol has, however, an affinity for chlorine such that it quickly breaks down the Dichloramine-T. This makes it impossible to use it directly. Eucalyptol can be first treated with chlorine and its affinities are thus partly saturated. This chlorinated eucalyptol is a good solvent for Dichloramine-T. Its chlorine affinities cannot be completely satisfied, however, and the stability of the solution is far from perfect. Dissolved in chlorinated eucalyptol, Dichloramine-T is slowly broken down, that is, the chlorine is given off and the toluol-sulphon-amid (an intermediate product between toluol and Dichloramine-T) is left. This substance crystallizes out. The chlorine given off is partly set free into the air and partly acts further on the eucalyptol to produce irritating volatile products. The decomposed solutions frequently cause much irritating pain when applied to wounds.

The breaking up of Dichloramine-T in chlorinated eucalyptol is hastened by the presence of water, alcohol, or anything else that has an affinity for chlorine. The chlorinated eucalyptol is capable of taking up a certain amount of water from the air. The breakdown is hastened by the action of light and by any rise in temperature.

For the foregoing reasons particular attention must be paid to the following points in handling Dichloramine-T and its solutions:

1. All bottles should be of a dark amber, glass stoppered. They should be thoroughly cleaned and dried before any of the materials are put in. If alcohol is used for drying the bottles, it should be allowed to completely evaporate before the bottles are used.

2. No solutions should be returned to the stock bottles from the ward bottles or atomizers at any time.

3. Bottles in which the solution has already undergone decomposition should be very carefully cleaned with hot water and then dried thoroughly before being used again.

4. If, in using the 20 per cent. solution, medicine droppers or glass rods are used to transfer the oil to the wound surfaces the droppers should be dry if put into the oil bottles. The common practice in some places has been to boil these utensils to sterilize them and then to use them while still wet. This results in the gradual accumulation of water in the stock bottles and a very rapid decomposition of the Dichloramine-T. The glass rods or pipettes or syringes if left in contact with the oil for five or ten minutes are entirely sterilized and do not need boiling. The method we have followed is to pour the required amount for the wound into a clean dry medicine glass and to take the oil with the pipette from this second container.

If these precautions are faithfully observed, no trouble from the decomposition of the solution will be encountered. We have repeatedly kept the 20 per cent. solution on the laboratory desk in brown bottles for three to four weeks before it decomposed.

Dr. Paul A. Lewis demonstrated an experiment improvised to emphasize the fact that the Dichloramine-T solution in oil gives off chlorine to water continuously over a number of hours, by taking a solution of starch

and potassium iodide and floating the oil solution of Dichloramine-T on its surface. The test for free chlorine is dependent on the exhibition of free iodine; chlorine replaces the iodine in potassium iodine and sets iodine free, which free iodine gives the blue reaction with starch. If one mixes a watery solution containing free chlorine with this it will give immediately and completely the starch reaction for free iodine. The experiment with oil shows that the decomposition is very gradual and continues for a long time. By adjusting these solutions a little differently one can show that the solution will become progressively more intense in its color during 24 hours.

Early in the spring Dr. Lewis visited Dr. Lee's surgical clinic where he had begun to use Dichloramine-T. The contrast between the condition of his patients and those seen in surgical dispensaries 10 or 15 years ago was so striking that he was convinced that unless some very radical change in surgical technic had taken place there must be something very good in Dichloramine-T. Visits to other clinics showed conclusively that no general advance in methods had taken place. This influenced him to try to oblige first Dr. Lee and Dr. Sweet in a very small way and to try to supply this solution for their use both here and abroad. The requests have increased in number gradually and it has seemed a duty, under the circumstances, for the Phipps Institute to supply what was needed to give a fair and extended trial to the material.

Laboratory men years ago had gradually come to the conclusion that what we know as a general antiseptic could be of little value in the treatment of infectious diseases or infected wounds. They had therefore been turning their attention to what they termed specific or partially specific disinfectants. Salvarsan is the outcome of that general idea. It is really revolutionary from the laboratory man's point of view that chlorine in any form should be found to be applicable in this way because chlorine is a general disinfectant and as such would have been expected to be a general protoplasmic poison; fully as destructive to tissue as to bacteria. It is an agent which destroys everything with which it comes in contact unless carefully controlled. The method of its control had never been developed until Dakin's studies led to the modified Labarraque's solution now known under his name. So adjusted, it has a certain disinfectant value in concentrations which do not destroy tissue. Dichloramine-T is a further advance in the direction of the controlled use of chlorine.

In another respect Dichloramine has been revolutionary. Koch thought that disinfectants in oil were useless. The fact is that this idea was based upon correct observation but it has no general application. Koch found that phenol, a strong disinfectant in water, was much reduced in activity by solution in a vegetable oil. These experiments were used as the basis of the generalization that disinfectants in oil were quite useless. Dichloramine-T shows that this generalization was incorrect and that oily solutions can be expected not only in the instance of Dichloramine-T but in other instances to do a great deal that water solutions will not do. Observations by Professor

A. N. Richards and Mr. McMaster, during the past summer, have shown that phenol itself is less active as a disinfectant if dissolved in water than in a mineral oil. The whole question of disinfectants which are soluble in oil will have to be gone over again. We have made only the barest beginning of that work this summer.

Some have said that the Dichloramine-T is not a disinfectant, that all its value is due to the eucalyptol. It is easy to understand that in the present chaotic condition of the question some one may have done an experiment which has led with more or less propriety to this conclusion. On the other hand, the experiments of Richards and McMaster do not lead to any such conclusion. He did not, however, consider that these experiments are by any means final or conclusive in the particular figures mentioned.

Phenol in a good grade of paraffin oil kills in 0.3 per cent.; eucalyptol fails to kill in 10 per cent. Chlorinated eucalyptol gives no killing in 100 per cent. in 24 hours; it is less active than eucalyptol. Dichloramine-T in solution has given very variable results; dissolved in chlorinated eucalyptol 0.3 per cent. has killed in 24 hours—equivalent to phenol. Dissolved in eucalyptol and paraffin oil in the hands of Richards and McMaster concentrations of from 0.03 per cent. to 0.002 per cent. have killed cultures. There can be no question that Dichloramine-T is a very strong disinfectant.

There is one other question which should be raised. We have no method really of contrasting properly or of stating on the basis of any of our laboratory tests what the therapeutic value of a disinfectant is going to be. The relative activities in test-tube as expressed in phenol coefficient, of course, mean nothing. We should know the relation between the disinfectant value and the amount that can be applied to the tissues, but have no satisfactory way of determining or expressing this. In this respect, without being able to be very precise either as to its exact disinfectant action or its exact ability to affect the tissues, we can say without question that Dichloramine-T is in a practical sense by all odds the strongest disinfectant that we have. We can apply to tissue at least once, and probably twice or three times, a 20 per cent. solution of Dichloramine-T in strong chlorinated eucalyptol. The solution is thus far stronger than phenol in the surgical sense because it is well known that a 5 per cent. solution of phenol cannot be safely applied and that a 1 per cent. solution may lead to gangrene if frequently applied.

Capt. Wm. H. Furness, M.R.C., said that for the use of Dichloramine-T in the treatment of contaminated and of infected wounds, the technic which Lieut. Walter E. Lee devised, in contrast to the elaborate technic employed by Doctor Carrel in the use of Dakin's hypochlorite solution, is simplicity itself. The technic embodies, of course, the fundamental principles of surgery and of asepsis; beyond these there is but little required other than a knowledge of the chemical actions and reactions of the dichloramine, which Dr. Paul Lewis has so clearly and concisely demonstrated.

In surgical dispensary work, where all the cases are ambulatory, the treatment with Dichloramine-T can be carried out with such simplicity and

system that the time required for a given number of dressings is less than one-third that required for the usual dressings with any of the other antiseptics, and the amount of gauze and of absorbent cotton and the number of bandages necessary is one-eighth of that ordinarily used.

The system consists of dividing up the work into three stages: the patients themselves remove the outer layers of bandage or of adhesive strips before coming up to the dressing table, but they leave in place the innermost dressing which covers the wound. The surgeon removes the inner dressing with sterile forceps and then gives to the wound whatever attention it may require, such as removing sutures, blotting up excess of secretions, or oozing of blood, etc., and then the nurse, who attends to the sterilization of the instruments also, sprays the oil over the wound from an atomizer; the surgeon renews the four layers of gauze (all that is necessary) over the wound and the patient passes on to an assistant to have the dressing held in place by the fewest possible turns of a gauze bandage. Or the dressing may be held in place by means of short strips of rubber adhesive plaster provided with eyelet-hooks on one end. These strips are placed on either side of the dressing and a light rubber ring is laced across; this not only holds the gauze in place but allows free ventilation to the wounded surface—an important requisite in dichloramine dressings.

With such a system the average time required for the third or fourth day's dressing of the ordinary dispensary wounds is about thirty-five or forty seconds; the whole treatment of the wound is, however, performed with strict attention to asepsis, the surgeon's rubber-gloved hands touching nothing but sterilized instruments, and everything that comes in direct contact with the wounds has been carefully sterilized.

The articles required on the dispensary dressing table are as follows. This number of instruments is found to be necessary in order to keep up a constant rotation between the sterilizer and the trays for sterile and soiled instruments: A small electric or a gas sterilizer. Tray for sterile instruments. Tray for soiled instruments. Instruments: 6 pairs of dissecting forceps, 4 pairs of scissors (2 pairs of sharp points, 2 pairs curved), 2 pairs of hæmostats, 4 grooved directors, 1 Luer syringe with glass pipette, 1 pair sterilizer forceps. A glass atomizer, preferably one with a small reservoir attached directly to the spraying tube. Gauze dressings cut and folded in the following sizes: one and a half by two inches; two and a half by three and a half; and four by six inches. Cotton sponges; these should be, for convenience, about the size of a hickory-nut and wrapped in a single layer of gauze to prevent the cotton fibres from sticking in the wound. Small cotton applicators (on wooden sticks). A small medicine glass. An amber glass, glass-stoppered stock bottle of Dichloramine-T.

Dr. George M. Dorrance said that in his service at St. Agnes Hospital, they had had great difficulty in carrying out the Carrel method of treatment on account of the frequent changes in their nursing force, and the changes of residents and assistants. Their results, therefore, with the Carrel treatment

have not been the results that Dr. Carrel reports. Their technic with the Dichloramine-T has not necessitated this refinement of technic and they have therefore been able to obtain more satisfactory results. Several cases stand out prominent in his mind: First, a knee-joint where half the outer surface of the joint was exposed and the joint was filled with street dirt. The wound was cleansed and a 20 per cent. oil used. The joint now is closed and a limited amount of motion is present. Case II, a stab wound of the pleura, was injected by the interne. This closed by primary union. In skin grafts they had been able to obtain takes in 85 per cent. of the grafts. Burns have healed more rapidly and with less constitutional symptoms. Compound fractures which were infected and dirty from street dirt have healed more rapidly, and usually without any suppuration. In the smaller wounds, infections are seldom seen and the amount of dressings and dressing time have been greatly diminished.

In the use of this oil, one must not forget to adhere to the usual surgical principles and particularly stop all hemorrhage. A number of patients have complained of the amount of pain, but he does not think it is any greater than one experiences with the average dressing.

BIRTH INJURIES OF THE SHOULDER*

By Astley P. C. Ashhurst, M.D.
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The clinical entity known as brachial birth palsy has been the subject of a number of rather controversial papers in recent years. These controversies have had to do both with the pathogenesis of the affection and with its treatment. The present contribution to this discussion is based on a careful study of about forty patients seen within the last few years in my services at the Episcopal and Orthopædic Hospitals, and is an effort to systematize the treatment of a condition still too frequently overlooked by the average practitioner, or, even if not overlooked, too often neglected. It is difficult to systematize the treatment of an affection whose pathogenesis is not known; but in spite of much study I must confess that my views on the latter subject are still uncrystallized. But I know that much good may be accomplished by definite lines of treatment and much harm done by neglect or by misdirected efforts. This is, in fact, one of those departments of surgery in which Science still lags behind Art; but as experience accumulates there is every reason to believe that Art, like Wisdom, will be justified of her children.

First brought prominently before the profession in 1872 by Duchenne, it was an affection long regarded as of interest solely to neurologists, owing to the prevalent theory as to its causation: Duchenne taught that the lesion was in the brachial plexus, but as his observations are recorded in a text-book devoted to Local Electric Treatment he did not enter into the question of exact anatomical localization of the lesions. Erb, in 1874, studied the similar but much rarer affection in adults, and specified more particularly that the lesion occurred at the junction of the fifth and sixth cervical roots of the brachial plexus. He thought it was due to direct pressure at this point ("Erb's point"). The teachings of Duchenne and Erb have dominated the minds of medical men until within recent years. It is true that Küstner, in 1889, stated that all such cases seen by him really were instances of separation of the upper epiphysis of the humerus; but his views were not accepted by others. Moreover, Whitman, in 1905, in a brief paper which seems to have been completely ignored until recent years, called particular attention to posterior dislocations of the shoulder often associated with this condition, and urged rational treatment of the dislocation when present on the plan adopted in cases of congenital dislocation of the hip. He expressed the belief that true congenital dislocation of the shoulder was exceedingly rare, as was also a dislocation due to injury during birth; holding that the posterior dislocations so often accompanying brachial birth palsy were the result of the paralysis, not of the birth injury. A. S. Taylor, still upholding

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the purely neurogenous theory, reported in 1907 a series of cases in which operation had been done by him on the brachial plexus, and referred to some experiments by himself (1905) tending to show that it was possible for the roots of the plexus to be ruptured by traumatism (see paper by Clark, Taylor and Prout).

Meanwhile, general surgeons had been studying cases of the similar lesions seen in adults, to which Erb at first called special attention. Duval and Quillain, in 1898, as a result of their studies, came to the conclusion that there were no such clinical entities as paralyses due to lesions of the brachial plexus, only two types existing, *radicular* and *terminal,* affecting either the spinal motor roots or the nerve-trunks below the plexus. Subsequent observations appear to have confirmed these conclusions, both as regards the injuries occurring at birth and those encountered during adult life. Delbet and Cauchoix in 1910 collected 36 cases of paralyses complicating dislocations of the shoulder: 25 of these were *terminal* paralyses, and were the sole lesions produced by the dislocation itself; the remaining 11 lesions all were *radicular* and were due not to the dislocation, but to the cause which produced the dislocation. There were no true lesions of the brachial plexus in this series.

Now T. Turner Thomas, who had been studying the "stiff and painful shoulders" for which Codman and others have erected a pathology based on so-called subdeltoid bursitis, turned his attention to the pseudoparalyses often, if not indeed usually, present in these cases, and at a meeting of the Philadelphia Academy of Surgery in October, 1910, proposed the theory, to which he has steadfastly adhered, that in almost all such cases, birth injuries or adult injuries, the supposed paralyses are secondary to a primary lesion of the capsule of the shoulder-joint; that the effused blood, lymph and synovial fluid catch the nerves in cicatricial tissue; and that the dislocation so frequently accompanying the birth injuries is primary, and therefore the cause, not the result, of the brachial palsy. Similar teachings were subsequently (June, 1912) promulgated by Lange; but neither Lange nor Thomas has been able to secure general recognition of the truth of their doctrines.

Sever and J. J. Thomas (1916) have recently published two studies based on 470 cases of brachial birth palsy, personally observed by one or both of them. Sever refers to his "numerous dissections on infantile cadavers" which showed that "traction and forcible separation of the head and shoulder puts the upper cords, the fifth and sixth cervical roots of the brachial plexus, under dangerous tension." This confirms Taylor's experiments of eleven years previously, and it may perhaps be accepted as proved that such a lesion can occur during obstetrical delivery by a similar mechanism.[1] The theory of direct pressure on the plexus as a cause has been abandoned. In his experiments Sever was unable to rupture the joint capsule, to separate

[1] However, it may well be, as suggested in a personal communication by T. T. Thomas, that the preservative fluid makes the brachial plexus of infantile cadavers more prone to laceration than is the plexus in the normal baby at birth.

the epiphysis, or to dislocate the head of the humerus. He notes, however, that in 1900 Stone had been able easily to separate the epiphysis; and T. T. Thomas says (*loc. cit.*, 1914, p. 212) that he has in several infant cadavers obtained by hyperabduction an epiphysial separation or a fracture of the upper end of the humerus, but the capsule was stronger than the humerus, as suggested by Lange. But the contention of Thomas is that rupture of the capsule is produced not by hyperabduction (which, as already noted, produces epiphysial separation or fracture) but by direct pressure on the humerus and acromion by the maternal pelvis, the arms being flexed and adducted at the shoulder (*loc. cit.*, 1914, p. 212).

As a result of these divergent views of the pathogenesis of the condition, there has been equally great divergence in the methods of treatment recommended; and until within the past ten years no very active treatment of any kind has been instituted even by neurological or orthopædic surgeons. My own active interest in the condition was aroused not much more than five years ago, by the apparently increased frequency with which patients of this type were being seen, and the consequent necessity of systematizing their treatment. My views of the pathogenesis were briefly expressed in discussing the views of Thomas already noted (*Trans. Phila. Acad. Surg.*, 1914, xvi, 235; ANNALS OF SURGERY, 1914, lix, 142). These views I still hold:

"First, that pure nerve lesions occur, and may be of much greater importance than any injury to the shoulder-joint even if this is present; and, second, that posterior subluxation of the humerus is a frequent lesion, often overlooked, and perhaps may be the cause of persistence of paralysis." Dr. Thomas, in reply, said "that he did not mean to say that none of these cases of birth palsy were due to rupture of the brachial plexus, but he believed that none of his twelve cases were. He thought it fair to say that most cases are not."

Formerly, babies with "birth palsy" which came under my notice at the Orthopædic Hospital, in the services of my chiefs, G. G. Davis and R. H. Harte, usually were referred to the Nervous Department of the Hospital, and seldom or never returned for observation by the surgeons. I remember asking the neurologists what became of such patients in adult life; and the consensus of opinion seemed to be that they all recovered without disability, as none of the neurologists whom I questioned had ever seen an adult who had had "birth palsy." I remember also that occasionally when these babies were brought to us at a very early age and the shoulder seemed particularly painful, the diagnosis made was epiphysial separation of the upper end of the humerus; then they were retained under surgical care, the arm bandaged to the side or in a sling, until acute symptoms subsided, and, after being referred to the mechanotherapeutic department for massage, were again lost to sight. I remember only one case diagnosed as "congenital dislocation of the shoulder"; this was in a boy of seven years or thereabout, with a subspinous dislocation of the left shoulder, and with the history that it had been present from birth. There was no question of the presence of the dislocation; and though the question of the etiology (whether truly a congenital deformity, or from trauma during parturition) was discussed, no satisfactory conclusion was reached, and as no active treatment was urged, the patient did not return. There was only slight disability and no apparent paralysis.

When I began to pay particular attention to these patients, stimulated largely by conversations with G. G. Davis and T. T. Thomas, it did not take very long to learn that the reason they had ceased to be brought to the clinic was not because no disability remained (though this was the case in a few) but because the parents were led to believe the condition was hopeless and that nothing more could be done.

It is the contention of the neurologists that the lesion occurs in most cases at the junction of the fifth and sixth cervical roots as they join to form the upper cord of the brachial plexus. This point is just above the origin of the suprascapular nerve supplying the external rotators of the shoulder; and it is these muscles which are most constantly paralyzed. They point out, moreover, that from the fifth and sixth roots comes also the musculocutaneous nerve, supplying the flexors of the elbow (biceps and brachialis anticus); while the axillary (circumflex) nerve supplying the deltoid (usually also paralyzed) comes almost entirely from the fifth cervical. But they conveniently ignore, or seek to explain by plausible arguments, contrary facts, such as that the very same nerve roots transmit fibres for the subscapularis muscle, the pectoralis major, the latissimus dorsi, the teres major, and the pronator radii teres muscles, none of which, as a rule, exhibit any lasting paralysis, if indeed they were not intact from the very moment of the injury. A. S. Taylor, Fairbank, Sever, and others, all acknowledge the truth of the common teaching that the subscapularis is supplied by fibres derived solely from the fifth and sixth cervical, and yet it is never found paralyzed. Fairbank alone boldly faces the dilemma, and, though he admits freely that this muscle by its contraction is responsible for the posterior subluxation of the shoulder, being unopposed by the paralyzed external rotators, puts forth this explanation: that "recovery of the nerves has taken place before this deformity has occurred or at any rate become fixed, and in cases in which the paralysis is permanent the subluxation does not occur." This is clearly an untenable theory: if recovery of the nerves to the subscapularis occurs with such regularity, why does not recovery of the nerves to the other muscles also occur, if the lesion has been where all the fibres pass in a common trunk? Moreover it is simply not true that posterior luxation does not occur when the paralysis is permanent; witness my Case V. Unless, indeed, he means that posterior luxation does not occur if the subscapularis remains paralyzed; but I do not know of any cases reported in which paralysis of this muscle has been observed. A. S. Taylor seems to have had but a confused idea of the effect of these paralyses: he refers to the deformity which develops from *contractures of the paralyzed muscles and the ligaments of the joints.* Thus he assumes that *contracture* of the subscapularis occurs because it was paralyzed (of which there is no

evidence), but he attributes *relaxation* of the external rotator muscles to their paralysis, and yet considers the limitation of elbow extension due to *contractures* of the paralyzed flexor muscles. It is despair over a theory such as this, which blows hot and cold out of the same mouth, that encourages others than neurological surgeons to look elsewhere for an explanation of the phenomena encountered in this still obscure condition.

Unless the anatomy commonly known is incorrect, I do not see how the immunity of certain muscles, especially of the subscapularis and teres major, can be explained, if the nerve lesion is supposed to be at the juncture of the fifth and sixth roots. The descriptions of what has been found at operation soon after birth are so vague that not much reliance can be placed on such observations; this vagueness probably is due to the impossibility of telling, even with the nerves exposed to view, how much they were damaged. In cases operated on months or years after the injury occurred, the extent of the scar tissue and the difficulty of the dissections render such observations also of limited value. It may well be, as indicated by some of these operations, that the suprascapular nerve itself (below the plexus) is damaged at the time of the original injury. Indeed it has occurred to me that it may be not improbable that all the nerve lesions in the majority of these cases are *terminal* and not *radicular*. Consider the course of the nerve-trunks (terminal) which supply the various groups of muscles: *all the muscles most constantly paralyzed are supplied by nerves which pass very close to the shoulder-joint* [2] and *ipso facto* are liable to injury; whereas *the muscles which habitually escape paralysis are supplied by nerves which at no part of their course come into close relation with the shoulder-joint or the bones which compose it.*[3]

This seems to bring us very close to the theory of Thomas and Lange, that the primary lesion is in the shoulder-joint, and that involvement of the nerves occurs secondarily. It is indeed a question in my own mind whether this is not the most acceptable theory for the majority of cases; but as already stated, I do believe that radicular lesions of the nerves occur, though in a comparatively small proportion of the total number of cases of birth injury.

When lesions in nerves occur by overstretching, it is accepted that rupture of the sheaths occurs first, permitting hemorrhage among the nerve fibres; eventually, if traction is continued, partial or complete rupture of the nerves themselves occurs. Any degree of injury, trifling or complete, may occur in this way; and it is a matter of common experience that in almost all cases of birth injury a remarkable improvement occurs without any operation, if proper non-operative treatment (massage and passive movements to prevent contractures) is begun soon after birth (Case I). Hence it is safe to assume,

[2] These include the suprascapular (most often injured), musculocutaneous, and the circumflex; the musculospiral also is frequently injured.

[3] These include the subscapular nerves, the median and ulnar nerves, the anterior thoracic nerves (to the pectorals), and the nerves to the rhomboids and to the serratus magnus.

in the majority of cases, that the nerve lesion, wherever and whatever it is, is not very extensive, and that in such cases no operation on the nerves is advisable. But there are cases, few in number, in which to my mind the evidence of extensive nerve lesion is undoubted (Cases IV, V, VIII, X, and XIII); Sharpe speaks as if he had had experience with this class of patients alone, and at least it is to be hoped that he is not subjecting all the milder cases to exploratory operation on the nerves. He says he has operated on 56 patients in all. Unfortunately none of his cases are reported in detail, and it is impossible to judge how much improvement has been secured, and especially whether any greater improvement has been secured than may be obtained by non-operative means. Most of his operations probably were too recent for end-results to be available; but until he can show better end-results than are being secured by others without operation on the plexus, he cannot expect his views to have great influence. His chief argument in favor of early operation appears to be that even if it proves useless it will be harmless. He acknowledges that it is usually impossible to tell without direct inspection of the nerves whether or not they are seriously damaged; but he contends that it is more to the patient's interest to have an exploratory inspection of the nerves than to wait until it may be determined clinically whether or not serious nerve damage is present. In cases of apparent "total paralysis" he urges operation at the age of one month; half of those patients so treated, he says, have shown marked improvement. But it is equally true that at least half, if not more, of such patients treated without early operation also show marked improvement; it is true they do not recover nearly as good function as do those patients in whom soon after birth the apparent paralysis was not total. Those infants he has operated on at the age of three months have shown more constant improvement, because, he claims, the paralysis was less severe at first; but he believes a still greater improvement would have occurred if operation had been done at the age of one month; and he seems to urge this early resort to operation in *all* cases in the future. Older patients, he says, give the worst results. In opposition to operative measures to lessen the mechanical disability of the patient (by reducing the dislocation, if present, by tenotomies of shortened muscles, etc.) he states: "I have yet to see cured by this method of treatment one case of brachial plexus paralysis in which at birth there was total paralysis of the arm, hand and fingers." Improvement, he admits, may occur even without any treatment, but he thinks it rarely continues beyond one year of age, and a useful arm is never obtained. If he really limits his remarks to cases of "total paralysis," probably all will agree with him, but will point out that no such cases have been "cured" by neurological surgery.

As regards *treatment*, then, I reject nerve operations in early infancy. Babies are seldom if ever seen for the shoulder injury until they have reached the age of three or four weeks. At this time they either have or have not a demonstrable dislocation.

In case *no dislocation is present*, I believe the proper treatment consists,

as pointed out by G. G. Davis, in keeping the hand and arm in front of the body (so as to prevent extension of the elbow and excessive internal rotation of the shoulder) by putting the arm in a sling or by pinning the sleeve to the front of the dress. In addition, as soon as the soreness of the birth injury permits, passive motions should be instituted, especially external rotation and abduction of the shoulder, to prevent shortening of the subscapularis and anterior capsule. Massage also is of value, and above all the child should be encouraged to make active movements of the kind indicated above. Electricity certainly has some value, at least in children of the age of six months or older. I think its value in early infancy is open to question. If these patients are treated in this way from the time of birth, most will recover with little permanent disability. In a few such patients, and in most of those seen for the first time a number of months after birth (especially if dislocation of the shoulder is present), additional measures will be necessary as detailed below.

In case *dislocation is present:* In some patients there can be no doubt that the dislocation was present at birth; but it is a question whether there are any examples of dislocations of the shoulder which were present *in utero, i.e.,* truly "congenital" dislocations.[4]

It is possible in some babies seen very soon after birth that proper treatment as above indicated will secure reduction of the dislocation by passive motions (Case IV). But in all cases where the dislocation is at all pronounced, I think it is advisable to anæsthetize the child at about the age of six months, and to reduce the dislocation bloodlessly in a manner analogous to that employed by G. G. Davis in treating congenital dislocations of the hip: the baby is placed prone on a well-padded orthopædic table, with the affected extremity hanging over the side of the table. Owing to the internal rotation of the humerus the arm will not hang vertically downward, but will point toward the patient's feet. First, this internal rotation should be overcome by very gently but persistently rotating the humerus outward by means of the flexed forearm. When the forearm has been brought thus into the horizontal plane (the coronal plane of the patient's body) direct downward pressure should be made on the head of the humerus, which usually will be felt to jump forward into normal relation with the glenoid process. Reproducing the dislocation and again reducing the head several times will leave no doubt in the mind of the operator or assistants that proper reduction has been secured. When the head of the humerus has thus been forced out onto the glenoid eminence, it will be found that the elbow can no longer be fully extended, owing to the shortening of the flexor muscles (long and short heads of the biceps and the coracobrachialis). This is analogous to the shortening of the hamstrings produced by reduction of a congenital dislocation of the hip. As in the case of the hip, so also at the shoulder, the head of the dislocated bone may be palpated anteriorly so soon as reduction is secured. It still remains to secure abduction of the shoulder-joint. This is most safely done by moving the child away from the edge of the table, so that the arm no longer hangs over the side of the table but lies upon it. With the flexed elbow lying upon the surface of the table, and the child's chest flat on the table, it will be observed that the shoulder is kept some distance above the table, by the tension of the anterior capsule and subscapularis muscle. Intermittent downward pressure is then made upon the posterior surface of the shoulder until its anterior surface comes into contact with the surface of the table. Then the elbow (still flexed) is very gradually raised from the table, by placing beneath it first one, then two, and later three or four folded towels, while intermittent downward pressure is made on the posterior surface of the shoulder. This process should be continued until the elbow lies well posterior to the frontal plane of the patient's body. There will now be little tendency for the dislocation to recur, and the entire upper extremity and chest are to be encased in plaster-of-Paris to maintain this position. This gypsum case should be retained for six weeks, when it should be renewed, with the arm in the same position; the second case should not be removed for six weeks more, thus maintaining reduction in the overcorrected position for a period of three months. If a shorter period of overcorrection is permitted, the dislocation tends to recur, especially in older patients. I have found that after the age of four years bloodless reduction is not efficient. It does more damage to the structures of the joint, and accomplishes less than bloody reduction by arthrotomy.

In patients over four years of age I recommend the following method for reduction of the dislocation:

A curved incision is made, as advised by Senn, around the acromion and about 3 to 4 cm. distant from it, from the coracoid process in front to the spine of the scapula behind (Fig. 1). This incision is deepened until the deltoid is exposed, and the skin and fascia are then turned upward as a flap, thoroughly exposing the acromion and the acromioclavicular joint. An incision is then made through the fascia and periosteum covering the spine of the scapula, and this spine is bared by stripping the periosteum from it until a guide can be passed under the base of the acromion, to protect the suprascapular nerve and vessels (Fig. 2). The acromion is then osteotomized obliquely at its base, the acromioclavicular joint is opened, and the acromion is turned forward, carrying with it the deltoid (modification of Kocher's

[4] I do not know how to explain the conditions encountered in Case IV. It is difficult to explain the persistency with which the arm rebounded to the highly abnormal position in which it was found at birth unless we admit that this position had been long maintained *in utero.* Though the labor in this case was difficult ("version was attempted"), it might be that the difficult labor was caused by the malposition of the arm *in utero,* not that the labor produced this malposition. Certainly in all ordinary recent traumatic dislocations, when the dislocation is reduced the deformity does not recur immediately, as it did in this patient during a period of from three to four months after birth. However, in this patient there is no reasonable doubt that there was injury in birth, since even as late as May, 1917, when the child was in her fifth year, considerable paralysis remained, the hand being almost useless, though the shoulder and elbow were normal.

method for excision of the shoulder). This thoroughly exposes the upper aspect of the shoulder-joint (Fig. 3). The long tendon of the biceps is identified; on its median or anterior border lies the lesser tuberosity, while laterally or posteriorly lies the greater tuberosity.[5] To secure normal external rotation of the shoulder, the insertion of the subscapularis is now divided while kept under tension by an assistant endeavoring to rotate the humerus outward. At once reduction of the posterior dislocation becomes possible without difficulty, and usually abduction also now becomes free; but if it is still resisted it may be necessary to divide or lengthen the tendon of the pectoralis major through a separate incision. Next, while the humerus is maintained in full external rotation and abduction, the tendons of the supraspinatus and infraspinatus and teres minor muscles, as they insert into the greater tuberosity, are plicated by mattress sutures of chromic gut, thus shortening them, and maintaining the head of the humerus in its forward and externally rotated position. The acromion is now replaced. In some cases it is so much deformed that it will no longer fit in its former position, as the place its tip formerly occupied is now held by the reduced head of the humerus. It is then necessary to remove a section from the sawn surface of the acromion, in order to raise its tip out of the way of the shoulder-joint (Case X). The acromion in younger patients is largely cartilaginous and may be held in place by sutures of chromic gut including the overlying periosteum, fascia and muscles, as well as the bone; but in older patients screw fixation is preferable. The skin flap is then replaced, and sutured without drainage, the arm being constantly maintained in the "light-house position." The plaster-of-Paris dressing is not to be changed for six weeks, when a new similar fixed dressing is applied for a second period of six weeks.

After removal of the dressings it is important to resume active and passive movements, especially to encourage external rotation, abduction and supination. I have adopted this operation in five cases, with no recurrence in any patient, and marked improvement in all (Cases V, VI, VII, VIII and X).

Even in older patients where no dislocation is present, very great disability may be caused merely by muscular contractures, and this may be relieved much more rapidly and efficiently by operative means than by prolonged courses of passive movements and gymnastics. The greatest disability in all these cases usually is due to *loss of supination* and to *loss of external rotation at the shoulder*. Even when all the muscles are strong and active, the children cannot get their hands to their mouth without abducting the humerus (owing to the fixed internal rotation), and in many cases they cannot

[5] In several cases I have found the bicipital groove located directly in the line of the external condyle, owing to excessive internal rotation of the shaft of the humerus below the tuberosities, presumably due to the unopposed action of the unparalyzed pectoralis major and teres major muscles. Hoffa, it should be recalled, treated some of his patients by osteotomy of the shaft of the humerus about its centre, rotating the lower fragment outward. This, however, does not overcome the chief cause of disability, namely, the internal rotation at the shoulder-joint, where the subscapularis is tense.

get their hands to their mouths at all, even in the position of pronation. Treatment by a series of plaster cases, endeavoring to overcome the contractures gradually, as in some contractures of tuberculous joints, has also been tried in my clinics, but has not been found so efficient as the cutting operation. For this purpose an anterior incision is made, as for excision of the shoulder, passing through the anterior fibres of the deltoid; the long tendon of the biceps is identified, and then the lesser tuberosity, where section is made of the tendon of the subscapularis. If contracture of the pectoralis major prevents full abduction, its tendon may be lengthened by Z-plasty or may be completely divided, through a prolongation downward of the same incision. I have not observed any disability to follow complete section of the tendon of this muscle, and believe it is simpler and therefore preferable to a formal lengthening operation.[6] I have employed this operation for birth injury of the shoulder in two cases (Cases XI and XII), and my assistant, Dr. A. Bruce Gill, has also adopted it with satisfaction.

In one case in the present series the disability at the shoulder arose chiefly from the paralysis of the deltoid; this was entirely relieved by transplantation of the pectoralis major to supplant the deltoid (Case XIII). In this same patient there was great disability as well from the residual paralyses in the forearm; function was materially improved by tendon transplantations.

In a fair proportion of patients with birth injury at the shoulder, who have not received adequate treatment soon after birth, considerable disability persists from deformity at the elbow. It is possible that the elbow is injured at the time of birth, but I am inclined to believe that the main deformity is gradually developed as the result of the malposition in which the elbow is held. The forearm is kept in full pronation, the elbow slightly flexed, and the whole limb internally rotated. The head of the radius gradually grows upward past the external condyle, and when seen in adolescence the patient may present a complete posterior dislocation of the head of the radius, as in Case X of the present series. All grades of subluxation may be present. It is known that in cases of hereditary deforming chondrodysplasia posterior dislocation of the radius is not unusual, owing to the lack of equal growth of the ulna; and it may be that disuse of the forearm and use of the hand (which is the usual state of function in patients with birth injury of the shoulder) tend to produce lack of development of the ulna (which is an elbow and forearm bone) and full development or even overdevelopment of the radius (which belongs rather to the wrist and hand than to the elbow or forearm).

The case histories which follow have been selected to illustrate the prognosis and treatment of certain types of the affection:

[6] Fairbank in 1913 described an operation similar to this, and Sever has lately described a modification of it as an original procedure; his modifications consist in making the incision in the deltopectoral groove (where the cephalic vein is in the way), and in dividing the tendon of the subscapularis on a grooved director.

(1) The usual mild case, recovering nearly perfect function under treatment by massage, passive and active movements, etc. (Case I).

(2) The same type of case, but complicated by posterior dislocation of the humerus (Cases II and III).

(3) The severe type, in which the residual paralysis causes far more disability than could any dislocation (Cases IV and V).

(4) The typical case of subspinous dislocation coming under treatment late, and with no disability except that due to the joint deformity (Case VI).

(5) The typical case of subspinous dislocation with moderate paralytic disability (Cases VII, VIII, IX, and X).

(6) The typical case of disability from contractures without either dislocation or paralysis (Cases XI and XII).

(7) The unusual type of flail shoulder (Case XIII).

The frequency of subspinous dislocation in the patients under my care is worth noting; it was present in more than 40 per cent.

Another feature which I think bears emphasis is the frequency with which two or more children in the same family are affected: in one instance three sisters were similarly injured in birth, and the fourth child was killed during delivery. In several other instances brothers or sisters have died at or soon after birth from injury; in one case (Case VI) 5 other children were killed at birth. There is room here for improvement in obstetrics.

CASE I.—*Birth injury of the right shoulder without dislocation; recovery under treatment by massage and active and passive movements.* Mollie R. was brought to the Orthopædic Hospital October 10, 1914, at the age of ten weeks. It had been a footling presentation, easy labor of four hours' duration, no instruments being used. There was one older child, now three years old.

Examination.—The right shoulder is held quietly by the side, in internal rotation. She makes no attempt to move the shoulder, but she moves the fingers slightly. No dislocation is present. The electrical report by Dr. Cadwalader shows that the deltoid does not react to Faradism, and Galvanic current causes too much pain to be used.

Treatment.—Massage and passive motions, three times weekly.

November 26: Has fair grasp in hand, uses arm a little. It can be passively raised above head and placed behind back. External rotation is limited a little within the sagittal plane.

January 9, 1915: External rotation is possible beyond the sagittal plane.

February 13: Nearly seven months old. Dr. Cadwalader reports: probably complete reaction of degeneration in the deltoid; no reactions of degeneration in other muscles.

June, 1915: Uses hand and arm all the time.

August, 1915: No dislocation has developed. Fair power has returned in the deltoid.

December, 1915: Puts hand to mouth in semisupination, and with shoulder slightly abducted. Scarcely any limitation of passive external rotation or abduction.

July, 1916: Can raise right arm above head almost as well as left arm. Puts hand to mouth and top of head easily, and can be placed behind back passively with ease.

October, 1916: Right arm almost normal. Dismissed from further treatment at the age of twenty-six months.

CASE II.—*Subspinous dislocation of right humerus; bloodless reduction at age of six months.* William A. F. was first seen at the Orthopædic Hospital November 6, 1913, at the age of three months. He had one sister, six years old, who was normal. This boy had been injured in birth which was not instrumental (L. O. A.) There had been a cephalhæmatoma at birth, over the right parietal, and this region was still palpably thickened up to the age of four months. He held his right arm at the side, in internal rotation, and all shoulder motions were limited, especially abduction. He has pain when the arm is moved. The hand, fingers and wrist are kept flexed, and the hand is in ulnar adduction. There is good power in the triceps, and a good grip in the hand, but no power of flexion of the elbow. The head of the humerus was palpable beneath the spine of the scapula, and a skiagraph (Fig. 4) showed the epiphysial centre for the head of the humerus not opposite the glenoid as on the normal side, but luxated out and up. As the child was brought from out of the city, the mother was directed to make the necessary manipulations at home.

December 4: The shoulder still is tender. When the humerus is abducted and externally rotated to the limit and pressure is made forward on the head of the humerus a distinct grating click or snap can be felt as the head slips over the posterior border of the glenoid. Active flexion of the elbow has developed.

February 5, 1914: Head of humerus still dislocated posteriorly, so on February 7, under ether anæsthesia, bloodless reduction was done, and the arm dressed in the light-house position. The child was taken home the same day, and the mother later reported that almost at once he began to show better use of his hand. Three weeks later it was noted that fair power of extension of the fingers had developed.

March 28: New gypsum case was applied, the humerus remaining in proper position.

May 7: Gypsum dressing permanently removed, the shoulder remaining reduced.

May 28: Since last note mother says he has been using the hand "just like normal." External rotation still limited at sagittal plane.

August 8: Can get hand to mouth, but only in pronation.

January 23, 1915: Uses right hand more than left, and beginning to hold his hand in supination. Active and passive exercises have been continued all the time.

March 20: Good extension in fingers, but none yet in wrist.

January, 1916: As progress seemed slow during the past year, the arm was again dressed in full abduction and external rotation in plaster-of-Paris (applied without any anæsthetic, at the limits of movement), and this dressing was worn for seven weeks. The power of supination and external rotation was decidedly improved when the cast was finally removed.

July, 1916: It was noted that the power of extension of the fingers and wrist was good.

December 30, 1916: Still prefers to use the left hand. Active movements: supination not quite complete, external rotation of shoulder only to sagittal plane; abduction and elevation of upper extremity about 30 degrees short of vertical. Passive movements: supination complete, external rotation about 20 degrees beyond sagittal plane; abduction (without elevation of scapula) about 50 degrees (limited by axillary fold muscles). There was a slight hollow beneath the acromion in front, and the head of the humerus was just palpable posteriorly beneath the spine of the scapula (subluxation).

March 10, 1917: The accompanying photograph (Fig. 5) was made, showing the boy putting his hand to his mouth.

CASE III.—*Birth injury of right shoulder, first seen at age of seven weeks. Dislocation of shoulder not observed until age of three years.* Ida May F. came to the Orthopædic Hospital when seven weeks of age, June 8, 1911. This was the first baby in the family, a head presentation, instrumental delivery.

Examination showed the right arm hanging by the side in internal rotation. The hand grasp was good; the anteroposterior motions (flexion and extension) of the shoulder were good, and abduction was fair. She could not flex the elbow. Passive motion was normal throughout, and there was no pain on motion. The epiphysis rotated with the shaft. There was some crackling in the region of the shoulder-joint.

Treatment consisted in bandaging the arm in the Velpeau position for two weeks; then massage, passive movements and electricity were given.

October 5, 1911: Can flex elbow, and has more use of shoulder, but it is still in internal rotation.

March 28, 1912: Slight improvement in strength.

June 11, 1914: Careful reëxamination reveals a posterior subluxation of the humerus at shoulder, with a hollow beneath the acromion. The use of hand and elbow are good. There is still limited abduction and external rotation at the shoulder. (It is highly probable that a more attentive examination soon after birth would have detected the posterior luxation of the shoulder; attention was now directed more particularly to this deformity on account of T. T. Thomas's paper.)

March 13, 1917: The child is now six years old. She was treated by massage and passive motions until two years ago. She now gets her hand to her mouth only with the forearm in midpronation and with the arm abducted. She gets her hand to her back easily and fastens her own petticoat. Supination is weak. There is no external rotation at the shoulder beyond the sagittal plane. A slight posterior subluxation of the shoulder persists. She uses her right hand normally, but prefers to use the left. Function could be improved by tenotomy of the subscapularis, and perhaps of the pectoralis major.

CASE IV.—*Subspinous dislocation (luxatio erecta) of left humerus from birth injury; persistent paralysis of hand.* Agnes T., ten weeks old, seen at Orthopædic Hospital, March 7, 1913. This is the fourth child, the previous births being normal. In the present instance "version was attempted" and at birth the left forearm was folded across the front of the baby's neck, in full pronation, and it has constantly rebounded to this position ever since when not held down by a bandage. The mother says that when two weeks old a long splint from axilla to palm was applied by the family physician, and was kept in place for two weeks; and that when it was removed the child could not move her fingers as well as when first born.

Examination at the age of ten weeks: the arm is held abducted to 90 degrees, and the head of the humerus is palpable beneath the spine of the scapula; there is some grating on attempts at rotation. A bony lump in the axilla is thought to be the glenoid. There is no active power to extend the fingers, wrist or elbow.

Two or three weeks later, the arm having been bandaged to the side constantly, it was noted that the arm stays almost against the side without being held down, and it is assuming the typical posture of "obstetrical palsy."

August, 1913: Now eight months old: the arm comes easily down to the side, and the head of the humerus stays in the glenoid. Wrist drop and paralysis of the triceps persist. Fair power in biceps, and fair grip in fingers; no power in axillary fold muscles; deltoid is doubtful.

October, 1913: Head of humerus is clearly anterior to acromion and there is no palpable deformity as compared with the uninjured side. Grip is good, the hand as a rule staying clenched and the wrist flexed, but not so persistently as before. No power yet in musculospiral; some power in pectoralis major. Dr. H. P. Boyer reported that the electrical examination of the muscles was a little doubtful, but he thought there was no reaction of degeneration in the pectorals or the extensors of the fingers. There was "some response to the Faradic current."

June, 1914: Very little further improvement has occurred. Massage and electricity have been given twice weekly. She can now abduct her shoulder (deltoid) to 90 degrees; the axillary fold muscles are good, and the biceps is good. There is no power in the triceps or in the extensors of the fingers; there is very slight power in the flexors of the fingers. The fingers are still held clenched and the wrist flexed. Passive movements: external rotation at the shoulder is easy to beyond the sagittal plane; the elbow can be extended to 170 degrees, supination is normal, but pronation a little limited. The mother says the child has been *biting* her hand (not very hard) for four or five months. A posterior splint was applied to keep the fingers and wrist in extension, and all other treatment was suspended.

August, 1914: Does not bite hand any more; hand no longer stays flexed, but there is no power in the fingers nor in the extensors of the wrist. The posterior splint was continued.

November, 1914: Has learned to hold a glass of milk or water in the bent elbow and drinks easily from it.

January, 1915: Burned the left elbow a few days ago, and it seemed to give her no pain. The finger nails of the paralyzed hand require to be cut about three times as often as those of the normal hand, the latter being worn down by use.

March, 1917: Now four years of age. The hand is useless—in flexion and ulnar deviation; she can barely flex the fingers. The biceps and triceps have very fair power. She gets the back of her wrist to her mouth, and holds articles in the bend of her elbow with great security.

CASE V.—*Subspinous dislocation of humerus, with complete flaccid paralysis of arm; reduction by arthrotomy.* Catharine B. came to the Episcopal Hospital in September, 1913, when past three years of age (Fig. 6). There were two older children: the first (now seven years old) had the left shoulder "broken in birth"; the second child (now six years old) had "the nerve hurt" in birth (right shoulder), but "both came all right about six weeks after birth." (See Cases V*a* and V*b*). A fourth child, born subsequent to this visit (in May, 1914) was killed during delivery.

Catharine was born head first, and no instruments were used. She seemed to have no sensation in the left arm. It has always been utterly useless. She chews the fingers, and has burned the hand several times without evincing any sensations of pain.

Examination.—There is complete flaccid paralysis of the left upper extremity; probably, it was thought, the lesion was a tearing out of the roots of the brachial plexus from the spinal cord. She has been seen by nerve specialists and orthopædic surgeons, who told the mother nothing could be done. Owing to the complete absence of sensation, persisting for over three years, this seemed reasonable advice, and it was repeated.

June 15, 1914: Nine months after the first examination the child was sent for, for reëxamination, especially as it had not been noted at the first examination whether or not there was a posterior dislocation of the shoulder. To-day it is learned that the child has not burned her fingers since Christmas, and that soon after the first of the year she began to move her fingers. She can now flex the shoulder slightly. The axillary muscles have fair power; there is some power in the biceps, and she can extend the wrist well. There is a subspinous dislocation of the humerus. Operation was now recommended to secure reduction of the dislocation, since it had been determined by an experience with six cases of reduction of similar dislocations (three "bloody" and three "bloodless" reductions), all treated since this patient was first seen, that a considerable degree of improvement might be expected in apparently paralyzed muscles if deformities were overcome and the weak muscles were allowed to work at a better advantage.

Operation (December 28, 1914).—Patient now four years of age. Senn's incision, with temporary resection of the acromion. The acromion was cut at its origin from the spine by an osteotome, but in turning it forward the acromion fractured through its epiphysial cartilage. The intervening detached piece of acromion was laid aside in dry sterile gauze and was re-implanted at the conclusion of the operation. The tendon of the subscapularis was divided, thus allowing external rotation of the humerus until the flexed forearm was in the coronal plane. The head of the humerus was thus easily and fully reduced to its normal position. The tendons of the supra- and infraspinatus muscles were then shortened; the detached piece of the acromion was replaced and fastened to the spine of the scapula by a small Lambotte screw; the cartilaginous tip of the acromion was turned up again and sutured to the periosteum covering the head of the screw; and the fascia and skin were closed with interrupted chromic gut sutures. The arm was dressed in abduction and external rotation, in plaster-of-Paris.

January 9, 1915: Went home.

February 15, 1915: New case applied. One granulation in the line of incision.

March 29: Case removed. Massage ordered. Incision healed.

April 10: Can get hand to mouth, but only with arm in abduction. Has fair power of flexion and extension in elbow, but scarcely any motion in hand.

November 15, 1915: Dislocation stays reduced; the acromion is solid. She can put her hand to her mouth with forearm in pronation and the humerus abducted. She has no active external rotation; has slight power in the triceps, can flex elbow to 45 degrees, and there is passive extension of the elbow to 150 degrees. She has some power in the extensors of the wrist, very slight power in the thumb, fair pronation and supination. There is no power in the other muscles of the hand.

CASE V*a*.—*Subspinous dislocation of left shoulder; slight disability.* Anna B., aged seven years, is the eldest sister of Catharine B. (Case V). It was a head presentation at birth, and no instruments were used; but after the head was delivered, the shoulders stuck, and the labor was difficult.

Examination.—The mother brought this child to the Episcopal Hospital, June 15, 1914, by request. Except for the fact that the baby's "shoulder had been broken in birth" it was thought that she had recovered perfectly by the age of six weeks. Examination showed, however, that there was a subspinous dislocation of the humerus, with the characteristic internal rotation of the arm, which was carried into marked abduction on putting the hand to the mouth. Treatment was declined by the parent, and was not urged, as the disability was slight (Fig. 6).

CASE V*b*.—*Birth injury of right shoulder, without dislocation of the humerus.* Mary B., aged six years, was the sister of the patients already described (Cases V and V*a*). She was brought to the Episcopal Hospital for examination, by request, June 15, 1914. There was the characteristic attitude of carrying the injured limb, with the arm in internal rotation and the forearm pronated. No dislocation of the shoulder was present, but there was limitation of external rotation and of supination, and in carrying the hand to the mouth the arm was forced into marked abduction. The disability was so trifling that no treatment was recommended (Fig. 6).

CASE VI.—*Subspinous dislocation of humerus, reduction by arthrot-*

omy. Theresa M. came to the Episcopal Hospital when five years old, April 5, 1915. She was the youngest of seven children, all but one of the six others having died at birth. In the instrumental delivery of Theresa, the right arm was injured.

Examination.—The arm is held in internal rotation with the elbow flexed; the head of the humerus is absent from its normal site in front of the acromion, and is palpable posteriorly beneath the spine of the scapula. She cannot put her hand to her mouth in supination, and in the act the arm is abducted until the elbow is higher than her ear (Fig. 7).

Operation (April 14, 1915).—Senn incision. Acromion detached and turned down. After section of subscapularis tendon the head of the humerus was replaced in the glenoid; the tendons of the supraspinatus and infraspinatus were plaited to shorten them and maintain the external rotation; and the acromion was replaced and held in position by sutures of chromic gut. The arm was dressed in plaster-of-Paris in full abduction and external rotation.

April 22, 1915: Went home.

May 28, 1915: New plaster case applied.

July 12, 1915: Plaster case removed permanently. Reduction is maintained, but shoulder is stiff and painful.

August 2, 1915: Can get hand to mouth in supination, but motion in shoulder is only about half normal. Continue massage and passive motion.

December 6, 1915: Nearly perfect result (Fig. 7). Can put hand to mouth in supination, and behind head; cannot put it behind back. Extension of elbow to 150 degrees. Has good supination in forearm, has almost normal external rotation, and can abduct arm to 90 degrees.

Case VII.—*Subspinous dislocation of shoulder; bloodless reduction.* Edward J., four years old, is a brother of Case IX. Three sisters are normal, but the third boy, born February 7, 1916, by instrumental delivery, was killed during birth (his weight is said to have been 16 pounds). When the present patient was examined, in September, 1914, there was a subspinous dislocation of the left humerus, slight cubitus varus, and limited rotation in the forearm. The arm was not so useless as that of the patient's brother (Case IX), but like Tom, he could not get his arm into external rotation, nor his forearm into supination (Fig. 8).

Operation (September 8, 1914).—Bloodless reduction, under ether anæsthesia; with the child lying on his abdomen, and the arm in abduction and the forearm hanging over the edge of the table, pressure was made downward on the head of the humerus, at first with the arm in internal rotation; then gradually, *after* reduction had been secured (ascertained by palpating the head of the humerus in front of the acromion, and observing that the flexors of the forearm had become tense, as do the hamstrings when a congenital luxation of the hip is reduced), the humerus was worked into external rotation. When complete reduction was effected, an upward dislocation of the acromial and of the clavicle was produced. The limb was dressed in plaster-of-Paris, with the humerus horizontal in the coronal plane, and the forearm vertical (full abduction and external rotation of the shoulder). The reduction was attended by a distinct jump and click, was easily reproduced, and again reduced, with characteristic jump and click.

November 6, 1914: Case removed eight weeks after reduction, which was still present.

November 9: Dislocation has recurred.

November 11: Bloodless reduction under ether anæsthesia, as before; dressed in plaster-of-Paris in same position.

December 28: New case applied. Shoulder stays reduced.

February 12, 1915: Case removed, three months after second reduction. Humerus remains in place.

April 10: Good use of hand, but humerus does not stay very far forward. Can get hand to mouth without much abduction of arm, but not in supination (Fig. 9).

March 13, 1917: Two years and four months after reduction. Has had no treatment for two years. He is nearly seven years old. He can get his hand to his mouth only in pronation, barely to his head, and not at all to the small of his back. Passive external rotation of the shoulder is possible until the flexed forearm lies almost in the coronal plane; active external rotation is limited at 45 degrees (midway between sagittal and coronal plane). Passive supination of the forearm is limited just beyond the mid-position; active supination stops just short of the mid-position. His arm and hand are very useful and still improving.

Case VIII.—*Subspinous dislocation of humerus; reduction by arthrotomy.* Joseph B., five years old, came to the Episcopal Hospital February 2, 1914. He was the fourth child of his parents, three older and one younger children being normal. The fifth child was delivered instrumentally, and died in two hours. Patient was also a case of instrumental delivery, and his left arm has been paralyzed ever since birth.

Examination.—He holds the left upper extremity in internal rotation and slightly abducted at the shoulder, flexed at the elbow, and hyperextended at the wrist (Fig. 10). When trying to put hand to mouth he raises arm in abduction and internal rotation, and the flexor surface of the forearm is carried against the mouth (Fig. 10, *C*). He cannot get his hand to his mouth, and the hand is useless. The head of the humerus is absent from its normal location in front of the acromion and is visible and palpable behind the spine of the scapula. His grip is good, but he cannot flex his wrist. The biceps is good, and there is slight power in the triceps. There is very slight power in the extensor carpi radialis. He cannot flex the index finger as well as the others, nor the thumb; and he cannot extend his fingers. Elbow cannot be extended beyond 160 degrees, and there is cubitus varus (195 degrees, *i.e.*, the forearm falls 15 degrees to the inner side of the axis of the humerus). The axillary fold muscles and the trapezius are good.

Operation (February 7, 1914).—Senn's incision; temporary resection of acromion. Lesser tuberosity could be only very imperfectly exposed until after division of subscapularis tendon, which allowed external rotation of humerus, thus bringing lesser tuberosity into view.

The head of the humerus could now be pushed forward in front of posterior lip of glenoid, and dislocation satisfactorily reduced. The supraspinatus and infraspinatus tendons were then shortened by plaiting to maintain external rotation; the acromion was replaced and fixed in position by chromic sutures, and the skin wound closed. Dressed in external rotation and abduction (Fig. 10, *D*).

February 28: Went home.

May 20: Case removed.

June 1: Massage and passive motions ordered.

August 31, 1914: Shoulder remains in joint. Better motion of the arm. Splint to hold wrist slightly flexed.

January 17, 1916: Has full external rotation, and almost normal supination. He can just put his hand to his mouth in supination (Fig. 11). He cannot put it behind his head or behind his back.

March 13, 1917: Now 8 years old, over three years since operation. Puts hand to mouth normally, but wrist remains in hyperextension. There is a strong grip in the fingers. Active flexion of the elbow is normal, but extension is impossible beyond 135 degrees (passive extension to 150 degrees). There is no active rotation in the shoulder, nor any active supination or pronation in the forearm. There is good power in the deltoid. He uses his hand constantly for holding things.

CASE IX.—*Subspinous dislocation of humerus; reduction by arthrotomy.* Tom J., aged six years, with his brother Edward, aged three years (Case VII), similarly deformed, was brought by his mother to the Episcopal Hospital January 22, 1913. After this date the patients were not seen until September, 1914. Boy's left shoulder had been injured in birth, and he has never had any use of the arm. Three sisters are normal, but the third boy, born February 7, 1916, by instrumental delivery, was stillborn (weight said to have been 16 pounds).

Examination (September, 1914).—The left arm hangs in internal rotation, with the forearm in pronation, and is several inches shorter than the right arm (Fig. 8). Finger movements are normal, but there is no active power of extending the wrist, and passive extension is possible only to 165 degrees. The elbow can be extended to 160 degrees, and flexed normally; there is cubitus varus. The head of the humerus is palpable behind the spine of the scapula, and the tip of the acromion is turned down. Active abduction at the shoulder (including rotation of the scapula) is possible to 75 degrees, and passively to 150 degrees.

Operation (September 8, 1914).—Senn's incision, with temporary resection of the acromion. The shoulder-joint was opened above the greater tuberosity, which was the only portion accessible. The head of the humerus lay against the posterior lip of the glenoid process, in posterior subluxation; and where the edge of the glenoid impinged on the humerus a deep longitudinal groove had been worn in the cartilaginous head of the humerus. It now became possible to reduce the luxation by forward pressure, if the humerus was in internal rotation, but impossible if in normal position of rotation, and also impossible to rotate the humerus out after reduction was secured. Therefore the subscapularis tendon was cut from within the joint. At once reduction became easy when the humerus was in external rotation. While

the humerus was maintained in reduction, with the arm abducted and externally rotated, the tendon of the supraspinatus was plaited, to aid in maintaining abduction and external rotation; the acromion was replaced and held in position by sutures of chromic gut uniting the deltoid, periosteum and trapezius over it. The skin was similarly closed with chromic gut. The arm was dressed in plaster of Paris in the usual position of abduction and external rotation.

September 14: Went home.

November 6, 1914: Plaster case removed.

December 7, 1914: Humerus stays reduced. Arm no longer in internal rotation. Fair power regained in musculospiral nerve. Passive movements normal, except extension of shoulder, which is absent. He can get his hand to his mouth in full supination (Fig. 9, *A*).

April 16, 1915: Humerus remains reduced. Gets hand to mouth very well. Very little disability.

February 21, 1916: Humerus remains reduced. External rotation normal. Deltoid feeble. Cannot raise hand above nor behind head. Can put hand to mouth, but not in *full* supination. Passive abduction in shoulder 60 degrees. Some weakness still in extensors of wrist and fingers. Triceps and biceps good. Supination: active, one-half normal; passive, normal. Does not use the arm very much.

March 13, 1917: Mother reports that child died from appendicitis in January, 1917. She says the arm was "just grand."

CASE X.—*Subspinous dislocation of humerus, deformity of elbow, and wrist drop; arthrotomy of shoulder; excision of head of radius, arthrodesis of wrist by bone transplant.* George W. was fifteen years of age when he came to the Episcopal Hospital May 24, 1914. He had three brothers and two sisters living and well. His right shoulder had been injured in birth, and his arm was practically useless.

Examination.—His right arm hangs in internal rotation, the humerus abducted, the elbow flexed, the forearm in pronation. The head of the humerus is absent from its normal site in front of and below the acromion and is visible and palpable below the spine of the scapula. Passive movements: these are normal in the fingers and hand, and in the wrist, except adduction at the wrist which is lost. Extension of the elbow to 145 degrees, and flexion to 50 degrees. Complete pronation and supination are both lacking, rotation being present only through an arc of 30 degrees, most limited in supination. The head of the radius is prominent beneath instead of anterior to the external condyle, being luxated posteriorly. At the shoulder abduction of the humerus is possible through an arc of 60 degrees, flexion through 45 degrees, and extension through 20 degrees. External rotation at the shoulder is possible until the flexed forearm just passes the sagittal plane. Internal rotation when the humerus is abducted is similarly limited just before the forearm reaches the coronal plane. The motions of the scapula are not limited. The head of the humerus is dislocated posteriorly beneath the spine of the scapula. The acromion is prominent, with its upper flat surface looking outward, being twisted through an arc of 45 degrees. The clavicle is subluxated upward. The coracoid is normal. Active movements: he has scarcely

any grip in his hand; there is slight power in the lumbricals and interossei, fair power of flexion of the thumb, very little adduction of thumb. The wrist cannot be actively extended (Fig. 13, *B*), but if hyperextended passively it can be held weakly in extension momentarily (Fig. 12). There is no power of rotation in the forearm. The elbow can be actively extended to 145 degrees, and flexed only to 70 degrees (passive flexion possible to 50 degrees). At the shoulder there is active but weak abduction of about 30 degrees, flexion of 30 degrees (secured solely by rotation of the scapula), and no extension, no external rotation, but good internal rotation. The axillary fold muscles are good, and there is fair power in the deltoid. The triceps is good. He cannot get his hand to his mouth, it being impossible for him to raise his arm higher than the plane of his shoulders.

Operation (May 31, 1914).—Senn's incision, temporary resection of the acromion. The bicipital groove was found directly in line with the external condyle of the humerus, apparently owing to the gradual internal rotation of the shaft of the humerus below the tuberosities. Section of the tendon of the subscapularis at once allowed external rotation of the arm until the forearm was in the coronal plane. It was still impossible to secure complete reduction of the dislocated head of the humerus, owing to tenseness of the pectoralis major. The tendon of this muscle was then divided through another incision (in the line of the anterior axillary fold), and at once easy reduction of the head was secured by external rotation, abduction, and slight pressure forward on the head. If abduction was carried too far the humerus again luxated posteriorly and upward (tension on teres major?). The most stable position was in abduction of 70 degrees and external rotation about 20 degrees short of the coronal plane. The outer end of the clavicle, which was luxated upward, was excised, and this allowed the acromion to come back into better position; but the tip of the acromion was so far bent downward that it kept the head of the humerus pushed backward. Therefore a wedge-shaped piece (base upward) was cut off the portion of the acromion temporarily displaced (not from the spine of the scapula), so that when the remaining portion of the acromion was replaced against the spine of the scapula, the tip of the acromion no longer interfered with the proper position of the humerus, but rode above it. The acromion was fixed against the scapula with a screw. The muscles and skin were sutured separately with interrupted sutures of chromic gut, and the arm was dressed in plaster of Paris in abduction of about 70 degrees and external rotation almost to the coronal plane (Fig. 12).

First dressing six weeks later, when another cast was applied and worn until three months after operation. It was next decided to operate on the elbow, as pronation and limitation of extension persisted and were evidently due to the dislocation of the head of the radius.

Second Operation (October 14, 1914).—Kocher's external incision. The brachioradialis and extensor carpi radialis were detached from the supracondylar ridge and pushed forward, and the anterior surface of the capitellum was exposed. The external lateral ligament was then cleared and the head of the radius was exposed in front of it. The

head luxated posteriorly in extension of the elbow and limited further extension. The neck of the radius was divided by a Gigli wire saw, and the head removed. This allowed 20 degrees more of extension. The anterior capsule of the elbow-joint was next divided, and then the anterior tendinous surface of the brachialis anticus, its muscle fibres readily yielding to extension when once the aponeurosis was divided. Complete extension was not even yet possible, so the olecranon was exposed behind the external lateral ligament, by displacing the triceps backward, and its tip was cut off (1.25 cm.) by osteotome. Extension to 170 degrees was now possible. The wound was closed in layers, and the arm dressed on an internal angular splint.

November 30, 1914: Passive motion in elbow 65 to 145 degrees. The wrist is no stronger than at first examination, but he now has a fair grip in his hand. He cannot flex his elbow actively beyond 90 degrees, and cannot get his hand to his mouth.

December 7, 1914: Brace applied to overcome wrist drop.

January 25, 1915: Elbow, passive movements, 65 to 155 degrees; active, 85 to 155 degrees. Shoulder movements are more free than before operation, and chief disability now is from wrist drop.

Third Operation (March 3, 1915).—Curved incision over extensor surface of wrist, slightly convex to ulnar side, from base of index metacarpal to 3 inches above wrist-joint. Annular ligament incised between thumb and index extensors, opening wrist-joint. Radius bared of periosteum. With twin circular saw a slot (6 to 7 mm. in width) was cut in extensor surface of radius, across carpus (scaphoid, trapezoid, and os magnum) and in adjoining surfaces of index and middle metacarpal bones. The slot was cleared of bone with chisel and gouge forceps; all fragments were preserved. A transplant of corresponding width and length was then cut from the subcutaneous surface of left tibia, and inserted in the groove at the wrist. Six transverse saw cuts were made in the transplant so as to allow it to be bent to permit slight hyperextension of the wrist. It was fixed in place by suturing periosteum and fascia over it, with No. 3 chromic gut. The fragments removed from the wrist were then inserted in the defect in the tibia, and both wounds closed. The wrist was dressed on a palmar splint of gypsum in slight hyperextension.

March 15, 1915: Returns to Dispensary for dressing.

March 22, 1915: Good union in wrist. Incision healed.

April 12, 1915: Skiagraphs show transplant in good position, and leg filling in with fragments transplanted from wrist. Gypsum splint continued.

May 24: Binder's board splint applied. Wrist has lost its hyperextension, but remains at 180 degrees.

June 28: Carries objects in hand, dresses himself, and can hold his French horn better. (He plays in an orchestra.)

July 26: Can now close all fingers but fifth. Improvement is marked.

October 5: A few days ago he broke his transplant in the wrist, while asleep, in turning in bed. This allows motion in the wrist of 30 degrees (180 to 150 degrees). Hand continues to grow more useful.

October 14, 1915: Skiagraph shows transplant incorporated with radius and ankylosed to the index metacarpal.

March 12, 1917: Nearly three years after first coming under observation: He finds his hand perfectly useful in playing the French horn. (It should be mentioned that the French horn is played by the left hand, and that the right hand is placed in the flaring end of the horn to support its weight, etc.) He has practically normal use of the thumb, index and little fingers. The fourth and fifth fingers have very little power. There is passive motion at the wrist from 170 to 140 degrees, flexion being possible actively, but there being no active power of extension (Fig. 13). Pronation in the forearm is complete, both passively and actively; supination, actively and passively, is possible to the midposition; that is to say rotation has increased from a range of 30 degrees when first seen to a range of 50 degrees or more at present. There is passive motion at the elbow from 60 to 160 degrees, and active motion from 90 to 160 degrees. At the shoulder passive abduction is 60 degrees, and active 45 degrees; passive flexion is 90 degrees and active flexion 60 degrees. He is still unable to get his hand to his mouth or to the small of the back.

Compared with his condition when first seen, his present condition is markedly improved; both his parents and himself are satisfied.

CASE XI.—*Disability from contractures; open tenotomies.* Joseph V. was brought to the Episcopal Hospital when twelve years old, April 19, 1915, for disability persisting from an injury to the right shoulder region during birth. He had four sisters, none of them injured in birth, and one brother, who had died of unknown cause (no birth injury).

Examination.—He carries his arm in internal rotation, and he cannot put his hand to his mouth nor behind his head. He cannot flex his elbow beyond 90 degrees nor can be fully extend it. Rotation in the forearm (active and passive) is limited in both supination and pronation. Passive movements in the elbow and wrist are not limited. There is passive external rotation at the shoulder only to the sagittal plane; there is no passive extension of the shoulder; passive abduction is possible almost to 90 degrees, but only with the arm anterior to the coronal plane (in partial flexion). Active movements of the hand and fingers are normal. There is good active flexion of the shoulder (by contraction of the coracobrachialis and pectoralis major), but no active extension nor abduction. There is no posterior dislocation of the humerus. The end of the clavicle is slightly above the level of the acromion.

It was recommended that the limitations to external rotation and abduction at the shoulder be overcome by a series of plaster casts. This was declined by his parents, and the boy was not seen again for almost a year (March 13, 1916). No improvement had occurred, and operation was recommended and accepted (Fig. 14, *A*). Re-examination shows slight posterior subluxation of the humerus.

Operation (March 20, 1916).—Ether. Incision as for excision. Division of tendon of pectoralis major allowed normal abduction.

The latissimus dorsi was not tight in abduction. Division of the tendon of the subscapularis, while it was kept under tension by attempts to secure external rotation, allowed suddenly full external rotation. This incision passed through the joint capsule, making the head of the humerus visible, and causing it to tend to luxate anteriorly; but even in full external rotation and abduction it did not actually luxate. The bicipital groove seemed displaced externally, looking outward rather than forward. Wound closed without drainage and arm dressed in full abduction and external rotation in plaster of Paris.

March 25: Went home.

May 5: New case applied.

June 9: Case removed. Ordered massage and passive motion.

June 25: Can put cap off and on.

March 7, 1917: One year after operation. Gets hand to mouth easily in supination, but arm still abducts slightly in this movement (Fig. 14, *B*). Uses right hand now in writing (formerly used left). Active external rotation is possible to 60 degrees beyond the sagittal plane (Fig. 14, *C*), passive external rotation perhaps 10 degrees further. Active abduction is possible through an arc of 60 degrees, passive abduction perhaps 10 degrees further.

CASE XII.—*Disability from contractures; open tenotomies.* William L. came to the Episcopal Hospital November 23, 1914, at the age of eleven years. His right arm had been injured in birth, and great disability persisted.

Examination.—Carries arm in internal rotation and cannot get hand to mouth; even with the aid of the left hand he can get his right hand to his mouth only with wide abduction of the humerus, and with the hand in full pronation. His hand is practically useless. There is atrophy of the supra- and infraspinatus muscles, of the biceps and triceps; and marked contractures of the pectoralis major, the subscapularis, and to a less disabling degree, of the latissimus dorsi. Passive external rotation is impossible beyond the sagittal plane. Extension of the elbow is limited.

Operation (December 9, 1914).—Ether. Incision as for excision of shoulder. Subscapularis was divided at its insertion into the lesser tuberosity; this at once allowed external rotation to the coronal plane. Then the tendon of the pectoralis major was lengthened by the usual method of tendon lengthening, known as Z-plasty, the lower half of the insertion being divided close to the humerus, and the upper half of the tendon being cut about 3 cm. nearer the chest. Thus fully one inch lengthening was secured. Dressed in the usual position (abduction and external rotation) in plaster of Paris.

December 15: Went home.

January 22, 1915: Six weeks and a half after operation: case removed.

February 1: Cannot get hand to mouth in supination. Ordered massage and passive motions.

February 8: Learning to write with his right hand (previously

used left hand). Can easily put hand to mouth in supination, and to the top of his head. The improvement was most striking.

March 22: Can put hat off and on, and put hand to back of neck.

May 24: Very good use of hand. Still tends to abduct humerus in flexing elbow. Passive external rotation of the humerus is as good as on the left.

December 6, 1915: Uses hand for everything. Good grasp. Full extension of the elbow. Active external rotation to the sagittal plane.

January 17, 1916: Almost complete active supination.

February 12, 1917: There is power in the deltoid. Can hold his hand above his head. There has been continued improvement during the year.

CASE XIII.—*Flaccid paralysis of shoulder (right) with flail joint; transplantation of pectoralis major to supplant deltoid; of pronator radii teres to become supinator, and of flexors of carpus to become extensors.*—Carl C. was thirteen years of age when he was brought to the Episcopal Hospital, October 20, 1913. He is the first child of his parents; the second and fifth children died at birth, but the third and fourth children are normal. This patient was born by instrumental delivery (head presentation), and his right shoulder was injured during the process. He was treated by massage and electricity from the age of seven weeks to that of one year. Since that time nothing had been done, and his parents were now anxious to know if something could not be done to lessen his disability.

Examination.—He carries the right arm rotated in, the elbow flexed, and the forearm pronated. The limb is useless. Passive movements were possible as follows: Shoulder can be abducted to 60 degrees; can be rotated externally about half the normal extent; while flexion and extension in the shoulder are normal. Flexion in the elbow is normal, but extension is very slightly limited. Wrist motions are normal. Supination beyond the mid-position is impossible. Active motions are as follows: scarcely any motion in shoulder, but the axillary fold muscles are good. The biceps and triceps have fair power. There is no active supination; no power in the extensors of the carpus; extensors of the fingers are good, flexors of the carpus and the fingers are good. He can put the back of his hand to his mouth, but not the fingers, owing to the persistent pronation (Fig. 15, *A*). Whenever the arm gets back of the plane of the body the humerus luxates forward at the shoulder-joint and it remains luxated anteriorly until with his left hand he pulls the paralyzed arm forward into a position of flexion and adduction. This causes great disability, and is evidently due to the complete paralysis of the deltoid. Limitation of external rotation at the shoulder and persistent internal rotation indicate there is no paralysis of the internal rotators.

The treatment proposed was to secure supination of the forearm and to prevent the recurrent anterior luxation of the shoulder.

Operation on Forearm (August 27, 1913).—Esmarch band above elbow. The pronator radii teres was transplanted through the interosseous space around the posterior and external surfaces of the radius,

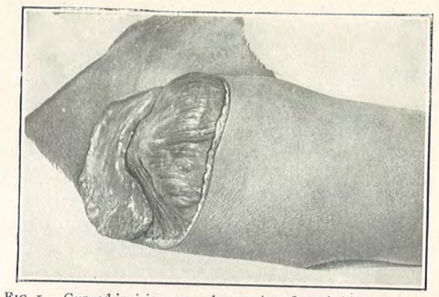


FIG. 1.—Curved incision around acromion, flap of skin turned up.

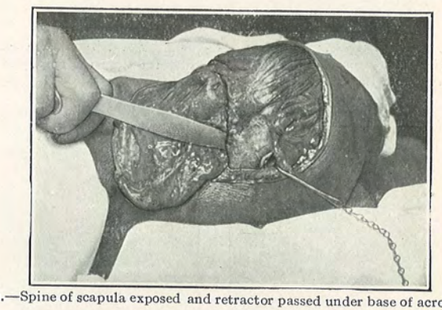


FIG. 2.—Spine of scapula exposed and retractor passed under base of acromion.

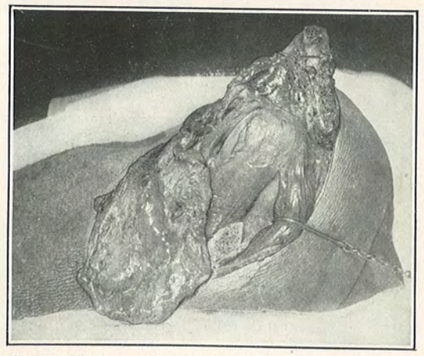


FIG. 3.—Acromion divided at its base and turned forward. The long tendon of the biceps is clearly exposed; in front of it the subscapularis just comes to view; posteriorly the supraspinatus and infraspinatus muscles are seen.

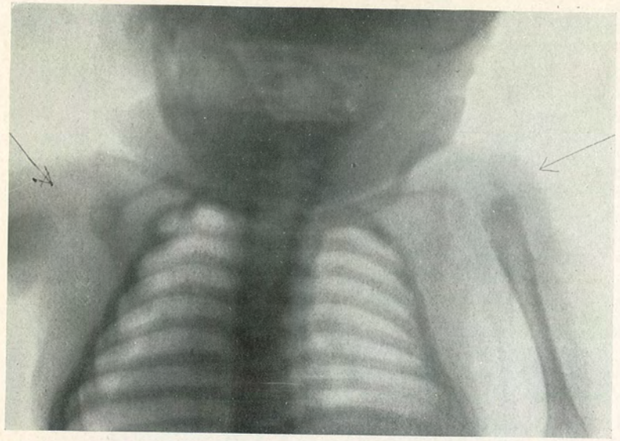
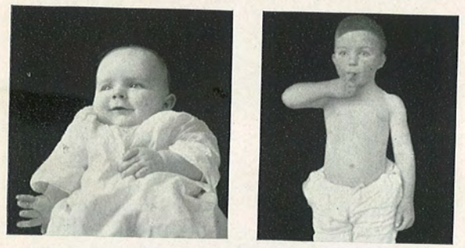
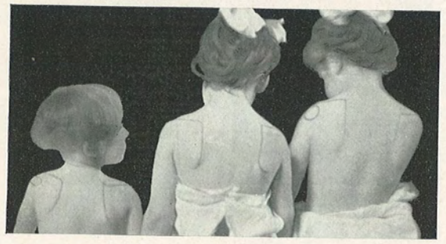


FIG. 4.—Case II. Subspinous dislocation of right humerus; patient aged three months. Note that on the injured side (arm held close to body in internal rotation) the epiphysis of the head of the humerus is far removed from the glenoid.



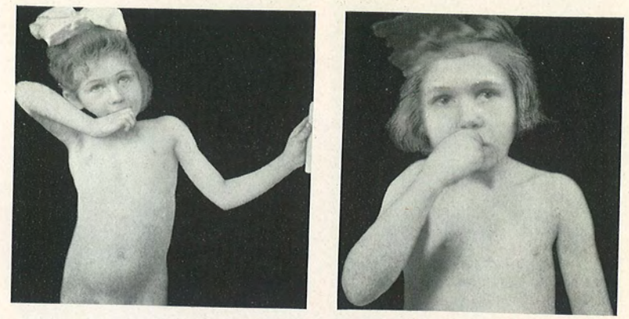
A B

FIG. 5.—Case II. *A*, aged six months; *B*, aged three and one-half years.



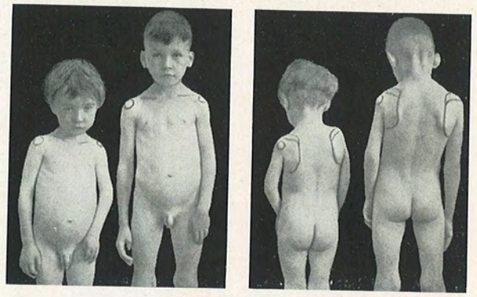
A B C

FIG. 6.—Three sisters with birth injuries of shoulders. (Fourth child killed in delivery.) *A*, child aged three years, dislocation of left shoulder; *B*, child aged six years, right shoulder (no dislocation); *C*, child aged seven years, dislocation of left shoulder.



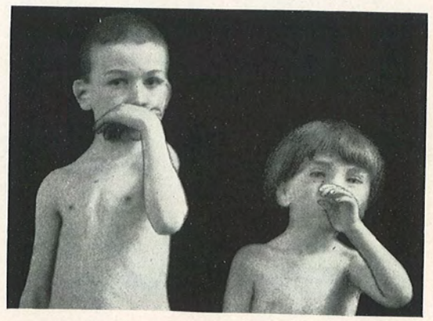
A B

FIG. 7.—Case VI. *A*, child aged five years, posterior dislocation of right shoulder from injury at birth *B*, eight months after operation.



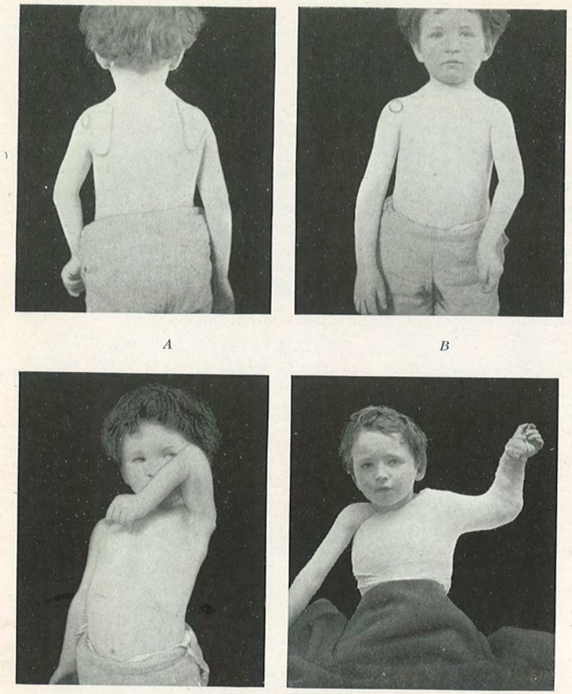
A B A B

FIG. 8.—Cases VII and IX. Birth injuries of left shoulders. *A*, child aged four years; *B*, child aged seven years.



A B

FIG. 9.—Cases VII and IX. Seven months after operation. *A*, "bloody"; *B*, "bloodless."



A B C D

FIG. 10.—Case VIII. Child aged five years. Subspinous dislocation of left humerus. *A*, rear view; *B*, front view; *C*, attempt to put hand to mouth; *D*, after operation, dressed in the usual position.

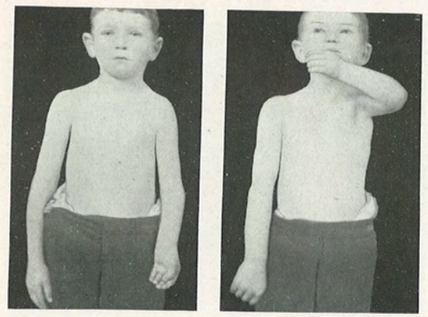


FIG. 11.—Case VIII. Child aged seven and one-half years. Birth injury of left shoulder. Two years after open operation.

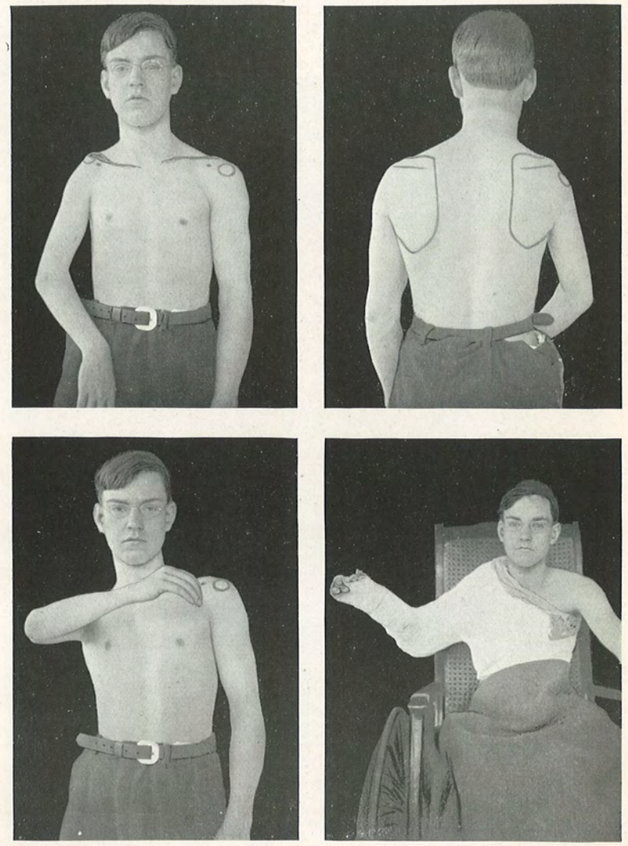
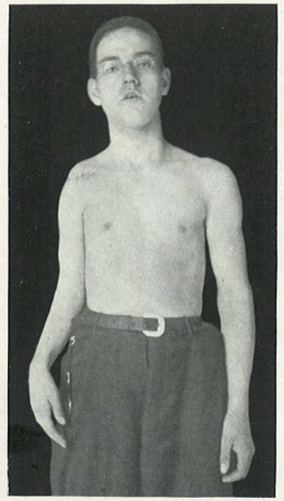
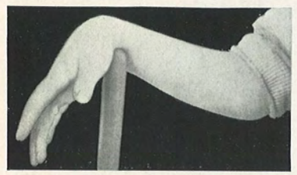
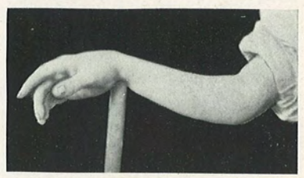


FIG. 12.—Case X. Patient aged fifteen years. Subspinous dislocation of right humerus. After reduction the arm was dressed in the most stable position.

A



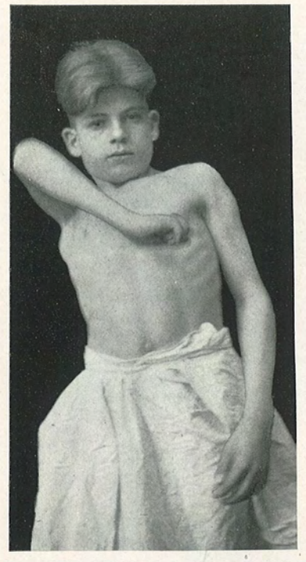


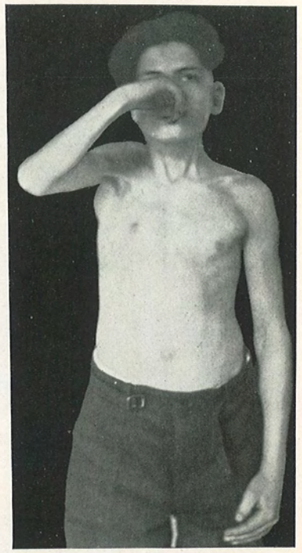


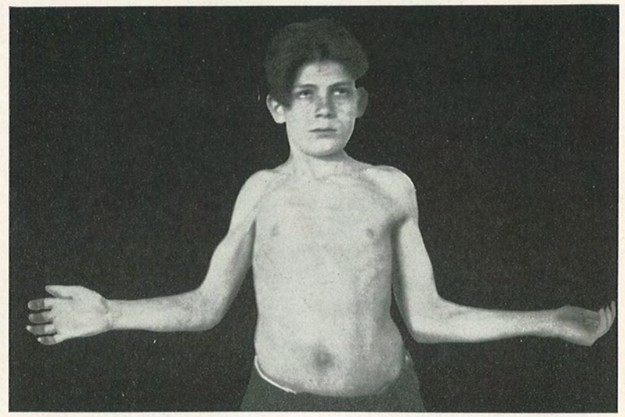
B C

FIG. 13.—Case X. *A*, photograph made September 21, 1914, four months after operation on shoulder; external rotation restored (compare with Fig. 12). *B* (February 15, 1915) and *C* (March 3, 1916), hand and wrist before and after arthrodesis.

A B

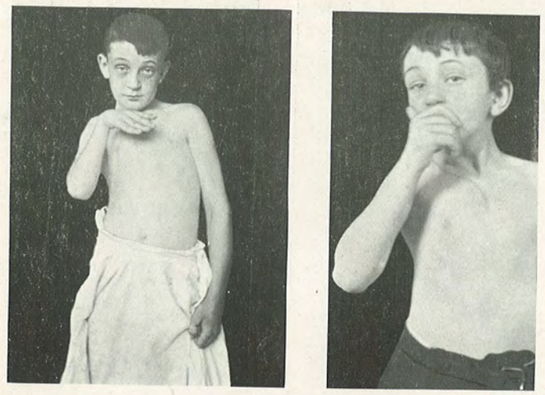






C

FIG. 14.—Case XI. Showing marked improvement in function secured by tenotomies. *A*, March 20, 1916; *B*, one year after operation; *C*, March 14, 1917, one year after operation.



A B

FIG. 15.—Case XIII. Brachial birth palsy of right upper extremity, with flail shoulder, and loss of supination in forearm and of extension in wrist. *A*, disability before operation; *B*, result four months after operations.

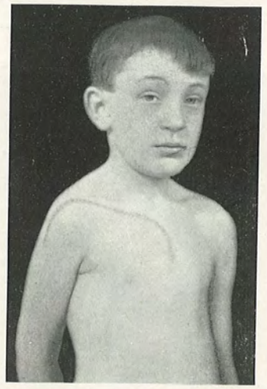


FIG. 16.—Case XIII. Showing the incision employed for transplantation of pectoralis major to take the place of the paralyzed deltoid. Before this operation the humerus became subluxated anteriorly when the position shown in the photograph was assumed, and the arm could not be drawn forward without the aid of the left hand. Voluntary flexion of the shoulder-joint is now easy.

and while the forearm was maintained in full supination (which became possible after section of the teres muscle) it was sutured to the lateral and flexor surfaces of the radius, the sutures being passed through drill holes in the radius. Next the flexor carpi radialis was transplanted (superficial to the thumb extensors) into the extensor surface of the base of the index metacarpal. Finally the flexor carpi ulnaris was transplanted to the extensor surface of the carpus (unciform or cuneiform bone). The arm was dressed on an anterior angular splint, with the forearm in full supination and the wrist hyperextended.

September 17: First dressing: all incisions healed. Can carry hand to mouth in supinated position. Wrist stays hyperextended.

Operation on Shoulder (September 24).—Incision from third costal cartilage to sternoclavicular joint, along clavicle to acromion, thence down outer surface of shoulder nearly to insertion of deltoid (Fig. 16). This large flap was turned down and the clavicular and upper sternal fibres of the pectoralis major were cut at their origin, and, with care to preserve their nerves and vessels, these portions of the muscle were shifted out over the paralyzed deltoid and were sutured to a groove cut by Hey's saw in the acromion and outer third of the clavicle. The incision was closed without drainage. A continuous linen suture was employed for the skin. The limb was put up in plaster of Paris, in abduction and external rotation, with the forearm still in full supination.

October 4: Went home.

October 20: Sutures removed through opening in case. Incision healed.

November 3: Case removed, six weeks after operation. Arm carried in sling. Massage ordered.

November 10: Sling removed. Passive movements ordered.

November 24: Can put hand to mouth in supination well. When arm is put behind back he can pull it forward easily by action of transplanted pectoralis major. He can actively extend the wrist, but there is still a tendency to ulnar deviation of the hand.

December 8, 1913: To go to school. Can take hat off and on with his right hand.

December 15: Slight active supination. Photograph in Fig. 15 shows his present condition.

December 27: Can cut his meat with his right hand.

January 17, 1916 (two years later): Works as messenger boy. Can button coat with right hand; can with difficulty get hand to back of head and to mouth(but not in supination). Wrist is in ulnar deviation. He can actively flex and extend wrist and fingers. Active supination is weak. The biceps is good (formerly very feeble). The head of the humerus is in position. There is no active abduction, but he can carry arm forward in sagittal plane (flexion of shoulder) by contraction of the transplanted pectoralis major, which can be felt contracting well.

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GALL-STONE ILEUS

DR. E. J. KLOPP presented a gall-bladder and duodenum, with the following history:

The specimen is from a patient of sixty, who was admitted to the medical wards of the Jefferson Hospital December 15, 1915. She was jaundiced at ten years of age. No history of biliary colic. Has had a good deal of constipation. On December 12, three days prior to admission, she began to have anorexia, followed the next day by severe epigastric cramps which were intensified each time she took food. A high enema was effectual. She vomited frequently. Several purgatives were taken without result. On the day of admission the abdomen was rotund and obese but not distended, slight tenderness in the midline over the epigastrium. Vomiting ceased for five days. Nine days after admission she vomited again and rapidly became worse. She was transferred to the service of Dr. Stewart, to whom he was indebted for the privilege of operating. The abdomen was opened by an incision through the right rectus. A calculus was found in the mid-portion of the jejunum, which was removed through a linear incision of the bowel. The gut above the calculus was distended and dark in color, below it was collapsed and empty. Owing to the grave condition of the patient not much attention was given to the gall-bladder, which was imbedded in a mass of dense adhesions. The abdomen was closed without drainage. The patient died 18 hours after operation. At autopsy the coils of intestine were matted together, but were easily separated. The mid-portion of jejunum showed a neatly approximated suture line 4 cm. extending in long axis of bowel and covered with plastic exudate. Below this point the intestines were collapsed, above it they were distended, lustreless, purplish blue and friable. In the region of the gall-bladder was a mass of adhesions binding the lower surface of the liver, the pylorus and the duodenum together. At the junction of the first and second portions of the duodenum is an opening 3 cm. in diameter from which intestinal contents escape. On the under surface of the liver is a piece of gall-bladder 2 cm. in diameter bound up in adhesions; it has a thick fibrous wall and is empty.

STATED MEETING, HELD NOVEMBER 5, 1917

DR. CHARLES H. FRAZIER, President, in the Chair

PROLAPSE OF THE RECTUM

DR. T. TURNER THOMAS said that in the *Zentralblatt für Chirurgie*, 1909, xxxvi, 1225, P. Sick offered a simple and apparently rational operation for prolapse of the rectum. Since that time Doctor Thomas had operated at the Philadelphia General Hospital on three or four cases by the Sick method besides the cases here reported, and had excised the prolapse in two others. He had not been able to follow any of these cases after they left the hospital. Very satisfactory results were obtained in the two cases in which the prolapse was excised, but the operation was time consuming, rather bloody, and in one it was observed that the rectovesical pouch of peritoneum was included in the excision. One must also consider the possibility of a stricture following this operation.

The Sick operation is much more quickly and easily performed, is more safe and is perhaps as effective. Sick describes it as follows:

> A longitudinal incision is made in the raphe between the end of the coccyx and the circular fibres of the sphincter ani muscle, where there are no vessels, nerves or muscular fibres to be injured. The superficial fascia and deep fascia are divided, and the loose connective tissue behind the rectum exposed. The rectum is then separated on its posterior wall by a suitable instrument as high as the promontory of the sacrum. In the cavity thus made, a strip of iodoform gauze of four to six thicknesses is laid and the small external wound protected from the anus by an adhesive plaster or collodion dressing.

The reporter had extended the incision alongside the coccyx when necessary. When Sick says that no muscle fibres need be divided he loses sight of the fact that the levator ani must be cut through. With good retraction of the wound one can readily denude the posterior wall of the rectum from one side to the other with the finger and can make a wide denudation of the anterior wall of the sacrum well up into its curve. He did not use any instrument for a higher denudation, believing that that accomplished by the finger on the rectum and sacrum would be ample for a permanent cicatricial adhesion of the rectum to the sacrum. The opportunity afforded to the sphincter ani to recover its normal tone is probably an important factor in the permanent result. He had not protected the wound from anal infection by an adhesive plaster or collodion dressing, but had in the recent cases, moistened with alcohol the gauze packed into the wound, and had depended chiefly, for protection against infection, upon the prevention

by opium of bowel movements for four or five days when granulations have developed over the wound surface. The perfectly dependent drainage is also a very important factor in this connection. In no case has there been any disturbance from infection and in all cases the healing has been rapid. The first case presented was a boy, six years old, an imbecile, who was transferred to the surgical ward September 27, 1917, because of an almost constantly recurring prolapse of the rectum of about a year's duration. The mother says that when the child was at home the reduction of the prolapse was always difficult. On one occasion while in the hospital the prolapse was accompanied by "violent and profuse hemorrhage," but this ceased immediately after reduction. The Sick operation was performed October 13, 1917. Packing removed from wound five days after operation and wound not packed at all afterwards. It was completely healed in two weeks and there has not been the slightest recurrence of the prolapse.

The second case was a woman, fifty years old, an epileptic who had had a prolapse of the rectum for ten years, which protruded three to three and a half inches. At first the patient could reduce it herself, but is no longer able to do so. It comes down on every movement of the bowel and at time of operation, October 27, had been down for about forty-eight hours. The operation was performed under gas-oxygen anæsthesia, and because of the difficulty of keeping the prolapse reduced the operation had to be done without reduction, the prolapse being covered by a piece of gauze and the reduction being maintained afterward by the packing of the wound tightly with gauze moist with alcohol. Two silkworm stitches were employed to close the lower part of the wound. The packing was removed in a week. There were no signs of infection and the patient did not complain of any pain in the wound, nor of any tendency of the prolapse to recur.

DR. JOHN B. ROBERTS said that it seemed to him that this operation was adapted only to mild cases. About twenty-five years ago he himself had devised and performed an operation for prolapse of the rectum which was original. The first operation was done at the Woman's Hospital of this city. The method was described in the ANNALS OF SURGERY and in his "Modern Surgery." Other operators have since practised it satisfactorily. It is intended for severe cases of prolapse of the rectum with great dilatation of the anal aperture. The dilated orifice of the anus is reduced in diameter by cutting out a portion of the sphincter with the perineal skin at its posterior part. The skin incision, which is V-shape, has its apex at the point of the coccyx. By burrowing in the cellular tissue behind the rectum with fingers and scissors, the surgeon is able to reach the posterior wall of the rectum for a distance of several inches, thus separating the gut from its attachment to the hollow of the sacrum. A sufficient V-shape portion of the posterior wall of the rectum is excised, the point of the cut-out V reaching several inches upward from the external opening of the intestine. After hæmostasis, the rectal wall is sutured from

apex downward with chromicized catgut sutures and the stumps of the excised sphincter similarly united; after which the skin is closed back to the end of the coccyx, leaving, however, a space for the insertion of a drain. This excision of the rectal structures, by two V's with their bases together at the anus, converts the lower end of the intestine into a funnel-shaped tube and contracts the anus by lessening the diameter of the sphincteric ring. There is little opportunity, therefore, for the intestine to be thrust downwards and through the anus. The operation is intended for complete prolapse and is satisfactory for adults and even occasionally might be used in severe prolapse in children.

Dr. George P. Müller called attention to the paper of Lockhart Mummery, describing an operation similar to the Sick operation. Doctor Müller had operated four times by this method and knew that it was successful in all of them up to thirteen months ago. This operation consists of a transverse incision an inch long between the tip of the coccyx and anus. The rectum is separated from the hollow of the sacrum and the cavity is packed with gauze to produce adhesions of the posterior wall of the rectum to the sacrum. This is the simplest operation one can do in children with prolapse. In the case of one adult in which he did this operation there was recurrence. In adults he performs the operation of Moschcowitz and had operated thus on five adult patients, with cure in all, so far as he knew. One case occurred in a colored boy who had had the prolapse for twenty years. It was eight inches long and yet was easily pulled up and for the past two years has shown no sign of recurrence. The only trouble with this operation is the difficulty in doing it. The pelvis is so deep and, especially in the male, one has to reach far to the bottom of the pelvis to insert the first pursestring suture. In males also it is difficult to place more than two and sometimes three pursestring sutures. In the female it is easier because of the ability to use the uterus to obliterate. By plastic work on the peritoneum one can cover all the opening so that the intestine cannot herniate in any little pockets afterwards.

Dr. Thomas, in closing, said that it seemed to him that the reason that in children prolapse will so often disappear permanently without operation after the bowel has been kept up for a long time, is that the sphincter regains its control, and the severe tenesmus which caused the prolapse does not recur. He could not see that merely taking a piece out of the adult sphincter, long stretched, thinned and almost hopelessly paralyzed by the prolapse, and sewing the rest together is going to help much in preventing recurrence. If any operation could keep the prolapse up long enough to permit the sphincter to fully regain its normal tone, this secondary result would assure a permanent cure. The long and wide cicatricial adhesion provided by this simple operation, between the sacrum and rectum just where the causal relaxation between them exists, ought to give the best possible support for this condition.

a. *b.* *c.*

Fig. 1.—*a.* Case II. Before operation, showing prolapse of rectum. *b.* Case II. Two days after operation. *A*, gauze protruding from wound; *B*, anus—two silkworm-gut sutures between *A* and *B*. *c.* Case I. Scar in median line three weeks after operation. Complete healing in two weeks.

NEPHROLITHIASIS WITH PERINEPHRITIC ABSCESS

Dr. J. Bernhard Mencke presented a woman, twenty-one years of age, who ten months ago had an attack of severe right lumbar pain, which subsided after a few days. Two months ago she had a child. From the third to the seventh day after delivery she ran a temperature. When admitted she stated that she had suffered from pain referred to the right side of her abdomen for three weeks. Her temperature on admission was $100^{2}/_{5}$. Leucocytes, 8,500. In the upper right quadrant of the abdomen extending into the loin was a tender nonfluctuating mass. X-ray showed numerous calculi in the right kidney. Cystoscopic examination by Dr. Tracey showed an œdematous right ureteral orifice surrounded by a zone of congestion. No urine obtained from the right side; normal on the left side. After preliminary treatment she was subjected to operation upon August 10, 1917. Lumbar incision opened an abscess cavity from which a number of calculi were removed. In the substance of the kidney proper there was an opening large enough to admit two fingers through which three more calculi were removed. Wound closed with tube drainage. Uneventful recovery. Eventual healing without sinus.

APPENDIX IN SAC OF INGUINAL HERNIA

Dr. J. Bernhard Mencke presented a man, twenty-two years of age, who had had a right inguinal hernia since infancy. It was now the size of a small orange when down.

When the hernia was reduced, the testicle also could be placed entirely within the abdominal cavity, apparently traversing a short inguinal canal. An examination of the blood having shown a normal coagulation time, operation was undertaken. Upon opening the sac its sole contents was found to be the appendix, the sac extending to near the base of the meso-appendix and the cæcum being far down back of the sac. An appendectomy was done. One testicle was found to be about one-half the normal size, the epididymis well developed. The testicle in its descent had come forward not as with a cord but with its peritoneal covering the wall of the sac flanging out to a broad base behind it. This was split and folded back, sacrificing the veins, and then the sac closed above and the hernial repair completed.

The convalescence was complicated by excessive oozing within the wound. This necessitated opening it superficially, closure being followed by primary union. The oozing continued for eight days, the coagulation time still being only three minutes. When the clot was evacuated capillary oozing was still taking place and a gauze wick inserted. Healing ensued and the ultimate result was good, although the testicle remained in the upper part of the scrotal sac.

END RESULTS IN EXTENSIVE NECROSIS OF THE JAW

Dr. J. Bernhard Mencke presented an adult patient who developed an infection after the removal of a left molar tooth. There followed, how-

ever, an osteomyelitis of the jaw. The case ran a protracted course and finally there separated several fragments which he presented. One fragment is about 2 x ½ x ¼ inches. The patient shows a good end-result, and illustrates the good outcome of a case treated with extreme conservatism.

NECROSIS OF THE MANDIBLE: REMOVAL OF ALMOST THE ENTIRE BONE AS A SEQUESTRUM

Dr. Alfred C. Wood presented a girl, aged fifteen years, who was admitted to the University Hospital, January 11, 1917, on account of swelling of the lower jaw and overlying soft parts. The trouble began twelve weeks before with severe "toothache" on the right side of the lower jaw. Subsequently ten abscesses formed, one after another, and opened spontaneously. Ten teeth were extracted at various times. The left side of the lower jaw was incised and a large amount of pus evacuated. At the time of admission the swelling was greatest about the symphysis; the mouth was very foul; there was no pain. The lower part of the face was greatly swollen, especially the chin; the swelling extending into the neck. The upper teeth were in fair condition. All of the lower teeth were missing. Almost all of the alveolar process appeared to be necrotic. The patient was able to take liquid nourishment only. Examination otherwise negative. Red blood-cells, 3,640,000; leucocytes, 23,300; hæmoglobin, 43 per cent. The urine contained albumin and a few hyaline casts. X-ray plates showed necrosis of both sides of the mandible, with an involucrum on the right side only.

The patient was ordered to use a mouth wash very frequently, and was sent home. She was readmitted July 16, 1917. The swelling of the face was much less and the general condition had greatly improved. The mouth was cleaner and could be opened more widely. The necrosed alveolar process was protruding through the mucous membrane throughout.

There was an external sinus at the angle of the jaw on the left side; X-ray examination showed necrosis of the entire lower jaw. The separation of the involucrum did not yet appear complete. She was therefore advised to continue the mouth wash and was discharged.

She was admitted for the third time October 4, 1917. The general appearance of the face had still further improved. The mandible was more exposed by extrusion through the mucous membrane. X-ray examination showed a complete regeneration of bone. Red blood-cells, 4,060,000; leucocytes, 8,320; hæmoglobin, 67 per cent. A trace of albumin and one cast were found in the specimen of urine examined. On October 13, under ether anæsthesia, the sequestrum was removed through the mouth. As Figs. 1 and 2 show, the specimen consists of the entire mandible, except the left articular process and a part of the ramus. The third molar tooth on the left side remains. Rapid improvement followed.

Dr. James K. Young remarked that while the complete reproduction of the bone from any periosteum is a remarkable thing, the most extraordinary instance of it is the reproduction of the clavicle. The entire clavicle can be

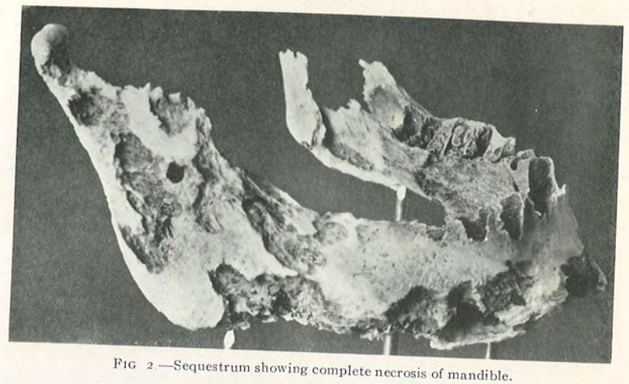

Fig. 2.—Sequestrum showing complete necrosis of mandible.

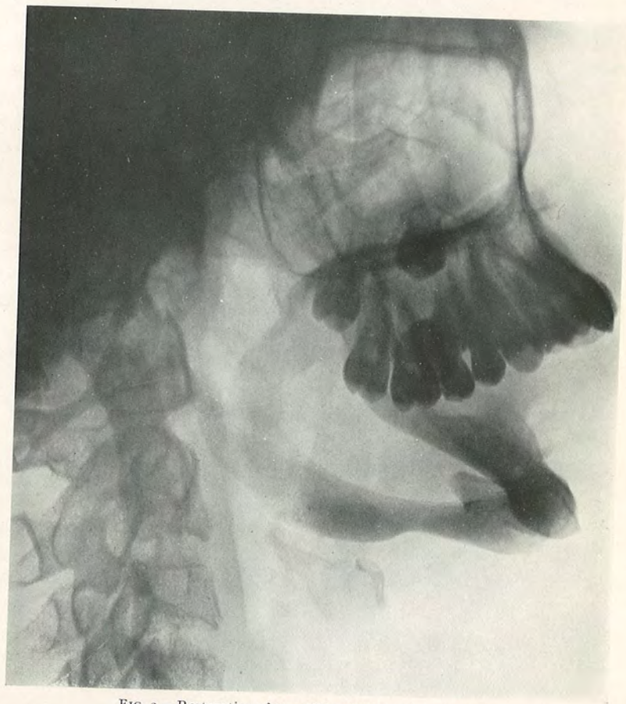

Fig. 3.—Restoration of mandible after complete necrosis.

removed and, if the periosteum is preserved, it will be reproduced. All are familiar with the reproduction of the tibia, femur, and the long bones of the extremities; but, in the jaw and the clavicle this fact is often forgotten. Some years ago he exhibited to the Academy a patient in whom after the removal of the entire clavicle it had been wholly reproduced.

MAJOR DONALD MCCRAE reported two cases of total removal of the scapula including the articular surface, with complete reformation and absolutely normal function. The size of the new shoulder blade was just about half that of the other one, but there was absolutely no difference in function. The humerus was entirely separated.

ACUTE DILATATION AND SPONTANEOUS RUPTURE OF THE STOMACH

DR. A. BRUCE GILL reported the history of a girl, aged sixteen years, who had been for eight years a patient and pupil in the Widener Memorial Industrial Training School for Crippled Children. She had at the time of her death a large fixed cervicodorsal kyphosis, and had been free from any acute symptoms of her disease for four to five years. On January 28, 1916, she complained of nausea following the use of atropine in the eyes for the purpose of refraction. The nausea passed away. On the following morning she had a similar experience following the second dose of atropine. She again soon recovered from the nausea, and seemed to be as well as usual, but she was kept all day under observation on the hospital floor, and her eyes were refracted in the late afternoon. At 7.00 o'clock the same evening she complained of pain in the upper abdomen and began to vomit. Her abdomen rapidly became markedly distended. The vomiting was persistent and her distention increased. No gas or fæces passed by the rectum. The nurse attempted to pass a rectal tube but was unable to enter it more than a few inches.

Doctor Gill saw the patient about nine o'clock. Her abdomen was then in a condition of very great distention, which was general and extended into the flanks and over Poupart's ligaments. Her pulse was 150, but of good quality. She complained of no particular pain except a feeling of tightness in the upper abdomen. Her respirations were not labored and she conversed without difficulty. At intervals she vomited without effort a few ounces of brown-colored liquid. There was no desire for a movement of the bowels.

A rectal tube was passed for a distance of twelve inches without the evacuation of any gas or fæces. While arranging for opening the abdomen, to determine the cause of the obstruction, the nurse came down and said that the patient attempted to turn over in bed and immediately expired.

The following morning a post-mortem examination was made. There was fluid and gas in the abdominal cavity. The small and the large bowels were collapsed. The stomach was partially distended, but a perforation was present in it on the anterior wall near the greater curvature about two inches below the cardiac end. The stomach contained a considerable quantity

of liquid mixed with particles of food. Some of the food was identified as that which had been eaten two days previous. The stomach was nowhere adherent to surrounding structures nor did it present any evidence of ulceration. The mucous membrane was rent in several directions radiating from the point of perforation. The perforation itself was not more than an inch in length.

Evidently the patient had had a rapid formation of gas in the stomach, arising from undigested food which had been present in part for at least forty-eight hours. The stomach, for some reason or other, did not empty itself into the duodenum. It does not seem probable that the atropine placed in the eyes was sufficient to paralyze the involuntary muscles of the stomach. And yet the patient experienced nausea on both days after the use of the atropine. After the distention began the stomach could not empty itself into the bowels either because of pyloric spasm or because of a kinking at the pylorus due to the distention. As the patient lay in bed the pressure within the stomach was sufficient to force back through the cardiac end some of the large amount of fluid present in it, but none of the gas. Finally the wall of the stomach became so distended that the effort of turning over in bed caused it to rupture, with instant death of the patient.

On looking through the literature of the past twenty years, as recorded in the *Index Medicus,* he could find no case entirely similar to this one. As a matter of fact, there is but little literature on the subject. Hartmann, in the *St. Louis Medical Fortnightly,* 1906, p. 613, records the case of a woman who probably died of spontaneous rupture of the stomach. She had for three years been trying to reduce her weight by eating something and drinking vinegar, and the post-mortem examination showed extreme atrophy of the walls of the stomach. Paul Fraenckel, in *Deutsches Archiv für Klin. Med.,* 1906, lxxxix, p. 113, discusses a series of cases of rupture of the stomach following long repeated lavage of the stomach, and several following the administration of narcotics. Rupture of the stomach due to ulcer or carcinoma is, of course, excluded from consideration.

Dr. John A. Brooke related the history of a somewhat similar case which was seen by him in a hospital in New York some time ago. The child in whom the rupture of the stomach occurred had been ill for some time and had been wearing a rather high hip spica of plaster of Paris. Following a severe attack of vomiting the child went into a state of collapse and died. The autopsy revealed a rupture of the stomach. It was thought that the plaster acting as a constriction may have had something to do with the rupture.

HEREDITARY MALFORMATION OF THE EAR

Dr. A. Bruce Gill presented three patients, two brothers and their mother, who presented similar malformation of the ears, lop-ears. The mother states that her three sisters, her brother, her father, and her paternal grandfather all had a similar deformity. There is here, therefore, an

authentic history of lop-ear in four successive generations. In October, 1916, Doctor Gill operated upon the ears of these two brothers by excising an elliptical portion of skin and a half-moon-shaped piece of cartilage. As a result, the ears now lie fairly close to the skull. In these two boys the deformity of the ear is a stigma of degeneration, as both are mentally subnormal.

INGUINAL HERNIA COMPLICATED BY HERNIA OF THE OVARY AND TUBE

Dr. George P. Müller reported a case of a child five months of age who had been operated upon nine weeks previously for acute strangulation of the ovary and tube in a left-sided hernial sac. The ovary and tube were removed. Five weeks later her physician noticed a mass in the right side, and as it was feared that strangulation might also occur here Doctor Müller operated four weeks later, the child being then five months of age. Through the usual incision a hernia was found extending into the canal of Nuck, and in the sac was the right ovary and tube. These were gently replaced within the abdominal cavity and the hernia repaired in the usual manner. The child made an uninterrupted recovery.

FOREIGN BODY REMOVED FROM ABDOMEN NINE YEARS AFTER IT HAD BEEN SWALLOWED

Dr. George P. Müller reported a case of foreign body (pin) removed from the abdomen. The patient was thirty-four years of age. Nine years previously she had swallowed a pin, but thought no more of it. Three years ago she began to suffer from pain in the loin and right iliac fossa, together with frequency of urination. At the same time it was noticed that a prolapse of the uterus had occurred. In December, 1916, she was operated on by a surgeon for the latter condition. The operation was unsuccessful and the prolapse recurred. Her symptoms also persisted, and recently she submitted to an X-ray examination, and a stone was found in the lower pole of the right kidney and during the investigation of the ureter the pin was discovered at the level of the right sacro-iliac joint, and about on the course of the ureter.

Operation was performed by Doctor Müller on September 27, 1917. A loin incision was made and the kidney delivered from the wound. The stone was removed without a great deal of difficulty. A second incision was then made through the right rectus muscle and the peritoneum incised to the outer side of the cæcum and the colon and posterior peritoneum reflected from the abdominal wall. Just over the right iliac joint a mass was found which proved to be the pin, lying across, and in direct contact with, the ureter, surrounded by some exudate and containing some calcareous material. The pin and the exudate were removed and the cæcum stitched back into place. A tremendous mass of adhesions was noted in the lower abdomen, the result of the previous operation (probably a Hirst operation

through a Pfannenstiel incision). The patient made an uninterrupted recovery.

Dr. Addinell Hewson reported an end-result of a condition found in a cadaver. The patient had been an inmate of an insane asylum and there were found in her abdominal cavity seven hairpins. The condition presented was that apparently of a huge abscess extending from Poupart's ligament to the cartilage of the chest and confined to one side. Examination of the umbilicus showed it to be perfectly cribriform from the openings made by the introduction of the hairpins into the abdomen. Further examination showed that the abscess extended throughout the abdominal cavity, that there was an opening through the upper segment of the rectus muscle about 4 cm. in diameter and that the muscle was entirely eroded. Examining further, it was found that the hairpins, one at least, had gone completely into the intestine. The whole mass was one of intense inflammation with the intestines all bound together. One of the hairpins was entirely within the lumen of the intestine, apparently without doing harm. There was the history that at the institution in which the patient died she had been found in the act of driving these pins into the umbilicus. Some of the pins had not been divested of their shiny covering. They were the usual 2½ and 3 inch pins; some of them with the fluted margins and not absolutely straight.

Dr. J. M. Spellissy said that Doctor Müller's report reminded him of an operation that he had performed years ago and in which the pre-operative diagnosis had hesitated between an inflammatory condition and a chondroma of the crest of the right ilium. Dr. G. G. Davis saw the case in consultation and advised exploration, as the result of which there was found at the bottom of a very deep extraperitoneal dissection a torpedo-shaped mass of lime salts having a pin as its nucleus. The incision was drained and before the resulting sinus healed the patient left St. Joseph's Hospital. Several months later he was readmitted, this time to the service of Doctor Davis, who, operating for the closure of the sinus, found that it terminated in a perforated appendix, which he removed, with subsequent healing of the abdominal wall.

Dr. Charles H. Frazier said, at the risk of going too far afield into a discussion of foreign bodies found in the appendix, he would mention the case of a little girl upon whom he operated a good many years ago for appendicitis. Upon putting his finger through a small incision to take out the appendix he felt a pin prick. After having made the incision wider and, picking the appendix up with a pair of forceps, he saw a black rusty pin protruding half an inch beyond the lumen of the appendix. The child made an uneventful recovery. He referred also to the case of a well-known colored employe of the University who succumbed to pneumonia. The autopsy revealed a large rusty nail in the appendix.

Major Donald McCrae said that a number of years ago a case was brought to him as one of appendicitis and with the history of having had several attacks. He made the usual incision and found the appendix quite normal. Of course, the appendix was removed, but a little higher up he

found quite a little mass, and in separating this there was seen a rather inflammatory adhesion between the cæcum and a loop of small intestine from which he evacuated a few drops of pus and in the centre of which was a tooth-pick. The tooth-pick had perforated the ascending colon, made its way into the loop of small intestine, and was in position to pass out the other side of the loop. It was pulled out through the second opening in the wall of the intestine. The opening was closed, a cigarette drain inserted, and the patient recovered. It struck him that there might be no end of the wanderings of this tooth-pick, having seen it actually passing through the cæcum into the small intestine and headed for the other side. Nature had shut off the other end. Having almost seen the process taking place he could imagine how such a body might under certain conditions wander about in many ways.

STATED MEETING, HELD DECEMBER 3, 1917

The President, Dr. Charles H. Frazier, in the Chair

OSTEO-ARTHRITIS FROM FOCAL INFECTION

Dr. William J. Merrill presented a number of patients to demonstrate the relation between arthritis and tonsillar and dental infections. He prefaced the presentation of these patients by remarking that inflammations arising in joints, muscles, tendons, etc., are due to bacterial infections or intoxications or physiologic poisoning. The tissues in normal conditions, under normal and even abnormal stress, do not undergo any permanent pathological change. If the tone and resistance are diminished and the cells are irritated, slight stress produces morbid change in the parts which are weakest. The effects of traumatism in normal tissues are readily repaired and the tissues return to their normal condition readily, except when there is some constitutional disorder which keeps up the irritation. Arthritis from traumatism readily recovers except when there is a toxic or infectious agent present, under which condition the arthritis may remain subacute or chronic for a considerable time. Even in the case of dislocation or severe traumatism in which there is considerable solution of continuity, when poisons are not present, repair takes place readily. He had seen marked evidence of this fact within the past seven years, in which time mild and severe cases of arthritis have been noted to exist in the presence of focal infection and which have cleared up when the source of poison was eliminated.

Six and a half years ago, a severe case of hypertrophic osteo-arthritis of the hip-joint, in which there were already hyperostoses of the joint and limited motion in the hip-joint, recovered, and nearly normal motion returned after three teeth had been removed and the infection eliminated.

A large number of cases of "sacro-iliac relaxation," "sacro-iliac strain," "sacro-iliac sprain," etc., have recovered when nothing more was done than to treat the focal cause. Many cases of arthritis and localized inflammatory states in the spine are due to physiologic poisoning. From observation of these many cases of pain and tenderness in the spinal and pelvic structures, it has been proven conclusively that when any irritation is continued there is some bacterial or physiologic poisoning to "fan the flame"; furthermore, that in all irritation in a joint or other structure there must be a constitutional toxic state when the condition persists. In cases of mild pain in the sacro-iliac and lumbosacral structures, continued for a long time, and the severe prostrating attacks which might be termed "sacro-iliac crises," the evidence has been in many hundreds of cases very conclusive that the condition was due primarily, as a predisposing cause, to systemic poisoning, and secondarily, as an exciting cause, to traumatism.

It is not possible to determine from the external appearance of a tooth whether it is infected or not, since many teeth are apparently not devitalized but are in the first stages of the infected condition. The tooth is infected by the invasion of bacteria to the root canal, which may take place by means of erosion through the dentine or enamel, which is chemical dissolution, or by means of abrasion, which is mechanical dissolution. The process of erosion takes place especially in the sulci of the crown and at the neck of the tooth at the junction of the enamel and the pericementum under the margin of the gum. When the dentine is encroached upon, the dental tubuli are opened up and bacteria can pass directly into the tooth. If an abrasion or lesion takes place in the pericementum, then by continuity the infection may travel external to the dentine up to the apex of the tooth and enter the root canal. The formation of tartar underneath the gum is a very frequent cause of erosion. When organic matter is lodged in the margin of the gum, chemical and bacteriochemical action takes place, especially when traumatism is added. Bacterial placques are formed which adhere to the tooth. Calcification takes place and tartar is formed. Under this tartar, erosion occurs.

When teeth have lost their normal whiteness or have become discolored, they are undoubtedly in the stage of early infection or totally devitalized. Such condition, often when there is no tenderness or pain, should be suspected. The teeth should be X-rayed. When the tooth is devitalized and the abscess involves not only the apex but more or less of the alveolus, it should be extracted. Pivots in the stumps and roots of devitalized teeth, especially when the root canal filling is incomplete, are very frequently sources of infection. Pyorrhœa, especially when it is superficial, does not necessarily cause any constitutional disturbances because, as a rule, under this condition, there is no absorption and the pus which collects and is swallowed is unquestionably neutralized in the stomach.

Focal infections in the tonsils, nasal cavities, sinuses, along the intestinal tracts, such as infected glands, appendix, gall-bladder, in the genito-urinary tract, such as prostatitis, seminal vesiculitis, infected tubes, etc., are unquestionably frequent causes of various forms of arthritis.

Dr. Walter G. Elmer confirmed the statement that infection about a tooth can be disseminated throughout the body and cause serious difficulty. At one time he was himself apparently the victim of faulty dentistry. A week or two after a filling had been removed he began to have pain in the whole upper jawbone, and bore with it as patiently as possible for about three months. As the pain grew steadily worse instead of better he consulted another dentist who drilled through the filling, and about a thimbleful of pus escaped. There was instant relief. It was a front tooth and the pus had evidently burrowed over the upper surface of the hard palate. This is a typical instance in which the local infection may cause serious disturbance elsewhere, as in a joint which had received some slight traumatism.

On the other hand, a certain amount of conservatism should be used. He related the experience of a friend who, during a visit to another city

where great interest and enthusiasm were shown in tooth infection, was persuaded to have X-ray pictures made of his teeth. He was in perfectly good health and, so far as he knew, his teeth were in excellent condition and caused him no trouble whatever. But it was concluded from the X-ray films that he had seven teeth with abscesses at the roots and he was urged to have them extracted at once; otherwise he was marching straight to his doom! However, he demurred, and returned to Philadelphia with all his teeth.

It would be interesting to determine in a series of about 5000 examinations how many gave evidence of certain shadows indicating foci of infection at the roots of the teeth. An inflammatory process in the pericementum at the root of a tooth may subside entirely, leaving behind it only clean healthy tissue, and yet this area will cast a shadow of different density from that one in which there has never been any inflammatory process. Even a circumscribed abscess may become absolutely sterile. It often happens that no culture can be obtained from an old pyosalpinx. And yet such a condition at the root of a tooth would cast its shadow on the film. Children who have had their teeth straightened show changes in the density of the shadows about the roots, but that does not mean infection there because there never has been any infection. It is due to the shift in the position of the root.

A very large proportion of people must have these evidences who are nevertheless enjoying good health. The subject must be viewed in that light and not without caution. Perhaps in the conduct of the orthopædic clinics sufficient attention may not be given to the teeth, but a large number of the joint conditions improve under the usual methods of treatment without having teeth extracted. There are two sides to the question: one in which the matter is overestimated, the other in which the teeth are neglected altogether.

Dr. Merrill, in closing, remarked that patients are always carefully examined in the dispensary. If there is any suspicion of trouble in the mouth, they are sent to the Dental School. Practically 100 per cent. who have been sent to the Dental Clinic have had some mouth lesion. What the percentage of persons not examined in this manner is, it is impossible to state. In regard to ignoring the evidence given by X-ray, it is unquestionably an unwise attitude, even though in certain cases of marked caries of teeth and of the alveolus there is often but little trouble, since the "fires have burned out." Again the X-ray may not show any absorption, erosion or abscess because it is too small to cast a shadow.

In several cases, X-rays have indicated a large amount of erosion and absorption and that the cavities were filled with pus. On extraction there was practically no free pus but infection was present. The associated disabilities which we practically always find act as our guide, and as a rule the affected teeth which are the predisposing cause are extracted.

A frequent cause of trouble which is not evident on inspection or X-ray examination is a small abscess at the roots of the tooth. The period when

the infection is most likely to take place is in the beginning of the formation of this abscess. With these facts in mind, the importance of careful and repeated search is emphasized. If the abscess is not shown by the X-ray taken in a given angle, it should be taken at various angles with a hope of finding the pus cavity. Many times it will be hidden behind the apex of a root and not show. In certain cases referred to, in which there were decided symptoms, such as nerve pain and joint conditions, the abscess at the apex of the extracted tooth was about the size of a pinhead.

The symptoms have subsided in practically every case which was treated at the Dental Hospital, or at least at the present writing, cases which returned to the dispensary have shown improvement or cure. It is, of course, impossible to state the percentage of persons who have apical or alveolar abscess and are apparently in good health.

SURGERY OF SPASTIC PARALYSIS

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

Spastic paralysis of infancy and childhood is a common affection, and its treatment has been more or less unsatisfactory. While the orthopædic treatment of anterior poliomyelitis has become quite definite and well established, and is productive of splendid results; the treatment of spastic paralysis has been comparatively neglected, and it remains more or less obscure and unsettled, and its results are uncertain.

Tubby and Jones collected 837 cases, of which 510 were hemiplegic, 157 diplegic, 140 paraplegic, and 30 monoplegic. The paralysis may be of intra-uterine origin, due to cerebral defects, hemorrhage and softening, syphilis, specific fevers, eclampsia and convulsions, etc.; or it may be due to injuries to the head during birth; or, finally, it may be acquired after birth from hemorrhage, chronic meningitis, hydrocephalus, etc. It is common in children of premature birth. Thus, it is seen there is a wide variety of causes of spastic paralysis, and according to the degree of injury or lack of development of the brain or the spinal cord there is a wide divergence in the extent and degree of the spasticity and weakness. Unfortunately, many children with spastic paralysis are mentally subnormal or even idiotic. This renders the prognosis more unfavorable and the treatment more difficult.

I shall not take the time to consider the various forms and the symptoms of this affection. Suffice it to say that they are dependent upon the distribution and degree of spasticity and weakness and upon the mental characteristics.

Nor shall I here discuss what cases are unsuitable and what ones suitable for treatment, nor the indications for and the methods of conservative treatment; but shall speak briefly of the various operative measures that have been employed to improve the condition of these patients.

Tenotomy of the contractured muscles is the oldest and the most commonly employed surgical procedure for the relief of spastic paralysis. This permits the limb to assume a normal position. It has two values; it relieves the weak opposing muscles from constant overstretching, and it breaks the vicious circle formed by tendon, afferent sensory nerves, spinal centre, efferent motor nerves, and muscle. If the weak muscles, which are the opponents of the strong contractured muscles, are relieved from the strain of overstretching, they will in a measure recover their strength and be better able to resist the pull of their strong opponents which are temporarily disabled by tenotomy and which will for some time be partially handicapped mechanically by the lengthening which they have suffered. In the second con-

sideration, it would appear that the tension of a muscle is somewhat dependent upon the tension of its tendon. If pull is made upon the tendon of a muscle a message is carried by sensory nerves to the spinal centre, whence an efferent impulse is sent out to the muscle which causes it to contract to resist the tension upon its tendon. Normally such impulses are controlled by the cerebral centres, but in spastic paralysis the cerebral centres have been disconnected from the spinal centres, have lost their control, and can no longer inhibit the excitability of the peripheral arc. Therefore the peripheral arc remains in a constant state of over-sensitiveness and over-excitability. This is manifested in the contracted muscles and the exaggerated reflexes. The tenotomy of a tendon cuts this arc, or circle, at one point, and breaks the stream of afferent impulses that were constantly pouring in upon the spinal centres. The centres, therefore, quiet down, and in their part cease to send forth the continuous stream of efferent impulses to the muscles that kept them in a state of constant contraction.

Unfortunately, tenotomy of contracted muscle tendons has not proved uniformly successful in practice. In many cases there has been a recurrence of the original condition. In numerous other cases an opposite deformity has been produced. A talipes equinus has been converted, for example, into a talipes calcaneus, which is a more disabling deformity.

Therefore, Foerster proposed and executed his posterior spinal root resection. This operation cuts the vicious circle by dividing the sensory nerves just before they reach the spinal centres. This surgical procedure is, however, so difficult and severe as to preclude its common use.

Stoeffel then attacked the problem in a different manner. He pointed to the fact that in spastic paralysis all muscles are alike spastic; and that, for example, in talipes equinus the anterior leg muscles are spastic as well as the posterior muscles, but that the latter are so much stronger they overpower the former. The anterior muscles are overstrained and overstretched and thus become definitely weakened. This weakness is not a real paralysis. In fact, in spastic paralysis there is no absolute paralysis. In the second place, tendons that often appear contractured are not really so. The muscles are shortened only by spastic contraction that disappears under ether. No real muscle shortening is present. Therefore a tenotomy lengthens a muscle which is not shortened and permits the development of an opposite deformity. If contracture persists under a general anæsthetic it is permanent, and the tendon should be lengthened. Stoeffel therefore proposed to weaken the strong muscles by a surgical procedure and to strengthen the weak muscles by freedom from overstrain and by exercise. Thus he would establish an equilibrium of flexors and extensors, for example, that would maintain the limb in normal position and allow more or less normal function. He weakens the strong contractured muscles by resecting a portion of their motor nerve supply.

To correct talipes equinus the internal popliteal nerve is exposed in the popliteal space. It is dissected into numerous bundles which are found

to supply the various muscles of the calf of the leg. A portion of each bundle supplying a spastic contractured muscle is then excised for a length of one to two inches. Approximately one-fourth to two-thirds or three-fourths of the nerve supply to a muscle is thus resected, depending on the amount of spasticity and deformity present in each case. The electrode is used in distinguishing the nerve-bundles which supply the various muscles, except when the surgeon's knowledge of the anatomy of the nerves enables him to dispense with its assistance.

For contracture of the hamstring muscles, operation is performed upon the sciatic nerve in the upper part of the thigh. For adductor spasm one or both branches of the obturator nerve are excised. In the upper extremity the median nerve is exposed in the flexure of the elbow and the branch going to the pronator radii teres and the branches to the various flexor muscles of wrist and fingers are resected as desired.

During the last four years the author has performed thirty-five Stoffel operations on the popliteal, the sciatic, the obturator, and the median nerves. A complete report of these cases will be published later. The results have been so satisfactory that the operations have been done routinely in the author's orthopædic services at the Episcopal and the Presbyterian Hospitals and in Doctor Ashhurst's service at the Orthopædic Hospital.

The following cases illustrate briefly the results that have been obtained:

CASE I.—C. C. *Spastic paraplegia since birth.* September 14, 1914: Is able to walk with the greatest difficulty. September 26, 1914: Operation upon both obturator and both internal popliteal nerves. April 25, 1915: Able to walk fairly well. Heels come to the floor, but toes strike the ground first. October 19, 1915: Second operation upon both popliteal nerves. January 18, 1916: Heels on the floor in walking. Walks much better.

CASE II.—E. M. *Spastic hemiplegia.* July 20, 1915: Marked flexion of right wrist and fingers. Foot in marked equinus, walks on toes. July 21, 1915: Operation on right popliteal nerve. At the same time the tendo Achillis was tenotomized and the extensor proprius hallucis was transplanted to the head of the first metatarsal. All the flexor tendons of the right wrist were lengthened. December 1, 1917: Walks well, with but slight limp. Foot is straight and firm on the floor in walking. Right hand is markedly flexed at the wrist and the fingers partially flexed in the palm. A Stoeffel operation will now be performed on the median nerve as the tendon lengthening has not cured her deformity.

CASE III.—W. G. *Spastic hemiplegia.* November 1, 1914: Left arm—forearm pronated, wrist flexed, fingers and thumb flexed into palm. No active extension of wrist, slight motion of fingers but none of thumb except slight adduction and flexion. Left leg—walks on toes, no active motion in ankle, tendo Achillis contractured, hollow-foot, hammer-toe. November 4, 1914: Operation on median and internal popliteal nerves, tenotomy of tendo Achillis, and transplantation of extensor proprius hallucis to the first metatarsal. December 7, 1914: Wrist, fingers, and thumb are straight. May 10, 1915: Can actively extend fingers almost to normal limit, can make good fist, can move wrist feebly. No active supination. September 13, 1915: Good grip, slight control of thumb. Can hold objects in his hand.

CASE IV.—R. J. February 26, 1914: Walks on toes with legs crossed, very unstable. October 2, 1914: Operation on both obturators and internal popliteal. January 9, 1915: Much improved, heels on ground when walking, legs straight, does not drag toes. Walks with braces.

CASE V.—C. J. March 20, 1915: *Contracture of tendo Achillis, ankle and patellar clonus.* March 24, 1915: Operation, partial resection of nerve supply to gastrocnemius, soleus, and peronei. May 1, 1915: Foot in good position. Can dorsiflex foot well. Much improved in walking.

These cases, which are but a few of those operated upon, illustrate the improvement which occurs after nerve resection. In several instances a second operation was performed, when it was found that too little of the nerve supply had been resected at the first operation. It is better to resect too little than too much. In operations upon the lower extremity the results have appeared to be almost uniformly successful and satisfactory. In resections of the median nerve of the arm the results are not functionally so good, although the cosmetic results are satisfactory.

Following operation the after-treatment should be thorough and persistent in educating the weakened muscles and in securing coördination. Unfortunately, the mental condition of the patients and the lack of proper facilities for the work interfere greatly with the training. Notwithstanding these difficulties, the Stoeffel operation appears to the writer to afford the best solution yet offered for these cases.

It may be mentioned that tendon transplantations, especially in the arm, may be productive of more or less improvement. Nutt's operation of intra-perineural neurotomy with immediate re-suture has also been performed with success.

The writer has considered a modification of the Stoeffel operation—instead of partial nerve resection, he proposes a transplantation of the same nerves into the weak opposing muscles. Anatomical difficulties would not permit of the universal application of this procedure.

It would be interesting to know what occurs in the muscles following the Stoeffel operation. Part of the nerve supply of the muscle has been removed and a portion of the muscle paralyzed. It seems probable that in time the remaining nerves will neurotize the entire muscle. Only time will tell whether the good results of the operation will be permanent.

Sharpe's cerebral decompression for spastic paralysis is on trial, but it would appear to be of value only in recent cases, and particularly in the new-born.

Dr. Gwilym G. Davis said that he thought that the operation on the brain for the localized traumatisms resulting in paralyses did not originate from Doctor Sharpe's suggestion, but rather from Cushing's. He had been over the same material mentioned by Doctor Gill in reference to the examination of the eyeground. Cerebral decompression is obviously a measure intended to lessen the pressure inside the skull, and one of the symptoms of such pressure is clouding of the optic nerve as observed by the ophthalmoscope and that is what one universally fails to find. A child with spastic paralysis, even at the age of two years, does not have the use of the limbs which it should have at that period. The condition is called cerebral spastic paralysis and is often associated with an impaired mentality. Some of the evidences of that are very obscure and interesting. In the treatment of the cases, the old method of tenotomy still continues largely in force for two reasons: (1) the ease of its performance, its availability, and (2) because at times the results which it yields apparently compare favorably with those of other methods. He was not willing to go quite so far as does Doctor Gill in the advocacy of the Stoeffel operation, for his experience with it has not been so entirely favorable as his. He had not found it always an easy operation, being considerably more difficult than the tenotomies. He, too, had done it on two sides, but the difference has not been so great as to incline him on all occasions to prefer it to the tenotomy. It should be emphasized that by tenotomies and transplanting the condition in many of the cases can be improved. Doctor Nutt, of New York, some years ago divided the sciatic nerve deliberately, paralyzing the limb. He noticed considerable improvement in his patient, both in the parts affected and in the intelligence of the child. Encouraged by his results Doctor Davis divided the median nerve in the case of a young woman of eighteen years with contracted arm. She improved to such an extent that she later wanted the nerve divided a second time. Arrangements were made to do this but the patient's husband objected and the operation was not done. The Stoeffel operation would be followed by considerable improvement. He did not wish to appear antagonistic to this operative procedure because he believed it to be a good one. There are cases, however, such as children who rise a little too much on the toes when they walk or run, in which cure is effected by simple tenotomy and without the necessity of the more elaborate operative procedure. Yet there is a field for the Stoeffel operation.

Dr. Charles H. Frazier remarked, with reference to resection of the posterior roots for the treatment of spasticity, there is no doubt that the operation is a very serious one and that the mortality is relatively high; there is no doubt also that there has been a considerable number of failures. It is easier to give the contra-indications for the operation than to give the indications. Certainly the operation should not be done in subjects not physically strong, in delicate children, nor in feeble adults. It should not be done for spasticity in the upper extremities. It should not be done when there is lacking good muscular reserve power, for when the spasticity

is relieved, the function restored in the way of locomotion will not be sufficient to have warranted an operation of that gravity. It should not be done in children who are mentally defective, because the after-treatment is essential, no matter what the operation be, and unless the surgeon is assured of coöperation on the part of the patient the results will not only not be good but in most instances a failure.

Now with regard to the technic of the operation, he emphasized the point, that in the early stages there were many failures because too few roots were cut. For complete and reliable statements of what can be done by this operation he referred to Förster's own writings. He has done more root resections for spasticity than any other surgeon, and has been more painstaking in the follow-up treatment. The end-results depend upon the care in the selection of the roots to be cut and the persistence of the after-treatment. Förster's articles are profusely illustrated and afford an excellent demonstration of what can be accomplished.

The operation itself is attended with a risk greater than that of the ordinary laminectomy because one is dealing chiefly with large bundles of sensory roots and any insult to these must be a predisposing factor in the causation of shock or collapse. He had found that by the application to the cord and roots at the level of operation of a cotton pledget, saturated with a 0.4 stovain solution, shock could be eliminated. This is a simple procedure and it seems entirely rational. As a matter of fact he had proven by pulse and blood-pressure tracings its efficiency in the experimental laboratory.

Another point of great moment in the technic is the question of postoperative bleeding. A small artery accompanies each root and if we are content with the mere section of the root with knife or scissors there will always be more or less postoperative oozing. A very little blood inside the dural sac will result in the formation of adhesions. Absolute hæmostasis is essential to the ideal operation. This can be applied with reference to root resection by ligation; in fact, he had done some of these operations without cutting the roots at all. With the finest silk suture he simply tied the ligature around the root. The root must undergo degeneration; regeneration cannot take place in the root any more than it can in the spinal cord or brain. By applying two ligatures and dividing the root between, the operation can also be made bloodless.

Theoretically, the operation is based upon sound physiological principles, but the technic is too difficult to warrant one's recommending it except to the neurological surgeon. Its successful performance requires great technical skill and dexterity and the mastery of many important manœuvres with which only those accustomed to the surgery of the central nervous system are familiar. With these restrictions he earnestly endorsed the operation in selected cases, and had practised it a number of times in his clinic.

From what Doctor Gill has said and from his own knowledge of the subject there is no doubt that the Stoeffel operation has a very much wider appli-

cation. The principle of the Stoeffel operation is fascinating. His first experience with it was in the laboratory. In trying to devise an operation for the relief of deltoid paralysis, one of the most common sequelæ of infantile palsy and particularly deforming and undesirable in young women, it occurred to him that it might be possible and feasible to sacrifice a portion of the function of the triceps muscle for the benefit of the deltoid, using for this purpose a portion of the musculospiral nerve, representing the innervation of the triceps muscle. Extremely painstaking dissections were made in the cadavers of monkeys, newborn infants, and adults. With these he was able to confirm the observations of Stoeffel and at the same time familiarize himself with the topographical anatomy of the musculospiral nerves. In two monkeys he carried out an end-to-end anastomosis of the intentionally cut circumflex nerve with the electrically isolated portion of the musculospiral nerve. (In the monkey this represents approximately the posterior third of this nerve.) Immediately after the operation there seemed to be a complete musculospiral palsy with wrist-drop and inability to abduct the upper extremity. At the end of five months the wrist drop had disappeared and movements of the upper extremity were quite unrestrained. This was his first experience with the Stoeffel principle and it was sufficiently positive to convince him of its physiological soundness and the practicability of its application. So far as the effect of cerebral decompression is concerned in the treatment of spasticity he said that in the beginning he viewed the proposition with absolute skepticism and that nothing he had heard since had led him to change his views.

MASSIVE DEGENERATION OF THE KIDNEY AND ITS ROLE IN THE CLINICAL CURE OF RENAL TUBERCULOSIS

Dr. Alexander Randall read a paper with the above title.