TRANSACTIONS
OF THE
PHILADELPHIA
ACADEMY
OF
SURGERY

VOL. X.

1908

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ACADEMY OF SURGERY

VOLUME X

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1908

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

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

1896. Deaver, Henry C., M.D., 1534 N. Fifteenth Street. Surgeon to the Episcopal Hospital, St. Mary's Hospital, and to St. Christopher's Hospital for Children.

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

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

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

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

1902. Girvin, John H., M.D., 3924 Walnut Street. Gynæcologist to the Presbyterian Hospital; Instructor in Obstetrics, University of Pennsylvania.

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

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

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

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

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

1898. Hutchinson, James P., M.D., 1702 Locust Street. Surgeon to the Pennsylvania, St. Timothy's, Methodist Episcopal, Children's, and Bryn Mawr Hospitals.

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

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

1895. LE CONTE, ROBERT G., M.D., 1530 Locust Street. Surgeon to the Pennsylvania, Children's, and Bryn Mawr Hospitals.

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

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

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

† MEARS, J. EWING, M.D., 1535 Land Title Building.

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

1904. MITCHELL, CHARLES F., M.D., 251 S. Seventeenth Street. Surgeon to the Germantown Hospital; Assistant Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to the Eastern State Penitentiary.

1906. MÜLLER, GEORGE P., M.D., 324 S. Fifteenth Street. Instructor in Surgery in the University of Pennsylvania; Assistant Surgeon to the University Hospital, Philadelphia General Hospital, and the Home for Crippled Children; Assistant Pathologist to the German Hospital.

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

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

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

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

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

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

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

1900. Rodman, William L., M.D., LL.D., 1904 Chestnut Street. Professor of the Principles of Surgery and Clinical Surgery, Medico-Chirurgical College of Philadelphia; Professor of Surgery, Woman's Medical College of Pennsylvania; Surgeon to the Medico-Chirurgical Hospital; Woman's College Hospital, Presbyterian, Jewish, and the Philadelphia General Hospitals.

1900. Ross, George G., M.D., 1721 Spruce Street. Surgeon Germantown Hospital; Assistant Surgeon, German Hospital.

1894. Shoemaker, George Erety, A.M., M.D., 1831 Chestnut Street. Gynæcologist to the Presbyterian Hospital.

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

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

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

1903. Stewart, Francis T., M.D., 311 S. Twelfth Street. Surgeon to the Germantown Hospital; Assistant Surgeon, Jefferson Hospital; Professor of Surgery, Philadelphia Polyclinic; Surgeon to the Out-Patient Department of the Pennsylvania Hospital.

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

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

1907. Walker, Warren, M.D., 1632 Spruce Street. Surgeon to the Out-Patient Department of the Episcopal and Children's Hospital.

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

1883. White, J. William, M.D., 1810 S. Rittenhouse Square. John Rhea Barton, Professorof Surgery, University of Pennsylvania; Surgeon to the Rush Hospital.

1902. Whiting, A. D., M.D., 1523 Spruce Street. Surgeon to the Germantown Hospital; Assistant Surgeon to the German Hospital; Surgeon to the Southern Home for Destitute Children; Surgeon to the Out-Patient Department, German Hospital.

† Willard, De Forest, M.D., Ph.D., 1901 Chestnut Street. Clinical Professor of Orthopædic Surgery, University of Pennsylvania; Surgeon to the Presbyterian Hospital; Consulting Surgeon to the Atlantic City Hospital, and Hospital for Chronic Insane, Pennsylvania Hospital, and the Germantown Hospital.

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

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

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

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1881. S. D. Gross.
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1883. William Hunt.
1884. John H. Brinton.
1885. John H. Packard.
1886. R. J. Levis.
1887. J. Ewing Mears.
1888. C. B. Nancrede.
1889. John B. Roberts.
1890. DeForest 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.

WINNERS OF THE SAMUEL D. GROSS PRIZE

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

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

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

HONORARY FELLOWS

J. Collins Warren, M.D. ..... Boston, Mass.
Maurice H. Richardson, M.D. ..... Boston, Mass.
George M. Sternberg, M.D. .....
Charles McBurney, M.D. ..... New York, N. Y.
L. McLane Tiffany, M.D. ..... Baltimore, Md.
Nathaniel P. Dandridge, M.D. ..... Cincinnati, Ohio.
Roswell Park, M.D. ..... Buffalo, N. Y.
Robert F. Weir, M.D. ..... New York, N. Y.
Frederic S. Dennis, M.D. ..... New York, N. Y.
Dudley P. Allen, M.D. ..... Cleveland, Ohio.
Robert Abbe, M.D. ..... New York, N. Y.
C. B. G. de Nancrede, M.D. ..... Ann Arbor, Michigan.
William J. Mayo, M.D. ..... Rochester, Minn.
John C. Munro, M.D. ..... Boston, Mass.

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1881	*Bernhard von Langenbeck	Berlin, Germany.
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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	Morris H. Richardson	Boston, Mass.
1898	George M. Sternberg	Washington, D. C.
1898	Charles 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.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING, HELD JANUARY 7, 1907.

The President, JOHN B. ROBERTS, M.D., in the Chair.

FRACTURE DISLOCATION OF THE ATLAS WITHOUT SYMPTOMS OF SPINAL INJURY.

DR. H. AUGUSTUS WILSON exhibited a man, a railroad brakeman, who fell from a train while it was moving at about ten miles an hour, striking upon his left shoulder and cheek. Fearing that he would be run over he forcibly wrenched or twisted his head and shoulders. He did not lose consciousness. During the first two weeks thereafter he did not manifest any symptoms as a result of the fall except some little soreness over his left malar bone and his left shoulder. Two weeks after his accident he began having dull dragging pains about his neck. He continued his occupation as brakeman without interruption for one year. During this year, with the exception of the first two weeks, he was under the care of several physicians for vague symptoms which were considered rheumatic in character and were not ascribed to the fall. At various times during the year, plasters, liniments and ointments were applied to his neck without apparent effect.

During the next year and a half—that is, up to two and a half years after he fell from the train—he worked about three-fourths of the time. During the several periods when he did not work he suffered with pain in his neck, but was otherwise competent to work. Patient said that the jarring and jolting of the train did not increase his pain. Three years after the accident the pain in his neck became more severe and constant, compelling him to discontinue his work, which he has not resumed up to the present time. The patient states that an abscess of the neck was diagnosticated and an attempt was unsuccessfully made to aspirate it.

A few months later he fell into the hands of an osteopath who told him that he had dislocation of the seventh cervical vertebra, and treated him for thirteen weeks. One of the methods resorted to was to suspend the patient so that his feet did not touch the floor; while in this position the head was forcibly rotated. He states that at one of his examinations quick forcible pressure was made upon the top of his head while he was standing. He immediately dropped to the floor and was momentarily unconscious.

In June, 1905, he was brought to the Orthopedic Department of the Jefferson Hospital. A steel brace was applied to remove the weight of the head from the spine and immobilize the neck. This he has worn constantly until the last two months. He has recently taken off the apparatus for an hour at a time every morning and afternoon, without disadvantage. His present condition is that of a well-nourished white man. The mucous membrane of the mouth is of natural color and appearance. No abnormalities of the superficial or deep reflexes. No disturbance of sensation, or other nerve function. Gait is normal. With the stiff supporting brace removed he carries his head in a somewhat stiff, unnatural manner.

Special Senses.—Eye examination by Dr. Wm. M. Sweet. Pupillary reflexes. Media clear, optic discs clearly outlined, and retinal vessels of normal calibre and direction. No defect of ocular rotations. Other fields of vision show no contraction.

Throat examination by Dr. J. L. Harkness, finds he has a subacute rhinitis, intumescent turbinates, relaxed and injected soft palate, and the pharynx bulges forward below the line of the uvula, apparently narrowing the œsophageal and laryngeal openings. Otherwise the pharyngeal conditions appear normal.

Physical Examination of the Neck.—Inspection from a directly posterior standpoint does not reveal any manifest irregularity. On view laterally, the patient's head is observed to be inclined forward and with the chin elevated apparently in the same position in which it was held by the brace. Surface at the back of the neck is observed to have its concavity posteriorly and an elevation above and below. The Adam's apple is not unduly conspicuous.

Palpation of the tumefaction above referred to shows that it is hard and immovable, not painful on pressure. Pressure in the depression just below the occiput elicits pain, but not of a severe

FIG. 1.—Fracture dislocation of the atlas.

type. The guarded manner in which the head is constantly held renders it difficult to determine the amount of motion at or above the seat of the injury. Definite knowledge as to the mobility of the upper spine was not considered of great importance. The risk of subjecting the patient to the accompanying trauma rendered it inexpedient to determine the extent of mobility.

The X-ray plate (Fig. 1) shows a fracture of the odontoid process and a forward dislocation of the atlas, which occupies a tilted position. Until recently the patient was unable to sleep in recumbency, but could do so sitting on a chair with his head forward on a pillow. Occasionally he has difficulty in swallowing because of the mechanical displacement of the œsophagus.

Dr. James K. Young said he had seen a similar case in a child who fell and dislocated the second cervical vertebra. With the injury there was loss of power and sensation in the lower extremities. The remarkable feature in Dr. Wilson's case is the absence of cord symptoms. From the history of the case he would consider it one of spondylitis following injury, this injury possibly being dislocation and spontaneous reduction; now there is dislocation as a result of the spondylitis.

Dr. George G. Ross mentioned a case of fracture of the bodies of the tenth and eleventh dorsal vertebræ and bowing of the spinal column without paralysis. The accident occurred in July; the patient when on a hay wagon catching his head and bending over, compressing the bodies of the vertebræ and springing apart the spinous processes. This formed a distinct ridge over which ran the cord, but there was neither permanent motor nor sensory symptoms. The diagnosis was confirmed by the X-ray.

Dr. Gwilym G. Davis said that recovery from injuries of the vertebræ in the cervical region are more frequent than is generally supposed. He has seen several cases end in recovery even though deformity was marked.

Dr. Wilson, in closing, said the man was very clear in his description of the accident and stated that the symptoms were not such as to demand the care of a physician until after two weeks. The railroad physicians in the relief bureau did not consider the case worthy of attention, hence the symptoms must have been very trivial. He believes the great deformity followed the "osteopathic treatment." The symptoms were so aggravated by it that the man could not lie down, being obliged to sit with his head forward. During part of the time he walked the street

night after night. There probably was some displacement originally, but that method of treatment increased it.

TENDON TRANSPLANTATION.

Dr. Henry R. Wharton exhibited a child aged twelve years, who, when three years of age, had sustained a fall, injuring the spine. Paralysis of the entire left side followed, and the patient was confined to bed for three months. The arm gradually improved, and the function was restored to normal. The leg improved, but with a persistence of muscular atrophy, and an equinus valgum. At the Presbyterian Hospital, in July, 1906, Dr. Wharton had performed the following operation:

The tendo Achillis and peroneus longus and brevis tendons were divided subcutaneously and the tendon or the tibialis anticus was exposed and divided. The tendon of the extensor longus digitorum was next exposed and divided and the proximal end of this tendon was sutured to the distal end of the tendon of the tibialis anticus. To overcome the dropping of the great toe the tendon of the extensor propius pollicus was exposed and divided, and after exposing the tendon of the peroneus tendon it was divided and sutured to the distal end of the tendon of the extensor proprius pollicis. The wounds were closed and the limb put in a position of over-correction in a plaster of Paris bandage. Later, a brace was fitted and the patient was allowed to walk upon the limb.

Dr. John H. Jopson, who assisted Dr. Wharton at the operation, said the patient showed extraordinary improvement, the foot previously being a useless member. He now resorts to this type of operation with a great deal of confidence. The main element of success is the selection of cases. In those with good muscles to utilize for transplantation, the results will be good. If complete paralysis be present, operation will result only in disappointment; those cases should be let alone, so far as transplantation operations are concerned.

RECOVERY FROM SELF-INFLICTED COMPLETE SUBHYOID LARYNGOPHARYNGOTOMY.

Dr. John H. Jopson and Dr. George C. Stout showed a patient recovered from self-inflicted complete subhyoid laryngopharyngotomy. He was an adult aged forty-seven, admitted to

the Presbyterian Hospital three months previously, suffering from shock and loss of blood. Two hours before he had cut his throat, and the wound extended from one sternomastoid muscle to the other, dividing the skin, the subcutaneous and the muscular tissue of the thyro-hyoid space, the pharynx being opened to the full extent of the wound. The epiglottis was cleanly severed at its attachment to the thyroid cartilage, drawn upward and turned backward out of sight. A small piece of the upper border of the thyroid cartilage was sliced off on either side. The false cords were not injured, the weapon having passed just above them. After reaction, which quickly followed, the patient was etherized through the wound in the neck. The epiglottis was drawn downward and forward and sutured to its place of former attachment by three sutures of No. 1 chromicized catgut passed through its entire thickness and through the thyroid cartilage, which was partly ossified. One suture passed through the median line and one was placed on either side. These sutures held the epiglottis in excellent position, and were reinforced by sutures passing through the superficial structures and perichordium. The lateral angles of the wound in the pharynx were then tightly closed by chromicized suture and the entire wound closed by deep and superficial stitches. Following operation, the patient did very well. There was considerable laryngeal irritation for some days, shown by cough and free expectoration of mucus and suppression of voice. The temperature was slightly elevated for ten days. There was a slight superficial suppuration at a couple of points. At no time were there evidences of œdema or respiratory obstruction. Inhalations of benzoin vapor were instituted. There was a gradual restoration of voice after ten days. Twenty-four days after operation it was noted that laryngoscopic examination showed the epiglottis to be in good position as far as its attachment was concerned, and leaning backward somewhat more than normal. The voice was then quite strong and is now normal. Recovery is now complete.

Dr. Astley P. C. Ashhurst said that he desired in this connection to report a case of self-inflicted suprahyoidean pharyngotomy, with fatal result, because it did not seem fair to let it pass unrecorded when the successful case of Drs. Jopson and Stout was being published. On January 5, 1906, Dr. Ashhurst was called to the Orthopædic Hospital to see a nervous patient

who had suddenly gone insane and had produced a large wound in his neck by sawing it with a broken bottle which he had prepared on purpose. Before Dr. Ashhurst reached him, the patient had been given morphin and an intravenous injection of saline solution; and to this treatment it was probably due that he had not died at once. The trachea and larynx were found wagging back and forth in the wound, the patient being speechless, nearly apnœic, and almost exsanguinated. High tracheotomy was immediately performed, and respiration being thus somewhat restored, the wound was examined. It extended from one angle of the jaw to the other, grazing the anterior surface of the larynx, passing between the hyoid bone and the jaw, and opening the pharynx widely between the epiglottis and the base of the tongue. Seven or eight bleeding points were ligated, including the right lingual artery. A nick in the right internal jugular vein was sutured. The right hypoglossal nerve was divided just below the mylohyoid muscle; but as its cranial end could not be found winding around the origin of the occipital artery, search for it was finally abandoned. The base of the tongue was then sutured to the muscular wall of the pharynx with mattress sutures of chromic gut; the depressor muscles of the jaw were sutured to those of the floor of the mouth, and the skin was closed, with drainage from each angle. The next day the temperature was 103 degrees F., and the following day 105 degrees F. By the third day it had fallen to 101 degrees F., and there appeared some hope of recovery. After consultation with Dr. W. J. Taylor and Dr. Morris Lewis, the tracheotomy tube was removed, and the patient in reply to a query said he felt "as fine as silk." He breathed fairly well through the larynx for about fifteen minutes, then became cyanosed and had an attack of coughing. Although the tube was at once replaced, voluntary respiration was not restored. Artificial respiration, and mouth-to-tube insufflation were practised, but fifteen minutes after the heart had ceased to beat the patient was abandoned as dead. This was seventy hours after the operation.

CERVICAL RIB.

Dr. Joseph M. Spellissy exhibted a seventh right cervical rib, with photographs and skiagraphs of the anomaly before its excision, and presented the patient, a girl of twenty years, from whom it had been removed. An accident, a year before the patient applied for advice at the Orthopædic Department of the University Hospital in the service of Dr. DeForest Willard, was followed by deformity of the right shoulder. Examination not only discovered a sternal luxation of the right clavicle, but the presence of a right seventh cervical rib. An X-ray plate made by Dr. William R. Pancoast confirmed the diagnosis. The rib was excised, but not without difficult dissection. The subclavian artery passed over the middle of the cervical rib, resting in a deep groove. The distal end of the cervical rib articulated with the upper surface of the first dorsal rib. This articulation was disarticulated. The artery was dissected free some 2 to 3 inches and looped over the distal end of the cervical rib as an umbilical cord is slipped over a fœtal head. The distal end of the cervical rib was now raised above the artery, freed from attachments, and disarticulated from the seventh cervical vertebra. The subclavian vein was not seen, and no abnormality was noted in the circulation of the right arm.

The specimen was pronounced the most perfect in the experience of Dr. W. W. Keen and of Dr. W. R. Pancoast.

PYRALIN AS A COVERING FOR METAL BRACES.

The use of pyralin dissolved in acetone and painted on stockinette as a fixed dressing by J. K. Young, suggested some years ago to Dr. Spellissy its probable suitability as a covering for metal braces. Its experimental use by Dr. Spellissy had verified his anticipations. He exhibited a spine brace so covered, that had been to Brazil and had required no recoating except where alterations obliged by the growth of the patient necessitated it. The pyralin is applied like paint, with a brush—or preferably by dipping—and in successive coats.

The finish is improved by the rubbing down of each coat with sandpaper and later with pumice stone.

CIRCUMCISION.—A PLASTIC IN CONSTRICTED PREPUCES.

BY OSCAR H. ALLIS, M.D.,

OF PHILADELPHIA,

Surgeon to the Presbyterian Hospital.

THE skin covering the penis differs in many respects from the integument in the other parts of the body. It is thin, elastic, has little if any subcutaneous fatty tissue, is loosely connected with the organ it covers, and at the free end of the penis instead of uniting at the terminus, as is the case with the fingers and toes, turns inward and finally becomes attached to the organ just behind the corona glandis. Thus the glans penis gets two layers, or rather two thicknesses, of true skin. This turning in of the skin serves an important function: it presents an epithelial skin surface to the epithelial surface of the glans penis and, as epithelial surfaces do not ordinarily fuse or unite, a permanent opening is left for the urethral canal to discharge the accumulations of the bladder.

The turning-in of the preputial covering must necessarily make the terminus less distensible than other parts, and it is not uncommon to find the preputial orifice narrowed at birth and resisting efforts at retraction. Some years ago my colleague on the staff of the Presbyterian Hospital, Dr. De Forest Willard, called attention to this narrowing of the prepuce and to the presence around the glans of a secretion that required removal. His article directed attention to a much neglected subject and elicited commendation from sources that would have been supposed to be familiar with the subject.

The importance of attention to the cleanliness of the glans penis while the child is in early infancy is not as generally practised as it should be. Between the prepuce and the glans penis there is at birth some inspissated smegma, and this, if permitted to remain, will occasion irritation that will give rise to uneasiness and repeated attacks of non-specific balanitis.

Hence, as a result, the inner surface of the prepuce and the glans penis becomes inflamed; the epithelial surfaces are covered with granulations, and ultimately the prepuce becomes adherent to the glans. This in itself would not be the source of further irritation were there not imprisoned the old inspissated smegma. The chief collection of this secretion is back of the corona, where it serves the purpose of perpetual annoyance.

I have seen three types of neglected prepuces in the adult. In one instance there was retention of urine. Dr. Roger Keys asked me to see a young man with retention of urine whose constriction would hardly admit a probe the size of a darning needle. When I entered the house I found him in the act of urinating. He was standing erect, leaning against a wall, and flowing from the penis was a fine spray that shot upward and forward for a distance of six or eight feet; the bladder was relieving itself under spasm. In a second case the glans penis had become adherent to the preputial covering and the most careful dissection could not uncover it. In this case the superficial surface of the prepuce was retracted, but in doing this a raw surface was all that was left for the glans. In a third case, epithelioma had resulted and amputation was necessitated, in a case that I had no reason to suspect an impure life.

In many children a marked redundancy of prepuce will be noticed. There is good reason to believe that this is occasioned by the traction the child makes upon the skin in efforts to relieve irritation. A redundant prepuce may resist retraction, it may be constricted and be as mischievous as the constricted and contracted variety.

Circumcision is relegated by works on operative surgery, and by the profession generally, to the class of minor surgical operations, as if it were a matter of so little consequence that it hardly deserved attention. But practical experience has much to say to the contrary. There is scarcely a surgeon of general practice who has not been called upon to patch up and complete the criminal mutilations of incompetent operators.

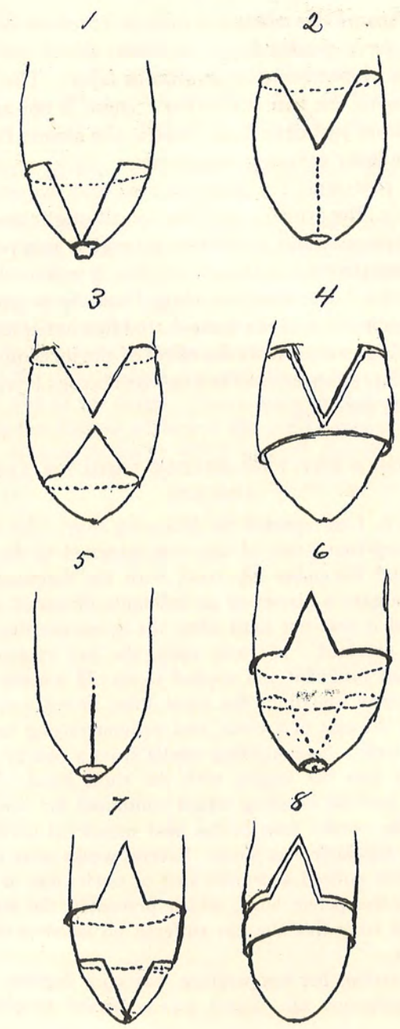
An operation that is very widely practised consists in

obliquely clasping the prepuce just anterior to the head of the glans, and with a single sweep of the knife removing the redundancy. The outer skin covering is now retracted and the inner mucous one trimmed off near the corona and parallel with it, leaving just enough to easily attach the skin flap. This usually results in a comely appearance. After attaching the two surfaces, I usually carefully test the freedom of the preputial covering and often nick the inner coat at its junction with the glans penis, since the least constriction in the mucous layer is apt to provoke swelling.

In all my early operations and in most of the operations I have witnessed, the glans penis is permanently uncovered. Whether this is the best possible result or not I do not know. One thing only I know, that the glans penis is always covered at birth, and it would seem that a hood that partially if not completely covered the organ, and which could be readily retracted for cleanliness, would be nature's model.

In some cases the prepuce is closely drawn over the head of the organ. In such, a simple splitting of both coverings upon a grooved director, from opening to the corona, yields a very satisfactory result. The dog-ears present at first shrink and leave no trace in after years of their early redundancy. The only objection to this operation is that it leaves the glans permanently uncovered, and it is with a view to preserve the original appearance, viz., partial covering for the glans, and at the same time have a retractable hood, that I have been led to contrive and practise the following operation:

Fig. 1 represents three steps in the operation. *First,* circumcision at the extremity of the prepuce. *Second,* making a V-shaped flap extending from the primary circumcision to a little beyond the greatest circumference of the glans, and, *Third,* carrying the incision from the base of this flap around the organ on dotted line. All of this is done in the outer skin covering. Fig. 2 represents the skin retracted and a dotted line extending from the point of primary incision upwards. Fig. 3 represents the effect of slitting up the inner or mucous layer. Fig. 4 represents the inner layer retracted and ready for suturing and the half covered glans penis.



The steps of this operation may be reversed, and instead of making the V-shaped flap in the outer skin layer it may be made in the deeper inverted or mucous layer. The chief difference between the two is that the frenum is not approached in the operation just described, while in the second the circumcision of the inner covering may do so.

Fig. 5 represents the glans covered and two steps in the operation, viz., the primary circumcision through the outer skin layer of the prepuce and an incision through it to a point in the greatest circumference of the glans. Fig. 6 represents the skin retracted and a dotted line extending from the preputial opening back, V-shaped, and the same dotted line extending around the glans. Fig. 7 represents the effect of the incision following this line. Fig. 8 represents the inner or mucous layer reflected and ready for suturing.

REMOVAL OF A KNITTING-NEEDLE FROM AN ABDOMINAL ABSCESS.

Dr. W. E. Lee reported the following case: An unmarried woman, twenty-four years of age, was admitted to the Pennsylvania Hospital December 28, 1906, with the diagnosis of iliac abscess. She gave a history of an indefinite illness of six weeks' duration, and it was not until after the operation that the true history was obtained. In June, 1905, she had reason for suspecting herself pregnant and applied to an old woman for help. With the patient standing, the right knee flexed and the foot resting upon the seat of a chair, and without raising her clothes, this woman took a bone knitting-needle from a nearby table and introduced it into the vagina with the right hand. This was followed by profuse bleeding which continued for several days. There was the normal flow at the next menstrual period, which has recurred regularly ever since. Several weeks after the operation the patient noticed a definite spot of tenderness in the right side close to the pelvic bone, which prevented the wearing of corsets; aside from this she has suffered no inconvenience from the operation.

On admission, her temperature was 99.2 degrees F., pulse 100 and respirations 24. There was a distinct bulging of the

abdominal wall in the lower right quadrant, caused by a firm, tense, intra-abdominal mass and a superficial fluctuating tumor about the size of half a walnut, ½ inch above and ½ inch to the median side of the anterior superior spine of the ilium. This mass was first noticed three days before her admission to the hospital.

General anæsthesia was induced with ethyl chloride and the superficial fluctuating tumor opened, evacuating a few drops of pus. At the bottom of this abscess cavity a hard, sharp substance was found; this proved to be a piece of the bone knitting-needle, 4½ inches in length. The needle came from a small sinus leading down into the pelvis.

A vaginal examination, made three days after the operation, showed a small uterus in the mid position, with the cervix pointing toward the right vaginal wall and the fundus pushed far over to the left side of the pelvis. There were no abnormal openings or scars in the vaginal walls and the cervix was normal except for a thin opaque discharge which escaped through the cervical canal.

STATED MEETING, HELD FEBRUARY 4, 1907.

The President, Dr. John B. Roberts, in the Chair.

ENDOTHELIOMA OF THE PALATE.

Dr. John H. Gibbon presented a man, aged 26 years, who was admitted to the Pennsylvania Hospital on January 4, 1907. He stated that he first noticed a swelling on the left side of the roof of the mouth five years previous. This has gradually increased until there was a large tense apparently fluctuating mass extending over about one-half the hard palate and all of the soft palate on the left side. The entire tonsil and left side of the pharyngeal wall was hid by the growth, which extended down nearly to the base of the tongue. It interfered with the patient's eating, and when ether was given him interfered very greatly with his taking the anæsthetic. The mass appeared to be cystic. At one or two points there was a suspicious hard area. Because of the duration of the growth, however, and its apparently cystic character it was not thought to be malignant. The blood vessels over it stood out very clearly. There was no obstruction of the nares and no apparent involvement of the pharynx, as the finger could be passed easily behind the growth. After the patient was anæsthetized the tongue had to be drawn forward and pressed down with a tongue depressor in order that he could breathe. He was placed in the Rose position and an incision made over the prominent part of the growth. A quantity of material immediately escaped from the mass, which seemed to be undoubtedly sarcomatous. Practically all of the growth was shelled out with the finger. The hard palate was rough, as if its periosteum had been destroyed. Neither the hard nor the soft palate were perforated by the growth. Bleeding at this time was very profuse but was controlled by gauze packing and digital pressure. The case seemed a perfectly hopeless one and a prompt and rapid recurrence was expected. The pathologist also on inspection of the material removed thought it was sarcomatous, but on later thorough examination pronounced it to be an endothelioma. This diagnosis has been fully borne out by the subsequent course of the case. The

packing was gradually removed, and although a small cavity still exists most of the induration has disappeared and the patient is entirely comfortable.

Dr. Gibbon is not sure that he removed all of the growth, but upon the slightest evidence of a recurrence he is prepared to again operate and freely remove it. He thinks that an endothelioma in this situation is rather rare. The most frequent site of such growth is the parotid gland. Many of the early cases reported of cure by excision of sarcoma of the parotid were undoubtedly cases of endothelioma.

Dr. J. T. Rugh said that some years ago a boy of 18, from Delaware, came to the Jefferson Hospital with a growth in the posterior nares of the right side. It appeared to be fibrous and was removed by means of a wire snare, removal being followed by almost fatal hæmorrhage. The growth recurred and was then diagnosed sarcoma. A second operation, however, resulted in complete cure. No pathologic report on the tumor was obtained, but as it did not recur a second time it was regarded as an endothelioma.

Dr. John B. Roberts described a case of endothelioma of the left nares, which was partially scooped out, and the patient then treated by the X-rays and by the injection of the toxins of erysipelas and prodigiosus. The tumor seemed to be lessened by this treatment. The patient later went to another Philadelphia hospital and was operated upon, it was stated after the principle of Dawbarn, attempts being made to plug the carotid and its branches with paraffin. Dr. Roberts had heard indirectly that the man died later of secondary hæmorrhage.

Dr. W. M. L. Coplin said that a few years ago he had the opportunity of presenting to the Association of American Pathologists a paper on endothelioma in which he collated all the cases that had been carefully studied—approximately 150. The great mass of these tumors involve the serosæ, particularly the meninges and pleuræ. Several observers have found similar tumors in the ovary, and a number of papers contain reports of endothelioma of the parotid, this being the basis of most of the so-called mixed tumors of that gland. The paper by Kelly is one of the best English productions on this subject; Borst, in his classic work on tumors, has made an exhaustive study of these tumors. They are interesting to the pathologist because of their histogenesis and peculiar position as to malignancy. In this respect

they bear the same relation to other tumors of the sarcoma group as does the flat-celled cancer to the more malignant epithelial neoplasms. They extend along the lymph channels usually without the detachment and transportation of cells seen in the more malignant tumors. During the routine examination of tumors at the Jefferson laboratories some unusual specimens have been seen. Among these are endotheliomata involving the fissural regions of the face. It is probable that many tumors regarded as originating in the antrum or other sinuses are really endotheliomata of the fissures of this region. A few endotheliomata of the mammary gland have also been observed, the diagnosis being confirmed by the subsequent relative benignancy after complete excision. Endothelioma of bone is less frequent than it is in other tissues. Here the tumor bears a striking resemblance to cancer, especially the flat-celled type, but the structure and location indicate the origin from endothelial elements. Vörstmann suggested the classification into hemangio- and lymphangio-endothelioma, but we find groups of cases not properly classified as either—for example, those originating in serosæ, commonly the pleura or meninges, less frequently the peritoneum. The histogenic study of these tumors arising in the ovary, indicate their origin from the endothelial investment of the marginal genetic layers or connective tissue stroma of the organ.

RESECTION OF ILEOCÆCAL COIL FOR TUBERCULOSIS.

Dr. John H. Gibbon presented a negro, aged 40 years, upon whom he had operated in September, 1905, for tuberculosis of the ileum and mesenteric glands, resecting a portion of the ileum and cæcum. Two subsequent intestinal anastomoses were done.

The patient was admitted to the Pennsylvania Hospital in September, 1905. He stated that he had lost weight and had suffered from abdominal pain and indigestion for about seven months. The pain complained of was a general pain in the lower half of the abdomen which seemed from the description to be peristaltic. He was watched carefully for two weeks, a test meal being given and the stomach contents carefully examined. He vomited once or twice during this period, but was able to take full diet without much difficulty. His abdomen was always scaphoid and somewhat rigid. On two occasions a distinct movable mass could be felt in the right iliac region. This was thought to be an enlarged mesenteric gland. There was no fever

at any time, and no blood or mucus was passed in the bowel movements. Rectal examination showed some tenderness behind the bladder. No tuberculous lesion of the lung could be discovered. After observing the patient for some time it was finally concluded that he must have some tubercular intraperitoneal lesion, and it was thought that an exploratory operation was justifiable.

The abdomen was opened through the right rectus, and the ileum near its distal extremity was at once encountered. It showed two marked constrictions with a dilated portion of bowel between them, containing a large number of small bodies which felt not unlike gall-stones. These proved subsequently to be watermelon seeds. The patient stated afterwards that he had not eaten a watermelon for over a year. Numerous tubercles were found over the constricted portion of the ileum, and there was a mass of large mesenteric glands behind the ileocæcal juncture. Some of these were as large as hickory nuts. Small tubercles were found in other portions of the peritoneal coat of the bowel. There was no evidence of any tuberculous lesion elsewhere, and there was but a small amount of fluid in the cavity. The bowel was excised from a point some distance proximal to the first stricture to a point above the cæcum. This portion of bowel was removed with its mesentery containing a large number of glands. Other individual glands were then removed. Certainly all the diseased bowel, and apparently all of the involved glands were removed. The open ends of the bowel were then inverted and a lateral anastomosis made between the ileum and the ascending colon. Catgut and celluloid thread were used in making the anastomosis. A gauze drain was inserted down to the inverted ends of the bowel, but not to the point of anastomosis. The operation was a very long one, occupying two hours; this was partly due to the fact that after dividing the ileum and inverting the end it was found that in order to remove all the enlarged glands a higher division of the bowel would be required. The patient made a very satisfactory recovery after his operation, but on the fourth day he had considerable pain and vomited. Chloride of ethyl was administered, the gauze drain was removed, and there was an escape of considerable gas and some liquid fæcal matter. There was no other interference with convalescence but the fæcal fistula did not close, although the discharge grew much less.

The patient was readmitted to the hospital on January 14,

1906, complaining of painful peristalsis and with the fæcal fistula still open, although discharging but a small amount of fæcal matter. The peristalic movement of the bowel could be distinctly observed through the abdominal wall, the bowel becoming greatly distended in the right iliac region near the wound. With the idea of removing whatever caused the obstruction to the small intestine, and of closing the fæcal fistula, the abdomen was opened on the outer side of the old scar. The adhesions were very extensive and it was discovered that the fistula opened probably at the point of anastomosis. The proximal portion of the ileum was enormously distended and hypertrophied. This extended up the ileum for probably two or three feet; the colon was quite collapsed. As the intesines were so matted together it was thought wise to make a new anastomosis between the ileum and the transverse colon. This was done without cutting off the ileum at the site of the previous anastomosis. The fistulous opening into the bowel was closed with sutures, but a drain introduced down to this point. The new anastomosis was surrounded by omentum and the abdomen closed, excepting at the point of drainage. The patient made a good recovery from this operation but the fæcal fistula continued to discharge.

He was operated upon again in March, 1906, by Dr. Le Conte, and an attempt made to close the fistula. This was not, however, successful, and a few months later the discharge was greater than it had ever been, although there was no longer any painful peristalsis.

The patient was again seen by Dr. Gibbon in December, 1906. He had gained 18 pounds and was able to do light work. He was greatly troubled, however, with the discharge of fæcal matter, and he was again admitted to the hospital. On January 11, 1907, Dr. Gibbon opened the abdomen through the left rectus, with the idea of dividing the ileum at the point of anastomosis to the transverse colon and anastomosing it with the sigmoid. The abdominal cavity was found in good condition excepting for numerous small tubercles over the bowel and mesentery; there was no fluid and there were no enlarged glands. The last anastomosis was in good condition and apparently working satisfactorily. There was no distention of the bowel. The ileum was divided near the anastomosis, the two ends inverted, and the proximal one anastomosed laterally to the upper portion of the

sigmoid. The abdomen was closed without drainage and without any attempt being made to close the fistula on the opposite side.

Since this operation the patient has progressed very satisfactorily. At first there was a free discharge of fæcal matter from the old fistula, but this stopped after a few days. The fistula was Y-shaped, having two external openings, and one of these closed over firmly after the operation, but the other is still discharging a small amount of mucus and pus. The patient's temperature is normal and he is able to move about and is quite comfortable.

The specimen removed at the original operation was exhibited. It is 38 cm. long, 34 cm. of ileum and 4 cm. of cæcum. The mesentery is attached to the intestine and contains a number of enlarged glands. There are two constrictions, one of 5 cm. from the ileocæcal juncture and the other 13 cm. above this one. The bowel between the two constrictions is very much distended and thickened; in this distended portion between the strictures there was found, when the specimen was examined, two or three ounces of watermelon seeds with one grape seed. The peritoneal covering of the bowel and mesentery is studded with small tubercles and numerous hard bodies can be felt in the intestinal wall. The mesentery is very thick and contains a number of large glands, the largest measuring 4 x 3.5 x 2 cm. These glands on section proved to be caseous. The appendix is tightly bound down to the cæcum by adhesions. The lower stricture is 3 cm. in length and the lumen of the bowel at this point .5 cm. The second stricture is 1 cm. in length and the lumen of the bowel 1.5 cm. The pathological diagnosis was tuberculosis of the intestine with chronic ulceration; tuberculosis of the mesenteric glands; and hypertrophy of the muscular wall of the intestine.

Dr. Gibbon stated that this case and another in which he had resected the colon from the hepatic flexure to the middle of the sigmoid and made a successful end-to-end anastomosis for tuberculosis, caused him to feel that patients afflicted with tuberculosis of the intestine stood extensive operation well, and that there was a chance for even the most apparently hopeless of these cases. The second case referred to was operated upon March 5, 1905, and is perfectly well at the present time. In this case an end-to-end anastomosis was made and a fæcal fistula persisted for some weeks, but finally closed. It is thought that a lateral anastomosis is better in resections of the large intestine than the end-to-end.

REPORT OF A CASE OF HÆMOPHILIC KNEE JOINT. OPERATION; RECOVERY UNDER THE USE OF THYROID EXTRACT

BY J. TORRANCE RUGH, M.D.,

OF PHILADELPHIA,

Orthopædic Surgeon to the Methodist Hospital; Associate in Orthopædic Surgery in Jefferson Medical College.

N. G., a waiter, twenty-two years of age, was referred to me for trouble in his knee, by Dr. Geo. C. Clarke of this city. The family history is negative so far as bleeding is concerned. His mother died when he was an infant; his father and one brother are living and well.

His personal history is that at five years of age he had suppurating inguinal glands, but had none of the diseases of childhood. Cuts or injuries occasioned no greater hæmorrhage than occurs in the ordinary individual. He had during boyhood an attack of nose-bleed continuing daily for several weeks, but without any deleterious effects. Prior to my seeing him, he had two hæmorrhages following biting of the tongue, each of which lasted for about three weeks and left him much exhausted by the loss of blood. The last one of these occurred within the past two years and he was cared for by Drs. Clarke and Page at the German Hospital.

When first seen, in March, 1906, he was extremely anæmic and sallow. He had not had good health for several years and constantly suffered from pain and soreness in his left knee. This trouble began when he was twelve years of age, at which time he fell, injuring the part slightly. Little attention was given it until the third day after the injury, when, following a long walk, the knee became greatly swollen and very painful. After two weeks' confinement in bed, the knee recovered entirely, but at irregular intervals of from one month to one year the joint has been swollen and painful just as after the first injury. Any overuse of the part sufficed to relight the trouble until finally tenderness became constant in spots and more especially on the inner side of the patella. Marked enlargement finally occurred and function became impaired. Flexion beyond 60 degrees was

impossible but extension was normal and walking was not painful. A slight fall or forced flexion would cause an outbreak of pain and swelling severe enough to put him in bed for two or three weeks. As no history of bleeding was obtained at this time, the condition was considered a chronic synovitis of probable tubercular origin with thickening of the synovial fringes. Local applications of ung. ichthyol and similar remedies were used without benefit. Plaster of Paris was applied for six weeks and the use of the part much restricted, but without appreciable results. An X-ray plate made shortly after coming under observation showed thickening of the soft structures but no apparent alteration of the bony. The condition finally became so troublesome that he was unable to continue his vocation, and operation was advised for the removal of a supposed hypertrophy of the ligamenta alaria just below the patella. He had been taking the Syrupus Ferri Iodidi for several months with some improvement in appearance and general health. He entered the Methodist Hospital on July 17, 1906, and was prepared for operation which was done on the following day. Attention was directed to the attacks of lingual hæmorrhage, but on account of the absence of bleeding in any other portions of the body following cuts, etc., these were considered as due more to the condition of anæmia and the vascularity of the tongue.

The joint was opened by a straight incision on the inner side of the patella. The appearance of the tissues of the joint was striking and totally unlike any I had ever seen. The synovial fringes were found thickened and the ligamenta alaria below the patella were very much hypertrophied. The entire synovium was of a dirty brown or chocolate color. There was no evidence of recent hæmorrhage, but the fringes appeared as if about to undergo sloughing, a condition which is described as characteristic of the hæmophiliac joint. The hypertrophied portions were thoroughly excised both on the lateral and on the infrapatellar surfaces. There was but an ordinary amount of bleeding at the time both in the skin incision and within the joint and no ligatures were used though two small vessels were cut in making the opening incision. Six strands of silk-worm gut were used for drainage of the joint and the incision was closed with the same material for sutures. One of the small vessels cut showed a tendency to bleed and was caught with a suture and easily con-

trolled. The leg was placed upon a posterior straight splint and an ice-cap ordered applied continuously.

July 19.—Wound dressed to-day. Considerable oozing but not more than is frequently seen after similar operation. The drainage was removed and there immediately occurred a gush of blood which continued to flow. The lower suture (which had caught a bleeding vessel) was removed and the vessel began to spurt blood. A pressure bandage was applied and an ice-cap kept on constantly. A few hours later, it was found that bleeding was still present and it was necessary to introduce two stitches to control it. Morph. sulph., ⅙ gr., and atrop. sulph., $^{1}/_{150}$ gr., were administered hypodermically several times during the day to control pain and hæmorrhage.

July 20.—Patient had a bad night. Was very restless and complained much of pain in the knee, describing it as a *pressure*. The knee was greatly distended and very painful. It was surrounded by ice-bags and no bleeding was perceptible from without. He had one grain of codein during the night without benefit. Strych. sulph., 1/30 gr., was given every three hours and iron in the form of Basham's mixture was begun. He also received a high enema of whiskey 1 ounce, ammon. carb., 20 grs., and normal salt solution 6 ounces, because of the exhaustion and weakness. Gradual improvement followed and the leg was not dressed until the twenty-fourth. Calcium chloride, 15 grs., every three hours was begun on the twenty-third and continued for three days and on this date his temperature rose to above 101 degrees.

When the dressings were removed on the twenty-fourth, bleeding began immediately. A probe was gently inserted into the lower end of the incision and the hæmorrhage became profuse. Pressure with the bandage controlled it completely and the ice-bags were continued. On the twenty-sixth the stitches were cut but not removed, and even this caused bleeding which could not be controlled by pressure and it became necessary to introduce two sutures. There was severe and constant pain in the knee and extending to the foot. Sleep was impossible without codein or morphin.

On the twenty-seventh, he was given by mouth 6 ounces of a 10 per cent. solution of gelatin twice daily and on the twenty-eighth the leg and foot were encased in an interrupted plaster

splint. Adrenalin solution (1–1000) in 8 minim doses was given every four hours but with no effect upon the hæmorrhage. The influence of the plaster splint was noticeable in the temperature which fell gradually during the following week. The effects of the gelatin upon the clotting of the blood were most marked, the resultant clot forming very rapidly and proving the most firm and elastic that I have ever seen. The escaping blood formed in a clot under the dressings and this could be lifted from its position with ease and handled very freely without breaking. It had much the consistence of gelatin but was slightly more elastic. The gelatin and adrenalin were continued until August 5, and constant oozing was present. The lips of the wound had separated and exposed an unhealthy granulating and bleeding surface. The entire knee was much swollen and the patient's condition was far from encouraging. On this date, thyroid extract in 5 gr. doses three times daily was begun. Immediate benefit resulted, the temperature dropping still further and the bleeding lessening. By the eighth, bleeding had entirely ceased, though there remained serous oozing from the necrotic area of the wound. Pain lessened and the patient began to eat. A blood count made on the eleventh, showed red cells, 4,310,000, white cells 6,720, hæmoglobin 60 per cent. The records of examinations made previously have been lost, but my personal recollection is that the hæmoglobin was as low as 30 per cent. a week after the operation.

From this time on the progress was rather rapid and in two weeks the wound had entirely healed and he was walking about on crutches. Strength quickly returned, color became better and he continued to take the thyroid and that alone. On August 27, while eating dinner, he accidentally bit his tongue and free oozing of blood began. Monsel's solution was immediately applied and the bleeding ceased. Repeated hæmorrhages occurred during the ensuing week, but were temporarily checked with Monsel's solution. Aside from this, the patient looked and felt well and had no pain or trouble in the knee. He left the hospital on September 8, seemingly in perfect health. The cast was removed from the knee a few weeks later and he was warned against using the leg in walking. A small clot or magma was still adherent to the tongue from the action of the Monsel solution, but there was absolutely no bleeding. A short stay at the seashore proved

extremely beneficial and he is now following his work as a waiter with perfect comfort to himself. He has not yet regained full use of the joint, though movements to increase flexion have been advised. He is extremely cautious of motion of the part so as not to injure it in any way. Since he was twelve years of age, he has also had slight "rheumatic" pains in his right hip with trifling impairment of function, but as there is no actual disability or interference with his work, nothing has been done for it. The thyroid extract is still continued twice daily and the changed color and appearance furnish the best evidence of its beneficial effects. Two weeks ago, while descending a stairway, he slipped and wrenched the knee, but experienced absolutely no ill-effects from it, which is in marked contrast to the results of a similar injury prior to the time of operation.

An examination of the eye-grounds was made by Dr. C. A. Veasey to determine any possible evidence of change in the vessels of the fundus or the optic nerve. His report is as follows: "Vision, pupillary reactions, fundi, fields and external muscle rotations are normal. No abnormality whatever can be observed in the vessels of the fundi."

The two most widely accredited theories of the location of the cause of hæmophilia are (*a*) that it concerns the coagulability of the blood, and (*b*) that it lies in the tissues of the vessels. Many researches have been instituted to determine if possible which is correct, but failure has attended them thus far. Weil (*La Tribune Médicale,* Jan., 1907) believes that in hereditary hæmophilia there exist incoagulable substances in the blood which may have their origin in various organs, one of which is the liver (Delezenne). Sahli (*Zeitschrift f. klin. Med.,* 1904, vol. lvi, Nr. 3 and 4) believes the coagulation of the blood is at fault, but the cause of it lies in the vessel structures themselves, chiefly the endothelial lining. Weil (loc. cit.) publishes the effects of the use of normal serum when injected into a "bleeder." He says, "The treatment with injections of fresh serum, efficient though it may be, has no value in the permanent cure of the affection. It does not attack the cause and is but an appropriate symptomatic medication. The dose . . . should be from ten to twenty cc. Human serum or the

serum of a horse should be taken as they . . . do not give rise to accidents." This is an admission contrary to what he has endeavored to prove and points very strongly to the tissues as the parts at fault. The use of the thyroid extract also adds to this view, as it appears to supply some vital substance to the tissues which is lacking either totally or in part in these cases.

In the case just detailed, the marked change in the appearance of the wound, the healthy color of the granulations, etc., is in thorough accord with the observed action of the thyroid in other conditions. We are forced to admit, however, our ignorance of its mode of action, and until this is known all theories must remain as such, though it is thoroughly justifiable to venture the opinion that the blood is at fault in some instances and the tissues in others, while in still others both are affected.

Dr. William J. Taylor said Dr. Rugh's results in this case confirmed his observations regarding the control of hæmorrhage, though he has had no experience with joints. The use of thyroid extract diminishes the coagulation time of the blood, though as yet we do not understand its action. In these cases two conditions must be considered: first, the coagulation time of the blood; second, the condition of the tissues. Dr. Sajous advances the theory that the pituitary body governs the adrenals and that coagulability is kept up by the thyroid stimulating the pituitary. This has a practical value when the coagulation time is lengthened, as in some cases of jaundice. In a number of the latter the time is not lengthened, hence thyroid extract will in them have no value. Murphy and Gould in a study of fifteen cases of jaundice from all causes—cancer, obstruction, etc.—did not find in one a change in the coagulation time. In one case of obstructive jaundice from malignant disease, under the care of Dr. Harte, the coagulation time was lengthened. Wiel has used for this condition injections of beef soup, practically bouillon, into the veins with good results. Dr. Taylor is confident regarding the value of thyroid extract when the coagulation time is lengthened. In one case its administration for a few days brought the time down from thirteen minutes to two minutes and six seconds. The individual making the test must be taken into account, as methods for deter-

mining the coagulation time are not well worked out. There are sources of error in Wright's instrument. In another appliance the blood is kept in motion by a current of air. A practical method is to place a drop of blood on a slide and determine by position of the latter when coagulation has occurred. The personal equation is great and all the tests should be made by one man. The subject is one that should be investigated more carefully. Dr. Taylor now uses thyroid extract whenever bleeding is a probability. He has employed it in operations upon the kidney, bone, for the extraction of teeth and in the case of removing glands of the neck from a boy whose grandfather was a terrific bleeder. In the last case the coagulation time was lowered from eight to three minutes in forty-eight hours and the operation site was perfectly dry.

Dr. W. M. L. Coplin said we know something of the basis of thyroid therapy in cases of hæmophilia. Women escape the affection, hence we look for organs in the female which possibly by an internal secretion combat any tendency to this diathesis. For such organotherapy ovarian extract has been suggested and in some cases has been of value. Hyperthyroidism is more common in the female, the relation between the thyroid metabolism and the general economy being more intimate in this sex. This is shown by the changes in the gland during menstruation and gestation; its relation to myxœdema and exophthalmic goitre is well known. If we are correct in the assumption that activity of the thyroid and parathyroid glands enable the female to escape hæmophilia, the basis of employing thyroid extract to counteract the manifestations of the disease becomes plain. Dr. Taylor referred to the exact cause of hæmophilia. Of the two theories, Dr. Coplin's inclination is toward the histogenous, the hæmatogenous not appealing to him as possessing a sound basis. There is no specific relation between coagulation time of the blood and hæmophilia, the relation being the same as in any anæmia. This diminished coagulability was shown at autopsy upon a case of pernicious anæmia in which the blood clotted in a basin some time after it had been removed from the body, yet there is no necessary relation betwen secondary anæmia and bleeding. Loeb's studies concerning the relation between tissue juices and the blood indicate that in coagulation there is necessary a certain element which is supplied by the tissues. He suggested as the source of this

element the endothelium of the capillaries. Such element is not supplied when metabolism is deficient, and on this basis may be explained the occurrence of periods when hæmophiliacs are not hæmophiliacs,—that is, when they do not bleed excessively. Wright's studies on the calcium content of the blood show that the explanation based upon its lowered quantity applies in some cases; in others the calcium is entirely within the normal limits, and therefore this cannot be the cause of the condition.

Dr. Rugh's case is an instance of the cryptogenic or latent type of hæmophilia. These cases are well known, there being at least the gastric, intestinal, biliary, arthritic, and renal types; possibly there is a meningeal form. In the renal type the kidney may show no microscopic lesion though hæmorrhage had been severe. It is also to be remembered that paranephric hæmorrhage may follow trifling injuries. König, Broca, and also Poillet, have studied particularly the joint manifestations of hæmophilia, Poillet analyzing 252 cases. In about 50 per cent. of cases the knee is involved and in 25 per cent. the elbow. In none of Poillet's cases was the operative result so good as in Dr. Rugh's case. None was diagnosed before operation. The findings in these joints were well described by Dr. Rugh. Chondroid erosion is marked, in some instances this process extending even into the marrow. Spongy articular cartilages are produced in some cases. Lipping of the articular cartilages at their margins is more marked in operative cases and may become so prominent as to lead to fixation of the joint. This is due to chondroplastic proliferation of the marginal genetic layers of the cartilages, hyperplasia of the serosa not being anatomically important in the locking. These joint lesions are not the result of primary changes in the bone. There has been reported an instance of hæmophilia with separation of the epiphysis due to hæmorrhage between the epiphysis and shaft, with resulting formation of a flail joint. Dr. Rugh's case illustrates the muscular wasting which often accompanies the joint lesion. This remains unexplained, as it is not a question of fixation as in tuberculosis. Sometimes even the tendons wither. This wasting suggests in a way the exploded theory of the neurogenous origin of hæmophilia. A practical point regarding these cases is the almost certain recrudescence of the hæmophiliac lesion. The age of Dr. Rugh's patient is against this, as the great majority of cases occur in boys of from four to six. A diagnostic

point in hæmophiliac hæmarthrosis is para-articular hæmorrhage. This is sometimes shown as a faint hazy bluing of the sulcus on each side of the patella. At times distinct hæmorrhage is present. This ought to constitute an important diagnostic feature.

PLASTIC RECONSTRUCTION OF THE EYE-BROW AND UPPER EYE-LID FROM THE TISSUES OF THE SCALP.

Dr. John B. Roberts reported this case with presentation of the patient. The child had a large arteriovenous angioma of the forehead and upper eye-lid, which he treated successfully by strangulation, excision, injection of boiling water and other methods. Its removal left the eye-ball exposed and a corneal ulcer developed. A pedunculated flap from the scalp was brought down to make the upper lid. Subsequently this was split horizontally and the hairy part transferred to the superciliary region to make the eye-brow. Later a portion of this soft hair will be shaved to cause it to become coarser, and probably some of the superfluous hair will be removed by the electric needle.

EXCISION OF BRANCHIAL FISTULA.

Dr. James W. MacIntosh presented a boy of twelve years. A small opening in the skin at the lower and inner border of the right sternomastoid muscle was noticed when the boy was two weeks old. This had remained open and discharged mucus except for a period of one and one-half years some time between the age of two and five. From the location of the opening and the fact that it was congenital a diagnosis of branchial fistula was made. Through the fistula a solution of quassia could be injected into the mouth, proof that the fistula was complete. A silkworm gut suture was at first inserted and finally a small lachrymal probe was passed. This enabled dissection and removal of the entire tube. The inner end was pulled down and a chromacized catgut ligature applied. Before it was tightened the ligature was carried to the pharyngeal wall by means of two pairs of curved hæmostats and a second knot then made. The stump was then twisted four times and allowed to retract. The lower end of the external wound is not yet healed because of the eczematous condition of the skin caused by the discharge from the fistula.

Dr. John H. Gibbon remarked on the difficulty with which these fistulæ are excised. He never before saw one removed so entirely as was the specimen shown. Only time will tell if the cure is permanent. Surgeons often feel that the fistula has been completely removed and yet it reforms. If a slight amount of the mucous lining be left, recurrence will follow.

Dr. W. W. Keen regards the use of quassia as an ingenious plan well worthy of repetition in future cases of such fistulæ. He agrees with previous speakers as to the difficulty of excising the fistulous tract in its entirety. Branchial fistulæ are rare, the similar condition of the thyroglossal duct being more common. The latter he has almost never succeeded in curing by one operation.

INTRALOBULAR ABSCESS OF LUNG.

Dr. Charles F. Nassau presented a man, aged thirty-eight years, who was first seen by him, with Dr. M. T. Prendergast, October 7, 1906. He had then been ill for ten weeks. The patient was dreadfully emaciated, extremely weak, with a rapid pulse, in the neighborhood of 120 per minute. He had very little cough and that was of a hard brassy character. There was constant pain at the base of the right lung. Puncture of the chest made in the mid-axillary line in the fifth interspace and in three different directions revealed no fluid of any kind.

October 19, 1906, he was seen again in consultation with Dr. Prendergast and Dr. Alfred Stengel at St. Joseph's Hospital. A preliminary puncture through the fourth interspace gave vent to abundant pus. About 3 inches of the fourth rib was then excised and through the adherent layers of the pleura an intralobular abscess of the upper lobe of the lung was broken into, evacuating somewhat less than a pint of pus. Light general anæsthesia by ethyl chloride, the patient almost dying on the table.

Following this operation the wound did very well, the walls of the abscess collapsed rapidly and the temperature fell immediately to normal. The patient was discharged from the hospital on November 13, 1906. The wound at this time was entirely superficial. The patient continued to do well for one week at his home, when he had a chill followed by high fever, sweating and general prostration. On November 23, 1906, after a second consultation with Dr. Prendergast and Dr. Stengel, it was determined that he probably had an empyema below the site of the previous incision into the lung, so a second operation was done, con-

sisting in still further excision of the rib previously operated upon, together with a wide excision of the rib below. About two pints of bad smelling bloody fluid, with here and there streaks of pus, was evacuated. In addition to the above the site of the primary operation, two encysted abscesses were encountered and evacuated. The patient's condition was so desperate that in order to give some support to the violent and wide excursions of the partially collapsed lung, a large quantity, about 7 square yards, of gauze was rapidly packed through the wound on the side of the chest. The patient's pulse at this stage was scarcely perceptible, his pupils were widely dilated, lips were purple, respirations could not be counted, his hands, feet and nose were cold. However, sufficient hypodermatic injections of camphorated oil began to bring about reaction. At the end of twenty-four hours one could say that they hoped he would recover.

From this time on convalescence was uninterrupted, although after the removal of the gauze packing introduced at the time of operation one could almost thrust one's whole hand into the patient's pleural cavity. Now the wound has entirely healed except a small granulating area in the skin, hardly an inch in length and less than a quarter of an inch in width. The lung has descended almost to its normal level and the breath sounds on the right side of the chest are quite normal.

RUPTURE OF KIDNEY AND LIVER.

Dr. Charles F. Nassau reported the following case: A man was admitted to the Frankford Hospital, October 27, 1906, with a history of having been kicked in the right side along the lower margin of the ribs by a horse. When first admitted he was in a state of shock, with rapid shallow respiration which was largely due to the fracture of four ribs on the right side. His temperature, which on admission was subnormal, reacted and rose rapidly. His pulse on admission, while rapid, was of good tension. There were no external marks of violence. The abdominal muscles were rigid, particularly on the right side.

The resident within an hour after his admission noted increasing power with a rapidly rising pulse rate and temperature. Respiration also became more shallow and of a slight sighing type. When seen by the reporter, about three hours after the injury, there was distinct dulness in the right flank. He passed

bloody urine, and on account of his increasing weakness since admission an internal hæmorrhage due to injury of the kidney was suspected. He was immediately etherized and prepared for operation on the table.

An incision was made along the right costal margin, beginning at a point about three inches to the right of the median line and ending well out in the right loin. As the peritoneum was approached it seemed to be infiltrated with blood, in fact so disorganized as to hardly require incision. Blood welled up rapidly out of the abdominal cavity and, as the intestines upon superficial examination seemed to be uninjured, they were packed out of the way and the region of the kidney exposed. The right kidney was found torn practically entirely in half. The whole organ lay free in the abdominal cavity, the peritoneal covering over the kidney not being recognizable. The hæmorrhage was furious. As quickly as possible the renal vessels were clamped and the kidney cut away.

After ligation of the renal pedicle blood continued to ooze from the direction of the liver. Investigation discovered a tear in the liver substance on the posterior edge, extending well up towards the vault of the diaphragm. This was firmly packed and the abdominal wound was then closed except for a point of generous gauze drainage. The man was put back to bed apparently very little worse off for the operative procedure.

During the first 24 hours he passed 15 ounces of urine. Day by day the kidney secretion increased, the urine being quite normal, until on the fourth day he passed 36 ounces of urine. On the fourth day his temperature shot up, he developed an annoying cough and examination of the right lung disclosed a wide spread pneumonia. He died in about three days after the development of the lung condition.

This man at no time had any symptoms that would lead one to suspect a peritonitis; his bowels moved naturally and post-mortem the peritoneal cavity was found well sealed off and appeared to be quite free from any evidence of inflammation.

STAB WOUNDS OF THE HEART.

WITH REPORT OF A CASE.

BY RICHARD H. HARTE, M.D.,

OF PHILADELPHIA,

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It has been the general impression on the part of the world at large that in all wounds of the heart, no matter how trifling, so long as the pericardium was injured, the injury must necessarily be fatal. This was the accepted opinion of all of the older surgical writers. Hallerius appears to be the first to differ from this old accepted theory, and to assert that heart wounds were not necessarily fatal. It would seem as though these conclusions might have been arrived at long before, especially when hand-to-hand combat was so common, and, from the very nature of the arms employed, punctured wounds of the heart must have been very frequent. Many non-penetrating wounds of the heart must have recovered, and persons sustaining penetrating wounds must have often lived for some time, and were capable of making considerable exertion. To bear out this statement I recall a case which occurred when I was a resident at the Pennsylvania Hospital, in which a sailor was stabbed on board ship with a sailor's sheath knife (an ordinary butcher knife) which inflicted a penetrating wound from 1¼ to 1½ inches in length in the left ventricle. The patient lived about two hours, but died shortly after his admission to the ward, apparently from the loss of blood and embarrassment of the heart's action due to a pericardium distended with blood clots.

Wolf, as long ago as 1642, gave the first reliable account of the healing of a heart wound. Later Desoult described the steps of an operation for the relief of pericardial empyema. In 1798 many cases were reported of heart wounds in which pro-

tracted periods intervened between the receipt of the injury and death. Up to the end of the nineteenth century the treatment of heart wounds was purely expectant, consisting of rest, ice, cardiac sedatives, blisters, etc., etc.

In 1881 Dr. John B. Roberts suggested the propriety of attempting to suture the heart muscle in cases of stab-wounds. This idea, however, did not meet with much encouragement, as so distinguished a surgeon as Billroth declared that a surgeon who wished to retain the respect of his confrères would not attempt such a procedure.

Again, as the result of experimental research much light has been thrown upon the future of heart surgery, which may be voiced by the statements of Elsberg, quoted by Stewart in his classic paper on this subject.

The consensus of opinion among experimenters is, that the heart after being exposed can be grasped with the hands or forceps and gently compressed with no appreciable effect on its action; that punctures with needle or knife produce only a temporary irregularity in the heart's action; that wounds produced during systole bleed more than those occurring during diastole; that wounds of the ventricle produced during systole are larger than those produced during diastole; that oblique wounds bleed more than perpendicular wounds; that wounds of the right ventricle are more dangerous, because of the thin ventricular wall and because the blood in the right heart coagulates more slowly; that wounds of the heart heal kindly, and that the cicatrix is complete in two weeks; that interrupted sutures are better than continuous ones; that the material enclosed in the grasp of the sutures causes atrophy and is replaced by scar tissue; that superficial stitches are less liable to tear out than deeper ones, and that the stitches should be inserted and tied during diastole, because of the danger of tearing out during systole.

It will be seen that some of these opinions are of practical importance, while others are theoretical and impossible to carry into effect.

With this much learned as the result of experimental

research, two unsuccessful attempts were made in 1896 at cardiorrhaphy, and a year later Rehn published the report of the first successful operation. Since that time a number of successful cases have been reported, two by Fellows of this Academy, Dr. Stewart and Dr. Gibbon.

The heart may be wounded by all kinds of vulnerating bodies producing punctured, incised, lacerated and gunshot wounds, all of which may be received in a great variety of ways. In a large percentage of cases the pleura will be wounded. In a number of cases carefully analyzed by Stewart, it was found that the pleura was wounded. Gibbon, however, was fortunate in his two cases not to have the pleura injured, which is of great advantage, preventing much of the danger from infection.

The symptoms following a penetrating wound of the heart vary greatly under different conditions. There are always varying degrees of shock which depend largely upon the size and character of the wound. If the pleura is opened and the wound is sufficiently large extensive hemorrhage may take place into the pleural cavity. Or, on the other hand, blood may pour out into the pericardium or externally. Auscultation produces a variety of symptoms, such as a splashing sound, indicating air and blood in the pericardium: sometimes a friction sound will be noticed, and in other instances a bruit, as though an aneurism existed. The heart's action is irregular and often very labored. The pulse may be less than 100. If the blood is confined to the pericardium the præcordial dulness will be greatly increased on percussion. (Upon these facts I based my diagnosis in the case which I here report.) The pulse will be very feeble and the apex-beat can be neither felt nor heard. The pressure manifests itself first on the auricles and the origin of the great veins, causing venous stasis, which may manifest itself by dyspnœa and cyanosis, the ventricles having a tendency to pump themselves dry, and the heart finally ceasing to act. Without surgical intervention the individual will die from anæmia, compression of the heart, or, later, from sepsis or functional incompetence.

From what has been surmised it would appear that the diagnosis of wounds of the heart could be made without much difficulty. But at times a positive diagnosis can only be determined upon by an exploratory operation. For instance, in punctured wounds involving the præcordium where the internal mammary and intercostal arteries are injured a violent hæmorrhage may ensue which may confuse the condition with that of a penetrating wound of the heart. The size of the wound of entrance is no index to the size of the wound in the heart, which may be greatly increased either owing to the heart's action or to the position and movement of the wounding instrument.

Stewart quotes Fisher, who analyzed 452 heart wounds, and says that from 7 to 10 per cent. of these cases recover spontaneously. This estimate seems high, but even if it were positive it should not deter one from prompt surgical intervention if the patient's condition warrants it. The prognosis in these injuries depends upon the kind and extent of the wound inflicted, and last, but in no wise least, upon whether or not there is infection, especially of the pleural cavity. Gibbon, in an unpublished paper, is disposed to think from an analysis of the reported cases that gunshot wounds of the heart would give a higher recovery rate than stab-wounds, if it were not for the injury of other viscera which nearly always accompanies gunshot wounds, especially injury to the lung and pleura. There are 19 cases on record where bullets have lodged either in the heart muscle or cavity, and in which the patients have lived for varying periods after receipt of the injury. It may be fair to presume that an individual who lives a couple of hours after the receipt of a heart wound has a fair chance to recover with an operation. Many cases which succumb in a short time, would recover if they could have prompt surgical intervention.

In operating on these cases an anæsthetic seems imperative. Except when the patient is unconscious ether is unquestionably the anæsthetic to be preferred. Time is an important factor, and every provision should be made beforehand so that the steps of the operation may go on without any interruption.

As to the incision for the exposure of the heart, this depends in a measure on the exigency of the case. If possible the incision should be so planned as not to involve the pleura. It is questionable, however, if any operative technique will ever be established for dealing satisfactorily with these cases. The formal osteoplastic flap, as employed by the Continental surgeons for exposing the heart, is liable to result in injury to the pleura, and is not to be classed with the simple suprapleural operation where two or more costal cartilages, and if necessary, a portion of the rib, can be divided and reflected back over the sternum. With care the pleura and pericardium are easily separated from the overlapping tissues, giving the operator every facility to open the pericardium without involving the pleura. In my own case I erred by following the course of the wound through the pleura, thus causing immediate collapse of the lung, and forming later a favorable field for infection. After a satisfactory exposure of the pericardium it should be opened with a blunt pair of scissors, after carefully raising the pericardium from the heart with forceps, as the latter will be floated or pushed forward if much hæmorrhage has taken place, into the pericardium. Loose blood and clots should be quickly sponged out, when usually the bleeding spot can be felt or seen, and controlled by pressure until sutures can be introduced.

The best suturing material is chromicized catgut, reasonably fine, introduced on a sharply curved needle. Each stitch should be left long after tying, as the ends materially assist as tractors and enable the more accurate introduction of the subsequent stitches. It will be found in many cases that the heart's action is very rapid and erratic, and that the introduction of the first suture is like attempting to perform the same operation in the back of a fish which has just been taken from the water and is still impaled on the hook. In ventrical wounds the sutures should be inserted deeply, even to entering the endocardium, as only by this means can accurate approximation be procured. In wounds of the auricle through-and-through sutures are imperative, as well as several superficial ones, as bleeding sometimes takes place through the suture wound, as experienced

in my case. This, however, can be easily controlled by a few superficial stitches inserted at the bleeding point. In introducing the sutures everything should be sacrificed in order to obtain accurate approximation of the wound. If the line of suture should involve the coronary artery little harm is likely to result if it is caught in the suture. This occurred in Gibbon's case without ill effect. Ricketts also showed in experimental work on the dog that either coronary artery could be tied without harm.

In wounds where the lung is also injured considerable bleeding may take place from the lung substance, but when there is an opening of any size in the pleura the lung invariably collapses. This in itself may be sufficient to control the bleeding point. This failing, however, several deep sutures may be inserted into the lung substance at the bleeding point and firmly tied. The pericardium should be closed with a continuous catgut suture without drainage, as this cavity is much less apt to become infected than the pleura, and it is the best practice to close the pericardium in this way, although it is just the reverse with the pleura. If the lung is collapsed, the pleural cavity if possible should be cleansed of all free blood and clots, and if the patient's condition admits, provision should be made for drainage by an opening in a dependent part of the chest. No power can prevent infection in a wound where air is drawn into the pleura with each inspiratory act.

It will be also noticed that when the heart has lost its natural support by the surrounding lung, owing to its collapsing, it will immediately begin to become more erratic in its action and to race in a most excited manner. This can, in a great measure, be overcome by loosely packing the large space with liberal pads of gauze wet with salt solution. This was very noticeable in my case, and it seemed as though the heart would almost jump out of the chest until surrounded and supported by the moist packs of gauze.

The after-treatment of these cases is simply routine, in which small doses of morphia may be employed to advantage.

W. W., aged twenty-one, colored, longshoreman, was admitted to the Pennsylvania Hospital on June 9, 1906, with a stab-wound of the left chest, in third interspace to the left of the sternum, inflicted with a long-bladed pocket knife. The wound was about ½ inch in length. On admission the patient was somewhat shocked but did not complain much of pain. After being placed in bed reaction took place, and when seen by me two hours later the heart's action was fairly good; the pulse was about 120 and could be readily felt at the wrist. On auscultation, however, it could be seen that the heart was laboring very considerably, the sounds being very indistinct and muffled. The præcordial dulness had very much increased and had been gradually doing so since his admission, as noticed by Dr. Drayton, the resident physician, and it was very evident that the knife had entered the pericardium and wounded the heart. Operation was immediately decided upon. The patient was etherized and an incision about 4 inches long made to the left of the sternum, following the line of the wound, which had opened the pleura. The two ends of the fourth and fifth costal cartilages were removed from their attachment to the sternum, which, with the aid of a retractor, freely exposed the pericardium. It was noticed that the lung was partially collapsed, and the heart was laboring very much within the exposed pericardium. The pericardium was freely incised and found full of clot, which was rapidly removed and a wound about ½ inch in length found in the left auricle, from which a stream of blood squirted to a height of about 9 inches. The heart's action on the removal of the clot became fearfully rapid, and it was with the greatest difficulty that a number of sutures were introduced into the auricle, which was finally closed with chromicized gut. It was rather curious to note that immediately on the introduction of the first stitch the size of the blood stream from the auricle was reduced, but in place of one stream there were four, two small ones coming from the needle wounds. Two stitches were introduced through and through the auricle and these had to be fortified by a number of superficial stitches. In a few minutes all bleeding was permanently controlled. After thorough cleansing of the pericardium it was sutured. Apparently owing to the lack of support which the heart did not receive from the collapsed lung, its action was very violent and erratic. Two large section pads were placed behind the pericardium saturated with normal salt solution, and the heart and respiration immediately became more normal. One pad was placed on top of the pericardium and brought out through the incision. The lower end of the incision was approximated with silk-worm gut. The patient reacted well from the operation. Subsequent to operation his pulse was of rapid but fair quality, about 120 to 140, and respirations ranged from 56 to 72.

The third day after operation the pads were removed and the patient's general condition was good. The following day the superficial drain was removed and another inserted; the left chest was strapped, which materially assisted the breathing. It was very evident that infection had taken place in the chest, as the discharge became very profuse and foul. On June 29 a rib was resected and a drainage tube inserted in the posterior axillary line. For some reason this did not drain satisfactorily. On July 3 another incision was made and the seventh and eighth ribs were resected in the postscapular line, and a tube inserted, but this did not in any way relieve the condition, and shortly after the removal of these two ribs the patient died.

The autopsy showed an empyema of the left chest, which drained badly. The left lung had collapsed, and was the seat of a bronchial pneumonia. The right chest contained 11 ounces of bloody fluid, and there was also a bronchial pneumonia of this side. There were extensive pericardial adhesions with no sign whatever of the stab-wound. The endocardium and valves were healthy.

Dr. John H. Gibbon said the fact that Dr. Harte's patient lived twenty-three days is an instance of what can be done in wounds of the auricle. Heretofore it has been thought by many that a wound of the auricle was necessarily fatal. This case is only another to show that a patient may recover from a stab wound of the auricle. Infection occurred here and proved fatal, as happens in many cases of heart wound.

Dr. John B. Roberts mentioned a case, which he previously had reported to the College of Physicians, of a suicidal wound of the heart, in which that organ was not perforated. He had not sutured the wound, but had been able to examine with his fingers the exposed heart. The patient died in twelve or fourteen days from infection, there being pleurisy on the left side and pneumonia of the opposite lung.

SEVERE BURN OF TOP OF HEAD AT SEVEN MONTHS OF AGE, FOLLOWED BY NECROSIS OF ENTIRE OSSEOUS CAP OF CRANIUM.

AT FOURTEEN YEARS OF AGE DETACHMENT OF THE ENTIRE CALVARIUM BY CIRCULAR CRANIOTOMY FOR EPILEPSY AND DEFECTIVE MENTAL DEVELOPMENT.

BY WILLIAM WILLIAMS KEEN, M.D.,
OF PHILADELPHIA,
Professor of Surgery in the Jefferson Medical College.

HARRY H. W., æt. fourteen, was admitted to the Jefferson Medical College Hospital, December 7, 1904, at the request of Dr. W. F. Haines of Seaford, Del., with the following history: At seven months of age his parents left him wrapped up in a shawl in a rocking chair in front of a wood fire, which then consisted chiefly of coals, while they went to attend to some farm work. They also left an older child, about two years of age, to take care of him. They were absent from the house for about forty-five minutes. Upon their return they found that the baby in the rocking chair had begun to cry and the two-year-old child had tried to climb into the rocking chair to comfort him. In doing so the chair was overturned forward and the baby thrown into the fire, so that the top of the head was in contact with the live coals. As nearly as can be ascertained by cross-questioning the two-year-old child, and knowing the length of their own absence, the baby's head lay in the coals not less than twenty and it may have been thirty minutes. As a result of this severe burn, the scalp being thoroughly charred, the whole top of the head sloughed off about six months later, including a large portion of both frontal bones, the two parietal bones in their entirety, and a part of the squamous portion of the right temporal bone. The piece of the squamous bone was lost, but a photograph (Fig. 1) shows the other four pieces of bone their natural size. The four pieces of bone which have been preserved can easily be identified. They are of a dark brown color, the result both of the burn and suppuration. Placing them in position, they measure from front to back 17 cm., and from side to

side 11 cm. When the bone sloughed away the dura was exposed, covered by that time with granulations. A year after the burn, the scalp was healed, and upon my recommendations (for Dr. Haines showed me the specimens and consulted me at that time) a tin cap covered with silk was made for the purpose of protecting the top of the head from blows, but it could not be used as it annoyed the child. Six months after cicatrix was complete, the scar broke down, and from that time till the present it has been alternately healed and open.

Soon after the accident he had nine convulsions. He was then free from them for over a year. Then he began to have distinct epileptic attacks. These have continued ever since and have increased in severity and frequency. They occur day and night regardless of any known influence, such as excitement, the direct sun's rays, etc. On an average, his father thinks he has about 400 attacks every year. Sometimes he goes several days without a spasm.

He began to go to school at seven years of age and appeared to learn rapidly. His memory was excellent till he was about eleven years old, when his epileptic attacks became more frequent and he became stupid. He was, therefore, removed from school, and he has forgotten most of what he learned and is becoming more and more deficient mentally. While at school he learned to read and write, but in the last three years he has lost the ability to do either.

Physical Examination on Admission.—He seems to be physically a well-developed boy of average height and weight, but his face presents a dull and stupid appearance. He responds rather indifferently to questions and talks, but can hardly be said to converse.

His heart, lungs, and abdominal viscera are, apparently, normal. The deformity of his skull is very marked (Fig. 2), showing a deep furrow a little to the right of the middle line, running obliquely from behind forward and to the right. On the top of the head there is a very large scar (Fig. 3). The oval line in this photograph is an ink line showing the present area under which there is no bone. This measures only 8 by 5 cm. Corresponding to this oval line the margin of the bones can be felt quite distinctly; under the scar, pulsation of the brain can be seen; pressure on the area where there is no bone causes pain.

There is also a scab at two or three ulcerated points. The scalp is as tense as a drum head over the entire top of the head.

His convulsions as observed in the hospital were at times chiefly manifested in the left leg and arm, at other times in all four extremities. There was no localization of the convulsions.

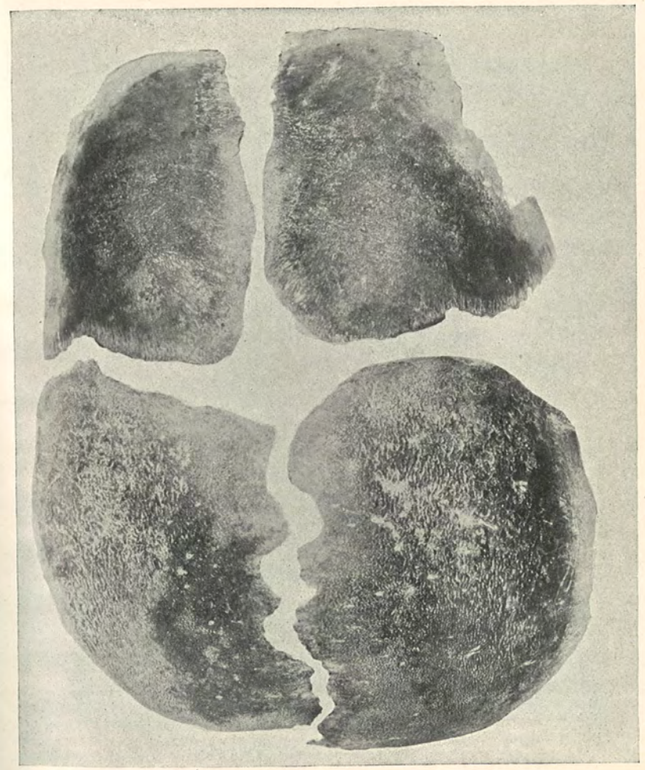
Urine: turbid, straw-colored, 1017, reaction acid, no albumin or sugar was found, urea 1.6 per cent.; no crystals, but amorphous urates, squamous epithelium, and a few leucocytes; no blood or pus. Dr. Wm. M. Sweet examined his eyes and reported as follows: Normal pupils; normal ocular movements. Optic nerves good color, vertically oval. Arteries and veins normal; smaller twigs tortuous. The arteries in the right eye-ground are a trifle small in proportion to the veins.

Dr. Bochroch examined him from the neurological standpoint and reported as follows. Knee jerks are equal; no asteriognosis; no Babinski; no ankle clonus; no impairment of sensation below the knees and no impairment of the muscle sense. No trophic ulcers; he stands equally well on both legs. There are ecchymotic spots on the arms, impeded circulation, cold sweaty hands; the radial arteries suggest hardening. The left hand, which was also burnt, is smaller than the right. The grasp is equally good in both. No atrophy of shoulder girdle muscles. No thermal anæsthesia. Pupils respond to light and accommodation. High arched palate; fairly good dentition. Hears the ticking of a quiet watch at about ten inches. Tendency to nystagmus laterally with the pupils turned to the right. No impairment of the sensation of taste.

After considering the possibility of doing any operation on the top of the head, I decided that that held out little hope of relief from the pressure, and as the covering of the top of the head consisted of the dura and scar tissue intimately adherent together, it would be very dangerous and probably fatal to attempt any operation there. Moreover, I supposed that probably the superior longitudinal sinus might be blocked as a result of the burn.* I decided, therefore, to do a complete linear craniotomy, so as to separate the entire top of the skull from the lower portion. To do this by an open incision of the entire scalp would almost certainly produce gangrene of the scar tissue of the top of the head. I therefore decided to make several incisions, say 4 to

* The operation showed that this was not the case.

FIG. 1.

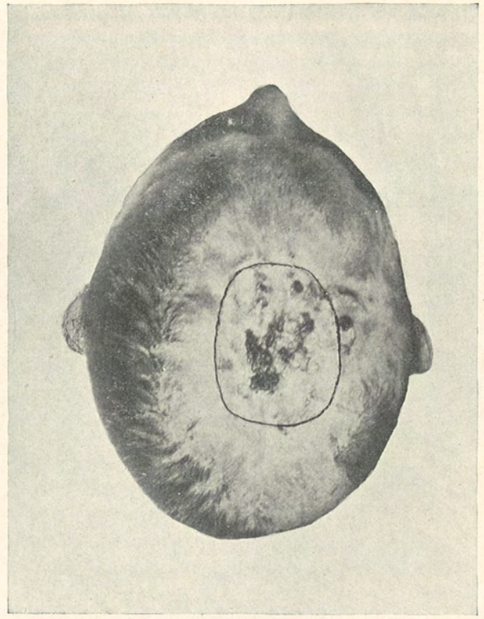


Photograph of the necrosed frontal and parietal bones, natural size, and measuring when approximated, 17 x 11 cm.

FIG. 2.

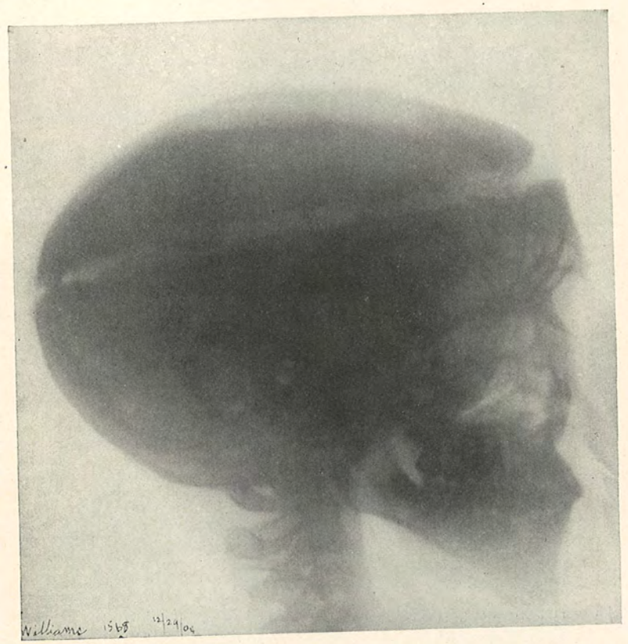
Photograph of the boy at 14 years of age.

FIG. 3.



Photograph of top of head. The dark line corresponds to the present opening in the bone and measures 8 x 5 cm. The original opening when the bones sloughed away at 13 months of age measured 17 x 11 cm. (see Fig. 1). While his head has increased in size with his growth, the defect in the skull has contracted 9 cm. antero-posteriorly, and 6 cm. transversely.

FIG. 4.



Skiagraph (Jan. 10, 1905) showing the gap left in the bone by the complete circular subcutaneous craniotomy. Note also the evidence of loss of bone on top of the skull.

5 cm. above the ears, and then by my craniotomy forceps to gnaw away a portion of bone about 7 mm. in width. I found that the scalp moved loosely over the skull at about the level indicated all around the skull, excepting at a small area over the right temple. I could, therefore, by undermining it, detach the scalp from the skull through the small openings and then, having made a small trephine opening in the bone, could detach the dura from the bone and do the linear craniotomy.

Operation, December 14, 1904.—I carried out my plans as above described, making the first incision a little back of and above the left ear. I got along without trouble (excepting that it was tedious on account of having to do a large part of the operation without the aid of sight) till I reached the middle line of the forehead. Here, unfortunately, the superior longitudinal sinus was caught in the bite of my rongeur and torn. I immediately checked the quite violent hæmorrhage by some iodoform gauze, extended the incision somewhat across the forehead to the left, rapidly made a trephine opening at this point and gnawed away the bone till I reached the point of the tear. I was able then by my finger to check the flow of blood sufficiently to see the bone well, and complete the craniotomy in the middle line. I packed some iodoform gauze into the opening, which effectually checked the hæmorrhage, and then discontinued the operation, having completed nearly one-half of it, and determined to do the other half a few days later.

In thinking over the matter I feel quite clear that the tear of the sinus was due to the fact that I did not adopt the proper method of approaching this portion of the bone. I should have continued the gnawing away of the bone till I reached almost to the middle line, then have made a trephine opening on the left side and gnawed away the bone on that side nearly to the median line, have exposed the sinus, and then by guarding it with my forefinger or some other suitable shield, such as the handle of a knife, I am quite sure I could have removed this piece of bone which projected inward more deeply than usual, at least 4 or 5 mm., with safety and I would not have torn the sinus.

December 20, 1904.—He has done so well that I completed the craniotomy to-day. Warned by my former experience, I attacked the superior longitudinal sinus posteriorly first from one side and then from the other, as just described, gnawing away the

bone over the sinus itself last and without any trouble. The hæmorrhage was not at all severe. Eight incisions were made in performing the complete craniotomy.

Two days after the first operation, and one day after the second, he was sitting up in bed with a backrest. In the interval between the two operations he had two convulsions, December 18 and 19, with but very little twitching. Before the second operation was done it was clearly noted by the resident, his father and several surgeons who had seen him repeatedly that his mental condition seemed to be distinctly improved even by the first operation. I hardly think that the wish was father to the thought, but, of course, it is difficult to express an unprejudiced judgment. The boy himself said that his head felt much better than before the operation. Very little pain followed either operation. His temperature after each operation only once exceeded 100 degrees.

January 9, 1905, a skiagraph was taken (Fig. 4). This shows well the absence of bone on top of the head and also the line of my linear craniotomy.

On January 10, 1905, just before his discharge, Dr. Bochroch again examined him and made the following report: The patient's face expresses apprehension and lack of intelligence. A considerable interval elapses between his answers to such questions as "Where do you live?" "How many brothers and sisters have you?" etc. There is apparently no paralysis of the muscles of the face; he is, however, unable to draw his cheek from either side in order to show his teeth. Most likely this is due to lack of understanding of what he is expected to do. The eye-balls have a tendency to twitching, or a slight jerky movement; possibly more marked in the right than the left eye. When following an object, especially toward the right side, lateral nystagmus is distinct. The pupils are somewhat dilated, but respond promptly to both light and accommodation. There is a fine tremor of the tongue; also a fine tremor of the hands, more marked in the right than in the left. Grasp good and equal. His walk suggests the "steppage gait;" this is exaggerated when walking with his eyes closed. During this test he always walks to the right. He has no Rombergism, but he stands with difficulty on either leg, with his eyes closed. The knee jerk on the right side is exaggerated, on the left side rather minus. No

Babinski or ankle clonus. The reflexes in the upper extremity, wrist, biceps and scapulo-humeral, are exaggerated. Tactile and thermal sense normal, though he occasionally gives evidence of paræsthesia. No asteriognosis.

He left the hospital on January 7 to visit an uncle in the neighborhood, but returned to the hospital on the tenth and then went home. His peculiar gait mentioned in Dr. Bochroch's last examination was improved, and his general and mental condition also were improved.

After the second operation, his convulsions were as follows: December 23, 5 minutes; December 24, 5 minutes; December 28, 7 minutes. They were chiefly on the right side and the mouth was drawn to the right. December 30, two attacks, 6 and 3 minutes long respectively, similar in type to the one on the twenty-eighth. December 31, one attack, duration 5 minutes. There were no movements on this occasion on the right side, but only a clonic spasm of the left arm and leg, and the face was strongly drawn to the left.

October 26, 1906.—He was shown to the Society of Clinical Surgery in a clinic which I held at the Jefferson Medical College Hospital. His father states that he has had fewer attacks and that his intelligence is slowly improving. The ulcers on the top of his head are rather worse than when I last saw him two years before and cover the central half of space where there is no bone.

A new skiagraph taken at this time shows persistence of the gap seen in the first skiagraph, but the edges of the gap are, of course, rounded off and less sharply defined. The width of the gap in the bone is the same as immediately after the operation. Dr. Haines writes me, January 25, 1907, that the top of the skull does not seem to him to be movable.

REMARKS.

That the baby did not die from the accident is extraordinary, but it is not a cause of astonishment that he should develop an abnormal shape of his head or an abnormal mental condition accompanied with epilepsy.

That popular myth, "pressure on the brain," is certainly realized in this case, as shown by the deep furrow on top of his head and by the measured contraction of the original defect in the skull. His head, though of very abnormal shape, is of

the average size for a boy of fourteen. Hence the head has enlarged very much since the bones exfoliated thirteen years before. But instead of the opening left by this exfoliation enlarging pari passu with the growing head, it has greatly contracted. Adjusting the necrosed bones accurately together and exclusive of the lost piece, the aperture left by their exfoliation must have been 17 by 11 cm. At fourteen years of age this opening had contracted to 8 by 5 cm. Not only had contraction taken place in the horizontal plane, but the deep furrow on top of the head shows that a marked contraction had taken place in the vertical plane.

That the epilepsy and mental dulness have been caused by the contraction and consequent pressure, and by the physical alteration in the structure of the cortex itself by the burn, I think there can be no doubt. The only wonder is that he is not wholly idiotic as well as epileptic.

While I had little hope of benefiting the boy by any operation, it seemed to me he ought at least to have the possible chance of benefit from the relief of pressure, provided such an operation would not be almost certainly fatal. As described in the notes, my idea was to make the entire calvaria movable so that it could be lifted like a lid on top of the head. If, then, the brain had any power of expansion it might lift the calvaria and so get more room.

The apparent immediate result seemed to promise considerable improvement, but after two years I fear that this will be slow in its progress and will not be as great as could be desired. Yet the lessened frequency of his epileptic attacks is a positive improvement and he is certainly somewhat less dull than he was when I first saw him.

STATED MEETING, HELD MARCH 4, 1907.

The President, Dr. John B. Roberts, in the Chair.

I. FRACTURE OF THE GREATER TUBEROSITY OF THE HUMERUS, WITH DISLOCATION OF THE HUMERUS INTO THE AXILLA. IMMEDIATE REDUCTION OF DISLOCATION. ON SEVENTH DAY NAILING OF FRAGMENT OF TUBEROSITY IN PLACE.

II. FRACTURE AT THE ANATOMICAL NECK OF THE HUMERUS AND DISLOCATION OF THE HEAD INTO THE AXILLA, WITH FRACTURE OF THE SHAFT. DIFFICULT REMOVAL OF HEAD OF HUMERUS.

BY WILLIAM WILLIAMS KEEN, M.D.,
OF PHILADELPHIA,
Professor of Surgery, Jefferson Medical College.

I.

E. F. K., æt. fifty-nine, first consulted me January 29, 1907. Three days before, on January 26, in getting off a trolley car on the ice-covered street, he slipped and fell, striking his left shoulder,—he rather thinks upon the point of the shoulder, though he is not certain of this. He also thinks that when he found himself about to fall he threw up both arms violently in the air, as would be very natural, but he is also not quite sure of this.

The moment the accident occurred he felt great pain about the head of the humerus, and the whole arm was useless; he was scarcely able to even move his fingers. He was taken to the Pennsylvania Hospital. Here he was attended by Dr. William Drayton of the resident staff, and I owe to him and to Dr. Montgomery, the skiagrapher, the early history of the case and the skiagraph. A dislocation into the axilla was diagnosticated and was reduced under ether. No crepitus was felt until after

reduction of the dislocation. An X-ray picture was then taken, which showed a fracture of the greater tuberosity (Fig. 1). The arm felt much better after the dislocation was reduced. No bruise existed about the shoulder to show the point of impact when he fell. When he came out of the ether, the arm was so bandaged to his body that he was unable to move it in any direction and hence whatever disability may have resulted from the fracture of the greater tuberosity cannot be definitely stated, as no opportunity for muscular movement had existed. He left the hospital the same day.

When he saw me, three days after the accident, I found the arm securely bandaged with a shoulder-cap splint and he was very comfortable. Examination of the excellent X-ray picture showed that the greater tuberosity was broken off in a triangular fragment, the base being uppermost and the apex extending about to the surgical neck. The fragment was drawn upward and backward so that it lay between the spine of the scapula and the head of the humerus. Evidently, if it remained there, it would be a serious bar to abduction of the arm to or beyond the horizontal, and probably also to other movements, and external rotation of the arm would be impaired or lost. I, therefore, took him to the Jefferson Hospital and had Dr. George W. Spencer and Dr. W. F. Manges try different positions of the arm, to see if any of them approximated the humerus to the fragment in such a way as to restore their proper relation, for it was clear that the fragment could neither be brought to its normal position by manipulation nor held there by any suitable dressing.

Several attempts were made to effect this purpose by elevation of the arm and external rotation with retention of the arm in place by plaster dressing and in other positions, but all were failures. I, therefore, determined to operate by exposing the parts, drawing the fragment of the tuberosity into place and holding it there by wire nails. Though at that time I knew of no case thus operated upon, it seemed to me both rational and reasonable to do so.

Operation, February 2, 1907.—I made a vertical incison a little in front of the middle of the acromion directly down through deltoid to the bone, separating the fibres of the deltoid as far as possible rather than cutting them. As soon as I reached the bone, I detected the anterior edge of the bony fragment lying at the

FIG. 1.

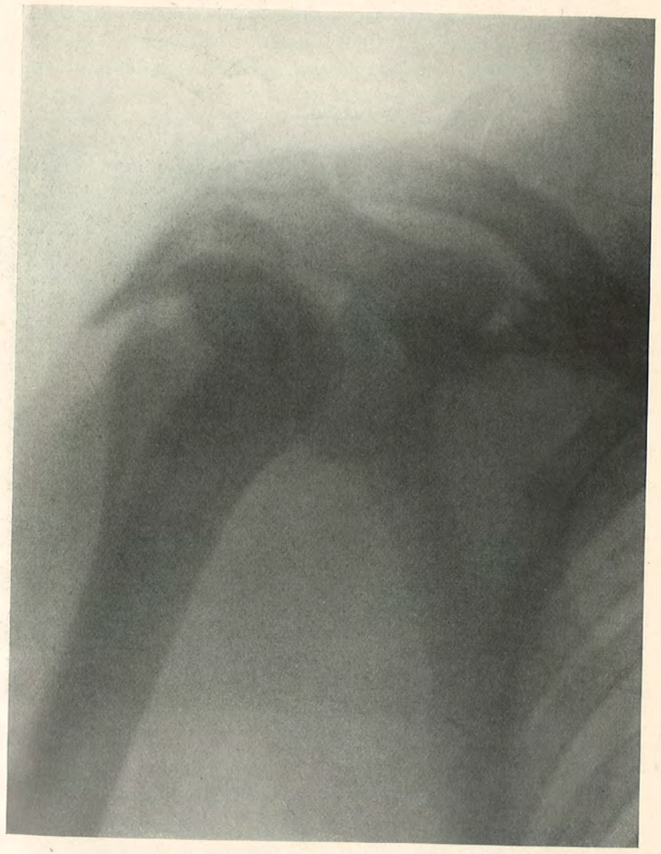
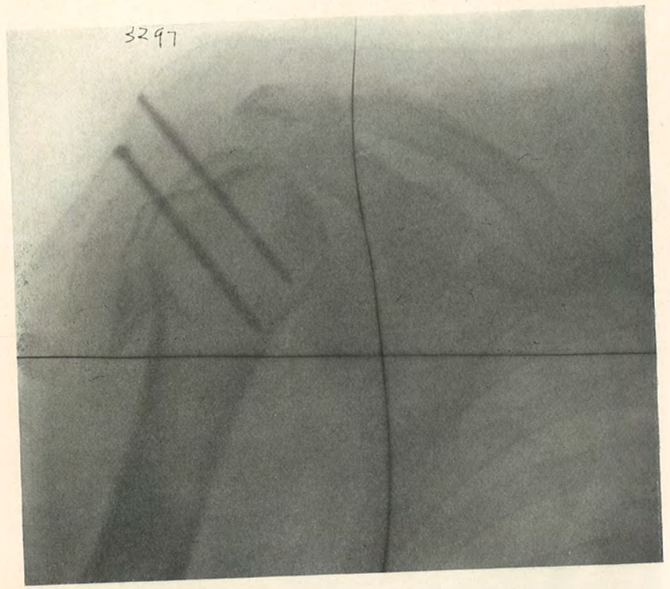


FIG. 2.



posterior margin of the wound. Carrying my examining finger under the anterior edge of the wound, I found the rough, raw surface from which the tuberosity had been torn away at a considerable distance from the anterior margin of the wound. The fragment torn away from the humerus was separated from it by about 5 to 6 cm., and lay posteriorly between the head of the bone and the acromion and spine of the scapula. Evidently no union other than perhaps a very poor fibrous union could ever take place between the normal surface of the bone and the capsular ligament and the raw surface of the fragment. Moreover, the position of the fragment would interfere with the usefulness of the arm, for whenever the arm was raised, this ectopic piece of bone would be a sort of wedge between the acromion and spine and the head of the humerus. An assistant, therefore, rotated the humerus externally as far as possible. This brought the posterior edge of the raw surface of the bone to the anterior edge of my incision. I was able then to expose this raw surface by strongly retracting the anterior edge and next to draw forward and downward the fragment of bone so that I brought it nearly into its normal position. It was impossible to get it absolutely into its former place. I found the best means to replace the torn fragment of bone was by seizing the tissues around it with the Allis "tissue forceps." These practically resemble the one-prong tongue forceps, the opposite blade being a simple curved notch rather than the broad surface of the tongue forceps.

Holding the fragment in position, I drilled two holes in it and nailed the fragment in place by means of two wire nails 7.5 cm. in length and about 2 mm. in diameter. These were long enough to allow the head of the nail to protrude beyond the skin. A large portion of the nail, of course, was outside the bone, corresponding to the thickness of the deltoid, the fat and the skin (Fig. 2).

The wound was then entirely closed, excepting where the nails protruded, and at the lower angle where I inserted a small bit of gauze for a temporary drain, especially because there was considerable grumous blood accumulated at site of fracture.

His highest temperature was 100°, and he made a perfectly uneventful recovery. One nail was removed without difficulty at the end of two weeks and the other at the end of the third week. The wound left by the nails healed quickly. Passive motion and massage were begun at the end of four weeks.

REMARKS.

Until very recently fracture of the tuberculum majus of the humerus has been believed to be very rare. In the statistics of Gurlt, covering one hundred years, he records but 46 examples found in literature and in museums. Usually the fracture accompanies dislocation. Gurlt found only 4 cases of fracture unaccompanied with dislocation, and even one of these was not free from doubt.

The systematic use of the X-rays, however, has entirely disproved this notion and has shown that, on the contrary, it is a not uncommon fracture. I have asked several skiagraphers in Philadelphia as to their experience, with the following results:

Dr. Manges of the Jefferson Hospital has only had one case; Dr. Kassabian has seen 4 in about 800 fractures; Dr. Leonard has no exact record, but recalls 2 of the great tuberosity alone, and at least 6 cases with other associated fractures; Dr. Pfahler of the Medico-Chirurgical Hospital in 84 cases found 7 such fractures with no other lesion, and 3 cases of this fracture associated with dislocation; Dr. Frederic Montgomery of the Pennsylvania Hospital, in 75 cases of injury of the upper end of the humerus has found 3 cases of this fracture including the present case; Dr. Pancoast, at the Hospital of the University of Pennsylvania, writes as follows: "In looking over the skiagraphs I have made of fractures of the upper part of the humerus, I found 6 cases of fracture of the tuberosity, which seem to belong in a class by themselves. In one of them there is also an incomplete fracture of the surgical neck, and in another, either an incomplete or an impacted fracture of the surgical neck. In this last case, no fracture whatever was diagnosed clinically. The other 4 cases were purely uncomplicated. In addition to these cases, I found 3 with fracture of the anatomical neck and the tuberosity. In all these 7 cases, as in the first 5, the tuberosity is a separate fragment by itself.

"The fragment representing the tuberosity varied in size from a thin scale of bone to the entire tuberosity and part of the neck below it.

"In 1 case only, out of the 12, am I certain that a clinical diagnosis of fracture of the tuberosity was made prior to the skiagraphic examination, but such a diagnosis could hardly have been expected in the seven distinctly complicated cases."

These six observers have, therefore, seen at least 21 uncomplicated cases and 18 more with other associated lesions, all, presumably, within about four or five years. Through their courtesy, I was able to show 23 of these 39 skiagraphs.

Before the X-rays were used, the lesion was generally diagnosticated as a severe "contusion" or "bruise" of the

FIG. 3.

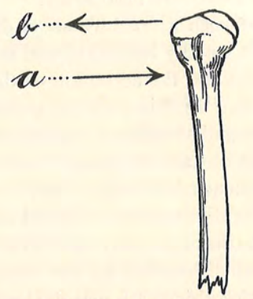


Diagram to show the opposite direction of the two forces acting on the head of the right humerus. *a*, direction in which the bone is forced in the dislocation; *b*, direction in which the muscles act either in suddenly throwing up the arms to prevent the fall or in the involuntary endeavor to prevent the dislocation.

shoulder, which often permanently disabled the arm to a greater or less extent. Now we know that the condition is more frequent and the consequences much more serious than has been believed.

Whether the cause is always the direct result of a fall or blow on the shoulder, or whether it may result from muscular contraction alone, is disputed. Doubtless both of them act together, the dislocation acting in one direction (inward) and the sudden contraction of the muscles in the opposite direction (outward) (Fig. 3). In the present case the blow dislocated the humerus, but the sudden and violent elevation of the arms to prevent his fall might well have produced the fracture in a man of fifty-nine, even if there had been no fall.

The pathology of the lesion has been well ascertained by the findings at operation and by the extraordinary good fortune of Jössel, who in 1880 reported the facts ascertained by the dissection of 9 cases of habitual dislocation of the shoulder. He found the supra- and infra-spinati torn loose, retracted and in fatty degeneration, part of the capsule was torn loose and the head of the humerus was in contact with the deltoid and the acromion. Of 8 cases of old dislocation operated on by Kocher, in 6 the tuberculum majus was torn off. Last year Perthes reported 10 cases of luxation of the shoulder, in 6 of which there was either a fracture of the tuberosity or the muscles were torn loose from the bone.

The results of such a fracture are a displacement of the fractured fragment usually backward and upward between the head of the humerus and the acromion or the outer end of the spine of the scapula. In this position, union of the fragment is often improbable and sometimes impossible. The fragment, if of any size, is an obstacle to upward movement of the arm. The loss of attachment of the supra- and infra-spinati and the teres minor involves diminution or loss of external rotation of the arm, and, as Perthes especially has shown, permits repeated and finally habitual dislocation of the head of the humerus. In fact, in his opinion this is the principal reason why habitual dislocation occurs.

Formerly the diagnosis was in most cases only presumptive until the advent of the X-rays. In fat persons especially it was often impossible to make a diagnosis if this fracture was associated with other fractures or with dislocation. The contour of the shoulder, in a minor degree, however, resembles a dislocation, as shown by the prominence of the acromion and a furrow below this prominence. The head of the bone may be broader than normal; if the fractured fragment is of any size, a groove can sometimes be felt between it and the head of the bone; crepitus may be felt but sometimes is absent, especially while the dislocation is unreduced, as in the present case, and it will usually be impossible to lift the arm above the horizontal—even passively—and external rotation is lost or lessened. The deltoid is sometimes atrophied as a result of injury to the circumflex nerve.

As long ago as 1886, Bardenhauer suggested suture as a means of treatment; but it seems not to have been done till 1898 by W. Müller. The latter surgeon excised an oval portion of the capsule of the joint and sutured the muscular attachment by advancement (Vornähung) of the external rotators. In 1904 Perthes operated on 2 cases by means of double-pointed, U-shaped nails. Both of his cases were ancient fractures, one being operated on over three years and the other five years after the accident. He made the posterior incision of Kocher for excision of head of the humerus, in one case chiselling a part of the spine and the acromion (which were wired later), and turning downward and forward a large deltoid flap. In both the results were good.

My own case is, I believe, the first in which a primary operation has been done. I made a vertical incision, seized and drew downward and forward the fractured piece, and, after external rotation of the arm, nailed the fragment as nearly as possible in place by two disinfected wire nails which were afterwards removed.

I should have delayed publishing the case until I could report the final result, but that a long absence in the immediate future prevents my waiting. Every indication points to a speedy and satisfactory result, as there is little ankylosis of the joint. Passive motion has just been begun.

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II.

CASPER K., æt. sixty, first consulted me December 23, 1905, with Dr. A. P. Hull of Montgomery, Pa., to whom I owe the following history:

On November 18, 1905, he fell from the top of a wagon of fodder about 10 feet, falling on his feet. The fodder followed, fell upon him and threw him forward. He fell, striking on his right shoulder. He was helped up and walked to his brother's house about 100 feet away.

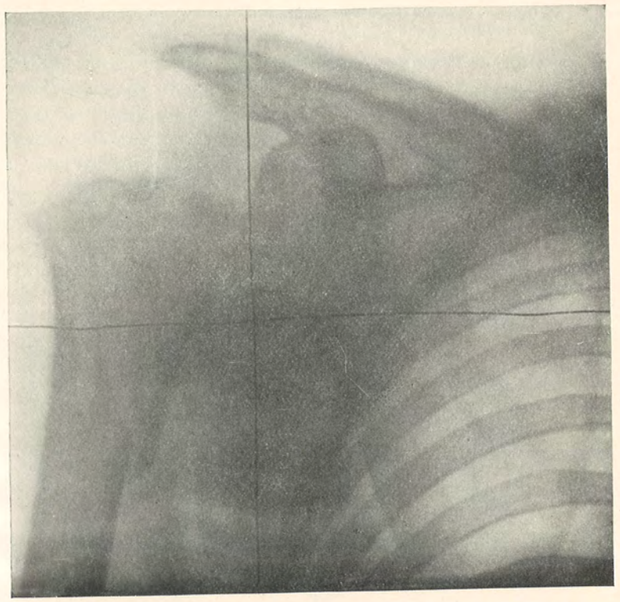
Dr. Hull saw him two hours later and found a subcoracoid dislocation. Under chloroform this was reduced and the forearm put in a sling. At the end of three weeks, as he had not called as directed, the doctor went to see him and found that the dislocation had been reproduced; he also discovered crepitus on moving the arm. The patient states that he has had pain ever since the accident. He has slept poorly, though occasionally he has had a good night. He has had to lie with extra pillows propping him up most of the time since the accident. His appetite is fair, bowels in fair condition. He has worn a sling most of the time.

On examination I saw clearly a marked fulness under the coracoid, like a subcoracoid dislocation, but there was no outstanding elbow, nor any change in the axis of the upper arm in relation to the body. The acromion was very prominent; a hollow existed below it; there was flatness over the muscles of the shoulder posteriorly and fulness in front under the coracoid. On attempting to rotate the arm, crepitus was easily elicited, but as movement was very painful, I decided to wait till I could get an X-ray picture of the arm. The arm was greatly swollen, especially over the forearm, there being less and less swelling from the elbow up toward the shoulder. The entire arm from shoulder to elbow was also still very much discolored from the effused blood.

December 26.—On examining the X-ray picture (Fig. 4) I found that there was a fracture exactly through the anatomical neck and that this fragment was dislocated inward under the coracoid process. In addition to this there was a vertical fracture from the upper end of the shaft downward to the surgical neck.

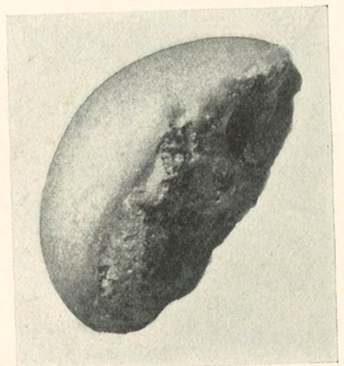
Operation, December 27.—I first made an incision from the coracoid process down nearly to the insertion of the deltoid. I separated the fibres of the deltoid, watching carefully for the

FIG. 4.



Fracture-dislocation of shoulder. Fracture of anatomical neck and shaft of humerus. Dislocation of head into axilla.

FIG. 5.



Fracture of anatomical neck of humerus.

circumflex nerve and the long tendon of the biceps. I did not at any time see the circumflex nerve. The tendon of the biceps was dislocated inward from its groove and the capsule of the shoulder joint opened. On inserting the finger, I found that the upper end of the humerus was almost entirely smooth and it was, of course, utterly hopeless to obtain union even if I had succeeded in replacing the dislocated head of the humerus or if it had any reliable blood supply. A considerable amount of fluid, black blood, evidently effused at the time of the accident, was liberated from the tissues. On dissecting toward the inner side, so as to lay bare the dislocated head of the humerus, I found it lying so much to the inside of my incision that it was evidently much more accessible by a separate incision. This started from just below the insertion of the tendon of the great pectoral in a direct line toward the sterno-clavicular articulation, reaching to a point below the middle of the clavicle. I separated the fibres of the great pectoral by blunt dissection and finally found the head of the bone with its fractured surface looking toward the middle line and the articular surface toward the humerus,—*i.e.*, completely rotated. It was very adherent, but gradually I was able to loosen it and finally to pry it up very slowly and carefully, lest I should either do harm to the nerves or to the axillary vessels which lay immediately in contact with it. By combined prying upward and traction by means of a large sequestrum forceps, I finally dislodged the head entirely (Fig. 5). Very deep in the wound a vessel immediately began to bleed very copiously: I was able, fortunately, instantly to put a finger of the left hand upon it and arrest the hæmorrhage. It was so deep, however, that it was impossible to ligate it through the existing incision. Accordingly, I divided completely the great pectoral tendon about 3 cm. from the humerus. This gave me wide access to the axilla and I was able finally to seize the bleeding vessel, which would have been otherwise inaccessible. The vessel was double ligated as it was bleeding from both directions. A few other small vessels required ligation. The parts were then irrigated with salt solution and the tendon of the great pectoral overlapped and sutured with twenty-day chromicized catgut. The long head of the biceps was replaced and sutured in place with catgut. A drain was placed in each wound, that in the second incision going deeply into the axilla, and the wounds were closed.

The arm was placed next the chest, the forearm flexed in front of the chest with a pad in the axilla and a Velpeau bandage applied.

On the evening of the day of operation his temperature rose to 101 degrees, but by the second day it was down to the normal and so remained. He went home on January 7, eleven days after the operation.

Dr. Hull writes me, February 1, 1907: "He can raise his arm to two-thirds of the normal height; the wasting of the muscles of the shoulder is disappearing with use and he can use the arm right well in digging, etc."

Fracture of the anatomical neck of the humerus is an extremely rare injury. Stimson [1] states that the only reported specimens of fresh fracture without discoloration or additional fracture through the tuberosities are those of Boyer and Spence. The cases of fractures associated with discoloration are more numerous, yet even they are so rare that Stimson himself "had seen only one case in which the diagnosis seemed probable," and a second undoubted case. Hamilton [2] also in his very large experience in fractures saw only one case. The present is the only case that I have ever seen.

This fracture may be either intra- or extra-capsular. "It is probable, since bony union is not denied to this fracture (*i.e.*, intra-capsular fracture), that the line of separation is not always, or generally, perhaps, completely within the insertion of the ligament, but that it is in some degree extra-articular if not extra-capsular. If it is entirely intra-articular, no doubt union of the fragments can never take place and necrosis with suppuration must ensue, demanding, at a period not very remote, an operation for the removal of the fragments, the same as in compound fractures. Gibson, however, thinks that the fragment occasionally remains, being gradually absorbed and changed in figure." [3]

In this particular case the specimen I think shows that

[1] Fractures and Dislocations, third edition, 1900, 216.
[2] Fractures and Dislocations, sixth edition, 1880, 234.
[3] Hamilton, ibid.

the fracture was wholly intra-articular. In addition to this the head of the bone was not only not displaced within the capsular ligament, but was thrust wholly outside of it, far into the axilla. Impaction of the upper fragment into the lower is not uncommon, as in fact would be natural from the force necessary to break off such a limited rounded fragment. If there is impaction, union, of course, may take place.

The last edition of Stimson's work was published only a few years after the X-rays were discovered and before their general use. Hence he makes no reference to their use in such cases. These rays have made perfectly possible correct diagnoses of fractures about the shoulder joint, such as the present case and the other one that I report this evening, a fracture of the greater tuberosity. Before the discovery of Röntgen, such cases were always obscure. In Stimson's next edition, without doubt, certainty will take the place of presumption in the diagnosis.

In the present case fracture of the anatomical neck was associated with dislocation and complete rotation of the fragment and also with a longitudinal fracture of a sharp fragment from the inner side of the shaft as far down as the surgical neck. When the head is in place, crepitus can often be elicited. Had the lesion been limited to fracture and dislocation of the head, no crepitus would have been felt. Undoubtedly, the crepitus felt at the time of my examination, almost six weeks after the injury occurred, was between the fragment fractured from the shaft of the bone and the shaft itself, for the skiagraph shows that the fractured and dislocated head could not have produced the crepitus. That this second fractured fragment should not have been united with the bone at so distant a time and yet, as the later history shows, never have undergone necrosis or caused any trouble is both surprising and gratifying. Union, of course, took place later.

The acromion is usually much more pronounced than normal, but it is not so prominent, nor is the furrow under it so well marked as in a subcoracoid dislocation. The skiagraph shows well the very great distance between the upper

end of the shaft and the acromion, although, as will be observed, the shaft is evidently pulled upward (to the mid-point of the glenoid cavity) by the action of the muscles and the arm is shortened by so much. Unfortunately, I did not make any measurements of the comparative length of the two arms.

When it is not dislocated the fractured head of the bone can usually be felt within the capsular ligament and its abnormal mobility determined. When it is dislocated into the axilla, as in my own case, it can also be felt as a marked abnormal prominence either directly below, or below and external to the coracoid. If the head is not displaced outside of the capsule, it is usually displaced with reference to the shaft of the bone, so that the upper end of the bone is considerably broadened.

After all, the Röntgen rays serve the best purpose and I think are an absolutely reliable means of diagnosis. It is precisely in these obscure lesions that the X-rays help us the most.

The usefulness of the patient's arm at the present time is quite as much as one ought to expect from so serious and complicated a case and especially one that had been neglected by the patient for so long.

Dr. Gwilym G. Davis mentioned a case of fracture of the anatomical neck of the humerus which he saw many years ago when a resident in Dr. Morton's service. The patient was an old person who had a fracture through the anatomical neck, with dislocation of the fragment into the axilla, under the pectoral muscle. An incision was made along the border of this muscle and through this the fragment was removed.

Dr. James K. Young has seen recently in consultation one case of fracture of the greater tuberosity of the humerus, the X-ray of which he exhibited, in which the diagnosis was made by him from the clinical symptoms. It was an illustration of the point mentioned by Dr. Keen regarding the manner in which this fracture is received, the patient falling with the arm high in the air. A second feature of this case, and a point not mentioned by

Dr. Keen, was the peculiar position of the resulting ecchymosis, which followed the biceps tendon and appeared down the front of the arm almost to the elbow. The disability following the accident was attributed by Dr. Young to injury of circumflex nerve.

Dr. George G. Ross said that at the German Hospital they see a number of fractures of the anatomical neck of the humerus. They treat them by applying ordinary dressings without resort to operative procedures. This fracture is not uncommon and the ultimate results are usually good. One man of forty-five years received the fracture three weeks ago, is now having passive motion applied, and can bring the arm almost to a right angle.

Dr. Lee said he had been three of the cases which Dr. Montgomery skiagraphed. He also saw Dr. Keen's case when the man first came to the receiving ward and also after reduction. Crepitus persisted and the provisional diagnosis was fracture of the coracoid process.

Dr. Keen, in closing, said in reference to fracture of the anatomical neck, that operation is not needed if the fracture extend outside the capsule, unless the raw surfaces of the bone are reversed and cannot be brought in contact, or unless the separation be entirely intracapsular and the fragment therefore be deprived of all blood supply. There was no hope of union in his case, without operation, as the fragment was displaced at a distance and was also reversed. He did not agree with Dr. Ross that the accident is a common one. Dr. Young's statement regarding the ecchymosis in his case is an interesting observation. In Dr. Keen's case there was no ecchymosis present, but when present its extension down the biceps would be of diagnostic value.

FRACTURE OF FEMUR AND PELVIS.

Dr. Robert G. Le Conte presented a boy of eight who on January 1, 1907, was caught on the fender of a trolley car and rolled along the ground, it being uncertain as to how much weight came upon him. He sustained a fracture of the upper third of the left femur, a fracture through the left ilium just to the outer side of the sacro-iliac joint (Fig. 1), a wound of the perineum extending to but not opening the membranous urethra, a scalp wound and general bruises over the entire body. Now, about ten weeks after the injury, the boy is able to walk well, although he does so with some limp. As the anterior and posterior spines of

the ilium of the left side are lower than those on the right, it has not been determined how much shortening, if any exists in the left leg.

GUNSHOT FRACTURES OF FEMUR AND FOREARM.

DR. LE CONTE presented a man of twenty-six who was shot on September 1, 1906, with a 38-calibre revolver, in the lower part of the left thigh and also in the left forearm near its middle. The thigh was fractured very obliquely; the line of fracture ran from below upward and from the outer anterior aspect inward for a distance of nearly 3 inches. The long, thin upper fragment had penetrated the knee joint and interfered markedly with motion. Four weeks ago an incision was made on the outer aspect of the thigh and 1½ inches of the spike-like portion of the upper fragment was removed sub-periosteally without opening the knee joint. There was firm union of the fragments. The two skiagraphs (Figs. 2 and 3), before and after operation, show very well the portion of bone removed. Motion at the knee joint has now increased to a little over a right angle and he walks without a limp.

The bullet which passed through the forearm fractured the radius into three pieces, the middle piece or fragment being 2½ inches long and having been driven into the muscles on the radial side of the forearm. The lower fragment had been driven toward the ulna and had become united to it. There was entire absence of pronation and supination, and flexion and extension at the wrist joint was almost gone. From the skiagraph (Fig. 4), which shows the position of the fragments accurately, and also small particles of lead embedded in the muscles, it would look as if the fragments were separated by the interposition of muscular tissue and that no union had taken place.

A long dorsal incision was made the same day that the femur was operated upon, and on exposing the fragments of the radius it was found that the upper and middle fragments were firmly united, while the lower one had grown fast to the ulna. This latter fragment was separated from the ulna and brought into line with the rest of the radius, drilled and wired to the middle fragment (Fig. 5). Now he has nearly 50 per cent. of pronation and supination and quite 50 per cent. of flexion and extension at the wrist.

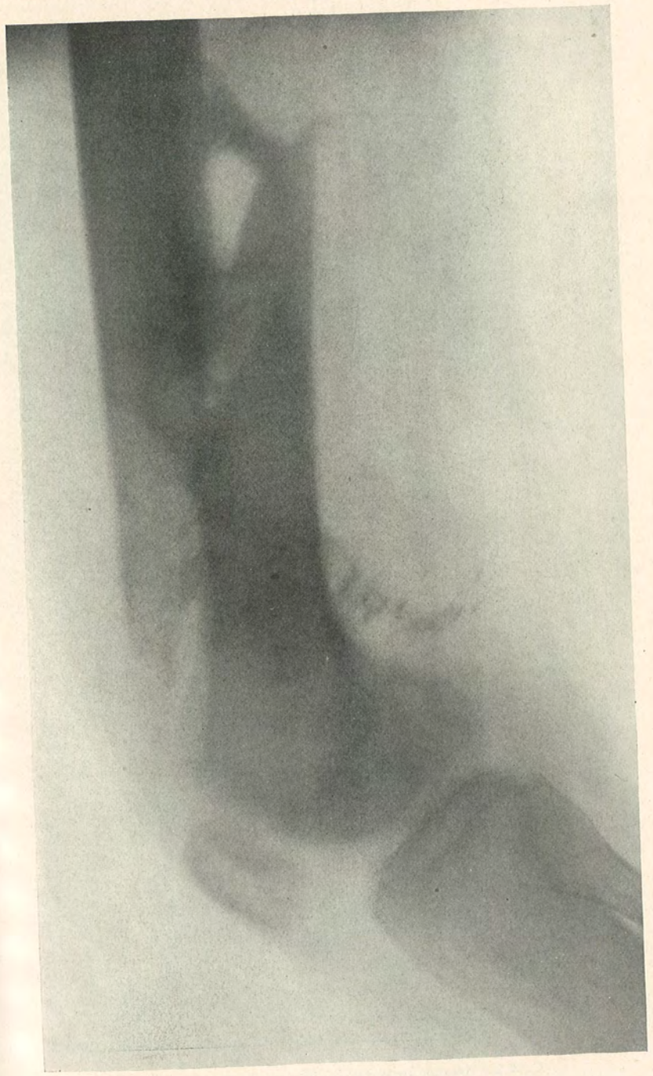
FIG. 1.

CASE I.—Showing fracture of the left thigh and left ilium.

FIG. 2.

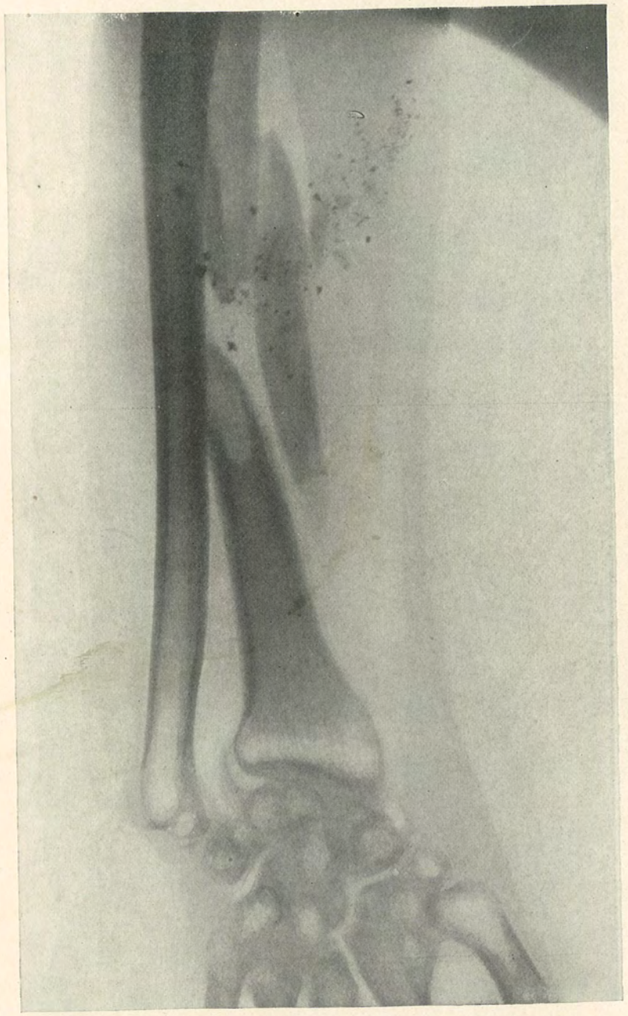
CASE II.—Gunshot fracture of the left femur, before operation.

FIG. 3.



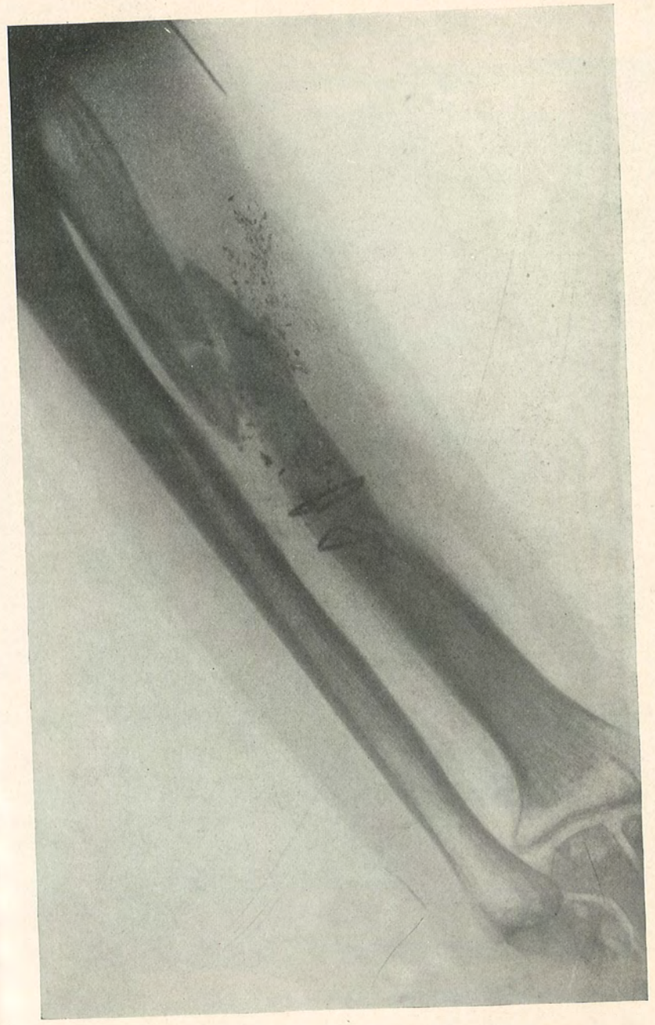
CASE II.—The same after removal of the spike-like process.

FIG. 4.



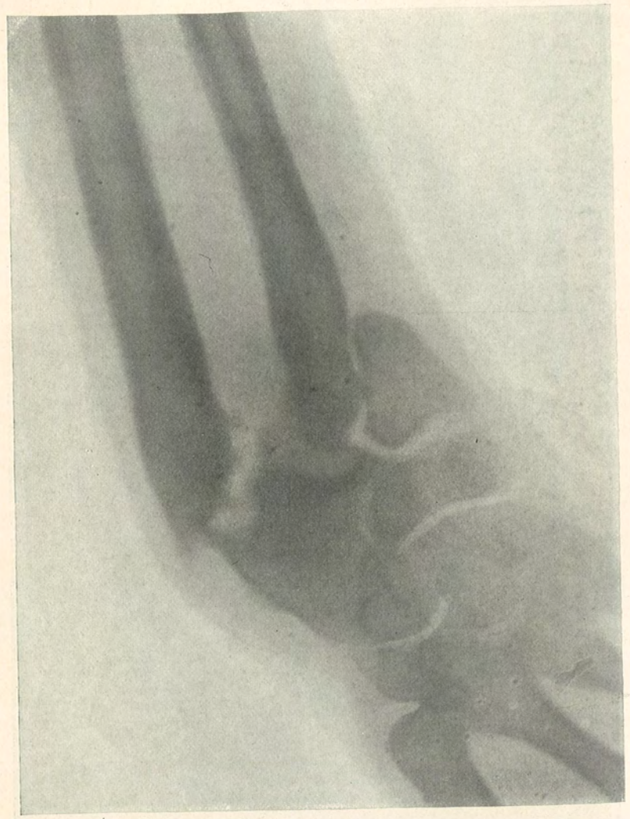
CASE II.—Gunshot fracture of left forearm, before operation.

FIG. 5.



CASE II.—The same after wiring.

FIG. 6.



CASE III.—Deformity following compound fracture of the radius and ulna.

FIG. 7.

CASE III.—The same after correction.

COMPOUND FRACTURE OF RADIUS AND ULNA.

Dr. Le Conte presented, also, a man aged thirty-two, who sixteen months ago had his right forearm caught in a bread mixer, and sustained a compound fracture of the radius and ulna about 1½ inches above the wrist joint, with a long oblique fracture of the external condyle of the humerus. As a result of this injury the hand was deflected to the ulnar side, between 45 and 50 degrees, rendering it practically useless (Fig. 6). At the elbow joint the motion was very good, although the deformity was marked. Two and a half weeks ago an incision was made on the dorsum of the radius and a second over the outer aspect of the ulna. With considerable difficulty the lower fragments of the radius and ulna were loosened from their bed of fibrous tissue and brought into a straight line, drilled and wired (Fig. 7). It is too early yet to foretell the degree of usefulness which will return to the hand.

Dr. Richard H. Harte, speaking of the results obtained in the forearm first described, said that he saw the operation and at first it appeared impossible to obtain any satisfactory result. There seemed to be multiple fractures and the wound appeared to contain a particle of lead. It seemed as though resection of the fragment would be necessary, but a good result was obtained without.

The other patient was shown by Dr. Harte to the students at the University. Deformity was extreme, being greater than he had ever before seen at the lower end of the radius. The part looked much as though it was the site of an enormous osteo-sarcoma. A great deal of exuberant callus was removed and the indications are that good results will be secured.

Dr. George G. Ross mentioned a case of fracture of the pelvis in a man caught between a swinging crane and a pillar, and rolled around the latter. In addition to the fracture there was rupture of the posterior wall of the bladder. A catheter in the bladder discharged only blood for twenty-four hours and then bloody urine. During one day 96 ounces were passed. After four or five days the man was operated upon. The ascending ramus of the pubis was fractured on both sides and the broken ends protruded into the bladder. It was impossible to reduce them. The man died of sepsis a few days later.

PARTIAL GASTRECTOMY.

WITH REPORT OF TWO CASES.

BY CHARLES H. FRAZIER, M.D.,

OF PHILADELPHIA.

FOLLOWING close on the heels of the agitation in favor of the surgical treatment of appendicitis came the invasion of the surgeon into the therapeutic field in diseases of the biliary passages. It was not long after he had laid down certain surgical laws or principles governing the treatment of cholelithiasis and cholecystitis, that he began to encroach upon the territory of the internist and lay claims based upon pathological and clinical evidence to the right to treat the chronic dyspeptic. One is struck with the immense amount of surgical literature touching upon gastric surgery, that has appeared in journals during the past five years, and one would draw the conclusion that the general surgeon here and elsewhere saw and operated upon not an inconsiderable number of cases each year. In looking into the reports of five representative hospitals in Philadelphia for the year 1905, I was amazed at the paltry number of cases of gastric ulcer or gastric carcinoma that were tabulated in the surgical tables. There were, all told, about 30 cases of gastric ulcer, 1 duodenal ulcer and 14 cases of carcinoma. My own experience in gastric surgery during the past year has been limited to 10 cases, including 2 perforating wounds of the stomach, 4 cases of gastric ulcer, 1 of atonic dilatation, and 3 cases of carcinoma. This array of figures would seem to cast a reflection either on the surgeon or the internist, or both. The surgeon might be held to account if either in technique and dexterity or in his selection of cases the results were not such as to warrant the internist entrusting his patients to the surgeon's care. The published statistics do not seem, however, to bear out this theory. The fault seems to lie rather with the internist, either in his failure to recognize the

existence of an ulcer as the disturbing lesion in the chronic dyspeptic or on his unwillingness to admit and take advantage of the permanent relief to be obtained by properly chosen and properly executed surgical procedures. In the out-patient department of one hospital there were 176 cases of so-called chronic gastritis and not one case of gastric ulcer treated in the wards, while in another there were 321 cases in the out-patient department, and but 4 ulcer cases treated in the medical and surgical wards. With the absolute superficiality and disregard of the modern methods of accuracy, so prevalent in the average dispensary service, is it not likely that some cases of chronic ulcer are overlooked and perhaps a greater number of cases of carcinoma unrecognized in the operable stage? To a certain but lesser extent the same is probably true of cases seen in private practice. If in weighing the evidence the surgeon is found reprehensible, it may be because, in his earlier experience, he was less discerning in his selection of cases and advised operations in cases in which the findings and the results proved the impropriety of such measures. Nothing has done more to discredit the gastrojejunostomy than its performance in cases of atonic dilatation of the stomach without pyloric stenosis. The patients suffering from this lesion are often of the neurasthenic type; many have had movable kidneys, if they have not already been anchored for the time being by one of the innumerable methods, or symptoms referable to the appendix or ovary if these have not already been removed.

The first of the cases in the report was a man fifty-four years of age. He was a lithographer by profession but attained greater notoriety and reputation as a professional foot-racer. He had never been addicted to the excessive use of alcohol or tobacco, and until the onset of his present illness he did not know what it was to be sick. About two years prior to his admission to the University Hospital his appetite began to fail and he began to lose weight. He complained at times of a good deal of pain after eating, and about eighteen months later he began to vomit. His condition became more and more aggravated until, when first seen, he vomited after every meal; he had constant pain in the epigastrium

and his weight fell from 150 to 98 pounds. It was noted in his clinical record that, among other things, he had signs of arteriosclerosis; his urine contained neither albumin nor casts, the hæmoglobin was 60 per cent., red blood corpuscles 4,080,000, and white blood corpuscles 10,720. From the analysis of the stomach contents it was reported that Oppler Boas bacilli were present, that there was no free hydrochloric acid or lactic acid, and a total acidity of 58. The stomach was somewhat dilated but there was no palpable mass. Despite some of the negative findings, the age of the patient, his emaciation, the duration of his illness, the presence of Oppler Boas bacilli led us to view the case as one of carcinoma of the pylorus, probably too far advanced to admit of more than a palliative operation.

The operation was performed October 24, 1906, under morphin-ether anæsthesia, with the patient in the reverse Trendelenburg position. Through a 3½-inch incision a little to the right of the mid-line the stomach was exposed and an extensive area of induration discovered in the pyloric portion of the stomach. There were two palpable lymph nodes in the greater and three in the lesser curvature. There were, however, no adhesions to surrounding structures and the lesion, still regarded as carcinoma, seemed especially suitable for a partial gastrectomy. The four vessels, two in the lesser and two in the greater curvature, were ligated, enough of the gastrocolic and gastrohepatic omentum was tied off to include the enlarged lymph nodes from the pylorus to the Mikulicz-Hartmann line. Clamps were applied to the duodenum and the stomach, the intervening tissue divided with a cautery knife, the respective ends of the duodenum and stomach closed with two layers of sutures and an anastomosis effected with the Murphy button between the posterior wall of the stomach and the jejunum (no loop gastrojejunostomy).

As after many of these operations, the patient's convalescence was remarkably short and free from any discomfort. On the fifth day he was sitting in a chair and on the eleventh day he left the hospital. When last examined, three months after the operation, he had gained 34 pounds; he had been entirely free from pain and had vomited but twice, and then after an indiscretion in diet.

Report from the Laboratory of Surgical Pathology.—Specimen No. 1159. The specimen consists of the pyloric portion of the stomach, on the external surface of which there were a few small glands about the size of a pea, and numerous fibrous adhesions. The ulcer occupied the region of the pyloric ring, and here the mucous membrane was thickened and eroded. Histological sections of tissues from the base of the ulcer failed to show any evidence of new growth. The mucous membrane was seen to be the seat of an inflammatory process; there was a decided infiltration of leucocytes, distention of the blood vessels, and some free blood in the tissues. The inflammatory action extended into the submucous coat where the blood vessels were quite distended and the tissues hyaline in appearance, resembling chronic granulation tissue. The muscular coats were involved to a lesser extent in the inflammatory process. In the numerous sections examined it was impossible to demonstrate any evidence of malignant infiltration.

Upon hearing the pathological diagnosis the questions arose in my mind as to whether it would have been possible to have made a correct clinical diagnosis in this case and whether if the benign nature of the lesion had been known at the time of the operation some other procedure should have been adopted. I think it would have been quite impossible from the naked-eye appearance of the tissue, either before or after its removal, to have distinguished it from a malignant lesion. The ulcer belonged to the indurated class which, according to Mayo, predominate over the non-indurated in the proportion of 85 to 15; the dimensions of the lesion, furthermore, suggested malignancy; and the enlarged lymph nodes which were present, though associated sometimes with ulcer, are more constant in carcinomatous conditions.

As to the clinical history and findings, the duration of the lesion—two years—should have pointed rather to ulcer, as the average duration of carcinoma before the surgeon is consulted has been estimated at nine months. Vomiting is complained of in the majority of cases of cancer, as it would be in a benign pyloric stenosis, and emaciation is common to both. It has been shown by analysis of a large series of cases that too much reliance should not be placed in the clinical and gastric analysis of the stomach contents. Thus in a series of 67 examinations of test meals reported by Graham (*Boston Medical and Surgical Journal,* vol. clv, No. 8), in only 32 was there free hydrochloric acid, in 42 lactic acid and in 13 both lactic and hydrochloric acid. In 10 cases no blood was found and in but

27, about one-third, could a tumor be felt before the operation. The absence of free hydrochloric acid, lactic acid or blood, and the absence of tumor did not preclude the possibility of the lesion being of a malignant nature. The lesson to be learned from these statistics is the danger of placing too much reliance upon what might be called the refinements of laboratory diagnosis. How many cases does the surgeon see in which the question of operation has been fatally deferred because what are regarded as the positive diagnostic features of carcinoma are absent either singly or collectively?

As to the surgical procedure which was adopted in this case, I am disposed to think that even had I known at the time of the operation that I was dealing with an ulcer, I would have performed a partial gastrectomy. Of the three possible operations—gastroduodenostomy, gastrojejunostomy or gastrectomy—the choice would rest between the two last, as the extent and seat of the lesion would have rendered the first impracticable. As between the gastrojejunostomy and pylorectomy, preference should have been given to the latter because of the danger of malignant degeneration. Though complete cicatrization might have followed a gastrojejunostomy, while the process was going on, or even subsequently the lesion might have undergone malignant ulceration. Observations at the Mayo clinic have made out a very strong case in favor of the relation of cause and effect between ulcer and cancer, despite the skepticism of the clinician or clinical pathologist. Thus, quoting again from Graham (loc. cit.), in over three-fourths of their cases (79.5 per cent.), the pathological evidence was good (54 per cent.) or fair (25.6 per cent.). Taking the clinical histories together with the pathological findings, in over half the cases the combined evidence pointed to an ulcer as the lesion, upon which a carcinoma had been engrafted. If, therefore, "ulcer is the great and fertile soil of cancer," a strong argument may be advanced in favor of what appears at first sight the more radical procedure. As to the relative mortality, I doubt whether in benign conditions the mortality following the excision of the pyloric portion of the stomach be much, if any, greater than after gastrojejunostomy, and the expectation of life should be greater because the favorite seat and a common predisposing cause of carcinoma has been removed. Rodman (*Journal of the American Medical Association,* 1906, vol. ii, p. 842) found but one death in a series of 31 pylorectomies for ulcer in the hands of five surgeons.

The second of the two cases included in this report was a gastric carcinoma. The patient was fifty years of age. According to her statement she had not observed any trouble with her digestion till seven months ago. She then began to complain of pain in the epigastrium and soon to vomit one or two hours after meals. The subsequent course of events, taken together with the presence of an easily palpable tumor in the pyloric region, and the gastric analysis, all suggested carcinoma of the pylorus. As the tumor was movable and the patient's general condition good, the case seemed quite favorable for a radical operation, and when the stomach was exposed at the operation this proved to be the case. The tumor had not spread beyond the pyloric portion of the stomach wall and had invaded but few lymph nodes. Accordingly, a partial gastrectomy was performed, the tissue removed including 1 inch of the duodenum, all that portion of the stomach up to the Mikulicz-Hartmann line, and the palpable lymph nodes. As in the first case, a gastrojejunostomy was effected with a Murphy button.

The recovery from the immediate effect of the operation was as satisfactory as one would have hoped for. At the end of a week the patient was sitting up in bed, had not vomited since the operation, and relished the food on her dietary. Two days later, however, she began to vomit and to complain of gastric distress; there was a little distention of the abdomen, but no rigidity or tenderness. The bowels were very loose and did not respond to any internal medication. The temperature meanwhile had been normal. Twelve days after the operation the patient began to fail very rapidly and on the fourteenth day she died.

An examination post mortem discovered almost a complete separation of the line of union between the stomach and jejunum. The Murphy button had passed on some two or three feet beyond the site of anastomosis. This result was quite unlooked for, and

it was the first unfortunate experience which I have had with the Murphy button, in so far as concerned the union of the apposed surfaces. Whether it was due to some mechanical defect in the button or to imperfect blood supply of that portion of the stomach at which the button was introduced, is a matter only of speculation. Had I not taken steps to prevent separation by the introduction at intervals of three or four interrupted sutures around the button I should have attributed the accident to an error of technic. In both of my cases the same technic was followed; the steps of the operation corresponded to the method of Billroth, in which the stump of the duodenum is completely closed and an independent gastrojejunostomy is performed. In neither case were there any technical difficulties; the pyloric end of the stomach was easily isolated, the gastric and superior pyloric arteries on the lesser curvature and the gastroduodenal and the inferior gastro-epiploic artery on the greater curvature ligated. Care was taken to avoid the middle colic, since occlusion of this vessel causes gangrene of the transverse colon. Clamps were applied to the stomach and duodenum, the intervening portion resected and the operation concluded in the conventional way.

The diagnosis of cancer of the stomach has been touched upon briefly already; suffice it to make two remarks with reference to the presence or absence of tumors. First, that on no account should there be any delay in recommending operation or exploration because of the absence of the tumor, since in a very considerable number in the early stage no tumor can be detected. Secondly, that the presence of a palpable tumor does not preclude the possibility of a radical operation. A small tumor near the pylorus on the anterior wall may be felt quite early in the course of the disease when it is still in the operable stage, whereas a large posterior cancerous mass may not be palpable until long after the time when it might have been removed.

The selection of the operation for gastric carcinoma depends upon whether a radical or palliative operation may be indicated. At first the operative treatment of gastric carcinoma consisted chiefly in palliative gastro-enterostomies, because cases were not seen in the curative stage. The surgeon's

experience with this operation has been most disappointing, both as to the mortality and as to the expectation of life. The Krönlein, Mikulicz, and Mayo statistics show that the average prolongation of life is only five months and that the mortality is from 15 to 33 per cent. At best there is but one chance in seven of getting over the operation, and then but five months more to live. Despite this wretched showing, the surgeon is quite justified in advising the operation when the patient is suffering intense pain, vomiting persistently and starving to death. I operated upon a patient of this description a little over a year ago; he was in a most forlorn condition, suffering intensely and emaciated to a degree. He survived the operation a little over a year, but in the meantime his gastric symptoms had been relieved, his vomiting ceased, he gained weight and one day he was carried off with an apoplectic seizure.

As compared with the discouraging results after gastro-enterostomy, there is an increasingly brighter outlook for partial gastrectomy. The mortality is (Mayo) in some hands only 10 per cent., and 25 per cent. of the operative recoveries live more than three years. Of the three most common locations of carcinoma—the stomach, the breast and the uterus—the stomach from the operative standpoint is the most favorable. Eighty per cent. or more are in the pylorus; this portion of the stomach is easily removed and a rich vascular supply guarantees repair of the visceral wounds. Of still greater significance is the distribution of the lymph nodes. These are so arranged on the lesser and greater curvature that they all lie to the right of the Mikulicz-Hartmann line, and can be removed easily by including with the pyloric end of the stomach portions of the gastrohepatic and gastrocolic omentum. For this reason in the treatment of malignant disease the stomach, as compared with the uterus or breast, is a much more favorable organ for operative intervention.

Dr. John B. Deaver said he was not surprised at Dr. Frazier's statement regarding the comparatively few cases of carcinoma recognized in the medical dispensaries. As long as

dispensaries are run in the slipshod manner they now are, there will be few cases referred from them. It is disappointing to think of the way these dispensaries are conducted, the patients being rushed through, this one ordered prescription No. 4, that one No. 6, and so on. At the German Hospital, Dr. Deaver diagnoses a fair number of cases of ulcer and cancer of the stomach which are sent to him, and no doubt his medical colleagues could do the same under proper circumstances.

He does not agree with Dr. Frazier as to the general value of the Murphy button. He has seen mishaps with it in cases of enterostomy, in spite of the fact that the nurse in charge was always careful to see that mechanically the buttons were all right. He has long since discontinued its use, which can well be done when there are still the various forceps and the needle and thread. The results in stomach resections in Dr. Deaver's hands are good.

What is more needed at the present moment than anything else is that either an earlier diagnosis be made, or, in the light of suspicious symptoms, abdominal incision recommended.

Dr. W. W. Keen, in speaking of the findings of the pathologist in Dr. Frazier's first case, said that when there was a difference between the pathologist's findings and the clinical history he was inclined to be guided by the latter in preference to the former, for the pathologist as well as the clinician makes mistakes. In Dr. Frazier's case where the microscope showed no carcinoma, in the speaker's opinion the clinical history pointed to the fact that carcinoma would have developed, and he showed good judgment in doing a pylorectomy.

In carcinoma of the stomach operation is often too long delayed. Adhesions often prohibit operation in cases where there is a palpable tumor. Dr. Frazier was fortunate in his first case in not finding adhesions so extensive as to prevent removal. In general, if in three or four months a gastric disorder becomes no better under careful treatment, abdominal section should be made. In this way carcinoma will be detected early before there is a palpable tumor, and relatively good results will be secured.

Dr. John H. Gibbon, in speaking of the differential diagnosis between indurated ulcer and carcinoma of the stomach, said there is nothing more difficult unless it is deciding whether to do a gastro-enterostomy when there is an ulcer at the pylorus. There are no rules for these cases. In a personal case reported

several years ago there was a palpable mass and he expected to find a cancer. He found a mass in the stomach and did a gastro-enterostomy, intending to do later a resection. The woman at once improved and to-day is well, the lesion evidently being ulcer instead of a cancer. Another case was exactly the opposite, cancer being present when the diagnosis of indurated ulcer had been made. The case, however, was inoperable and the patient died, there being cancer of the suprarenals also. Moynihan states that differentiating points are hardness and glandular involvement in cancer and more extensive adhesions in ulcers.

Dr. Gibbon does not agee with Dr. Frazier that partial gastrectomy is no more dangerous than posterior gastro-enterostomy; hence the importance of differentiating between ulcer and carcinoma. He also has had trouble with the Murphy button, particularly in a case of end-to-end anastomosis of the large bowel in which ulceration due to the button was followed by abscess behind the colon and death in five weeks. Murphy is now using an oblong button with the intestinal side larger and heavier than the other in order to prevent the accidents caused by the older form; but this is not appreciated by many, especially by foreign surgeons. Still, trouble may occur with the new pattern.

A palpable mass in the stomach does not always mean carcinoma, as shown by the presence of the ulcer in his case. Robson has shown that where there is a palpable mass one is justified in operating, although under such circumstances one feels that he is operating too late. Dr. Gibbon agrees with Dr. Frazier that in cases of cancer partial gastrectomy is preferable to posterior gastro-enterostomy. Although the latter gives great relief for a few weeks, improvement lasts only a short time.

Dr. Gwilym G. Davis said the referring of but few cases of early gastric cancer is not entirely the fault of the out-patient medical men, but is due partly to force of circumstances. Typhoid fever is so rife that admission to other cases is denied and hence chronic stomach affections that should be carefully studied have to be turned away. Dr. Davis agrees with those who eschew the use of the Murphy button, as he came to grief with its employment some time ago in an end-to-end anastomosis of the small intestine. If in a stomach lesion he believes he is dealing with cancer a radical operation is performed; if the lesion is regarded as an ulcer, he performs posterior gastro-enterostomy as being less dangerous than the former.

Dr. Frazier, in closing, mentioned a case somewhat similar to that of Dr. Gibbon's, as an example of the improvement and apparent restoration of health which may follow gastro-enterostomies. The patient was operated upon about four years ago for a tumor at the pyloric end of the stomach, which was believed to be carcinoma. He was very much emaciated at the time, owing chiefly to obstructive symptoms. A posterior gastro-enterostomy was done and the patient rapidly gained in strength and weight, and was apparently wholly restored to health; consequently the lesion is believed to have been an ulcer, although there was a distinct mass which was quite palpable before the operation.

As to the terms partial gastrectomy and pylorectomy, he thought that the term pylorectomy might now be employed to include not only resection of the pylorus, but resection of the pyloric portion of the stomach, that is, up to the Hartmann-Mikulicz line.

The unfortunate results in the second case of gastrectomy may not have been due to the use of a Murphy button. It is only fair to say that the button used in this particular case was found upon its removal at the autopsy to have been imperfect in its construction and mechanism. Whether or not this defect was responsible for the accident it is impossible to say, although perhaps it would be only fair to give the button the benefit of the doubt.

STATED MEETING, HELD APRIL 1, 1907.

The President, Dr. John B. Roberts, in the Chair.

(*a*) CHRONIC PANCREATITIS RESEMBLING CARCINOMA; (*b*) A SERIES OF BREAST CASES, BENIGN AND MALIGNANT; (*c*) A SERIES OF GOITRE CASES.

Dr. William L. Rodman reported these cases, with presentation of patients. The first patient was a man of 56, first seen one year ago when he was suffering from jaundice and marked cachexia. He had lost 15 pounds and his symptoms were suspicious of carcinoma though no positive diagnosis was made. Opening the abdomen revealed in the head of the pancreas a densely hard mass large as a fist. This appeared to confirm the suspicion of cancer of that organ, but because of the possibility of chronic pancreatitis the gall-bladder was drained. The man was out of bed on the second or third day and made an unusually rapid and gratifying recovery, drainage being kept up for 3 or 4 weeks. In the light of the results, the case is regarded as one of chronic interstitial pancreatitis, probably due to the habits of the man, who used alcohol freely.

Benign Tumors of the Breast.—Dr. Rodman next presented three patients illustrating the results of plastic resection of the mammary gland for benign tumors. He was greatly impressed by Dr. Warren's description of this method at the meeting of the American Medical Association in Portland, and has since employed it in 17 or 18 cases, regarding 15 of which he has full notes. Two of the patients shown were the first and last of the series. All did remarkably well. The diagnosis of benign growth was made in each instance and there has been no recurrence or evidence of malignancy in any of them. It should be remembered, however, that one cannot always be absolutely sure, hence the clinical diagnosis should always be supplemented by microscopic examination of the removed specimen, as the majority of mammary tumors are malignant and all of them potentially so. One of the patients was

in the second month of gestation when operated upon for a fibroadenoma the size of a goose-egg, the largest one seen. Theoretically an incision in the lower part of the breast, and turning up of the organ, might interfere with its blood supply, but this objection does not hold good in practice, as the blood supply comes mainly from above. The incision is made along the line of junction between the gland and the thoracic wall. One might think this method applicable only to tumors in the lower quadrants of the breast, but in most of Dr. Rodman's cases the growth was in the upper and outer quadrant. Such tumors can be reached, as the breast can be turned upward to the clavicle. Functional activity and usefulness have been preserved in all the cases operated upon. The pregnant patient referred to was the sister of a prominent German surgeon, who insisted that this operation be done. Dr. Rodman is better pleased with the operation the more he uses it and believes that the profession too often sacrifices the breast. One has no right to remove that organ in those who use or expect to use it.

Malignant Tumors of the Breast.—A second series included three cases of malignant tumor of the breast. The first is interesting for two reasons. The patient was the youngest he has operated upon for this condition, 25 years at the time of the operation 3 years ago. A second point is that last year he operated upon her mother for scirrhus. The second patient was operated upon in 1900 for a large carcinoma of the left mamma. The third has had both breasts removed, the first one 5 years ago for malignant disease, the other 2 years ago for a benign growth. The patient was so informed regarding the latter, but insisted upon complete removal, which revealed a large cyst with a small area of solid growth. Other interesting cases could not be shown. One was operated on in 1897, another in 1898, both for scirrhus, and both were in perfect condition a few months ago; the first had been operated upon twice before. A third case had been operated upon in 1899 and two others in 1900.

Goitre.—Finally Dr. Rodman presented two patients upon whom he had operated for goitre, of which he has had 7 cases within 3 months, one a large mediastinal growth. The first patient has also a goitre on the left side which was not removed, she nearly dying under ether when the right half was extirpated,

it being necessary to stop the ether three times. The woman was pregnant when first seen, operation being postponed until after delivery. Pressure was evidently made by the growth of right side, as difficulty in breathing has passed away and the patient is in all ways better than she was. She was so anæmic that malignant disease was feared, but the microscope showed this not to be the case. Case second was that of a large goitre upon which operation was deferred for a few weeks until the patient, who was profoundly anæmic, had been put in good condition. One of the silk ligatures has lately given some trouble, this being the only one of buried Pagenstecher ligatures, of which he uses 25 to 50 in each case, to cause any difficulty. A piece of the thyroid the size of the end of a finger was left. The patient has since gained eight pounds, a gratifying result. Dr. Rodman has never removed a goitre under cocain, as he is certain general anæsthesia is not so dangerous as many believe it to be. He would hesitate to attack such large goitres under local anæsthesia. He employs ether and puts the patient in the reversed Trendelenburg position, this aiding very markedly in the control of hæmorrhage.

Dr. Henry R. Wharton expressed his interest in the question of removal of non-malignant growths of the breasts. He has employed this method of turning up the breast in a few cases of small growth. The operation was first recommended by Thomas, of New York, and is very satisfactory, permitting removal of the tumor with little resulting scar.

Dr. Frazier said that he had used the Warren incision quite recently in two cases. In both instances the tumors were cystic and not solid. The first one proved to be a galactocele, the sac of which was dissected out in toto. In the second case a cyst of considerable size was exposed and removed through the same incision. Microscopic examination of the tissue adjacent to the cyst demonstrated the fact that the cyst removed was only a part of a general cystic mastitis. When this was discovered a second operation was performed, at which the entire breast was removed, together with a mass of enlarged glands near the anterior axillary fold. He was afraid upon finding these glands that a mistake might have been made in the diagnosis, but subsequent histological study proved that they were not malignant.

Dr. John H. Gibson said that until he witnessed Kocher's

operations upon goitre he thought his own failure to relieve pain with infiltration anæsthesia in these cases was due to a faulty technique, but that now he thinks this was not the case. Kocher's local anæsthesia consists entirely in an anæsthesia of the skin; the rest of the operation is carried on practically without an anæsthetic, and can only be borne by the Swiss peasants. Kocher himself admits that in the more highly cultivated and organized patients he is obliged to use a general anæsthetic.

MULTIPLE FRACTURES.

WITH AN ANALYSIS OF 240 CASES AND A REPORT OF SIX PATIENTS WITH MULTIPLE FRACTURES OF THE UPPER EXTREMITY.

BY ASTLEY P. C. ASHHURST, M.D.,
OF PHILADELPHIA.

VERY little is to be found in systematic works on surgery on the subject of multiple fractures; and, though there have been isolated reports of such cases, the subject, it seems to me, has not received the attention which it deserves. My own attention has been called to it from the unusual experience of having under observation at the Episcopal Hospital during less than five years, six patients with multiple fractures involving one upper extremity.

Malgaigne, almost alone among the writers of special monographs, consecrates some paragraphs to the questions of the frequency and prognosis of cases of multiple fractures. Among 2358 fractures from the records of the Hôtel-Dieu, he found 30 cases of multiple fracture, or 1.28 per cent. of the whole number. Among 5057 fractures which have been treated at the Episcopal Hospital within the last five years (1902–1906 inclusive), I have found records of 73 instances of multiple fractures, or 1.44 per cent.

According to Bruns, a series of 124 cases of multiple fractures was collected by Weber, Moritz, and Leisrink. Bruns found that among these patients the mortality was 40 per cent., no cases, of course, being included in which the original injury produced immediate death. The rarity of multiple fractures is due to this very fact, that so many patients die almost immediately after the injury. Among the 73 cases at the Episcopal Hospital, there were 20 deaths, a mortality of 27.4 per cent. In calculating this percentage, not only have cases of crush of the extremities, calling for immediate amputation, been excluded from the list, but those patients admitted in a state of

profound shock, and dying in a few hours without reaction, have also been omitted; so that I think it is fair to conclude that 27 per cent. is close to the true mortality at the present day from multiple fractures themselves, without the added deaths that would be attributed to lesions of the brain and internal organs.

For the sake of comparison, the mortality of fractures in general may be seen from the following figures, which show that multiple fractures are just about ten times more dangerous than others:

PROTESTANT EPISCOPAL HOSPITAL, CASES OF FRACTURE 1902–1906.

Year.	Cases.	Recovered.	Died.	Mortality per cent.
1902	943	910	33	3.5
1903	927	899	28	3.0
1904	954	931	23	2.4
1905	1114	1088	26	2.3
1906	1119	1094	25	2.2
Total	5057	4922	135	2.7

Multiple fractures in general may be conveniently classified in three groups, as follows: I. Fractures of the skull or trunk and the extremities; *e.g.*, of the pelvis and the thigh, of the skull and the arm, of the spine and the foot, etc. II. Fractures of different extremities, including (*a*) Similar fractures, *e.g.*, of both legs, of both forearms, of both clavicles, etc.; and (*b*) Dissimilar fractures, *e.g.*, of the leg and the forearm, of the arm and the thigh, of the thigh and the opposite leg, etc. III. Multiple fractures confined to one extremity, as of the femur and one or both bones of the leg; of the humerus and one or both bones of the forearm, etc.

It is not usual to consider a fracture of two or more parallel bones, as of the ribs, or both bones of the forearm, or of the leg, as an instance of multiple fracture; still less should a comminuted fracture, or even a multiple fracture of a single bone, be so considered. The latter injury is more correctly designated as a double fracture, a triple fracture, etc.

The accompanying table gives the distribution in 240 cases of multiple fractures, which have been collected from the following sources: Malgaigne, 30 cases; Index Catalogue of the Surgeon-General's Office, Series I, 100 cases; Series II, 37 cases; Records of the Episcopal Hospital, 73 cases.

DISTRIBUTION OF MULTIPLE FRACTURES.

	Malgaigne.	S.G.O.,I.	S.G.O.,II.	P. E. H.	Total.	Per cent.
I. Skull and extremities	7	13	8	11	39	16.25
Trunk and extremities	3	38	6	10	57	23.75
Skull and trunk	1	8	3	1	13	5.41
Trunk alone	0	5	3	2	10	4.20
II. Different extremities:						
Similar lesions	10	6	6	7	29	12.08
Dissimilar lesions	6	20	9	35	70	29.16
III. One extremity:						
Upper extremity	0	7	1	7	15	6.25
Lower extremity	3	3	1	0	7	2.90
Total	30	100	37	73	240	100.00

In addition to the above cases, Dr. W. J. Taylor and Dr. H. R. Wharton have each reported a case of such extensive multiple fractures that they deserve a class to themselves. Dr. Taylor's patient, who recovered, had in the left upper extremity fractures of the humerus through the surgical neck and through the middle of the shaft, and also of the radius and ulna close to the wrist; while in the right upper extremity she had a T-fracture involving the condyles of the humerus, a fracture of the radius and ulna in their upper third, and of the radius in its lower third. Dr. Wharton's patient, besides a compound fracture of the nose, had a fracture of both bones of each forearm, and a fracture of both thighs; he did well for a week, and then died rapidly, possibly of fat embolism.

The mortality of the various combinations of fracture may be seen in detail in the following analysis of the Episcopal Hospital cases:

MORTALITY OF MULTIPLE FRACTURES AT THE EPISCOPAL HOSPITAL, 1902–1906.

	Total.	Rec.	Died.	Mortality per cent.
I. Of skull or trunk, and extremities:				
1. Skull and { Upper extremity..	6	6	0	.....
1. Skull and { Lower extremity..	5	2	3	60.00
2. Trunk and { Upper extremity..	8	3	5	62.50
2. Trunk and { Lower extremity..	2	1	1	50.00
3. Skull and trunk	1	0	1	100.00
4. Trunk alone	2	2	0	.....
II. Of different extremities:				
1. Similar Lesions:				
Both forearms	3	3	0	.....
Both femora	2	0	2	100.00
Both legs	2	2	0	.....
2. Dissimilar Lesions:				
Upper and lower extremities.	20	15	5	25.00
Both upper extremities	6	6	0	.....
Both lower extremities	9	7	2	22.50
III. Confined to one extremity:				
Upper extremity	7	6	1	14.30
Lower extremity	0	0	0	.....
Total	73	53	20	27.4

The great amount of violence which attends the production of all these fractures makes the prognosis necessarily grave, and renders the prospect of recovering useful limbs more dependent upon the character of the injury than upon the treatment employed. When the head or trunk is involved, the injury is more apt to be due to a fall from a height, or to the patient being caught in machinery and tossed against the walls of the room. It is often due to the patient being struck and thrown by a locomotive or a trolley car. In the second class the patient is more apt to have been injured by a crushing force, as the passage of a wheel over the extremities, or the fall of a heavy beam. In the third class, which is the smallest of all, and to which all of the patients reported to-night belong, falls and machinery accidents hold about equal place. In the 18 examples of this injury which it has been possible to find recorded, the cause in 4 is unknown; in 7 the patients were caught in revolving machinery, in 5 they were injured by falls,

and in 2 the accident was due to their being knocked down, run over, and dragged by moving vehicles.

In such severe injuries as these it is frequently impossible to do more for the patients when they are first admitted than to combat the shock. Thus in one of the cases reported to-night, reduction of a dislocated hip was not accomplished until the third day after admission; and in another patient over three weeks elapsed before his precarious condition made it seem advisable to have him removed to the second floor for skiagraphic examination. It is on this account that accurate coaptation of the fragments cannot always be obtained, as well as for the reason that the injuries to the soft parts are often of more pressing importance.

The chief difficulty in the treatment of multiple fractures involving the upper extremity consists in the fact that many of these patients are necessarily confined to bed for a number of weeks after the injury, and that therefore deformity in the humerus is hard to prevent, since the weight of the forearm, which is available in the ambulatory treatment of fractures of the humerus, cannot be used when the patient is confined to bed. This fact, together with the absolute obliteration of all landmarks from œdema, was the cause in Case I of the projection of the lower fragment at the shoulder joint, so as nearly to penetrate the skin, necessitating excision. In Case III the muscular contraction was so violent and spasmodic that even the use of weight extension to the lower fragment of the humerus, while the patient was in bed, suggested by Dr. Hutchinson, together with heavy shot bags over the seat of fracture, was not sufficient for a long time to keep the fragments in position.

In spite of the gravity and extent of the injuries, if once the patient survive the immediate effects of the accident, there is no good reason why union of the fractures should not occur, and the limbs prove eminently useful. Indeed, Dupuytren contended that the very multiplicity of the fractures tended to promote rapid healing, since the pain, discomfort, and inflammatory reaction are distributed among many parts, instead

of being concentrated in one: somewhat upon the same principle, I suppose, that it is said a man does not feel the dentist treading on his toe while his tooth is being pulled. Dupuytren says (I quote from Packard's translation of Malgaigne) "that the danger of wounds and fractures, although doubtless increased by an increase in their number, is still not in direct ratio with that number. At first sight, one would presume that several fractures complicating one another would naturally react unfavorably, each one thus giving rise to graver symptoms than if it had occurred alone. Now, the contrary is true; when there are several fractures, each one induces slighter symptoms than if it were by itself; and Dupuytren, after at first viewing this fact with astonishment, became assured of it, and looked for it subsequently, as natural and to be expected." These remarks of Dupuytren prove the correctness of that saying of Heister: *"In prædicendis fracturarum eventibus magna utique chirurgis opus est circumspectione."*

I am indebted to my chiefs at the Episcopal Hospital for permission to report the following cases. The first four, in the services of Drs. Neilson, Deaver, and Harte, came under my care as resident; and the two last were treated this winter in the out-patient department:

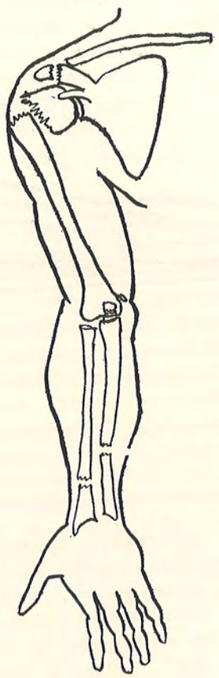
Case 1.—Michael C., 15 years (P. E. H. No. 867), admitted May 6, 1902, had fallen 40 feet from the side of a ship where he was at work, landing on the dock. *Diagnosis:* Fracture of both bones of forearm, in lower third (compound of ulna); fracture of olecranon; fracture of internal epicondyle of humerus; high fracture of surgical neck of humerus; fracture of acromion process of scapula; shock. The fractures all involved the right side. The dressing consisted of a Bond splint, an axillary pad and a shoulder cap of binder's board; the arm was bandaged to the chest, the elbow being extended and the forearm in supination. The dressings were changed every other day at first, owing to the very great œdema. Ice-caps were applied to the arm from shoulder to elbow. The œdema in a few days became so great that it was uncertain whether gangrene might not ensue.

May 11.—The œdema is less. The wound of compound fracture of ulna is healing.

May 22.—Union progressing. Bone projecting beneath skin of shoulder thought to be comminuted acromion. Shoulder very black and blue. No landmarks palpable yet.

May 29.—Anterior obtuse angled splint, and posterior straight splint to forearm. Binder's board shoulder cap as before.

Fig. 1.



Case I.—Fracture of acromion, of surgical neck of humerus, of internal epicondyle, of olecranon, of radius, and compound fracture of ulna.

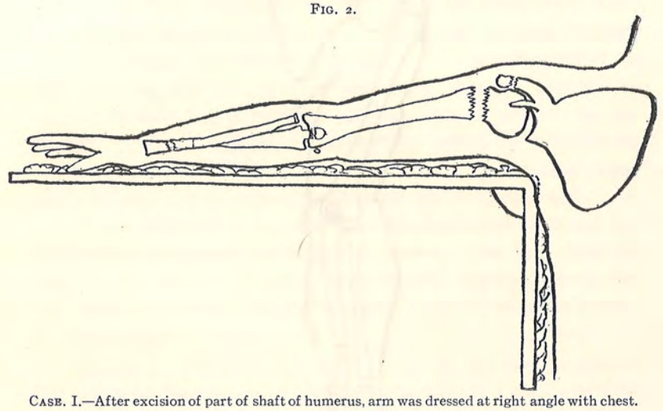
Union apparently firm throughout. At normal site of coracoid process, below clavicle, is a bony prominence, apparently too large for coracoid, but it seems hardly possible that it is the head of humerus in subclavicular dislocation. The comminuted acromion moves with, and seems immovably fixed to shaft of humerus.

June 1.—Skiagraph of shoulder joint shows high fracture of surgical neck of humerus, upper end of lower fragment almost jutting through skin below acromion. The head of humerus is apparently in glenoid cavity. (Fig. 1.) Out of bed in wheel-chair.

June 3.—Walking about ward. Four weeks since injury.

June 5.—*Operation:* Partial excision of right humerus, by Dr. Thomas R. Neilson. Ether. Incision in line of deltoid fibres from acromion down about 5 inches. Muscular fibres separated and bone bared. Shaft of humerus united by fibrous

FIG. 2.



CASE. I.—After excision of part of shaft of humerus, arm was dressed at right angle with chest.

union in malposition with head of humerus. Fracture below anatomical neck. Fragments separated, shaft turned out through wound, and about 1½ inches excised, subperiosteally, with saw and nippers. End of shaft returned and fractured parts put in good position. This was accomplished by abducting the arm to a right angle with the body. (Fig. 2.) Iodoform gauze drain, silkworm gut sutures. Arm dressed in semipronation, and held at right angles with body by long right angled splint. Short posterior splint to forearm, and shoulder cap of binder's board.

June 6.—Dressings reinforced on account of bloody ooze. Much pain all night, none to-day.

June 9.—Dressed. Parts in excellent condition; about half

of gauze drain removed. The fractures of forearm show slight anterior bowing. No special dressing for olecranon.

June 12.—Dressed. Drain entirely removed. No oozing.

June 15.—Dressed. Looped stitch at site of drainage tightened. All other sutures removed.

June 19.—Arm put at angle of 45° with body, with acute angled anterior splint in axilla. Slight anterior prominence of head of humerus corrected by a pad.

June 22.—Out of bed. While in bed lay very quietly on back. The best patient I ever had.

June 24.—Dressed with obtuse angled internal angular splint. Considerable pain in flexing elbow to this extent—about 135°.

June 30.—Dressed with right angled internal angular splint (Physick splint).

July 2.—Fergusson's dressing for fractures about shoulder. No splint to forearm, which is carried in bandage sling at wrist.

July 3.—Discharged cured; to return to Dispensary for occasional dressings.

February 20, 1907.—Returned in answer to letter. All functions of upper extremity are perfect, including rotation of forearm, and external rotation of humerus. From the left acromion to the head of the radius measures 29.5 cm. On the injured side the distance is 26.5 cm. There is no visible or palpable deformity anywhere. The patient, now a grown man, does heavy laboring work, and would not know his arm had ever been injured, except that it is a little shorter than the left, and he is therefore obliged to have his clothes made to order.

CASE 2.—E. B., 38 years (P. E. H. No. 1083), admitted June 1, 1902, was a fireman, and had fallen from a ladder. The height is not known. *Diagnosis:* Fracture of radius in lower third, fracture of the olecranon, and high fracture of surgical neck of humerus, all on the right side. *Dressing:* A straight anterior and short dorsal splint to forearm, the fracture of humerus being masked by great swelling.

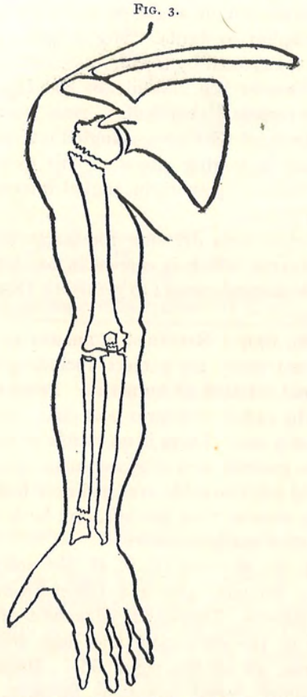
June 5.—Skiagraph shows fracture of shoulder. Dressed with long straight anterior splint, from axilla to finger tips, and short dorsal splint to forearm, which was held in semipronation; shoulder cap of binder's board, and arm fastened to chest by broad binder. Lies on back very quietly. Redressed from time to time.

July 2.—Out of bed, elbow still in full extension.

July 3.—Obtuse angled internal angular splint applied; short posterior splint to forearm, and shoulder cap.

July 5.—Right angled internal angular splint, other dressings as before.

FIG. 3.



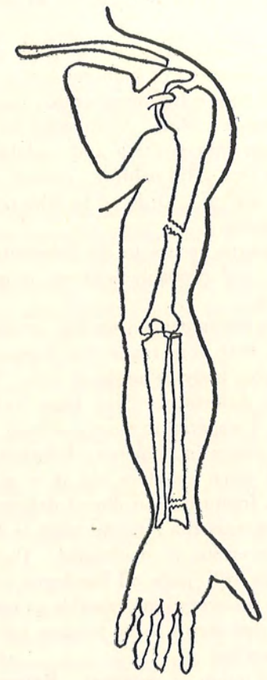
CASE II.—Fractures of surgical neck of humerus, of olecranon, and of radius.

July 7.—Fergusson's dressing applied. Over 5 weeks since injury; all fractures firm, little deformity. Discharged.

It has been impossible to trace this patient.

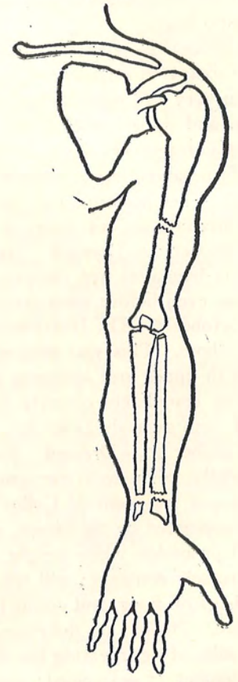
CASE 3.—J. C., 38 years (P. E. H. No. 2029), admitted September 27, 1902, was a pipe-fitter, and fell 40 feet from scaffolding, striking earth with left arm and shoulder. No unconsciousness. On admission: mind clear, considerably shocked. *Diagnosis:* Fracture of humerus below insertion of deltoid, and Colles's fracture of radius, both on left side; dislocation of right femur into ischiatic notch, where head of bone is easily felt:

FIG. 4.



CASE III.—Fracture of L. humerus below insertion of Deltoid, and Colles's fracture of L. radius. (Also dislocation of R. hip.)

FIG. 5.



CASE IV.—Fracture of L. humerus below insertion of Deltoid; Colles's fracture L. radius, and fracture of L. ulna, lower fifth.

shortening 1½ inches, adduction, and inversion of the affected limb. Deformity of fractures easily corrected by extension and manipulation. *Dressing:* Bond splint to forearm; short internal splint to humerus, with shoulder cap of binder's board. Dislocation of hip not reduced on account of shock.

September 28.—Patient has reacted well. Under ether an unsuccessful attempt made to reduce dislocation by flexion and circumduction.

September 30.—Dr. Harte, with Drs. Neilson and Deaver in consultation. Patient again etherized, and hip successfully reduced by manipulation and vertical traction. Buck's extension and sand bags.

October 1.—Arm dressed. Colles's fracture in good position, forearm in semipronation. Fracture of humerus below deltoid in very bad position indeed, lower fragment drawn up into axilla, and upper jerking out against skin. With considerable difficulty fragments were brought into position and maintained with firm bandaging of shoulder cap. Hip painful. Patient very restless. Temperature 100° to 101° F. Ordered to take potassium bromide, gr. xx, every 3 hours.

October 4.—Dressed. Humerus recurs to its deformity as soon as bandages are removed, and probably was not in good position even before unbandaging.

October 5.—Dr. Hutchinson recommended weight extension from elbow. This was applied, with forearm in full pronation, and with upper arm abducted from body to angle of 45°. This dressing completely corrects the deformity. Shot bags laid on top of arm, over shoulder cap. Temperature nearly normal.

October 10.—Dressed. No union in humerus; deformity is apparently fairly well corrected when shoulder cap is in place. The upper fragment of Colles's fracture is in dorsal deformity, being supinated by the biceps, whereas the forearm must be kept in full pronation while weight extension is maintained. Patient is extremely contrary; will not lie still, pulls off bandages, kicks sand bags on floor, and seems to do everything possible to retard his cure. He has no delirium, and seems to be restless for the mere sake of aggravating his disorder.

October 17.—Dressed; some union of humerus. Extension to arm continued. Deformity less. Patient very much quieter. Hip extension removed. Three weeks since injury.

October 24.—Dressed. Four weeks since injury. Radial union good; position good; wrist a little stiff. Lower fragment of humerus still tends to draw upwards and inwards. Patient of model deportment.

October 31.—Extension removed from arm. Five weeks since injury; 26 days since extension was applied to arm. Union in humerus quite firm. Little visible deformity; fair amount of callus. Arm brought in to side of chest; Bond splint left off; elbow flexed with difficulty to nearly a right angle; and a modified Fergusson's dressing applied. During use of extension to humerus, forearm was at angle of about 105° with arm, and elbow is now quite stiff. Sitting up makes patient faint and giddy. Right knee and leg feel somewhat numb. Functions normal, no pain at hip.

November 14.—Soon after last note got out of bed, and to-day was discharged.

February 19, 1907.—Returned in answer to letter. Still employed at Cramp's ship-yard, and says his arm is perfectly useful. There is no noticeable deformity. There is 0.5 cm. shortening in the fractured humerus, none in the forearm. No callus felt anywhere. Can completely extend elbow, but flexion beyond 80° is impossible. Pronation of forearm is complete, but supination is only about three-fourths complete—that is to say, there is rotation of about 135° instead of 180°.

Case 4.—A. W., 65 years (P. E. H. No. 2387), admitted November 12, 1902, fell against the steps of the house where she lodged, while intoxicated. History of accident is incomplete. *Diagnosis:* Fracture of humerus below insertion of deltoid, Colles's fracture of radius, fracture of ulna in lower fifth—all on the left side; acute alcoholism, general contusions, acute bronchitis, lacerated wound of left eyebrow. *Dressing:* Bond splint, forearm in full supination; elbow extended; shoulder cap, axillary pad, arm bandaged to side. Lies on back in bed.

November 14.—Developed delirium tremens.

November 15.—Dressed. Fractures in fairly good position.

November 17.—Dressed. Delirium tremens worse.

November 29.—Pulse failing.

December 1.—Chill. Temperature 105.6° F.

December 2.—Diffuse bronchitis. Dressed.

December 6.—Stuporous. Temperature 101° F.

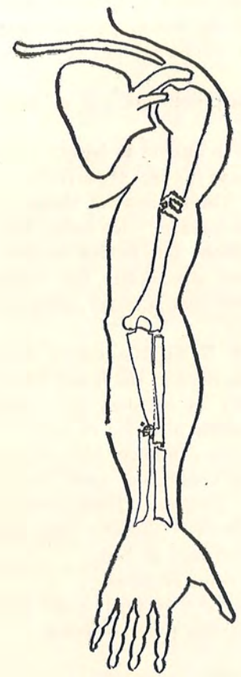
December 7.—Uræmic. Urine very scanty. Temperature 103.4° F. Fractures united in good position.

December 11.—Died. Temperature 108° F.

Case 5.—H. D. E., 57 years (P. E. H. No. 3579), admitted November 26, 1906. Was knocked down and run over by coal

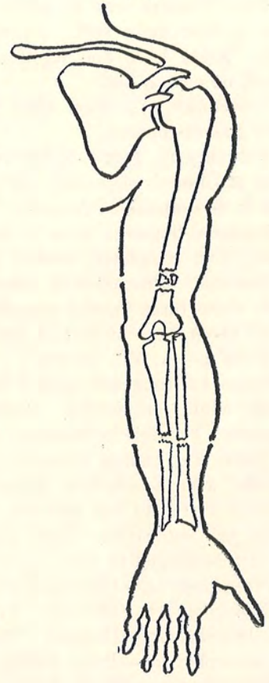
wagon, while intoxicated. Admitted in semi-conscious condition. *Diagnosis:* Lacerated scalp, comminuted fracture of left humerus above insertion of deltoid; compound comminuted fracture of both bones of left forearm in middle third. Seen in Dispensary 5 days later, with no union of any of the fractures, overlapping of fragments of humerus, and deformity of forearm. Forearm was dressed in full supination, with long palmar and short dorsal splints; moulded coaptation splints of binder's board to humerus, with shoulder cap of same material, and arm bandaged to chest.

FIG. 6.



CASE V.—Comminuted fracture of L. humerus, above insertion of Deltoid; compound comminuted fracture of both bones of L. forearm.

FIG. 7.



CASE VI.—Compound comminuted fracture of L. humerus, lower third; compound fracture of both bones L. forearm.

Wrist supported by sling. Progress of case uneventful. Forearm alone was redressed December 10, and whole upper extremity redressed on December 13. All fractures were then found to be knitting. Redressed December 20 and December 27, on which latter date all fractures were found solid. There was considerable deformity from œdema below elbow, and apparently some outward bowing of bones of forearm. Only the long palmar splint and the shoulder cap were replaced.

January 5.—Dressed. Long splint on ulnar side of forearm, short dorsal splint, and a third splint on external (radial) surface, to overcome the outward bowing.

January 8.—Œdema much less. Lower fragment of radius apparently united to upper fragments of both radius and ulna, leaving lower fragment of ulna partially ununited. Same splints continued. Skiagraph made laterally shows some dorsal displacement of both lower fragments.

January 15.—Ulna seems firmer.

January 22.—Radius very firm. Skiagraph made anteroposteriorly confirms notes made January 8.

February 1.—Ulna is decidedly firmer. Rotation of about 45° from full supination. Only long dorsal splint continued.

February 12.—Referred to Orthopædic Hospital (Dr. G. G. Davis) for massage and passive motion.

February 23.—Can almost make a fist. Rotation a little more extensive. To continue treatment.

March 25.—Has been working as usual, for some weeks, at saw-making. Finds little disability from injury. There is considerable deformity in forearm, the bones being bowed to radial side. Rotation a little more extended. Can make a fist. Strength is normal.

CASE 6.—A. M., 14 years (P. E. H. No. 3860), admitted December 22, 1906. Caught in belting, carried around and thrown to ground. *Diagnosis:* Compound comminuted fracture of left humerus in lower third; compound comminuted fracture of both bones of left forearm at junction of middle and lower third. Seen in Dispensary nine days later. Some union in forearm, but both bones were bowed to ulnar side. No union in humerus, the lower fragment being drawn up and back by triceps, upper fragment being pulled forward and in by deltoid and muscles of axillary folds. Dressed precisely like Case 5.

January 9.—Dressed. Position of all fragments excellent. Wound over inner surface of humerus healing, that over ulna scabbed. Fair union in all fractures.

January 16.—Dressed. All fractures firm. Moderate amount of callus over humerus; wounds all healed solid. Rotation of forearm from full supination to mid-pronation good.

January 23.—Dressed.

January 30.—Dressed. Long dorsal splint and shoulder cap only. All fractures solid, and motions good.

February 6.—To wear only a handkerchief sling. All functions perfect, except extension of elbow, which is possible only to 140°.

February 16.—Elbow can be extended to 150°.

March 2.—Arm normal in every respect, but elbow can be extended only to 165°, owing to callus around comminuted fracture of humerus.

N.B.—Patients 1, 5 and 6 were exhibited to the Philadelphia Academy of Surgery, April 1, 1907.

For the sake of completeness the following abstracts of cases of multiple fractures confined to one upper extremity are added. These, with the six original cases just reported, comprise all examples of this injury it has been possible to find.

7. Alquié (Gaz. Méd. de Montpel., 1846–1847, vii, 84). Fracture of clavicle and humerus. (Access has not been had to this journal.)

8. Blum (Arch. Gén. de Méd., 1887, xx, 214). Patient caught in revolving wheel: compound comminuted fracture of left humerus, fracture of left radius, and compound fracture of left ulna. Shoulder joint amputation on third day for traumatic emphysema. Recovered.

9. Davis, G. G. (Records of Episcopal Hospital, Phila., No. 320 of 1906). Male, 14 years, caught in revolving machinery. Admitted January 27, 1906. Shock; transverse fracture of left humerus in lower third, fracture of both bones left forearm in upper third, compound fracture of both bones left forearm in lower third, compound fracture of several fingers. Dressed on posterior splint; irrigation for 1 week. Recovered with good rotation of forearm, and flexion and extension of elbow. Discharged March 8, 1906.

10. Green (N. Y. Med. Record, 1880, xvii, 538). Caught in a revolving wheel: fracture of left humerus through surgical neck and in lower third; fracture of left ulna in upper third; compound fracture of left radius and ulna in lower third. Dressed in plaster of Paris; elbow in full extension for a week, then flexed to right angle. Recovered with good functions.

11. Laborie (Bull. Soc. de Chir. de Paris, 1866–1867, 2 sér., vii, 297). Patient seen 3 months after injury, which had produced multiple fractures of right scapula, clavicle and humerus, and a posterior dislocation of right shoulder. Fractures all had united except in humerus, where false joint persisted.

12. Mariani (Rev. de Med. y Cirug. práct., Madrid, 1882, vi, 110). Double comminuted fracture with wound of forearm and arm. (Access has not been had to this journal.)

13. Nicholls (Lancet, 1873, i, 877). Knocked down and dragged by horses: fracture of left humerus above deltoid, compound fracture below deltoid; posterior dislocation of left elbow, and fracture of both bones left forearm in middle third. Dressed in full extension for three days; splints then abandoned on account of œdema. Recovered with much deformity and poor function.

14. Packard (Internat. Encyclop. of Surg., Ashhurst, Revised Ed., N. Y. 1888, V. iv, p. 18). Male, 22 years, caught around a revolving shaft: fractures of humerus, radius, ulna, and metacarpus. Recovered with almost perfect functions.

15. Pezevat (Jour. Compl. du Dict. des Sc. Méd., Paris, 1831, xl, 276). Caught in revolving wheel: fracture of left clavicle, posterior dislocation of left elbow, and fracture of both bones of left forearm in lower third. Arm laid on pillows; recovered with fair function.

16. Robertson and Fifield (Bost. Med. and Surg. Jour., 1877, xcvii, 570). Fall; fracture of right humerus above condyles, Colles's fracture of right radius. Dressed in full extension: good recovery.

17. Schwartz (Bull. et Mém. de la Soc. de Chir. de Paris, 1904, xxx, 1102). Fracture of surgical neck of humerus, and fracture of lower extremity of radius. Plaster cast to forearm; and on sixteenth day after injury weight extension to humerus. Union reported progressing.

18. Since the above was written there has been admitted to the Surgical Dispensary of the Episcopal Hospital, another patient with multiple fractures of the upper extremity, for notes of which I am indebted to my Resident, Dr. Price. Male, 20 years, was caught in a revolving shaft on March 16, 1907. He sustained fractures of the left humerus in lower third, and of both bones of left forearm in middle third. He was treated precisely as were Cases 5 and 6: progress satisfactory.

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Bruns. Die Lehre von den Knochenbrüchen, Stuttgart, 1886 (Deutsche Chirurgie, Lieferung 27), S. 116.
Dupuytren. Gazette Médicale, 1832, iii, p. 394.
Malgaigne. Treatise on Fractures (Packard), Philadelphia, 1859, p. 76.
Taylor (W. J.). Times and Register, Phila., 1893, xxxvi, 387.
Wharton (H. R.). Times and Register, Phila., 1893, xxxvi, 388.

Dr. John H. Jopson cited a case of multiple fractures treated in the Presbyterian Hospital as an illustration of the shock that

results from such injuries. An Italian was thrown from a wagon and sustained a fracture of the pelvis, the shaft of the humerus, one or both clavicles, and a Pott's fracture. The fracture of the humerus was complicated by paralysis of the musculo-spiral nerve. Shock was great and prolonged, but the patient made a good recovery. There is now under his care in the Children's Hospital a child referred because of supposed rachitic deformities, who was found to have a fracture of the right thigh, both bones of the right leg, and both bones of the left leg, evidently of rachitic origin, and with no history of traumatism. All surgeons are familiar with multiple fractures due to carcinoma. In Dr. Jopson's experience, the double Colles's fracture is the commonest example of multiple fracture encountered.

Dr. George G. Ross mentioned two cases of multiple fractures. One was in a woman of 65, weighing 250 pounds, and included a fracture of the middle of the shaft of the right humerus, a Colles's fracture of the right side and a Colles's fracture of the left side. The patient recovered. The second case was a multiple fracture of the upper extremity, including a fracture of the middle of the humerus and what corresponded to a Colles's fracture on the same side, though there had previously been a fracture in that location. The man was violently drunk and no history could be obtained. There was great trouble in controlling the upper fracture.

Dr. William J. Taylor cited the case of a woman who had a fracture of one patella wired by another surgeon and afterward came to him with a fracture of the other patella. He wired that one, but soon after recovery the woman got drunk and refractured it, the bone breaking at the line of union and also in three other places. It was again wired, but the woman again got drunk and fractured the patella a third time.

Dr. Richard H. Harte said, regarding the question of repair in these cases, he has noticed in a number of instances that nature appears capable of carrying on only a certain amount of repair; that is, multiple fractures do not unite so quickly as do single fractures. When three bones are broken some one of them will remain practically without union until the others have united, and will then unite in the ordinary manner. It might be said that something was between the fragments preventing union, but that is not the case; the tissues simply lie dormant while the others are healing, and then union promptly occurs. He is surprised that such a close observer as Dupuytren should state that multiple fractures unite as readily as does a single fracture.

Dr. Ashhurst, in closing, said that Dr. Harte had apparently misunderstood his reference to Dupuytren's statements. The latter had referred to the union of multiple fractures with less inflammatory reaction in each than is ordinarily the case where only one fracture is present; and by inflammatory reaction Dupuytren no doubt understood the formation of excessive callus, as well as profuse suppuration, the latter of course being a much more prominent feature of compound fractures in Dupuytren's time than it has become since the general adoption of antiseptics. In Dr. Ashhurst's fifth case union did not begin in the forearm until that of the humerus was quite firm. Dr. Ashhurst thought the treatment adopted by Dr. Neilson in the first case reported was interesting in connection with the attempts now being made to secure union in ununited fractures of the neck of the femur without screw or wire fixation, by freshening the bone fragments and then dressing the thigh in a plaster cast in the position of extreme abduction. In the humerus thus treated (Case 1) firm union had occurred without difficulty, and in at least one case of fractured femur of which Dr. Ashhurst was cognizant, a patient under Dr. Davis's care, the same result was obtained.

RHINOPHYMA.

Dr. John H. Gibbon exhibited a case of rhinophyma upon which he had operated. The patient was 57 years of age. The condition had gradually developed in about 4 or 5 years. The lateral aspects of the lower portion of the nose were covered with large pedunculated masses of hypertrophied tissue. The whole lower half of the nose was involved, although over the central portion there were none of the pedunculated tumors.

Dr. Gibbon removed all of the hypertrophied tissue with a scalpel, shaving off the outer layers of the skin over the whole involved area. The bleeding was quite profuse and there was an escape of a large amount of sebaceous material from the divided ducts and glands. The bleeding was controlled simply by pressure. The patient left the hospital without a dressing at the end of a week, and in two weeks the entire area was covered by new skin.

GALL-STONES WITH SUBACUTE PANCREATITIS.

Dr. Edward B. Hodge reported the case of a man, aged 27 years, who was admitted to Dr. J. H. Musser's service at the Presbyterian Hospital October 30, 1906. Nausea, vomiting, sharp epigastric pain of 12 hours' duration. Subject to similar attacks for some years. Never had typhoid fever. Examination showed moderate distention, slight rigidity of upper right rectus, distinct tenderness in the epigastrium, most marked over gall-bladder. Pain extends to the left side, but not to the back or shoulder. Later, gall-bladder could be felt and slight transient jaundice developed. Highest temperature, 101.4°; pulse, 100; respiration, 20.

Two weeks later, after attack had subsided, operation was performed in Dr. DeForest Willard's service. Right rectus incision. Very extensive fat necrosis in omentum, mesentery, and subperitoneal fat. Collection of purulent material between gall-bladder, liver, and pylorus, amounting to about 2 oz. Gall-bladder not distended, and containing one large and a dozen small stones. Dense adhesions about gall-bladder, ducts, pancreas, and pylorus. No stones felt in common duct. Pancreas hard and head as large as a fist. Tube drainage of gall-bladder with gauze to abscess cavity and right kidney pouch.

Drainage never very free, but patient did very well until tube was removed at end of three weeks. Then followed fever, enlargement of liver dulness, and slight jaundice, subsiding in a week. This was followed by an attack of pleurisy at the left base and later by the discharge from drainage sinus of numerous pieces of necrosed tissue, reported from the laboratory as probably fat necrosis. This continued for several weeks with general condition poor. Exploration of sinus and aspiration of left chest negative.

Second Operation.—Incision through scar. Adhesions freed. Cystic duct followed down to junction with hepatic, and found kinked and strictured. Hepatic and common duct unobstructed. Cholecystectomy; tube drainage of hepatic duct through stump of cystic. Fat necrosis very much reduced, though some small areas still present. Pancreas reduced to nearly normal size. Condition on table very bad, but reaction took place. Drainage free. Later purulent bronchitis and septic nephritis developed, ending in death on the tenth day. No autopsy.

RUPTURED ECTOPIC PREGNANCY DURING TYPHOID FEVER.

Dr. F. O. Allen reported the case of a woman who was admitted to the Women's Medical Ward of the Presbyterian Hospital February 22, 1907, and came under the care of Dr. Musser. She was 32 years old, was married, and had been ill for three weeks. She had menstruated last at about the time she was taken sick. The case seemed to be one of typical typhoid fever, with an unusually large number and wide distribution of rose spots.

The second day after admission some tenderness was noted on the left side of the abdomen. At about five o'clock the following morning, the twenty-fifth day of her disease, she complained of severe abdominal pain, her temperature dropped to 98°, her pulse became more rapid and very weak (at times imperceptible), and her respirations increased in frequency. Intestinal hæmorrhage was suspected and she was treated accordingly. An examination a few hours later showed that abdominal breathing was restricted; the abdomen was slightly distended, but not tender; peristalsis was present; there was no loss of liver dulness; there was no dulness in the flanks. The Widal reaction was reported positive; the leukocyte count was 19,200. The temperature remained subnormal throughout the day. In the evening, the temperature rose again moderately; there was increasing tenderness of the abdomen; rigidity was not marked, but there was a distinct resistance, especially on the left side; she vomited; a bowel movement following an enema did not contain blood. Her general condition became very bad, but improved somewhat after copious injections of normal salt solution beneath the skin.

During the evening the patient was seen by Dr. Wharton, who agreed with Dr. Musser that operation was indicated, and that intestinal perforation was the condition probably present. The speaker was indebted to Dr. Wharton for the privilege of operating upon and reporting the case.

Operation was done twenty-one hours after the onset of acute abdominal symptoms. An incision was made through the right rectus muscle. The peritoneum showed black in the wound; when it was opened, large quantities of blood poured out. The ileum was drawn through the wound and inspected, but no perforation or other abnormal condition was found. On exploring the abdominal cavity, the pelvis was found filled with blood and clots, which were scooped out by the handful. A mass, the size

of a small lemon, was felt, springing, apparently, from the left Fallopian tube. The uterus was enlarged to about the same size and was soft. The small mass had a distinct pedicle, and at its upper pole there was a rupture into which the finger could be passed. The pedicle was ligated with silk, the abdominal cavity filled with salt solution, and the wound closed. The mass was a thin-walled sack filled with clot. No fœtus was found.

The patient's condition was considerably better during the following day, but the temperature soon rose and remained high, the lungs gradually became œdematous, and she died on the fourth day after operation.

A complete autopsy was not permitted, but the wound was opened and the peritoneal cavity examined. No signs of peritonitis or other intra-abdominal lesion were discovered; there had been no further hæmorrhage.

Dr. Henry R. Wharton said when he saw this patient the question was the differential diagnosis between hæmorrhage from an ulcer and perforation. An enema brought away no blood, hence perforation was considered probable, though it was noted that the pain was in the left side and that there was not marked rigidity of the right side.

Dr. John B. Deaver asked if a differential leukocyte count had been made in the case reported by Dr. Allen. He operated in one case which proved to be typhoid hæmorrhage, the blood being confined to the intestine. There was absolute rigidity. The small intestine was found to be filled with blood and was not opened. The patient recovered.

Dr. William L. Rodman cited a case in which typhoid perforation was diagnosed by two medical colleagues, who insisted upon operation, although he did not favor it. When the abdomen was opened hæmorrhage was found in the gut, but no perforation. The patient recovered from the operation, but died from a second hæmorrhage a number of days later. Autopsy showed there had been no perforation. If one opens the abdomen in these cases he is probably warranted under certain conditions in opening the intestine and searching for the bleeding point, but in general the chances are better if the hæmorrhage be allowed to take its course. There is not a large field for operation in typhoid fever and one is not warranted in opening the gut unless there are adhesions or thin places in the wall make the finding of the bleeding point reasonably sure after the opening has been made.

CARCINOMA OF THE BONES FOLLOWING CARCINOMA OF THE BREAST.

BY HENRY R. WHARTON, M.D.,
OF PHILADELPHIA,
Surgeon to the Presbyterian and Children's Hospitals.

Mrs. F., aged sixty-one years, consulted me in January, 1906, in regard to a tumor involving the left breast, which had been giving her some uneasiness for several months. Upon examination I found a distinct mass in the substance of the breast, which I considered carcinoma, and advised its removal. The breast was removed with axillary glands in February, 1906, and the patient made a good recovery. Three months after the removal of the growth the patient complained of pain in the lumbar region of left side, extending into the left thigh; this pain was intermittent. She passed out of my observation in June, when she went away for the summer, but returned to my care in October. She stated that she had suffered quite severely at times during the summer from pain in the lower lumbar region and thighs. At this time she was not able to walk well without the aid of crutches. Walking became more difficult, and she finally was compelled to abandon it entirely, although she was able to sit in a chair. After sitting for a time she complained of pain in lumbar region. Examination of the back showed no kyphosis, but there was tenderness on pressure over the lower lumbar vertebræ and sacrum and pain over the trochanters. The pain also extended to the thighs as far as the knee joint. There was no paralysis of the lower extremities and the knee jerks were normal. There was no loss of power in the bladder or rectum. The pain was intermittent and was described as acute at times and sometimes dull in character. The temperature was slightly elevated for a few weeks before the patient's death. There was no evidence of any recurrence of the growth at the seat of operation.

After repeated examinations and a careful study of the case it was thought probable that her symptoms were due to a secondary carcinomatous growth in lumbar vertebræ or sacrum. Dr. H. A. Hare, who saw the patient with me upon two occasions,

was inclined to this diagnosis. During the last month of her life the patient was kept comfortable by the use of a moderate amount of morphia. Death occurred suddenly from angina pectoris on January 7, 1907.

Autopsy.—The lower lumbar vertebra was found much softened, and cord and dura were thickened. Report of the microscopical examination of the fifth lumbar vertebra, cord and dura, made by Dr. A. G. Ellis, was as follows:

"Sections from the fifth lumbar vertebra show at points marked erosion and disappearance of the osseous structure which remains only in the form of isolated, irregular fragments. In these areas is a new growth made up of spheroidal epithelial cells and an irregular fibrous stroma. The nuclei of the former react well to stains, the protoplasm is in many instances granular and fragmenting. In a few areas are fairly distinct alveoli bounded by fibrous tissue and containing masses of the described cells. Tissue of this type surrounds many of the fragments of bone and extends into the overlying soft parts.

"Sections from the spinal dura in the region of this vertebra (4) show at one circumscribed point a decided thickening. Here the membrane is twice the thickness of the remaining portion, the increase being entirely due to fibrous tissue, epithelial elements being lacking. This area corresponds to the thickening of the dura noted macroscopically at the extreme lower end of the removed portion.

"*Diagnosis.*—Fatty degeneration of heart; scirrhous carcinoma of lumbar vertebra; chronic productive pachymeningitis of overlying dura."

Dr. B. F. Curtis [1] reports a case of carcinoma of the vertebra following removal of the breast for carcinoma. In this case, seven months after removal of the breast, loss of power over the bladder and rectum was observed, the knee reflexes were lost, and there was paralysis of the parts below the line of the umbilicus. There was also kyphosis in the mid-dorsal region. Pain was not severe. Laminectomy was performed, and upon exposing the cord it was found congested; the sixth dorsal vertebra was softened and projected slightly into the spinal canal. The pressure symptoms were not relieved by the operation. The patient died sixteen days after operation.

Primary carcinoma of bone is extremely rare, whereas secondary metastatic carcinoma of this tissue is not uncommon. The occurrence of metastatic carcinoma of bone, following

[1] N. Y. Med. Record, 1898, vol. i, p. 347.

primary carcinoma of the breast, is well recognized. The infection may occur months or years after the removal of the primary tumor. The character of the secondary tumor always corresponds to that of the primary one. The infection of the bone may occur by direct extension of the growth to this tissue when it originates in tissues adjacent to the bone, as is not infrequently seen in involvement of the ribs in recurrent carcinoma of the breast.

The development of carcinoma in bone distant from the primary growth results from the localization of carcinomatous emboli, and is said to occur at that portion of the bone subjected to the greatest traction or pressure. Carcinomatous infiltration of bone causes diffuse lacunar absorption, rendering the bone soft and easily bent or broken. There may also be present at the seat of infiltration a tendency to the development of new bone tissue; this condition has been described as osteopathic carcinosis.

According to von Recklinghausen, the bones most frequently the seat of secondary metastatic carcinoma are the vertebræ, femur, ribs, humerus and cranial bones. The vertebræ are said to be not infrequently the seat of carcinomatous infection from carcinoma of the breast, but my personal observation of a large number of cases has shown only one case in which the vertebræ were involved. On the other hand, Dowd [2] reports 29 cases operated upon for carcinoma of the breast, in 5 of whom symptoms of spinal metastasis developed. It should, however, be noted that no autopsies were recorded in any of these cases.

My experience with secondary carcinoma of the bone, following carcinoma of the breast, located at points not adjacent to the primary growth, has been confined to the following cases:

Case I.—Carcinoma of the lumbar vertebræ in the case previously reported.

Case II.—Carcinoma of the left clavicle in a woman of

[2] Annals of Surgery, 1898, vol. i.

fifty years, which developed five months after the removal of the left breast. In this case the patient complained of pain in left clavicle, which was fractured while turning in bed. In this case a marked tumor developed at the seat of fracture before her death, which occurred two months subsequently.

CASE III.—A woman, aged forty-five, removal of breast for carcinoma, in whom six months subsequently there were no signs of local recurrence, but the patient complained of pain in both femora. One morning while sitting in a chair both femora were fractured, apparently by muscular action. This patient before her death, which occurred two months later, developed a tumor of the right humerus and one of the left parietal bone.

CASE IV.—Woman of fifty years, who had had right breast removed for carcinoma, who, eight months after the removal of the breast, fractured her right femur while turning in bed, and developed a large spindle-shaped tumor at the seat of fracture. Death occurred several months after the appearance of the tumor of the femur.

CASE V.—Woman, aged fifty-five years, who while walking in her room felt the left leg give away under her, and she fell to the floor. When I saw her a few hours later I found a marked tumor at the middle of the left femur, mobility and crepitus were marked. Upon questioning her, she said she had for some months suffered from pain in the left femur and a painful tumor of the left breast which had never been operated upon. Upon examination of the breast I found a firm tumor involving the left breast, adherent to the skin, which presented the typical pig-skin induration. This patient died several months later of pulmonary metastasis.

The most prominent symptoms of metastatic carcinoma are localized pain, which may be dull or acute in character, and thickening of the bone at the seat of infection. The former is most common, and should direct attention to the occurrence of this affection. In this affection of bone, operative procedures offer little chance of relief, although in cases involving the spine, where pain and pressure symptoms are marked, as in the case reported by Curtis, it would seem justifiable to resort to operation, if only for temporary relief of

the symptoms. In cases involving the long bones, the possibility of fracture, which adds greatly to the patient's discomfort, should not be overlooked, and the patient should as far as possible be carefully guarded against the occurrence of this accident.

DR. MORRIS BOOTH MILLER described a fracture following operation for carcinoma of the breast in a woman of 40, the thorough operation having been performed. The patient when coming from the seashore, where she was during convalescence, was holding on to the seat to steady herself while standing in a street car. A slight jolt was followed by sharp pain in the arm and examination revealed an oblique fracture of the humerus. This suggested a recurrence, though there was no thickening of the bone and only the signs of an ordinary fracture. Demonstrable metastases occurred and the woman died the following winter.

DR. JOHN B. DEAVER said that Osler in 1902 reported 16 cases of carcinoma of the spine following carcinoma of the uterus or breast.

DR. WILLIAM L. RODMAN said that bone metastases in breast tumors are not particularly common, yet they are not extremely rare. Personally he has seen three cases. Two were unquestionably scirrhous carcinoma, the third was a sarcoma. In one of the carcinomas the metastastic growth was in the spine, the other in the left humerus, the same side as the primary tumor. The metastasis of the sarcoma was in the right femur six months after operation. The patient was the daughter of a prominent surgeon and had carried a benign growth for years.

Metastasis in sarcoma is more easily understood as the cells are in contact with the wall of the vessels, while in carcinoma the vessels are in the stroma. He has seen many cases of bone involvement in the sternum, but there the reason is very plain. Of indirect infection he has seen only the two cases, it not being difficult to see how metastasis to the spine occurs. The retromammary lymphatics drain through the second and fourth interspaces and then run along the course of the intercostal arteries to the thoracic duct. In this way spinal metastases occur. Dr. Wharton said that primary cancer of the bone is rare; he questions if it ever occurs, as epithelial cells are not found in bone. Such tumors are really endotheliomata or sarcomata. Bone metastases are important as they are never located before opera-

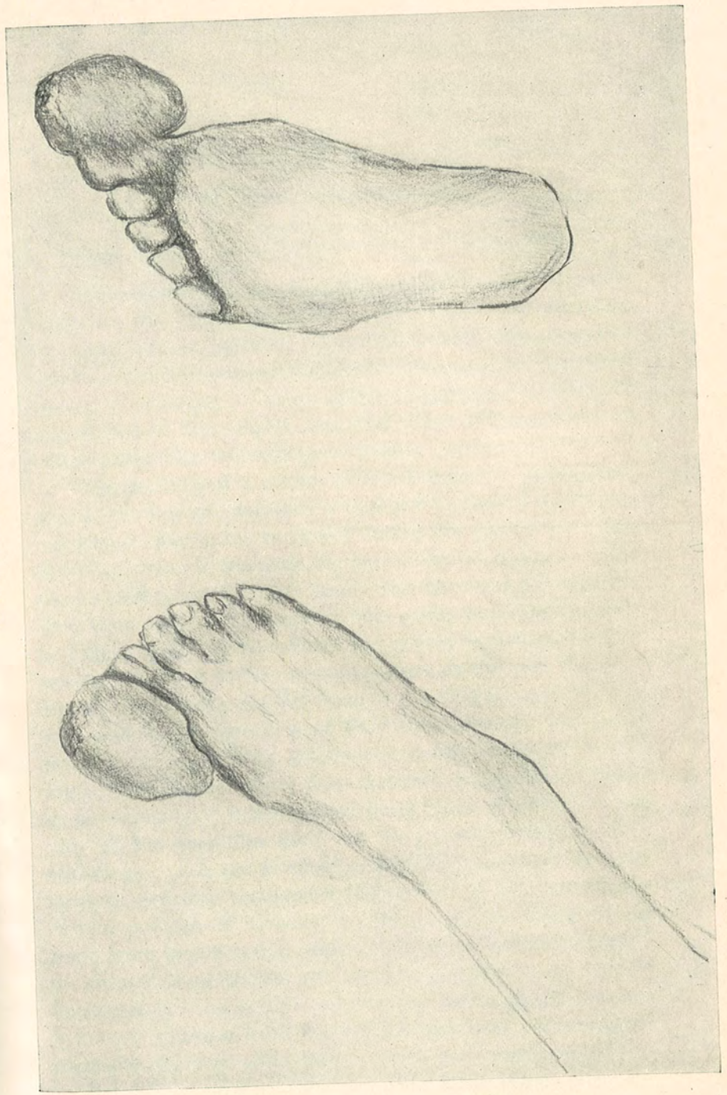
tion. The same chains of lymphatics as previously mentioned also explain metastases to the liver; this being the most common site of the secondary growths.

Dr. John B. Roberts saw eight years ago a case similar to that reported by Dr. Wharton. He was not able to determine if a growth was present, but regarded it as probably a case of spinal metastasis.

FIBROMA OF THE GREAT TOE.

Dr. Henry R. Wharton reported the case of a man, aged 50 years, who noticed 12 years before he came under the care of Dr. Wharton a tumor of the right great toe; it was painless, but increased gradually in size. He found it necessary to have the shoe for the right foot made upon a special last to accommodate the increasing bulk of the tumor. A casual inspection of the feet with the shoes on showed no marked difference in their size. Within a few weeks a portion of the tumor had ulcerated and gave him pain, which caused him to apply for relief.

The tumor was a fibroma and was attached to the periosteum. It was removed without difficulty, the wound being covered by skin flaps dissected from the tumor. See Fig. 1.



Fibroma of great toe.

POST-OPERATIVE TREATMENT.

BY JOHN H. GIBBON, M.D.,

OF PHILADELPHIA,

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PROBABLY no part of surgical work offers a better opportunity for the display of individuality than the post-operative treatment of our patients. Many of us attribute our good results as much to our particular after-care as to our individual operative technique. There can be no question regarding the importance of this subject, and after many operations and in certain conditions its importance becomes prime.

The welfare of a patient after an operation depends not only on the skill and accuracy with which the operation is done, but also on the means employed during the operation to conserve his strength, maintain the normal resisting power of his tissues, and render his early hours after operation peaceful and free from pain. The operator who works regardless of time and the amount of anæsthetic his patient is taking, or who pays no attention to the patient's posture on the table, the protection of the body not involved in the field of operation, or who uses large quantities of fluid regardless of whether it drains away properly or accumulates under his patient, is laying up for himself many post-operative complications which he who employs "speed without haste" and is thoughtful not only of the operation itself but his patient's condition, will seldom see. I do not advocate a want of thoroughness in operating in order to accomplish the closure of the wound in a certain number of minutes, or the constant shifting of the mind from the operation itself to the patient's condition, but I do mean that we should not drag an operation along over an unnecessarily long period, and that we should establish in our operating rooms a habit among our assistants and nurses of carefully looking after the comfort and condition of the patient. The post-operative treatment really begins when the

patient is still on the table. This is prophylaxis, the best of all treatments. We sometimes see patients anæsthetized long before the operator and his assistants are ready to begin their work. Again, we see patients put on the table with an unnecessary exposure of the body, with scant covering for the portion that is covered, and the whole or a large portion of the trunk, if it is an operation on the upper abdomen, deluged with water which quickly loses its temperature and chills the patient. Not infrequently we see patients placed on the operating table with nothing between the body and the glass or metal table but a thin, wet sheet, and more frequently still with the arm hanging over the edge of the table in such a way that the musculospiral nerve is pressed upon sufficiently to produce a palsy. These are only some of the thoughtless things of which we are occasionally guilty, and which go later to spell disappointment and sometimes disaster. Who has not seen a troublesome wrist drop which long outlasts the convalescence from a simple operation, or a pneumonia from exposure and cold on the operating table or during transit to the ward or room, without appreciating the importance of the thought of the post-operative period before and during the operation? We should never become so wrapped up in our operation and in demonstrating its steps to onlookers as to forget our patient's condition.

The choice of an anæsthetic to suit the individual case is a matter of great importance from a post-operative point of view, as many of our complications in this period have their origin in the anæsthetic, such as pneumonia, suppression of urine, vomiting, etc. It is a great mistake to confine ourselves exclusively to one anæsthetic. Many a feeble patient who could not stand ether or chloroform anæsthesia can be operated upon with impunity under infiltration anæsthesia or with the morphia-chloride of ethyl and ether, or the morphia-scopolamin-chloride of ethyl and ether sequence. I have been able with the latter sequence to remove a large ovarian cyst from a very old lady to whom I should have hesitated to give the required amount of ether alone. In this case one hypodermic

of morphia, $^1/_6$ gr., and scopolamin, $^1/_{100}$ gr., was given 2 minutes before operation. She was rendered unconscious with chloride of ethyl in about a minute, but one-half ounce of ether was employed during the entire operation, and the patient slept for an hour or more after it. In another case I was able by intraneural injection of cocain to amputate the leg without shock in a tuberculous patient to whom I feared to give ether lest his lung condition should be rendered active. In many cases of empyema chloride of ethyl will suffice for a rapidly performed thoracotomy. The same applies to the drainage of other collections of pus, and to amputations where time is an element and ether is contraindicated. It is well to familiarize ourselves with the different anæsthetics in order that we may be able to choose the best for the individual case.

Another factor in operative technique which has a marked post-operative influence is the way we handle the tissues and close the wound. A potent element in producing pain and predisposing to suppuration is the ligation of large masses of tissue and the tight suturing of wounds. There is no doubt that a comparatively clean wound, such as a lacerated wound of the scalp, which would otherwise heal by first intention, can be made to suppurate simply by tight sutures. All that Nature requires is a gentle approximation of wound edges, and more than this is detrimental. The present custom of closing wounds in layers has done much to reduce suppuration and to increase the patient's comfort.

Among the chief complaints after operation are pain, nausea, and thirst. The pain of course varies greatly according to the site of operation, and the individual disposition. Probably abdominal operations produce more pain than others, but this may be only because of the aggravation of the discomfort caused by the movement of the diaphragm, especially such excessive actions of this muscle as take place in retching and coughing. One of the surprising things about post-operative pain is that it is not more marked in certain plastic operations, such as hernia, repair of the perineum, etc. In all of these, however, it can be made very severe by too tight con-

striction of wound edges. Too much attention cannot be given by the surgeon to the prevention of pain at the critical period when quiet and sleep do so much to aid a prompt convalescence. There was a time not long since when it was the rule of most surgeons to withhold pain-relieving drugs, such as morphia, after abdominal operations. To give a hypodermic of morphia in these cases was thought to be a great mistake, but now we have learned that when properly employed in the post-operative treatment it is a great boon both to the patient and to the surgeon. All the bad effects formerly attributed to this drug, such as the production of flatus, bad effect on the kidneys, etc., we seem now to have forgotten, or at least we have learned that it was our own faulty technique which produced much of the trouble attributed to the morphia. It was usually infection and not morphia that caused the trouble. I am glad to say that I have never done an abdominal operation without administering a hypodermic of morphia and atropia before the patient has recovered consciousness, and I have never observed in any single case a bad effect, and my results generally have not been so bad as to make me change this plan of preventing, to some extent at least, the post-operative discomfort of the patient. When I was a hospital interne and assistant it was the custom of most of the operators after a laparotomy to order morphia, probably a small dose, to be given only if absolutely necessary. My experience was that it usually became necessary, and then, the patient having learned the relief to be obtained by its use, begged for a repetition of the dose. My present custom is to give a single hypodermic of morphia, ¼ gr., and atropia, $^1/_{150}$ gr., before anæsthesia is started or certainly before the patient regains consciousness. The result is that the patient passes from the sleep of the anæsthetic to the morphia sleep, gets comfortably over the most distressing hours after operation, those first few when ether is being eliminated by the lungs in large quantities and nausea and vomiting are common, and never knows that morphia has been given. The idea that morphia causes vomiting after an operation is absurd. Formerly I only used this

plan in abdominal cases, but the vomiting was so much less than in the other cases where it was not employed, and the patient's comfort so much greater and his return to consciousness so much quicker, that I now give the hypodermic after any operation of magnitude or long duration, or where I expect much after-pain. It is seldom that I am obliged to give a second dose, and this I try particularly to avoid, for I think it is better not to let the patient learn the comfort of morphia. It is largely for this reason that the drug is given before the close of the operation, and this time is also chosen because I want the drug to act before the patient begins to regain consciousness and vomit. A large majority of patients after this treatment never vomit at all. All one has to do to become convinced of the advantages of this method of treating post-operative pain is to employ it in a few cases and compare the results with those obtained when no morphia is used, or when it is given late and in small quantities. The repeated small dose of morphia does not appeal to me, because it would seem that the patient would become dependent upon it. Where the single full dose is given before the close of anæsthesia the patient if not disturbed will often sleep for from one to three hours, and remain quiet for a much longer period.

Pain developing some hours after an operation is not to be treated by the administration of an anodyne, but its cause should be carefully sought and removed. A careful and considerate nurse can do much to relieve such pain. Oftentimes the simple change of posture, the cutting of a tight bandage, the relief of pressure on some bony prominence, straightening out the clothing, and such little attentions will give relief. I have seen a patient kept awake all night by pressure on the heel after fracture of the leg, and by pressure on the internal condyle by an internal angular splint. Pain under such circumstances is absolutely unnecessary, and its possible cause should always be considered. I have known a safety pin to be passed through the patient's skin in fixing a bandage and to remain in this position for days. Therefore, instead of putting down the patient's complaint of pain to nervousness or to want

of pluck, we should always make sure that there is not some actual cause for the complaint.

Nausea and vomiting are not nearly so troublesome after operations as they once were. This has largely been due to the improved methods of administering our anæsthetics, and it can be largely obviated by making the quantity of anæsthetic employed as small as possible. The amount of ether and chloroform administered has much to do with the continued vomiting after operation, and it can easily be reduced by the judicious use of morphia and atropia administered either before or during the anæsthesia, or by administering chloride of ethyl or nitrous oxide before the ether or chloroform. It is my invariable custom to employ chloride of ethyl first, and in this way the amount of ether is reduced nearly one-half. The less ether there is for the patient to eliminate, the less nausea and discomfort he will have and the less likelihood of interference with the eliminating function of the kidneys. As I have indicated before, the use of morphia at the close of the operation before the patient regains consciousness will entirely obviate or greatly reduce vomiting. Inhalations of vinegar have long been employed to reduce nausea, and do seem to be productive of some good. So simple a means as elevation of the head will often reduce the sensation of nausea, and a draught of water will sometimes not only not increase the nausea, but will reduce it. Where it is possible for the patient to be placed in the sitting position nausea will frequently be relieved. This is particularly true after operations on the stomach itself. A drainage tube placed in the abdominal cavity may produce continued reflex vomiting, which will cease on removal of the tube. In my own experience troublesome vomiting is rare where a full dose of morphia is given at the close of the operation.

Thirst, too, is a symptom which is much less troublesome now than formerly where water was withheld for long periods after operation. The thirst can be largely relieved by giving large quantities of salt solution by the rectum. There are few operations, however, after which water cannot be given promptly by the mouth. If a patient is not nauseated I allow

him water within a few hours in quantities of an ounce. It has not been my experience that this is apt to start up vomiting. This early administration of water applies after abdominal operations as after others. I think the giving of a considerable quantity of water at regular intervals is preferable to the continual sucking of ice. Liquid food should be given as soon as the patient has a desire for it, or as soon as the nausea has passed away.

Confinement in one position, with the restriction of all movement after an operation, is extremely trying on a patient, and often results in insomnia and nervousness. Any movement that does not directly interfere with the healing process of the wound should be allowed. It does not hurt a properly closed abdominal wound if the patient is early placed upon his side, or if the shoulders are elevated, or the legs drawn up. When a patient is very anxious to change his position and you are sure this change will not be comfortable, it is not a bad plan to allow him to try the new position, when he will be convinced of his own error and more contented in the position he had first occupied. Too much care cannot be given to obtaining a comfortable attitude in bed after an operation. Restraint in an unnatural position gives rise to the greatest restlessness and discomfort. This is well illustrated in the tight confinement of the arm to the chest after breast operations. The patient is much more comfortable, the wound heals better, and there is less restriction of subsequent motion of the shoulder, if the arm is dressed at a right angle to the body.

One of the problems after abdominal operations is the best time at which to open the patient's bowels. Formerly it was the custom of most surgeons to give some laxative, usually calomel, on the day following the operation. This was due to the fact that an early movement of the bowels usually meant that no infection of the peritoneum had occurred, or that such an infection was not extending. The mere movement of the bowels, however, is in no way curative under such circumstances, and it is far better to allow the intestine to rest quietly

after an operation than it is to stir up painful peristalsis by means of laxatives. This, of course, applies to the cases in which a proper preparation for the operation has been made. A movement by a glycerin suppository, or an oil or soapsuds enema is much more comfortable to the patient and less disturbing to the healing viscera than a purgative. If nothing but liquid food is given for two or three days after operation the third day is early enough to open the bowels.

Inability to empty the bladder is of common occurrence in the post-operative period, and resort to the catheter is often necessary. To resort to catheterization when the bladder is not painfully distended is a mistake, and it is far better to have the patient empty the bladder himself than to pass the catheter. Some surgeons even go so far as to allow the patient to get out of bed for this purpose, and where it is possible I believe it to be good treatment. I avoid the use of the catheter as much as possible. When the catheter is employed the greatest care should be exercised and the catheterization done by experienced orderly or nurse. Even under the best circumstances infections of the urethra and bladder occur, and it is the surgeon's duty to see that all necessary aseptic precautions are taken to avoid these unfortunate complications. No nurse or orderly should ever be allowed to use a metal instrument. Catheterization in children is to be particularly avoided, as injury of the male urethra in childhood is easily accomplished. In children I would much prefer to have the patient get out of bed to having a catheter used.

The time at which a patient is allowed to get out of bed varies with the operation which has been performed. A few rules, however, can easily be laid down. In the first place, old people should be gotten out of bed as soon after operation as possible. The advantage of this is easily shown in the present-day results from prostatectomy, where the patient is gotten out of bed on the second or third day. In abdominal operations on old people a change of posture and early transference from bed to couch or chair is very important. There has been a marked tendency during recent years to shorten the period

which a patient spends in bed after an abdominal operation. After simple appendectomies many surgeons allow their patients to get out of bed on the following day. I have not been able to bring myself quite to this point, but I am constantly shortening the period. In clean cases where the abdominal wound is accurately closed and no muscle cut across its fibres, I get the patient out of bed on about the eight or ninth day with the abdomen well supported by a binder, and allow moving about on the tenth or eleventh day. In this particular I think the individual disposition of the patient must be taken carefully into account. There are many patients who are benefited by a longer rest in bed, whereas to others, such as old people, and those who are inclined to magnify their ailments, a prolonged rest may be harmful.

In closing I would say that I think we are often guilty of paying too little attention to our patients during the post-operative period, and during the convalescence which follows. Many good results are spoiled by this neglect. For instance, take the tuberculous lesions for which the surgeon is frequently operating. If the after-care of these patients is not properly carried out, especially the hygienic treatment, an early recurrence is the rule. And again, after operations for syphilitic lesions we too frequently fail to instruct the patient in the necessity of continuing his specific treatment. A proper restoration of function is frequently not realized because of our neglect of such agents as massage and passive movements. Recurrences after operations for knock-knees and bow-legs often take place because no brace to prevent the recurrence is employed. These are only a few instances which show the importance of treatment after operations.

Dr. John B. Deaver endorsed much that was said by Dr. Gibbon. He believes, however, that instead of patients being neglected they receive too much attention. His motto for the house physician is, "Let the patient get well." No medicine should be given after an operation as a rule. He is opposed to the indiscriminate and routine use of strychnin. He employs nothing but ether as an anæsthetic, being afraid of chloride of ethyl, as he has

heard of deaths from it. Giving the anæsthetic is an important thing and ether usually does no harm. It is best to anæsthetize the patient on the operating table, as it is a mistake to move him there after ether is begun, this always meaning an extra amount of the drug. The patient may be anæsthetized in the high pelvic position even, the intestines thus being floated up and requiring less packing when the operation, being an abdominal one, is begun. When operating upon the upper abdomen he always has the patient wrapped in cotton and put upon a hot water bed; the cotton is at once removed when the patient is taken to his room.

As to scopolamin, Dr. Deaver does not know what it looks like and is thankful he does not. Tight sutures, as stated by Dr. Gibbon, make trouble; he usually places a drain in stout walls for a day. He was sorry to hear Dr. Gibbon say he uses morphin after operations; Dr. Deaver would at once discharge a resident if he did that. Its immediate effect is to make the patient more comfortable; after that it makes him more uncomfortable. It creates more thirst and often more nausea. Occasionally he employs morphia, but never as a routine measure. He administers oxygen immediately after operation and this lessens nausea, that fact being noted in the German Hospital by the Sisters who have been on duty for fifteen to twenty years. A careful nurse is of more moment than a hypodermic of morphia. There is not so much in the use of morphia after gastro-enterostomy as formerly supposed. When this operation is performed by making the communication with the jejunum as near as possible to its commencement vomiting does not occur.

Dr. Deaver never sees shock, except in cases of hæmorrhage or prolonged operation or bad anæsthetization. The pulse of his patients after short operations is always about 84 to 90. Getting the patient out of bed early is an important point. Cases of hysterectomy are gotten out in a week and are encouraged to turn on their side early. Many of the cases of phlebitis, formerly so frequently seen, were due to lack of these measures. As regards passing the catheter, he allows hernia patients to get up to pass urine; worse results than are made possible by this come from catheter cystitis. He never operates upon an empyema without first aspirating it.

Dr. William L. Rodman now has largely the opinion of Dr. Gibbon regarding morphia, though formerly he was afraid of it.

Since its use he sees much less post-operative vomiting. Perhaps it is unwise, however, to use it as a routine measure. He has never known a gastro-enterostomy to give trouble when morphia is given. There is less shock and less anæsthetic is necessary. A quarter grain of morphia and one one-hundred and fiftieth grain of atropia are invariably given in cases of gastro-enterostomy. Of seven recent cases only one patient vomited, and that one only once. We give anæsthetics much better now than formerly and do not see so much distress from their use. When ether is given by the drop method there is but little post-operative vomiting, with or without morphia. Dr. Rodman prefers chloroform in empyema cases, of which he has operated upon 100 to 150 without losing a patient, and has never seen any ill results; with ether these cases are more unpleasant. Patients should be gotten out of bed early, especially the subjects of cancer, who should be out in 48 hours. If such persons, particularly when the cancer was in the abdomen, are kept in bed a few days they never get out. The possible development of a ventral hernia is not to be regarded in these cases. In gastro-enterostomy for cancer of the stomach, the patient should be out of bed the day following the operation.

Dr. William J. Taylor finds that patients occasionally are benefited by washing out the stomach before they are out of the anæsthesia. This is especially true in cases of intestinal obstruction or in emergency operations where previous emptying of the bowels has not been possible. Food should not be given too soon. He had rather keep a patient three days without food than to give milk and soup and have it ferment in the intestine instead of digesting.

Dr. Richard H. Harte does not believe in the indiscriminate use of morphia in operative cases. He believes that the routine dose of a quarter grain of morphia before a patient is etherized is in time liable to lead to serious results, numerous cases being reported where this dose has been fatal. As a rule, the less medicine given after operation the better for the patient. Invariably the bowels, if left to themselves, will move in the course of two or three days. Their action can, however, be supplemented by the use of a simple enema. Dr. Harte lays great stress on the importance of keeping patients warm and dry during operation, avoiding exposure as much as possible, as shock is often induced by air coming in contact with wet clothing, as well as by prolonged

unnecessary manipulation of the intestine. Fortunately this latter is less noticeable now, as the non-operative field is pretty well shut out by the judicious use of pads of gauze.

The early feeding of patients is unquestionably a great error, as food introduced into the bowel too soon only ferments and causes an immense amount of discomfort. Patients are as a rule much better by waiting 24 to 48 hours before any food is ingested, and even then, if there is any question of irritability of the stomach, they can be readily nourished by the bowel. Thirst, which is so common in post-operative cases, can be relieved by keeping the bowel filled with normal salt solution.

Dr. John B. Roberts said that post-operative backache is not due to operation itself or to the fact that the patient is kept in bed, but is usually caused by the flat operating table upon which the patient lies during anæsthesia and operation. A hard pad should be placed on the table under the lumbar region of the patient. A hard mattress is also too flat. The table ought to be made to fit the curves of the back, so that the muscles and ligaments may not be strained during a long operation. For 18 or 20 years he has given before almost all operations a quarter of a grain of morphia and one one-hundred and fiftieth of atropin hypodermically. Less anæsthetic is required, there is less interference with breathing by mucus, and the heart is strengthened by this preliminary to anæsthesia. He has never known it to hurt a patient. The curse of thirst, due to the operator insisting that abdominal cases should have no water to drink till hours have elapsed, should be avoided by all sensible surgeons. The unnecessary torture thus induced should meet with the strong condemnation of the profession. Dr. Roberts has always contended, since the rise of abdominal surgery, that its principles are identical with those of general surgery; and has acted on that belief. A little morphia before anæsthesia and water afterwards do no harm in either case. Another point in post-operative treatment is that nurses nearly always put patients on the stretcher without a pillow under their heads; a low pillow surely can do no harm and is much more comfortable to the patient than to lie with the head thrown backward on the bed.

Dr. John B. Deaver said regarding backache being due to flat tables, he has noted that few gall-stone patients complain of their backs after operation. This would indicate that Dr. Roberts is correct in his statement about the lack of support to the back.

Dr. George G. Ross wondered how many of the surgeons present had suffered as have the patients they were discussing? He had had his appendix removed, and the following night suffered the tortures of the damned. One of his friends surreptitiously gave him a morphin suppository which afforded great relief. The nurse brought in a large bowl of ice, which he did not interfere with until the ice all melted, when he drank every drop of the water. And this was not followed by vomiting.

Dr. Gibbon, in closing, said that he agreed with the other speakers that as few drugs should be used after operation as possible. He emphasized the fact that in using morphia in the manner described it formed rather a part of the anæsthetic than of the after-treatment. Dr. Deaver's dissatisfaction with the use of morphia was the result of using it after, and not during or before, anæsthesia. It has not been Dr. Gibbon's experience that distention follows its use in the way described. His own personal experience after an operation for acute appendicitis had confirmed him in the value of the ethyl chloride-ether-morphia sequence. He slept comfortably for four hours after his operation, was not at all nauseated, and had no taste or smell of ether. He said that he should have mentioned in his paper the great value of washing out the stomach, especially in those patients who had not been properly prepared for operation.

STATED MEETING, HELD MAY 6, 1907.

The President, JOHN B. ROBERTS, M.D., in the Chair.

SURGERY OF THE VASCULAR SYSTEM.

I. LIGATION OF THE DUCTUS ARTERIOSUS.

BY JOHN C. MUNRO, M.D.,
OF BOSTON, MASS.

THAT I may be allowed to bring this suggestion for a new operation before your Society, I ask on the basis that it has not been hastily conceived. On the contrary, long ago I demonstrated its technical possibility on the cadaver of new-born children, and felt that it was justifiable on the living. At various times I have tried to inspire the pediatric specialist with my views, but in vain. Now, in view of the recent advances in cardiac surgery, for much of which we are indebted to the surgeons of this city, I will venture to place my ideas before you, asking that you do not dismiss them hastily.

Nineteen years ago I saw a healthy girl baby that, soon after birth, exhibited symptoms of some cardiac lesion, out of keeping with the general appearance of perfect health and development. On severe exertion, such as straining at stool, it would become cyanotic, and the cardiac beat would cease. At times the child would apparently die, only to recover as soon as the heart was stimulated with electricity. In a few weeks atelectasis developed for which I tried artificial expansion of the lungs under negative pressure in a pneumatic cabinet. This met with only temporary success. Auscultation at this time revealed a cardiac murmur with the pulmonary râles, but cyanosis was not a marked feature. After death, which took place without œdema or marked cyanosis, examination showed an open ductus arteriosus lying easily within reach

behind the sternum, without any other defect or lesion except a dilated right ventricle. The simplicity of the remedy was so striking that I at once made further dissections, and satisfied myself that it would be possible to ligate the duct provided a diagnosis could be made beforehand. In regard to making a diagnosis, however, my pediatric advisers were not reassuring. In the hope that it may be possible to detect such a lesion in time to allow surgical interference, I would urge those skilled in the diagnosis of infantile lesions to lend their aid.

To attempt to disentangle the confusion of signs that attach to the various congenital lesions of the heart would be folly. Only faint light can be gained from authorities like Vierordt and others.

In the new-born the duct of Botalli is a little over 5 mm. in diameter and 10–15 mm. long. The length increases generally up to the time of obliteration which normally is complete by the twentieth day. Thus there must be an early period in the infant's life when the patency of the duct cannot be considered as pathological. It seems as though auscultatory signs during this period would throw some light on those which we should expect when the persistence of the duct forms a pathological factor. Townsend, however, examined 100 new-born babies during the first three days of life with this in view, but was unable to hear anything distinctive.

The causes for a persistent duct are not known. It may be due to some histological variation in the circular fibres, or to an absence of the inflammatory reaction that normally obtains. Very rarely is there an aneurysmal condition, or is the duct so short that a direct communication between the aorta and the pulmonary artery exists. The cases collected by Vierordt do not number a hundred, but that must be quite far from a correct estimate. It is not at all necessary that other congenital anomalies co-exist with the anomaly under consideration. Most writers find hypertrophy and dilatation of the heart, and the pulmonary artery may exceed the aorta in diameter. In typical cases the foramen ovale is closed, but not because of the theoretical reason that an open duct is dependent on a foramen that has closed prematurely.

In typical cases cyanosis is wanting. One finds rather an anemia or later a waxy appearance. Cyanosis is less characteristic of this than of other serious cardiac malformations. In late life it may be present, however. Cardiac dullness is increased laterally, and there may be projection and pulsation of the dullness, leftwards, in the upper costal spaces. This projection is visible by X-ray. The pulse shows little change though Franck considers that there is a fall with inspiration and a rise with expiration. We may find true attacks of suffocation, and bleeding from the mucous membranes as in other serious malformations. A loud systolic whir conducted into the cervical vessels may be heard, but as a matter of fact there are no definite auscultatory signs established as yet.

Of 26 cases recently collected about half lived to puberty, but it seems as though this must be an unduly large proportion owing to the lack of autopsies in infants. Death follows from atelectasis, general œdema, pleural exudate, pneumonia, endocarditis, etc.

Among the cardiac anomalies to be differentiated is, first of all, an open foramen ovale. The distinguishing signs are not well determined and it is useless to take up the question here. In open ventricular septs, in congenital pulmonary stenosis, in persistent truncus arteriosus, where the patient dies as a rule shortly after birth, we must expect marked cyanosis. Congenital aortic-pulmonary communication and stenosis of the various ostia are so rare that they may be disregarded.

Why should we consider surgical interference in cases of open ductus arteriosus? Because in spite of the fact that some cases may live to puberty, the chances of which must be small, we have the one cardiac-valvular lesion which is, relatively speaking, superficial. Furthermore the anomalous vessel is of good size, its ligation must be followed by instant and permanent restoration to a normal function of the lungs and arteries, and it can be reached by a short surgical route.

The operation I would propose, as demonstrated on the cadaver, is as follows. Under ether, which I prefer to chloroform in any case involving collapse of the lung, the sternum

can be easily split along its centre or a little to the right, opposite the second costal cartilage. This is easily done with a knife. The sternal halves are then retracted, ample room for working being obtained. The right pleural cavity will probably be opened but the left one will not. Judging from analogous cases in surgery, this should not be serious, but if necessary the physiologist's apparatus for maintaining artificial respiration could be employed. I hardly believe that it would be needed. After retracting the thymus upward, the pericardium is exposed. Its reflection lies so high on the large vessels that the ductus to all intents and purposes is intrapericardial. In the upper angle the aorta will be seen on the patient's right and the pulmonary artery on the left. By following close to the aorta towards the under surface of the arch the ductus, as large as the aorta itself, will be seen as the first vessel to the left pointing upward and a little to the right. Both pulmonary branches lie too far posteriorly to be seen, and by keeping close to the aorta the main pulmonary trunk will escape injury. On pushing through the tissues by blunt dissection the ductus, theoretically, should be easily surrounded with a ligature. It is a question whether or not simply crushing it would not accomplish as much, and in case of necessity, I believe that it would be worth trying. After closing the anterior pericardial wound the sternum can be sutured or not and the skin closed.

Would it be justifiable to subject a child to this risk without knowledge of the exact lesion? In a case with beginning atelectasis or other evidences of impending death from circulatory disturbances, with a reasonable basis for believing that the duct were open, it seems as though such an operation would be justifiable. I doubt if it would materially hasten a fatal issue in case the diagnosis were not confirmed.

II. ARTERIOTOMY FOR THROMBOSIS AND EMBOLISM.

BY FRANCIS T. STEWART, M.D.,
OF PHILADELPHIA.

THE usual treatment for arterial obstruction involving the limbs and depending upon thrombosis or embolism, is in brief to keep the part dry, warm, sterile, and slightly elevated, in order to prevent gangrene, or at least limit it and cause it to assume a dry and circumscribed form. With the development of aseptic surgery and the progress which has been made in the suture of arteries more active measures demand at least consideration. These measures will vary according to the cause of the arterial obstruction, since the problems to be solved differ with the lesion encountered. We shall confine ourselves to the two forms which we have an opportunity to investigate by operation.

1. *Traumatic thrombosis* due to contusion of an artery.—By contusion we mean an injury produced by blunt violence which does not result in immediate dissolution of the continuity of the external coat of the vessel, in other words, such injuries as are often described as partial ruptures. The lesions found after a contusion of an artery vary with the violence of the contusion and the state of the arterial walls. The slightest grade, in which there is perhaps no change but a little ecchymosis of the vessel wall, may be disregarded, as such causes neither immediate signs nor remote ill effects. The older surgeons explained some of the cases of obliteration of an artery after contusion, by rupture of the vasa vasorum, and extravasation of blood between the vessel and its sheath in sufficient quantity to press upon and considerably narrow the lumen of the vessel. This was supposed to be followed by a traumatic arteritis with consequent thrombosis. It is now known that in practically all instances the inner coats of the vessels rupture and that such leads to thrombosis. As in the application of a ligature, although the force acts from without inwards, the

lesions, owing to the friability of the internal coats, are produced from within outwards. The injury may expend itself on the internal coat alone, leaving the outer coats intact and practically normal. The lesion here observed is a fissuring of the intima, which may be complete or incomplete, *i.e.*, involving the entire circumference or only a part thereof. Complete circular division is best seen after the application of a ligature. In contusions by blunt violence the fissures are apt to be multiple, and frequently involve only a portion of the circumference of the vessel, usually that first struck. The sole result of clinical importance is thrombosis with its consequences. If the fissure is small and incomplete, there may be a minute mural thrombus, which causes no interference with the blood current, but simply protects the wound until healing is complete. Obliteration of the vessel by clot is liable to follow, however, if the rent in the internal coat is large, if the fissures are multiple, if the tunic is sufficiently detached to wave in the blood stream, if the detached tunic is infiltrated with lime salts, if tight compression is applied after the accident, or if the state of the heart or the blood is such as to predispose to coagulation. The conditions just mentioned determine also the rapidity with which an occluding thrombus forms. It may immediately follow the injury or it may not develop for several hours or even days. Generally speaking, complete obliteration after a lesion of the internal coat alone is delayed, although in the femoral artery we have observed it to occur within a few minutes. Yielding of the internal and middle coats is much more likely to be followed by immediate thrombosis, since they curl up within the vessel in obedience to the elasticity of the middle coat. The adventitia maintains the continuity of the vessel and prevents extravasation, although the blood may make its way for some distance between this coat and the media, sometimes for an inch or more. Ordinarily the clot extends centrally in a conical form as far as the first collateral branch. Peripherally its length varies; it may fill the main branch and the smaller arteries or it may terminate like the central portion near a collateral. Upon its extent and upon the

activity of the collateral circulation depends the integrity of the limb. If the injury is confined to the artery alone, and the vessels are healthy and the collaterals abundant, no harm need follow. If the clot forms slowly, ample opportunity is afforded for the development of an adequate collateral circulation, which becomes progressively more efficient the more the lumen is closed; thus pulsation may never be absent from the peripheral vessels, even though the vessel at the contused point becomes impervious. If, however, the vessels are narrowed by disease, or if the collaterals are involved in the injury or pressed by extravasated blood or a tight bandage, the collateral circulation will be insufficient and the thrombosis may extend to the finer vessels. In either event the limb falls into gangrene. Another possible factor in the production of gangrene is the detachment of portions of the clot during the formation of the thrombus, the emboli plugging the smaller vessels and leading to circumscribed gangrene. In the absence of sepsis secondary hemorrhage does not occur.

The signs of obliteration of the vessel (pain, pallor, loss of pulsation, loss of heat, hypesthesia of anesthesia, paresis or paralysis) when marked are followed by gangrene, but when present in a lesser degree complete recovery is still possible. Such, however, is the exception and the limb usually perishes for several reasons. Unlike simple ligation, after which gangrene is comparatively rare, in a contusion the accompanying vein also may be involved and thrombosed. The collateral vessels are too apt to suffer from the trauma, or if they escape direct injury they may be compressed by the extravasated blood resulting from the associated laceration of the environing tissues. Of 34 cases of traumatic thrombosis collected by Lears 18 recovered, and of these only 4 escaped gangrene.

If the pulse alone has disappeared and there are no other signs of impending gangrene, the treatment mentioned at the beginning is all that is needed. A hematoma, however, should always be opened, in order to lessen the compression on the collateral vessels. If the hematoma is of large size, one can never be sure that the artery has not been opened, hence in

these cases incision has a double rôle, to permit evacuation of the blood and to ascertain the condition of the artery. The clots adhere strongly to and infiltrate the surrounding tissues, but the tissues should not be scrubbed in order to remove them. If the bleeding has completely ceased we believe it good practice to suture the wound without drainage, since the latter always predisposes to infection, particularly in bruised tissues.

On theoretical grounds ligation of the artery above the injured part has been suggested in order to prevent the detachment of emboli. If the pulse has disappeared, indicating complete obliteration of the vessel, no reason exists for this procedure; if the pulse is still present, although of lessened force and volume, we believe the chances of embolism should be accepted rather than completely to suppress the circulation. Although the possibility of opening the artery, removing the thrombus, then suturing the wound in the vessel has probably occurred to many surgeons we imagined at the time of our first operation that we were the first to put the idea into practice. On looking over the literature, however, we find that both Sabanajew and Lejars have attempted to relieve arterial obstruction by arteriotomy.

Sabanajew's operation was performed in 1896 (Höpfner, Archiv f. klin. Chir. Bd. 70, S. 417, 1903). His patient, suffering with polyarthritis rheumatica, was suddenly stricken with signs of gangrene of the leg depending upon obstruction of the femoral artery, which was believed to be due to an embolus. The femoral artery was exposed, but no occlusion found in the expected situation. Owing to the desperate condition of the patient, further search was deemed inadvisable, and the vessel was closed with sutures and the limb amputated at a lower level. The patient died 19 days later of endocarditis.

Lejars' (Bull. et mem. de la soc. de chir. de Paris, 1902, p. 609), patient was a man, aged 26 years, who was caught between two cars, sustaining a severe contusion of the left inguinal region. Signs of thrombosis of the femoral artery were in evidence, and the foot became gangrenous. Six days after the accident the artery was exposed below Poupart's ligament, a soft black clot removed, and the wound in the vessel closed with sutures. The gangrene progressed, however, and one month later the leg was amputated below the knee.

For our first case we are indebted to Dr. Robert G. Le Conte, who was absent from the city when the patient was admitted to

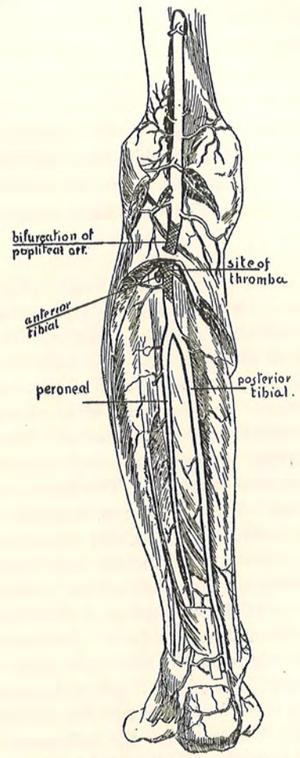
the Pennsylvania Hospital, June 20, 1905. The patient was a man, aged 60 years, who presented all the evidences of advanced atheroma, with mitral regurgitation and hypertrophy of the heart. He had been squeezed between the tail-board of a wagon and a wall. Over the lower portion of the left abdomen and upper part of the corresponding thigh was a diffuse swelling due to extravasated blood. The skin was unbroken and there were no other injuries. Both legs were bluish and covered with a network of small varicose veins. Pulsation in the tibial vessels was as strong and full on the left as on the right side. During the night of the same day, or about twelve hours after the injury, he complained of severe pain, first in the popliteal space, and later radiating down the leg to the foot and toes. The following morning we found the pulse absent from the tibial vessels and popliteal artery. The femoral could not be satisfactorily palpated because of the swelling mentioned above. The pain had disappeared, but the leg as far as the knee was pale and cold, and the toes and foot shriveled. Sensation was present but markedly reduced in the entire foot and leg. There was no power in the toes, and the ankle could be flexed only with difficulty. Movements of the knee were unimpaired. The thigh was warm and apparently in the same condition as on admission. Owing to the condition of the thigh, the very sudden onset of symptoms, and the seat of the initial pain, it was believed that a large clot embolus had been swept from the point of injury and lodged at the bifurcation of the popliteal. About 12 hours after the onset of pain and 24 hours after the injury the patient was anesthetized with ether, and the popliteal artery opened by a small longitudinal incision. There was a slight flow of dark blood, but no clot could be found. A probe was gently passed up into the artery for about 6 inches and no obstruction found nor flow of blood induced. The wound in the artery was closed with through-and-through silk sutures and the skin approximated. A longitudinal incision was next made over the femoral artery, from just above Poupart's ligament downwards. The sartorius muscle had been ruptured and all the tissues were infiltrated with dark clots. The vein was uninjured. The artery was not discolored, but was hard to the touch from Poupart's ligament down to its bifurcation. Poupart's ligament was severed in order to permit an assistant to grasp the vessel above the thrombus, and the artery was opened by a longitudinal incision.

After removing the clot, which was almost black in color and firmly adherent, it was discovered that, like a valve, a calcified portion of the intima had been turned into the artery from the anterior wall, probably occluding it one-half. The posterior wall of the artery, although calcareous in places, was apparently uninjured. The detached atheromatous plate was removed, and the compression on the artery diminished for an instant in order to wash out any remaining débris. The artery was then closed with through-and-through silk sutures. The circulation was immediately reëstablished, but after the lapse of a brief period pulsation below the injured point ceased. The arterial stitches were then removed and the vessel again found filled with clot. This was removed and the artery resutured. The same phenomena were repeated, and the hopelessness of securing a patent lumen by simple removal of the thrombus realized. The injured portion of the artery was therefore excised by a diamond-shaped incision, with the idea of closing the wound transversely. This, however, was found to be impossible, so that the artery was completely severed and each end split on the posterior wall, the flaps thus formed being turned outwards and the segments of the artery united with through-and-through silk sutures, bringing intima in contact with intima. Although the circulation was again reëstablished, at the time the skin wound was sutured pulsation in the artery below the site of anastomosis had become very feeble and no pulse could be felt in the tibial vessels. The gangrene, which was of the moist septic type, progressed rapidly and the limb was amputated through the upper thigh 10 days later by Dr. Le Conte. The flaps subsequently sloughed and reamputation was performed about one month later by Dr. Hutchinson. The patient finally recovered.

The chief difficulty in an operation like the foregoing is to prevent the reformation of the thrombus. The clot intimately adheres to the internal tunic and can be completely removed only with some difficulty, thereby subjecting the delicate lining membrane of the artery to further injury. If the artery is simply opened, the clot removed, and the vessel sutured, the cause of the thrombosis, *i.e.*, the multiple cracks in the intima or the curling up of the internal coat, is not suppressed, and the thrombus will quickly reform as it did in our case. There

are several ways in which this may possibly be prevented. If the contusion is sufficiently limited, the injured portion of the artery may be resected, and the vessel anastomosed by Carrel's technic. The advantages of this method over Murphy's anastomosis by invagination are quite obvious, as the latter considerably diminishes the lumen of the vessel and does not permit the removal of as much artery as the former. The extent of vessel which may be excised without exerting too much tension on the sutures will vary somewhat with the situation; thus in resection near joints flexion may be utilized to diminish tension, while in other regions, particularly where the artery is bound to the surrounding parts by branches, it will be impossible to effect anastomosis after the removal of a large extent of vessel. In the latter instance severances of the collaterals would probably facilitate this manœuvre, but generally would be contraindicated. Kümmel was able to approximate the ends of a femoral artery after resecting two inches, during an operation for cancer of the inguinal region. Another method of restoring the circulation after traumatic thrombosis which at once suggests itself is to substitute a segment of a vein for the injured portion of the artery, a procedure which has already been employed in the treatment of aneurysm. Whether or not the operation is feasible cannot be definitely stated at the present time. Experimentally varying results have been obtained. Höpfner transplanted a segment of a vein to an artery in 10 animals. The vein at once became twice the size of the artery. The twirling of blood within it could be seen and, as in aneurysm, this led to thrombosis. Efforts were made to prevent the dilatation of the vein by doubling it, *i.e.*, by turning one end back like a cuff, and also by suturing the surrounding tissues over it. The ultimate results were negative, as secondary hemorrhage occurred in one and thrombosis in all the others. The success obtained by Carrel in the transplantation of vessels in animals is well known and need not be recited here. Whether or not the companion vein should be employed for this purpose would depend upon the artery involved. One would not think of

transplanting a segment of the popliteal or the femoral vein to its accompanying artery, as in case of failure both the arterial and venous circulations would be suppressed and the



Showing thrombus in popliteal artery.

chances of gangrene very great. Probably the best vein to substitute would be the external jugular, although one of the brachial veins or even the opposite femoral vein might be employed. If the saphenous vein is sufficiently large, it like-

wise might be transplanted. In the arm where there are two venæ comites one of these could be selected.

Embolism.—The difficulty mentioned above would not be encountered in dealing with an embolus soon after its lodgment, indeed the chances of thrombosis would be no greater than after the most favorable form of arteriorrhaphy, since the intima is likely to be smooth at the point of impaction of the embolus. Case two we submit as one of embolism, although we have no means of definitely excluding primary thrombosis. As an impacted embolus quickly becomes the nucleus of a thrombus, the exact diagnosis from the standpoint of arteriotomy is unimportant. The important thing is the condition of the intima.

The patient was a man, aged 61 years, who had never been seriously ill before. He was suddenly attacked with generalized abdominal pain, vomiting, and constipation. This persisted for two days, at which time we saw him with his physician, Dr. James M. Montgomery, who feared the case might be one of intestinal obstruction. There was no fever, the pulse was about 100, and the intrathoracic organs normal. The abdomen was flat, soft, and slightly tender in the region of the left kidney. Rectal examination was negative. The blood vessels were distinctly atheromatous. With the use of laxatives and enemas the bowels were finally induced to move, and the abdominal symptoms subsided. In the meantime the patient developed a cystitis with bloody urine, possibly as the result of the catheterization which was found necessary at the beginning of the illness. About five days after the abdominal pain subsided the patient experienced a sudden excruciating pain in the right foot, which rapidly extended to the lower third of the thigh, and was accompanied by pallor, loss of heat, loss of tactile sensation, inability to move the limb, and coldness. We saw him the following day and found the limb cold as far as the middle of the thigh. The foot was shriveled, and the leg purplish as far as the upper third. Pulsation could not be felt in any of the vessels below the bifurcation of the femoral. Thirty-six hours after the onset of pain the patient was sent to the Jefferson Hospital, and the common femoral artery exposed by a longitudinal incision. It pulsated

vigorously to within one inch of the bifurcation. From this point to the bifurcation it was hard, and below the bifurcation collapsed. The vessel was isolated, compressed, and opened by a longitudinal incision about one inch long. The thrombus was Y-shaped, corresponding to bifurcation, the base of the Y being about one inch long and tapering at the tip. The limb corresponding to the superficial femoral was ½ inch long and also tapering at the tip. The limb corresponding to the deep femoral was one inch long and likewise tapering. The color of the thrombus was dirty white, with bright red spots and black blotches, except the terminal ½ inch of the limb corresponding to the deep femoral, which was jet black. The intima was smooth, although the vessel wall was decidedly thickened. On removal of the thrombus blood flowed freely from the peripheral part of the deep femoral, but not from the peripheral part of the superficial. The vessel was closed with a continuous through-and-through suture of silk, and over this a second layer uniting the outer coats only. Pulsation immediately reappeared in the femoral below and in the popliteal, but not in the tibial vessels. The skin wound was closed without drainage. After operation pulsation continued in the popliteal about one-half the strength for three days, then began to grow weaker, finally disappearing on the eighth day. In the meantime a large vessel on either side of the patella (superior external articular, anastomotica magna) pulsated more vigorously as the pulsation in the popliteal became weaker. The pain in the leg continued, being particularly marked in the popliteal space. The line of demarcation which formed was an irregular oval, the inside reaching to the junction of the lower with the middle third of the leg, and the outside to the junction of the upper and middle third. In the deeper structures the gangrene ascended to a higher level. Forty-two days after the first operation the leg was amputated below the tubercle of the tibia, lateral flaps of equal length being employed. About 15 ligatures were necessary, and the bone bled freely on section. The popliteal artery contained a small clot, and a probe passed up into the artery for several inches caused a slight flow of blood.

Perhaps the first thought which strikes one after reading the above cases is the inability which was encountered in two

instances to locate definitely the obstruction by the mere symptoms. In our first case we feel sure that the mistake would not have occurred could we have palpated the femoral artery itself. It seems that the symptoms are caused, not by the thrombus itself or even the sudden impaction of an embolus, but by the result of the arterial obliteration, *i.e.*, the acute anemia, thus the pain, etc., are referred to the area from which the blood is excluded, and not to the seat of obstruction. It will be seen, however, that the operation of thrombectomy or embolectomy, if it may be so called, can be readily performed without danger of secondary hemorrhage. We believe it to be indicated particularly when the intima is smooth, and that to be of value it must be performed as soon as possible after the arterial obstruction develops. Even though the vessel again becomes obstructed with clot, as in our second case, this may form slowly and give the collateral vessels a chance to dilate, thus saving at least a portion of the limb.

III. TECHNIQUE OF BLOOD-VESSEL SUTURE.

BY J. EDWIN SWEET, M.D.,
OF PHILADELPHIA.

If we will remember for a moment that the first suggestion of repairing wounded blood vessels, as well as the first attempt to carry out the suggestion, dates from the year 1759, —when Hallowel, an English surgeon, at the suggestion of his fellow, Lambert, attempted to repair a wounded brachial artery, and perhaps succeeded,—it is not surprising that many have endeavored, experimentally and clinically, to elaborate a successful technique for the suture of blood vessels.

Longitudinal wounds of blood vessels, and transverse wounds involving only a portion of the circumference, are easily repaired, the technique of such procedure being the common property of all surgeons of experience. The question before us to-night is the technique of the repair of wounds which completely divide the vessel,—the question of the end-

to-end anastomosis of blood vessels; a question involving accident cases, the treatment of aneurisms, the transfusion of blood from one human being to another, and, possibly, the transplantation of organs.

A most superficial consideration of the tubular structure known as a blood vessel leads to the conclusion that such a tube may be reunited in one of four ways,—I mean from the mechanical standpoint, (1) the ends may be brought as nearly as possible into their original position, approximating the various coats of the vessel to each other; (2) the edges may be everted, turning the cut edges outward; (3) one end may be inserted into the other end, invagination; (4) a mechanical aid may be employed.

I am personally inclined to the belief that the method of exact end-to-end approximation,—the method which has given such remarkable results in the hands of Carrel and Watts,— is easier of execution, and since it accomplishes that great surgical desideratum, the restoration of tissues as nearly as possible to their original position, is perhaps theoretically correct.

There seems to be unity of opinion as to the choice of suture material,—fine silk, of a size carefully chosen so that it will completely fill the hole left by the needle. The needles should be of the smallest possible size, round, either straight or curved, according to the individual and the site of operation. Experimenters are further agreed that the stitches should include all the coats of the vessel, since the penetration of the intima is a matter of no consequence.

The actual technique is, then, as follows: the exposed vessel is clamped by some means which must be very gentle, the simplest and best clamp being, in my opinion, the one devised by Herrick. The loose connective tissue of the external coat of the vessel must then be dissected away, the best procedure being to draw it down over the cut end of the vessel and to snip it off even with the vessel end; it will then retract, leaving the vessel free. This must be done, else the loose tissue will interfere by being dragged with the suture into the needle

holes. All insult to the vessel wall, such as grasping it with forceps, must be religiously avoided. If the edges of the wound have been crushed they should be freshened by resecting a bit with a very sharp scalpel; since the cut of scissors is always a crushing cut they should not be used.

Three tension sutures of fine silk, impregnated with vaseline, are then laid at equidistant points of the circumferences of the vessel ends. An assistant then applies traction to two of these guide sutures in turn, stretching the portion between the two sutures into a straight line, facilitating the laying of the continuous suture, and preventing a narrowing of the lumen. If at this time the third tension suture is weighted by means of a hemostat the circumference of the vessel will be arranged in the form of a triangle, the points of which are determined by the three traction sutures, and there will be no danger of catching the opposite wall while laying the suture, The suture is a continuous, overhand stitch, through all coats; the separate stitches should be drawn just tightly enough to secure absolute approximation, but not too tightly else the tissues be everted; they must be laid very close together. After the completion of the suture and the removal of the clamps there will often be some hemorrhage; if this is too free a few interrupted stitches may be laid, but a considerable hemorrhage will almost always stop under gentle digital compression. I wish to emphasize this fact, because of its bearing upon the later theoretical discussion. The danger of aneurism formation is very small; secondary hemorrhage is also as rare.

Now this sounds very easy, and, in truth, it is not very difficult, except for the extreme delicacy of the needles and the silk, and of the vessel walls; it is unusual surgery, since it partakes of the art of the watch-maker. Why, then, cannot everybody succeed in performing these simple, though delicate operations? Why do we read reports varying between absolute failure and uniform success? Why, out of four operations on the neck of the same animal, do we sometimes find the arteries perfect, the veins thrombosed, or the veins patulous and the arteries closed, or only one success, or all failure, or

all success? This is the question which, I think, leads us far away, into the fields where fact and theory too often establish a circulus viciosus.

In the first place, every author since Jassinowsky, whose work formed the first real contribution to our knowledge of this subject, has emphasized the necessity of a perfect aseptic technique. Carrel goes so far as to express his opinion that under ordinary "aseptic" conditions there are always a few bacteria which gain entrance to the wound; now these are so few that under ordinary conditions the tissues are able to destroy them. Not so in blood vessel surgery,—here we must have "absolute asepsis."

That infection around an uninjured blood vessel will cause thrombosis is banal. But I cannot believe that infection is the cause of the frequent thrombosis after blood vessel suture for several reasons; first, we find thrombosis with none of the usual macroscopic signs of infection, and, secondly, an early examination will show small non-occluding thrombi, and older specimens will show such thrombi completely healed over. In the third place, I have often observed that a thrombus will form in a sutured vessel, especially a vein, within a few moments after the clamps are removed, certainly hours too soon for these few bacteria to have caused it. Further, if this thrombus be removed by gently "milking" the vessel, another thrombus will replace it. In other words, the causes of thrombosis lie nearer at hand than bacterial action.

Just what happens when a blood vessel is wounded? The final processes of repair have been studied sufficiently to enable us to say that the vessel wall is completely repaired. The wound of the interior is covered with proliferated endothelium; some elastic fibres may regenerate, though the elastica is possibly not as perfectly repaired as are the other coats; the external coats are reconstructed by that excess of reaction so common in Nature as to be universal, and the vessel wall becomes stronger at that point than it was before the injury.

The problem of the coagulation of the blood is an extremely complex one. We know various factors in the process;

we know that foreign bodies and roughenings of the intima favor coagulation; that an interference with the free current of the blood is a favoring factor. We know that the tissues contain a substance or substances which cause rapid coagulation of the blood plasma, and that these substances are present in the tissues of the vessel wall. The formed constituents of the blood also contain these same or analogous substances. Calcium salts are necessary for the formation of fibrin. Experiments upon the vessels of animals whose blood had been made incoagulable by injections of hirudin or of peptone have shown that another process enters into the play, an agglutination of the blood plaques or platelets.

It is not necessary for us to decide between the theories concerning what happens first, or what happens further, as whether the action is a ferment action or whether it is not.

Let us think of the action of some of the factors in coagulation which I have mentioned. The suture, being inelastic, must offer a point where the current of the blood is more or less influenced; the sutures are the foreign bodies; the holes in the intima are rough; the tissue coagulins contained in the vessel wall have access to the blood through the needle holes; blood platelets are deposited in the wounds of the intima, even in incoagulable blood, and we know that a true coagulum can start from such a deposition of platelets. Further, if two factors are united in these biological phenomena, the result is usually much greater than the sum of the separate action of each factor.

That some coagulation occurs in every case seems to me to be proven by the statement to be found in every report of extensive work,—that slight hemorrhage is to be controlled by gentle digital compression. Such a method could only stop hemorrhage, it seems to me, by favoring the filling of the needle holes with a coagulum.

I therefore think that those who report uniformly successful results have succeeded not because they enjoy a monopoly of aseptic technique, but of mechanical technique. In other words, the man who will master the numberless details of

asepsis in experimental work on animals, where matters are more complicated than in human surgery, is probably the man who will master the delicate mechanics of the operation. The vessels are brought together with the least possible stretching or narrowing of the lumen, thus affecting the blood stream as little as possible. The foreign body is made less active as a foreign body by impregnating the silk with vaseline. The silk is so chosen as to fill the holes made by the needles and thus prevent the admixture of tissue coagulins from the vessel wall. Having excluded these factors, the deposition of blood platelets, which, I believe, always fills the wound of the intima at least, may perhaps be insufficient to cause the formation of fibrin and thrombosis.

The exclusion of these factors brings me to the consideration of a mechanical aid to blood vessel anastomosis, which is commonly called the method of Payr, but which, if my literary researches are correct, should be accredited to von Quirolo, his report appearing in 1895. The method consists in drawing the cut end of the vessel through a tube of glass, or ivory, or metal; the internal diameter of this tube is the same as the external diameter of the blood vessel. The vessel is then turned inside out, back over the tube, so that the intima is on the outside. This cuff is fastened in place by a ligature, and is then inserted into the other end of the blood vessel, which is fastened in its place by a second ligature. The ligatures are prevented from slipping off the little tube by placing them over grooves cut in the tubes, or back of a raised thread made on the outside of the tube. By this method broad surfaces of endothelium are placed in contact, and no wounds are made by the needles; the cut edges of the vessel, exuding coagulins, are entirely outside the vessel lumen. The method does not appear to have given specially good results except for temporary anastomoses, as in transfusion, where it seems to me to approach the ideal. It is not so easy to execute as it may seem. Crile has improved upon the original suggestions by attaching a handle to the tube, which greatly facilitates the eversion of the vessel.

The theories of the coagulation of the blood have carried me far out to sea; I was left there by the following facts concerning an operation little known, because of no practical importance. In 1876 a Russian army surgeon named Eck conceived the idea of making an artificial opening between the portal vein and the vena cava, in order to relieve the congestion in the portal system in cases of cirrhosis of the liver. He not only conceived this idea but executed it experimentally; and since that time the operation has been often performed, yet in no report do we find that thrombosis or embolism has resulted.

The operation has been done in several ways, none of which is calculated to prevent thrombosis. The vessels are brought together by interrupted sutures; wires or threads are then placed in position in the lumen of each vessel so that when the small scissors, the blades of which are fastened to the wires, are drawn through, after a second row of sutures has been laid, each blade must cut a linear incision through the wall of its respective vessel, an incision limited by the points of entry and exit of the guiding wires; the line of this incision is then enclosed by a second row of interrupted sutures parallel with the first, and the scissors are pulled through between the two rows of sutures. In my own method the wire of an electro-cautery is substituted for the scissors. The portal vein is then tied off at the hilus of the liver, thus forcing all the blood through a torn or burned wound through all the walls of the veins. The interrupted sutures also pierce the intima.

We have then a beautifully torn, rough wound, sutures with no attempt to neutralize their action with vaseline, undoubted coagulation,—since we have no hemorrhage between the sutures, which are laid from one-sixteenth to one-eighth of an inch apart,—and yet no thrombosis. The explanation may be that the portal vein has no collateral branches to open and enlarge, and the blood is forced to pass through this artificial opening; but on the other hand the pressure cannot be so great as it is in an artery. It might be that the portal blood contains peptone-like bodies which inhibit coagulation, but this

is hardly probable, for the portal blood coagulates outside the vessels as rapidly, if not more rapidly, than does blood from any other vessel. I have thought that the burned wound made by my cautery sealed the edges so that the tissue coagulins could not exude; yet equally good results have been obtained by using scissors; further, I have attempted to prove my idea by cutting the vessels of the neck with the cautery, and then joining them according to various methods; the results are possibly not so good as after the vessel wall had been severed by a sharp scalpel. In short, I am willing to admit that the processes governing thrombosis are not sufficiently clear to my own mind.

For the practical surgeon I feel that we may draw these conclusions: in any case where the anastomosis of a blood vessel is indicated, it should be tried; aneurisms and secondary hemorrhages should not occur. If immediate thrombosis occurs we would be as well off as though the vessel had been ligated; if gradual thrombosis occurs, we might well hope that such a process would be more favorable to the formation of a collateral circulation than would immediate ligation; and if we should succeed, the literature of surgery would undoubtedly be enlarged and enriched.

IV. ENDO-ANEURYSMORRHAPHY (MATAS).

BY CHARLES H. FRAZIER, M.D.,
OF PHILADELPHIA.

One of the most fascinating chapters in the history of modern surgery concerns the application of the suture as applied to lesions of the vascular system. These revolutionary measures have attracted wide attention not only because of their applicability to the treatment of the everyday lesions of the vascular apparatus, but because in simplifying the technic of direct transfusion they open a field of speculation, the possibilities of which are just beginning to dawn upon us.

The history of the development of the suture in the surgery of the vascular system and its applicability to the treat-

ment of aneurysm has been so graphically described by Matas that I will confine my remarks to my personal experience with his operation, adding such comments as may be suggested by the conditions which presented at or after the operation.

CASE 1. B. T. (University Hospital, No. 1313, Series 2.) *Popliteal Aneurysm: (Sacciform) Endo-Aneurysmorrhaphy (reconstructive): Recovery.*

A colored man, 38 years of age, was referred to me by Dr. C. S. Weeks in April, 1906. He was a waiter by occupation. He had had syphilis about eighteen years ago and was addicted to the free use of alcohol and tobacco. Eight months ago (September, 1905), the patient began to complain of a dull pain in the popliteal space. The knee joint felt stiff and the patient thought he had rheumatism. The pains and stiffness increased but it was not until two months later (December, 1905) that he noticed a small swelling, about the size of a chestnut, in the right popliteal space. The swelling gradually increased in size, until one month before his admission to the hospital, when it began to increase so rapidly that he was obliged to give up his work.

Upon examination there was found a pulsating tumor occupying the lower portion of the popliteal space measuring 10 cm. in its longitudinal and 11 cm. in its transverse axis. The circumference of the limb over the tumor was 32½ cm. as compared with 29 cm. on the unaffected limb. The leg below the aneurysm was somewhat swollen and the superficial veins quite prominent. There was a visible expansile pulsation and a marked bruit on auscultation. Pulsation could not be felt in the anterior tibial vessel. Operation. April 28, 1906. Under nitrous oxide-ether anæsthesia, an Esmarch tube having been applied to the thigh, a longitudinal incision was made directly over the tumor. Upon opening the sac a careful inspection proved that we were dealing with an aneurysm of the saccular or sacciform type, having but one communication with the parent artery. The operator then proceeded to remove the clot which partially filled the aneurysmal sac. This proved to be a rather slow process because the laminæ, particularly the deeper ones, were well organized and quite adherent to one another. These were peeled off as one peels an onion. Microscopically these clots were found to be well

organized, being composed of a stroma of young connective tissue within which were sprouting newly formed blood vessels. When the sac wall was finally stripped of its clots the single communication with the artery was closed with a continuous silk suture and the sac cavity obliterated by means of two layers of fine silk sutures. The cutaneous wound was closed with silk worm gut suture, the dressing applied, and fixation assured with a posterior splint. The post operative convalescence was devoid of interest. At no time was there any cause for apprehension as regards the vitality of the limb below the seat of operation. The temperature of the foot on the affected side was unaffected, the limb was not swollen so that I was quite sure neither the arterial nor venous circulation had been affected by the operative manipulations. The patient complained of numbness in the limb for a few days but this sensation soon passed off. There was some suppuration in the upper layers of the wound. While accidental infection may occur in any wound there are two factors, which in this particular operation may be regarded as predisposing causes, one traumatism, such as may be inflicted in removing the laminated clot, the other, impairment of circulation; Matas, in speaking of the chief points to be observed in closing the wound, says "too tight or too many sutures must be avoided in order not to compromise the circulation of the sutured tissues."

When the patient was discharged from the hospital there was no pulsation detected in the anterior tibial artery, a condition which was noted before the operation. The patient was examined in October, 1906, nine months later, when there were no signs of recurrence.[1]

Comments.—In this case I was surprised with the comparative simplicity of the procedure from the technical standpoint. There was of course no difficulty in rendering the field of operation bloodless, the aneurysm was easy of access. At no time was there any danger or fear of injuring the popliteal vein, which there would have been had any attempt been made to remove the sac. Whatever difficulty there may have been was entailed in removing the laminated clot and in determining when the intima had been reached. The layers which com-

[1] The patient died January, 1907, of pneumonia, at which time it was reported that there was no recurrence.

posed the clot were firmly adherent one to the other, in fact there was, as proven by microscopic examination, absolute union between the layers. A good deal of force had to be applied to separate them from the sac wall, and on several occasions I thought the intima had been reached only to find one or more layers still adherent. With more experience and with greater familiarity with the gross appearance of the structures involved this step of the operation could have been conducted more expeditiously. The necessity of removing everything necessary to lay bare the intima is apparent; inasmuch as the success of the operation depends absolutely upon the apposition and union of the serous coat of the aneurysmal sac and arterial orifice. The single communication with the parent artery was situated at the bottom of the sac near its upper extremity and not in the middle. We are accustomed to see the communication with the artery, in cases of saccular aneurysm, diagrammatically represented about the middle of the sac. This was the position in which I expected to find it in this case; failing to find it there, it was some time before I discovered it near the upper pole.

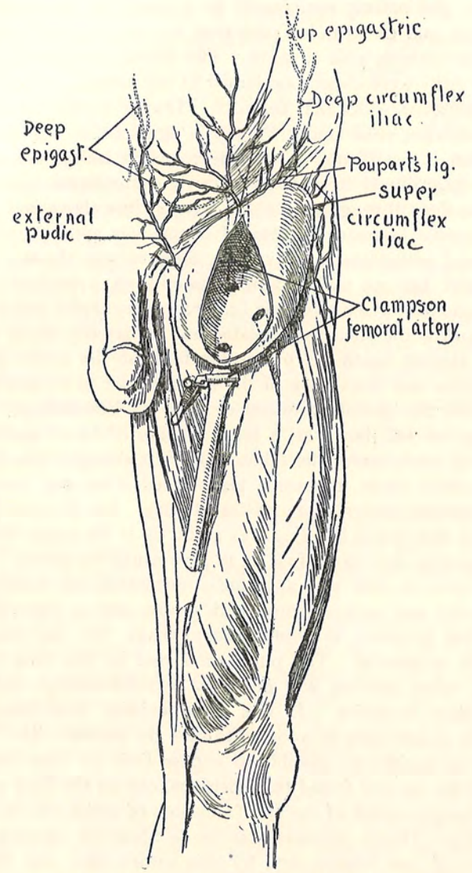
CASE 2. T. S. (University Hospital, No. 1785) *Femoral Aneurysm (Sacciform: two communications with parent artery): Endo-Aneurysmorrhaphy (Obliterative), Gangrene, Amputation, Recovery.*

A colored man, 34 years of age, presented himself for treatment at the University Hospital, October 8th, 1906. He had contracted syphilis eight years ago, he used alcohol very freely and his occupation, as a porter, required him to lift heavy objects. Although by occupation and habit he had paved the way for aneurysmal formation he attributed the lesion to an injury which he had received three months ago. He struck the groin against the corner of a table and two weeks later he noticed in the femoral region a small lump, which increased in size and soon began to pulsate. An examination revealed a powerful subject with numerous cicatrices on the cutaneous surface, the result of old syphilitic lesions. The arteries did not seem to be sclerotic. Extending from Poupart's ligament to the apex of Scarpa's triangle and some 12 cm. in width was the aneurysmal tumor.

Pulsation was controlled by pressure upon the femoral artery just below Poupart's ligament. Below the knee the limb was swollen, the patient complained of a sense of numbness about the knee, and of so much pain that for the past two weeks he has been scarcely able to walk. The character of the operation and its risks were clearly explained to the patient.

Operation.—October 10, 1906. Owing to the situation of the aneurysm, close under Poupart's ligament, it was quite evident that it would not be feasible to use a tourniquet. I proceeded accordingly to close temporarily the external iliac artery: this was done through an oblique incision just above and parallel to Poupart's ligament an arterial clamp was applied and as an additional precaution a heavy silk ligature was thrown around the vessel, but not tied. This accomplished, a vertical incision was made over the site of the tumor, the aneurysm exposed, the artery below the aneurysm isolated and an arterial clamp applied here. Having taken the precaution to close the artery on both the cardiac and distal side of the sac, I hoped to be able to proceed with the operation unembarrassed by hemorrhage. Upon opening the sac, however, a large column of blood spurted out a foot or more above the table. My first thought was that the blood which made its escape represented what was present in the aneurysm under more or less tension, but it soon became apparent that active bleeding was going on in the aneurysmal sac. The bleeding was so profuse as to give cause for alarm. I have never seen so free and apparently uncontrollable hemorrhage. The cavity was packed firmly with gauze, and an attempt made with firm pressure to control hemorrhage, but this was only partially successful. The pulse soon rose to 160 then to 170; normal saline solution was given by hypodermoclysis and other appropriate remedies. It was quite evident that some more effective means must be adopted to save the patient's life. I proceeded as rapidly as possible to expose little by little the inner wall of the sac and found two openings, one on the floor and one on the lateral aspect of the sac, from both of which the blood was streaming. Direct pressure was made upon the openings with the tips of two fingers, and by this means only was bleeding finally arrested and an opportunity offered to inspect the sac. The latter was found to have three openings, two on the floor and one on the side. These were closed as rapidly as possible

with fine catgut sutures. The laminated clot was then peeled off, as in the first case, and the cavity of the sac obliterated by taking



Femoral aneurism:—showing openings in floor of sac.

up the lateral folds and bringing them together with a continuous mattress suture after the manner prescribed by Matas. Three

layers of sac superimposed over the arterial orifices sufficed to obliterate most of the aneurysmal sac; there still remained a small pocket at the upper pole, so far distant from the artery itself, that there seemed to be no objection to leaving it undisturbed. A drainage tube was introduced, the wound closed with interrupted silk worm gut sutures. After the dressing was applied the limb was enveloped in cotton and elevated. The patient's condition when he left the table was better than it was earlier in the operation. On the following day the toes were exposed and found to be warm, but anæsthetic; there was no pulsation in the dorsalis pedis. On the fourth day the patient complained of pain in the calf of the leg, there was marked tenderness when pressure was exerted over the course of the posterior tibial vessels, the limb was evidently swollen, and the foot was cold. It was quite evident that the circulation was seriously impaired and that gangrene would follow. The line of demarcation soon formed and the limb was amputated. A careful dissection of the specimen made for me by Dr. B. A. Thomas revealed the cause of the gangrene in a thrombus which had formed in the popliteal vessel just above its bifurcation, and extending for a short distance into both tibial vessels.

This case has been presented in greater detail than would at first sight seem warranted, because of two more or less distinctive features; the tremendous hemorrhage and the gangrene. Of the 35 or 40 cases that are on record this is the first case in which gangrene followed an uncomplicated endo-aneurysmorrhaphy. This was a very unfortunate occurrence, inasmuch as one of the strongest arguments in favor of the Matas operation is its safety to the patient and to the parts involved, because of the non-interference with the collateral circulation and the avoidance of gangrene. The operation is founded upon such sound principles and the mode of procedure has been so carefully elaborated by Matas that I am quite willing, if not anxious, that in this case some error in technique may be discovered which will account for the thrombus formation and ultimate gangrene. From the subjective and objective symptoms it would seem that the thrombus had obliterated the vessel on the third or fourth day. The process may have

originated at the site of the thrombus or it might have been due to the lodgment at that point of an embolus. There was an accidental infection of the wound, but there could be no relation of cause and effect between an infection above the seat of the aneurysm and the thrombus below the aneurysm, a segment of obliterated vessel intervening between the two. It seems much more reasonable to attribute the thrombus formation to an inadequate collateral circulation.

The second rather distinctive feature was the tremendous hemorrhage. One of the conditions which Matas considers essential for the success of the operation is provisional or temporary hemostasis. The aneurysm should be so situated that provisional hemostasis may be obtained by controlling the proximal arterial supply of the tumor on the cardiac side. "When circular constriction (as in my case) is impossible great care must be observed," writes Matas, "in securing the distal as well as the cardiac side of the main trunk in order to obtain a comparatively bloodless field." Accordingly I closed temporarily with arterial clamps the vessel on the distal and proximal side with what results has already been told. While the hemorrhage was most profuse, it was at the same time a most instructive demonstration, for it proved at once how utterly futile in this case it would have been to have practiced one of the older operations, particularly ligation, and illustrated beautifully the point upon which Matas has so frequently laid stress, namely, that the complete obliteration of the sac and the freedom from recurrence depends not only upon closure of the parent artery, but the collateral branches.

Had the reconstructive rather than the obliterative type of operation been carried out gangrene might not have occurred. There were two communications with the parent artery, but there was nothing left by which the course of the parent artery between the two openings could be recognized. It was blended with the aneurysmal sac throughout its circumference. Even had it seemed possible or desirable to reconstruct the artery the operation in this case could not have been carried out in the presence of so much free and uncontrollable bleeding.

Because of the evidence of so free a collateral circulation I was disposed to give a favorable prognosis as to the preservation of vitality and was much surprised when gangrene developed. While there is an erroneous impression that the Matas operation implies the reconstruction of the artery, "for all practical purposes the preservation of the continuity of the artery is not essential to success and is only indicated positively in the sacciform aneurysm with a single opening, when the parent artery already exists as a formed vessel." (Matas.) With this experience, however, I should be disposed in the future particularly in femoral aneurysms and under favorable conditions to attempt to reconstruct the artery, rather than depend entirely upon the collateral blood supply.

V. ENDO-ANEURYSMORRHAPHY (MATAS).

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

THE ideal operation for the cure of aneurism is one which arrests completely and permanently the circulation of blood in the sac, without interfering with the blood supply in the parts beyond the aneurism. These two objects have always been in the mind of the surgeon and numerous operations have been devised which have accomplished them in certain situations.

The Matas operation comes nearer the ideal than any other, and is more generally applicable. Certain aneurisms, like those of the thoracic aorta, are probably beyond the field of operative surgery, but in every accessible variety where the circulation can be temporarily controlled, the Matas operation can be employed. Accessibility and temporary control of the circulation are essentially necessary, and where impracticable the operation should not be attempted. These limitations, however, do not prevent endo-aneurismorrhaphy being more universally applicable than any other operation for the cure of aneurism. It is not, however, the general applicability of the operation which has caused it to take first rank as a

radical cure, but especially the fact that it interferes less with the blood supply beyond the aneurism than any other.

The experimental work of Carrell, in this country, and of San Martin, Höpfner, Payr, Ullman, Jassinowski, Glück, and others abroad, together with the clinical and experimental work of Abbe, Murphy, Crile, Brewer, Hubbard and Matas, has shown with what readiness the blood vessels lend themselves to plastic operations. Suture, anastomosis, transplantation, substitution of vein for artery, arteriotomy for embolism, all of which have now been shown to be perfectly practicable, give some idea of the possibilities of vascular surgery.

The Matas operation has for its foundation this experimental and clinical work. It having been shown that when intima is approximated to intima union occurs just as when two peritoneal surfaces are placed in contact, Matas conceived the idea of closing the openings of the blood vessels in the aneurismal sac and of obliterating the sac by approximating its walls. He first operated by this method in 1888,[1] and reported a case, but his paper attracted little attention. At the time of publication of his second paper, in 1903,[2] he had done this operation four times. He suggested two other possibilities; first, the repair of the artery in sacciform aneurism, and second, the reconstruction of the artery in fusiform aneurism when the openings of the vessel were on the same line and not too far apart. To show that these were good suggestions it is only necessary to point to the successful cases since reported.

Bickham,[3] in an excellent paper, has shown that the principle of endo-aneurismorrhaphy is equally applicable to all accessible arteriovenous aneurisms, a variety in which ligation is especially dangerous, because of the likelihood of gangrene resulting from obstructed circulation.

Matas' own papers are so complete and comprehensive that it is unnecessary to go minutely into the technique. Briefly, the operation consists in controlling the flow of blood in the diseased vessel by compression; the free incision of the sac from end to end; the evacuation of its contents; the closure

by suture of the arterial openings in it; and then the obliteration of the sac by plication and infolding of the skin. In the case of a sacciform aneurism but one opening requires closure, and when this is done the caliber of the vessel is, of course, reëstablished. In the fusiform aneurism there are two courses open to the operator—one, of closure of the two openings of the artery into the sac, and of any collaterals which may originate within the sac, and then the entire obliteration of the sac by continuous rows of sutures; or, he may reconstruct the arterial caliber by suture over a catheter which is withdrawn before the last sutures are tied. Although I consider that the operation is no longer on trial, yet it is important that all cases operated on should be reported in order to compare the results with those of the older operations. In Matas's last paper [4] he classified 34 operations performed by twenty-one American surgeons, and referred to 6 foreign cases done by three operators, in which there was considerable variation of the technique—so much in fact that he is not inclined to combine them with the American cases. He believes that there has been a great misapprehension regarding the technique on the part of foreign surgeons, many of whom have on this account disapproved of the operation. In this series of 34 cases there have been but two deaths, neither attributable to the operation itself. One patient died fifteen days after operation from associated pyelitis and nephritic coma, the wound having healed completely. The other patient died on the seventeenth day after operation. This patient had an aneurismal diathesis and after operation developed multiple aneurisms. He was first operated on for a ruptured aneurism of the right popliteal, the sac was extirpated; he then developed a left femoral aneurism which was operated on by the Matas method. Twenty days later the vessel above the aneurism dilated and ruptured at a point where a traction loop had been applied for the temporary control of the circulation. Ligation of the femoral high up was then done but suppuration took place and later gangrene of the foot. Six days after this a secondary hemorrhage occurred and the external iliac was

ligated, the gangrene extended, and the leg was amputated in the mid thigh. The patient died in about two weeks from exhaustion. It should be noted that in this case neither secondary hæmorrhage nor gangrene took place until the vessel was ligated.

In none of the other cases did either hemorrhage or gangrene occur as a complication.

In considering the question of permanent cure, Matas divides the operations into obliterative, those in which the arterial openings were closed and the sac obliterated; restorative, those in which the aneurisms were sacciform and the arterial opening was closed without interfering with the circulation in the artery; and reconstructive, those in which a new vessel was constructed from the aneurismal sac. There were 22 of the obliterative cases with no relapses; there were 7 restorative cases with no relapses; there were 5 reconstructive cases with 2 relapses. In one of these an amputation was done at the patient's request. In the other case a second operation was done, the openings in the sac being occluded by suture, and a cure resulted.

I have been able to add to this collection of 34 cases 3 from recent literature, (McCord,[5] Brown,[6] and Yocum,[7]); a second case of my own, and a second case of Frazier's,[8] making in all 5 additional cases. Two of these were reconstructive operations, both of which were followed by good recoveries without complications; one was a restorative operation with an equally good result; two were obliterative operations, in one gangrene occurring on the fourth or fifth day necessitating amputation, after which the patient recovered; and in the second, my own case, death occurred on the 59th day from uræmia, the patient having been in a bad condition from chronic Bright's disease at the time of operation. The wound in this case was practically healed and the œdema of the limb had disappeared. My first case was operated upon on October 26, 1904.[9] I examined this man a few days ago and there was no evidence of any return of the aneurism, and after two years and a half it is unlikely that any recurrence will take place.

In this connection it is interesting to refer to a case of popliteal aneurism reported by J. Goyanes,[10] of Madrid, in which he ligated the artery above and below the sac, and then transplanted a section of the popliteal vein to bridge the defect in the artery. The result was successful. This operation was suggested by San Martin in 1902, and this is the first clinical case. The anastomosis was made according to the technique of Carrell. It is impossible to say what the future of this operation will be, but it certainly is of limited applicability and requires the most expert handicraft. It is unlikely that one who has not done considerable experimentation with arterial suture would be justified in attempting it, especially when the Matas operation is so much simpler and gives such remarkably good results.

In a ruptured aneurism with a large false sac, such as was found in my second case, it is difficult to carry out completely the Matas technique. The lining membrane has not yet taken on the characteristics of the intima of the vessel, nor is it sufficiently organized to stand the necessary traction by the sutures to permit of obliteration. Even in these cases, however, the openings of the vessels in the sac can be closed by suture and the principal benefit of the Matas operation gained, namely, the cure of the aneurism with the least possible interference with the circulation of the part.

The great disadvantage of the older operations is the extent to which they interfere with the circulation of the part beyond the aneurism, and the consequent frequency of gangrene. The ligation operation not only interferes with the circulation in the sac, but also cuts off a certain number of anastomotic branches which originate between the ligatures and the sac. The extirpation operation, although it allows the ligatures to be applied much nearer the sac, also greatly interferes with the establishment of anastomotic circulation by injury of the surrounding tissue, and gangrene frequently follows.

The Antyllion operation, although not cutting off as many anastomotic branches as the ligation or extirpation operations,

at the same time does require considerable manipulation beyond the sac in order to apply the ligatures and consequently is objectionable. To my mind, the Matas operation is the simplest yet devised, and the least likely to be followed by gangrene. That it is curative the statistics show conclusively.

The following is an account of my second case:

Dr. F., aged 57 years, was operated upon at the Bryn Mawr Hospital, on November 24, 1906. I first saw the patient on October 30th with Dr. Walter Chrystie. At that time he had a small popliteal aneurism about the size of a hen's egg. He had been having some fever and was generally in very bad condition. His urine contained albumin and casts and the secretion was scanty. His vessels were atheromatous and he had valvular heart disease. At this time he was put on increasing doses of iodide. I next saw him on November 13th with Drs. Earnshaw and Gamble. His general condition had not improved, excepting that the kidney secretion was greater. Two days before operation his pulse was 120 and of very high tension. The leg was very much swollen, which had developed since I first saw him. The pain had been so great since the increase in the size of the aneurism that morphia had to be used pretty continuously. On account of his general condition I was very loathe to operate upon him, but he suffered so much that there seemed to be nothing else to do. He had gotten up to 75 grains of iodide a day. Half an hour before operation he was given 1–6 of a grain of morphine and 1–100 of a grain of scopolamine. A tourniquet was applied until the pulsation ceased, and I then injected the line of incision with Schleich fluid. I made an incision, opened and evacuated the aneurismal sac without causing much pain. The aneurism had ruptured and a false sac had been formed in the surrounding tissues. The removal of the organized portion of the clot caused considerable pain, and as I was unable to detect with my finger the arterial openings in the sac, and if I had found them, would have been unable to suture them because any attempt to put the patient's leg straight gave him a great deal of pain, I was compelled to give him ether. I found both openings in the sac and closed them by suture. The sac was very friable and the sutures cut very easily, so that I had considerable difficulty in closing the openings, especially the proximal one. The sac wall was so friable that I could not reef it over, as is done in the Matas operation, and I therefore simply introduced a gauze pack and a few sutures in the muscular structures. The patient stood the operation, which occupied forty-five minutes, very well.

The next day he was passing a sufficient quantity of urine, his pulse had dropped to 104, and was of much lower tension. The swelling of the leg had greatly decreased, he had practically no pain, and his temperature was normal. The circulation in the foot was good, though no pulsation could be felt in the anterior tibial. This pulse could not be detected before the operation. This improvement in the patient's condition was only temporary, however, as the kidney and heart lesions steadily progressed until January 22, 1907, when he died of uræmia. At the time of his death there was no œdema or other recurrence of the aneurism. The wound had gradually filled up with granulation, until there was only a superficial area unhealed.

The only advantage of the operation in this case was that the patient was completely relieved of his pain and was able for a while to get out of bed with comparative comfort.

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[2] Matas, Annals of Surgery, February, 1903.
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[4] Matas, Journal of American Medical Association, September 29, 1906.
[5] R. C. McChord, Jour. Amer. Med. Assen., Vol. 47, 1906, p. 993.
[6] Israel Brown, Jour. Amer. Med. Assen., Vol. 47, 1906, p. 362.
[7] James R. Yocum, Jour. Amer. Med. Assen., September 29, 1906.
[8] Charles H. Frazier, Annals of Surgery, September, 1907.
[9] John H. Gibbon, American Medicine, August 19, 1905.
[10] J. Goyanes, Siglo Medico, September 8, 1906.

Dr. George E. Brewer, of New York, said that for years he had been interested in this phase of surgery, particularly the Matas operation, and has long wished to hear the results of that procedure as detailed in the instances just reported. He has never carried out the procedure himself as none of the cases in which he expected to employ it proved suitable. He has, however, met with a case similar to one of those described by Dr. Frazier. It was one of aneurism of the first part of the femoral artery and

the vessel above and below was ligated with the expectation of later excising the sac. Ten days later he began excision but found excessive hemorrhage, due, as in Dr. Frazier's case, to two or three branches in the wall of the sac. Hemorrhage was with difficulty controlled. Such vessels are apt to be found in aneurismal sacs in this location. Dr. Munro's suggestion regarding the ligation of the ductus is to be thought of in suitable cases. If the diagnosis can be made the treatment is rational as the hopelessness of these cases is well known.

Dr. Brewer's own work has been experimental, based on efforts to close accidental wounds of arteries. The first accident was the wounding of an external iliac during a hernia operation, the suture being introduced from below upward instead of downward. Bleeding was profuse and it was found that a Hagedorn needle had passed through the vessel. Two attempts were made to suture the artery, in which the wound was one-fourth inch long. Tension was high and the sutures tore out each of two times they were inserted. The vessel was then ligated. Fortunately there was a free collateral circulation which maintained such satisfactory conditions that the patient never knew he had more than a hernia operation.

The second case was one of cancer of the breast in which a house surgeon who was operating plunged a knife into the axillary artery. The vessel was sutured and apparently no thrombus formed. Several mattress sutures of fine silk were inserted with a round needle, the walls of the vessel being so thick that the intima was probably not wounded. Six weeks later the clinical result was good. This is the only artery he has ever successfully sutured. These accidents led to the experimental work reported a few years ago, in which he used for wrapping the vessels, an elastic plaster made up of a strip of very thin gum, coated with an adhesive material like that used in the zinc oxide plaster. Experiments were made on a large number of animals and some of the results were good. He regards the method as worthy of trial in accidental wounds of the arteries.

Dr. John B. Murphy, of Chicago, described a case of double embolism involving the right femoral below Poupart's ligament and the left common iliac, the case being one of sepsis and malignant endocarditis following extraction of a tooth.

Removal of the obstruction in the legs was thought of but embolism of the brain caused death before the operation was undertaken.

The work of Dr. Sweet is appalling from the standpoint of the time and labor necessary. Dr. Murphy is pleased with the results obtained, not only in the technical work but also in the train of thinking in respect to thrombosis in arteries and veins. From this one comes finally to the practical results of arterial work shown in the cases of Frazier and Gibbon; the work from 1889 on by Matas and others is showing results. In analyzing the work done in the suture of arteries it may be reduced to three essential methods: first, end-to-end suture; second, end-to-end implantation; third, suture by mechanical support. The third, promulgated by Abbe, was not a bad idea.

For practical suturing of vessels two things are essential; there must be no immediate hemorrhage and no immediate thrombosis. Gangrene results from immediate primary ischemia. If ischemia come on gradually there is no thrombosis, this being shown clearly by specimens in the British museum. If therefore we can devise an operation that will tide over a few days, we will succeed. In an aneurism where it is impossible to employ the Matas operation if we can produce a gradually occluding endarteritis in the proximal vessel the lesion will be cured. Most of the work upon arteries previously reported was too coarse. The greatest element in the production of endarteritis is trauma and not infection; where the artery is pinched is the point of greatest danger. Carrel's great care in handling and suturing the vessels is his dominant point, and this adds more to his success than does any other feature of his work.

Dr. J. C. Hubbard, of Boston, said that his experience in arterial surgery had been obtained by doing an arterial venous anastomosis in two cases for reversal of the circulation.

The first case, already published in the Annals of Surgery for October, 1906, was that of a man of 80 years with senile gangrene of a portion of the right foot. Physical examination showed him to be a decidedly senile old man with atheromatous arteries and a systolic heart murmur. No pulsation could be felt in the right dorsalis pedis artery. In May, 1906, he was operated upon. The femoral artery and vein were isolated in Scarpa's triangle below the origin of the profunda and divided

between Crile's clamps or elastic ligatures. The upper end of the artery was then invaginated into the lower end of the vein and the distal end of the artery into the proximal end of the vein. A complete reversal of the circulation was thus established. The technique of the invagination was as follows: Three double headed sutures were passed equally distant through the entire wall of the artery from inside out. The needles were then passed into the lumen of the vein about a quarter of an inch and at this point through its wall. When these sutures were drawn tight the artery was drawn into the vein. Reënforcing sutures including only the outer portion of the arterial wall were then placed here and there to catch the edge of the overlying vein to the artery. Number 1 Pagenstecker thread was used for all these sutures. When the controlling clamps were removed there was no leaking at either suture line and weak pulsations could be felt in the vein for a short distance below the anastomosis. There was absolutely no shock shown by the patient and recovery from the operation was satisfactory in spite of the fact that the senile condition of the patient made it difficult to keep him in bed or a dressing on the wound. After the operation the appearance of the leg did not change. There was no œdema, dilatation of the veins or cyanosis. The gangrene which existed before the operation spread a little and then a line of demarkation formed. When the foot was later amputated at the point of election on the tibia both tibial arteries contained arterial blood. The stump healed satisfactorily but slowly. In March of this year, ten months after the operation he saw the patient. The stump was well supplied by the circulation and there was no difference in appearance or size of this leg and the unoperated one.

Clinically this case was most successful but the exact meaning of the presence of arterial blood in the tibial arteries at the time of the amputation he did not know. It seems that the arteriovenous anastomosis must have increased in some way the amount of blood in the leg, for it is hard to believe that an amount of blood so small as to permit gangrene of the foot would be sufficient to nourish for ten months an amputation stump made only a short distance above the gangrenous area and had clots formed at the sites of the anastomoses it seems most probable that the gangrene would have extended up the leg instead of remaining localized.

The second case was that of an old woman of 60 years with senile gangrene of the foot and a portion of the leg. The arteries were atheromatous. She was operated upon during February of this year. The femoral artery and vein were divided as in the first operation. The artery was much calcified and was so hard that some force was necessary to drive the needles through it and so brittle that the stitches tore out most easily. The intima formed a distinct lining to the vessel and was much like a second smaller tube inside a larger one. These characteristics of the wall complicated the technique immensely as the attempt was to make the anastomosis according to Carrel's method, turning the walls so that at the suture line intima should come in contact with intima. The artery was so much like a pipe stem that this was impossible although a conscientious attempt was made. The ends of the artery and vein were therefore cut off freshly and the artery invaginated into the vein as in the first case the only difference being in the use of vaseline to smear the ends of the vessels. The distal end of the artery and the proximal end of the vein were then ligated. The vein pulsated after the controlling clamps were removed. Pagenstecker No. 1 was used. There was no shock and no change in the appearance of the leg. Ten days later it was necessary to amputate above the knee for the gangrene which had been present before the operation. During these ten days it had become more pronounced but its limits had extended only a little. During the amputation the anastomosis was cut down upon and removed. The artery was found filled with a loose, easily detached clot. This case was therefore a distinct failure.

From these cases he believed it to be perfectly evident that there is no danger in continuing investigations further as there is no shock to the operation. Carrel's method is not applicable to a certain number of the cases where the operation is done on old persons with atheromatous arteries. On young persons and experimental arteries it doubtless is most satisfactory but as the operation has been proposed to cure conditions dependent upon lack of circulation in the extremities some other technique must be found as practically all cases, except perhaps some due to trauma, will necessarily be in elderly persons. An objection which may be raised to the invagination method as employed in the above cases is the fact that the divided end of the artery

leaves a certain portion of its wall in the blood stream uncovered by intima which favors clot formation. This method was introduced by Murphy in 1897 (*Medical Record,* Jan. 16) for the repair of the continuity of an artery and was recommended only after experimentation. The slight modification of invaginating the artery into a vein instead of into another portion of the same artery would seem not to invalidate the method. However, as at present this objection might be raised, he was working on some scheme to obviate this difficulty, but as yet could not report results. Two ways had occurred to him. One is by smearing vaseline or some other substance onto the cut end of the invaginated artery to keep it out of the blood stream. The other way was suggested by the appearance of the arterial wall in the second case where the intima formed a distinct layer inside the others and one which remained intact when the others cracked away from it. He had thought that it might be possible to cut the outer layers of the artery a quarter of an inch or so back of the intima and thus leave a greater length of intima as a cuff, the back of which could be covered with vaseline so that when invaginated into the vein it might stick to the venous wall and cover over the cut end of the outer portion of the artery.

Dr. Robert H. M. Dawbarn, of New York, said Dr. Sweet's statement, that silk sutures were everywhere admitted to be the best, he must take exception to. A good many years ago Dr. Willy Meyer, of New York, proved by experiments that linen, cotton, and silk threads are tolerated equally well by the body tissues.

Of these linen is, size for size, the strongest, and is not seriously weakened by boiling; whereas silk is distinctly weakened.

For these reasons Dr. Dawbarn said he has not for years past used silk in surgery for any purpose whatever. In bowel and stomach work he has long advocated linen sutures—probably for ten years; though he would not bury it elsewhere in the body, except when exceedingly fine in diameter, as in Dr. Sweet's work upon arteries.

By asking at any large department store for such linen thread as is used in mending Renaissance lace, one can get size one thousand—which is as fine as can be used, practically, in vessel-

work. It would seem to Dr. Dawbarn that if one employs women's finest sewing needles, removing the temper by heat enough to allow of curving them, and avoids having the thread pass through the intima, so that it does not touch the blood current nor invite clotting, it might be a help. And yet Dr. Dawbarn did not wish to claim the least personal experience of work, such as that of Dr. Sweet, and would defer to his opinions in these matters.

Regarding Dr. Brewer's ingenious device for control of an important artery wounded accidentally at operation, Dr. Dawbarn said he must repeat his criticism offered upon the occasion when Dr. Brewer presented before the New York Surgical Society the results of his experimental work upon dogs. These experiments were very ably done, and the results satisfactory. To Dr. Brewer belongs the credit of the thought, and Dr. Dawbarn merely suggested a different material to wrap about the artery after its suture, and before allowing the current to be resumed; namely, Cargile membrane. This is always at hand, and, whether the adhesive or non-adhesive, will be equally satisfactory. It is very strong. After wrapping the vessel several times the final edge is sewn to the layer just beneath.

Being absorbable tissue it will in time disappear. As to the special kind of thin surgeon's rubber plaster advocated for this purpose by Dr. Brewer the life of rubber plaster is short, at best, and nobody would be likely to keep this specially thin kind on hand, and renewed often, to meet so very rare an accident. Also, being non-absorbable, it is capable at times of causing trouble later; becoming finally an irritant, however thoroughly aseptic it may be.

Dr. Dawbarn has tried upon two dogs' common carotids the gold-beater's skin adhesive plaster as just advocated by him, and with excellent results. The specimens, with others to be obtained by later work, he hopes to show in time.

Dr. Dudley P. Allen, of Cleveland, said his first experience in suturing vessels was in connection with wounds of the veins. The first case occurred between ten and twelve years ago. It was a wound of the longitudinal sinus, the length of the wound being ¾ of an inch. The wound occurred in an operation upon the brain and it was closed by a continuous suture of fine silk,

the skull was re-placed, and healing took place without any complications.

There is one condition which has not been mentioned in which suture of the vessels might prove to be of great value. Occasionally sarcomata develop in the popliteal space, being unattached to bone. It may be impossible before operation to tell whether the sarcoma surrounds the popliteal vessels or has pushed them to one side. If the vessels are surrounded, it may be necessary to divide them in order to remove the growth. Under such conditions, if a suture of the vessels could be successfully made it would be an operation of very great value. In a recent case it was necessary to divide the vessels and the operation was followed by gangrene of the leg which required amputation. Could an anastomosis have been made the leg might have been saved.

Dr. J. F. Binnie, of Kansas City, said that in a typical case of sacculated aneurism with one opening of moderate size he closed this opening with a suture and then obliterated the sac in the Matas' fashion thus performing a reconstructive operation although he did not at the time recognize the fact. In other cases, named by Matas fusiform aneurisms, there are two openings into the sac, these two openings being connected by a groove or strip of comparatively healthy vessel wall, along the wall of the sac. Such aneurisms are *not* fusiform, they are sacculated, only a narrow strip of one side of the vessel being diseased and constituting the sac. In this class reconstructive operations are of much value; there is sufficient healthy tissue to give a good prospect of success. Even if complete success is not attained, *i.e.*, if the newly created arterial tube becomes obliterated, this obliteration may take place slowly enough to permit the circulation being kept up while collateral circulation is being established. In true fusiform aneurism the whole circumference of the vessel wall is diseased—no healthy material remains out of which to construct an artery—hence in these cases the ordinary Matas' obliterative operation is proper and easy, the reconstructive operation is out of the question.

Dr. Munro, in closing, said he found in one case the same trouble experienced by Dr. Stewart. There was thrombosis of the femoral resulting from a fracture-dislocation. The clot stuck

to the vessel wall and the artery was then opened below the thrombus and dislodgement attempted by hydrostatic pressure, but this was also unsuccessful.

Dr. Sweet, in closing, said that the needles employed in arterial suture were so fine that if one attempted to sterilize and bend in a flame the steel would at once burn and be ruined. Regarding different suture material, silk probably has the finest individual strands and hence is to be considered better. A point to be considered in the case of arterio-venous anastomosis is that time is gained for the establishment of a collateral circulation.

Dr. Frazier, in closing, said in answer to a question by Dr. Dawbarn regarding the control of hemorrhage from the femoral in operating upon aneurism, that the latter's suggestion to use McBurney's technic in securing a bloodless amputation by opening the abdomen and compressing the common iliac against the psoas was worthy of consideration.

Dr. Gibbon, in closing, said regarding Dr. Stewart's suggestion that the vein be substituted for the artery, that in looking up the literature of the subject he had discovered the report of a case by Goyanes,[1] of Madrid, in which that suggestion had been put in practice. The popliteal was divided distally and the vein substituted for the artery, the expedient proving a success

[1] (Siglo Mèdico, Sept. 8, 1906.)

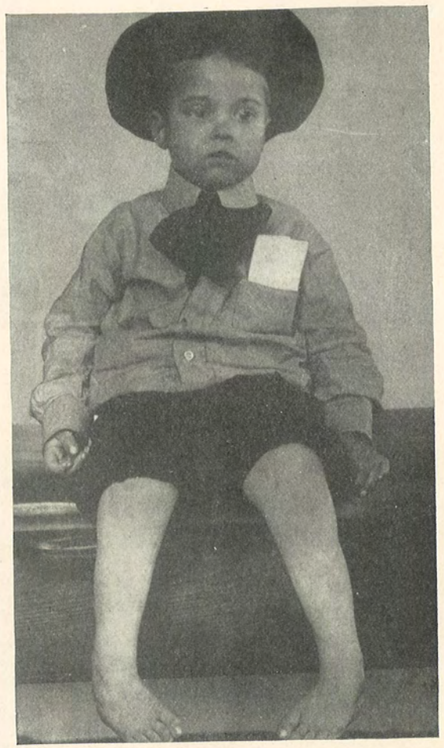
STATED MEETING, HELD OCTOBER 7, 1907.

The President, Dr. John B. Roberts, in the Chair.

TENDON TRANSPLANTATION FOR CONGENITAL CLUB FOOT.

Dr. Richard H. Harte presented a boy, born in February, 1901, with double congenital equino-varus. He came under the care of Dr. G. G. Davis at the Orthopædic Hospital, when 3 months of age. Dr. Davis did tenotomy of the tendo-Achillis of both feet, and partially corrected the deformity. The child was then sent to his home in Hazleton, Pa., and next applied to the Orthopædic Hospital in December, 1903, when he was under the care of Dr. Barton Hopkins, who found such a recurrence of the deformity that he did a cuneiform tarsectomy on both feet. He resorted to this operation only after failing to maintain a good position by the use of forcible manipulations and the use of plaster casts. The patient was sent home two months later, February, 1904, wearing braces. He was readmitted, coming under Dr. Harte's care March 17, 1905, with recurrence of the varus deformity in both feet. Without his braces he could not walk at all. On April 6, 1905, Dr. Harte did astragalectomy on the left foot, combined with tenotomy of the plantar fascia and the tendo-Achillis. On May 18, 1905, the same operations were repeated on the right foot. By these second bone operations it was hoped that a recurrence of the deformity would be prevented, as the foot came into very good position. The patient was again sent home wearing braces. Six months later, January 11, 1906, he was again admitted to Dr. Harte's service at the Orthopædic Hospital, with recurrence of the varus deformity. Both feet were forcibly stretched, the patient being etherized, on January 12, 1906. The plaster casts were finally removed March 15, 1906, and the feet treated by massage and overcorrection (without ether) daily for two months. New braces were applied in May, 1906, and the boy was again sent back to his home June 19, 1906, with his feet in very good position. Six months later, in January, 1907, he was again re-

Fig. 1.



Before tendon transplantation; congenital equino-varus, second relapse after cuneiform tarsectomy and astragalectomy.

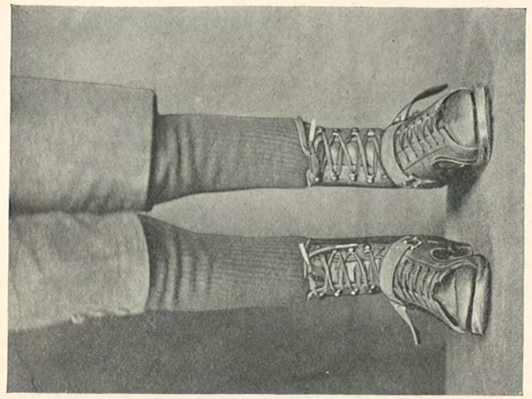


FIG. 3. Shoes with soles extended and raised on outer side; also instep strap.

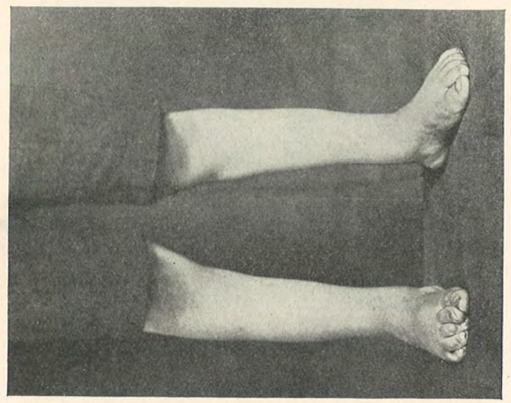


FIG. 2. After tendon transplantation; tibialis anticus transplanted to insertion of peroneus brevis.

admitted, the varus deformity having recurred to the extent shown in Fig. 1. On January 16, 1907, Dr. Harte did open tenotomy of all structures in the contracted soles of both feet, dividing tendons and fascia down to the bones. These wounds were left unsutured, and plaster casts applied. On February 18, 1907, both feet were stretched (ether) manually, and again put up in plaster. On March 9, and again on April 13, 1907, both feet were forcibly overcorrected by means of Hopkin's osteoclast, and Davis's tarsoclast. The feet now could easily be maintained in the overcorrected position by the pressure of one finger. On May 23, 1907, tendon transplantation was done, the tibialis anticus being separated from its attachment in each foot, and sutured to the tendon of the peroneus brevis at its insertion into the tuberosity of the fifth metatarsal bone. On July 10, seven weeks after this operation, the casts were removed, but as a matter of precaution new casts were applied for several weeks longer.

The boy now wears shoes with the sole extended and raised on the outer side, to throw the foot into a position of overcorrection (slight valgus), and with stout instep straps, to keep the heel of the foot well down in the shoe. The transplanted tendons by their action effectually prevent any tendency to the reproduction of the varus deformity, and it is hoped that at last the patient is permanently relieved of his deformity, as well as of the necessity for wearing ponderous and cumbersome braces. Figs. 2 and 3 show the present appearance of the feet, as well as the style of shoes worn.

DR. GWYLYM G. DAVIS said that the main interest in this class of cases to him was the question of the transplantation of tendons for congenital club-foot. The transplantation of tendons for paralytic deformities is well known, but for congenital deformities it is not so much practiced. The cause of congenital deformity is unknown; the cause of paralytic deformity is of course the paralysis, and if this paralysis is not recovered from it produces an obstinate laming which is permanent. Therefore, if one transplants an active tendon to the opposite side and judges correctly the relative amount of strength of the two sides, then there results a balanced foot. But in a congenital case an entirely different thing is to be dealt with. There is contraction of tendons on one side and a lengthening of tendons on the other side, but the muscles of the lengthened tendons do not give the reaction

of degeneration. They are not paralyzed tendons; therefore, if one can succeed in straightening the foot and keeping it straight with massage, electricity and exercise, then one gradually gets a restoration of function, and, theoretically, one should have the foot well balanced, and have an apparently normal foot as a result.

In his experience every now and then a case comes up, such as this boy, in which, even though the foot be kept in good position, the lengthened muscles do not contract and regain the tonicity and strength and power of the muscles on the contracted side. Therefore, in certain cases, even of congenital club-foot, surgeons are fully justified in transplanting the tibialis anticus muscle from the inner towards the outer side of the foot, and then allowing the child to get around. If, as the child grows older, it is found the transplanted anterior tibial and the peroneal muscles produce a preponderance of power on that side, one can put the anterior tibial back again. Therefore as a sort of temporary expedient he believed in a certain few selected cases in the transplantation of tendons even for congenital deformities.

LUXATION OF SPINAL VERTEBRÆ.—GUNSHOT WOUND OF BRAIN.

Dr. Joseph M. Spellissy reported four cases of vertebral luxation; and one of gunshot wound of the brain, as follows:

Case I.—(*G. B.*) *Luxation of Last Thoracic Vertebra, Kyphotic Deformity, Slight Paralysis; Recovery with Apparatus in Seven Weeks.*

The injury was received March 10, 1907, while working beneath a roof, the supports of which gave way, thus permitting the weight of the structure to come suddenly upon the patient's head and back. He was removed to the Methodist Hospital, where examination discovered posterior deformity, extreme tenderness, and complaint of pain at the junction of the thoracic and lumbar vertebræ. Pain was also referred to the abdomen and posterior regions of both thighs. X-ray examination showed separation of the posterior margins of the vertebræ involved. Examination by Dr. James Hendrie Lloyd found slight paralysis of the lower limbs and diminished knee jerks. These conditions were still present two weeks after the injury.

The condition was treated as is a case of spinal caries, with

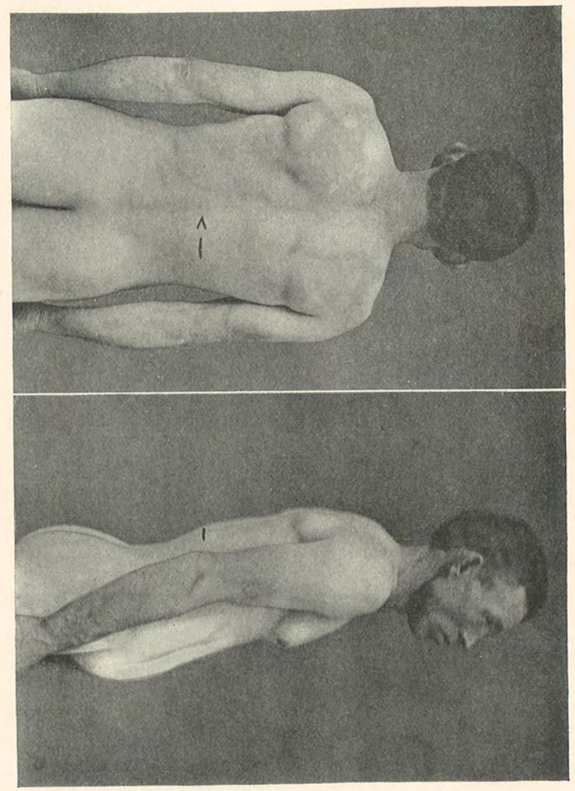
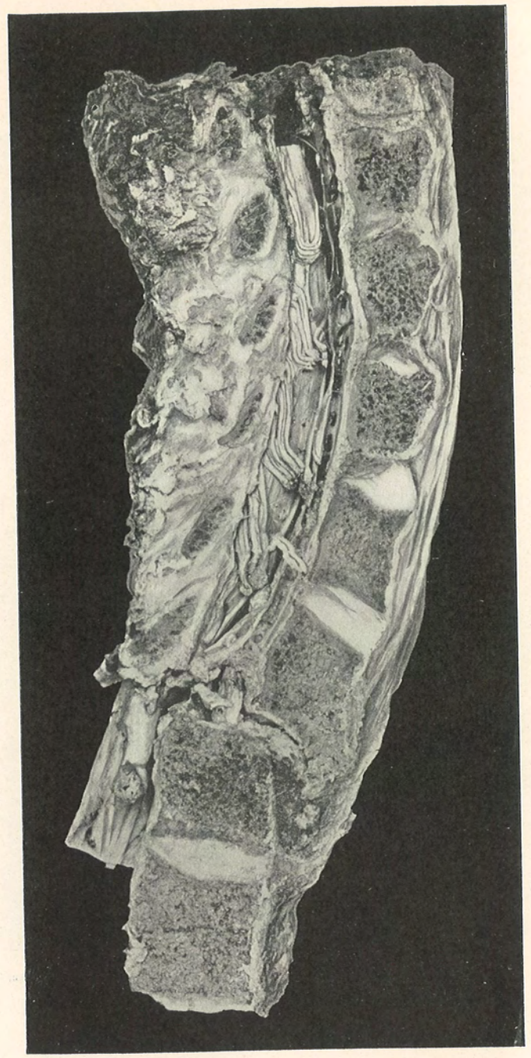


Fig. 1.—Luxation of last thoracic vertebra.

Case I.



(Photograph by A. R. Allen, M.D.)

Fig. 2.—Anterior luxation of upper thoracic vertebra.

CASE IV-A.

(Radiograph by F. O. Allen, M.D.)

FIG. 3.—Luxation of second cervical vertebra.

extension and counter-extension in the supine position, and with a pad beneath the kyphos for six weeks, at the end of which the patient became ambulant with a Taylor spine brace, and was discharged from the hospital at the end of the seventh week with complete recovery of the use of his lower limbs. Three and a half months after the injury he had discarded his brace and resumed his occupation. Slight posterior deformity remains, as shown in the accompanying photograph. (Fig. 1.)

CASE II.—(*H. M.*) *Rupture of the Common Spinal Ligament, Luxation of the Third Dorsal Vertebra, Laminectomy on the Fifth Day After the Injury, Delirium Tremens on the Sixth Day, Death on the Nineteenth Day.*

The injury resulted from a fall of thirty feet from a scaffold, on October 14, 1906. The victim did not lose consciousness, but suffered immediate paralysis of his lower limbs, was unable to flex his fingers, and experienced, through his arms and upper back, pain likened to the passage of a red hot iron. He was removed to St. Joseph's Hospital.

The pupils were normal, there was retention of urine and loss of knee and plantar reflexes. There was total anesthesia up to the level of the second rib, and there was slight evidence of posterior deformity in the upper thoracic vertebræ.

Surgical intervention was delayed until the fifth day after injury, at the suggestion of Dr. Charles K. Mills, who saw the case in consultation.

The posterior common spinal ligament was found ruptured at what appeared to be the joint of the third and fourth dorsal vertebræ, suggesting that the cord lesion had resulted from forced spinal flexion and anterior luxation of the third dorsal vertebra. (Fig. 2.). The lamina of the third and fourth dorsal vertebræ were removed, and the wound closed with drainage.

Following the operation, sensation descended to the level of the third sterno-costal junction. Delirium tremens appeared upon the following day, and was followed by rectal incontinence, trophic sores, and on the nineteenth day by death.

For the thorough and interesting study and for the excellent photographs of the spinal cord in this case, he was indebted to Dr. Alfred Reginald Allen.

CASE III.—(*J. L.*) *Dislocation of the Sixth Cervical Vertebra; Death in Twenty Hours.*

While driving a wagon rapidly under a doorway, on November 1, 1906, the patient's forehead struck a beam and he was bent backward and immediately paralyzed, being unable to move his limbs or his left arm. He had to be lifted from his driver's seat. He was taken to St. Joseph's Hospital.

Examination showed complete motor paralysis of the lower limbs and inability to draw either hand to the head. There was total anesthesia below the junction of the second rib with the sternum, and in both arms posteriorly.

Consultation with Dr. Charles K. Mills deferred surgical intervention. Sixteen hours after admission the temperature had risen continuously from 94° F. to 103°. Twenty and one-half hours after admission it had declined to 101°, the respiratory rate having advanced from 16 on admission to 36, when death took place suddenly.

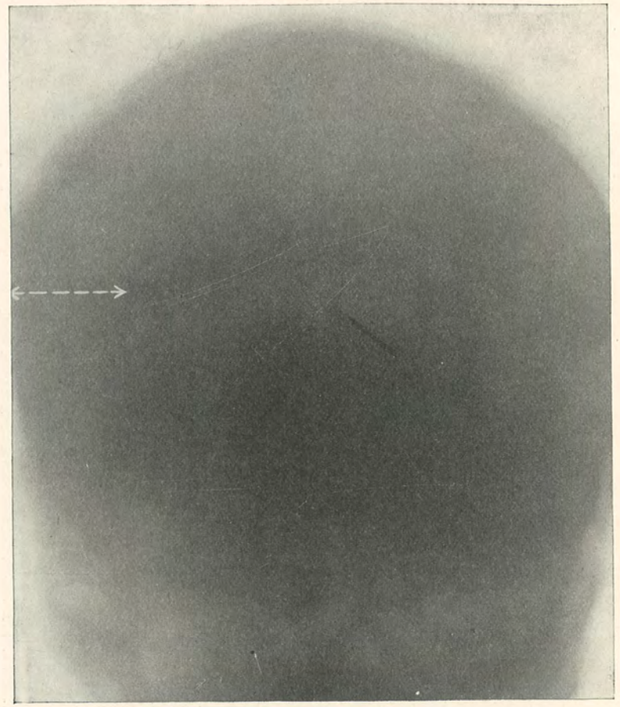
The character of the injury was established by autopsy, but careful study of the interesting specimen was prevented by its loss. Its gross examination showed rupture of the posterior common ligament, stripping of the anterior ligament from the vertebral bodies, posterior luxation of the sixth and upper cervical vertebræ en masse, with resultant laceration of the cervical spinal cord, which was nearly completely severed, and the presence of free hemorrhage as evidenced by a clot between the surfaces of the partially divided cord, and down the side of the cord to the level of the fifth thoracic vertebra.

CASE IV.—(J. D.) *Luxation of the Second Cervical Vertebra. Patient Ambulant from Time of Injury. Mechanical Cure of Traumatism, Followed by Surgical Neurosis.*

A crane for lifting beeves broke and fell on the patient's head in May, 1906. Two days later, examination in the out-patient service of the Pennsylvania Hospital discovered luxation of the second cervical vertebra. X-ray examination corroborated the clinical opinion. (Fig. 3.) The patient, who was unwilling to remain recumbent, was treated with a fixed dressing of plaster, until the completion of the brace exhibited. (Figs. 6, 7, and 8.).

While the surgical condition is now cured, and the brace could be dispensed with, the patient for several months has exhibited various hysterical symptoms, including convulsions, and is now attending the nervous dispensary of the University Hospital.

CASE V.



(Radiograph by J. E. Roberts, M.D.)

FIG. 4.—Bullet 1⅝′ internal to left margin of skull. View in *vertical* transverse plane.

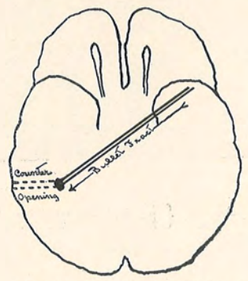
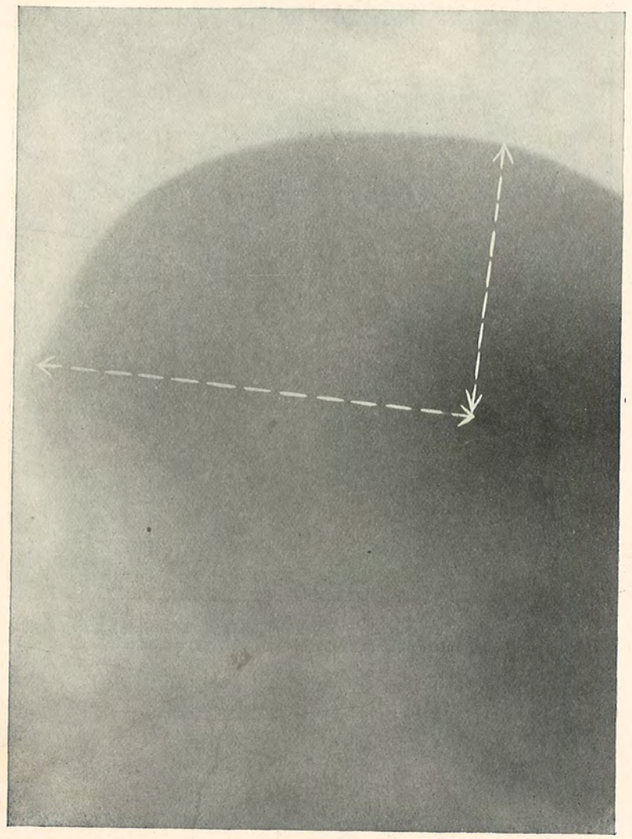


Diagram in *horizontal* transverse plane of bullet tract and of counter-opening.



(Radiograph by J. E. Roberts, M.D.)

FIG. 5.—Bullet. $\left\{\begin{matrix}5\frac{1}{4}'' \text{ posterior to frontal eminence.} \\ 3\frac{1}{8}'' \text{ below the vertex.}\end{matrix}\right.$

GUNSHOT WOUND OF BRAIN.

CASE V.—(*A. G.*) *Location of Bullet in Brain by X-ray Verified at Operation. Death on the Ninth Day. Autopsy Discovers Bullet One-Eighth Inch from Operative Counter-Opening.*

The injury was self-inflicted, terminating a debauch. The wound of entrance was at the angle of the right eye. The patient was unable to speak, though there was a little evidence of his understanding some of what was said to him. The right arm was paralyzed, and there was deviation of the tongue.

The X-ray plates printed in the illustrations were made on the admission of the patient to St. Joseph's Hospital within a couple of hours after the shooting. They confirmed the indications of injury to the left side of the brain, and located the bullet in a plane 1⅝ inches internal to the left side of the skull (Fig. 4), and 3⅛ inches below the vertex of the skull, and 5¼ inches posterior to the frontal eminence. (Fig. 5). The patient being prepared for operation, a trephine button was removed from the left side of the skull in accordance with these measurements, and a probe passed inward encountered the bullet on three different occasions. Attempted extraction by forceps proving futile, a little finger was inserted, but failed to recognize the bullet's presence. The patient was then turned over so that the operative wound was below, and an attempt was made to shake the bullet out. This was also ineffectual. The patient lived for nine days, being restless, but on no occasion having a convulsion; the temperature keeping between 97° and 99°, with the exception of one day, on which it mounted to 101°. The pulse was generally rapid and the respiratory rate was but slightly increased. The path of the bullet nearly traversed the brain. The operative wound for its removal completed the pathway, making an obtuse angle at the location of the bullet. Had the patient's head been turned with the counter-opening wound downward as soon as the latter was made, the prospects of the bullet's removal would have been increased. As it was, the bullet was sustained in the jelly-like consistency of the brain, and was easily dislocated and lost by the instrumental attempts at its removal.

At the suggestion of Dr. Addinell Hewson, the post-mortem examination of the pathway of the bullet was made by vertical transverse sections of the brain from before backwards.

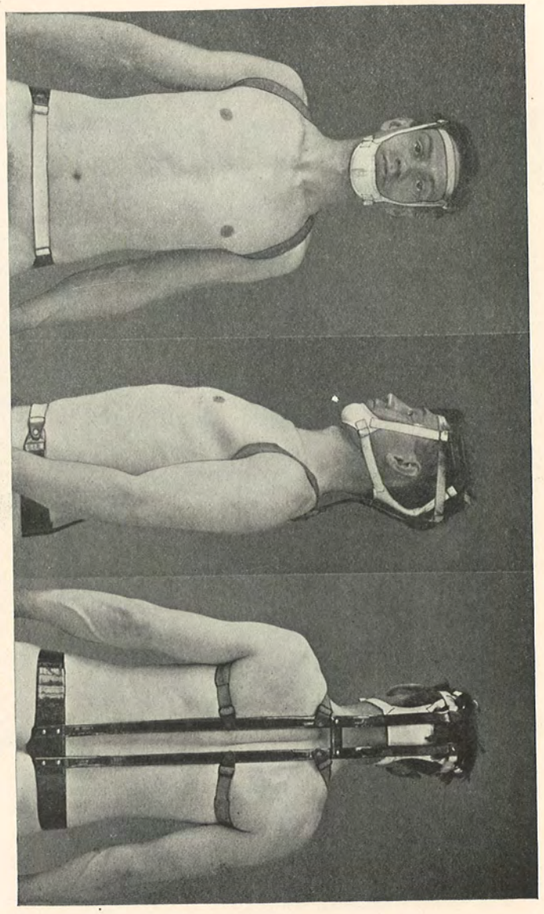
The bullet after passing through the skull just outside the

external angle of the orbit, immediately above the zygoma, entered the brain on the basal surface of the right frontal lobe, just in front of the temporo-sphenoidal lobe, two inches anterior to the central fissure, and one and one-quarter inches from the mesial surface of the right hemisphere, passing upward, backward, and to the left through the right lenticular nucleus, the anterior segment of the internal capsule, the caudate nucleus, the lateral ventricle of the right side, the septum lucidum, and the corpus callosum on the left side and then in to the left lateral ventricle, lodging at a site the plane of which was two inches posterior to the plane of the point of entrance. The position of the exploratory counter-opening, through which the bullet was touched at operation, was one inch posterior to the central fissure, and one inch above the plane of the fissure of Sylvius, in the lower post central convolution.

At autopsy, the bullet was removed from the site to which it had been dislodged in attempts at extraction. It was one-half inch posterior to the central fissure and one-half inch above the fissure of Sylvius; that is, one-half inch above the trephine opening, one-quarter inch posterior to it and one-quarter inch internal to the dura-mater. The original site of the bullet having been one and five-eighths inches internal to the skull.

Dr. Spellissy remarked that in the four cases of spinal luxation the injury resulted from great weight or force being suddenly applied to the head. The character of the injury was verified in the first and fourth cases by X-ray examination, and in the second and third by autopsy, the sites of injury being: in Case I, the lumbar-thoracic junction; in Case II, the third and fourth thoracic junction; in Case III, the sixth and seventh cervical junction; and in Case IV, the second and third cervical. In Cases II and III, there was gross injury to the cord, and death followed. Case II operated upon on the fifth day, became complicated by delirium-tremens and terminated on the nineteenth day, in no way improved by the operation.

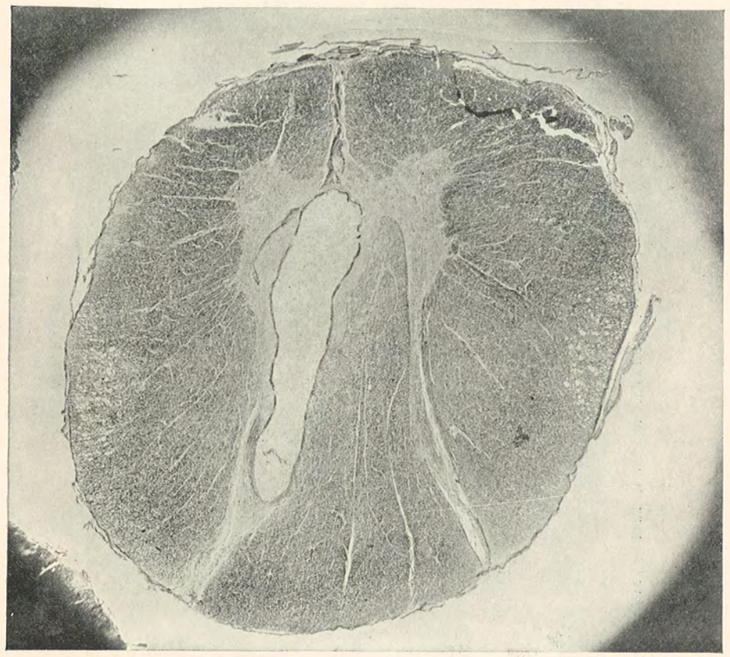
Might immediate intervention have accomplished any more either for Case II or III? In Cases I and IV there was complete recovery. In Case I there were symptoms of cord injury, which disappeared with fixation and extension. In Case IV, there was only pain and muscular rigidity. He had successfully used the appliance employed in it in a case of cervical caries.



Figs. 6, 7, 8.—Front, side and back of cervical spine extension, steel and hard rubber brace.

Case IV.

Case II.



(Photomicrograph by A. R. Allen, M.D.)

Fig. 9.—A section of the spinal cord in the thoracic region showing an area of softening in the gray matter, as well as an area of traumatic myelitis on each side in the anterior part of the direct cerebellar tract. Section stained by Weigert method.

The apparatus (Figs. 6, 7 and 8) consists essentially of a pelvic band, united in front by a webbing strap. From the back of the band two uprights, equally distant from the median line, follow the contour of the back, neck and head to the level of the parietal eminences, where they turn at right angles and laterally embrace the head, terminating on a line with the external angle of the eye. An occipito-mental headpiece is buckled with webbing straps fore and aft, on each side, to the horizontal arms of the uprights and affords effective extension of head and spine, when sufficient traction is made. A webbing band passing round the brow and buckling to the uprights of this bifurcated jury-mast just below their horizontal turn, fixes the head and prevents lateral movement. The use of webbing straps permits easier gradation of the degree of extension employed.

There is no doubt that some cases of cord injury can be benefited by immediate operation and that in others it is at least an unnecessary hardship if not an absolute injury. But whether as a routine practice in severe cases it is the most conservative measure to at once make an inspection of brain and cord is a question that is worthy of study by trial.

The report of the gunshot wound of the brain instances the accuracy of X-ray localization in these cases, a nine days survival of through and through brain injury, and the advisability of turning the counter-opening downward when probing and attempting extraction of bullets from the brain.

Dr. Alfred R. Allen said that he had studied microscopically the case (Harry M.) of spinal fracture dislocation.

The line of fracture was from above and posteriorly downward and anteriorly, the luxated vertebra tearing away the anterior superior lip of the body of the vertebra next below. The pathological material which he received was a part of the vertebral column, comprising six vertebræ above the fracture-dislocation and two vertebræ below.

A section of the spinal cord at the highest level of that particular specimen indicated from the relationship of gray and white matter that it was a thoracic segment. Now if it be allowed by way of argument, that the highest level of the specimen was the first thoracic segment—and that is the highest it could possibly be—then the fracture-dislocation involved most probably the fifth and sixth thoracic vertebra, crushing thereby the lower

part of the seventh and upper part of the eighth thoracic segments of the spinal cord. This is a little lower than Dr. Spellissy thought at the time.

There was one interesting finding in this cord: an area of central softening (Fig. 9) extending from about 2 to 6 cm. below the level of fracture. That central area of softening, had he been able to examine every section serially, would probably have revealed a damaged blood vessel, possibly two or three, in relation to it. Traumatic hematomyelia is due to a purely hydraulic action in one or more of the branches from the anterior spinal artery within the anterior median fissure.

The question that Dr. Spellissy brought up as regards operation in these cases is one on which neurologists and surgeons will never agree, until some means is discovered by which the surgeon can say with a reasonable amount of assurance, "I can, by this method, so successfully bridge over the injured portion of the spinal cord that there will be functional continuity." That of course is a perfect impossibility as yet. In the first place there is an absence of neurilemma nuclei in the spinal cord and on these neurilemma nuclei is regeneration supposed to depend. In going over records of hundreds of cases he had been impressed by the fact that those cases which have had expectant treatment have had as high a percentage of would-be cures as those operated upon.

Dr. Richard H. Harte said that the manner of dealing with these cases of spinal injury is the point which interests surgeons. A man falls from a roof, or something falls on him, and he is forcibly bent forward, the vertebra gives way at the vulnerable point, the juncture of the first lumbar and last dorsal, and as a result there is in all probability a partial dislocation, and a fracture possibly of the lip of the upper or lower portion of the body of the vertebra. Now the question comes up, what are we going to do with these cases? As a rule they are fatal. If there is a certain amount of pressure on the cord without any destruction of the cord substance the sooner that pressure is removed the better the chances of recovery. On the other hand, if there is a certain amount of pressure on the cord, and it is not relieved, the patient being treated expectantly, the cord will in a short time degenerate, and then there is very little to be expected in the way of recovery. It seemed to him if he were in a position where he had a fracture of the spinal column and had to decide the question whether he would rather lie on a water bed for a time and then die as the result of bedsores, cystitis, etc., or have his neural canal opened and dealt with, he should certainly take the chances and have his canal opened. He thought that on the whole, if one gets one per cent. of recoveries one is fortunate.

He recalled one case where he did an operation for this condition. The man had a fracture of the lower portion of his spinal column and he is now putting up gutters and tin roofs through the country!

He had opened many canals with indifferent results, but on the whole he thought this procedure offers to the majority of cases the best chance of recovery. He could not see, in these cases, what was to be gained by treating them expectantly. By waiting a degeneration of the cord is likely to occur, and when that occurs, as the result of pressure, little can be later accomplished by going into the neural canal. He had tried both ways, and while the results are not brilliant in either, he had obtained better results by promptly relieving the pressure.

Dr. Alfred R. Allen said that it was doubtful whether in fracture-dislocation of the spinal column, the degeneration of the cord which is found in cases which have lived some time after the accident, is due to unrelieved pressure. He mentioned a case of gunshot wound where the bullet impinged instantaneously on the dura, not enough to even ruffle the surface. A laminectomy revealed the cord apparently normal. The case died, and the cord at autopsy was found to be just like jelly for at least three centimeters. In this case there was a pressure which had been brought to bear and then instantly removed, and yet there was complete degeneration.

PUNCTURED FRACTURE OF THE SKULL.

BY GEORGE G. ROSS, M.D.,

OF PHILADELPHIA, PA.,

Assistant Surgeon to the German Hospital; Surgeon to the Germantown Hospital.

THE case herewith reported, as the basis of this paper, is unusual in many ways. It offered diagnostic difficulties which were completely solved only at the post mortem table, and has many points of interest, clinically, pathologically and in a legal way.

ADOLPH H. Age 21.—On October 4, 1906, patient was seen by Dr. L. Demme Bauer. He gave a history of having been struck about the right eye with an umbrella, five days previously, on September 30th. The patient complained of a great deal of pain over the right temporal region, and of general malaise. He was entirely rational and answered questions intelligently. Physical examination showed that the right eye was the seat of a conjunctivitis, and the eyelids were puffy. There was no discoloration, ecchymosis or external evidence of any abrasion, in or about the eye. Both eyes reacted normally to light and accommodation, and the pupils were equal. The tongue protruded in the median line, and the naso-labial fold on either side unaffected. The temperature was 102° F., pulse 90, respiration 18. In spite of the fever there was an unusual coldness of the body. A boric acid lotion was ordered for the eye.

On October 5, 1906, the patient was again seen. His mental condition was still good, but the malaise was more marked. There was no paralysis of the extremities. The temperature was 102°. He was removed to the German Hospital in the afternoon.

Patient is a well-nourished and well-developed German lad. He is in a stuporous condition, and answers questions slowly and incoherently. He lies upon his back, with his eyelids closed, and desires not to be disturbed, but occasionally tosses his head from side to side. He complains of chilliness, and a great deal of tenderness over the right temporal region. There was no evidence of alcoholism or uremia.

The head was carefully examined, and no evidence of fracture was detected. There were no cuts or bruises on the scalp. There was no discharge from the nares or from either external auditory meatus. There was no œdema over either mastoid. The tongue was protruded in the median line, without tremor. There was no facial paralysis. There was no cyanosis of visible mucous membrane on the lips, or of the finger tips. The right eye showed slight injection of the bulbar conjunctiva, but there was no evidence of injury to the eye. Both eyes reacted normally to light and accommodation and there was no irregularity of the pupils. The sclera was not icteroid.

The chest, heart and lungs were negative. The pulse was slow and regular. The abdomen was negative. The patient having been sent in with a suspicion of enteric fever, was examined very carefully for enlarged spleen and spots, and for a history of nose bleed, all of which were negative. The extremities could all be moved. The superficial and deep reflexes so far as examined were unaffected. Temperature, 99 2–5°; pulse, 64; respiration, 22.

A catheterized specimen of urine, 570 c.c., had a reddish-yellow color, acid reaction, specific gravity 1038, faint trace of albumin and many amorphous urates, but no tube casts.

At 12 o'clock midnight, October 5, 1906, the temperature was 102 2–5°, respiration 24, pulse 64. During the night the patient was very restless, talking constantly and complaining of a great deal of pain in the head. He passed 1060 c.c. (35 ounces) of urine during the first twenty-four hours in the hospital. October 6, 1906. Leucocyte count 15,900.

October 7, 1906. About 10 A.M. it was noticed that the right pupil was more widely dilated than the left but still reacted to light and accommodation. No evidences of paralysis were yet found, but a tentative diagnosis of cerebral pressure was made, the possible causes considered being either depressed fracture, a clot from rupture of some portion of the meningeal artery or its branches, or a collection of pus. The diagnosis of cerebral abscess was suggested by the intermittent temperature, leucocytosis, and the chilly feeling of the patient.

The X-ray of the skull showed a shadow which was interpreted as a fissured fracture of the vertical plate of the frontal. This opinion was not positive. The patient grew worse, and on

the night of October 7th, became very delirious, and tried to get out of bed. Morphia ⅛ gr. was given and quieted the patient.

October 8, 1906. Patient had become quite comatose and the right pupil was widely dilated. There was no paralysis of either arm or leg. The patient's condition in other ways was as twenty-four hours before.

An eye examination was made by Dr. Wm. T. Shoemaker. O.D. and O.S. react to light and accommodation. O.D., dilated pupil. O.S., normal pupil. Ophthalmic examination. O.D. shows slight obscuration of disc. No hemorrhage into retina.

Soon after this examination was made it was noted, that while the patient was moving his right arm and leg, the left arm and leg were limp by his side. One hour before this, however, the resident physician saw the patient move his left arm and leg, and a patient in the adjoining bed saw him attempt to get out of bed, using his left arm and leg in doing so. An examination showed a complete left-sided hemiplegia. The indications of intracranial pressure were now unmistakable, and operation for relief was decided upon and performed about 5 P.M., October 8th.

Operation.—October 8, 1907. Ether anæsthesia. A curved incision, with its center over the most prominent part of the parietal eminence, was made. It started some distance behind the right ear, and was carried upward and forward. The tissues were divided down to the bone. A one-inch trephine opening was made over the most prominent part of the parietal eminence, and was enlarged with a rongeur forceps. The dura bulged into the wound. It was opaque, non-pulsatile, and dark underneath. The dura was incised, and a large abscess of 150 to 200 c.c. of dark, foul-smelling pus evacuated. The brain then came down into the opening and pulsation became evident. The abscess cavity was carefully and thoroughly wiped out with gauze sponges.

Three pieces of iodoform gauze were placed in the abscess cavity for drainage, the ends being brought out of the opening. The skin wound was closed with interrupted sutures of silk-worm gut, room being left for gauze drainage to come out. An antiseptic dressing was applied.

After coming out of the ether the patient was semi-conscious, could be aroused with little difficulty, and had periods of restlessness alternating with stupor. Such was his condition all of the next day, October 9. The right pupil was dilated and did not

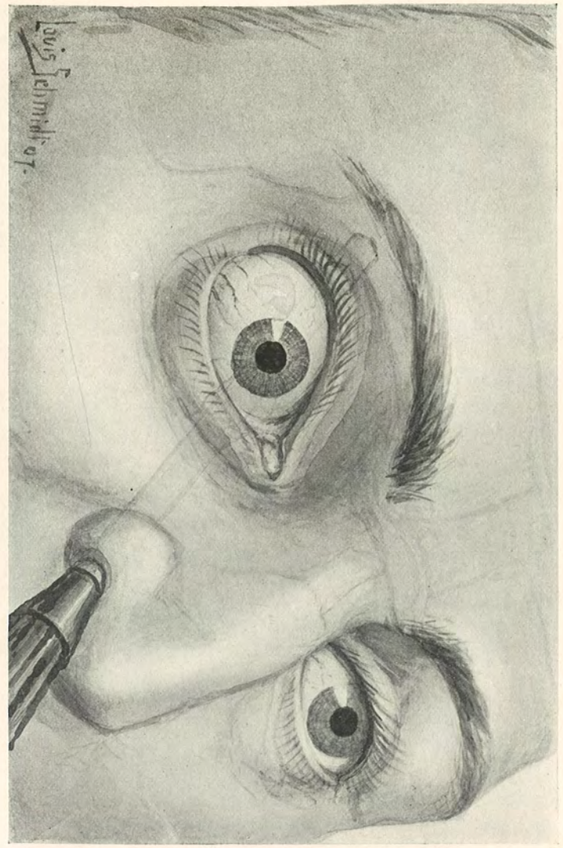


Fig. 1.

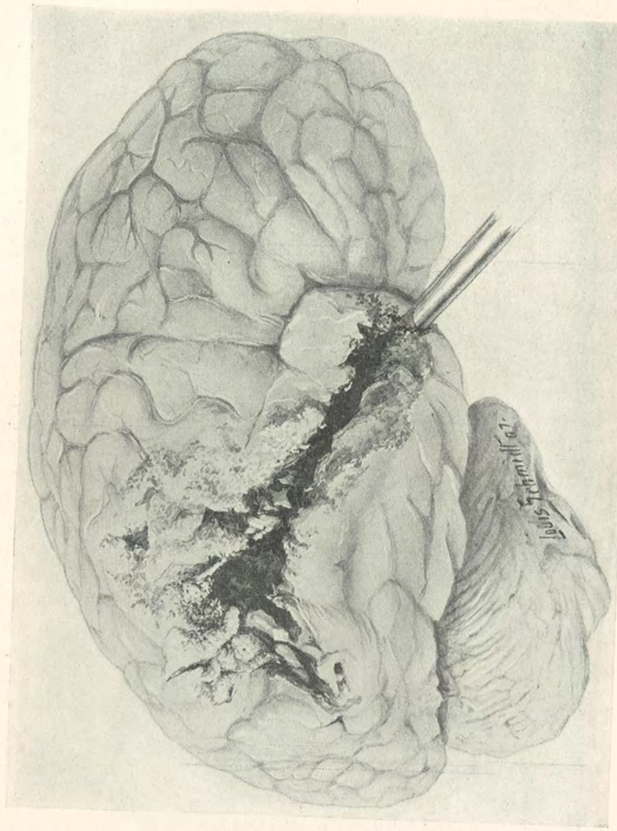


FIG 2

respond to light. The left side still paralyzed. The outer dressing was changed and the wound was found to be discharging freely.

October 10th. In the morning the patient was improved. He answered questions in a fairly rational way; his pupils were equal and reacted to light and the paralysis of the left arm was not so profound.

At 10.25 A.M. the patient suddenly stopped breathing and became deeply cyanosed. The pulse remained full and strong for two or three minutes after breathing ceased. Artificial respiration was performed without avail and the pulse gradually weakened and stopped.

Post-Mortem Examination.—The face and head presented no external evidences of injury. There was no ecchymosis or swelling about the eyes or forehead.

The skull cap was removed and the brain exposed. A large abscess cavity, about the size of a large orange, was found in the right temporo-sphenoidal lobe. An investigation of the middle fossa showed a fracture of the greater wing of the sphenoid, a little below and to the outer side of the outer end of the sphenoidal fissure. Several loose spicules of bone were removed and the fracture opening was found to be nearly circular. The right eye was removed, exposing the floor of the orbit. A fissured fracture, with a loose fragment of the bone, was found opening the roof of the antrum of Highmore. The antrum was full of pus, and showed a fracture of the inner wall into the nose. The line of penetration was then from before backward, from nose to antrum, antrum to orbital cavity, and thence to the middle fossa of the skull, thus furnishing an avenue of infection direct from the nasal cavity to the temporo-sphenoidal lobe of the brain. A straight probe could be made to traverse the entire tract without obstruction.

The instrument of penetration had traversed the fatty bed of the eyeball and had not infringed upon or in any way injured the eyeball, its vessels or nerves, thus accounting for the lack of ecchymosis or permanent swelling. (Figs. 1 and 2.)

A septic embolus having the appearance of a chicken fat clot, and about the size of a small bean, was discovered in the floor of the fourth ventricle. This explains the sudden death from respiratory failure. There was no evidence of any intracranial hemorrhage, either extradural or subdural. The inner

wall of the mastoid cells seemed normal and intact. The rest of the body was normal in every respect.

In looking over the literature of Punctured Fractures of the Skull I have failed to find a similar case. The vast majority of punctured fractures of the skull are, as would be expected, the result of bullet wounds received in battle, and come under the hands of military surgeons. The majority of these cases are instantly fatal or live so short a time that secondary results do not supervene. This is particularly true of wounds caused by the modern high velocity bullets, the injury to the brain in these cases being highly destructive. In civil life the wounds are caused generally by other instruments or by low velocity fire-arms. Here the skull offers enough resistance to take up most of the energy, with the consequent low grade of injury to the intracranial organs, and hence these cases often survive the injury long enough to permit of the development of hæmorrhage and infection. These are the two great dangers of punctured fractures in those cases which do not succumb at once. The hæmorrhage is most often subdural. The infection may involve the cerebrum, the meninges or both, and any portion of the brain may be the seat of an abscess.

In a series of 316 cases of foreign bodies in the brain analyzed by Dr. Henry Wharton in 1879 [1] a number of cases of punctures by objects other than bullets are recorded. Gunshot wounds of the skull and brain I have not attempted to include in this summary of the literature. In Dr. Wharton's series there were stab wounds by swords and bayonets, and wounds caused by the ferrules of canes and umbrellas. Five cases of penetration of the sphenoid bone are recorded, and 18 of wounds of the orbit.

Since that time numerous cases have been reported.

Brown and Birch,[9] Ferguson,[10] Lemonnier,[28] Fisher,[11] H. M. Holmes,[13] MacKellar,[16] Wilson,[18] Beckwith,[19] Taylor,[20] D'Cruz,[22] Schmid,[24] Odell,[25] Batut,[28] and Kennedy,[29] have reported cases of simple puncture of the skull, not followed by abscess.

Felty,[2] Rehm,[5] Glasgow,[33] Mandel,[23] and P. Ross,[21] have reported punctured fractures of the skull followed by cerebral abscess.

Griffith [30] has reported a case of cerebellar abscess following puncture of the skull and brain.

Dutra,[6] Laplace,[7] A. S. Holmes,[12] Jewett,[14] Lusk,[15] Prideau,[17] and Grekoff,[27] have reported punctured fractures through the orbit with brain injury but not followed by infection, while Builer,[8] and Lee,[4] reported similar injuries followed by abscess and meningitis.

Randall has reported a case (quoted by Spiller) of perforation of the ethmoid through the nose by the rib of an umbrella, with secondary cerebral abscess. I reported a case to this academy last year, of a puncture of the vertex of the skull in which the superior longitudinal sinus was opened. The case recovered, and there was no infection. I also know of another case in which the olfactory plate of the frontal was perforated by the rib of an umbrella which entered the nose. This case was fatal.

In practically all of these cases the diagnosis of the primary and secondary conditions was made easy by a knowledge of the injury and local evidences of trauma. In the case here reported, however, we did not have these facts to guide us. The history, in itself meagre, was misleading, as no indication of an injury to the nares was present on superficial examination. The diagnosis of a cerebral abscess could not be made with certainty. At best the recognition of this condition is a matter of difficulty.

There is no symptom or combination of symptoms pathognomonic of brain abscess, therefore in the absence of a recognized fracture, middle ear infection or suppuration elsewhere in the body, its diagnosis must be doubtful.

Spiller, Penn. Med. Jour., Oct., 1906, P. 30. says: "The diagnosis of cerebral abscess depends chiefly upon the signs of some more or less rapidly developing lesion of the brain, with the discovery of a purulent process somewhere else in the body or of a wound of the head." Note the qualifying clause.

Von Bergman states that marked symptoms of localization, provided they are accompanied by headache and fever, constitute the most important signs of cerebral abscess. He also lays great stress upon the condition of the skull wound, when one is present, and upon the flow of the pus from the fissure in the skull or from between the fragments of a comminuted fracture.

Leucocytosis of course may aid us in the diagnosis of abscess, as may also at times the presence of choked disc—not found, however, in the case I here report. The main features upon which we had to form our opinion in this case were:

1. Pain in the right temporal region. 2. Tenderness in the right temporal region. 3. Leucocytosis. 4. A persistent feeling of cold. 5. The intermittent temperature. 6. Persistent slow pulse.

The factors which operated against the establishment of a positive diagnosis were: 1. Existence of fracture without external evidence of injury. 2. Delay of paralysis until the abscess was large enough to cause pressure on the motor area. 3. Absence of choked disc.

The diagnosis was not made definitely and this is not surprising in view of the facts. The operation was undertaken primarily for the relief of intracranial pressure.

Granting that the existence of an abscess or of other serious intracranial complications can be established, operation is of course indicated, and indeed operation offers us a better chance in punctured fracture of the skull when the signs of intracranial lesion are not well marked, or even absent. In making this statement, I am taking into consideration the great mortality in fractures of this kind especially when they traverse the orbit. In Dr. Wharton's series, 17 of the 18 cases of orbital penetration died, although it is stated by him that "in many cases the persons were unconscious of the injury and the unfavorable symptoms developed suddenly."

Therefore it is a wise procedure to open the skull at the wound of entrance at the earliest possible moment after the

accident, irrespective of symptoms or lack of symptoms. The fatality of brain abscess or septic meningitis is so great that any procedure looking toward prevention is imperative. When as in this case, the history of the injury is vague and no wound of entrance can be found, the indications for early operation are not so positive.

In conclusion, I would call attention to the wisdom of nose examination in any case of traumatism about the head when the history is at all doubtful or undetermined.

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Dr. Addinell Hewson said that in view of the statement made by Dr. Ross that the cerebral abscess is often not recognized, he would report a case which in the last few days came under his observation. A man died in one of the hospitals in Philadelphia from pulmonary tuberculosis with intestinal involvement. The body was unclaimed and came to the Anatomical Board and was distributed to one of the colleges. After the injection of the body the brain was removed, and there was found a nail nearly 2½ inches in length which had perforated the sagittal suture near the bregma, and an abscess was found about this nail probably holding as much as an egg. He questioned the resident of the hospital—he did not even know that there was any wound about the man's head. The nail did not penetrate the brain, it was between the longitudinal sinus and the brain substance involving the dura and the arachnoid.

He mentioned this case here as one where there were no symptoms of any kind, and the resident who attended the man for six months knew nothing whatever about this condition.

Dr. G. G. Davis said that he had seen a couple of cases of these punctured wounds, one a man who received a punctured wound of the orbit by a metal hook which penetrated the brain, going upwards and backwards. The point of the hook struck the dura in the upper posterior portion of the vault of the skull. This case occurred while he was a resident at the Pennsylvania Hospital. The man died from septic cerebritis. A second case was under his care some fourteen years ago for the first time. The patient, a young man, was riding on a bicycle and was struck by a wagon, and something penetrated his eye. The left eye was lacerated and the wound entered through the top of the orbit and went some distance into the brain. The eye was removed, as well as some pieces of glass, and for several days thereafter there was quite an amount of brain matter discharged. He introduced a drainage tube and simply washed the part out with boracic solution. That young man recovered, and he heard nothing from him until within a few months ago, when he came back with the report that he had attacks, which he took to be epileptic, which were preceded by a very offensive subjective odor, and he likewise complained of a headache. For this he was placed on bromides, and he has had no attacks since, although he only takes ten grains of bromide of sodium once a day. This is an example of the fact that if the brain is injured very markedly, and if recovery ensues, the patient later shows some nervous trouble.

HERNIA CEREBRI.

Dr. Macy Brooks reported a case of recovery from hernia cerebri involving the frontal lobe, resulting from extensive fracture, as follows: A boy of 11 years, rather low order of intellect, was kicked in the head by a horse.

When first seen there was a large gaping wound over the left brow from which blood and brain matter were oozing.

An incision was made from the glabella, inclining upwards towards the upper temporal region, exposing a compound comminuted fracture. Fragments of bone were removed which included the crista galli and a large portion of the frontal bone of that side; this exposed an opening in the dura three-fourths of an inch in diameter; the dura had been punched out over this opening and driven into the gray matter. Upon probing this cavity with the little finger he felt something hard in the brain substance about an inch in from the cortex, parallel with the base of the brain. Upon introducing a pair of forceps he extracted a fragment of bone and a matted lock of hair. The boy being very dirty, the accident having happened in a stable, and there being extensive laceration of brain matter, he did not close the opening in the membranes with a pericranial flap. After removing all loose fragments of bone and trimming up the edges, the wound was well irrigated with hot saline solution, a strip of iodoform gauze was introduced and the wound dressed with gauze and a firm bandage.

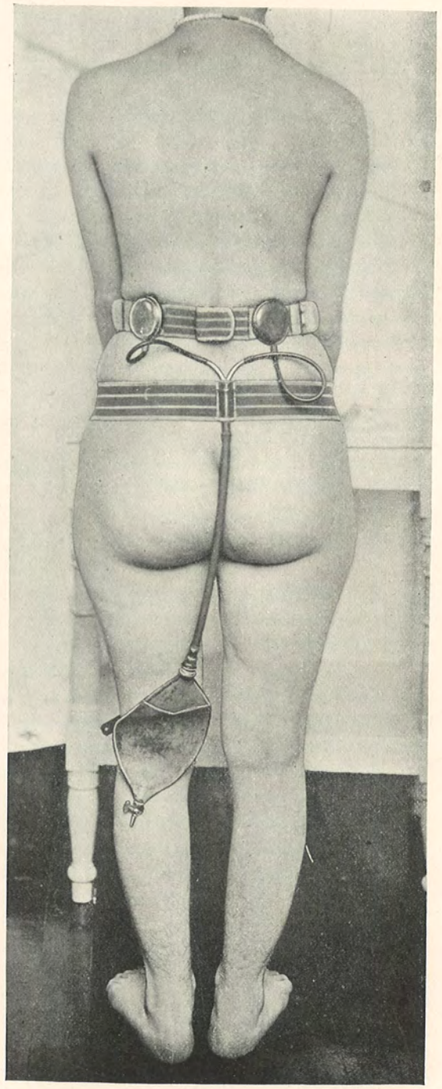
The patient was not unconscious at any time. He recovered nicely from the operation. On the third day the gauze was removed from the cavity. Its removal was followed by a flow of a considerable quantity of disorganized brain matter. A small drain was reintroduced; this was removed in twenty-four hours. By this time the brain had started to protrude. There was a hernia about the size of a pigeon egg. This upon the advice of Dr. W. J. Taylor was dressed with a ring of gauze to avoid pressure and dry gauze over the ring. The skin edges were touched at each dressing with silver stick and as the skin grew in around the hernia, the protruding gray matter was gradually cut off until the opening was entirely closed. Apparently the

boy's mental condition has not changed in any way since the accident. The wound healed in forty-eight days.

Dr. G. G. Davis said that this case is simply another which shows that it is apparently unnecessary to operate for the cure of hernia cerebri, and in substantiation of that position he mentioned a case somewhat similar to this, in which he saw a hernia cerebri on the vault of a skull from a fracture in which the protrusion of the brain was approximately 1½ inches long and oval in shape. Gauze was placed around it very much as in Dr. Brook's case, only it was wet with alcohol. He thought that the alcohol tends to tan and shrivel and dessicate the hernia cerebri. In a few weeks contraction took place and the skin covered it. Unfortunately the child, which was quite young, was said later to be completely blind. In the majority of these cases some decrease in the mentality of the patient is later to be expected.

Dr. John H. Gibbon called attention to the portion of bone which had been driven in. This recalled to his mind a case he had assisted Dr. Keen operate upon. The patient was a soldier who had been shot in Cuba. He was trephined shortly after his injury; he then developed epileptic attacks and was operated upon again in Cuba. He then came back to this country, was admitted to one of the large hospitals and operated upon again, an osteoplastic flap being turned back. He was then sent home as apparently incurable. He continued to have his attacks and got into pretty wretched condition. He applied for admission to the Jefferson Hospital, and through certain influences, although it was thought there was little to be done for him, he came down to be examined. It seemed that there was some pressure which might be relieved. Dr. Keen operated upon him, and about an inch and a half below the brain surface, near the median line, in the parietal region, he found a piece of bone as large as the first joint of the thumb, with about an ounce of pus around it. The patient had been trephined three times, once immediately after the injury and twice subsequently, without this bone being discovered. The necessity for exploring the brain thoroughly where there is a comminution of the skull, is most important.

Dr. Richard H. Harte said that Dr. Gibbon's remarks recalled to his mind a case at the Pennsylvania Hospital where a boy was injured, being hit over the brow with a brick, resulting in a large scalp wound. There was also a distinct transverse



linear fracture with slight depression in one spot, but without any symptoms. The tendency in many cases would have been to let it take its course, but for some reason or other he felt suspicious about it. He therefore explored it and found some gritty substance, raised up part of the anterior lobe and worked back into the anterior fossa, and took out about a teaspoonful of plaster. The boy was evidently struck with a brick which had plaster on it, and this plaster had been scraped from the brick by the receding skull and deposited in the cranial cavity.

This only goes to prove that many times a fracture may be carefully explored and nothing found, while at other times something is found, and he therefore agreed with Dr. Gibbon that it is best to make a thorough exploration of these cavities.

PERMANENT DRAINAGE OF BOTH KIDNEYS THROUGH LUMBAR OPENING.

Dr. Hiram R. Loux described a case of permanent drainage of both kidneys, and exhibited the apparatus used for the collection of the urine.

Dr. John B. Roberts asked whether this apparatus would answer satisfactorily in cases of tuberculosis, extirpation of the bladder, or other conditions of the bladder where some such measure is necessary?

Dr. Hiram R. Loux said that the apparatus shown would answer very well for tuberculosis, especially where the condition of the bladder was such that it made the patient a great sufferer. In extirpation of the bladder it would hardly do, unless the ureters were removed at the same time.

This patient was instructed about the care of this apparatus, and she boils the catheters fifteen minutes and takes the utmost care with the urinal so that there is no odor attached to its use.

STATED MEETING, HELD NOVEMBER 4, 1907.

The President, Dr. John B. Roberts, in the Chair.

ESOPHAGOTOMY FOR IMPACTED COIN IN A NINETEEN MONTHS OLD INFANT.

Dr. Chas. F. Nassau presented a child who had been referred to him by Dr. Bridgett of West Philadelphia, on account of a suspicion that the child had swallowed a five-cent piece. She was not particularly ill for a while, but she could take only liquid food, even soft potato being vomited. Shortly the child had a quite serious gastro-intestinal upset, as it was supposed. When she was finally brought to Dr. Nassau he had an X-ray plate made, which showed the nickel piece lodged in the esophagus just above the suprasternal notch. On the following day, the twelfth after the swallowing of the nickel the child was admitted to St. Joseph's Hospital. Dr. Nassau passed esophageal forceps readily down the esophagus and could feel them strike a metallic object, but he was not able, with some little pains, to grasp this object. Considering the length of time this foreign body had been imbedded in the child's esophagus he thought it wisest to do an esophagotomy rather than try to force the nickel out. The operation consumed but fourteen minutes, and there was little trouble about the operation. There were no vessels requiring ligation; the wound was closed after the introduction of a gauze drain, without suturing the esophagus. The nickel lay in the anterior portion of the esophagus with the edge turned up a little toward the left and spanning it tightly, as though in a pocket. There was no leakage of either fluids or food and the child made a perfectly uninterrupted recovery.

Dr. Nassau also referred to a second recent case. The patient, a physician, swallowed a set of caps and pivot teeth at 3 A.M., and the operation was performed at about 9.30 following, there being no question about attempting to remove them by any other method. The patient had a rather stoutish neck which it was impossible to stretch out quite as desired. The operation was performed in a country house and took about twenty minutes. This esophagus was sutured and the entire lower half of the

wound was drained. The pack was inserted for about 4½ inches, which Dr. Nassau afterwards considered extremely wise as the wound was badly infected within two days. This wound is now very well cleaned up, there being healthy granulation and no leakage. Any kind of liquid food can be swallowed without pain.

Dr. William J. Taylor stated that in 1900 he operated upon a child of 16 months who had swallowed a good sized metal clip. This was in the child's throat for seven months. It was a nursing baby and therefore had swallowed its milk fairly well, but it was absolutely impossible for it to swallow solid food. An X-ray picture was taken soon after the swallowing occurred but unfortunately the child was not etherized and the plate was a failure. When the child was referred to Dr. Taylor he had Dr. Leonard take a skiagraph, which gave a most excellent view of this clip which was open. The child was etherized, and but slight efforts were made to reach the object with instruments. Dr. Taylor agrees with Dr. Nassau that the only safe plan when foreign bodies have been in the esophagus a long time is to do an esophagotomy. This was done in his case and the child made a very satisfactory recovery and is now a strong healthy boy with no stricture of his esophagus and has had no difficulty whatever in swallowing. Dr. Taylor showed the corresponding clip to that which had been swallowed and called attention to its nickel-plated condition, stating that the nickel-plating of the clip which had been swallowed had been absorbed while the clip was in the child's throat.

Dr. Taylor desired to repeat his statement that he thought it always safest, after a foreign body had been for some time imbedded in the esophagus, to do an immediate esophagotomy rather than try to remove the object with a coin catcher or forceps.

Dr. John H. Gibbon considered Dr. Taylor's attitude rather radical. He referred to a case in which he had removed an ordinary campaign button which had been in the esophagus for eleven days. This patient made a good recovery. He thought one had to be guided entirely by the character of the body in the esophagus and by the symptoms. Esophagotomy carries with it a certain amount of danger especially from pneumonia, and a case in which an esophagotomy is done in the presence of ulcers is always in danger of a pneumonia. He considered it wise to make an endeavor to remove the foreign body unless the evidence

goes to show that such an attempt would be dangerous. He did not believe any rule could be laid down as to the performance of an esophagotomy after the foreign body had remained any certain time in the esophagus, especially when the foreign body was smooth or round.

Dr. John B. Roberts mentioned the case of an infant who had swallowed a jackstone. The patient was referred to him last spring, a day or two after the accident. It had been seen by other physicians in the meantime. Dr. Roberts tried unsuccessfully to get the jackstone out by the mouth. Finally an esophagotomy was done, and unfortunately, on account of not being able to get a guide into the esophagus he made a slight puncture in the trachea. He removed a six-ended jackstone from the child's esophagus. The patient did fairly well for a few days but the wound finally became very septic and she died of a capillary bronchitis. Dr. Roberts thought that if he had seen the patient earlier and had resisted the temptation to attempt removal through the mouth, and done esophagotomy earlier he might have had a better result.

Last winter, with an ordinary coin catcher he succeeded in removing a coin from the esophagus, after it had been swallowed but a few hours.

Dr. A. C. Wood agreed with Dr. Gibbon that some judgment should be exercised in adapting the method of removal to the kind of body, as well as to the time that had elapsed since it was swallowed. An irregular object, such as a jackstone, would cause ulceration more rapidly than one that was smooth and round such as a coin. There is good reason to believe that it would have been dangerous to attempt to fish out the clip shown by Dr. Taylor.

He referred to his experience in five cases in which jackstones had been swallowed. In two of these the jackstone was removed by means of a gastrotomy, after efforts at removing it through the mouth failed. The stones were brought into the stomach and removed without serious consequences, the children making normal recoveries. He had tried various esophageal forceps without success in three cases in which he was able barely to touch the jackstone with the tip of the index finger. By using this finger as a guide and employing a hook like a tenaculum, bent to the proper curve, he was able in these three cases to get

the body up without difficulty and without danger to the child. He considers esophagotomy such a serious operation in itself that it should be resorted to only when all other appropriate means have failed.

Dr. John H. Jopson recalled several cases in this connection. In one case he was able to extract a jackstone by passing an English catheter alongside of it and withdrawing catheter and jackstone together. He has never had much success with the esophageal forceps in children. He referred to an unfortunate case at the Children's Hospital this Spring where a nickel had been imbedded in the esophagus for several days. The X-rays located it in the neighborhood of the cricoid cartilage and an attempt at extraction was made with some new instruments. The coin catcher was too large and almost became impacted. Jopson feared it would be necessary to do an esophagotomy, but on the following day his assistant brought a coin catcher from the University Hospital and with this the coin was brought out with the first effort. Dr. Jopson therefore considers the shapes and sizes of coin catchers important. This child was taken home that night against his advice, and had an attack from which it died in a few hours. The cause of death was not determined, but there may have occurred a pressure perforation of the esophagus or an edema of the glottis.

Dr. John H. Gibbon also referred to a case which was under his care at the Pennsylvania Hospital last winter. The patient was a child four or five years of age who had swallowed a jackstone. Numerous attempts had been made at removal of the stone before her admission to the hospital. Dr. Gibbon thought he could feel the stone with the forceps but was unable to remove it. The child was anesthetized and the stone seen distinctly through the fluoroscope. This case illustrates well the advantage of the fluoroscope. This stone and forceps could be distinctly watched throughout the removal: the forceps grasped first the smooth end of the jackstone and slipped off, the stone was then turned round and the knobbed end of the jackstone caught. This was one of the most satisfactory uses of the X-ray in the removal of foreign bodies that Dr. Gibbon has ever experienced. This child developed a pneumonia from which she died two or three days after the removal of the stone.

Dr. Charles L. Leonard (by invitation) referred to a case

sent to him from North Carolina for examination by the X-ray. The patient had been X-rayed but no foreign body found. He discovered a coin in the esophagus, which was finally removed with the coin catcher some 18 months after it had been swallowed. This was in a boy of twelve years. Dr. Leonard also stated that it was not now necessary to make an X-ray examination under ether, because these examinations could now be made with exposures of ten seconds, or less.

Dr. Charles F. Nassau, in closing, said there is no question whatever that when given a foreign body, either smooth or a jackstone, attempts may be made to extract the body. With this baby he made reasonable efforts after touching the object with the esophageal forceps, which he had no difficulty in introducing. He thinks a difference should be made between bodies which have been for a comparatively short time and those which have been in for months, for where an object has been in only a short time infection there is severe; if it had been there for a long time Nature will have done, as she does everywhere, build a wall round that body which will protect the tissues outside from the extension of infection due to reasonable manipulation. He does not believe from his small experience that esophagotomy is such a serious operation as one would suppose. In the case of this child he cut no vessels, while in that of the heavily built man with the plate of teeth in his esophagus, Dr. Nassau tied the inferior thyroid and one small branch running anteriorly from the vessel and put only two ligatures in the wound. When he opened this esophagus there was a gush of purulent material, and of course with this condition present it would have been death to his patient to have attempted to remove the object by any other means. In neither of his cases could the object be felt by a finger in the throat, they were both lodged in the esophagus. They could, however, be touched with the forceps. As to the use of a guide Dr. Nassau said that after feeling the foreign body he took out the forceps, made the incision as far as the esophagus, and then reintroduced the forceps in the case of the man, but not in the baby. The prongs and edges of the plate of teeth had imbedded themselves and sepsis was beginning at a serious rate, and he found the forceps a great aid in this condition. The patient's temperature went up that night to 104°, but on the fourth day was normal.

SIGMOID DIVERTICULITIS (MESOSIGMOIDITIS) IN A CHILD.

Dr. Astley Paston Cooper Ashhurst presented a boy aged seven years and nine months, whom he had seen on the evening of July 18, 1906. In the absence of Dr. Hutchinson, to whom he was indebted for the privilege of operating and of reporting the operation, he was called to the Children's Hospital to see the patient, who had just been admitted with the diagnosis of appendicitis. The patient's family history was negative; he had had measles and mumps, but not recently. For the past two weeks he had had pains in the abdomen, chiefly around the umbilicus, and not very severe until three days before admission. Then he lay on the bed, doubled up as if with cramps, but did not vomit until the day he was first seen by Dr. Ashhurst. His mother said that his bowels had been opened several times daily. The pain was said to be paroxysmal, becoming very severe at times. On admission, at 9 P.M., the temperature was 101.4° F., pulse 128, respirations 32 per minute. The abdomen was held very rigid throughout, but it seemed to be a voluntary rigidity, and there did not appear to be diffuse peritonitis. There was retention of urine, the dulness due to the distended bladder being evident on percussion in the hypogastric region. The urine was drawn twice by catheter, but subsequently was voided spontaneously.

The presence of appendicitis was excluded after the first examination, but no satisfactory diagnosis was made. Rectal examination was negative. It was decided to await the development of more certain symptoms before undertaking an exploratory operation. The bowels were opened only by enema. No purges were given at this time.

Not until the third day after admission was palpation of the abdomen entirely satisfactory. It was now possible to feel a mass in the left iliac fossa. This mass was firm and tender on palpation, and seemed attached to the iliac bone in the neighborhood of the left sacro-iliac synchondrosis. The mass extended nearly half way from Poupart's ligament to the umbilicus. It was dull on deep percussion, and did not seem to be in close contact with the anterior abdominal wall. The rest of the abdomen was flaccid, and there was no tenderness except on firm pressure over the tumor. The tumor could not be reached by

the finger in the rectum, and rectal examination was in no way painful. No polyp was detected. The question of diagnosis was still undetermined, but lay between sarcoma of the sigmoid and an inflammatory mass, which latter, it was thought, might have been caused by a previous attack of appendicitis. Psoas abscess was excluded on account of the absence of all bone lesions, and because of the presence of early symptoms of intraperitoneal irritation. Iliac abscess, of traumatic or tuberculous origin, was also excluded for the latter reason.

The child was seen by various members of the staff, both surgical and medical, but no positive diagnosis was suggested. Purges and enemata were administered until the possibility of fæcal impaction was absolutely excluded. The leucocyte count was 6,400 the day after admission. One week later 7,200.

Exploratory laparotomy was done on July 27, nine days after admission. An incision, nearly three inches in length, was made in the left rectus muscle above Poupart's ligament. There was much bleeding from the abdominal wall, and the transversalis fascia and peritoneum were much thickened. On opening the peritoneum there escaped several drachms of clear serous fluid, with no odor. Its appearance suggested the possibility of a rupture of the bladder, with the extravasated urine encapsulated by adhesions. There were light inflammatory adhesions between the outer layer of the mesosigmoid, and the parietal peritoneum. A gauze pack was introduced to exclude the small intestines from the field of operation, and in doing this there was detected in the mesosigmoid a dense mass, nodular, stony, hard in places. The sigmoid with its attached mesentery was then partially delivered through the wound, the mesosigmoid turning on its attachment to the posterior abdominal wall like a door on its hinges. The tumor in the mesosigmoid was the size of a goose egg, and several enlarged lymph nodes were seen on its surface, just beneath the serous covering. The sigmoid itself was in no way obstructed, but passed over the surface of the growth, and was normal to all appearances. No tubercles could be seen on the tumor, the sigmoid, the parietal peritoneum, or elsewhere in the field of operation. The tumor was of such cartilaginous hardness in places that it seemed impossible for it to be merely inflammatory in nature. It was thought to be a retroperitoneal sarcoma, and as its removal would have required resection of the

sigmoid from the level of the iliac crest down into the true pelvis, all thought of radical operation was abandoned. One enlarged gland, close to the mesenteric border of the sigmoid, was removed from the surface of the tumor beneath the external layer of the mesosigmoid; the incision in the mesosigmoid was sutured; and the abdominal wound was closed in layers. The time of the operation was forty minutes. The convalescence was uneventful. The wound was dressed at the end of a week, the last sutures were removed three days later, and on the twelfth day the patient was allowed out of bed. He was discharged August 11, 1906. An examination of the blood, made August 1st, five days after the operation, showed that the leucocytes numbered 13,200, and that the hæmoglobin was 55 per cent. On the same day Dr. C. Y. White reported that microscopical examination of the gland removed at operation showed marked inflammatory exudate throughout its structure. No evidence of tuberculosis could be detected.

The patient was seen again in the Dispensary three weeks after operation. The wound was firmly healed, but the tumor seemed to be nearer the median line of the abdomen, and was not apparently attached to the left iliac bone as before the operation. His bowels had been opened normally, without enema or purge, twice daily since leaving the hospital. The patient's mother was informed that an inoperable tumor had been found, and a gloomy prognosis was given.

On November 17, 1906, about three months and a half after the operation, Dr. Ashhurst examined the patient at his home. He was playing around the streets, and had been in excellent health. His bowels opened normally, his appetite was good, and he never had any pain. Careful abdominal examination failed to reveal any evidences of the tumor. He had seen the child at intervals since then, and presented him to the Academy in perfect health, and without the slightest evidence of tumor.

Dr. Ashhurst said that until within the past year, very little surgical attention had been devoted to inflammatory lesions of the sigmoid and its mesocolon. During that time a large number of contributions have appeared, and the pathology and nomenclature of these affections are becoming better understood. The literature of acquired intestinal diverticula, up to 1904, has been admirably summarized by Dr. Edwin Beer of New York, and

within the past year the diagnosis and treatment of inflammatory affections of the sigmoid have been discussed by Brewer, Lejars, Mayo, Monsarrat, Patel, Ries, Rosenheim, Sieur, and others. The lesions reported by these authors may be classified as follows:

1. Sigmoiditis—inflammatory hyperplasia of the walls of the sigmoid converting it into a rigid tube, and usually causing a certain amount of obstruction.

2. Perisigmoiditis—suppuration, usually localized, due in most cases to perforation of a sigmoid diverticulum. Appendicitis is still recognized as a possible cause of perisigmoiditis.[1]

3. Mesosigmoiditis—which, in the patients reported by Ries, was characterized by the presence of cicatricial bands in the mesosigmoid, leading in one case to volvulus, these bands being the result of previous more or less acute inflammatory changes.

Most of the cases reported have belonged to one of the former classes, a majority probably being characterized by perisigmoid suppuration. It seems probable that in this case, described by the term mesosigmoiditis, the original lesion was a diverticulitis within the layers of the mesosigmoid. It is well known that diverticula occur in this situation, as well as on the free border of the sigmoid; and though their presence in any but adults is denied by many writers, other authorities acknowledge the existence of congenital diverticula. In none of the reported cases, however, so far as he had been able to ascertain, was the patient below the age of puberty;[2] and in none has there been such a marked tumor of the mesosigmoid, with so little perisigmoiditis. Dr. Deaver, however, had informed him that he had operated on a patient (an adult) in whom the pathological lesions considerably resembled those in the patient now reported; except that in Dr. Deaver's patient the mass in the mesosigmoid was much softer, the sigmoid itself was quite strictured, and when the bowel was opened an ulcerated spot (not a diverticulum) was found at its mesenteric attachment.

The treatment to be adopted depends very much on whether the condition is recognized as a purely inflammatory one, or

[1] Perhaps the term pseudo-sigmoiditis might be employed to describe inflammatory lesion in the neighborhood of the sigmoid, caused by primary disease of the appendix, ovary, or Fallopian tube.

[2] Patel, in a paper published since the above was written, refers to a case in a girl of 10 years, reported by Walcha.

whether, as in most of the earlier cases, it is considered malignant. In the latter case resection will be adopted for the operable cases; and the inoperable cases will be treated by either colostomy, enteroanastomosis, or exclusion if there is obstruction, or the abdomen will be closed, as in the present case, when no obstruction exists. If the presence of pus, or the history of early inflammatory symptoms, on which as a diagnostic point Lejars lays so much stress, make it seem probable that the condition is inflammatory, it will probably be best merely to drain the purulent focus and release such adhesions as obstruct the lumen of the sigmoid.

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Dr. A. C. Wood considers the pathology of these inflammatory lesions about the sigmoid more complex than might be supposed at first thought. They are not all secondary to diverticula; probably but a small minority are due to this cause. He has read of cases that were due to perforation of the sigmoid by foreign bodies; in one instance a pin had passed through the wall of the bowel, causing an abscess, and in another fragments of straw had in like manner perforated the bowel. Cases are reported in which the epiploic appendages were involved in these inflammatory swellings. Although the case reported by Dr. Ashhurst is the youngest he has heard of, he believes it is generally admitted that these diverticula may be either congenital or acquired, and if congenital, there is no reason why they may not cause trouble in early life. He does not consider the explanation that the diverticula result from constipation and distention of the bowel with protrusion of pouches of mucous membrane through the muscle fibres a satisfactory one.

Dr. Astley P. C. Ashhurst, in closing, said that in his case the diagnosis was of course largely conjectural; he thought

however, that the mass certainly was one of enlarged glands, but he believes that if these glands had been simply tuberculous in character, which he considers a rarer condition in the mesosigmoid than the presence of diverticulum, there would have been symptoms of tuberculous disease and the course of the case would not have been so favorable. Although the condition is a rare one he sees no reason why this should not be considered a case of diverticulitis.

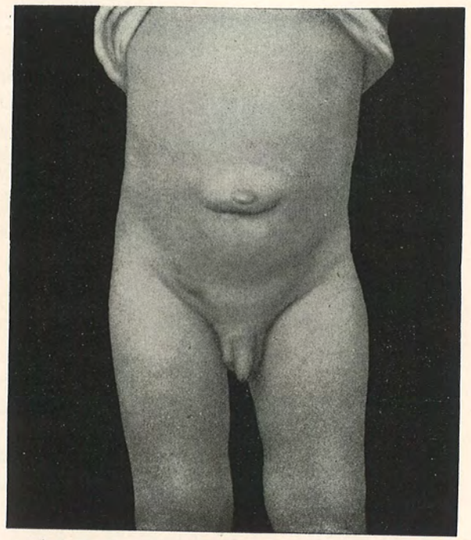
RADICAL CURE OF UMBILICAL HERNIA IN A CHILD WITH PRESERVATION OF THE NAVEL.

DR. ASHHURST reported the case of Thomas S., aged two and a half years, who had suffered since infancy with an umbilical hernia, which on admission was the size of an English walnut, and was easily reducible. The ring admitted the little finger. There was also a right inguinal hernia.

Having seen the suggestion that the navel be preserved in operating on children, especially boys, for the radical cure of umbilical hernia, he determined, at the risk of being thought to do a complicated operation where a simple would suffice, to attempt such an operation in this case. For the privilege of operating and of reporting the operation, he was indebted to Dr. Hodge, in whose service at the Children's Hospital the patient was treated.

The operation was done July 25, 1907. A crescentic incision was made below and surrounding the navel, down to the sheaths of the recti muscles. The flap of skin and subcutaneous fat thus outlined was dissected upwards, for an inch or more above the navel, the hernial sac being opened just beneath the umbilicus. The flap containing the navel was then turned upwards, and the sheath of the rectus muscle on each side was opened transversely at the level of the ring. The sheaths with the intervening linea alba were then dissected free from the underlying transversalis fascia and peritoneum. Then with three mattress sutures of chromic catgut the aponeurosis below the ring was drawn upwards into the slit between the transversalis fascia beneath and the sheath of the recti muscles superficially. The flap of aponeurosis on the thoracic side of the hernial ring was then sutured (with continuous stitches of chromic gut) to the sheaths of the recti muscles below, thus interposing, as in the usual overlapping

FIG. 1.



Result of operation for umbilical hernia with preservation of the navel.

operation, two layers of aponeurosis between the peritoneal cavity and the subcutaneous tissues. The skin flap was then sutured back in place, and a small catgut drain was introduced beneath it at one angle of the incision, because the absence of the hernia and the overlapping of the aponeurosis had made the skin flap somewhat redundant, and it was feared that some serum might collect beneath it were no drain employed. This drain was absorbed, having fulfilled its purpose, before the first dressing of the wound, when union was found firm throughout. The operation took only twenty minutes to do, and as the scar fades away in the natural creases of the abdomen it will be barely possible to tell that any operation has been done (Fig. 1). The boy at least will not be an object of ridicule among his companions in bathing, etc.

The inguinal hernia was operated on at the same sitting. It was a hernia into a patulous processus vaginalis testis, and the Bassini operation was done. Both scars are now perfectly firm, and the boy is in excellent health.

Dr. John H. Jopson said that in 1906 he had seen Dr. James Stone of Boston operate for umbilical hernia in a child at the Boston Children's Hospital, and Dr. Stone advanced the same reasons for preserving the umbilicus that Dr. Ashhrust had mentioned. He did not do as Dr. Ashhurst described, but made a linear vertical incision. Dr Jopson repeated this operation on a child at the Presbyterian Hospital last winter. Referring to Dr. Ashhurst's first case it seemed to Dr. Jopson that the diagnosis of diverticulum was only a matter of conjecture, and that in the absence of an opportunity for resection and examination of the tumor and as there were undoubtedly enlarged glands in the mesentery it might just as well have been considered a case of enlarged glands in the mesosigmoid as the rare condition of diverticulitis.

LUDWIG'S ANGINA.

AN ANATOMICAL, CLINICAL AND STATISTICAL STUDY

BY T. TURNER THOMAS, M.D.,

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LUDWIG in 1836, described a condition which he considered a morbid entity, and which since that time has been designated, more or less universally, as Angina Ludovici. Various attempts have been made to establish it upon a definite pathological basis, but the results of none of these can be said to have been generally accepted. That it is an infection there can be no doubt, but the character of the infection if it has a special character, has never been decided. That it is more rapidly fatal than similar infections occurring in other parts of the neck than the submaxillary region, is amply proved by the recorded cases, but why or how it acquires so dangerous a character, has never been clearly demonstrated. It is well known that certain cases assume a grave aspect and threaten or take the life of the patient in twelve to twenty-four hours, while others begin and continue as a comparatively mild affection for days and then suddenly assume an alarming character. That its general course and symptoms are typical and essentially constant is convincingly shown by the numerous cases that have been reported. Yet many have been and some are still being reported, which should not be designated by this term. The following case led the writer to make a study of the subject.

W. W., male, age 32 years, machinist, admitted to drunk ward of the Philadelphia Hospital, August 10, 1903. On admission the temperature was 98, pulse 110, respiration 30. Has been drinking for about a month. Is nervous and has marked tremors of the hands and tongue. He cannot eat or sleep. The heart is rapid but the sounds are good, and there are no murmurs.

He has no hallucinations, and is well nourished. He complains of a small, painful swelling under the right side of the lower jaw which has been there for about a week. On August 13 he was transferred to the surgical ward, in the service of Dr. A. C. Wood, to whom the writer is indebted for the privilege of reporting the case. Temperature 98.2, pulse 78, respiration 22. The swelling is increasing in size. The pain keeps him awake at night and prevents him from taking his nourishment. Incision made in the submaxillary region, the index finger being introduced its entire length without evacuating any pus. August 14th swelling is increasing rapidly, is hard, non-fluctuating, and involves the whole under side of the jaw. Speech is difficult, and he is having such difficulty in swallowing that he is being fed with a spoon. Temperature 101, pulse 100, respiration 26. General condition otherwise good. August 15, at 8 P.M., he was cyanotic and respiration was very difficult. Tongue swollen. Oxygen inhalations given for a time with some relief. Then he became rapidly worse. Pulse intermittent, rapid and weak. At 10 P.M. tracheotomy was performed by the resident in charge, Dr. Speese. Incision below the cricoid cartilage. Profuse bleeding from the veins in front of the trachea. Surrounding tissues very œdematous. From the time the trachea was opened the patient's condition rapidly became worse, and although he breathed through the tube, he could not be kept alive by artificial respiration, which was continued for about fifteen or twenty minutes.

Autopsy—Pathological Diagnosis.—Œdema of the glottis; unilateral interstitial nephritis; hemorrhagic infiltration of intestinal mucosa. The tissues about the glottis and epiglottis are intensely swollen. This swelling is so extensive about the glottis that only a chink, about 2 mm. in breadth and 6 mm. in length of the glottis remains.

The writer regards this case as a typical Ludwig's Angina. The following case was reported, September 4, 1905, before the North West Medical Society of Philadelphia, as a "Gun Shot Wound of the Lower Jaw, followed by Submaxillary Cellulitis, simulating Ludwig's Angina." Since then a study of the literature has shown other cases, reported as Ludwig's Anginas, which were essentially of the same

type. The writer considers that this grade of infection in this region has every dangerous characteristic, indeed somewhat exaggerated, of a typical Ludwig's Angina. The reader is referred to the later discussion on etiology and pathology, for the writer's reasons for including it here as an example of this disease.

J. W., colored, age 31 years, admitted to the Philadelphia Hospital, August 9, 1905, in the service of Dr. A. C. Wood, with whose permission the writer reports the case. His general health and strength were excellent.

On August 8th, in a quarrel, the patient was shot twice by a revolver in the hands of a companion, who stood in front of him, and about five or six feet away.

There are three wounds of the face, one of which is a well-rounded and perforating wound of the cheek, about three-eighths inch in diameter, just to the right of the symphysis. A second wound with irregular edges is situated on the right cheek, about one inch in front of the lobule of the ear. A fragment of a bullet was removed from this wound. The third perforation, which was so insignificant and covered by stubby beard that it was not discovered for a few days, is shaped like the first, and is situated on the left cheek about two and a half inches posterior to the angle of the mouth. The probe enters this wound for about two inches, when it strikes what at first was thought to be the ramus of the jaw. A skiagraph later showed a bullet lodged in the tissues in about the situation of this opening. At first the patient did not complain of this wound, and it was then thought that the two on the right side were produced by the two bullets. It seems evident now that they were due to a single bullet which entered near the symphysis, struck the jaw, splintered it, and was divided, one fragment glancing off and producing the wound in the right cheek near the lobule of the ear. Both wounds of the right cheek met within the mouth at the injured portion of the jaw.

The tissues of the interior of the mouth, internal and external to the jaw, are intensely swollen, particularly internal to the jaw in the floor of the mouth. The tongue almost fills the mouth and interferes with normal respiration. Speech and deglutition

are disturbed. There are four teeth missing in the lower jaw in the right molar region. The patient says the teeth were not missing before the shooting. In the space corresponding to the missing teeth the alveolar border of the lower jaw is splintered, the loose fragments being removed with forceps. There is a complete fracture of the lower jaw on the right side about an inch anterior to the ascending ramus. The wounds were all washed out and packed with gauze, dressings applied, and a cardboard cup was fitted to the jaw and held by a Barton's bandage.

On the following day the patient's condition became alarming on account of the difficulty in breathing. The face was more swollen, particularly in the submaxillary region. The tongue and the floor of the mouth were more swollen than on the preceding day, and the tissues in the floor of the mouth were more brawny to the feel. The patient was etherized and the two wounds on the right side of the face were enlarged into the mouth. All loose fragments of bone and soft tissue were removed and the wounded tissues irrigated with boric solution. An incision about two and a half inches long was made parallel with the lower jaw and about midway between the hyoid bone and jaw. This wound was deepened until the finger was close to the mucous membrane of the floor of the mouth in the region of the damaged portion of the lower jaw. Irrigation and dressing as before. Temperature 101.3°, pulse 128.

On the following day, August 11th, his condition had improved slightly, but the swelling and temperature were about the same. Respiration, deglutition and speech were still disturbed. On examining the region of the injury to the jaw, the wound in the floor of the mouth was found covered with gangrenous sloughing tissue, and the odor was very foul. The wounds in the lip and cheek leading away from this region were discharging foul pus. A mouth gag was introduced on the opposite side of the mouth and the tongue held away from the infected area, thus exposing it. After clearing away all shreds of gangrenous tissue and irrigating with boric solution, the infected surface was cauterized with pure carbolic acid, which was neutralized at once by applications of alcohol. The patient was placed in charge of a special nurse, who cleansed the infected region every half hour with peroxide of hydrogen and boric solution.

On the following day a marked improvement was noticeable. The swelling was evidently decreasing, the patient could talk, swallow and breathe better, and said that he felt much better. In the few succeeding days the temperature fell to normal. The discharge was still copious and offensive. The septic condition soon subsided and the case resolved itself into one of healing wounds of the face and neck and fracture of the lower jaw, which later united.

History.—Parker, in 1879, published an interesting historical review of this condition as recorded before the appearance of Ludwig's paper, with particular reference to the cases occurring in England. He gives some details of a case referred to by Auretius which seem to have been those of a Ludwig's Angina. He called the condition, "cynanche." Paulus Aegineta spoke of a somewhat similar condition, which he called "paracynanche." Many of the older authors, both Greek and Arab, including Hippocrates, Galen, Celsus, Aurelianus, Rhases and others, had described the disease. Dr. Fothergill gave an account of "Putrid Sore Throat" (1739–1746), which appeared to have some of the characteristics of Ludwig's Angina. He also gave an historical review of what is believed to have been the same disease. Dr. Kirkland in 1786, Dr. Wells in 1809, and others reported cases of this type.

It remained, however, for Ludwig to present the first accurate description of this dangerous condition, which he called "gangrenous induration of the neck." Cameror, in the following year was the first to apply to it the name, Ludwig's Angina. Following the appearance of Ludwig's paper considerable interest was manifested and an increasing number of cases were reported. Probably, greater interest has never been shown during any one period, than that which was bestowed on it by the French Surgical Society, in 1892. Several successive meetings were devoted to it and many cases cited by those present. There was a marked difference of opinion manifested, which culminated in a division of

the members into two parties, one being led by Nelaton, the other by Delorme. Nelaton took the stand that Ludwig's Angina should not be recognized as a separate disease, and was instrumental in having resolutions to this effect passed by the society. At the following meeting Delorme caused this action to be reconsidered and Ludwig's Angina to be given its proper place in surgical pathology. In the following year Leterrier published a thesis in which he reported 27 cases collected from the literature and communicated four new ones, three of Delorme's and one of his own. The chief object of his paper appeared to be to support the position of his teacher, Delorme, who contended that Ludwig's Angina was primarily a sublingual phlegmon.

In the same year, 1893, Poulsen published the results of a study of 530 abscesses of the neck collected from hospital statistics. In 1886, he had presented a paper in which he reported his observations on a series of lime injections under the deep fascia of the neck, to prove the existence of communicating channels of loose connective tissue between the various adjacent interfascial spaces. In his second paper he attempted to show that infections tended to follow these channels and to invade the various spaces, successively. His explanation of the progress of the infectious process in a Ludwig's Angina will be taken up later in the discussion of the etiology and pathology of this disease.

In 1895, Semon's paper appeared, in which he maintained that acute septic inflammations of the throat and Ludwig's Angina were pathologically identical, and should be included together as one group of diseases, thus eliminating Ludwig's Angina as a separate disease. Since that time nothing new has been offered on this subject so far as the writer can learn.

Etiology and Pathology.—Although fairly authentic cases were recorded before, practically, nothing was presented in the literature to establish the cause and nature of this condition, until Ludwig's paper appeared. Since that time many cases have been reported and much has been written, which is of value in clearing up the obscurities sur-

rounding Ludwig's Angina. Yet its etiology and pathology still remain obscure. In the writer's opinion, one of the basic causes of confusion lies in the obscurity associated with the cause of death, in connection with which, the chief question is as to whether it results from septic intoxication or from invasion of the air passages. Probably, both conditions are always present to some degree, in typical cases; but the relative importance of each has never been established. If septic intoxication is the essential cause of death, then the especially high mortality of this condition is to be explained by the presence of a rare and especially virulent infection. If invasion of the respiratory tract is the dangerous feature, peculiar to this condition, then the mortality is to be explained by extension of the phlegmonous inflammation to the larynx and in some cases to the lungs. Upon the solution of this question depends, in the writer's opinion, the explanation of the etiology and pathology of Ludwig's Angina.

Ludwig suggested that it was epidemic in its nature, that it was allied to erysipelas and that it was a true morbid entity. Every one of these suggestions has been supported and combatted vigorously by many different authorities and it may fairly be said that they remain unsettled up to the present time. Tissier, Roser, and Chabri, for example, agree with Ludwig, as to its being a morbid entity. On the other hand, Boehler, who collected and studied 35 cases, refused to accept this view and tended to suppress the name of Ludwig's Angina. v. Thadden gave to it the name of "submaxillary bubo," while Chantemesse considered it a true erysipelas of the larynx. Roser believed that the disease began in the submaxillary salivary gland. This theory has not been borne out by the post-mortem evidence which has been accumulated. It will not be profitable to discuss here more than a few of the theories which have been offered as to the etiology and pathology of this condition, and it is particularly, to the later authorities that the writer will confine his attention.

As already indicated the investigations have followed two distinct channels; the bacteriological, which attempt to prove that a particular type of infection and therefore a septic intoxication is responsible for the condition; and the anatomical, which try to show that the condition is due to the particular location of the infection and its peculiar opportunities for dangerous extension.

Influence of Septic Intoxication.—Definite and positive convictions on the relative importance of septic intoxication, can not be reached without difficulty. In studying this phase of the subject, first importance should be given to the bacteriological findings. A search of the literature has shown the following cases in which different bacteria were found and reported.

Delorme, staphylococcus in one case and streptococcus in another; Leterrier, undetermined bacillus in one; Macaigne and Vanverts, pneumococcus predominating, with streptococcus and staphylococcus in one; Lockwood, streptococcus, staphylococcus and bacillus of malignant oedema in one of his own cases and in another, streptococcus, cocci and diplococci. In Gibson's case he also found the streptococcus; Biedert and Robertson, streptococcus in one; Gasser, streptococcus and bacillus coli communis in one; Ross, streptococcus and staphylococcus in one; Davis, streptococcus alone in two cases, and streptococcus and staphylococcus in a third; Ombredanne and Keim, streptococcus and staphylococcus in one; Humphrey, pneumococcus alone in one; Duplay, staphylococcus in one; Chantemesse and Widal, streptococcus in one; Magnal, streptococcus in one.

It will thus be seen that of the 18 cases, the streptococcus was found alone in 6 cases; the streptococcus associated with other organisms in 8; the staphylococcus alone in 2; the pneumococcus alone in one; and an undetermined bacillus in one.

The fact that stands out most prominently in this group of cases is that the streptococcus was present in almost all, either alone or associated with other bacteria. That it may be present in some cases in which the investigation has failed

to show it, may be inferred from the fact that Lockwood, by different methods, found the streptococcus in Gibson's case, although Cameron reported that he could find "no specific microörganisms in the tissues." In all the writer's collection of cases, the inflammation of the connective tissues has appeared to be of a severe type, and in a considerable number a gangrenous or fetid process has been present. The inference to be drawn from these facts is that a severe septic infection and a corresponding grade of septic intoxication has been encountered. Yet in many cases the constitutional symptoms have been only moderate or very mild. Even if they were severe in all, this would not show that they were the cause of the high mortality, since the same infections occurring in other parts of the body, giving as severe local and constitutional symptoms, do not produce the same death rate as does Ludwig's Angina. Since the existence of a special infection, capable of explaining the high mortality, has been searched for, carefully, by qualified investigators without success in a fairly large number of cases (probably many more than the writer has found record of), we may assume with some confidence, that none such is present. The clinical as well as the post mortem evidence, so far accumulated, is decidedly against the existence of such a cause; while the evidence in favor of ordinary severe types of infection, particularly, the streptococcus is very strong.

Ludwig, whose description of the clinical course, has remained the standard up to the present, said that in the first four or five days, the constitutional symptoms were not severe, but became so later. From a study of 104 cases collected from the literature and his own two, the writer believes that this change in gravity of the constitutional symptoms, has a definite relation to the invasion of the mouth and pharynx by the phlegmonous process: and that the increase in severity is out of all proportion to the increased area infected, and the corresponding amount of toxins absorbed. This raises the question as to whether the constitutional symptoms are due entirely to septic intoxication, or whether

they may not be due in part to interference with respiration. Davis says "whether these deaths are due to suffocation or heart failure caused partly by sepsis and partly by the impeded respiration is sometimes difficult to say." He also adds that "these sudden deaths occur usually in patients in which the epiglottis and larynx are affected and the dyspnoea marked." One would infer from this statement that Davis believes that these sudden deaths are the result of the affection of the epiglottis and larynx. The writer believes that practically all deaths in Ludwig's Angina are to be accounted for in the same way. Some develop pneumonia and pleurisy, while a few may die of septic intoxication. Engelman says that seventy-five per cent. of children dying of diphtheria have broncho pneumonia. Diphtheria is a severe infection of essentially the same parts of the throat as are involved ultimately in these cases of Ludwig's Angina, and broncho pneumonia should be as likely to result in one as in the other. Septic intoxication, itself, probably, kills no more patients suffering from Ludwig's Angina, than do these same types of infection occurring in other parts of the body, as in the palm of the hand, the forearm or leg, or in other parts of the neck. "In Robertson and Biedert's case," Davis says "sudden death occurred after a tracheotomy had been performed, so that suffocation could not have been the cause." While it would be difficult to show that suffocation, actually, occurred in this case, the fact that the first symptom complained of was dyspnoea, and that six hours after the onset it was so severe that tracheotomy became imperative, points to the fact that disturbance of the respiratory tract probably killed the patient. In this case as in most of the 14 which Semon reported, the phlegmonous process, evidently, began close to the larynx. In Semon's cases extension to the lungs or pleurae occurred in 5 out of the 6 fatal cases. Pneumonia developed in 3, in one on both sides, and in two double pleurisy was present. In two of the eight cases, which recovered, a double patchy pneumonia was noted. On the same point Davis says further: "In one of Ross' cases, like-

wise, sudden death resulted while the opening existing through the larynx was sufficient to preclude respiratory obstruction." In this case the focus from which the phlegmonous inflammation extended was, evidently, the necrotic wisdom tooth, and from this focus pus and gas escaped on prying away the tooth. With the beginning of the process only about two inches away from the larynx and within the mouth close to the pharynx, it is more than likely that oedema of the larynx developed early. On the fourth day after operation, two patches of impaired resonance were made out, one in each lung. It would seem to be evident, therefore, that in both these cases, the invasion of the respiratory tract and not septic intoxication, caused the death of the patients. Why these cases in which the clinical evidence of oedema of the glottis, *i.e.*, the intense dyspnoea, is so pronounced as to demand immediate tracheotomy do not recover when this operation permits an apparently free passage of air to and from the lungs the writer is not prepared to explain. That the deaths in these are, indirectly or directly, the result of the invasion of the respiratory tract, larynx alone or larynx and lungs, the writer believes. One of his own cases breathed through the tube after the tracheotomy had been performed, but could not be kept alive by artificial respiration. In one of Baker's cases, tracheotomy was done soon after his admission to the hospital, but the pulse stopped during the operation and the patient died. The autopsy showed oedema of the glottis (see autopsy cases). In one of Tissier's cases, tracheotomy was performed for intense dyspnoea on the day of his admission to the hospital, the third day of the disease. Notable relief followed the operation, but the patient died the same night. In Weiss' case, a tracheotomy was done on the first day of the disease. It was necessary to continue artificial respiration for a half hour to revive him. He recovered. Fenwick's case required a tracheotomy, 4 hours after the beginning of the disease. Great relief followed the operation, but the patient died three hours later. In Gibson's case, swelling began in the neck

below the lower jaw, at noon of one day. On the following day the swelling was enormous, extending to the chest and zygoma. The floor of the mouth was considerably thickened, and there was slight dyspnoea. He was admitted to the hospital about 1 P.M. At 3 P.M. of the same day, he became intensely dyspnoeic and tracheotomy was performed immediately, followed by artificial respiration. He recovered and the respiration became normal. On the next day at 11 P.M. there was dyspnoea and considerable cyanosis of the face and lips. He gradually became comatose and died at 3.15 P.M. The autopsy showed oedema glottidis (see autopsy cases). There can be little room for doubt that in all these cases the essential cause of death was the invasion of the respiratory tract, larynx alone or larynx and lungs. Septic intoxication, probably, played only a secondary part in bringing about the fatal result.

It is well known that the partial obstruction of the pharynx from faucial and pharyngeal adenoid growths, will impair the general health of a child by interfering with the normal respiration. Much greater interference coming on suddenly in Ludwig's Angina, from pushing the tongue upwards and backwards and crowding the mouth and pharynx should produce a more serious deleterious effect upon the general condition, the signs of which will be added to and confused with those of the septic intoxication which is already present. When we take into consideration the fact that there was oedema of the glottis in, practically, every fatal case in the writer's group of cases, in which the larynx was afterwards exposed at autopsy, it becomes evident that the interference with respiration is greater than is generally supposed. Dyspnoea was noted in nearly all the fatal cases, and in the opinion of the writer it is the invasion of the larynx and lungs, not the septic intoxication, which is the peculiarly dangerous feature of Ludwig's Angina. It is sufficient to explain the high mortality, septic intoxication is not.

While in most of the cases it is difficult or impossible to differentiate between the parts played by these two factors,

in a few it is shown clearly that all the alarming symptoms characteristic of a Ludwig's Angina may develop in the absence of severe constitutional symptoms, as in the following. Where temperature alone is given it should be borne in mind that this was the only symptom mentioned in the report of the case, from which one could infer the degree of the constitutional disturbance; and where it is not given here it was not mentioned in the report, and any statement implying the degree of constitutional disturbance or absence of it was extracted and employed in these brief summaries. In one case reported by Huguet and DeBovis, there was an extensive submaxillary swelling, "enormous" sublingual swelling, dysphagia, dyspnoea and a considerable quantity of fetid pus; yet the temperature never went above 39°C (102°F). In one of Parker's cases, the usual severe symptoms were present except dyspnoea, which may have borne some relation to the presence of a discharging sinus in the floor of the mouth. This may have checked the progress of the inflammation towards the larynx. The general health was not impaired. In another of Parker's cases, the general health was reported to be good. Leube's case, which underwent resolution, had a normal temperature. In Trump's case and in three of Davis' cases, the temperature was only 101°F. In Margerison's, the temperature was 100.8°F, pulse 104, and in Humphrey's it was never above 100°F. Leterrier reported that in his case the general condition was good, the temperature 37.4°C (99.3°F) and that the patient would have taken food if he could swallow. All these cases recovered. Michel's patient was admitted to the hospital on the 5th day of the disease, when he had an enormous submaxillary swelling. On the day preceding admission asphyxia was threatened. He died 4 hours after admission. The temperature was given at 39°C (102°F). One of Schwartz's cases, on the day of admission to the hospital, insisted on going out again to attend to some business, which he was permitted to do. He returned later in the day and died of syncope that night. In Gibson's case, the submaxillary swelling began at noon of one day. On the following day at 1 P.M., when he was admitted to the hospital, the swelling was enormous. A little later the dyspnoea became intense. Tracheotomy was performed and artificial respiration carried out with relief to the patient. At 3 P.M. of the same day he died in coma and dyspnoea. Yet the temperature on admission, 2 hours before death, was only 97.8°. In Fenwick's case, the swelling began in the morning. Two hours later the face was almost unrecognizable. In 4 hours he was cyanosed and could hardly breathe, and in 7 hours he was dead. Yet the temperature was normal, the pulse 140. It would seem, therefore, that in some cases essentially all the symptoms of a Ludwig's Angina may be present, and those of septic intoxication be very moderate or practically absent. Indeed, in only a comparatively small number of the cases collected by the writer, was high temperature referred to, and in the great majority the presence of severe constitutional disturbance could only be inferred from the general gravity of the case. Inspection of the atopsy cases, given later, will confirm this statement.

Influence of the local condition.—While definite results have never been obtained from bacteriological investigations, beyond the fact that the streptococcus is present in nearly all the cases, pure or mixed with other organisms; the study of the local inflammatory conditions have yielded more satisfactory results: The observations of Poulsen, Delorme, Semon and more recently Davis, in the writer's opinion, have been the most valuable of recent years. These writers seemed to consider the infection from a distinctly local standpoint, and to regard the larynx as the essentially vulnerable point of attack.

Poulsen says that the deep cervical fascia in the submaxillary region is dense and resistant, and that the submaxillary salivary and lymphatic glands are enclosed in a fascial space. This submaxillary fossa communicates by means of loose cellular tissue and blood vessels with the deep retromaxillary fossa, so that a cellulitis beginning in one of these spaces readily extended to the

other through this communicating passage. He explains the dangerous symptoms of dyspnœa and dysphagia in Ludwig's Angina, by an extension of the inflammation through the wall of the pharynx to the pharynx and larynx from the retromaxillary fossa. He contended that those cases beginning with a preliminary angina gave secondary involvement of the lymphatic glands in the retromaxillary fossa about the bifurcation of the carotid artery, and that the resulting periglandular cellulitis then passed through the wall of the pharynx. When the phlegmonous process began in the submaxillary lymphatic glands, as from a carious tooth or ulcer in the tongue or floor of the mouth, the overlying strong fascia gave rise to great tension so that the inflammation, seeking the direction of least resistance, passed along the communication to the retromaxillary fossa, and thence through the wall of the pharynx to the pharynx and larynx. Poulsen's conclusions are not based upon strictly anatomical studies, but upon the results of his lime injections. When the lime was injected under the deep fascia in the submaxillary region, it first produced a swelling in this region which was soon followed by extension to the region of the large vessels of the neck, and almost simultaneously to the alveolo-lingual sulcus in the floor of the mouth. In no case did it work its way through the wall of the pharynx, the path by which Poulsen claimed that the inflammation reached the larynx. He obtained hospital statistics of 530 abscesses of the neck, of which 251 occurred in the submaxillary region. Of the 251, there was a swelling in the floor of the mouth or alveolo-lingual sulcus in 22. In 2 of the 22 there was a spontaneous opening in the floor of the mouth, in one at the orifice of Wharton's duct. As a rule the inflammation subsided after incision in the submaxillary region, and only twice was the œdema so abundant that an incision in the mouth was necessary. Of the 251, 11, or 4 per cent., died. Poulsen considered that only three corresponded to the clinical picture of Ludwig's Angina, in which he attached especial significance to the non-fluctuating swelling in the submaxillary region, the lack of large pus foci, the intact skin, and the extension of the swelling to the floor of the mouth. He eliminated one of these because of the absence of an autopsy. The writer has included the other two in his collection of cases, and they will be found among the autopsy cases.

The two points in Poulsen's paper, to which the writer attaches greatest importance are: first, that Ludwig's Angina results from the extension of an infection of the neck to the larynx and pharynx; and secondly, that the cellulitis had its origin in extension from the lymphatic glands. He was far, however, from proving the path of extension. His most important evidence lay in the fact that in several cases, when the abscess was opened the finger of the surgeon could be passed down to the pharyngeal wall, the infection being traced in this way nearer to the pharynx and larynx than in any other direction. He attached considerable significance to the fact that in one case, not regarded by him as a Ludwig's Angina, during the making of an external incision into the abscess, there occurred a spontaneous opening into the throat. In no cases did he demonstrate an opening in the pharyngeal wall. Spontaneous openings have been reported rather frequently, generally in the mouth, some of them occurring near the base of the tongue or in the throat, and are readily explained in another way.

As the result of his clinical observations and experience Delorme concluded that Ludwig's Angina was nothing more than a sublingual phlegmon; although on account of its exact anatomical seat and constant symptoms, he was inclined to view it as a morbid entity and to retain the name of Ludwig's Angina. Leterrier in his thesis, already referred to, offered two arguments to support Delorme's theory. In the first place it was found necessary in all their cases to cut through the mylo-hyoid muscle from the neck, and, therefore, into the sublingual tissues, before pus was reached. In the second place, according to Leterrier, the almost constant swelling in the floor of the mouth and the elevation of the tongue, could be due only to a sublingual phlegmon. He also added that when there was a spontaneous opening made by the pus, it was usually internal. He believed that if this theory was generally accepted and the external incision extended deeply enough, the mortality would be much diminished. All of their cases recovered. A number of writers,

particularly in France, accepted Delorme's view and reported Ludwig's Angina as synonymous with sublingual phlegmon. Huguet and DeBovis, who collected and studied 49 cases, regarded them as sublingual phlegmons, but held that "these sublingual phlegmons can only be the result of diffusion of an inflammation developed more posteriorly in the region of the parotid or angle of the jaw." They believed that its anatomical seat was intramuscular, *i. e.,* that it was a basic glossitis. They could not admit that a purulent collection under the mucous membrane in the floor of the mouth would produce a hard, non-fluctuating swelling; and they added that some surgeons who have intervened by the mouth have not met with success or have had to plunge the bistoury to a considerable depth.

With reference to this point the writer has investigated his 104 collected cases with the following rather indefinite results. Nelaton made a sublingual puncture, only blood escaping. Later he made two external incisions, one a suprahyoid incision exposing a putrid focus, the other a submaxillary incision, only infected serum escaping. Death resulted from syncope. No autopsy. Chauvel made a double sublingual incision and exposed a gangrenous focus above the mylohyoid muscle, extending to the upper border of the thyroid cartilage. (Extension to the thyroid cartilage implies that the focus was below the mylo-hyoid muscle also, and therefore in the neck.) Dubois found phlegmonous pus by a sublingual incision. Haering made buccal scarifications but found no pus. Cuffe made a buccal incision toward the posterior part of the tongue but found only blood. Later the incision was repeated and pus was found. Holthouse made buccal scarifications but found no pus. Ross found no pus by a sublingual incision, but with an external incision located a large abscess. Ripault evacuated 2 or 3 cupfuls of pus by a buccal incision, and by a median external incision also found pus. There were sublingual and retromaxillary fluctuation in this case.

In most of the cases, however, it was the external incision which located the pus, and in only a few was the mylohyoid muscle said to be divided. The writer will show later that the sublingual phlegmon is the result of extension in the great majority of the cases, and that it is not the primary phlegmon as Delorme maintained. Leterrier explains the origin in the sublingual tissues by assuming that the infectious germs gaining entrance by a focus in the mouth as a carious tooth or an ulcer, are carried by the lymphatics to the cellular tissue about the sublingual gland. He says also that Richet has described a chain of lymphatic glands arranged in a horse shoe manner along the internal surface of the inferior maxillary bone, thus implying that if these glands existed, they would explain the frequency of cellulitis by periglandular extension.

Semon's paper, which appeared in 1895, is the most recent to attract wide attention. His conclusions are based upon clinical observations on 14 cases, which he saw in 20 years of special practice as a laryngologist. The main conclusion he reached was that "these acute septic inflammations of the throat and neck, described by a large variety of terms, such as acute oedema of the larynx, oedematous laryngitis, erysipelas of the pharynx and larynx, phlegmon of the pharynx and larynx, and Angina Ludovici, are pathologically identical. They merely represent different degrees of severity of one and the same septic process due to invasion of the throat and neck by various micro-organisms." He adds that this can be finally proved only by a harmonious combination of clinical, pathological and bacteriological evidence. In every one of his cases, except the first he had tried to obtain a bacteriological investigation, but only in the last was this opportunity afforded, and then the evidence was purely negative. He called attention to the fact that Virchow could not exactly define the mutual relationship between erysipelatous and phlegmonous affections. Semon believes that the question of the primary localization and subsequent development depends, in all probability, upon accidental

breaches of the protecting surface, through which the pathogenic microörganisms gain entrance to the tissues.

According to Semon, therefore, we are not concerned with any particular infection, so much as with a special type of inflammation, an acute septic phlegmonous process, which may be due to various microörganisms. Lockwood, who studied this condition from the bacteriological side, reached the conclusion that Ludwig's Angina is a mixed infection of the most complicated kind, and that several pathological conditions are included in this affection. He found that usually the streptococcus was present, though not always; and that this microörganism may be present alone or associated with other organisms, as the staphylococcus. From his study of the subject the writer prefers to accept Semon's view on this point. The complicated nature which Lockwood assigned to this infection, becomes simplified by the fact that whatever microörganism is found, the process is always the same, a rapidly spreading phlegmonous infiltration of the cellular tissues. This is the result usually produced by streptococcus infection, and it may be due to staphylococcus infection. Gasser quotes Queno as saying that any of the pyogenic organisms may be found in these cases. Other organisms may also produce it, as the bacillus of malignant oedema, which Lockwood found in one of his cases. We are not yet familiar with the exact results produced by the various bacteria, and Semon's statement seems sound that "it is absolutely impossible to draw at any point a definite line of demarcation between the purely local and the complicated, or between the oedematous and suppurative forms."

Semon maintains, however, that all acute septic phlegmonous inflammations of the throat and neck should be classified together, and that Ludwig's Angina as a separate disease should be eliminated. That they are all pathologically identical and that the throat, *i.e.,* the larynx, is the most vulnerable point in all, the writer believes. From the standpoint of prognosis and treatment, however, there is a very practical difference between those in which the

phlegmonous process begins in the throat and those in which it begins in the neck, where the condition described by Ludwig had its origin. Many of the latter have shown a preliminary angina, it is true, but this usually disappeared later and did not form a part of the phlegmonous process beyond serving as the portal of entrance for the microörganisms. In most of Semon's cases and in one of the writer's collected cases, the acute septic process began in the throat and spread out from there. These in the writer's opinion, form a distinct group, and are laryngological; those which Ludwig described are distinctly surgical and in the majority of cases respond to surgical treatment. The following advice given by Semon, may be proper for the former but not for the latter. "Should there be anywhere distinct fluctuation or merely justifiable suspicion of such, of course you will incise upon such foci. Our promise for the future must depend on the fact that we have a bacterial infection, and that by the injection of an appropriate antitoxine we may be able to save the patient." Fluctuation or even a suspicion of it is practically never present. Prompt and suitable incision in the absence of any sign of fluctuation, has arrested the progress of many cases, probably, after œdema of the larynx had already set in. Antitoxines may be employed with advantage after incision and drainage have been provided, but not before.

No fact is more evident from a study of the literature, or is so generally conceded, than that the cellular tissue is the essential seat of the inflammatory process, and that the surrounding structures become involved by contiguity. The literature also shows clearly, notwithstanding the claims of Delorme and his followers, that in the great majority of cases the cellulitis originates externally in the submaxillary region and not in the sublingual region, *i.e.,* in the mouth. Of the writer's 106 cases, in 61 the swelling was first noted in the submaxillary region of one side. In 16 it was bilateral and under the jaw when first seen by the physicians reporting them. In 2 there was a submental swelling which may have been a bilateral submaxillary involvement. In 13 others the

swelling was described as involving the cheek and neck, face and neck, parotid region, etc., *i.e.,* it was in the beginning an external swelling. Of the 106, therefore, 92 began in the tissues of the neck external to the mouth and throat. In 8 cases the first swelling was sublingual, and from the description in 3 (Huguet and DeBovis 2, Holthouse 1) the writer considers it doubtful whether a sublingual or a submaxillary swelling first appeared. In two cases (Tordeus and Aldrich) it was described as a submaxillary and sublingual swelling. One case began in the throat as in Semon's cases, and is included here because it was considered by the writers reporting it as a Ludwig's Angina. The writer regards these facts as of much value in establishing the nature of the disease, and considers that they support what Ludwig claimed, that the cellulitis begins in the submaxillary region, at least, in the great majority of cases. Those which begin in the mouth can be easily accounted for, but there has been much dispute concerning the submaxillary origin and the term, idiopathic, has been employed in connection with them. Semon says "A little abrasion on the side of the neck exposed to the action of those pathogenic organisms may, of course, invade the body from the outside and may cause what has hitherto been called an Angina Ludovici. The original focus is purely accidental." One would infer from this that Semon considers that from such an abrasion, invasion occurs by direct continuity of tissue until the throat is involved. Davis says: "When the teeth are the starting point the inflammation involves the periosteum of the lower jaw and thence invades all the surrounding tissues. While the point at which the infection starts localizes the disease at its commencement, it progressively spreads and invades all the tissues within its scope. No matter how it commences it spreads along the connective tissues by direct continuity. It is not transmitted by the lymphatics. The lymphatic glands do not become enlarged by infection carried to them by the lymph stream from the infectious focus, but they are involved

in the connective tissue surrounding them." As already stated Leterrier considered that the infection was transmitted from some focus in the mouth to the cellular tissue about the sublingual gland setting up a cellulitis there. Roser believed that the infection was transmitted to the submaxillary salivary gland, and that the extension occurred to the surrounding cellular tissue.

That the primary focus in the great majority of cases is some insignificant lesion in the mouth, as a carious tooth, an herpetic or other ulcer, a tonsillitis, etc., has been generally admitted and so far as the writer can learn has never been denied. In many, however, no such focus was discovered. If the infection gains entrance to the tissues by such a focus in the mouth and the signs of inflammation first appear in the submaxillary region, external to the mouth and some distance from the original focus, the process can not be said to have extended by direct continuity of tissue. This applies with greater force to those in which no preliminary focus could be found, the typical, so-called, idiopathic cases. The writer's statistics on this point will be found later in connection with the clinical course of this condition.

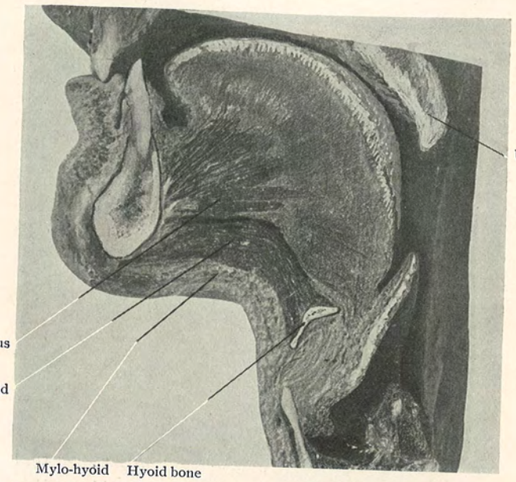
There can be only one explanation for such a transference of infection, and that is by way of the lymphatic vessels to the glands in the submaxillary region. Most infections in this region are of glandular origin. Poulsen said that the great majority of his 251 submaxillary abscesses were cases of simple or localized adenitis, and he takes it for granted that his cases of Ludwig's Angina began also in the lymphatic glands. v. Thadden considered it a lymphatic disease and gave to it the name "Submaxillary bubo." Localization of infection is the rule in any part of the body, and this is particularly true of those which lodge in lymphatic glands. Fulminating cases are rare. Typical Ludwig's Angina is rare and is also fulminating. It is easily conceivable that such an infection might be transferred from some slight focus in the mouth, where there is no retention, the discharge being free, to a submaxillary lymphatic gland where the

infection is confined, and therefore more active, and from there on account of its increased activity invade the peri-glandular tissue so rapidly that its glandular origin is overlooked. In some cases the glandular origin was indicated by an early localized pain in the submaxillary fossa, which was soon followed by rapid swelling.

While the glandular origin was concealed by the rapid swelling in most of the writer's cases, this was not true of all. In one of Tissier's cases there was pain in the left submaxillary region on the first day. Swelling appeared on the following day. In one of Delorme's cases, the condition was first observed in the submaxillary region as "three glands," rapidly increasing in size. Bauer reported one in which the patient had similar attacks before. Ludwig's case in 4 days, had only reached the size of a hen's egg. One of Haering's when first seen was of the same size, Heyfelder's the size of a goose egg, and Timpe's of a five franc piece. Davis says of two of his cases, that one week before, the neck began to swell and later increased rapidly. In Blasburg's case there was an indolent swelling for 8 days and rapid swelling began on the 11th day. In the writer's case there had been a small lump for about a week before rapid swelling began. There can be little doubt of a glandular origin in these cases, and in the writer's opinion, they go far toward proving the glandular origin in the so-called idiopathic cases.

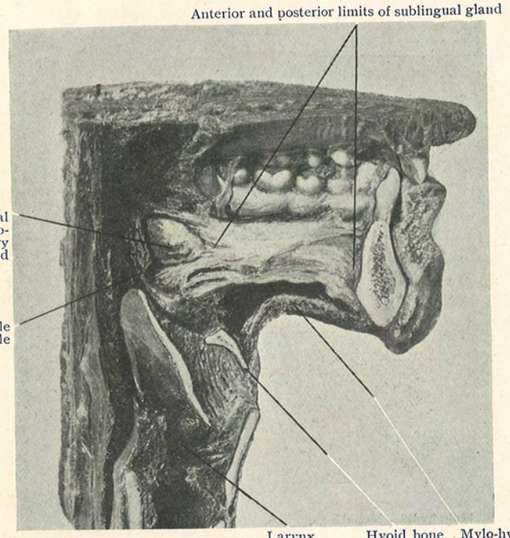
A cellulitis localized to the submaxillary region, regardless of the kind of infection, in the writer's opinion, is not a Ludwig's Angina; but becomes one as soon as the process invades the floor of the mouth and the pharynx. Poulsen as we have seen, assumed that the invasion occurred through the pharyngeal wall. Delorme merely located the phlegmon in the sublingual tissues without attempting to trace its further progress, while Semon simply stated that extension occurred from the throat to the neck, or from the neck to the throat, without reference to the path of progress. Davis seems to agree with Semon, but adds that it spreads along the connective tissue by direct continuity.

FIG. 1.



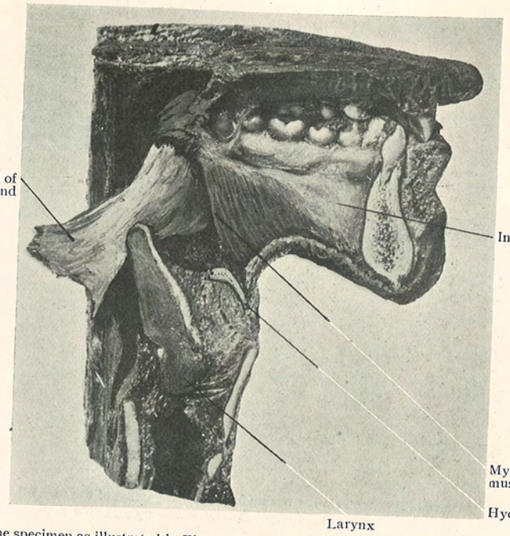
Median, sagittal section of that part of face and neck involved in Ludwig's Angina. Horizontal section about $\frac{1}{16}$ inch below highest part of roof of mouth. Tongue, somewhat shrunken from loss of body fluid, almost fills mouth.

FIG. 2.



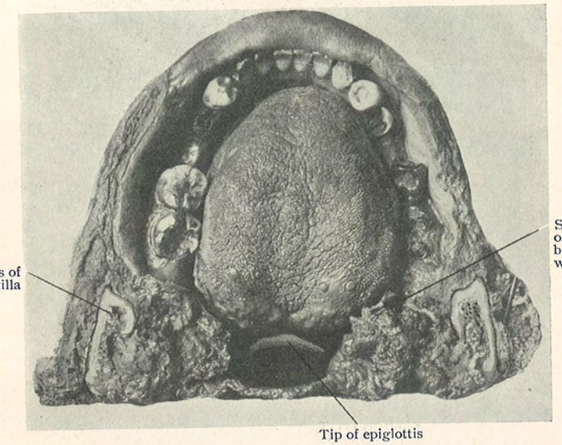
Half of specimen opposite to that illustrated in Fig. 1. Half of tongue removed, to show continuity of cellular tissue about the submaxillary and sublingual salivary glands, and proximity of deep portion of submaxillary gland to larynx.

FIG. 3.



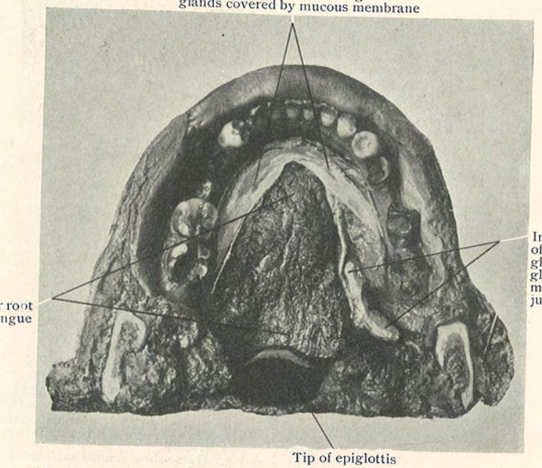
Same specimen as illustrated in Fig. 2. Sublingual gland and deep portion of submaxillary turned backwards, showing from within the mouth the anterior boundary of the opening in the muscular bucco-pharyngeal wall.

FIG. 4



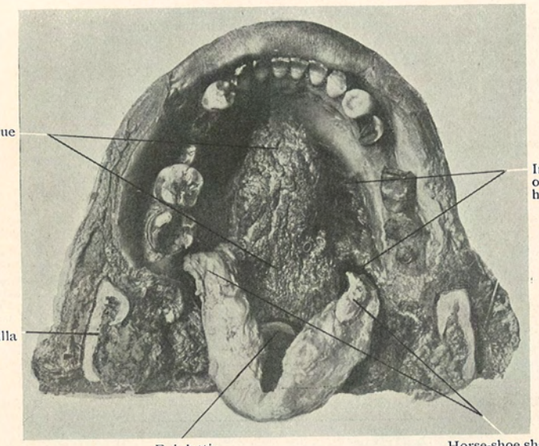
Upper surface of specimen similar to that formed by the union of the two, illustrated in Figs. 1, 2 and 3. Tongue crowds teeth laterally. It is loosely attached and has dropped backwards, slightly.

FIG. 5.



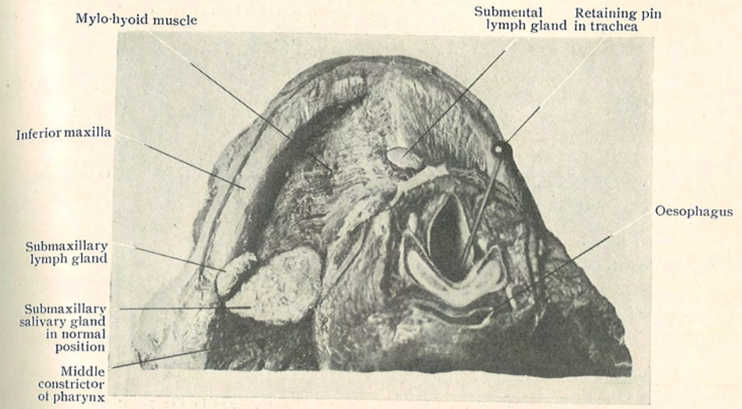
Same specimen as illustrated in Fig. 4. Tongue removed showing horse-shoe arrangement of sublingual cellular tissue and salivary glands.

FIG. 6.



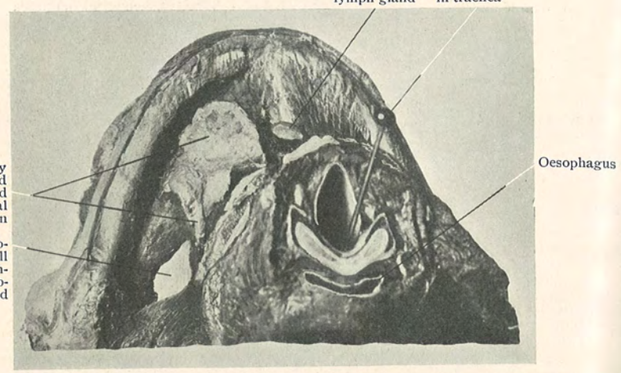
Same specimen as illustrated in Figs. 4 and 5. Horse-shoe shaped sublingual tissues turned backwards showing their continuity with similar tissue in the submaxillary region through the bucco-pharyngeal opening. The alveololingual sulci are also shown.

FIG. 7.



Same specimen as illustrated in Figs. 4, 5 and 6. External view. Submaxillary and submental regions. Bucco-pharyngeal opening plugged by submaxillary salivary gland.

FIG. 8.



Same specimen as illustrated in Figs. 4, 5, 6 and 7. Same view as in Fig. 7. The submaxillary salivary gland being drawn forward the bucco-pharyngeal opening is well shown. The fissures between the mylo-hyoid and middle constrictor muscles, however, extends from the hyoid bone to the angle of the jaw.

The writer hopes to demonstrate how a cellulitis about the submaxillary salivary gland, may progress along planes of connective tissue to the mouth and pharynx, and why such extension so quickly invades the region of the larynx. Leterrier said that not enough attention had been paid to the anatomy of the mouth in connection with Ludwig's Angina, and he is the only author so far as the writer can learn, who has paid any attention to it. He drew his conclusions from a study of the topographical anatomy of Tillaux and the demonstrations of Sebileau. The writer has made a special study of this subject by dissections of this region.

The anatomical work was done in the department of Applied Anatomy of the University of Pennsylvania, and the writer wishes, here, to thank Professor Gwilym G. Davis, the department head, for his kindness in furnishing all the necessary facilities. To Professor Geo. A. Piersol the writer is indebted for the freedom of his anatomical department and his specimens, and to Mr. Erwin F. Faber for valuable assistance in emphasizing in the illustrations those points which are essential to an understanding of the text. This opportunity is taken to acknowledge also the writer's indebtedness to Professor J. William White for kindly criticism and valuable suggestions.

Few portions of the body are so imperfectly dissected by the average student as is this region. As a result few physicians can comprehend with any detail the anatomical relations of the floor of the mouth in its relation to the pharynx and larynx. Special sections were necessary to expose the tongue, the pharynx and the larynx, and the adjacent parts of the neck in the same specimen. By a transverse section of the head above the upper surface of the tongue, and a vertical section through the pharynx, of the lower part removed by the transverse section (see figure I.), a part of the head was obtained which gave a free exposure of the tongue from above and of the posterior part of the tongue, the anterior wall of the pharynx, and the complete larynx. The parts involved in Ludwig's Angina were thus

preserved in this portion of the head and could be dissected from above and below. The facts brought out by these dissections taken in conjunction with the clinical facts repeatedly demonstrated by the recorded cases and with the autopsy reports, seem to clear up many of the obscure points associated with this condition. Only those autopsies which have shown the condition of the larynx have been considered.

Anatomy.—The muscular floor of the mouth is formed by the two mylohyoid muscles which fuse with each other at the anterior median raphe. This muscular diaphragm separating the mouth from the neck is a complete one from the posterior edge of one mylohyoid muscle to that of the other and is a comparatively strong one. There are no openings in it for the passage of planes of connective tissue between the mouth and neck. From the posterior border of the mylohyoid on each side, extend backward the constrictor muscles of the pharynx, separating the pharynx from the neck, the muscles of the two sides fusing together at the posterior median raphe. The three constrictors, superior, middle and inferior, overlap each other, so that here also, the submucous tissue of the pharynx is not continuous with the connective tissue of the neck through these muscles. Between the posterior edge of the mylohyoid and the anterior border of the middle constrictor, however, is a considerable deficiency in the bucco-pharyngeal muscular wall (see figure 8). This opening extends from the hyoid bone upward and backward to the inner side of the lower jaw near its angle. The hyoglossus muscle, which viewed externally forms a part of the floor of the submaxillary triangle, does not enter into the formation of the floor of the mouth or pharyngeal wall. It passes upward through this muscular opening or gap to become a part of the root of the tongue, and fills the gap considerably. Those structures which pass from the neck into the mouth or in the opposite direction, do so through this opening. These are the glossopharyngeal and hypoglossal nerves, the lingual artery and vein and the styloglossus muscle. The greater part of the opening, however, is occupied

by the deeper portion of the submaxillary salivary gland which here projects into the floor of the mouth, near the root of the tongue, where it lies just under the mucous membrane. The gland may, therefore, be said to form a small part of the floor of the mouth. The submaxillary gland within the mouth is adjacent to the posterior part of the sublingual gland and is attached to it by the surrounding loose connective tissue (see figure 2). We thus see that the connective tissue in the submaxillary fossa is directly continuous with that in the floor of the mouth, so that the extension of a submaxillary cellulitis to the sublingual region, which occurs so early and so constantly in Ludwig's Angina, is readily understood. The observations of Huguet and DeBovis, who, while regarding Ludwig's Angina as a sublingual phlegmon, said that this "can only be the result of diffusion of an inflammation developed more posteriorly in the region of the parotid or angle of the jaw," is seen to have a sound anatomical basis. What is more important, it supports the statements of Ludwig and the great majority of writers reporting these cases, who said that it began in the region of the submaxillary gland. The difficulty in explaining why this extension occurs so rapidly in some cases is not so great as in explaining why such extension does not occur in more cases. Probably it does occur much more frequently than we have suspected and is overlooked because its nature has not been understood. It has probably been arrested many times by prompt incision before alarming symptoms have had time to develop. While walking through one of the wards of a hospital recently, the writer's attention was arrested by a case of extensive submaxillary cellulitis. The mouth could not be opened and when the patient was asked if he experienced any trouble inside the mouth he said that beginning with the day before he had considerable difficulty and pain in swallowing. An incision had been made that day. On the following day he reported that he felt much better and that the dysphagia had disappeared. The inflammation had probably begun to extend

into the mouth in this case, and had been arrested by the incision. Of Poulsen's 251 submaxillary abscesses, as already stated, in 22 the swelling involved the floor of the mouth, and in 2 (not the 2 reported by Poulsen as examples of Ludwig's Angina) this swelling was so abundant that an incision in the mouth was necessary. As a rule the inflammation subsided after incision in the submaxillary region. Poulsen regarded only 3 of the 22 as examples of Ludwig's Angina, and paid little or no attention to the rest; so that we can obtain light on the progress of the other cases, only by inference from the associated facts. Of the 251, 11 or 4 per cent., died. Poulsen says that the great majority were cases of simple or localized adenitis. A death from simple or localized adenitis must be exceedingly rare, so that almost all of the 11 deaths, in all probability, occurred among the 22 in which the floor of the mouth was invaded, since as the writer will show, this must always be a very dangerous condition. If this were true of all the 11 deaths the mortality among the 22 cases would then be 50 per cent., which is approximately that of Ludwig's Angina, as determined by other writers. In the writer's collected cases, the mortality was 40 per cent. In the anatomical specimens it was observed that the connective tissue about the gland in the opening in the muscular floor of the mouth, was small in quantity. The gland being somewhat wedge shaped, with its base external and its apex internal it is possible that a massive exudate external to the gland might force it more snugly into the opening as a plug, thus aiding in localizing the inflammatory process to the external tissues, more effectively in some cases than in others. It was generally the fulminating infections which were present in Ludwig's Angina, in all probability because of the great facility with which they extend along planes of connective tissue.

A phlegmonous cellulitis in the floor of the mouth as from an infected wound, is a menace to the life of the patient, regardless of the kind of microörganism producing it. Relief must be afforded promptly or, the process extending, the larynx will soon be invaded and the patient suffocated. To

appreciate the reason for this a further study of the anatomy of the floor of the mouth is necessary.

The mouth with the jaws closed may be roughly compared to a small box of which one side has been removed. The upper side or roof is represented by the roof of the mouth, the lower side or floor by the two mylohyoid muscles, the front and lateral sides by the teeth and jaws. The posterior side is absent. With the jaws closed the mouth is practically filled by the tongue and the normal sublingual tissue. Therefore, when the cellular tissue under the tongue is invaded by inflammation, as in Ludwig's Angina, the tongue is pushed upward and the mouth must open to make room for the new inflammatory material. Speech and deglutition are necessarily interfered with and the saliva now increased by the inflammation can not be properly swallowed and frequently escapes from the mouth. The tongue crowded for room may show between the teeth and appear to be swollen when it is not. It was actually swollen, in one of Parker's cases, from invasion by the inflammatory process (see page 226). The tip, at least, is probably rarely involved. Posteriorly the tongue becomes wider and dips downward and backward toward the larynx, where the base of the epiglottis is attached to its posterior surface. Laterally the base of the tongue reaches the side of the pharynx, where it receives the attachments of the styloglossus and palatoglossus muscles. These attachments of the sides of the tongue to the walls of the pharynx, make on each side a strong muscular ridge covered by mucous membrane and submucous tissue, the latter being scanty here. This prominent ridge separates the floor of the mouth from the pharynx, so that a submaxillary infection extending through the opening already described, and finding itself in the floor of the mouth in front of this ridge, must extend through it along the intermuscular fascia or over it along the scanty submucous tissue. This explains why the swelling in the floor of the mouth is so well developed before the œdema has produced alarming symptoms in the pharynx and larynx.

The finger placed in the mouth will easily find this ridge. Since the tongue turns downward and backward, the sublingual swelling lies in front of this posterior portion, so that the tongue with the epiglottis attached to its dorsum is pushed backward toward or against the posterior wall of the pharynx, tending to obstruct the air which is passing from the nose and mouth to the lungs. By the same mechanism in anæsthesia, the dropping backward of the tongue and epiglottis may interfere with respiration.

It is probably little appreciated how limited is the space confined within the arch of the lower jaw. It will suffice here to point out that the distance in a straight line from the symphysis along the floor of the mouth to the base of the epiglottis and, therefore, to the upper orifice of the pharynx is, approximately, only 2½ inches (see fig. 1). The submaxillary salivary gland lying in the opening in the floor of the mouth is about on a transverse plane with the base of the tongue, *i.e.*, just anterior to the larynx; so that the portion of the gland projecting into the mouth is only about 2 inches external and anterior to the larynx. The chief protection of the larynx, at first, is the muscular ridge already described.

A further brief description of the floor of the mouth will be of value in explaining some of the points which have attracted the attention of various writers. For instance, it has been frequently reported that the hard sublingual swelling was of a horse shoe shape. The floor is divided into two lateral portions (see figure 6) by the muscles which pass upward from the symphysis of the lower jaw and the hyoid bone to the tongue, the hyoglossus and geniohyoglossus. The geniohyoid aids in forming the lower portion of this median septum (see fig. 1). The two lateral alveololingual sulci thus formed are freely continuous with each other anteriorly under the frænum of the tongue, but are terminated abruptly posteriorly by the lateral attachments of the base of the tongue. They are thus seen to have a horse shoe shape, and as they are filled by the sublingual and portions of the submaxillary glands surrounded by loose cellular tissue, the

swelling due to cellulitis in them will assume a horse shoe shape also. It has been observed in a few cases that a submaxillary cellulitis of one side with extension to the floor of the mouth, has been followed in a short time by a corresponding but smaller swelling on the opposite side, the two not being continuous under the chin. Some of these cases are probably to be explained by extension of a submaxillary cellulitis of one side to the floor of the mouth, along the sublingual sulci and out through the opening in the floor of the mouth on the opposite side. More frequently bilateral swelling results from extension along the external connective tissue under the symphysis.

What has made Ludwig's Angina so important is the frightful rapidity and certainty with which an unchecked case proceeds to a fatal termination. The submaxillary region is already intensely swollen, so that the jaw can not move downward to relieve the crowding of the mouth and pharynx. The sublingual pressure can not find relief in that direction, even if the mylohyoid muscle did not resist its downward progress. Above it meets the resistance of an overhanging probably rigid tongue, which is already pressed against the roof of the mouth. Extension anteriorly or laterally is resisted by bone and teeth. The direction of least resistance is backward, in fact it is the only direction in which the rapidly accumulating new material can force its way. When we take into consideration the fact that it enters the mouth not far from the larynx and that while the inflammation is invading the floor of the mouth it is also more slowly passing backward toward the larynx, we can better appreciate why the dyspnoea follows so soon after the swelling of the floor of the mouth.

Only prompt relief of a pus collection by incision or a spontaneous opening can be expected to give relief, and these have failed in some cases. It is true that spontaneous resolution has occurred in some cases, but this can not be depended on. Leterrier doubted if it ever occurred and believed that in those cases in which it was reported to have taken place,

an unobserved spontaneous opening had developed. In the writer's 106 cases there were 17 in which a spontaneous opening was reported, and in every one there was an internal opening. In only one was an external opening associated. While he would not deny the possibility of spontaneous resolution, the writer would consider it very likely that in some cases in which it was reported to have occurred, a spontaneous opening had been overlooked. It could be so situated under the tongue that it could not be exposed on account of the difficulty in opening the mouth. Only the escape of pus would announce its presence, and this is frequently so small in quantity or so gradual that it could easily escape unrecognized in the abundant and often turbid saliva.

The spontaneous opening is usually internal, probably because pus developed about the submaxillary gland finds itself nearer the mucous surface than the skin of the neck. The inflammatory material inside the jaw and under the tongue is probably under greater pressure than that external to the gland in the neck, which is always abundant so that the inflammatory area should break down more quickly where the pressure is greatest and, therefore, the blood supply most compromised.

Of the writer's cases the following, reported by Parker, illustrates clinically better than any of the others, the mode of origin and path of progress of the cellulitis in a Ludwig's Angina.

JOHN K., aged 12½ years, was admitted to the hospital Sunday, September 8, 1878, at about 10 P.M. On the preceding Thursday (before which time he had been quite well) a "small lump" appeared below the jaw on the left side. It increased in size until Saturday, and then appeared to be an ordinary abscess of the neck. On Sunday it remained much the same until 4 P.M. Then the patient began to complain of his tongue which was swelling. By 6 P.M. his tongue had reached about quadruple its normal size and it protruded from his mouth. On admission to the hospital at about 10 P.M. there was considerable swelling below the jaw on the left side and to a less extent on the right side. No fluctuation, but great œdema. Tongue much swollen, red and tense, and protruding between the teeth, preventing closure of the mouth, which is open to its full extent. Escape of much saliva. On the following day breathing more uneasy. Incision in neck at most likely place, but no pus reached. Toward evening, on account of great distress, the tongue was freely incised on each side of the median line with considerable relief in a short time. September 11th the condition had somewhat subsided. On raising the tip of the tongue pus can be seen issuing at a point where the mucous membrane is reflected from the tongue to the floor of the mouth, and a probe can be passed downward and backward for three or four inches. September 14th neck again incised and pus found. Convalescence soon followed.

This is probably as clear a clinical demonstration as one could find of the origin in a lymph gland, with periglandular extension to the cellular tissue, first in the submaxillary region, then to the floor of the mouth and tongue, and finally to the region of the larynx as shown by the increasing difficulty in breathing. The occurrence of the spontaneous opening under the tongue with a subsidence of symptoms, probably, had much to do with the recovery of the patient. It was the only one to be found among the writer's cases, in which the mouth was reported to be opened widely and the only one in which the tongue was markedly invaded. The opened mouth is probably to be explained by the fact that the floor of the mouth and the tongue were invaded before the submaxillary swelling had become too massive to prevent depression of the lower jaw, which in this case was demanded early for the accommodation of the early swelling in the mouth.

The writer's study of his cases does not show that the pathological changes occurring in the infected area differ materially from those which may be expected from any severe pyogenic infection occurring under similar anatomical conditions. Of the 106, spontaneous resolution was reported in 8. In 26 no pus was found. Two of these showed putrid foci. In 66 pus was found. In 12 of these the pus was

described as putrid, and in 5 gas was associated. In three gas without pus was reported, and in 3 more the process was spoken of as gangrenous. While this classification is, probably, more or less inaccurate—the pus might have been putrid and the fact not have been mentioned, and gangrene might have been present and the fact have been overlooked—it will demonstrate that, in all probability, the pathological changes present were the result of ordinary severe infections, as the streptococcic or staphylococcic. The bacteriological examinations which have been made in these cases, would then be seen to have agreed with the other pathological findings. The proximity to the alimentary tract will account for the frequency of gas and putrescence, while the intensity of the inflammatory process and the compression of the inflammatory swelling inside the jaw and under the tongue with the massive, hard, tense swelling externally, will explain the tendency to gangrene. It is probably no more frequent here than when such an infection occurs under the dense palmar fascia.

The question as to the advisability of retaining or rejecting the name, Ludwig's Angina, is one that probably will not be easily decided. While the process is pathologically identical whether it begins in the throat, in the mouth or in the neck, from the standpoint of prognosis and treatment, as already stated, a sharp distinction should be made between those beginning in the throat and those beginning in the neck. From the same standpoint those beginning with a cellulitis in the mouth by direct extension from the primary focus in the mouth (there were 8 of this type among the writer's cases) might be included with those originating in the submaxillary region. If the primary focus in these cases is exposed before the development of the submaxillary swelling prevents opening of the mouth, it can be thoroughly disinfected and the process, probably, arrested early. We might speak of these two varieties as sublingual phlegmons, one being primary the other secondary. But this would disregard the submaxillary cellulitis, which in the great majority

of cases would be the primary condition and then the most important because it is the one to be attacked surgically. We might speak of this class as cases of submaxillary cellulitis with extension to the mouth and throat. Ludwig's Angina would be more convenient and would be sufficient, since this is exactly the condition which Ludwig described. Delorme, who regarded it as essentially a primary sublingual phlegmon, argued for the retention of the name, Ludwig's Angina. The writer believes that the time has not yet arrived when we can conveniently discard it.

Clinical Course.—While the etiology and pathology of this condition has not been established, the clinical picture as given by Ludwig has, probably, never been questioned. He recognized the fact that various grades of severity may be met with, but presented the clinical course of the severest type, in order to emphasize the symptoms more forcibly, and to facilitate the diagnosis. From his study of the subject, the writer has been led to the conclusion that Ludwig's picture, while it may accurately describe the average case of his time, will not answer so well for that of the present. That is to say, the gangrenous or putrefactive conditions are not met with so frequently nor do they reach the advanced stage when present, which seems to have been the rule in his day. This change is due, probably to the fact that expectant treatment is now much less frequently employed. The progress of the infection is arrested earlier by more prompt incision and drainage. The irregular septic temperature, profuse sweats, delirium and progressively profound typhoid state, are by no means so common now. With few exceptions modern surgical treatment will arrest the progress of the infection or the patient will die in less than 10 to 12 days. Since his clinical picture appears to be the standard, and from time to time is given in more or less detail in journal articles, the writer wishes to present it here in order that he may apply to it briefly his own interpretation of the symptoms.

"The condition is ushered in with the usual symptoms

of a rheumatic or erysipelatous angina, *i.e.*, slight fever, repeated chills, headache, coated tongue, etc., sometimes with slight difficulty in swallowing. At the same time there develops a unilateral or bilateral hard swelling usually of the cellular tissue surrounding the submaxillary gland, sometimes of that about the subligual or parotid. Extension of the process occurs in all directions along the cellular tissue, toward the chin and the opposite side, and toward the larynx, and the parotid, forming a considerable swelling. The intermuscular tissue and even the muscles become involved. The sublingual tissues form a hard, congested swelling, arranged like a cushion just inside the inferior maxillary bone; and the tongue is pushed upward and backward. The mouth is opened with pain and difficulty. Movements of the jaw, swallowing and speaking are considerably disturbed. The skin is movable during this local stage (4 to 6 days), the general condition is little disturbed, and the fever moderate. Soon the skin becomes reddened, the sublingual swelling softens and at times shows crepitation. Occasionally fluctuation appears to be present as though pus were there. But this is not the case. Soon an opening occurs in the floor of the mouth discharging a thin grayish or reddish brown, offensive fluid, which more and more assumes in character the discharge of a putrefactive process. The constitutional symptoms now become more severe, *i.e.*, the fever is higher, sleep is disturbed, profuse sweats and delirium appear and the typhoid condition becomes more profound. Deglutition remains difficult, although the swelling becomes less tense, and suggests improvement. Dyspnoea sets in and increases, and probably indicates an affection of the nervous system rather than a mechanical obstruction of the respiratory tract. Perhaps this is due to effusion into the chest. The symptoms develop with alarming rapidity and are characteristic of a putrefactive typhoid process. Death from coma and lung paralysis occurs in 10 to 12 days from the commencement of the disease."

The following points he considers to be diagnostic:

"1. The insignificant inflammation of the throat, which often disappears entirely after the first few days, and which if it persists may be looked upon as superficial.

"2. The 'wood like' hardness of the swelling, which does not pit on pressure.

"3. The hard sublingual swelling, forming a ring just within the lower jaw, reddish or bluish in color.

"4. The sharp limitation of the indurated tissues which are surrounded by uninvolved healthy connective tissue. The slight involvement or more often lack of involvement of the glands although the inflammation attacks the connective tissue around the gland."

The writer believes that there will be nothing obscure in this clinical picture, if we take into account the anatomical facts to which he has already called attention, and the known facts concerning the usual rapidly spreading infection of the connective tissue. It is assumed that we are dealing with a case in which the infectious germs have gained entrance through some focus in the mouth and the first signs of cellulitis have appeared in the submaxillary region, where Ludwig located them. In the ordinary case of infection arising in this way, the germs pass by the lymphatic vessels to the glands, causing no trouble in the vessels. As soon as they reach the gland they begin to produce inflammatory changes and being confined the inflammatory material produces pain. If the infection is mild or moderate, it will probably remain limited within the capsule of the gland long enough to permit a localizing barrier of lymph to be prepared. In this way is developed the ordinary localized lymphadenitis which is so common in this region. Occasionally such a localized swelling will take on rapid growth and become diffuse, *i.e.*, the infection breaks through the barrier of lymph and spreads quickly along the cellular tissue. A localized osteo-myelitis, for example in the tibia, may break through the periosteum and set up an overlying cellulitis so rapidly as to confuse the diagnosis with that of erysipelas. Much more rarely than in the localizing cases and most characteristically in

streptococcic infections, the process extends from the gland to the cellular tissue so rapidly that its glandular origin is overlooked. The fever, chills, headache and early difficulty in swallowing may be accounted for by this inflammation, or it might be due to the preliminary angina present in some cases. The characteristic extensive swelling of the neck is due to extension along its cellular tissue. The superficial fascia offers no hindrance to it in any direction, while the connective tissue in the submaxillary fossa is abundant and lax and freely continuous with the same tissue in the retromaxillary and submental regions. In Ludwig's description and in almost all the reported cases the sublingual swelling and elevation of the tongue are referred to after the submaxillary swelling has been mentioned, which is to be explained by extension through the opening in the floor of the mouth, already described. The submaxillary swelling is hard so that its extension should be hard also. The skin is at first movable and not inflamed because the process begins deeply in the lymph gland and invades the adjacent connective tissue with great thickening or swelling of the latter before it reaches the skin, which is inflamed later. The invasion of the floor of the mouth by the inflammation and its extension to the pharynx and larynx in the writer's opinion, will satisfactorily explain the troublesome dysphagia and the dyspnœa. Its early invasion of the larynx and in some cases of the lungs will explain the rapidity and certainty with which an unchecked case goes on to a fatal termination.

The following description of Ludwig's Angina, taken from Poulsen, is that given by Boehler more than twenty years ago, and was based upon a study of 35 cases. It is repeated here because of its brevity and simplicity, because it will be of value for comparison with Ludwig's more detailed account of the clinical course, and because, as the writer views it, it is nothing more than the description of a submaxillary lymphadenitis with periglandular extension along the connective tissue, due to a virulent, probably, pyogenic infection.

"Under febrile and slight disturbances in swallowing there develops in an otherwise healthy person, in the region of the submaxillary gland, of one or both sides, an indurated, in the beginning indolent, somewhat movable tumor, which appears to proceed from the connective tissue around the submaxillary salivary gland. The overlying skin is natural and movable. The swelling which is at first the size of a hen's egg, extends more and more over the side of the neck reaching as far down as the sternum. There is an infiltration of the connective tissue which surrounds the muscles of the neck, and extends to the alveololingual sulcus, the soft palate and the pharynx. The tongue from the great swelling in the floor of mouth is elevated and pushed to the opposite side. Generally as the process extends farther, the skin of the submaxillary region becomes oedematous and dark red. Perforation occurs in the oral cavity, and in the submaxillary region with the escape of brown fetid pus. The breathing becomes laborious, and the patient dies in a state of septic intoxication."

Autopsies.—Of the writer's 104 collected cases, autopsies were reported in connection with 25. In only 16 of these is there a description, direct or indirect, of the condition of the larynx. Those in which such reference was found are briefly reviewed here. Thirteen showed positive laryngeal involvement, two were negative, and in one (Zillner), the writer would infer from the vague reference to the involvement of the mucous membrane, that oedema of the glottis was present. Of Cartonli's case it was said that the larynx, trachea, pharynx and oesophagus were not damaged. This patient on the day of his death had symptoms of pneumonia with orthopnoea, so that it is more than probable that death resulted from respiratory failure. The blackish condition of the subcutaneous tissue with ichorous pus oozing from its cut surfaces, was said to have extended into the tissues above the hyoid bone and under the jaw and as far as the posterior surface of the pharynx, destroying the surrounding tissues. This would have brought it so close to the larynx that the

question naturally arises as to whether the condition of the pharynx and larynx was determined from their outer surfaces through an external incision, or whether the internal surface was exposed freely and the mucous membrane directly inspected. Of Macaigne and Vanvert's case it was said that the larynx was sound and that the aryo-epiglottic folds were not oedematous. Yet in this case dyspnoea developed on the second day, about 24 hours after the onset of the condition, and the patient died a few hours later, although his general condition did not seem to be very grave. In the writer's judgment, the clinical side of the case points strongly towards oedema of the glottis. Death could hardly have been due to septic intoxication. If oedema of the glottis were present in these two cases or if these were excluded from this group, the strongest kind of a case would be made out for invasion of the respiratory tract, more especially of the larynx, as the essential cause of death in the typical Ludwig's Angina.

CASE I.—HEIN.—Man, 32 years, military officer, robust constitution. Admitted to the hospital, Aug. 15, 1823, for an indurated submaxillary swelling of the left side, which had begun some days before in the region of the submaxillary gland. Movements of tongue limited and painful. Deglutition disturbed from beginning. Could swallow only liquids. In the bucco-pharyngeal cavity, no redness nor inflammation. Respiration normal. Later swelling reached clavicle. Increased difficulty in respiration. At end of some days, softening in lowest part. Incisions here give fetid purulent liquid. No relief to patient. Death from asphyxia, Aug. 28th, the 13th day of the stay in the hospital.

Autopsy.—Some fibres of gangrenous cellular tissue in abscess. Surrounding tissues form a putrid mass which communicates at the level of the angle of the jaw, with pharynx. Complete mortification of muscles above and below hyoid bone, and muscles of larynx nearly completely destroyed. Mucous membrane of larynx and trachea dark colored, like gangrene. Ventricles of Morgagni contained thickened, grayish black mucosites. Other organs normal.

CASE II.—HEYFELDER.—Female, 37 years, pale, cachectic and gouty for 7 years. Towards end of August, 1837, exposed to repeated chills, which were followed on Aug. 30 by moderate fever, heat, lumbago and acute pain in right side of neck. Aug. 31, swelling in region of right submaxillary gland, was the size of a goose's egg. Movements of head disturbed. Deglutition painful. Tonsils swollen, but not inflamed. Isthmus of fauces red. Sept. 1, swelling much greater, and of "woody" hardness. Mouth opens with acute suffering. Tongue projects posteriorly. Speech and deglutition difficult but not painful. Examination of posterior part of mouth impossible. Tumor under tongue. Very considerable prostration. Sept. 3, everything much worse, and patient very weak. Cannot expectorate abundant mucus which collects in mouth. Jaws separate only a few lines. Deglutition nearly impossible. Delirium. Sept. 5, suppuration and crepitation on palpation. Deglutition and opening of mouth better, but general condition worse. Puncture at a soft spot, with escape of abundant fetid pus. Sept. 6, median incision from chin to hyoid, with escape of fetid pus, gas, and gangrenous debris. Sept. 8, coma. Sept. 9, death.

Autopsy.—Affected region a dark foul mass. Salivary glands pale bluish at periphery, normal in their depth. Cervical portions of vagus and recurrent nerves were a dirty red. Muscles had lost their relations in consequence of the gangrene of the cellular tissue which surrounded them.

Mucous membrane of tongue, pharynx and nose, slightly inflamed and covered with grayish mucus. Tonsils healthy. Mucosa of larynx and trachea presented a livid appearance and was covered with foul adherent mucus. Small abscesses were disseminated in the inferior lobes of both lungs. Heart soft and flabby. Turbid fluid in pericardium. Liver, spleen and right kidney softened.

CASE III.—BERMAN.—Female, 18 years, habitual good health. Complained of bad second left molar on Aug. 26, 1838. Aug. 27, on same side, appeared a hard, parotid swelling. Alveolo-dental periostitis, opposite the carious tooth. Aug. 28, abscess opened itself on external side of diseased tooth and discharged a mass of fetid pus. External swelling does not diminish, and it is extremely hard. Sublingual swelling forms a hard ring around the tongue, which is pushed up against the roof of the mouth. Voice harsh and muffled. Considerable dyspnœa. Aug. 29, spontaneous opening under the tongue with escape of fetid pus mixed with blood. External inflammation progresses to opposite angle of jaw and to sternum. Deglutition and respiration very troublesome. Aug. 30, bad night. Delirium. Considerable dyspnœa. Swelling invades greater part of thorax. Aug. 31, prostration increases. Extreme dyspnœa. Deglutition impossible. Sept. 14, stupor develops, finally coma and death.

Autopsy.—36 hours after death. Complete mortification of muscles from chin to sternum. Impossible to recognize their structure. Voluminous cellular debris and a considerable mass of fetid pus.

Epiglottis destroyed. Mucous membrane of larynx and trachea swollen and covered by viscid mucus. Mucous membrane of pharynx and œsophagus is blackish in color. On internal surface of inferior maxilla is a fistula, communicating with the gangrenous focus.

CASE IV.—ZILLNER.—M. B., 30 years, insane for 3 years. As the result of a cold there developed a hard non-painful swelling of the left cheek. About seventh day, chills, agitation and delirium. Ninth day, spontaneous opening in the mouth near angle of jaw, discharging abun-

dant sanious pus. Swelling continued to spread anteriorly and toward the clavicle. Thirteenth day, second spontaneous opening externally below angle of jaw. Fourteenth day, death.

Autopsy.—Crepitation on pressure over the whole swollen region. Overlying skin bluish red. Subcutaneous tissue granular, while hard and resistant. In the suprahyoid region, below the floor of the mouth, all the organs, mucous membrane, cellular tissue and muscles are transformed into an extremely putrid mass. Periosteum destroyed and inferior maxilla denuded, in the greater part of its extent. In the place of the submaxillary and sublingual glands there is a large cavity filled with pus, its walls being made up of connective tissue. The sheath of the sternomastoid is filled with pus.

Case V.—Finger.—Woman, 29 years, presented a Ludwig's Angina, on the twelfth day of a typhus fever. In the morning the sublingual gland and the surrounding cellular tissue were much swollen. Tongue considerably infiltrated and pushed against the roof of the mouth by the prominent swelling in the floor. Respiration much disturbed, causing fear of an œdema of the glottis. Patient died in the evening, presenting all the symptoms of suffocation.

Autopsy.—Cellular tissue around the submaxillary and sublingual glands on both sides of the neck, infiltrated with a yellowish purulent serum, and much swollen. Muscles of the velum palati, mucous membrane of the pharynx and larynx and all the corresponding half of the tongue are much swollen and infiltrated with a pale purulent serous fluid. The infiltration descends as low as the sternum.

Case VI.—Doig.—R., 22 years, soldier. Has had swelling of the neck for some days. When admitted, Feb. 4, 1876, he had a painful swelling extending over the whole of the left side of the neck. Parotid, submaxillary and sublingual glands of the same side, much swollen and very painful. On the right side the submaxillary gland is equally indurated, but is not of the same size as on the left side. Floor of mouth elevated and tongue pushed upward. Hypersalivary secretion. Considerable disturbance of deglutition. Intense dyspnœa. Insomnia. Paroxysmal anxiety. Skin over swelling normal, except that it is a little œdematous near angle of jaw. Puncture here, no pus. Death by asphyxia, Feb. 8th.

Autopsy.—43 hours after death. All the left side of the neck, from inferior maxilla to clavicle, is a semiliquid, extremely fetid mass. All the tissues of this region, glands, muscles and cellular tissue, are nearly completely destroyed. The portion of the jaw, adjacent to the destroyed submaxillary gland, is denuded of its periosteum. In the buccal cavity, one finds the mucosa, epiglottis and vocal cords, swollen, red and covered with mucus. There are ulcers of the tonsils.

Case VII.—Cartonli.—Man, 50 years. Admitted to hospital on evening of October 4th, 1879. Hard right submaxillary swelling. Speaks and opens his mouth with difficulty. It was learned from his companions, that on the evening before, he was feeling well and that the swelling had not been there for more than two days. Oct. 5th, temperature in morning

and evening was 39.5. Trismus present. Deglutition impossible. Esophageal sound introduced into stomach to relieve dysphagia but did not meet with any obstacle. Abundant salivation. Lungs congested. Oct. 6th, temperature 39.5. Delirious during night. During day appeared symptoms of pneumonia with orthopnœa. Tongue protrudes between teeth. Death during night.

Autopsy.—Left lung hepatized. Right submaxillary region hard and œdematous. Skin cyanosed. Subcutaneous tissue blackish. Small quantity of ichorous pus oozed from cut surfaces. This condition of the tissues extended more or less into the tissues above the hyoid bone and under the lower jaw. The submaxillary gland is hypertrophied, sclerosed, grayish, and on section gives issue to an ichorous material. The ichorous infiltration extended deeply internally and below to the posterior surface of the pharynx, destroying the surrounding tissues. Larynx, trachea, pharynx and esophagus not damaged.

Case VIII.—Baker.—J. A., 25 years. Admitted to hospital, Feb. 6, 1862. When first seen, he was suffering from "swelled neck and great difficulty in breathing." Great swelling on left side of neck and smaller swelling on right side, extending toward median line. Skin dark purple, very brawny and here and there is boggy. Higher up under the chin is an indistinct sense of fluctuation. Mouth open. Tongue against the roof of the mouth, and of normal size, and consistency. Mucous membrane of floor of mouth elevated to level of free edges of lower teeth. Fauces cannot be seen. Dyspncœa began night before admission, when he could not breathe without being propped up in bed. Soon after admission, he was found not to be breathing. Immediate tracheotomy. Pulse stopped.

Autopsy.—Seropurulent, necrotic infiltration of cellular tissue and muscles. On opening trachea, the rima glottidis is found nearly closed, with effusion of semipurulent matter into submucous tissue. This extended to the epiglottis. Glandulæ concatenatæ, submaxillary and parotid glands, much enlarged.

Case IX.—Bickersteth.—Man, 40 years. On admission, speech very difficult and indistinct. Breathing embarrassed. Great swelling beneath jaw. Floor of mouth raised and tongue pushed upward and backward against roof of mouth. Examination of fauces impossible. Surgeon notified and came immediately, but patient died a few minutes before he arrived at the hospital. Patient had been seized with rigors and severe pain in submaxillary region three days before admission. Shortly afterwards, there was swelling from the lower jaw to the sternum. Skin was normal in consistency, color, and mobility, but was tense.

Autopsy.—Shortly after death, a puncture with a tenotomy knife was made in the floor of the mouth, when a small quantity of air and some sero-sanious fluid escaped. All the connective tissue around the trachea and between the muscles is infiltrated with a seropurulent fluid, extending upward to the root of the tongue and downward into the anterior mediastinum. The submucous cellular tissue is similarly affected, producing anteriorly, sublingual tension, and posteriorly, œdema glottidis and general œdematous laryngitis.

Case X.—Michel.—Man, 38 years. Admitted to hospital, Dec. 2d, and died same day. Vigorous health. Duration of disease, four days. Suprahyoid, median and lateral swelling as high as ear, more marked on right side. No fluctuation. Constriction of jaws. Swelling of buccal floor. Marked dysphagia. Dyspnœa marked also, but no threatening of suffocation. Abundant foul saliva. Speech embarrassed. Temperature at 4 P.M. 39. Origin in carious tooth, causing a submaxillary swelling, which rapidly increased. At 6 P.M. median suprahyoid incision, only blood escaping. Patient seemed slightly relieved, but at 11 P.M. he died suddenly of suffocation.

Autopsy.—24 hours after death. Only the larynx and adjacent organs removed. Cellular tissue gangrenous only on right side. Coffee-cup-full of phlegmonous pus in right retromaxillary region, where the lymph glands are very large. Submaxillary and sublingual glands congested and slightly indurated. Pharyngeal mucosa red and slightly thickened in its retrolaryngeal portion. Tonsils slightly enlarged with some points of intraglandular suppuration. In cutting through the anterior wall of the pharynx there is seen a whitish, soft tremulous œdema of the supraglottic portion of the larynx. The aryteno-epiglottic folds, the superior vocal cords and the epiglottis are double their normal size. The uvula is hypertrophied and œdematous.

Case XI.—Gibson.—Man, 49 years. Came to out-patient department with swelling of neck below lower jaw, which began at noon of the previous day, when there was observed a scab on the right side of the neck below the jaw. At that time the swelling was enormous, extending to the chest and as high as the zygoma. Is a heavy drinker and had been drunk the evening before the trouble began. Perceptible enlargement of the salivary glands. No lymphatic glands could be felt. Skin normal in color. No pain on firm palpation at any part of the swelling. Floor of mouth considerably thickened, but tongue was not swollen or raised to any perceptible extent. Slight dyspnœa. Just beneath the jaw on the right side is a scab, ¾ in. in breadth with a pustular margin, very like a variola but having no areola. Did not feel ill enough to wish to stay in hospital, but on being warned, he consented to remain. Admitted about 1 P.M. At about 3 P.M. of the same day, he suddenly became unconscious and intensely dyspnœic. Tracheotomy done immediately, and artificial respiration carried out. Recovered and respiration became regular and rhythmical. Large tracheotomy tube introduced. A little later a median incision was made from the chin to the hyoid bone, dividing the structures almost to the floor of the mouth. Thin serous discharge. No pus. Crepitation under the skin of the chest. At 10 P.M. dysphagia, but no difficulty of respiration. Next day, 9. A.M., good night, increased swelling toward the chest. No fluctuation. No pain. 11 A.M., very feeble. Dyspnœa and considerable cyanosis of lips and face. 2.40 P.M., rapidly becoming livid and respiration more rapid. Gradually became comatose and died at 3.15 P.M.

Autopsy.—Emphysema detected from eyelids to nipple. Well marked œdema glottidis, the œdematous tissue partly resembling that found elsewhere, though perhaps not quite so firm. Infarctions found in lungs. Bacteriological examination showed no specific pathogenic organism. (It was of this case that Lockwood said that by different methods he later found the streptococcus in the tissues.)

Case XII.—Poulsen.—At midday, day before yesterday, patient observed a swelling of right side of his face and difficulty in swallowing. The swelling extended farther and farther toward the submental and parotid regions. To-day (3rd day), mouth can be opened only slightly, just enough to permit the introduction of a finger, with which the isthmus of the fauces can be felt to be free. Floor of mouth considerably swollen on both sides. Swelling œdematous but non-fluctuating. No carious teeth. When the beard was being shaved, suddenly he became dyspnœic. Sat upright in bed and died in a few minutes. This was 3 hours after admission, *i.e.*, 2 days after the beginning of the attack.

Autopsy.—Both parotid regions and upper part of neck considerably swollen. Some œdema of subcutaneous tissue. Swelling most marked in submental and submaxillary regions. Foul, grayish, rather thick fluid between the muscles passing from lower jaw to hyoid bone. Salivary gland somewhat thickened and its tissue to a slight extent infiltrated with this fluid. The glandular tissue seems unchanged. Same infiltration but with a clearer fluid invades the connective tissue of the neck. In the submaxillary salivary gland the infiltration of the connective tissue is somewhat more marked, and has the appearance of connective tissue pus and an inclination to abscess formation. On the right side the gangrenous pus infiltration extends between the sternomastoid and sternohyoid and sternothyroid muscles to just above the thyroid gland. It also extends along the blood vessels to the lower part of the thyroid gland. On the left side the pus infiltration extended only a little below the submaxillary gland. The lymph glands on both sides were somewhat swollen, but without pus. The pus infiltration did not extend to the tongue nor to the sublingual gland. Tonsils not swollen.

Enormous œdema of the uvula, and of the mucous membrane of the pharynx, particularly in the laryngo-pharyngeal sinus and especially in the aryteno-epiglottic folds. There was œdema also on the anterior surface of the epiglottis, a little on the posterior surface. Very marked œdema on the sides of the larynx, even as far as the vocal cords, especially on the left side, where the upper surface of the left cord was very prominent. In the left parotid gland there was œdema, and foci of pus infiltration in the connective tissue.

Case XIII.—Poulsen.—Man, 54 years, presents himself with a virulent phlegmonous swelling involving the left cheek, left retromaxillary region, and the lateral region of the neck. Some swelling of the eye-lids. Can scarcely swallow, and is hoarse, which symptoms are of a few days duration. No real difficulty in respiration. Mouth can be opened only slightly. Numerous stumps of teeth present. Fauces cannot be inspected. As far as one can palpate there is found considerable swelling of the left side. Epiglottis cannot be reached. Patient says that condition has developed in last three days. Before that he had suffered for a half day

from difficulty in swallowing. Temperature 40.5°. Under chloroform, incision made in submaxillary region parallel to jaw. Finger worked into a soft stinking pus infiltration of the connective tissues, as high as the mylohyoid muscles and posteriorly opposite the parotid as deep as the pharyngeal wall. At no time did pus flow out, but there escaped from the cavity a putrid offensive odor. Irrigation, iodoform packing. Following day, temperature 41°/39.2°. Respiration freer, and swelling subsided. Still a firm infiltration in submaxillary region. Gauze removed and found to be putrid and stinking. Another incision made downward. No denudation of maxilla. Patient collapsed. Toward evening, temperature went up to 41.1°. No dyspnœa.

Autopsy.—Diagnosis: Gangrenous phlegmon of submaxillary region. Pericesophageal and laryngeal phlegmon. Hyperplasia lienis. In the larynx: considerable swelling and infiltration, especially on the left side. The swelling has a dusky, gangrenous appearance, as the infiltration itself, through an incision shows a dusky, gangrenous tissue. Above the left vocal cord is an abscess the size of a pea, with thick yellowish pus, in which were found numerous micrococci of various kinds, especially long chains. The greatest infiltration is found in the intermuscular connective tissue on the left side of the trachea and larynx, close to the internal jugular vein. The infection, here, extends to the left tonsil and the upper surface is the seat of gangrenous ulceration. The process extended downward around the œsophagus, where almost to the heart, was found a thick rather firm, dusky infiltration of the connective tissue, between the mucosa and the muscularis upon the posterior and left side. In the left submaxillary region, the edges of the incision were almost black and gave a very offensive odor. (It is interesting in this case to observe the difference between the clinical and post-mortem evidence of involvement of the larynx.)

Case XIV.—Ombredanne and Keim.—Man, 26 years. Dec. 29th, at 9 P.M., patient arrived at hospital, nearly asphyxiated. It was necessary to carry him. The swelling began on the 26th, at the same time as an inflammation about a carious tooth. Dec. 28th, dysphagia developed and already dyspnœa was present. Patient continued, nevertheless, to work. Respiration became more and more difficult. On admission, 29th, there was considerable suprahyoid, hard swelling, predominating on the left side. No fluctuation. Floor of the mouth slightly elevated and tongue swollen. Mouth full of mucus. Pulse 152. Submaxillary incision made 6 cm. long; 3 to 4 grammes of fetid pus escaped with the blood. While on operating table, respiration became more difficult and stopped. Tracheotomy and artificial respiration revived him. Dec. 30th, right side of neck more swollen and is enormous. Temperature 39.2°, pulse 140. Patient calm. Swallows liquids. Dec. 31, incision posterior to angle of jaw on left side. No pus, only blood. Temperature 39°, pulse 161. General condition worse. From first incision bloody serum and bubbles of gas can be expressed. Jan. 1, swelling invades base of neck and thorax, where crepitation can be felt. Jan. 3, swelling occupies whole thorax. Jan. 4, incision in right side of neck, evacuates some

drops of pus with blood and gas. Death at 7 P.M., with an intense dyspnœa. Face cyanosed. Tracheotomy tube is always in place and working freely.

Autopsy.—Pleural cavities contain considerable quantity of bloody liquid, and at the fissures were fibrinous deposits. Lungs engorged with blood and serum. Nevertheless, they crepitated under the finger. A portion of the tongue, floor of the mouth and soft parts of the neck were removed. The whole of the floor of the mouth, especially at the angle of the jaw, was transformed into a gangrenous mass. The muscles of the tongue are absolutely preserved and retain their red color, but the pus has infiltrated in front of the trachea to behind the sternum, where there was an extensive discoloration. The carotid glands were in full suppuration.

The epiglottis was œdematous, turgescent and curved like a horse shoe; the two ends touching each other. The aryteno-epiglottic folds were equally infiltrated, especially the right which was nearly a centimetre thick. The glottis and trachea were red and injected. No subcutaneous emphysema around the trachea wound. Bacteriological examination showed: streptococci, and staphylococci, the latter predominating. Injection of the pus into one of the lower animals gave rise to an ordinary phlegmon without the development of gas.

Case XV.—Macaigne and Vanverts.—L., 62 years. Entered hospital, March 12, 1896. Previous health good. Found on waking on morning of March 11, that his neck was swollen and painful in the suprahyoid region. Yet he worked all that day. At 5 o'clock he was compelled to go to bed from fatigue, chills and high fever. At 9 P.M., March 12, swelling was considerably increased. The lesion is deeply seated because the superficial layers of tissue move easily on it. Skin normal. Swelling of "woody" hardness. Floor of mouth swollen and indurated. Mucous membrane red. Tongue pushed upward and backward. Carious teeth. Respiration difficult because of narrowing of isthmus of fauces by elevation of tongue. Dyspnœa increased on slightest effort. Speech difficult. Some constriction of jaws. Pulse rapid. Temperature 38°. General condition does not seem very grave. At 11 A.M., a few whiffs of chloroform were given and a long median incision made. This was deepened to the mucosa of the buccal floor. Neither a serous nor a purulent collection found. Abundant blood escaped. Dressing applied and patient taken back to bed. A quarter of an hour later he was dead.

Autopsy.—46 hours after death. Inspection showed that no pus collection had escaped the bistoury. Larynx sound. Aryo-epiglottic folds are not œdematous. Lungs are normal. All the organs are congested, but present no other lesion. (The writer questions the post-mortem report of a sound larynx in this case. Death in less than 36 hours was too rapid for septic intoxication. The patient worked nearly the whole of the first day. Temperature was only 38° (100⅘ F.), and general condition said to be not very grave, at end of the first day. Floor of mouth invaded by inflammation. Speech difficult and dyspnœa on first day, increased on slightest effort. Sudden death.)

CASE XVI.—BIEDERT AND ROBERTSON.—Male, 22 years, admitted for typhoid fever of two weeks duration. One week later, the typhoid being moderately severe, patient began to complain of some dyspnœa. A swelling developed very rapidly on the left side of the neck, just below the angle of the jaw, hard and tender. Dyspnœa increased and examination of throat showed an œdema of the whole of the pharynx and larynx and epiglottis, the larynx being almost entirely closed. Six hours after the onset the dyspnœa had become so severe that tracheotomy became imperative. This relieved him. Temperature 103°. External swelling continued to increase very rapidly and was very tender. About ten hours after the onset he died suddenly. Cause of death not clear.

Autopsy.—Four hours after death. Typhoid ulcers in small bowel, particularly near the termination of the ilium. Tissues of the neck very œdematous and swollen, but no evidence of breaking down. Mucous membrane of larynx, particularly about the left vocal cord and epiglottis, was œdematous, greatly swollen and almost purple in color.

Bacteriological Examination.—Cultures taken from spleen by Dr. Ghriskey showed the Eberth bacillus. Unfortunately no cultures were taken from the cervical region, but a microscopical examination of the swollen laryngeal tissues showed a pure streptococcus infection.

A further study of the 104 collected cases, and the writer's two, gave the following results.

Age.—The phlegmon was present at birth in one. In another it began on the 6th day; in a third at 3 weeks; and in a fourth at 6 months. There were 7 cases between the ages of 1 and 10 years; 6 between 10 and 20 years; 33 between 20 and 30 years; 15 between 30 and 40 years; 12 between 40 and 50 years; 10 between 50 and 60 years; and 5 between 60 and 70 years. In 9 cases the only reference to age, was that the patients were adults, and in 5 there was no reference at all to age. The greatest number, therefore, occurred between 20 and 30 years. Poulsen's 251 submaxillary abscesses, showed about the same proportion in this period. Between 16 and 30 years, he regarded as the age of carious teeth.

Sex.—Of the 106 cases, there were 76 males, and 20 females, while in 10 cases the sex was not mentioned. Males being more exposed to changes in the atmosphere are, probably, more frequently the subjects of angina; while among the poorer classes they, probably, give less attention to their

teeth and are, therefore, more frequently sufferers from dental caries, than females.

General Health.—Murchison reported an epidemic of Ludwig's Angina in the Hebrides, and found that previously impaired health was associated with most of the cases. He reported none of his cases, individually, so that none is included in the writer's list. His view has received little or no support in the literature. Of the writer's 106, there were only 15 cases in which the general health, previous to the beginning of Ludwig's Angina, was considered to be in any way impaired. Two of these were gouty; one insane; 5 alcoholic; one albumenuric, alcoholic and diabetic; one worn out by privation and long walking; one was in the early stage of secondary syphilis; one, probably, had measles just preceding the beginning of Ludwig's Angina; in one the trouble developed during typhus fever; and in 2 during typhoid fever.

There were 21 cases in which the general health was said to be good; and 10 others in which, from the vigorous occupations followed by the patients and the absence of any reference to previous health, it may be assumed that it was not essentially impaired. In 60 more there was no mention of the general health previous to the attack, or of anything which would indicate that it might have been impaired. The natural inference is that in these it was normal. In 90 of the 106, or 85 per cent. of the cases, therefore, it may be assumed that previous to the beginning of Ludwig's Angina, the general health was practically normal.

Primary Focus of Infection.—Dental caries was noted in 36 cases, in 4 the wisdom teeth being involved. So far as reference to special teeth is concerned, they were always molar or wisdom teeth, *i.e.*, those nearest to the submaxillary region. Angina was present in 11 cases, and in these there were no references to carious teeth. In one there was a wound of the mucous membrane just posterior to the incisor teeth, which had been broken by the kick of a horse. In one there was a wound of the chin. In another there had

developed infection in the wound made by cutting a tongue tie. In one of the writer's cases the infection began in a similar wound resulting from a gun shot injury, producing a fracture of the lower jaw. In two cases there were ulcers on the side of the neck. In two others, otitis media seemed to be the primary focus. In one the trouble began with a peritonsillar abscess, and in one secondary syphilis was present, probably, giving lesions in the mouth and on the skin, which would account for mixed infection of the lymphatic glands. In 49 cases there was no mention of a primary focus other than the cellulitis in the neck.

Swelling in floor of mouth.—In 81 cases this symptom was noted. In 8 one is left in doubt as to its presence by the description of the case, while in 17 no reference is made to it. From the associated symptoms the writer would infer that it was present in most of these 25 cases, if not in all. With the jaws so close together that one can not see the floor of the mouth, without special efforts, and the finger can be introduced only with difficulty, this symptom might easily be overlooked.

Difficult speech.—Disturbed speech was mentioned only in 38 cases. In 4 the patients were too young for speech. The absence of mention of this symptom in so many cases is a matter of little importance since it is not a valuable symptom. Speech must be more or less disturbed, whether the case be one of localized submaxillary cellulitis or true Ludwig's Angina, from the failure to open the mouth and the limitation of the movements of the tongue, due to the fixation of the suprahyoid muscles going to it.

Dysphagia.—This symptom was mentioned only in 68 cases, but was said to be absent in only one. Like disturbed speech it must have been present in many more, and for the same reasons.

Dyspnoea.—This symptom was present in 81 cases, was not mentioned in 20 and in three was specifically said to be absent. In two others there were syncopal attacks.

The writer has tried to show that Ludwig's Angina,

probably, kills in the great majority of cases by invasion of the respiratory tract, first of the larynx and later in some cases of the lungs. The fact that dyspnoea could be overlooked in 20 cases and could have been reported absent in 3 cases, out of a total of 106, implies that in a fair percentage of cases death occurs without oedema of the larynx. The writer, however, has become convinced during his study of this subject that not all cases of oedema of the larynx give prominent and positive symptoms upon which the diagnosis can be easily made.

In the first place the two cases showing syncopal attacks, without any mention of dyspnoea were suspiciously like cases of laryngeal involvement. Death from syncope occurred in Nelaton's case in which the submaxillary swelling was enormous and became bilateral, and the floor of the mouth was involved. In one of Huguet and DeBovis' cases, syncopal attacks occurred in a new born infant, but there was in this, as in Nelaton's, no mention of dyspnoea. There was sublingual swelling also. That dangerous involvement of the larynx may occur without the development of dyspnoea is shown by Poulsen's case (see autopsy case No. XIII). There was said to be no dyspnoea in this case, and yet the autopsy showed considerable swelling and infiltration of the larynx, especially on the left side, dusky and gangrenous in appearance. Above the left vocal cord was an abscess the size of a pea, and the process extended downward around the oesophagus in the submucous tissue almost to the heart. If dyspnoea can be absent in a case of this kind, then it is probable that oedema of the larynx existed in many of the 20 cases, in which dyspnoea was not mentioned.

Parker, writing on tracheotomy in laryngeal diphtheria, says: "Membraneous laryngitis begins in one of two ways, primarily in the larynx and by extension to the larynx. In the former the chief symptoms are those of suffocation outweighing and hiding all others. In the latter the laryngeal symptoms are preceded by those of depression and blood poisoning. As a rule this spread (to the larynx) is *very*

gradual and *very insidious*. In consequence of the antecedent blood poisoning, but chiefly of the very gradual onset of the disease, the body becomes reconciled to its deprivation of oxygen; hence the suffocative symptoms, which are so prominent and so distressing in the other variety, are less marked, indeed often absent in this. Sometimes medical practitioners have themselves underestimated the gravity of the disease on account of this apparent absence of discomfort in their patients."

J. Solis Cohen, writing on the symptoms of oedema of the larynx, says: "Acute oedema of the larynx occurs so suddenly at times that the subject perishes without any premonitory symptoms whatever. Van Swieten mentions a case, of death with sudden change in the voice, while dining. Morgagni mentions a similar case, in a physician, who suddenly became hoarse, and died at once. Porter knew of two young men found dead from oedema in the morning, without any complaint having been made by them the night previous. Ruehle mentions a young man with swollen tonsils and overheated by dancing, found dead in the morning from oedema which had suffocated him without awakening him; and likewise the case of a servant girl, slightly hoarse, who went out lightly clad in the morning, and was suffocated while going up stairs on her return. Roger, while an interne at Hôtel-Dieu, was summoned to an attendant in an adjoining ward, who died of suffocation before he could be reached; and yet there had been no complaint save of a sore throat, so slight as not to interrupt the man's work in the hospital. These instances of sudden death certainly seem to indicate a sudden occlusion of the glottis from spasm of its constrictors, rather than a mechanical death from serous effusion. It is quite probable that the oedematous condition may have existed for some hours or days undetected and unsuspected, and that some sudden inspiration of dust or of saliva, has produced an immediately fatal spasm." The writer believes that there is abundant proof in the preceding statements, to show that a patient may die from oedema of the larynx in Ludwig's

Angina, without recognition by the attending physician of the laryngeal condition.

Diagnosis.—The first essential in making a diagnosis of any pathological condition is to have a definite conception of what that condition is. The writer's idea of it has been so fully set forth, already, that little more need be said on the subject. It may be permitted him to repeat that what Ludwig described was a virulent cellulitis beginning in the submaxillary region, rapidly spreading to the adjacent connective tissue of the neck and then into the floor of the mouth and pharynx; in consequence of which the patient's life is threatened; partly from septic intoxication, but chiefly from invasion of the respiratory tract, *i.e.*, the larynx, primarily, and in some cases the lungs, secondarily. Those cases in which the phlegmonous process begins in the throat in the immediate vicinity of the larynx have been purposely excluded, for reasons already given. Those beginning in the floor of the mouth are not so easily disposed of; and these the writer is inclined to include with those beginning in the submaxillary region and invading the floor of the mouth, secondarily. Those beginning in the floor of the mouth practically always extend to the submaxillary region, secondarily; as may those beginning in the throat, but the latter not so constantly nor so quickly for obvious reasons. It will thus be seen that a Ludwig's Angina is not actually present until the sublingual phlegmon has developed. Its diagnosis, therefore, depends upon the recognition of the latter condition.

While in a case of submaxillary cellulitis still localized to the tissues of the neck, it would be folly to wait for the signs of Ludwig's Angina to develop, it is vital to be competent to recognize this condition when it is already present. With rare exceptions the teeth will be forced so close together that a finger can be introduced only with difficulty. In most cases, however, it can be introduced and by it the swollen, indurated and inflamed floor of the mouth can be felt. In some cases it can be seen without any effort to expose it, and in most cases by separating the lips and teeth as far as possi-

ble. The tongue will be elevated and may protrude between the teeth. Pain and a feeling of fulness will be experienced by the patient within the mouth. Disturbance of speech and deglutition will be more marked than in a case of simple submaxillary cellulitis. Those symptoms and more particularly dyspnoea all speak for a Ludwig's Angina.

About the only attempt at a differential diagnosis that the writer found in literature was that of Leterrier, although his ideas have been repeated by a few other writers. He said that osteoperiostitis of the inferior maxilla, adenophlegmon and hygroma of Fleischman's bursa, are the only affections with which one can confound a sublingual phlegmon. An osteoperiostitis of the lower jaw is generally a local inflammation and is usually the result of a carious tooth. In most cases which the writer has observed it involved the external portion of the jaw. If it involved the internal surface of the jaw, it would probably still be localized; but if it gave a rapidly spreading cellulitis of the floor of the mouth which is adjacent to it, it would then be, essentially, a Ludwig's Angina, because a sublingual phlegmon, when there would be no occasion for a differential diagnosis. If distinctly localized, there would be none of the characteristic symptoms of Ludwig's Angina, and this condition would not be suggested. But such cases should receive prompt attention, *i.e.,* they should be disinfected and drained at once to prevent a possible extension to the floor of the mouth, which must always be a dangerous condition.

In an adenophlegmon, Leterrier says, one finds small rounded masses, painful and distinctly separated from each other; he further says that a sublingual phlegmon gives a single mass with special characteristics and occupying at least a part of the submaxillary region. That an adenophlegmon can give an extensive single mass in the submaxillary region, the writer believes, is a matter of common knowledge and hardly needs discussion. The cases of Ludwig's Angina, beginning as small localized swellings, to which the writer has already referred, are in all probability, instances of this

kind. An hygroma of Fleischman's bursa, which is situated under the tongue, could hardly be confused with a Ludwig's Angina, since it is not inflammatory, and is distinctly localized and movable on the surrounding tissues.

The only condition, which in the writer's opinion, could be confused with a Ludwig's Angina, is a localized submaxillary cellulitis, or rather an extensive cellulitis in this region which has not invaded the mouth or pharynx. Indeed, it is only this condition which has been confused in the literature with Ludwig's Angina, and the writer has found it necessary to exclude a number of these cases which were reported as Ludwig's Anginas. Gasser, for example, reported four cases, in all of which the streptococcus was found. The writer excluded three, because he could see nothing more than submaxillary cellulitis in them. The extension to the floor of the mouth and pharynx is what determines a Ludwig's Angina in these cases, and working upon this basis, the diagnosis should be comparatively easy. That the term, Ludwig's Angina is still useful in describing this extension, the writer believes.

Prognosis.—The prognosis of a sublingual phlegmon, which is the essential condition in a Ludwig's Angina, in the writer's opinion, will vary according to the virulency of the infection and, therefore according to the rapidity with which the mouth and pharynx are crowded and the larynx reached by the inflammatory process. There is also the lesser danger of septic intoxication which, of course, varies according to the virulency. Pyaemic deposits from invasion of the blood vessels, especally the veins, by the infection have resulted in a few cases, but neither this nor the septic intoxication is, probably, any more to be feared in Ludwig's Angina than in similar infections of other parts of the neck or body. Above all the prognosis will depend upon the promptness with which the condition is recognized and upon the thoroughness of treatment.

In a considerable number of cases, although free incision was made no pus was found and in these death usually re-

sulted. Where pus was found early a cure usually followed, although in some other foci existed and a fatal termination was the result. The writer believes that some of these as well as some of the cases in which no pus was found by incision, are to be explained by the fact that one or more lymphatic glands being involved, the foci of infection were still intraglandular in some or all of them, and the incision missed them. Similar periglandular cellulitis is common in the inguinal region, where it is the rule not only to evacuate the pus, but to shell out all inflamed glands, for we have learned by experience that the inflammation in these cases will frequently continue after a considerable abscess has been thoroughly opened and properly drained. The well known tendency of streptococcus to develop serous rather than purulent exudation in some cases, as in erysipelas, will explain the absence of pus in many. Of the writer's 106 cases, 43 died and 63 recovered. The more recent cases, however, have given much better results than the earlier, as in Ludwig's time, because of earlier recognition and more prompt and thorough treatment. There can be little doubt that a better appreciation of the pathology of this condition will lead to better results in the future.

Treatment.—Antitoxines are not our only hope for the future in those cases, as Semon says. Prompt surgical interference will, probably, always be of first importance. There has been considerable difference of opinion as to what this should consist of. Although spontaneous openings when they have occurred, have almost invariably been found in the mouth, incisions there have not given satisfactory results, and it is generally conceded that the external incision is best. Surgical experience has taught that incisions should first of all lay open freely the focus from which the infection is spreading. The focus in these cases is not the preliminary insignificant lesion, tonsillitis, carious tooth, etc., which, however, should receive suitable attention; but the lymphatic gland in the submaxillary region, or the infected wound, ulcer, phlegmonous inflammation about a tooth, etc., from

which the infection is extending directly to the adjacent connective tissue. If this focus is on the surface within the mouth an effort should be made properly to expose and disinfect it, as with pure carbolic acid. Care must be observed, of course, to prevent the caustic from doing damage to surrounding parts. When this was done in one of the writer's cases, prompt subsidence of the inflammation and a cure followed. If such a focus is in the pharynx, it will be practically impossible to reach it and, as in Semon's cases, treatment will be of little avail. Spontaneous resolution with or without spontaneous opening, or an effective antitoxine are about all we can hope for.

When, however, the cellulitis originates in the submaxillary region, the focus is, probably, in one or more of the lymphatic glands. It is in these cases that the best results have been obtained. This is, undoubtedly, due to the fact that the inflamed area, from the beginning, is better exposed for recognition and treatment. The dangerous invasion of the floor of the mouth and the pharynx is a later development, thus giving more time for arresting its progress before it reaches the larynx or lungs. Delorme reported that in one of his cases the submaxillary salivary gland was exposed without the location of pus, and that the prolongation of the incision towards the median line and through the mylohyoid muscle, located pus. There is room for question whether in such a case the salivary or a swollen lymphatic gland was exposed. The incision of necessity is a deep one in the presence of the massive, indurated exudate, which is always present. Hemorrhage is free and retraction of the edges of the wound difficult. A swollen lymphatic gland may readily be of the same size as the normal salivary gland, and under these circumstances in the absence of an opportunity to scrutinize its structure carefully the one might easily be mistaken for the other. The writer believes that in Delorme's case the pus first developed where the swelling was first observed, in the submaxillary region, and if the submaxillary salivary gland had been freely exposed by the

incision it would have located it. If, however, an outlying lymphatic gland were exposed the pus collection might have been overlooked until its extension through the opening in the floor of the mouth had been reached by the extension of the incision forward and through the mylohyoid muscle.

The best incision is undoubtedly the one which Delorme selected, *i.e.,* over the submaxillary gland and parallel with the lower jaw. The frequency of the spontaneous openings in the floor of the mouth and the fact that a number of writers have reported that they did not find pus until the mylohyoid muscle had been divided, indicate that this muscle should be freely divided, at least unless frank suppuration is found before it is reached. The dangers of an external incision increase as we approach the angle of the jaw, where the largest blood vessels of the neck and head as well as the largest branches going to the face are located. They are all, practically, posterior to this gland. The facial vein lies over it and the artery under it. The gland lies in front of the angle of the jaw, and from the anterior border of the masseter muscle where the pulsation of the facial artery can be felt as it crosses the border of the jaw, forward to the symphysis there are no blood vessels large enough to be feared. The anterior part of the submaxillary incision, therefore, should give little or no trouble, while with a little care it can be safely extended backward far enough to expose the region of the submaxillary gland freely. The mylohyoid muscle may be penetrated with the knife, finger, or a grooved director. The finger should be passed upward in the wound until only mucous membrane intervenes between it and the mouth.

Many writers have employed the median incision from the chin to the hyoid bone. It is safer than the submaxillary incision, since there are no blood vessels in the median raphe, or only small ones. If Ludwig's angina were merely a sublingual inflammation, *i.e.,* beginning in and essentially localized to the sublingual tissues, as Delorme maintained, one would expect that Delorme would select the median incision

to evacuate the pus, as it is the ideal incision for an abscess located under the tongue. Yet he employed the submaxillary incision in all his cases, and this incision has been called by a few French writers following his paper, the Delorme incision. The median incision carried through the mylohyoid muscle may find pus in the floor of the mouth in the typical case of Ludwig's angina, but only after it has extended along the floor of the mouth from the submaxillary region.

The point of greatest importance, however, in connection with this whole subject, is to recognize the dangerous possibilities of every submaxillary cellulitis, and to open the infected area promptly and efficiently. If we have waited too long or our efforts have not been effectual, and asphyxia is threatened, a tracheotomy must be done at once with the hope that the process may soon subside and recovery follow. Intubation is out of the question, at least in most cases, because the mouth can not be opened and the tongue is pushed up. Artificial respiration may be necessary to tide the patient over the crisis. The question of the anaesthetic is an important one. Local anaesthesia has been employed several times and Davis emphasizes its value. When the dyspnoea is marked the added burden of a general anaesthetic is not a trifling one. It would seem that local anaesthesia should then receive the first consideration.

Conclusions.—The condition known as Ludwig's Angina, is a rapidly spreading cellulitis, beginning in the region of the submaxillary salivary gland as a perilymphadenitis, and extending to the floor of the mouth and pharynx. The primary focus usually is some neighboring surface lesion as a carious tooth, tonsillitis or ulcer in the mouth.

The infecting organism is, usually, the streptococcus, alone or mixed with other organisms, as the staphylococcus, pneumococcus, or bacillus of malignant oedema; but it may be the staphylococcus alone or any organism capable of producing a rapidly spreading cellulitis.

Death results from invasion of the larynx in most cases. In a considerable number the lungs are also involved. The

associated septic intoxication is, probably, no more severe than that which results from streptococcus infections of the same grade in other parts of the body.

The opening in the muscular buccopharyngeal wall, through which the submaxillary salivary gland projects into the floor of the mouth, is the path by which the submaxillary infection invades the mouth and pharynx.

Any rapidly spreading cellulitis in the floor of the mouth is a menace to the life of the patient, as the anatomical conditions there, favor the early involvement of the larynx.

It is this invasion of the floor of the mouth and the pharynx which determines the alarming symptoms characteristic of Ludwig's Angina. It is evident, therefore, that a cellulitis of a given grade of severity, beginning in the floor of the mouth, is more dangerous than one beginning in the submaxillary fossa, since the larynx will be more early and surely invaded. The opportunities for recognizing and checking the danger are, therefore, correspondingly lessened. For the same reasons, the most dangerous cases are those in which the phlegmonous process begins in the pharynx or in the larynx, the danger being greatly increased in these because, even if recognized immediately, the parts can not be inspected or properly incised and disinfected.

The pathological changes occurring in the infected area do not differ, materially, from those which may be expected from any severe pyogenic infection, occurring under similar anatomical conditions. The proximity of the alimentary tract explains the frequency of gas and putrescence, in many cases in which gangrene was not reported; while the intensity of the inflammatory process and the compression of the inflammatory material, inside the jaw and under the tongue accounts for the frequency of gangrene.

The condition occurs with sufficient frequency and is sufficiently constant in its clinical course, to deserve a place as a morbid entity. No name is at the same time so brief and so comprehensive as that of Ludwig's Angina. Those cases in which the cellulitis originates in the floor of the mouth, may be included with advantage among the Ludwig's Anginas. Those in which the phlegmonous process begins in the throat, should form a separate group, from the standpoint of prognosis and treatment.

Modern surgical treatment has reduced, considerably, the number of cases in which irregular septic temperature, profuse sweats, delirium and a progressively profound typhoid state, occur.

Incisions in the floor of the mouth may be advisable in a few cases for the relief of excessive swelling, but they have rarely given satisfactory results. The median suprahyoid incision, while the safest of the external incisions, does not expose the usual primary seat of infection and should not be selected, except to evacuate an evident purulent collection in the submental region. The submaxillary incision, *i.e.,* over the submaxillary triangle and parallel with the lower border of the jaw, will, probably, locate an existing pus collection in the greater number of cases. If frank suppuration is not found before, the mylohyoid muscles should be divided and the sublingual tissues exposed.

On account of the added irritation of a general anaesthetic to an already dangerously inflamed larynx, local anaesthesia will in all probability prove to be the more valuable means of controlling the pain during the making of the incision.

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DR. G. G. DAVIS said that this was an intricate subject and one with many points needing elucidation. The pathology is intimately associated with the treatment. The disease is quite a fatal one, the mortality is still quite large. There seems to be no absolute accepted line of treatment: Dr. Thomas' paper points out a line of treatment. If the disease kills by interfering with the breathing, then the line of treatment should be to obviate as much as possible the edema of the glottis and the encroachment upon the air passages. If, however, infection is the lethal agent, then the treatment should be directed to that cause. Dr. Thomas spoke of 92 out of 106 cases beginning external to the mouth and this brings up the cause of the infection beginning external to the mouth, probably in the submaxillary or retromaxillary region. It is very hard to see what should cause a primary infection of that region. Dr. Davis personally believes that the infection begins most often in the mouth and travels to the other tissues. He called attention to the statement made by Dr. Thomas that one author stated that the infection travelled to the lymphatic glands in the submaxillary region, being conveyed by the lymphatics from the primary focus in the mouth. Dr. Davis does not believe it is a question of the lymphatic nodes. Inflammation of the submaxillary lymphatic nodes and of the retromaxillary lymphatics along the large vessels can as a rule be outlined by the sense of touch. The involvement of lymphatic nodes is usually more or less limited. This disease to Dr. Davis' mind pursues an entirely different course. Instead of producing discrete lymphatic enlargement we practically never see discrete inflammatory enlargement of the lymphatics. There is a widespread, board like, inflammation in which all evidence of lymphatic nodes is obscured and there is no outline of any nodes. He believes the disease propagates itself by direct continuity of the cellular tissue.

It is hard to point out an absolute cause in all cases. In several cases which Dr. Davis has seen he believes the cause of the infection to have been in the teeth. He called attention to the specimen presented by Dr. Thomas showing the connection between the mouth and the throat. It is obvious that if a person has an ulceration of the root of the teeth, and particularly if there is pus around a decayed tooth, it involves the submaxillary gland because this gland lies quite close to it, and if it simply

follows the submaxillary gland down it goes right out of the mouth into the neck. It is extremely difficult to state definitely that the trouble originated submaxillarily and not intra-buccal.

As regards the character of the inflammation Dr. Davis believes it is generally admitted from a bacteriologic standpoint that several kinds of bacteria give rise to this disease; in other words, not only has the streptococcus been found in a large number of cases, but in several of the cases the disease has been found to contain, so to speak, only microorganisms which are of a single type, not streptococcal: for instance, pure pneumococcus cultures, and the staphylococcus, besides other bacteria have been found.

There is a question as to what extent is there sepsis and to what extent is there suffocation as relative lethal agents in this disease. There have been cases in which there was absolutely no indication of the slightest obstruction with respiration in which death ensued, which could only have been caused by infection.

Dr. Davis does not accept the temperature as a guide for septic infection. He stated that in some of the worst cases of diphtheria the temperature is low, while in other parts of the body, the appendix for instance, the infection can be very marked and the temperature can be low. One of the first things that strikes the physician in many of these cases of Ludwig's Angina is the depression of the patient. Some patients have the great swelling with no depression whatever, while others have a terrible amount of depression. Sometimes the pus is both free and offensive. Dr. Davis has seen two or three cases where the swelling has broken alongside the alveolus close to the bone. With regard to the making of incisions his favorite one is directly in the median line, as through this incision the finger can be put right through into the mouth, and the serum also drains freely into it.

He believes the disease is a local one, and that it often kills by infection, although a certain proportion of the cases are accompanied by respiratory symptoms. In these cases the larynx is gradually choked off, and then the patient goes around until something causes complete obstruction, when naturally he dies. There are other cases which pass through a typical pyemic condition with chills, fevers, sweats, temperature 104° to 105°, who

die absolutely of sepsis without any respiratory difficulty whatever.

Dr. Davis believes the line of treatment to be pursued is that which would direct against any local septic trouble; he considers free incisions perfectly justifiable in bad cases, in fact one reaching almost from below the ear posteriorly to near the symphysis anteriorly.

Dr. W. Joseph Hearn called attention to the difficulty of etherizing patients suffering from Ludwig's Angina. In three cases which he had the opportunity of seeing there was great difficulty in this direction. In every case the patient was nearly suffocated. He was present at one operation where the surgeon had hardly got the patient half under ether when he was obliged to do a tracheotomy to keep the patient from suffocation. In one case of his own he attempted to give ether, and the man became cyanosed. Dr. Hearn therefore discarded the anesthetic and made free incisions as in ordinary cellulitis: this patient recovered. Dr. Hearn presumes from the difficulty in administering ether that the pharynx and larynx must be involved.

Dr. Charles F. Nassau stated that his experience with this condition was limited to two cases, although he also had the opportunity of observing a third that was under Dr. DaCosta's care at the St. Joseph's Hospital: this patient died.

It is Dr. Nassau's belief that the patients who get well are those in whom suppuration has been established. In one of his cases the condition followed during convalescence from scarlet fever; cover slips were made and there was found to be a streptococcus infection. In both his cases the operation was done on account of the extremely rapid spread of the infection outwards and over the chest; in both the infections probably occurred through the tonsil as both patients complained of a tonsillitis a few days previous. In one of his cases this tonsillitis cleared up to some extent and then this infection began, slightly at first, occupying at least three or four days in its development; the patient did not have much fever nor pain, but when seen by Dr. Nassau she was in a good deal of pain; she took ether very well. The other patient, not only on account of her extremely ill condition but particularly on account of the place where she was, was operated upon under cocaine anesthesia. This merely saved her the pain of the skin incision. In neither of his cases did he

find any pus; the nearest approach to it was in the second case, where behind the sheath of the common carotid a few flakes of lymph were found, possibly the beginnings of suppuration.

Dr. Nassau believes in the very widest and largest possible opening, even by the tearing up of tissues if this is found necessary. He believes that where the infection simply travels without suppuration the patient has a splendid opportunity of being carried off by the infection. He argues that sometimes one organism or one infection can be replaced by another; for instance, in an infection of the Fallopian tube which was probably of gonorrhœal origin, there may be an acute flare-up, and at operation no gonorrheic organism found, it having been replaced by the streptococcus or some other organism of suppuration. In the same way there may be a peritonitis from, say, the colon bacillus, and at autopsy one may find only streptococcus as the fatal cause. Therefore one organism will kill another. This is the basis of what treatment Dr. Nassau has given other than incision. His idea was to bring about suppuration as quickly as possible and to get the wound infected with something else. He does not consider it good treatment to keep these wounds too clean, but that a chance should be given for suppuration.

Dr. W. M. L. Coplin (by invitation) stated that he considered this subject of special interest to pathologists. For twelve years he has been directly interested in it. To call the condition cellulitis may be the truth but it is not the whole truth; it is really a myositis. It is peculiar in its distribution along the course of the muscles, and the change that takes place in the muscle fibres. If one will carefully examine these muscle fibres one will find that within the perimysium there is an extending exudate with the usual progressive myolysis occurring in various types of muscle inflammation, and an accumulation of numerous leucocytes within the muscle. He thinks one of the conspicuous features in cases of Ludwig's angina is the immunity of the lymph system. He has one specimen, a complete evisceration of the cervical region, in which the lymph nodes were examined microscopically, and showed practically no infiltration, one knows of course that where an inflammatory condition involves the primitive lymphatics there is almost invariably a leucocytic invasion of the lymph nodes. In two of the cases in which Dr. Coplin made complete sections of the neck he secured the glands and was

amazed by the escape of the glands from this process. With regard to the submaxillary and the sublingual salivary glands, he has a specimen from a case which has been reported, in which these glands are bare and section shows that they practically escaped infiltration. The condition in one case in which it was impossible to make a complete dissection of the neck certainly began as a paramygdalitis. Sir Felix Semon refers to one or two cases beginning with what we would now call paramygdalitis. In this case the tonsil was almost completely dissected out by the extending necrosis but on section the organ is but slightly involved, again illustrating the fact that the lymphatics may escape. With regard to the type of infection it is Dr. Coplin's opinion that it is etiologically a polymicrobic process. It is not a disease that should be given a distinct pathological position; because of its symptomatology, largely determined by the peculiar anatomy of the neck, it might be regarded as a clinical entity.

To return to the phenomenon observed in the muscle. The myochrome disappears early, giving the muscles a washed meat appearance. Dr. Coplin has seen muscles of the body of the tongue almost the color of the white meat of chicken. The muscle change resembles, possibly superficially, that peculiar disease known as the infectious myositis of Japan. The washed meat appearance is a very striking manifestation of infection travelling widespread through the muscle without focal necrosis. If one recalls the capillary injections of muscles in which a muscle fibre is seen festooned by the most elaborate capillary circulation, like vines around a column, one can understand that an infection gaining sufficient headway to sweep like fire through that kind of a circulatory field, yields its toxin directly to the circulating blood, hence must cause great depression; even with a limited area of infection the systemic phenomena would be largely dependent upon the toxicogenesis of the invading organism.

Dr. Coplin would look at the suggestion made by Dr. Nassau that where suppuration occurs the patients would be better, from just the other side. It seems to him that the explanation of these cases is that the attack made by the antibodies is such as to secure a focusing of the infection and establish a necrosis in that area of limitation; that where the individual is unable to resist the infection it travels with such rapidity that we do not see a marked

accumulation of leucocytes. That in these cases where suppuration does not occur there is just as much disintegration and destruction of the myochrome as in cases where suppuration does occur, but there is an immeasurably less abundance of leucocytes, and a less accumulation of antibodies.

Dr. Coplin was greatly interested in the effect of the disease upon the organs of respiration. In one case which he had the opportunity to examine in very great detail, there was a clearly defined streptococcal bronchitis, while between the intralobular spaces one could see the lines of an interstitial pulmonary lymphangitis. Delicate yellowish lines traced over the incised surface of the organ and extended toward the pulmonary lymph nodes, and in this very case there was, in the peribronchial lymph nodes, no cellular infiltration.

In some of these cases there is a respiratory difficulty behind the respiratory obstruction of the larynx, just as we occasionally see in puerperal sepsis, in erysipelas, and in that peculiar disease, Brinton's disease, the absorption of toxic material and the induction of advanced suppurative interstitial pneumonia. Dr. Coplin believes this is in some cases mistaken for capillary bronchitis, which presents a very similar clinical picture.

With regard to the atrium of the infecting organism Dr. Coplin does not consider this of much importance, and believes that it has little material influence on the pathology of the lesion.

COINCIDENT ABDOMINAL LESIONS.

CASES: (I) *Appendicitis with ruptured extra-uterine pregnancy.* (II) *Appendicitis, pregnancy and ureteral calculus.* (III) *Dermoid cyst of ovary, pregnancy and gallstones.* (IV) *Tuberculosis of ovary and appendix with floating kidney.*

DR. GEO. ERETY SHOEMAKER said that the subject of combined operations or of operations for different lesions present at the same time, was one of interest and importance, frequently calling for the exercise of judgment. A number of years ago he read a paper before the Academy of Surgery advocating the removal of the appendix, if not normal, in all suitable cases when the abdomen was opened for other purposes. The proposition was received with little respect at that time, but in the evolution of surgical opinion has since become the practice of many good abdominal operators. When operating for other abdominal conditions, examination of the appendix, in all patients not in immediate danger from shock or exhaustion, and where the fear of spreading septic material from another focus does not deter, will result in demonstrating in at least 25 per cent. of cases evidences of sub-acute or chronic disorder of the appendix. In his last 400 abdominal operations not undertaken for appendicitis alone, the appendix was removed in 88, or 22 per cent. Some of these disorders involve the organ only from without and can do harm chiefly by interference with drainage, through angulation from contraction of the meso-appendix or of surrounding adhesions. Other cases show evidences of intrinsic disease of the appendix in various stages of development. This is particularly true of chronic pelvic inflammation with definite lesions of other viscera, especially tubercular.

It may be difficult before operation to separate the appendiceal from the other inflammatory conditions present. Interesting papers have been presented on the topic of referred pain leading to obscurity in diagnosis between appendicitis and kidney or gall bladder disease chiefly. His object here was to draw renewed attention to the fact that even when one definite and important lesion is demonstrated and removed at operation the surgeon should not stop, particularly in chronic cases, until he determines that other organs are not involved. Dr. Mayo has recently spoken of the systematic examination of the gall bladder from the lower incision. This of course can only be done when the incision is large enough to admit the hand and wrist, and should be omitted when dealing with pelvic infections. It does not by any means follow that the second lesion should be operated upon at the same sitting. Indeed, it might be a serious error, to attempt to deal with a badly adherent and inflamed gall bladder, the same day that an acute appendicitis required operation, or vice versa. A bad hysterectomy may tax the patient's resources, and the removal of an adherent appendix might bring the colon bacillus risk into an otherwise clean field. Quiescent inflammatory conditions of moderate severity in strong patients may, however, be attacked at the same sitting, especially if in the same general locality. A movable kidney which is bad enough to cause trouble may be anchored at the same time that a chronic appendicitis is cured by appendectomy.

In gynecological work it is constantly found that the same

patient presents several conditions each of which causes trouble. Hemorrhage requiring the curette; laceration of cervix and perineum requiring repair; bleeding and prolapsed hemorrhoids requiring operation; chronic salpingitis and appendicitis requiring conservative operation. These may all be dealt with at the same sitting only if the inflammatory processes are quiescent. If they are active the operations must be done in two groups, and the more serious should be done first. He had a patient now convalescing in whom all of these conditions were operated upon at the same time.

The patient must not be kept too long under ether and after the abdomen is opened, no work on another part should be done. Minor procedures, such as repair of lacerations, should be carried out first, as these cause no definite strain, and the patient's danger begins only when the abdomen is opened. Of course gloves and instruments are changed when the field is changed to the abdomen. He reported the following instances of combined lesions of important type:

I. *Extra-uterine pregnancy associated with appendicitis.* C., 41 years. Not previously pregnant for 14 years. Menses irregular and apt to be profuse for nine months. No periods missed, but the last one, which began six weeks before examination, had been a week late, and bleeding had continued ever since. The rupture of the left pregnant tube had occurred two weeks before with sharp pain followed by fainting and perspiration. The ovum was still in the tube in a tiny unruptured sac of fluid. Pregnancy was probably not over six weeks old. There had been much rectal bleeding for several months, temperature had never been found by her physician to be over 100 when taken. Symptoms had been so mixed including bleeding from bowel and vagina, severe pain in left abdomen chiefly and abdominal soreness and chronic indigestion, that attention had never been definitely fixed by her physician upon the appendix region and an attack of moderate severity had doubtless passed over before the ruptured extra-uterine pregnancy occurred.

When referred to him in his office, the diagnosis of ruptured extra-uterine pregnancy was made and operation advised and performed the same day. The left tube was ruptured near the attachment of the broad ligament, many ounces of free blood and clot found in the peritoneal cavity. Tube removed leaving corresponding ovary. Examination of the appendix showed a hard meso half an inch thick, the appendix walls dusky red, hard, thick and rigid, the mucous coat purple, no pus; removal. Diagnosis: Decided sub-acute appendicitis without perforation. Ruptured left pregnant fallopian tube and intra-abdominal hemorrhage. It is interesting to note that in the four months which have elapsed since the operation the troublesome chronic indigestion present for years has disappeared.

II. *Coincident acute appendicitis: pregnancy and ureteral calculus with nephritis.* E. G. A patient is now in the Presbyterian Hospital where three prominent conditions had to be considered. *First,* pregnancy at four and a half months, with a very high right uterine cornu. *Second,* severe pain with tenderness behind and about right kidney, much blood in the urine, abundant dark granular and other casts, the pain passing down the course of the right ureter to right vulva. *Third,* an acute right sided abdominal inflammation with temperature to 103°, chills and a septic look. Leucocytosis 25,000.

This case was cleared up: first by the passing on the day of admission of a sharp pointed crystal with the urine with relief of kidney pain; second, by laparotomy and removal of appendix, the abdomen containing about two ounces of free turbid fluid, no adhesions, peritoneum deeply congested in right abdomen; third, by the use of large quantities of water by mouth and salt solution by rectum to overcome the nephritis. The pregnancy was undisturbed, the child lives. The gauze drainage has now been removed and the wound is healed. The general condition good except for nephritis.

III. *Coincident dermoid cyst of ovary, pregnancy and gall-stones.* J. C., 35 years old, 6 children. Applies (*a*) because of severe pain in gall bladder region for one month, through to shoulder. Constant distress also in epigastrium. No vomiting, no jaundice, no putty-colored stools. Only similar attack followed a confinement two years before. Examination shows (*a*) a tender, small gall bladder. (*b*) A rounded tumor four inches long, adherent in pelvis with much soreness and pain about it. (*c*) Pregnant two months. Perineum and cervix much lacerated.

As an adherent tumor overlying a pregnant uterus was a greater present menace than the sub-acutely inflamed gall bladder,

the abdominal incision was made low down and a dermoid cyst of the left ovary four inches by three by two and a half firmly adherent was removed without rupture. It contained bone an inch long and cholesterin. The appendix was quiescent but showed old inflammatory changes. It was removed through the same incision. The gall blader was examined through the lower incision and found to be tightly contracted around two large gall stones into an hour glass shape. There was no fluid. Operation on the gall bladder was postponed until after delivery, in the absence of dangerous symptoms. Recovery followed from the dermoid operation and appendectomy, the woman was delivered at term seven months later. She was seen a few days ago, and as she still complains of the gall bladder soreness she is to have an operation as soon as her child is old enough to wean.

IV. *Tuberculosis of ovary and appendix. Movable kidney.* M. E. Single, 27 years. Attack called appendicitis four years before and a second two months before; ever since which walking and jarring hurt the right lower quadrant and up behind the kidney. Loss of weight 13 pounds, now 105. For two months an inflammatory swelling on 7th rib in front. Pain in right upper abdomen at times severe and apparently due to a very movable kidney which varies in size, now presenting a fusiform swelling which is movable and can be displaced upward as far as the umbilicus. The appendix is tender, the tubes and ovaries are fixed. The patient was bright, cheerful and intelligent; keenly desired relief. Urine normal.

To overcome the pain crises in the right kidney region, as the fusiform swelling was probably an early hydronephrosis, the kidney was anchored. The appendix was exposed through a gridiron incision. The peritoneum nearby was sparsely studded with small tubercles; no fluid, no adhesions. In the meso appendix a cheesy nodule size of grain of corn. Appendix sub-acute catarrhal inflammation, removed with cheesy meso: stump buried. Through the gridiron incision the tubes were felt to be diseased. It was therefore closed and a small median incision made, through which by catgut ligation, the right tube was resected and the left removed at the cornu. One-third of the left ovary was removed. The tubes formed closed sacs imbedded in adhesions. No drainage.

Convalescence extremely smooth. Wounds healed primarily.

Several days later under local anesthesia a fusiform yellowish flocculent mass of material looking like coagulated lymph was removed from the periosteum of the 7th rib, leaving a smooth glistening cavity which promptly healed with packing. Pathological report of Dr. Steele: Tuberculosis of ovary, giant cells and typical areas of infiltration. Cells of larger type found in tubercles. No giant cells or caseation found in tubes.

These operations were done two years ago. Patient seen recently. Scars sound. No abdominal symptoms. Menstruation regular and painless. Walks well and works without distress. Kidney in place, no trouble since. No disease or tenderness in tubal or ovarian regions discoverable on examination of pelvis. Lungs negative. Weight same as before operation, 105. Considers that operations were of enormous benefit to her and claims to be gaining in general health, though still slender and rather pale.

STATED MEETING, HELD DECEMBER 2, 1907.

The President, JOHN B. ROBERTS, M.D., in the Chair.

MELANOTIC SARCOMA OF THE SHOULDER.

DR. JOHN H. GIBBON exhibited a case of melanotic sarcoma of the shoulder and showed photographs of the patient before operation. The patient was a child of eight years of age, upon whom Dr. Gibbon operated last March. She had a large melanotic growth involving the skin over the shoulder and back. There was also a metastasis to the axillary glands. Numerous melanotic spots were observed in the skin all over the body and face. The growth was removed, together with the gland. Several skin grafting operations were subsequently performed. The wound is now all healed excepting an area about the size of a dime. The child has put on weight, and looks and seems perfectly well. There has been an increase, however, in the number of black spots in the skin. The clinical diagnosis was melanotic sarcoma and this was confirmed with the microscope.

FALSE ANEURISM OF THE FEMORAL ARTERY.

DR. GIBBON also exhibited a man with a large swelling in the lower third of the thigh; this man had been shot through the thigh twenty years previous. From the history it seemed that he had developed some years later an aneurysm in the neighborhood of Hunter's canal. Last February the swelling became much larger and has recently gradually increased, until it reached its present proportions. A bruit can be heard over the inner aspect of the tumor, but nothing can be heard over the outer portion of it. It extends across the posterior and two lateral aspects of the lower portion of the thigh. The veins over it are very much dilated. There was a question whether this was a pulsating sarcoma, or whether it was a ruptured aneurysm. Dr. Gibbon was inclined to think it was the latter condition.

(The patient has since been operated upon and a large false aneurysm due to gunshot injury of the vessel was found. A

Matas operation was done and several portions of the bullet and spicules of bone were found embedded in the vessel wall. The patient is making a good recovery.)

DR. J. CHALMERS DA COSTA stated that on examining this patient he had thought the condition was an aneurism, the result of injury in Hunter's canal, and that its situation had made the development slow. The fact which particularly attracted his attention was the sudden increase in size of the swelling, which the patient stated had occurred in a single sight. Since then the swelling has progressed slowly.

DR. OSCAR H. ALLIS said that he had had a case somewhat similar to the one exhibited, at the Presbyterian Hospital, and that the bruit was so distinct in the popliteal space that everyone who examined the case regarded it as one of aneurism, but it was shown to Dr. Samuel W. Gross and he immediately said it was not an aneurism, and it was later proved that it was sarcoma.

ENCHONDROMA OF CLAVICLE.

DR. GIBBON also exhibited a specimen of enchondroma of the clavicle. This growth, which was larger than two fists, was attached along the outer one-third of the posterior border. The tumor had grown down underneath the clavicle and underneath the scapula, it also filled the supraspinous fossa and covered the spine of the scapula and came forward over the clavicle. Because of its slow growth it was supposed to be an osteoma or enchondroma, but it was feared that a sarcomatous change might have taken place. The patient was an adult aged 49. The clavicle and scapula constricted the tumor in its centre, giving it the appearance of an hourglass and rendering its removal very difficult.

GUNSHOT WOUND OF BRAIN.

DR. J. CHALMERS DA COSTA reported a case of gunshot wound of the brain. The patient was 50 years of age. Six months before Dr. Da Costa first saw him he had attempted suicide by shooting himself in the head. The weapon was a revolver the calibre of which was No. 22. He shot himself back of the right ear and the bullet did not emerge. He is said to have been unconscious for hours after the infliction of the injury. He gradually recovered from the coma but was found to have

almost complete amnesia. He remembered his name and had some hazy knowledge of his life before he shot himself, but had no knowledge whatever of recent events and no memory of the suicidal attempt. Shortly after the accident he developed epileptiform attacks in each of which there was complete unconsciousness for a brief period and irregular generalized muscular spasm. The epileptiform attacks were occasional and irregular. On entering the hospital it was found that there were no distinct sensory phenomena, that the eye grounds were normal, and that the epileptiform seizures did not have a local beginning. Amnesia was complete as to all events subsequent to the injury and to most events before it. The registration element of memory was completely destroyed and the reproductive element was sadly impaired. Dr. Manges, by the X-rays, located the bullet beneath the parietal eminence of the left side. The patient was showed to the clinic as a case in which a bullet had crossed the brain and lodged beneath the cortex of the side opposite to the entry. A diagnosis of subcortical left-sided lesion was made. That very afternoon he developed status epilepticus of great violence. His life was thought to be in imminent peril and he was trephined over the supposed point of low gunshot. The dura was normal and when it was opened the cortex appeared normal. The cortex was incised and at a depth of one-fourth of an inch a cavity was entered. The cavity contained some partly clotted blood and some fragments of brain substance adherent to fibrous tissue and to the bullet. The bullet was removed. It was partly flattened and had a bit of fibrous tissue and some brain substance firmly adherent to it. It seemed that the projectile had been encysted but had been detached from its encompassing wall. A piece of gauze was inserted, the dura was sutured and the wound was closed.

For some days he was very delirious but he gradually recovered and now is vastly better. At this period (2 months after operation) his memory has notably improved and he remembers well all events antecedent to his suicidal attempt. Registration is again taking place and he remembers things from day to day, but has no memory whatever of the time between the shooting and the time at which he became fairly normal after the operation. Dr. Da Costa had hoped to have had him here at the meeting but his family had failed to bring him. The bullet was found in the exact position and at the exact depth indicated by Dr. Manges.

GUNSHOT WOUND OF THE SPINAL CORD.

Dr. Da Costa also reported a case of gunshot wound of the dural spine. This man had been shot by accident some weeks before. He had had a laminectomy performed upon him but the bullet was not found. On admission to the hospital it was found that he had the symptoms of a complete transverse lesion at the level of the third dural vertebra. Dr. Manges located the bullet with the X-rays. He developed a fever, due it was thought to cystitis. He died in a few days. The necropsy showed the bullet in the interior of the spinal cord. The cord was virtually destroyed at this level and the bullet could not be seen where the dura was opened. It could only be seen when the cord was incised. Dr. Da Costa exhibited the specimen and stated that it was no wonder that the bullet was not discovered by the surgeon who performed laminectomy.

LOCALIZATION OF FOREIGN BODIES IN SKULL AND SPINAL COLUMN.

Dr. W. F. Manges spoke as follows:

The apparatus, used to determine the location of the bullet in each of the two cases reported by Dr. Da Costa, is a modification of the Mackenzie Davidson cross thread localizer. It was devised by the Roentgen Mfg. Co. of Philadelphia, and is a detachable part of the tube carriage of their radiographic table.

All parts of the tube carriage are accurately graduated, and to the base of the tube holder are attached two spirit levels, so that it is possible to manipulate the X-ray tube in a definite and most precise manner.

The localizer has four adjustable rods, three of which are used to bring the localizer in a definite relation to the patient, and the fourth, to point to the exact location of the foreign body in relation to the localizer. There is a cross bar deeply notched at intervals corresponding to graduations on the cross bar of the tube carriage.

A clamp to hold the sensitive plate in relation to the tube carriage is attached to the edge of the table, and a shadowgraph of this clamp makes it possible to bring the developed plate back to the position it occupied at the time of exposure.

The relations, then, between the X-ray tube, the localizer, the patient, and the sensitive plate, are definite and can be manipu-

lated with mechanical accuracy at will, and regained with equal precision after the exposures are made.

The technique of localization by this method is briefly this: The position of the bullet, or, other foreign body, is first approximately determined by means of the fluoroscope, or by making a skiagraph or two.

A sensitive plate is then put on the table and held by the clamp above mentioned. The patient is placed on the table so that the region containing the foreign body will be in the field of radiation, and that the desirable field of surgical operation will be directed towards the X-ray tube.

The localizer is then attached to the tube carriage; the carriage brought to position, and lowered so that the localizer approaches near the skin surface; the three adjustable pointers are made to touch the surface of the body at convenient spots, and in this position they are firmly fixed; these spots are made indelible with silver nitrate; all readings of the tube carriage and the spirit level are carefully noted. The localizer is then removed; the focus point of the X-ray tube (the source of light) is brought to a position which exactly corresponds to the position of one of the deep notches on the cross bar of the localizer, when it was in position; an exposure of but few seconds is made; the focus point of the tube is then made to correspond with the other deep notch on the cross bar of the localizer, and a second short exposure is made on the same sensitive plate.

The patient is removed, and the plate is developed. On the plate are then found two images, or shadows, of the foreign body and shadows of the two arms of the clamp which held the plate. When the plate has become thoroughly dry a piece of thin white paper is pasted as its corners to the film on the plate, and tracings of the several shadows are made. The plate with the tracings attached is then placed on the radiographic table in its original position with relation to the tube carriage and localizer; the tube carriage and localizer are also made to occupy their original position, so that the two deep notches on the cross bar of the localizer assume the exact positions of the focus point of the X-ray tube at the time of exposure. A thread with a weight attached to one end is passed through one deep notch, and the weight end placed on the centre of the shadow made with the tube in that position, and a second similar thread is directed from the other notch to its

corresponding shadow of the bullet. The point at which the threads cross is the location of the bullet in its relation to the localizer.

The fourth adjustable rod of the localizer is then placed in position so that its point touches the crossing of the threads, in which position it is fixed, except in the direction of its long axis and superficial to the location of the cross threads. At the time of operation for removal the localizer is sterilized, and the radiographer observes the rules of surgical cleanliness so that he may adjust the localizer to the patient.

The three fixed points of the localizer are placed on their respective marks on the patient, and then the fourth rod will point in the exact direction of the bullet and at the same time give the exact depth from that point of the surface which it touches.

If necessary, at intervals during the operation the localizer may be reapplied to determine the depth of the wound and bullet.

Dr. Manges claimed no part in the designing of the apparatus except the valuable addition of the spirit levels to the tube carriage, but he believed that the idea of sterilizing the apparatus and taking it to the operating table originated in the X-ray department of Jefferson Hospital, and that it was first put into practice in one of Dr. Da Costa's clinics during the winter of 1906–7. They had had its efficiency tested in five cases, in all of which the results have been most satisfactory, one of the cases having been determined on the postmortem table.

NAILING A RECENT INTRACAPSULAR FRACTURE OF THE FEMUR.

Dr. G. G. Davis said that a couple of years ago he showed a case before the Academy in which he had fastened the fragments together with a steel screw, which was allowed to remain in for approximately four weeks. He considers it an interesting question as to whether or not to operate in cases of recent fracture. He believes that the case he refers to was the first to be reported, and he advocated that method of procedure, that is, operative treatment in a recent intracapsular fracture. He considers the question as to the propriety of operative interference now lies in our estimate of the value of conservative measures. There are two ways of treating intracapsular fractures which have proven very successful; one, in which there is longitudinal traction together with lateral traction; the other is in the position of

forced abduction. The question hinges upon the desirability of introducing foreign bodies into these bones on account of the danger of sepsis. He said that Dr. Da Costa would recall a case which he had him see several years ago, where there were beautiful symptoms of active sepsis, evidently caused by steel pins driven into an old ununited fracture, and since then Dr. Davis has had other cases in which it has been desirable to remove the pins. In one case where he tried using ivory pins, these pins broke and therefore in some of his recent cases, instead of using pins or screws to fix the fragments he has resorted to placing the limb in very marked abduction in plaster-of-Paris. Most of his cases have been those of ununited intracapsular fracture, but the union has been so prompt that he is growing sceptical regarding the necessity of using pins or other means of fixation by foreign bodies in these cases of intracapsular fracture. In justice, however, he states that he has seen one case in which this method of abduction was tried in a recent fracture but union did not occur.

Dr. H. Augustus Wilson said with regard to the disadvantage of driving the spike through the head of the acetabulum, that he considered that this was a proper mechanical procedure, for if the point of the spike went simply into the head it would have little opportunity of holding the head of the femur at the point of fracture. In one of his own cases he also drove the nail through the head into the acetabulum, and yet in two years' time there was perfect bony union; there was some restraint, however, to rotation, abduction and adduction, in which positions the point of the spike in the cavity in the acetabulum prevented these functions. Flexion was unimpaired. It seemed as though there were strong indications for the removal of the nail, but the patient was so well satisfied with the firm union that she declined to have the nail removed. The kind of nail used is of great interest. Nicolaysen drove in a steel nail, making no skin incision and without anesthesia, driving the nail into position through the skin, leaving the head outside. In 21 cases he removed the nail in three weeks' time and he states that in every case the nail was found loose. Since that time large numbers of various materials have been used and in all cases where steel nails have been used the nails have had to be withdrawn. Being impressed with the

fact that the nails were always found loose Dr. Wilson resorted to a method of barbing the nails; he has coin silver nails prepared in such a way as to make their entrance easy and their removal difficult. In one case this was found of decided advantage in that it held the nail fixedly in position and an X-ray taken two years after the insertion of the nail showed it in the original position. This method also got rid of the objection of drilling beforehand.

With regard to the old idea that old ununited fractures must have the edges freshened before they will unite, Dr. Wilson stated that in the January, 1908, number of the *American Journal of Orthopedic Surgery* he will make a report based upon the 35 cases on record. Comparatively few had the edges freshened, yet union almost invariably occurred. He believes that Dr. Da Costa is the first to resort to nailing a recent intracapsular fracture, as in all other cases reported considerable time had elapsed between the time of injury and that of operation.

Dr. Robert G. Le Conte wanted to know what practical value the nail could have if, as stated, it became loose a few weeks after its introduction. He thought its use might in a way explain the treatment of Bier for delayed union, viz.: that it produces enough irritation and exudation of blood around the fracture as to be the cause of the union, and that the success of the operation depends on this, and not the fixation of the fragments by the nail.

Dr. Oscar H. Allis said that the loosening of the nails was due to a certain inflammatory process by which they are absorbed, and that a nail as well as a screw acts as a foreign body. He believes that he was the first to put in an ordinary carpenter's screw in a fracture, and with only one exception has he ever had to search for the screw. After leaving it in for about six weeks it is almost ready to be picked out with the finger. In one case of fracture of the femur between the junction of the middle and upper third he turned the patient on the belly and cut right down on the posterior aspect of the thigh, and in that way he had absolutely perfect drainage. In this case, when he was ready to take out the screw, he found the wound entirely closed, and he believes that if the patient is still living she still carries the screw with her. Dr. Allis believes that in some instances the nail or screw acts as a dentist's plug in a tooth.

Dr. Allis stated that the cancellous structure of the head

of the bone is very much firmer and closer than in other parts. He believes oftentimes the good done by the nail or screw is in the presence of a foreign body.

RECONSTRUCTIVE ENDO-ANEURYSMORRHAPHY.

Dr. Francis T. Stewart reported the case of I. C., colored, laborer, aged 36, who was admitted to the Pennsylvania Hospital June 1, 1907, in the service of Dr. Le Conte, who assisted in the operation. Nine years ago he acquired syphilis, but otherwise has been in good health. About four months before admission he developed a painful swelling in the right popliteal space. He had received no injury, but just before this time, he had slept, on one occasion, with the affected leg hanging over the edge of his bed. Examination revealed a swelling about 4 inches long and 2 inches wide in the right popliteal space, giving all the intrinsic signs of an aneurysm. The knee was slightly flexed, the tibial vessels pulseless, and the leg free from swelling but the seat of severe pain. General examination revealed nothing abnormal except slight atheroma of the arteries. After exsanguinating the limb and applying an Esmarch band the swelling was exposed by a longitudinal incision; the internal popliteal nerve, which was stretched over the sac, drawn to one side; and the sac opened. The aneurysm contained a large quantity of clot, which was soft and black in the middle, and white, tough and cribriform on the walls. The aneurysm had grown at the expense of the postero-internal wall of the artery, and the antero-external half being represented by a groove two inches long. A catheter was placed in this groove and the walls of the aneurysm approximated above it with catgut sutures, the catheter being removed before the last stitches were tied. One small collateral opening in the sac also was sutured. The sac was then obliterated by approximating its walls as described by Matas and the skin sutured without drainage. Immediately after the operation feeble pulsation could be felt in both tibial vessels, which became stronger with the lapse of time. There was no bleeding during or after the operation. The leg was dressed on the twelfth day, the stitches removed, and healing found to be complete. The patient could extend and use his limb as freely as before the development of the aneurysm, but complained of the same severe

pain as before the operation. Some weeks after leaving the hospital he returned with a lacerated hand. Because of the pain a splint had been applied to the leg at another hospital and this had caused ulceration near the heel; otherwise the leg was in the same condition as at the time of discharge.

That the Matas obliterative operation is superior to all other forms of treatment in cases in which it is applicable seems, at least in this country, to be generally admitted. The only possible disadvantage, as compared with extirpation, of which we can think is that in cases in which the nerves are encompassed by inflammatory tissue or incorporated in the sac wall, the motor, sensory, or trophic symptoms may not be relieved. There is doubt, however, in the minds of many surgeons as to the advisability of the reconstructive operation. Excluding secondary hemorrhage, which in the absence of sepsis need not be feared, there are two reasons for this, viz., thrombosis at the seat of operation and recurrence of the aneurysm. Occlusion of the newly made vessel by thrombosis has probably followed most of the reconstructive operations. In our case the pulse in the leg reappeared immediately after the operation and persisted. It is possible that, although the first pulsations in the tibial vessels were due to blood flowing through the repaired artery, this soon became occluded, and that the pulse persisted because of the development of a collateral circulation, aided by the removal of the pressure of the aneurysm from some of the collateral vessels. With, however, the application of the principles of modern vessel suture, *i.e.*, fine needles, fine threads, close sutures, and the minimum of trauma, thrombotic occlusion should be less frequent. If it does occur, it may do so slowly enough to allow an efficient collateral circulation to form, but even though it occurs immediately, the same result would be obtained as in obliterative endoaneurysmorrhaphy. Recurrence of the aneurysm is the strongest objection to the reconstructive operation, as it has occurred twice in 16 cases. These figures do not include arteriorrhaphy for recent aneurysms following wounds of healthy arteries, in which there is no question as to the best treatment. They do, however, include the Matas restorative operations, as there is no essential difference between these and those of the reconstructive variety, except the size of the opening and consequently the number of sutures applied. As Binnie has pointed out, the aneurysm which

Matas calls fusiform is in reality a sacculated aneurysm whose mouth has extended for some distance along one side of the artery. No doubt with improved technic and larger statistics recurrence will be less frequent. A recurrence of course leaves the patient no worse than he was before and may be dealt with by any of the methods applicable to a primary aneurysm. As gangrene is inevitable in a certain proportion of all operations interrupting the circulation in the main artery of a limb, we believe that, despite the possibility of recurrence, the reconstructive operation should be encouraged.

DR. J. CHALMERS DA COSTA said that he had never done the reconstructive operation for aneurysm, but that he had done the obliterative, and in his case had found it impossible to use very fine needles. In this case there was a thick, tense sac and large needles had to be used. He obliterated the sac but could not completely close it, and had to pack gauze down upon it, and the result was a large cicatricial mass in the popliteal space which caused partial flexion of the leg. A number of months passed before it was possible to get the leg straight again. He believes the old Hunterian ligation still has a place.

RUPTURE OF THE LUNG WITHOUT COSTAL INJURY.

WITH THE REPORT OF A CASE.

BY ROBERT G. LE CONTE, M.D.,
OF PHILADELPHIA, PA.,
Surgeon to the Pennsylvania and the Children's Hospitals.

CASE.—James McG., aged eleven, white, was admitted to the Children's Hospital January 10, 1906, at 11.30 P.M. He had been run over by a rubber-tired brougham, the wheel apparently having passed over the the lower thorax. On admission the patient was cyanotic, with labored and rapid breathing; pulse rapid and irregular. He was unable to lie down on account of pain in the left side of the chest and difficulty in breathing. There was a slight lacerated wound over the left eye produced by the horse's hoof. The pupils were dilated and equal.

Thorax.—There was better expansion of the right side of the chest than of the left. Percussion note was normal throughout the right side, although the liver seemed depressed. There was dulness over the cardiac area. Over the left lung there was a tympanitic, hollow, drum-like note; fremitus was absent. Breath sounds were distant and breezy on both in- and expiration. The heart sounds were distant.

Abdomen.—Soft, but on percussion duller than normal; no tenderness. No movable dulness in the flanks. Urine was freely voided and contained no blood. There was a large normal movement shortly after admission.

There was no injury to the spine nor could a broken rib be demonstrated. The boy was conscious but very restless. I saw him five hours after the accident when the restlessness was perhaps not so marked owing to his having had bromides.

Examination of the chest at this time revealed the same physical signs as noted above, except that the entire cardiac area was tympanitic, apparently continuous with the stomach tympany below. The heart sounds were very distant. The pulse was still rapid and irregular; the abdomen was dull and the note in the flanks not clear. It was feared that abdominal hemorrhage was

taking place from injury to one of the solid viscera and the tympanitic note over the cardiac area, which seemed continuous with the stomach note, suggested a rupture of the diaphragm, with hernia of the stomach into the pleural cavity. Nausea was complained of but there was no vomiting.

The boy was etherized and an incision was made to the left of the median line in the epigastrium. The abdominal contents were found entirely normal. There was no rupture of the diaphragm and no hemorrhage. A slender needle was passed into the left pleural cavity and air withdrawn with a syringe. The diagnosis was then revised to rupture of the lung alone. The ether was well taken and both pulse and respiration improved under it.

At 7 P.M. the boy was resting quietly upon his back, the breathing much easier, though shallow, the pulse had improved and he complained of no pain. The following day it was noted that the heart dulness had moved to the right of the median line and the sounds were best heard at the xyphoid cartilage. There was apparently no increase in the pneumothorax, nor was any emphysema present. The patient was much more comfortable and respiration was less difficult. From then on convalescence was uneventful and the boy was discharged February 15th with the physical signs of a slight pneumothorax still persisting.

The patient was seen again November 26, 1907, when the only evidence of previous injury to the chest was a slight impairment of resonance over the lower border of the left lung, most noticeable in the axillary line.

In rupture of the lung the physical signs will depend, to a large extent, upon the degree and the situation of the injury produced in the lung. First. The contusion may be so slight as to produce only a rupture of a few capillaries and vesicles, with extravasation of very minute quantities of blood through the lung tissue. The diagnosis of such a condition by physical signs would be impossible, and unless infection took place later, with the production of a broncho-pneumonia, it would pass unrecognized. Second. There may be rupture of the lung substance without pleural injury. Then there would be no pneumothorax, and if air entered the loose areolar tissue from a

broken bronchiole it would dissect its way to the root of the lung, traverse the mediastinum and show itself at the root of the neck as a crepitant tumor. Third. In rupture of the lung with laceration of the visceral pleura, pneumothorax would probably be the immediate and prominent symptom. Fourth. When laceration is so extensive that a portion of the lung is almost severed from the rest, hemorrhage will be a prominent symptom in addition to the pneumothorax.

These various lesions of the lung may be produced in five different ways: 1. Bruising, where the force is not sufficient or not sufficiently concentrated to cause more than a slight subpleural ecchymosis.

2. Bursting, where the force is of such intensity that the lung cannot empty itself of air with sufficient rapidity. It has been likened to a paper bag inflated with air which receives a sharp blow. Whether it is necessary at the time of injury that the glottis should be closed to produce this result is a mooted point. Perhaps in some cases it is closed, for in times of sudden fear it is very common for an individual to take a short, quick inspiration and hold his breath. Yet it is easy to believe that if the force is sudden and violent the lung would not have time to empty itself of a sufficient amount of air even though the glottis were open.

3. Penetration from a green-stick fracture of a rib, where after the force has expended itself the rib returns to its normal position. Such fractures frequently cannot be diagnosed either by palpation or by the X-ray.

4. Compression of the lung against some more resistant tissue, as the pericardium, producing an injury resembling the wound of a dull, blunt instrument.

5. Tearing, where the lung has previously been glued to the chest wall by adhesions.

The condition of a lung in a cadaver and during life is so different that these injuries cannot be experimentally produced on the dead. In a dead body there is no rapidly circulating blood, and the results of a traumatism in a lung full of blood and air would not be the same as in an empty one, the

resistance to injury being different and perhaps lessened in the living lung.

Symptoms.—1. Shock. Shock is always present, and its degree seems to be proportionate to the amount of injury in the lung, and to the temporary derangement of the nerves which control the heart action.

2. Dyspnœa is always present and its degree will depend to a large extent upon the compression of the lung from the pneumothorax and to the derangement of the heart action. The more rapidly the pneumothorax forms the greater will be the dyspnœa.

3. The heart action will be interfered with owing to the traumatism of its nervous mechanism, the pneumothorax and the increasing resistance to the blood current from a collapsing lung. The pulse is therefore rapid and often irregular, and the aeration of the blood having been interfered with there will be cyanosis of the skin.

4. Cough will always be present, in part due to the compression of the lung, in part to the irritation of the injury itself. It may be short and hacking, without expectoration, or there will be hæmoptysis when the extravasated blood finds its way into an open bronchus.

5. The symptoms of pneumo- and hæmothorax will depend upon the lacerated visceral pleura communicating with an open air passage and upon the size of the vessels which are torn. With pneumothorax there may be absence of heart dulness at first, followed later by displacement of the heart. Hæmothorax will show movable dulness.

6. Emphysema. Emphysema may appear in two different localities. If it appears first in the region of the injury it would be conclusive proof that there had been a fractured rib, for it would show a laceration of the parietal pleura as well as of the visceral, with the escape of air through this avenue to the subcutaneous tissues. If it shows itself at the root of the neck as a crepitant tumor the air dissects its way in the loose areolar tissue surrounding a bronchus into the mediastinum and from there to the neck. From either of these positions it may spread over the entire body producing an annoying complication.

Diagnosis.—In the majority of cases the diagnosis of a ruptured lung is not difficult; the physical signs present will clearly indicate the injury. There is one condition, however, in which an error in diagnosis may easily be made, viz., rupture of the diaphragm with displacement of the stomach or large intestine into the pleural cavity. In this condition there would be the same shock, dyspnœa and cyanosis, with rapid heart action, as would be present in rupture of the lung. The tympanitic note of the hollow bowel could hardly be differentiated from a pneumothorax, and metallic tinkling, two coin test, etc., might also be present. There would probably be a dry, hacking cough on account of compression of the lung. The tympanitic note, however, should not extend to the apex of the pleura as the lung would be crowded upward, and there should be breath sounds at the apex as well as over the root of the lung. Nausea and vomiting should be prominent symptoms in rupture of the diaphragm on account of the compression, perhaps strangulation, of the gut, and as the case progressed these symptoms would become more and more marked. In rupture of the lung nausea and vomiting, when present, appear soon after the accident and do not continue after the stomach is emptied. In both rupture of the diaphragm and of the lung there may be displacement of the heart to the right side, and in both in the beginning there may be entire absence of heart dulness.

The two main differences then would be the prominence of vomiting in rupture of the diaphragm and the fact that the tympanitic note would not be universal over the pleural cavity. However, if the lung is partially glued to the chest wall from a previous attack of pleurisy, we may have breath sounds present over certain areas, with vocal fremitus and resonance, even when the lung has ruptured and a portion of the pleural cavity is filled with air.

I have never been able to place a just estimate upon the value of auscultatory percussion. In the case just reported

this method of examination gave to my ear a tympanitic note continuous with that of the stomach, and I therefore made the error of diagnosing a rupture of the diaphragm. I have seen several acute observers make a similar error in diagnosing intestinal perforation where the abdomen was distended and tympanitic, relying upon the clear transmission of sound from a distance as proof positive of the presence of air in the peritoneal cavity.

Treatment.—For the most part the treatment is symptomatic. Absolute rest in such position as is most comfortable to the patient, whether it be prone in bed or semi-recumbent; stimulation of the heart and sedatives for the nervous system. As a rule opium should not be given on account of its slowing effect upon the respiration. When respiration is very difficult from the pneumothorax pressure, aspiration of the pleura will usually give great relief and may be repeated from time to time. This should be done with a rather slender needle, as any amount of air may be drawn out through a small opening. If a needle of large calibre is used there will be danger of producing emphysema on its withdrawal. Strapping of the chest has been recommended for the control of the pneumothorax, but I cannot understand why it should do any good. It can only slightly decrease the capacity of the chest and it can in no way control or overcome the pressure exerted within the chest from the escaped air. The size of the pleural cavity is of no consequence; it is the pressure within which needs to be relieved. Strapping can do no good and it may impair the expansion of the uninjured lung.

If aspiration of the air from the pleural cavity is not giving the relief desired, for it will not be sufficient in cases where a fairly large bronchus has been opened, an incision between the ribs may be made or a portion of a rib excised and a drainage tube introduced. This will also permit the removal of blood from the pleural cavity and will tend to control the bleeding from the lung. Should the hemorrhage still persist after opening the pleura, a resection of one or more ribs will be necessary, with ligation, suture, or packing of the bleeding

area. When the blood which is retained in the pleural cavity becomes infected through an open bronchus, the treatment will be the same as in ordinary empyema, *viz.*, drainage.

The three principal complications or sequelæ of this injury are broncho-pneumonia, empyema and gangrene or abscess of the lung. The mortality for this injury is somewhere in the neighborhood of 75 per cent.

Dr. Oscar H. Allis considered that the mechanism of the lung might be explained as in the mechanism of a lacerated intestine; such laceration depends on the condition of the intestine at the time of injury, whether full or not, and if laceration occurs it will be at the point where the mesentery is shortest. With regard to the lung, this organ is never seen at postmortem in its normal condition; it is heavier under ordinary circumstances than at postmortem. Hence, it seems there might be enough weight to tear it entirely away. Dr. Allis considers this adds another argument with regard to the mechanism of that lesion.

Dr. Astley P. C. Ashhurst said that it might be of interest to know that about one-sixth of the cases of rupture of the lung without injury of the thoracic parietes have been reported by Philadelphians. In 1871 (Trans. Path. Soc., Phila.) his father had collected 20 such cases, 14 of which are not included among the 20 instances of this injury recently analyzed by Schwartz and Dreyfus [Revue de Chir., 1907]. If these tables be combined, and there be added to them the cases reported by Le Conte, and by Stewart, as well as a second case reported in 1894 by Prof. Ashhurst, there would be 47 cases in all, 33 of the patients recovering. Dr. Ashhurst does not believe the mortality rate has been altered in recent cases, as practically no changes have been introduced in the treatment. He said that there had been a number of cases of traumatic rupture of the diaphragm reported, where laparotomy was done, but that in these cases the mortality rate was high. Mortality after a thoracotomy, however, he states is very much less than after abdominal section for all forms of diaphragmatic hernia, and thoracotomy is also a much easier operation, especially for stab wounds and traumatic rupture of the diaphragm.

DOUBLE-FACED SURGICAL ADHESIVE PLASTER.

DR. CHARLES LESTER LEONARD presented samples of a double-faced adhesive plaster. This plaster has a double coating. On one side zinc oxide and on the other plain rubber adhesive. Thus the plaster can be applied directly to the skin and covered with a bandage or can be made to hold the initial end of the bandage in place. It can also be utilized to hold compresses and splints in place insuring absolute fixation in their original position. Applied in strips between the layers of bandage it adheres to both fixing them intimately together preventing any displacement and increasing their rigidity, and consequently the support obtained for the parts. It is very serviceable, neat and effective as a method of fixing the loose end of any bandage, a transverse strip, the width of the bandage in length, beneath the end holding it firmly and neatly in position, a very desirable result, especially in dressings on the head and face. Local dressings, as in boils, abscesses or ulcers, can be held in place by strips, concealed beneath the final layer of gauze.

Other applications of this form of surgical adhesive plaster will readily suggest themselves to the surgeon when employing it in practical work, where it will be found particularly useful in fixing dressings, pads or splints to the skin.

Its only use has heretofore been in the retention of wigs and toupes and has not been utilized in surgical dressings or previously made in a form suitable for surgical application.

It is now manufactured in five-yard rolls one inch, one-half and one-fourth inch wide, and can be furnished, if desired, in sterile packages.

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