THE TECHNIC OF

MODERN OPERATIONS FOR HERNIA

BY

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THIS BOOK

IS

DEDICATED

TO

HON. DR. JOHN H. O'DONNELL

OF

WINNIPEG, MANITOBA, CANADA

IN GRATEFUL REMEMBRANCE OF

ASSISTANCE GIVEN THE AUTHOR

BOTH AS A STUDENT AND

PRACTITIONER OF

MEDICINE

PREFACE.

Believing that there is room for a book on hernia which presents only the purely surgical phase of the subject, the author has prepared this work. All discussion of etiology, symptoms, diagnosis, prognosis and treatment other than surgical has been omitted (because this can be found in all text-books on surgery), and there has been gathered together here the results of twenty years of active work in surgery. These years have been of great value to the experience of the author, and in the hope that others may derive some small benefit therefrom he has set forth the following pages. He bespeaks for this work the kindly consideration which his previous writings have received at the hands of an indulgent profession.

ALEXANDER HUGH FERGUSON.

TABLE OF CONTENTS.

PART I.

CHAPTER I.

Page.

General Considerations and Classification 9

CHAPTER II.

The Technic of Operations for Hernias 30

CHAPTER III.

Instruments Used in Hernia Operations 39

CHAPTER IV.

Materials Used for Hernial Operation (Ferguson) 45

CHAPTER V.

The Chicago Hospital Operating Room Technic (Ferguson) 52

CHAPTER VI.

Indications for Operation 58

CHAPTER VII.

Preparation of the Patient 73

CHAPTER VIII.

Surgical Bacteriology 81

CHAPTER IX.

Infection 89

CHAPTER X.

Sterilization and Disinfection 100

CHAPTER XI.

Antiseptics and Disinfectants 109

CHAPTER XII.

Sterilization of Catgut 123

CHAPTER XIII.

The Wound 130

CHAPTER XIV.

Treatment of Wounds 144

CHAPTER XV.

Complications Incident to the Relief of Hernia 149

CHAPTER XVI.

Complications Incident to the Relief of Hernia (continued) 166

CHAPTER XVII.

General Complications Found at the Operation 194

CHAPTER XVIII.

Results of Hernia Operations 200

CHAPTER XIX.

Results of Operations for Strangulated Hernia 209

CHAPTER XX.

Results from Ferguson Method 215

PART II.

CHAPTER I.
Operations for Inguinal Hernia 225
CHAPTER II.
Operations for Inguinal Hernia (continued) 258
CHAPTER III.
Operations for Inguinal Hernia (continued) 265
CHAPTER IV.
The Typic or Anatomic (Ferguson) Operation 280
CHAPTER V.
Radical Cure of Femoral Hernia 289
CHAPTER VI.
Radical Cure of Umbilical Hernia 304
CHAPTER VII.
Repair of Large Defects in Abdominal Wall 315
CHAPTER VIII.
Diaphragmatic Hernia 318
CHAPTER IX.
Internal and Inferior Hernias 324
CHAPTER X.
Strangulated Hernia 336
CHAPTER XI.
Hernia in Infants 343
CHAPTER XII.
Unusual Forms of Hernia 345
CHAPTER XIII
Local Anesthesia in Hernia Operations 358

ILLUSTRATIONS.

Opposite page

PLATE I.—Interstitial Hernia, Oblique Inguinal Hernia, Epigastric Hernia, Direct Inguinal Hernia, Femoral Hernia 10
PLATE II.—Inguinal Hernia, Femoral Hernia, Obturator Hernia 16
PLATE III.—Petit's Triangle, Braun's Space, and the Anatomy of Sciatic Hernia 22
PLATE IV.—Sliding Hernia of the Sigmoid 26
PLATE V.—Sliding Hernia of the Sigmoid—laid open 30
PLATE VI.—Inguinal and Ventral Hernia with Suprapubic Vesical Fistula 34
PLATE VII.—Ventral Hernia Following Rupture of Rectus Muscle 40
PLATE VIII.—Posterior Hernia through Duodeno-jejunal Fossa 46
PLATE IX.—Pericardial Diaphragmatic Hernia of the Omentum 54
PLATE X.—Diaphragmatic Hernia 60
PLATE XI.—Ischiatic Hernia 66
PLATE XII.—Anatomical Parts 74
PLATE XIII.—Diagrammatic frontal section through the pelvis 82
PLATE XIV.—Femoral Hernia, Internal, Anterior, External 90
PLATE XV.—Congested Hernia—2 hours 94
PLATE XVI.—Congested Hernia—4 days. 102
PLATE XVII.—Inflamed Hernia 110
PLATE XVIII.—Ulcerated Hernia 116
PLATE XIX.—Gangrenous Hernia 124
PLATE XX.—Gangrenous (Littre's) Hernia 130
PLATE XXI.—Instruments 134
PLATE XXII.—Instruments 138
PLATE XXIII.—Incisions 144
PLATE XXIV—Incisions 150
PLATE XXV.—Macewen's Operation for Inguinal Hernia 154
PLATE XXVI.—Bassini's Operation for Inguinal Hernia 160
PLATE XXVII.—Kocher's Operation for Inguinal Hernia—second step 168
PLATE XXVIII.—Kocher's Operation for Inguinal Hernia—fourth step 174
PLATE XXIX.—Halsted's Operation for Inguinal Hernia 180
PLATE XXX.—Halsted's Operation for Inguinal Hernia 184
PLATE XXXI.—Halsted's Operation for Inguinal Hernia 188
PLATE XXXII.—Halsted's Operation for Inguinal Hernia 194
PLATE XXXIII.—Halsted's Operation for Inguinal Hernia 200
PLATE XXXIV.—Fowler's Operation for Inguinal Hernia 204
PLATE XXXV.—Fowler's Operation for Inguinal Hernia 210
PLATE XXXVI.—Fowler's Operation for Inguinal Hernia 216
PLATE XXXVII.—Parks' Autoplastic Suture 220
PLATE XXXVIII.—Bassini's Operation for Inguinal Hernia with Imbrication of Structures 226
PLATE XXXIX.—McArthur's Autoplastic Suture used in Bassini's Operation .. 230
PLATE XL.—McArthur's Autoplastic Suture used in Bassini's Operation 234

PLATE XLI.—M. L. Harris' aluminum bronze wire suture used in Ferguson's operation 238
PLATE XLII.—Davison's Removable Silkworm Gut Suture 242
PLATE XLIII.—Showing Deficiency of Internal Oblique at Poupart's Ligament. 246
PLATE XLIV.—Ferguson's Operation for Inguinal Hernia 250
PLATE XLV.—Ferguson's Operation for Inguinal Hernia 254
PLATE XLVI.—Ferguson's Operation for Inguinal Hernia 260
PLATE XLVII.—Diagram of the position of the transplanted rectus muscle, demonstrating the slight change in the direction of its fibers.—Bloodgood's operation 266
PLATE XLVIII.—Ferguson's Operation for Inguinal Hernia 270
PLATE XLIX.—Ferguson's Operation for Inguinal Hernia 274
PLATE L.—Ferguson's Operation for Femoral Hernia 284
PLATE LI.—Fabricius' Operation for Femoral Hernia 290
PLATE LII.—Fabricius' Operation for Femoral Hernia 294
PLATE LIII.—Ochsner's Operation for Femoral Hernia 300
PLATE LIV.—Mayo's Operation for Umbilical Hernia 304
PLATE LV.—Mayo's Operation for Umbilical Hernia 310
PLATE LVI.—Large Umbilical and Post-operative Ventral Hernias 318
PLATE LVII.—Blake's Operation for Umbilical Hernia Completed 324
PLATE LVIII.—Ferguson's Modification of Blake's Operation in Suitable Cases 330
PLATE LIX.—Ferguson's Modification of Blake's Operation in Suitable Cases.. 336
PLATE LX.—Final Result of Operation for Umbilical Hernia 346
PLATE LXI.—Hernia Into Ileo-colic Fossa 350
PLATE LXII.—Loop of jejunum into lesser cavity of omentum 354

PART I.

CHAPTER I.

GENERAL CONSIDERATIONS AND CLASSIFICATION.

A hernia or rupture is the protrusion of any viscus from the cavity in which it is normally contained. The term is usually applied to protrusions of abdominal and pelvic viscera, although organs situated in other cavities may become herniated. The author will limit his discussion of hernia entirely to the abdominal variety.

The hernia may be a congenital or an acquired one. Its protrusion may occur through openings in the abdominal wall, which were present in fetal life and failed to close at birth, as, for instance, the umbilicus and the funicular process of the peritoneum. These are congenital hernias.

The protrusion also may occur at points where the abdominal wall is weaker than elsewhere, such as the inguinal region, where the spermatic cord passes through the inguinal canal; at the umbilicus, where the muscle tissue is naturally deficient; in the femoral region, where the large vessels and nerves pass out of the pelvis; and at other points where there is a normal diastasis of muscle fibers, the space being bridged over by connective tissue only, as in Petit's triangle, between the latissimus dorsi and the external oblique muscles, and in the diaphragm. Hernias occurring at these points are of the acquired variety.

The traumatic hernias or ruptures occur at points in the abdominal wall that have been weakened as the result of operation or trauma. Hernias following abdominal sections and appendectomies are well-known examples of this variety of hernia. When a viscus protrudes through one of these weak spots in the abdominal wall, it pushes before itself the parietal peritoneum and the various layers of tissue constituting the abdominal wall at that particular point; but the innermost layer invariably consists of a pouch of thin parietal peritoneum which is known as the sac of the hernia.

The sac is usually pear-shaped or pyriform, although it may be multilocular, or constricted, the so-called hourglass sac (*en bissac*). Irregular-shaped sacs, double sacs, invaginated sacs and sacs having diverticula are also met with occasionally. The form of the sac depends in part on its contents and in part on the duration of the hernia, its location and the presence and extent of adhesions. On the other hand the sac may be absent, although this occurs only in the rarer forms of hernia, such as the diaphragmatic, the foraminal, in hepatocele, nephrocele, etc., where the viscus has only a partial investment of peritoneum, and is either partly or wholly

outside of it; or when the hernia occurs through a slit in the peritoneum. When the sac has ruptured it is sometimes difficult to find it, and such hernias may be diagnosed wrongly as having no sac.

The constricted part of the sac, the part that is engaged in the hernial orifice, is known as the neck of the sac. The part beyond, the larger, distended part, is called the fundus or the body of the sac. The coverings of the sac are the tissues outside of it, and they vary with the site of the hernia.

The contents of the sac also vary (see *Classification*). Every viscus in the abdominal cavity has been found to form the whole or a part of the contents of the hernial sac. The small intestine and omentum, and then parts of the large intestine, are most often found to form the contents of the sac. Intra-abdominal pressure is an important factor in determining not only the occurrence of a hernia, but also the contents of the sac. The size of the opening is also an important etiologic factor that must be reckoned with clinically. It is evident that a large viscus cannot protrude through a small opening until the intra-abdominal pressure, exerted for a sufficiently long period of time, has converted the small opening into a large one.

Patent fetal processes, weak spots, and intra-abdominal pressure are the factors of paramount importance in the production of hernia. When the hernial sac is closed by adhesions at its ring, it may be empty. It is then usually converted into a cyst containing serous fluid.

There is no race or class of people that is free from rupture. It has been shown, however, that hernia occurs most often among the Portuguese and Spaniards, while the United States Indians are least often the subjects of hernia. As mentioned above, hernias are met with early in life (in fact the child may be born with a hernia), and very late in life, but hernia occurs most frequently during the active period of life.

Various writers have endeavored to ascertain the prevalence of hernia among certain peoples by studying the records of schools, workhouses, infirmaries, and recruiting offices, but inasmuch as many suffering from hernia never apply for relief, it has been impossible to establish exactly the percentage of occurrence. It was estimated by Marcy that from one-eighth to one-sixteenth of the human race is afflicted with hernia. From the tables of the late J. H. Baxter, Surgeon-General, U. S. A., we learn that of 334,321 recruits, substituted, drafted and enrolled men of various nationalities examined, 16,901 were rejected on account of hernia. Of this number, over half (8,598) had right inguinal hernia. Malgaigne estimated that in France 3.6 per cent. of the total population was ruptured; while Berger claims that in Paris only .44 per cent. are ruptured.

Hernia occurs more often in the male than in the female, the percentage of frequency varying from 3 to 5. Mr. Kingdon, of London, stated that there are 6.7 per cent. of males ruptured to 1 per cent. of females.

Many interesting points in connection with the etiology and occurrence of hernia might be dwelt on in this connection, but it is not the intention of the author to do more than to call attention to a few of the more

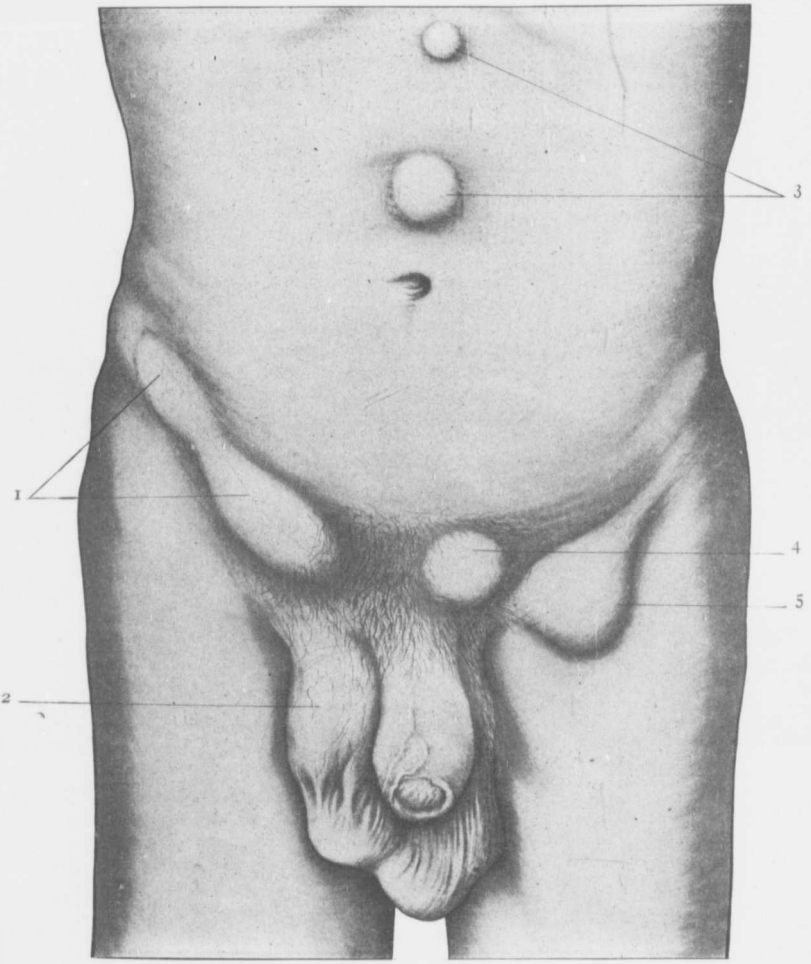

PLATE I.

1. Interstitial Hernia. 2. Oblique Inguinal Hernia. 3. Epigastric Hernia. 4. Direct Inguinal Hernia. 5. Femoral Hernia.

(Author's Case.)

essential points, inasmuch as this work is not designed to discuss the clinical history of hernia, but rather the operations for the relief and cure of hernia.

CLASSIFICATION.

In attempting to make a classification of abdominal hernias, one is confronted at the outset by the fact that up to the present no one has made a classification which is of any marked service to the clinician or to the student. There are so many varieties of hernia and combinations of different kinds that it seems almost hopeless to undertake to make any sort of classification that would be of use to anyone.

It is customary to refer to hernias as being either congenital or acquired. That is a classification based on etiology. It cannot be subdivided. Then hernias are divided into inguinal, femoral, ventral, diaphragmatic, etc., making it incumbent on the physician to memorize the various forms of the affection without any systematic attempt at classification.

In presenting the following arrangement, the author has divided hernias of the abdomen and its walls with reference to their topography into I ANTERIOR, II POSTERIOR, III SUPERIOR, IV INFERIOR, V LATERAL, and VI INTERNAL. This classification, although new, possesses the recommendation of being exceedingly simple and withal logical. It is an anatomic classification. To the best knowledge of the author no other concrete and complete classification of abdominal hernias has been made; and the one here offered may be somewhat crude and open to improvements. However, it will serve as a guide for future attempts at classifying these hernias.

ANTERIOR

- Inguinal (supra-pubic) Hernia into inguinal canal, through internal and external fossa
  - *Direct*. Through Hesselbach's triangle (internal inguinal fossa).
    - Internal (passes to inner side of obliterated hypogastric artery).
    - External (passes to outer side of hypogastric artery).
  - *Oblique* (through internal abdominal ring).
    - Congenital.
    - Acquired.
    - Infantile (behind the funicular process of the peritoneum).
    - Interstitial.
  - Pre-inguinal (interstitial, sac protrudes external to inguinal canal; mouth situated near internal abdominal ring).
  - Sliding (hernia without a peritoneal sac, e. g., cecum and sigmoid).
  - Cruro-properitoneal (Kronlein's).
  - Labial { Anterior. / Posterior.
  - Parainguinal [Bruggiser's properitoneal).
  - Intra-iliac (hernia of iliac fascia in internal iliac fossa).
  - Inguino-interstitial (Goyrand's or Boyer's — hernia not passed beyond external abdominal ring).
  - Scrotal (contents occupying the scrotum).
- Femoral (crural) Hernia into femoral canal.
  - Saphenous (Beclard's—through the saphenous opening).
  - Anterior (Velpeau's—in front of vessels).
  - Posterior (behind vessels).
  - Internal (inner side of vessels).
  - Pectineal (Cloquet—behind pectineus muscle).
  - Laugier's (through Gimbernat's ligament).
  - Ascending subcutaneous.
- Inguino-crural (Holthouse—combined femoral and inguinal.)
- Anterior retroperitoneal (Treves—sac lies along ilio-psoas muscle, inward toward pelvis and upward from internal ring).
- Epigastric (just below xyphoid cartilage). { Congenital. / Acquired.
- Ventral { Median: Linea alba hernia, congenital and acquired. / Lateral: Linea semilunaris hernia, congenital and acquired.
- Urachal (into urachu-).
- Umbilical (omphalocele). Protrusion of bowel or omentum at navel.
  - Supraumbilical.
  - Annular (paraumbilical).
  - Funicular (cord).
  - Infraumbilical (coeliocele).
  - Interstitial (a) subcutaneous (b) subperitoneal.

POSTERIOR

- Intersigmoid (protrusion at intersigmoid fossa in sigmoid meso-colon).
- Sacro-rectal, also inferior.
- Duodenojejunal
  - Enterocele into lower fossa duodenojejunalis { Right. / Left.
  - Enterocele into upper fossa, into the lesser cavity of the peritoneum.
- Retrocecal (small intestine behind cecum or subcecal).
- Ileo-cecal (into ileo-cecal fossa and extends behind the cecum).
- Ileo-colic (into ileo-colic fossa).

SUPERIOR LATERAL

- Lumbar (emerging from back of abdomen between pelvis and last rib). { Congenital (Petit's triangle). / Acquired.
- Hepatocele (hernia of the liver).
- Splenocele (hernia of spleen).
- Nephrocele (hernia of kidney).

SUPERIOR

- Diaphragmatic (through the diaphragm). (Phrenic).

INFERIOR

- Perineal (ischiorectal—rests on floor of pelvis).
- Obturator (infrapubic—into obturator foramen).
- Ischiatic (sciatic— through sacrosciatic foramen).
- Sacrorectal—due to defective ossification of sacrum (also posterior).
- Vaginal { Rectovaginal, / Cystovaginal (bladder into vagina).
- Vesical { Vesico-rectal (bladder into rectum). / Vesico-inguinal (bladder into inguinal canal). / Vesico femoral (bladder into femoral canal).
- Proctocele (may be mistaken for postanal duct).
- Hernia into Douglas' Pouch.

INTERNAL

- Foraminal (Winslowian—into lesser cavity of the peritoneum through foramen of Winslow).
- Mesenteric (Cooper's—retroperitoneal). (Passage of portion of bowel through congenital weak spot in mesentery).
- Diverticular (hernia through the mesentery of Meckel's diverticulum).
- Omental (protrusion of a knuckle of bowel through a congenital weak spot in omentum.

CONDITION OF SAC

- En bissac (hourglass).
- Multilocular (Cooper's or Hesselbach's femoral).
- Lipomatous.
- Sac absent (sliding).
- Double Sac.

CONTENTS OF SAC

- Enterocele (intestine): { Diverticulum—Meckel's. / Sigmoid. / Rectum. / Cecum. / Appendix. / Colon. / Small intestine { (a) entire loop. / (b) portion of bowel (Littre).
- Epiplocele (lipocele, steatocele, fat, omentum).
- Entero epiplocele (intestine and omentum).
- Gastrocele (stomach).
- Cystocele (bladder).
- Hysterocele (uterus): { Gravid. / Non-gravid.
- Hepatocele (liver).
- Oopherocele (ovary).
- Tubocele (oviduct) { Normal tube. / Gravid tube.
- Splenocele (spleen).
- Nephrocele (kidney).
- Pancreocele (pancreas).

Hydatidocele (hydatid cyst).
Dermoidocele (dermoid cyst).
Tumor { Benign. / Malignant.
Seminal vesicles.
Fluid { Blood (sanguinocele). / Pus (puracele). / Serum (hydrocele).
Aneurysmocele (aneurysm).
Sarcocele (muscle).

CLINICAL VARIETIES OF HERNIA {
- Inflamed.
- Incarcerated (complete obstruction of bowel).
- Strangulated (constricted) { Complete / Incomplete { Richter's. / Littre's.
- Cystic (cystocele).
- Displaced (between layers of abdominal wall).
- Concealed (not perceptible on palpation).
- Reducible.
- Irreducible.
- Encysted (Cooper's sac is pushed into congenital opening in tunica vaginalis).
- Complete (sac and contents passed through orifice).
- Incomplete (Bubonocele—sac does not protrude beyond external abdominal ring).

EPONYMIC HERNIAS.

Beclard's	(through the saphenous opening).
Berkett's	(into vaginal process of peritoneum—coming on late in life).
Boyer's	(intrainguinal—Goyrand's)
Bruggiser's	(properitoneal or parainguinal).
Cloquet's	(pectineal—behind pectineus muscle).
Cooper's	{ 1. Crural, with protrusion through the superficial fascia. / 2. Congenital, in tunica vaginalis.
Gerdy's	(adumbilical).
Goyrand's	(inguino-interstitial—Boyer's).
Hesselbach's	(crural, with protrusion through the cribriform fascia).
Holthouse's	(inguino-crural).
Kroenlein's	(having both parietal and inguinal sacs, cruro-properitoneal).
Laugier's	(crural, through Gimbernat's ligament).
Linhart's	(retroperitoneal, parietal—a properitoneal hernia).
Littre's	(a portion of ileum, strangulated).
Malgaigne's	(congenital—inguinal).
Partridge's	(femoral, anterior to or to the outer side of the femoral vein).
Petit's	(lumbar).
Richter's	(partial enterocele).
Treves'	{ anterior retroperitoneal—sac has made its way upward from / internal ring along ilio-psoas muscle, or inward toward pelvis.
Velpeau's	(femoral, anterior to vessels.

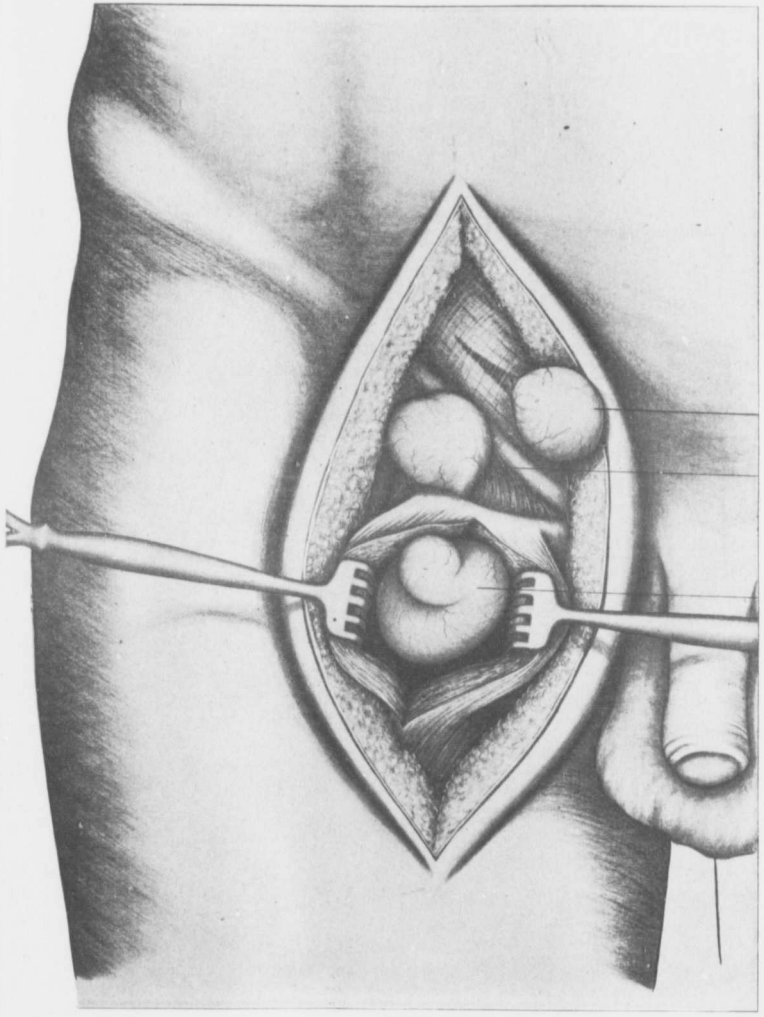

PLATE II.

1. Inguinal Hernia. 2. Femoral Hernia. 3. Obturator Hernia.
(Author's Case.)

CONTENTS OF SAC.

BLADDER. Quite a number of instances have been recorded in which a diverticulum or pouch of the bladder formed the whole or a part of the contents of the hernial sac. Personally, I have always felt that it is only by accident that the bladder is found in the canal, either because of careless manipulation by the operator, or because of the formation of adhesions which draw upon the bladder. However, I am free to admit that the bladder, or a diverticulum thereof, has been found inside the canal and must be considered as a possible content of the hernial sac.

Charles Adams (*Clinical Review*, Vol. 12, No. 4) reports an instance where the tumor was quite distinct from the testicle, was easily reducible, and presented all the indications of hernia without any vesical symptoms. On incising what was supposed to be the sac, he encountered and opened, inadvertently, a diverticulum of the bladder. This diverticulum which was firmly adherent to the cord and canal, was cut away, its walls being too thin to suture, and the opening into the bladder was closed by a continuous suture.

S. C. Plummer (*Jour. Am. Med. Ass'n.*, July 22, 1905) reported a hernia of the bladder complicating an inguinal hernia, with an undescended testicle on the left side. While operating for the hernia, he discovered a second sac. He opened it and much to his surprise found it to be the bladder. The wound in the bladder was sutured and primary union took place.

Harrington (*Annals of Surgery*, September, 1900) cites a case of hernia of the bladder through the pelvic outlet caused by the traction of a large subperitoneal fibroma of the uterus. The bladder was restored to the pelvis, the tumor was removed, and the uterus was utilized to occlude the opening, its appendages having first been removed.

A rather unique case is reported by Collier (*Lancet*, June 6, 1903). The patient was being treated for a double reducible congenital hernia. A truss failing to retain the hernias an operation became necessary. On the right side the sac was found to contain the urinary bladder, and on the left side it contained the cecum and appendix.

In another instance reported by C. E. Ingbert (*Jour. of the Amer. Med. Ass'n.*, Aug. 4, 1906), the patient had a right inguinal hernia for seven years, but kept it in place with a truss. It finally became irreducible. The tumor mass was three inches long, two inches wide, and one inch in diameter ventro-dorsally. It was rather painful when pressed on or moved. In the hernial canal was found a hard mass about the size of an egg, which proved to be continuous with the bladder. It was pushed back and the canal closed.

It will be seen from these recorded cases that unless the patient exhibits symptoms of cystitis or distress referable to the bladder, it is almost impossible to make a diagnosis of cystocele. F. Karewski (*Archiv f. Klin. Chir.*, Vol. 75) reports 5 cases, in one of which he succeeded in making a clinical diagnosis. In two cases the diagnosis was confirmed by the cystoscope. In one case the condition was not recognized until the sac was

opened, and in the remaining case the bladder was injured accidentally, its presence in the canal not having been suspected. Three of the cases were crural hernias occurring in women. Karewski states that no case of congenital hernia of the bladder has ever been reported. In 250 cases of cystocele reported the bladder was found forming a portion of the contents of the sac of inguinal and crural hernias in five instances of the former to one of the latter. H. J. Curtis (*Brit. Med. Jour.*, July 11, 1903) observed only one case in two years.

No matter whether or not hernia of the bladder is a genuine hernia, the fact that it may be found in the canal makes it incumbent on the operator to exercise the greatest care when cutting down on the sac of a hernia, because of the possibility of finding a pouch of the bladder in the canal.

Appendix—Enterocele. All parts of the intestinal tract may be found within the sac of a hernia. Of course, the small intestine, particularly the ileum, is usually contained in the sac. In 3,054 cases of hernia the appendix was found in the sac 58 times, or once in about 33 cases. Of 100 cases of appendicular femoral hernia, 81 occurred in women and 7 in men; no sex being mentioned in 12. The youngest patient was 19 years of age, the oldest 87. More than one-half of the patients were over fifty years old, and over 85 per cent. were past forty.

J. B. Hall (*Brit. Med. Jour.*, June 28, 1902) reports a case of perforation of the appendix within the hernial sac, occurring in a man 23 years of age, who five days before his admission to the hospital, while lifting a heavy sack of flour, was seized with a sudden acute pain in the right groin. When operated ten days after the accident, the sac was found to contain a mass of intestine together with lymph, disorganized blood clot and pus. The appendix presented a perforation near its base through which exuded pus, fecal matter and also two small concretions. The cecum was so infiltrated, softened and septic that it was excised and an anastomosis made with a Murphy button. The patient recovered, the button being passed on the seventeenth day.

C. J. Symonds (*Trans. Lond. Clin. Soc.*, Vol. 32) cites a case in which the appendix occupied the sac of a right inguinal hernia. The tip of the appendix was perforated by a pin. The patient was a woman, and the diagnosis lay between its being a piece of incarcerated omentum and a prolapsed ovary. When the sac was opened it contained some serous fluid and a hard, elongated swelling looking like a piece of omentum. On raising this mass the end of a pin was exposed, protruding from the central swelling. The mass proved to be the appendix. The canal was closed with sutures and a drainage tube inserted into the superficial part. The appendix occupied a patent funicular process.

In one instance cited by A. C. Wood (*Annals of Surgery*, May, 1906) the patient, a woman, aged 70, had a painful, fluctuating swelling in the right groin which was supposed to be a suppurating inguinal gland. On incising the mass, Wood encountered a small, gangrenous, offensive mass,

which proved to be the appendix. It was contained in the sac of a femoral hernia.

Four years afterwards he saw another patient who had a tumor in the right groin, supposedly a femoral hernia. At the operation the swelling was found to consist chiefly of serum, but the sac also contained the appendix, a portion of which was grasped so tightly at the neck of the sac that its reduction was impossible until the constriction had been divided.

In 1900 I operated on a man 45 years of age for a swelling in his right inguinal region. He had worn a truss for six years for his hernia. Owing to increased swelling in this region the truss was discarded three months before consulting me. The swelling continued to enlarge and finally gave him discomfort while at work. The sac contained nothing but the appendix in the condition of a *retention* cyst. The root of the appendix was completely occluded. Almost an amputation of the appendix had occurred.

Broughton and Hewetson (*Lancet*, June 16, 1906) report another case of herniated appendix, the hernia in this instance being of the femoral variety, occurring in a woman 63 years of age. After having been present for twenty-four years, the small lump in the right groin showed signs of inflammation. A diagnosis was made of inflamed femoral epiplocele. An incision over the mass was made, an abscess containing about two ounces of fetid pus and surrounded by ragged, gangrenous walls was evacuated, and a pin, incrusted with fecal matter, was found lying in the mass. Nothing resembling a hernial sac could be distinguished up to this point. The whole gangrenous mass was isolated down to the saphenous opening. After carefully covering up the gangrenous area with gauze, this was opened and the contents were readily recognized as a thickened appendix and a small mass of omental tissue. The appendix was withdrawn and amputated close to the cecum, the omental loop was divided and both were pushed just within the abdomen. A strand of iodoform gauze was inserted into the femoral canal, partly to act as a drain to the appendical stump, but chiefly to protect the peritoneum from becoming infected from the gangrenous Scarpa's triangle. A large drainage tube was passed into the bottom of the wound and the skin margin was approximated by silk-worm gut sutures.

My first (1885) operation for strangulated hernia proved to be one whose contents was the appendix and a portion (Littré-like) of the cecum. The appendix was almost ruptured, greatly enlarged and inflamed. Its root was so friable that a pressure forceps applied to it about half an inch from the cecum cut it clear off, allowing fecal matter to pour over my wound. I managed to ligate it with stout silk leaving the end long. The cecum was adherent to the internal ring and I left it undisturbed, resting content with cleansing the wound and packing it with iodoform gauze. He made a good recovery and has not yet needed another operation.

This, no doubt, was a case of appendicitis, and not one of strangulated hernia, as I diagnosed it. The appendix became inflamed while it was extending into the sac of the hernia.

Since that time I have removed the appendix through the hernial

opening in a considerable number of cases. Before tying off the sac the appendix should always be inspected. A very useful instrument for dragging the appendix down into view is that devised by Dr. Barrett (F. 21).

Another instance of the difficulty of making a diagnosis when the appendix is contained in the sac of the hernia is reported by Macewen (*Lancet*, June 16, 1906). The patient presented himself for the relief of a strangulated hernia which he said had existed for twelve years. A truss had been worn until two weeks before the patient was seen. It was left off because the man began to suffer considerable discomfort, which eventually turned into a distinct pain. On examination, Macewen found a large, pyriform swelling affecting the right inguinal region and scrotum. The scrotal tissue was much inflamed. The testis appeared to be fused with a mass which was firm in consistence and dull on percussion. No impulse on coughing was elicited. The hernia was not reducible. At the operation the hernia was found to consist of the appendix, the latter being held in position by a pin, the point and about one-half the shaft of which projected through a small ulcerative aperture in the wall of the appendix.

A unique case of femoral hernia was reported by S. Castellani (*Annals of Surgery*, Dec., 1898.) The sac contained small intestine, cecum, appendix, ascending colon and transverse colon. He also reports a case of inguinal hernia in which he failed to find a sac. There had been intermittent symptoms of strangulation, and one month before the hernia appeared an abscess formed in this region and was opened. What was thought to be the sac of the hernia turned out to be the lumen of the bowel. On incising the external oblique aponeurosis it was seen that the knuckle of bowel adhered to the abdominal wall opposite the external ring.

R. C. Turck (*Jour. Amer. Med. Ass'n.*, April 26, 1902) reported a case of hernia of the cecum, which was complicated by hydrocele and suppurative appendicitis. The appendix, testis and sac were removed *en masse*, together with a large amount of omentum.

Meckel's Diverticulum.—There is no end to the varieties of hernia that one may encounter. R. E. Webster (*Annals of Surgery*, April, 1902) reports a case of hernia of Meckel's diverticulum. The patient had symptoms of intestinal obstruction, but examination showed a strangulated, left inguinal hernia, and when the sac was opened a diverticulum measuring three and a half inches in length was found arising from the ileum, which was removed.

Liver.—Among the very rare varieties of hernia are the following: A case of congenital hernia of the liver into the umbilical cord is reported by J. W. Bullard (*American Medicine*, Nov. 8, 1902), as occurring in a male child. Radical operation was attempted when the child was twelve days old, but owing to the presence of extensive adhesions the operation had to be abandoned. The child died twenty hours afterwards.

Pancreas.—Guimaraes (*Progres. Med.*, Oct. 10, 1896) reported a case of hernia of the pancreas following a bayonet wound. Forty-eight hours after the accident the tail of the pancreas protruded from the in-

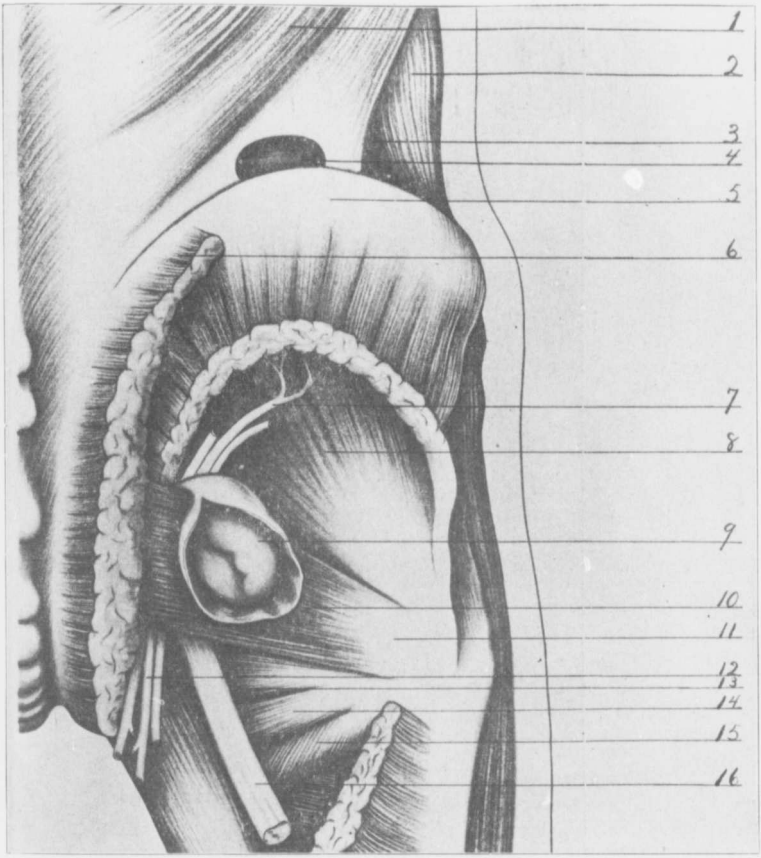

PLATE III.

Petit's Triangle, Braun's Space, and the Anatomy of Sciatic Hernia. (After Sanders.)

1. Latissimus dorsi muscle. 2. External oblique muscle. 3. Petit's triangle. 4. Braun's space. 5. Gluteus muscle. 6. Gluteus maximus muscle. 7. Gluteal artery. 8. Gluteus minimus muscle. 9. Sciatic hernia. 10. Pyriformis muscle. 11. Great trochanter 12. Sciatic artery. 13. Gemellus superior muscle. 14. Obturator internus muscle. 15. Gemellus inferior muscle. 16. Sciatic nerve.

cision. It was restored to the abdomen and the wound closed. The patient recovered.

Quenn collected 6 cases of hernia of the pancreas. In each case the herniated portion of the pancreas was cut off. Five of the patients recovered.

SEMINAL VESICLES.—Nogues recently reported a case to the French Urological Association in which a periprostatic abscess was drained through a perineal incision. Eight days later, while straining at stool, the patient expelled both seminal vesicles through the wound.

HERNIA OF FEMALE PELVIC ORGANS.

Although the individual surgeon does not, as a rule, meet with cases of hernia of the female pelvic organs very often, the cases recorded in the literature are quite numerous. Frank T. Andrews, of Chicago, has made a very thorough study of this class of hernias, and his contributions on the subject cover the field very well.

In 1905 (*Jour. A. M. A.*, Nov. 25) he reported 366 cases culled from the literature, including a full report of four cases of hernia of the tube without the ovary. He found 46 cases of hernia of the tube without the ovary; 80 cases of hernia of the ovary and tube, 267 cases of hernia of the ovary without the tube; 43 cases of hernia of the non-gravid uterus; 30 cases of hernia of the pregnant uterus. Of the 46 cases of hernia of the tube alone, 27 were inguinal, 14 femoral, 2 obturator and 3 not stated. The tube alone was found to be the contents of the inguinal sac in 23 cases; tube and intestine in 2; tube and omentum and tube and part of bladder in one each. In eleven cases the sac contained fluid. Of the femoral hernias the tube alone was contained in the sac 11 times; tube and omentum once; tube and epiploon once; tube and part of the bladder once. In seven cases the sac contained f[illegible].

In 1906 (*Jour. A. M. A.*, November 24) he reported 88 cases of inguinal hernia containing both ovary and tube, 80 of which were operated on. In 18 of these 80 cases the ovary and tube were returned to the abdomen. In 2 cases the ovaries were removed and the tubes returned to the abdomen. A tubal pregnancy within the hernial sac occurred in five instances. In one case the uterus was pregnant in the pelvis while the ovary and tube were in the hernial sac. There was strangulation in 11 cases; twisted pedicle in 13 cases; cystic ovary in 6; tuberculosis of the tube in 2, and sarcoma of the ovary in one. In eight cases intestine or omentum was contained in the sac, and in two the appendix.

There were five cases of femoral hernia containing both ovary and tube. There was incarceration and strangulation, with operation and recovery in all.

There were four cases of obturator hernia and two of ischiatic hernia.

Hegard (*Archiv f. Klin. Chir.*, Vol. lxxv, p. 425) refers to fourteen cases of hernia of the ovary reported by Deneux in 1814. Of this number 9 were inguinal hernias; 2 were ischiatic, and there was one hernia each of the crural, vaginal, and ventral varieties.

In 1871 English reported 38 cases, of which 27 were inguinal, 9 crural, 1 ischiatic and 1 obturator. In 1892 Bitzako compiled the literature of 113 cases, 91 of which were inguinal, 17 crural. Puech in a series of 88 cases gives 54 congenital, 17 doubtful and 17 acquired cases. English believes that 17 of his cases were congenital. Bitzako states that 66 of his series were congenital. Thus far the ovary has been found to constitute the contents of the sac in 4 cases of ischiatic hernia.

Lockwood (*Brit. Med. Jour.*, June 13, 1896) reports an unusual case of hernia of the ovary that occurred in an infant only six months of age. The child became ill suddenly, and two days later there appeared a swelling which was tender to touch but was easily reducible. It was about three inches long and one and a half inches broad. The skin over it was inflamed. There was no impulse on crying, but the child vomited occasionally. There was no obstruction of the bowels. A diagnosis was made of strangulated hernia and at the operation the sac was found to contain the ovary, the fimbriated end of the Fallopian tube, and a grumous fluid. There were no adhesions at the internal ring. The tube and ovary were replaced, the sac was ablated, and the wound closed. Mr. Owen reported a similar case.

P. F. Morf (*Annals of Surgery*, March, 1901) reports one case of hernia of the Fallopian tube, without hernia of the ovary, occurring in a woman who had suffered from a congenital hernia in the left inguinal region. The case illustrates the extension of the inflammation from the vagina through the uterus and then through the tube into the sac of the hernia where it caused suppuration. A portion of omentum was also found in the sac. Of 24 cases recorded in the literature, 13 were inguinal, 10 crural and one obturator. Strangulation was present in 14 cases. Of these six were inguinal, seven femoral and one obturator.

J. H. Jopson (*Annals of Surgery*, July, 1904) reports the case of a woman, aged 27, multipara, who had had a small right inguinal hernia as long as she could remember. It was of about the size of a walnut, a small, hard, painless protrusion, which always descended when she was on her feet and disappeared on lying down. It always was reducible; it gave her no trouble, and she never wore a truss. Suddenly, while washing, a large protrusion appeared in the right groin, accompanied by severe pain. There was neither vomiting, constipation, fever or chill. The swelling then was of about the size of a fist, situated in the right inguino-labial region, coming from the external abdominal ring; hard, irreducible and somewhat tender. A probable diagnosis was made of omental hernia. The tumor was pear-shaped, the wide end presenting. The sac was adherent, except at the constricted base. While endeavoring to unfold the sac, it suddenly split longitudinally and about three-quarters of an ounce of a yellow, odorless pus escaped. An ovary was seen to protrude from the canal to the right of the neck of the mass, also the broad ligament and tube. It was then discovered that the herniated mass was the uterus turned over forward, the supravaginal portion running backward, downward and inward toward the cervix. The necrotic and infected condition of the body of the uterus forbade its reduction and it, with the ovary and sac, were removed. To se-

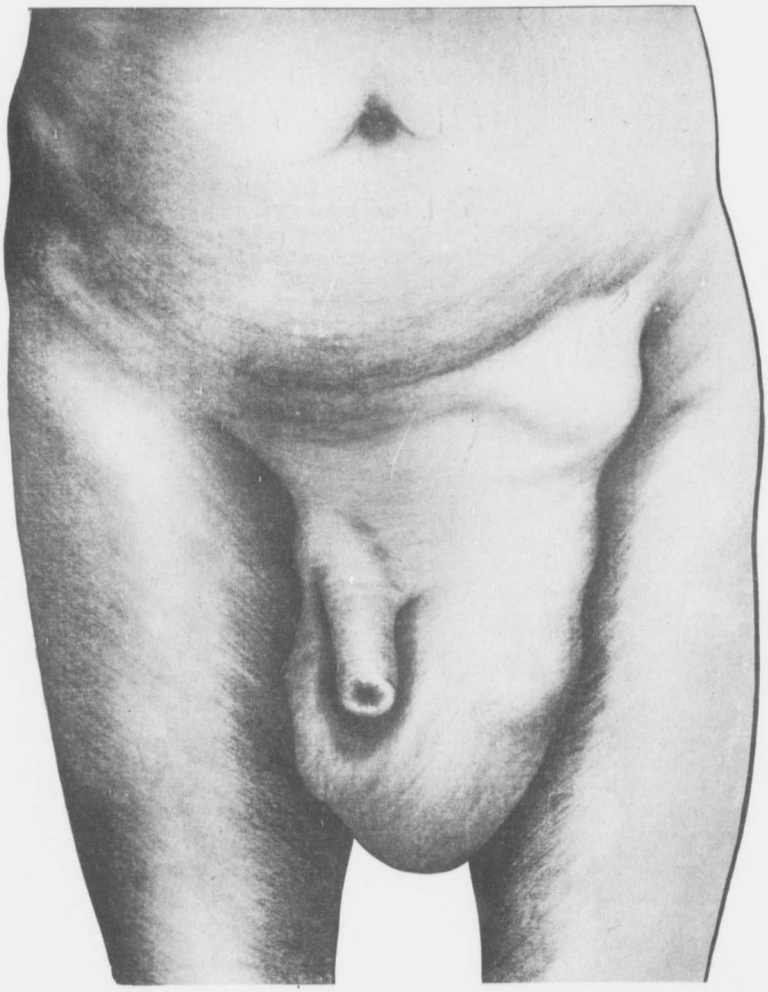

PLATE IV.

Sliding Hernia of the Sigmoid.
(Author's Case.)

cure drainage, to exclude the peritoneum and to close as far as possible the canal, the pedicle was fastened in the external abdominal ring, the pillars of the latter being sutured with chromicized catgut above, around and below it. A small gauze wick was laid over the stump and the wound was closed in its deeper portion by a continuous chromicized catgut, and the skin with silkworm gut. The patient made an uneventful recovery.

Hilgenreiner (*Berliner Klin. Woch.*, xliii, No. 11) reports a case of inguinal hernia of the uterus, and refers to 39 similar cases reported in the literature. In the majority of these cases the defect was congenital and was accompanied by other anomalies. In four instances the patients were men and in another a male hermaphrodite. In eight cases the uterus was pregnant. In the case personally observed the patient suffered from melancholia, which subsided completely after the operation. The uterus and right adnexa with some loops of intestines were found in the hernia. They were adherent and, on account of shock, the operation was done in two stages. The psychosis developed during the interval of about nineteen months.

In a case of hernia of the female pelvic floor reported by Keiller (*Amer. Jour. of Obstet.*, March, 1906), the whole vagina was everted, the intravaginal cervix uteri and its os occupying very nearly the center of the tumor. There was no marked erosion of the vaginal mucosa. The hernia contained two-thirds of the contracted bladder, the lower three inches of the uterus, and half of the urethra; the whole vagina, which was completely everted, at least four inches of a much-elongated uterus, the canal, and 5 cm. of rectum, as well as the uterovesical and rectovaginal pouches of peritoneum. The fundus of the uterus was only slightly lower than normal.

CHAPTER II.

THE TECHNIC OF OPERATIONS FOR HERNIAS.

THE PATIENT. (a) *Physical Condition.* Before attempting to perform an operation for hernia, it is of paramount importance to establish definitely the exact physical status of the patient. A thorough physical examination should be made of the heart, lungs and other vital organs, including the determination of the renal functions and the condition of the nervous system. The patient's habits and mode of life ought also to be looked into. It is a good rule to make it a routine practice to conduct this examination just as carefully as one would in the case of an individual applying for life insurance, particularly as there is more at stake.

There is no operation for hernia that is not attended by more or less risk, although the vast majority of operations are accompanied by only a minimum risk, and do not endanger life. Some operations are attended by special dangers. These will be discussed later on. When the operation is not done in an emergency, to save the life of the patient, it is the duty of the surgeon to estimate and choose between the danger to life incurred by operating and the danger to life if the hernia is left uncured. If the patient is in good health, the danger attending an operation for the relief of a small, acquired, reducible hernia should be slight; but if the patient is the victim of a chronic nephritis, or some other equally serious affection, the operation might prove fatal. A form of hernia that is attended by considerable operative risk is the ventral hernia which follows appendicectomy or abdominal section, especially when many adhesions have formed. It is here that the operator must possess keen judgment of the conditions present and a full knowledge of possible results, in order that he may decide wisely before advising operative intervention.

Another factor that must be reckoned with is the occurrence of suppuration in the wound following a herniotomy, because this is the principal cause of relapse of the hernia. We know that some patients are more prone to infection than others, and it is not only advisable, but necessary, to determine this fact before operating. Sometimes it is well not to operate on such patients. It is to be hoped that before long it will be possible to forestall the occurrence of suppuration by immunization done before operating.

It is wrong and inadvisable to promise the patient a cure, because even under the most favorable circumstances relapses have occurred. Of course, the operator is expected to express an opinion as to the outcome of the case, but this opinion should be given only after weighing carefully all the evidence he may have obtained by thorough examination and careful observation.

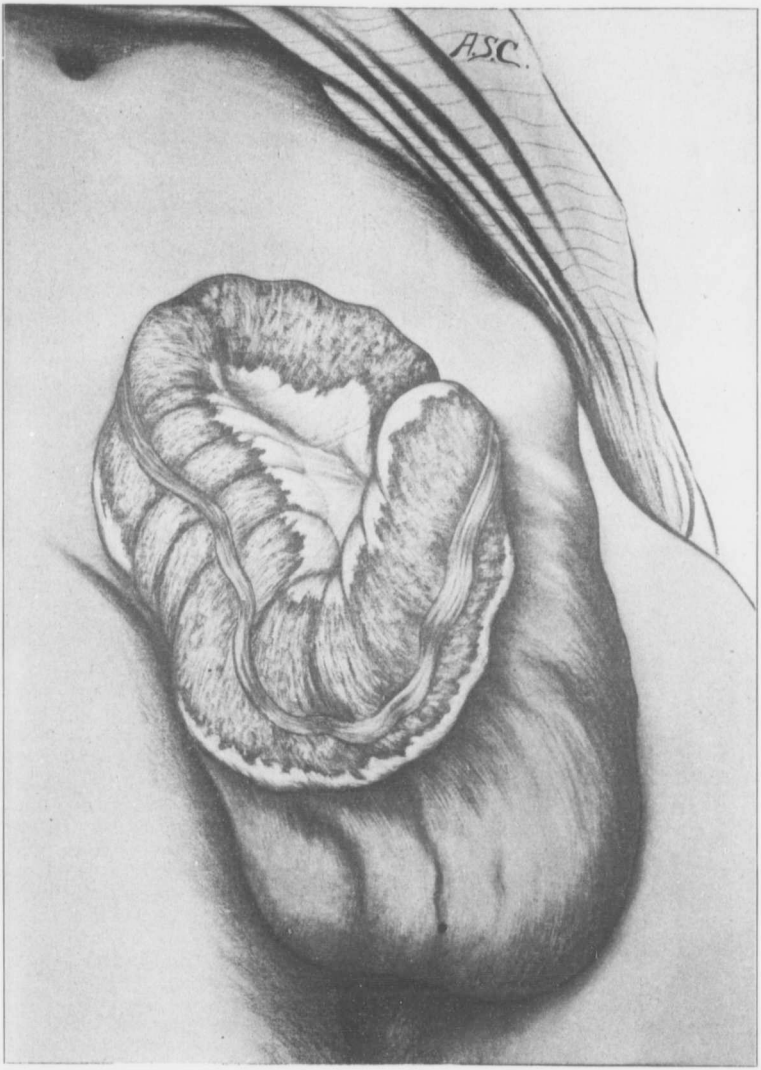

PLATE V.

Sliding Hernia of the Sigmoid—laid open.
(Author's Case.)

When strangulation of the hernia has occurred, and efforts at reduction made by the patient himself (or by others) have failed, operation is indicated; except in most rare instances and only under the most unusual circumstances. Then the operator should resort to taxis, under anesthesia, before doing anything else. Here, again, we must not overlook the dangers which attend the giving of an anesthetic.

Another affection which is likely to prove serious is that peculiar dyscrasia known as hemophilia—the bleeder's disease. Under no circumstances should the victim of hemophilia be operated on (strangulation excepted) until he has been under treatment looking toward the relief of this condition. Short and easy operations on hemophiliacs have resulted fatally. While a herniotomy usually is not a serious operation, yet it is apt to be a long one, which would surely prove fatal under the conditions just referred to.

In contrast to the "bleeder" is the man whose blood vessels are too full, whose functions are too active. His tissues are producing a large amount of waste which requires a correspondingly increased activity on the part of the emunctories to remove. As a rule, such individuals have been accustomed to an active life and they rebel when they are compelled to remain in bed for a few weeks while recovering from the effects of an operation. In such cases the chances of recovery are not as good as they are in the less robust patient, the less active individual, whose metabolism has not been over-active, and whose emunctories have not been over-taxed. Before an operation is undertaken on these robust persons, or what at one time was called a condition of plethora, the patient should be dieted and purged freely for a week or two, if necessary, so that all his functions may be balanced. It is not often, however, that more than four or five days of such treatment are necessary. Each individual is a law unto himself, and must be treated accordingly.

(b) *Age.* The resisting and recuperating powers vary at different periods in life. Experience has shown that between the ages of five and fifteen major operations prove more successful than at any other period of life. The death-rate is higher both before and after that time. All wounds heal more rapidly in children than in adults. In the former regeneration of lost tissue takes place more quickly because all the tissues are in a state of growth, whereas in the adult, regeneration means the awakening of a dormant process.

Another factor in favor of the child is that worry and anxiety because of the impending operation do not exist. Children also stand the confinement better; they are not so restless; they are more easily amused and entertained than the adult. On the other hand, however, children cannot endure pain without suffering markedly ill effects. They are very prone to suffer profoundly from shock. In the case of very young children and infants, the dressings, if not protected properly, become soiled with the discharges and suppuration ensues.

If possible, an operation should not be performed during the time of first dentition, because gastro-intestinal disturbances, convulsions, and pyrexia are apt to develop on the slightest provocation.

It cannot be denied that from the time of maturity to the termination of life the mortality after major operations for hernia increases with each year of life. The aged patient, however, who is well-preserved mentally and physically will withstand the operative cure of hernia without any material danger to life. Of course, the old are much more likely to succumb to the effects of shock, because the vitality of their tissues has been undermined, so that in some instances the risk to life is greater from the convalescence than it is from the effects of the operation itself.

It is not in the highest interests of surgical advancement to perform an operation for the cure of hernia on an octogenarian unless it is undertaken for the purpose of relieving actual suffering or to prolong life. Old age of itself is serious enough as a contra-indication to operation, but senile degeneration of the arteries and internal organs is to be dreaded by the surgeon. Nevertheless, in taking a retrospective view, the surgeon cannot be otherwise than impressed by the fact that the comfort of the body has been increased and many lives saved by timely operations on hernias.

(c) *Sex.* Sex, on the whole, seems to exert but little influence on the outcome of operations for the relief of hernia. This is particularly true in both the young and old in the comfortable walks of life. Females, between the ages of fourteen and forty, usually stand the stress of an operation better than do males between those ages. Women lead less active lives; they are more patient and tolerant to house life; they bear pain better; they are more easily encouraged, and they are less affected by hemorrhage, pain, shock, vomiting, etc., than are men. The only conditions that must be considered in connection with sex are those of menstruation, pregnancy, lactation, and the climacteric; but as the time for operations for the cure of hernias can in most instances be chosen, it is unnecessary to operate during the periods mentioned, except when the hernia has become strangulated, when operation is positively indicated.

(d) *Habits and Disease.* Alcoholism. There are two classes of alcoholics that demand the serious consideration of the operator, (1) the confirmed drunkard, and (2) the man who takes his "nightcap" and his "eye-opener" every day. In both these classes the operative mortality is much higher than it is in the temperate individual. Delirium tremens complicates any operation. It is advisable to refuse all except the most urgent operations in heavy drinkers. It takes more than two weeks to eliminate alcohol from the system of one who uses it every day, and a still longer time to tone him up before he can be operated on safely.

Tuberculosis. Tuberculous patients suffer from hernia quite frequently. As a rule, it is best not to recommend an operation for the cure of hernia in this class of patients unless strangulation occurs, when it is necessary to operate in order to save life. Then a cure of the hernia should be effected at the same time. If the victim of the hernia is also suffering from a tuberculous peritonitis or a tuberculous condition of the hernial sac, an operation is not only justifiable, but commendable for the treatment of both the tuberculous disease and the hernia. Such operations should be performed through the hernial area, even at the risk of infecting

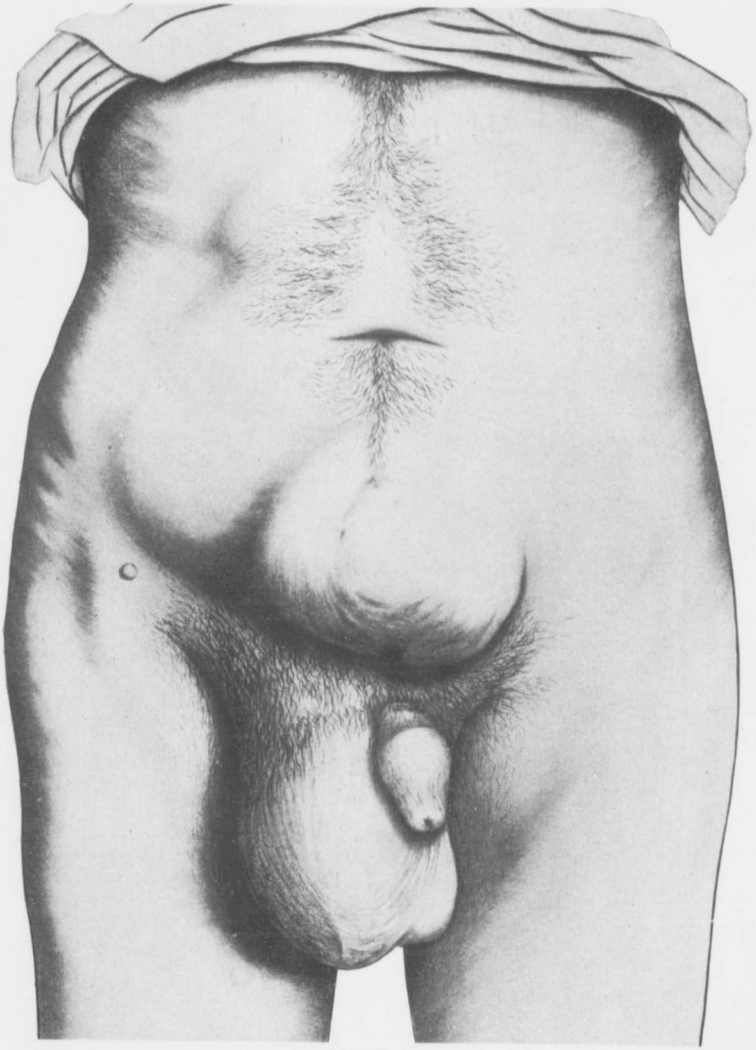

PLATE VI.

Inguinal and Ventral Hernia with Suprapubic Vesical Fistula.
(Author's Case.)

the wound with tuberculosis. In the case of phthisis and tuberculosis of the joints, the operation for the relief of hernia should be deferred until such time as the tubercular condition has been relieved. When the tuberculosis is confined to the lymph glands of the neck, and a hernia also exists, the glands should be removed first, and the hernia not operated sooner than three months afterward. Children who are puny and poorly-nourished should not be operated on, even though no positive evidence of tuberculosis is found, unless it is certain that the hernia is materially interfering with the child's well-being. Of course, strangulation always is a positive indication for operation.

Syphilis. This affection, in any of its stages, is a contra-indication to operation for relief of hernia, except when strangulation has occurred. While it is true that, as a rule, wounds of the tissues of a syphilitic heal well, still there is the exceptional case that does not heal up promptly, but breaks down with local manifestations of specific disease.

Rheumatism, Gout, Diabetes Mellitis and other Constitutional Diseases. What is true of tuberculosis and syphilis also applies to these constitutional diseases, especially during their acute stage. Operations on diabetics are always to be dreaded because of the uncertainty of the outcome. The tissues are not in a state that favors prompt and uncomplicated regeneration. Their condition favors sepsis and gangrene. Therefore the subjects of such diseases are not to be operated on, except in an emergency. Rheumatism is not so serious a complication as is diabetes, yet it is advisable to put the patient under energetic medical treatment before attempting to perform an operation for the cure of the hernia. Sometimes it is necessary to operate on a patient who is suffering from some acute infectious disease, but it will be understood that these are only emergency cases. The judgment of the operator must be the sole guide in determining when and when not to operate.

Mental Condition. The mental condition of the patient always materially affects the prognosis after a surgical operation. The patient who has a nervous temperament always dreads an operation. He is afraid of the anesthetic; he is afraid of the knife; and he fears being hurt. Often, however, it is these patients who display most courage when there is no alternative. They are more calm and more considerate than the average patient, because they yield to the inevitable, knowing that it is the only way to avoid a fatal issue. The sullen, gloomy and apathetic person, who is filled with an indifference to all that is going on about him, and who is convinced that there can be only one outcome, a fatal one, is the most unfavorable to operate on. I recall one case, that of a man who deliberately starved himself to death. He stood the operation well, and the wound healed nicely, but he absolutely refused either to drink or eat. He would not even retain food passed into the stomach through a stomach tube. Although his hands were tied, he succeeded in vomiting up the food by persistent voluntary efforts. Nutrient enemeta were expelled at once. Normal salt solution kept him alive for two weeks.

The epileptic and the insane bear all operations well because their men-

tal condition in no way interferes with the outcome. Operations have been known to cure epilepsy. Two such cures have occurred in my own experience. The statistics of operations on the insane show a remarkably low mortality and the surgeon need never hesitate to operate on this class of patients, although operations done for the cure of hernia in the insane are undertaken only in an emergency.

(e) *Preparation.* The preparation of patients for operations is both deliberate and emergent, and at the same time local and constitutional. The deliberate preparation consists in allowing from one or two to seven or fourteen days, before the patient is safely submitted to the operative cure for hernia. As a rule, patients are in the hospital twenty-four hours before an operation is performed. Those who earn their living by hard manual labor, who indulge excessively in athletic sports, as well as those who lead an automobile and club life, had better be dieted, purged and generally strengthened by suitable tonics before being operated.

When a surgeon consents to shorten the time of the preparatory treatment, contrary to his usual and special practice based on his experience and knowledge, regretable complications and results may have to be borne with chagrin, disappointment and sorrow. In the surgical treatment of hernia, as in that of all other surgical conditions, let him not be dissuaded from carrying out the dictates of his conscience.

CHAPTER III.

INSTRUMENTS USED IN HERNIA OPERATIONS.

The instruments employed by the author in performing operations for the cure of hernia are shown in illustrations Nos. 21 and 22.

Ferguson's straight and curved—large and small—angiotrypsic forceps (1, 2, 3).
Halsted's mosquito forceps—straight and curved (5, 6).
Barrett's bowel holder (7).
Needle holder—Ferguson.
Scissors: One Mayo (dissecting), and two small—curved and straight.
Three retractors—Byford, Mayo, Ferguson.
Forceps.
Three sets needles—
Mayo (bowel) (1).
Ferguson, round and cutting (2).
Straight skin needles for horsehair (3).
Knives—Two center-pointed for dissecting.
Two back-pointed for making incisions, using one for skin incision, and the other for incising the remaining structures down to the sac.

Sterile Instruments in Reserve.

Several sharp knives, 3 or 4 scissors, and a razor.
An assortment of needles.
Two dozen forceps, small and large.
Catheters—silver, glass and rubber.
Retractors—sharp and blunt.
Transfusion needles, etc.

In addition to the above, the surgeon should have in readiness a transfusion apparatus, Downes' transformer, a thermo-cautery, and a stomach tube.

While an expert surgeon can perform the operation for the radical cure of hernia with a very few instruments—a knife, or scissors, tissue forceps, and a needle and thread—better, safer and cleaner work is done by him with a suitable supply, as here enumerated.

The knives chosen should, above all things, be sharp. A dull-cutting scalpel worries the operator and unduly traumatizes and also endangers the tissues. An instrument that cuts clean affords the artistic operator an opportunity to sweep along so lightly that even the small branches of blood vessels are brought into view, clamped, and then severed, thereby

preventing blood-staining of the tissues. In order to obtain the best results in operations for inguinal hernia, it is absolutely essential to differentiate and study the structures involved, and this cannot be done accurately when the tissues are stained with blood.

A large-bellied scalpel should not be used while a careful dissection is being done around the spermatic cord. This work demands a knife whose point is in its center, and then the operator knows and feels where the cutting point is all the time.

Halsted's mosquito forceps are sufficient to check the subcutaneous hemorrhage, but when the superficial epigastric, superficial pudic, or superficial iliac vessels are exposed, and have to be severed (usually only the superficial epigastric), the Halsted forceps are not powerful enough to permanently check hemorrhage without the use of ligatures, and the fewer the ligatures the better, consequently it is better to use the author's angiotrypsic forceps, the smaller size, straight and curved, which should be left holding the vessels until the sac is ablated, and then removed, when hemostasis is complete and permanent. When we consider that every ligature is a tax upon the tissues to care for it, and that it may be an additional source of infection, it is an advance in surgical technic when the number of ligatures is limited to a minimum by using efficient crushing forceps, such as those mentioned. The author has repeatedly performed such operations as herniotomies and breast amputations, and trusted entirely to these forceps for hemostasis, and he has never been disappointed.

A larger vessel than is severed in operations on hernia, such as all the arteries and veins below the upper third of the leg, may be trusted to the angiotrypsic crush of the large forceps for hemostasis. Vessels situated inside the body, as, for example, the ovarian and uterine vessels which are only secured in intermediate hemorrhage at great risk to the life of the patient, are not trusted to the angiotrypsic force of the large forceps, but this much is gained, and that is, that a very small-sized ligature may be used efficiently on the vessels thus crushed, say No. 00, and 0, or 1, formalin chromic catgut, instead of No. 2 or 3, when no such crushing is done.

Barrett's bowel holder is a useful instrument to drag out, hold and replace bowels, appendix, omentum, ovaries and tubes. It greatly facilitates inspection of intra-abdominal contents without undue manipulation.

The three retractors mentioned (Fig. 22), Byford's, Mayo's and Ferguson's, have each an especial application in different hernial localities.

The Byford retractor is suitable to raise up and retract the abdominal wall after the abdomen is opened in umbilical or ventral hernias, without tearing the peritoneum. This simple act of raising the abdominal wall and looking at the abdominal contents before passing the hand is a useful source of information as to the position of organs and as to the existence of pathologic conditions.

Mayo's retractor is the best to protect the spermatic cord while operating on inguinal hernia. The cord is placed in the broad space between the two blunt prongs of either end of the retractor, and is held there without fear of injury.

PLATE VII.

Ventral Hernia Following Rupture of Rectus Muscle (Thos. Pickering Pick.)

The Ferguson retractor has a blunt and a sharp end. Occasionally a sharp retractor is needed. The needles selected should be both round and cutting. The author, of course, prefers his own in all hernial operations. The cutting needles are used only to sew the skin. When the bowel has to be sutured or the appendix removed, bowel needles of Mayo's kind had best be employed. The best needles for inserting wire are those devised by M. L. Harris.

When it is necessary to remove adherent or strangulated omentum, the electro-thermo-cautery of Downes is the most efficient instrument for this work. At the selected site for ablation, seize hold of the omentum with one or two of Downes' clamps and turn on the current, which in a minute or so heats the blades and cooks a strip across the tissues within its grasp, and permanently forestalls any hemorrhage. The mass is then cut off, care being taken not to cut outside of the center of the cooked, ribbon-like tract. Inasmuch as the end of the omental stump has lost its vitality by heat, no adhesions can take place to it.

In dealing with extensive omental and fibrous adhesive bands, and when it is clear to the surgeon that the separation of these adhesions by force would leave many or extensive raw surfaces on the parietal peritoneum or elsewhere, then Downes' electro-thermo-cautery is an instrument of great value. It is applied to the adhesions, a ribbon-like tract seared, and in the center of the cooked tissues the scissors is applied and passed through the stump or stumps proximal to the viscera. These are allowed to recede and the distal stump or stumps left to cling by their adherent ends, without the danger of new adhesions forming. Should, however, the elaborate apparatus of Downes be not at hand or out of order, and adhesions, as above mentioned, are encountered, then the angiotrypsic forceps come in well; clamp *en masse* in two places; release the forceps; tie in the crushed grooves, and cut between them. Then bury the raw stumps between omental or peritoneal folds which will prevent the formation of extensive new adhesions.

In hernial cases the omentum should not be amputated because it is found within the sac. If it is not attached and it appears normal, it should be left alone. It is singular but true that it takes two raw surfaces to create adhesions. A wonderful example in nature is to be found in the ovary, whose surface, where the follicle ruptures, becomes raw once a month during menstruation, and no adhesions follow, but let infection come on the scene of operations, and cause traumatism to the surrounding structures, and the ovaries will soon become buried in adhesions, only limited by the nature and virulence of the special bacteria in the field.

The operator must not forget how delicate the peritoneum is, and that even handling bowels with gloves is liable to cause dangerous traumatism and paresis of the muscular coats, with subsequent distention, which favors the transmission of bacteria from the mucous to the peritoneal membrane, sufficient to agglutinate many coils of bowel, perchance permanently.

The dissecting scissors, devised by Mayo, or Greig-Smith's, greatly facilitate the delicate task of liberating one deep structure from another, with

the least amount of danger. Seizing the tissues with a thumb and finger forceps, the operator makes gentle traction. Then in a clear field a small snip with the scissors makes an opening through which the closed point of the scissors is inserted, and immediately opened widely, which reveals the structures sought for. In quick succession the scissors are used as above mentioned, until the dissection is completed, and all the structures in the hernial area are differentiated and dealt with *secundum artem*. In my most delicate operations I am very fond of using the knife and gauze, but I am sure that I can work more rapidly and just as safely with the scissors.

The only operation for hernia that requires special instruments to carry out its original technic is MacEwen's. He devised a right and left ligature carrier, but even in the performance of his operation they are no longer required, because any large-sized, round-pointed needle, grasped firmly in a suitable needle holder, will answer the purpose equally well.

CHAPTER IV.

MATERIALS USED FOR HERNIAL OPERATION (FERGUSON).

Formalin chromic catgut.
Chromic catgut—No. 00, 0, 1, and 2.
Silkworm gut—small size.
Horsehair—large size.

The chromic or the formalin chromic catgut comes from the dealers in alcohol in sealed glass tubes, which are boiled for forty-five minutes without breaking the tubes.

Ligature and Suture Material.—In all surgical operations extended use is made of various materials both for ligature and suture purposes. These materials are classified according to their source into animal, vegetable and mineral, but for surgical purposes the classification is made usually with reference to the behavior of these materials in the tissues, so that we have absorbable and non-absorbable materials, as follows:

I. Absorbable.
   1. Catgut.
   2. Tendon.
      a. Kangaroo.
      b. Deer.
      c. Ox.

II. Non-absorbable.
   1. Wire.
      a. Silver.
      b. Gold.
      c. Aluminum bronze.
   2. Silkworm gut.
   3. Horsehair.
   4. Silk.
   5. Linen thread.
   6. Celluloidin thread (Pagenstecher's).

I. ABSORBABLE SUTURES.

1. *Catgut.*—Catgut is obtained from the fibrous coat of the intestine of sheep. The intestines are macerated until the serous and muscular coats on the one side, and the mucous coat on the other, are easily scraped off. The fibrous coat remains. This is cut into strips of different lengths and thickness. These strips are then twisted spirally and are allowed to dry. After they have dried thoroughly they are polished with pumice stone and

rolled into coils, when the catgut is ready for the market. This is dry or raw catgut.

The ordinary commercial catgut (raw) is not sterile. It is therefore unfitted for surgical work. Besides, it is too brittle. When it is placed in water the catgut swells, becomes soft, slippery and elastic, and has a tendency to curve upon itself. But its strength is not impaired. If catgut is boiled in water without having been put through a special process, it is cooked and rendered useless for surgical purposes. In order to be used for ligatures and suture material, the catgut must be made aseptic and pliable.

Catgut is used in two forms, either as aseptic or antiseptic. The first form is simply rendered sterile, while the second is permeated with some antiseptic agent, such as iodine, carbolic acid, chromic acid, etc.

The aseptic catgut is used either dry or moist. The dry form is softened in the tissues, swells and acts as a culture medium for bacteria. Because of this fact the dry form of catgut must not be used to suture the skin or mucous membranes. The germs that are not removed from the skin find this aseptic catgut a more suitable pabulum on which to multiply than the wound secretion. This gives rise to stitch abscesses. Aseptic catgut has no germicidal power, while the blood serum has a very marked action in that direction, as have also the living tissues. Aseptic catgut is more suitable for tying blood vessels that are situated deeply in the tissues where bacteria are not found normally. If, however, a large amount of catgut is placed deeply in these tissues, infection is quite likely to occur. Inasmuch as sterile or aseptic catgut has no advantage over antiseptic catgut, and has many disadvantages, it has practically been discarded, especially in operations for the cure of hernia.

There is another reason why aseptic catgut cannot be used in hernia operations, and that is because it is absorbed in too short a time, before granulation tissue has become thoroughly organized, when the structures yield readily to intra-abdominal pressure and relapse of the hernia is favored.

Antiseptic catgut may be prepared in a manner that either will hasten or retard its absorption. Carbolized catgut remains antiseptic in the tissues for only a short time. As soon as the carbolic acid is eliminated from the catgut, the latter is converted into an aseptic catgut, and possesses the same properties and disadvantages as does aseptic catgut. The same is true of catgut that has been sterilized with bichloride of mercury and certain other agents.

The best catgut is that which has been prepared by the formalin method. It becomes very hard and can be boiled safely without being cooked. This is also true of chromic catgut. Catgut that has been treated with formalin and with chromic acid, a variety that I have been using for some years, does not swell in the tissues as does the plain sterile catgut, and the action of the phagocytes on it is from without inward, so that the catgut remains antiseptic while a shred of it is left. This catgut is not absorbed rapidly, and it is therefore very suitable for use in hernia operations. Even the

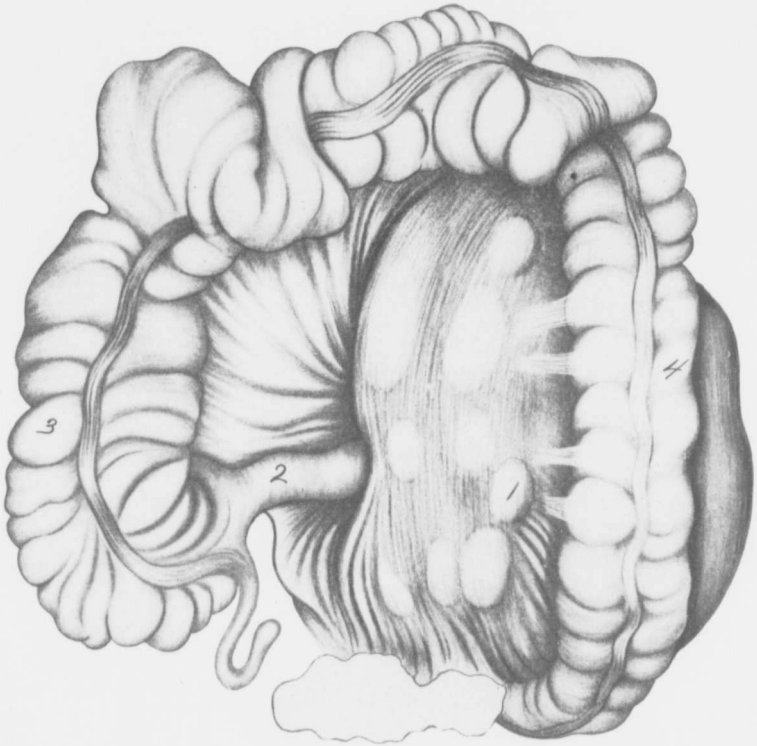

PLATE VIII.

Posterior Hernia through Duodeno-jejunal Fossa.

Transactions of the Society (Pathological) of London, Vol. II.

1. Sac of the hernia situated behind the folds of the meso-colon. 2. The lower portion of the ileum, passing out of the hernial sac. 3. The caput coli. 4. The displaced portion of the transverse colon.

finest strand of formalin-chromic catgut does not become absorbed before the expiration of twelve or fourteen days. No. 6 catgut is not absorbed until the expiration of six months. Nos. 1 and 2 are absorbed inside of three or four weeks, just the time required in hernia work. Chromic catgut, because of its greater strength, can be used in smaller sizes. I prefer to use sizes No. 00, 0, 1 and 2.

Iodine catgut and pyoktannin catgut are also used, in fact preferred, by some operators, but this catgut, like that prepared according to the cumol and abolene method, becomes aseptic when the agent used is abstracted from the catgut by the tissue fluids. For some purposes the iodine and pyoktannin catguts are very useful because of the color.

The fine catgut that is prepared by the formalin-chromic acid process may be made so antiseptic that it can be used for suturing the skin and mucous membranes with impunity, because before absorption of this very hard material can take place the time for its removal has passed.

There is no operation for hernia of any kind in which catgut cannot be used without danger of infection, but it is not the most suitable material to use for coapting the skin wound.

2. *Tendons.*—The tendons that are used in surgical work are derived from the kangaroo, the deer and the ox. Tendon has one very great advantage that is not possessed by catgut—viz., when it is removed from the body it is sterile. If, however, the tendons are not properly cared for immediately after their removal from the body, or if they are not removed from the body before decomposition takes place, they may be found loaded with germs.

Because of these accidents which may render tendon septic, it is advisable to asepticize it by the use of chemicals, such as alcohol, carbolic acid, corrosive sublimate, etc.

Tendon has another advantage over catgut, and a very valuable one at that, in that it is not readily absorbed, so that it does not require hardening or any special preparation with formalin, or some other substance; nor does it require boiling. The natural asepticity of tendon, its durability in the tissues, and the readiness with which it can be split up into small and large threads, makes it a very suitable material for suturing together the deep structures in hernia operations. To H. O. Marcy, of Boston, may be given the credit of championing this material.

II. NON-ABSORBABLE SUTURES.

1. *Wire.*—Wire sutures possess some advantages that make them very useful for certain kinds of work, but, all things considered, they do not take the place of either catgut or tendon. Wire is easily made aseptic. It is pliable, especially the silver wire, and it is not affected by the tissue fluids. Aluminum bronze wire is better than silver wire, because it possesses greater tensile strength. It does not break or kink as readily as does silver. The only objection to gold wire is its cost.

Silver wire was at one time used very freely as a buried suture. It does not cause any irritation of the tissues and in the passive tissues of the body, such as bone, it remains for an indefinite period without causing any

disturbance whatever. It is still used extensively for wiring bones. Experience has shown that silver wire when used in hernia operations will work its way out to beneath the skin, necessitating its removal. This does not occur until months or sometimes years after it has been placed in the tissues, but this property makes the use of the wire decidedly objectionable. Many cases have been reported where the wire was removed as long as fifteen years after its insertion. If wire is used at all in operations for the cure of hernia, it should be according to the method described by M. L. Harris. This method makes it possible to remove the wire after it has fulfilled the purpose for which it was intended.

2. *Silkworm Gut.*—This is obtained from the silkworm in the larva stage. It is small and strong, smooth and hard. It is sufficiently pliable to stand the tying. It does not harbor germs in its interstices to any marked degree, and does not readily carry germs to the deeper structures. It is easily sterilized, and withstands repeated boilings. It must not be used as a buried suture, however, experience having shown that it causes irritation not unlike that produced by wire. This is followed by suppuration, necessitating the removal of the material. Silkworm gut is very suitable for suturing skin wounds. If found necessary for suturing the deeper structures it should be used according to the method recommended by Charles A. Davison, so that it can be removed after the tissues have united. Although silkworm gut is not elastic, it accommodates itself very nicely to the shape and form of the tissues. It is sterilized by steam or boiling water for half an hour, and is then preserved in suitable vessels.

Lockwood doubts its ready sterilization by one boiling, having found it septic in two cases out of thirty-seven instances after it had been boiled for twenty minutes. If silkworm gut is boiled with soda it is softened, and its tensile strength is lessened. Inasmuch as Lockwood's observation is no doubt true, it is better to sterilize silkworm gut by the fractional method. Whenever hernial wounds have to be drained, several strands of sterilized silkworm gut can be used advantageously.

3. *Horsehair.* This material is obtained from the manes and tails of horses. It is smooth, elastic, and resilient. It is easily rendered aseptic and is only slightly absorbable. It is very suitable material for coapting skin wounds. It can be rendered aseptic without boiling. Boiling destroys the elasticity of the hair more or less, and makes it very brittle. In order to render it absolutely aseptic, it ought to be sterilized by the fractional method, but this process destroys the hair and unfits it for use as a suture material. Hair is the only material that nature allows to pass through the skin with impunity. This is its normal habitat, and consequently the hair does not cause any irritation. That is probably the reason why hair, though not absolutely aseptic, can be used very freely as a superficial suture without causing any infection. It is not suitable for buried sutures. Another point in its favor is that even when it is tied too tightly, it accommodates itself readily to the wound by stretching and thus does not cause the local necrosis which occurs so often when silkworm gut, wire or other suture material is used.

Horsehair is prepared by first immersing it in a four per cent. boiling soda solution, which removes grease and other foreign substances. After being brushed and washed it is boiled for fifteen minutes, and is then kept in a weak solution of carbolic acid, 1-20, or bichloride, 1-1000. Horsehair is also prepared by putting it through the same process as that used for disinfecting the hands and then preserving it in alcohol.

4. *Silk.* Silk is employed in the form of twisted or braided silk. The varieties of twisted silk used are ordinary surgical silk, cable twisted silk, and saddler's silk. Surgical silk is used in sizes from No. 00 to No. 14, and in color is either white or iron dyed, the advantage of the latter being its easy detection when deeply embedded in the tissues.

Cable silk, or Tait's silk, is more easily manipulated, is of firmer texture, and is less liable to slip when knotted than ordinary silk on account of the animal matter left in its meshes by the worm during the spinning process.

Saddler's silk, except for its cheapness, possesses absolutely no advantages over surgical or cable silk.

Braided silk is prepared by braiding together several strands of twisted silk. It is very strong and has no tendency to kink.

Silk is very strong and pliable, and the smaller sizes of it are disintegrated by phagocytic action. The small particles are carried to different parts of the surrounding tissues, where they become encysted. Applied to the more passive structures, such as tendons and fascia, silk nearly always becomes encysted. The objection to it as a buried suture is that it is a foreign body, hence predisposes to suppuration.

Of all the suture materials used, silk follows the needle with the least amount of traumatism; but it is non-absorbable, and is likely to carry bacteria in its wake. In my opinion, it should not be used as a buried suture in any hernia operation. If its use is imperative from lack of choice, the smallest size possible should be selected. Clinical surgery is replete with so many instances of secondary suppuration following the use of buried silk in hernia operations that it is practically discarded, although a few noted surgeons still use it.

5. *Linen Thread.*—Linen thread is a substitute for silk, but should be used only in an emergency. The same objections pertain to it as to silk, even more so, because it is coarser and more easily absorbs germs in its meshes. It also breaks more easily. If linen thread must be used for ligature material, the smallest size possible should be chosen.

6. *Celluloid Thread.*—In the absence of catgut and tendon the celluloid thread, or Pagenstecher's thread, may be used. It has the advantage over silk and linen in that it is coated with celluloid and consequently is less absorbent. It is impermeable to fluids. Like silk, it is easily manipulated, and is readily sterilized. It is stronger than silk and also is more durable. While it will stand a few boilings, frequent repetitions of the boiling will disintegrate the thread. It should not be used in operations for the radical cure of hernia. Only catgut or tendon should be employed. The celluloidin thread is used to some extent in intestinal surgery.

CHAPTER V.

THE CHICAGO HOSPITAL OPERATING ROOM TECHNIC (FERGUSON).

Head Nurse.—The head nurse is the surgical nurse. She has charge of the operating room, the daily work and instruction of the three nurses under her, and during operations handles the instruments, and must wear gloves. She prohibits visitors running in and out; and no lounging, coughing, laughing, talking, whistling or singing at any time is allowed in aseptic quarters. The head nurse is responsible also for the personal toilet of the nurses.

Second Nurse, Daily Work.—Order drugs, muslin, gauze and cotton. Keep front operating room in order. Keep clean labels on bottles. Work quietly.

Before Operation.—Scrub up; assemble materials; have in place surgeon's gowns, visitors' gowns, rubber goods, caps and brushes. Help set operating room, and keep surgically clean by covering all breaks in the antiseptic chain.

During Operation.—Help fill basins, solutions and percolators. Keep solutions proper temperature. Help scrub patient. Keep clean.

After Operation.—Ventilate rooms. Clean rubber goods, brushes, and help with instruments.

Third Nurse, Daily Work.—Keep back operating room in order. Sterilizers and sterilized. Fill boric and carbolic buckets. Boil soap, brushes, and nail files.

Before Operation.—Scrub up. Set anesthetizer's tray; help with operating room. Keep clean.

During Operation.—Help fill basins; place sponges. Take binder off. Help with stirrups.

After Operation.—Pick up soiled linen and help with basins.

Fourth Nurse, Daily Work.—Order soap (laundry and toilet), candles, soda, sapolio, razors, matches, toothpicks. Keep preparatory room in order, and sinks clean. Sterilizers and surgeon's bathroom, dressing chute, supply closet, cart, and wind clock. Keep quiet.

Before Operation.—Scrub up. Wash furniture with 5 per cent. carbolic. Tie door-knobs with gauze wet with bichloride. Fill glasses with green soap (sterile), and put in place. Help set operating room. Keep clean; help to gown operator and assistants aseptically.

During Operation.—Wear gloves. Sponge when needed. When not sponging, keep faces clean. Help fill solutions. Count sponges carefully and count again when finished. Disgown operator.

After Operation.—Assist in putting on dressings, changing gown, getting in cart, blankets over patients. Go to room with patient, taking towels, wet gown and record. See that porter comes to mop. Pick up dressings, and clean basins. After each operation all basins are sterilized by live steam for two hours under high pressure, and when used in septic cases 1 in 20 carbolic acid solution as well, and kept in canvas bags.

CARE OF OPERATING ROOMS.

Porter.—Cleans floors after each operation. Every morning before operations the floors and furniture are mopped with carbolic acid (5 per cent.). The walls are washed with soap and water and then with carbolic acid solution (5 per cent.) or bichloride solution (1 to 500), at least once a week. After a pus case the operating room is immediately fumigated with formaldehyde for twelve to twenty-four hours. Once in three months the walls are repainted. All the windows are closely screened and kept clean.

After pus cases instruments are boiled twenty minutes, allowed to stand twenty-four hours, and boiled again. This is done three times, allowing twenty-four hours' interval each time. A shorter method is to scrub the instruments in lysol solution until they are thoroughly freed from pus, blood, etc., then submerged in 95 per cent. carbolic acid for five minutes, and transferred directly to the 2 per cent. soda solution, in which they are boiled for twenty minutes. The instruments are then finally dried, polished and returned to the instrument case.

For Sterilizing Horsehair.—Ten minutes in ether; 10 minutes in alcohol; 10 minutes in bichloride. Then allow to stand in alcohol. Boil silkworm gut and wire with instruments, after being autoclaved or sterilized fractionally by boiling in sealed glass tubes (chromic, Nos. 00, 0, 1, 2, from dealers).

All catgut is to be boiled forty-five minutes before using. (This is chromic or formalin chromic catgut that is bought in sealed glass tubes.)

Iodoform Emulsion.—Ten parts sterile glycerine, 1 part sterile iodoform. (Supply always on hand.)

Iodoform Gauze.—Glycerine, sterilized, oz. 2; iodoform powder, oz. 2; alcohol, oz. 2; green soap solution, oz. 2.

Things necessary for making: Two sterile basins, 1 for hand solutions, 1 for iodoform powder; 1 sterile medicine glass; 1 sterile sheet; sterile plain gauze. When finished, sterilize twenty minutes at fifteen pounds pressure, then put in sterile jars.

Normal salt for filling flasks for transfusion: Dissolve 8 tablets (in one bottle) in small amount of water; filter through sterile cotton into sterile flask, which holds one quart; sterilize in autoclave at high pressure (fifteen pounds), for one hour. (1,000 cc. flasks always ready.)

Normal salt in bulk: Dissolve 8 tablets to each mark on normal salt bottle; filter through sterile cotton, after boiling, into sterile bottle. Add enough sterile water to fill bottle. Sterilize in autoclave at high pressure for one hour.

Carbolic, 5 per cent. in bulk: Take 12 ounces of 95 per cent. carbolic,

add 2 ounces of 95 per cent. alcohol, boil with small amount of water. Add enough sterile water to make two gallons.

Carbolic, 95 per cent., in bulk: Add 5 per cent. of water to carbolic crystals, take cork out of can, place can in pail of water and boil until liquid, or liquefy the crystals first in a water-bath and add the 5 per cent. water afterwards.

One to 500 bichloride, in bulk: Dissolve 600 grains bichloride powder in a small amount of water, add to make 4½ gallons. Add enough picric acid to give a distinct color.

Harrington's Solution: Commercial alcohol (94 per cent.), 640 c. c.; hydrochloric acid, 60 c. c.; water, 300 c. c.; corrosive sublimate, 0.8 grams.

Saturated Solution of Boric Acid (in bulk): Place boric crystals in gauze, then in pail or jar. Pour in hot water. Allow to stand and dissolve as much as possible, keeping more crystals in pail than possible to dissolve. Strain and boil before filling percolators.

Green Soap Solution (in bulk): Take ¼ ounce of hard green soap to one-half gallon of water and boil.

Sterilized Gauze: Measure five yard lengths of 18 pieces at a time; loosely roll and place in sterile sheet, and sterilize in autoclave at high pressure (fifteen pounds) for two hours. Then cut for dressings or for surgical jars, after which each must be sterilized in autoclave for one hour. Sponges and drawn gauze are sterilized by the same process as above. All the sheets are loosely rolled and autoclaved for at least one hour. The same sterilization is done with glass jars loosely filled with cut gauze.

Sponges are kept in 5 per cent. carbolic before using, are washed by gloved nurse in sterile water, and then boiled twenty minutes. All articles, glass parts, catheters, rubber tissue, etc., kept in glass jars in solution of saturated boric acid, except silk (95 per cent. alcohol), and again boiled before using.

Brushes, when gotten out of sterilized jars, are kept in bichloride, as are also the catgut tubes.

Floor laparotomy sets contain one large piece and two small pieces of combination dressing, inclosed in a cotton cloth cover.

Operating room laparotomy set in cloth cover contains 15 safety pins in a string, laparotomy binder, perineal straps, 2 large pieces of combination dressing (cotton and gauze), sterile gauze packages, one dozen in each, supplied separately.

Floor dressing set contains one large piece of combination cut into three pieces. Gauze in separate packages.

Operating room set contains in cover one binder, two pieces of combination, 15 safety pins.

All specimens must be plainly marked with patient's name, floor, number of room, and doctor's name. Put in 4 per cent. formalin, sealed, and taken to laboratory without delay. Head surgical nurse responsible for specimens.

Each full set of basins in a sterile bag contains: Hand solution basins, 7 for racks, 4 smaller, 1 specimen, 2 small for instrument table, 1 pitcher; 15 pieces.

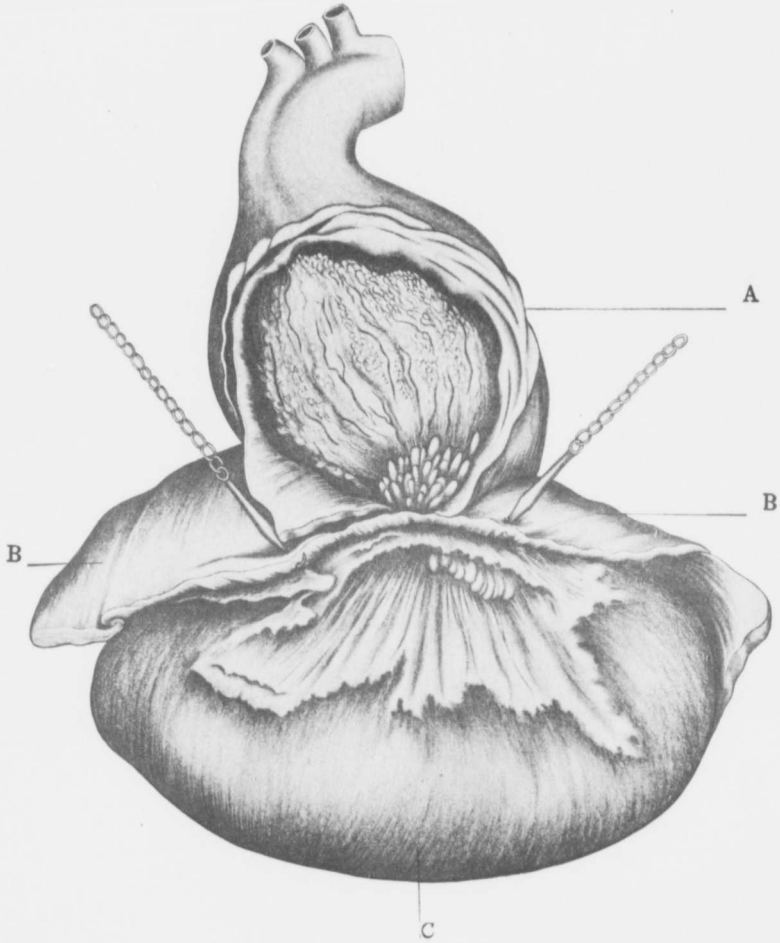

PLATE IX.

Pericardial Diaphragmatic Hernia of the Omentum.

Transactions of the Pathological Society of London. (M. Murrant Baker.)

A. Pericardium laid open and reflected so as to expose the omentum, which covers the front and sides of the heart. B. The diaphragm. C. The stomach.

Odds and ends in a sterile bag: Four pitchers; 2 long basins, one for alcohol, for needles, knives, etc., and one for carbolic, for sterilizing cutting instruments, needles, etc.; 2 small round basins; 2 hand solution basins; 1 pus basin; 1 small basin, for Harrington's solution for hands; 14 pieces.

SERVICE STAFF—NIGHT SUPERINTENDENT.

Has charge of office; answers telephone, bell calls, makes three rounds of all the floors; posts operations for following day; instructs night nurse in operating room; reports births and deaths to Superintendent at once; looks after the comfort of relatives and friends; assembles emergency supplies, and takes charge of the operating room when emergency cases are admitted for operation. While in the operating room, the head nurse on the second floor takes charge of the office. The entire hospital is kept in readiness for any kind of professional work by night as well as by day.

NIGHT SURGICAL NURSE.

Stays in preparation room between the two operating rooms all night. In emergency work puts the room in order, boils instruments, prepares solutions, etc., etc.; in brief, assumes the functions of the day surgical nurses. Her chief function outside of the above is to prepare gauze and sterilize in autoclave or boil (fractional method) all materials used in operations. Usually both methods of sterilization are simultaneously carried out. She also assists the internes when night dressings of wounds are imperative, or transfusions are made.

Operator and assistants appear in sterile clothing from cap to shoes.

Fifteen Minute Method.—Scrub up with sterile brushes and sterile soap for ten minutes, changing nail brushes two or three times, and using running sterile water. The nail files are sterile and must be used before the final scrub. The hands are then scrubbed in alcohol, 70 per cent., and lysol (℥i to ℥j), or bichloride solution (1 to 2,000) consuming five minutes with the antiseptics. Then sterile rubber gloves are filled with lysol solution and pulled on. This antiseptic permeates the skin of the hands while thus gloved, acting as a continuous antiseptic, and should a glove be injured there is no danger of infecting the wound from this source. Instead of the alcohol, lysol or bichloride, the Harrington solution is preferable.

Ten Minute Method.—(a) Scrub up with soap and water for eight minutes; (b) scrub hands in Harrington's solution for two minutes. Ready for operating with or without gloves.

Four Minute Method.—Two minutes with ether, using (a) brush for one minute; (b) gauze for one minute. Two minutes with Harrington's solution.

In five minutes the surgeon can render his hands and operative field practically aseptic: Ether on hands, one minute; ether on hands and field of operation simultaneously for two minutes, and then Harrington's solution simultaneously for two minutes.

Rubber gloves are used by the operator (Ferguson) in 70 per cent. of cases; by his assistant internes and nurses in all cases in which contact infection is possible.

CHAPTER VI.

INDICATIONS FOR OPERATION.

OBLIQUE INGUINAL HERNIA.

Any person afflicted with an inguinal hernia is a surgical case, but the mere presence of such a hernia does not invariably and indiscriminately demand an operation. The general health of the patient, his age, occupation, obesity and various other conditions must be taken into consideration.

General Health.—The presence of a hernia sometimes detrimentally affects the general health of a child or of a youth. Because of fear of injury, chafing of the truss, pain or strangulation of the rupture, the afflicted one is not able to participate fully in the exercises, plays and out-of-door sports so essential to good health and natural development. I have frequently observed a delicate boy, handicapped in almost every muscular movement, undergo a remarkable change in health and habits soon after his rupture was cured, becoming a ruddy, romping, muscular fellow.

Age.—In infants an operation is indicated: (a) When the hernia is very large (colossal) and constantly increasing in size. If an early operation is not performed the abdominal cavity is liable, in time, to become too small to hold the hernial contents with comfort. (b) If strangulation occurs. (c) Should the hernia be a source of continual annoyance, and not readily controlled by pressure, it is not in the best interests of the hernial area, nor beneficial to the general health and development of the child, to defer operation until he begins to walk. Mechanical appliances have a wide range of usefulness from birth until the time the child begins to walk. A large percentage of cases are spontaneously cured with gentle support to the hernial protrusion during this age.

Weak and undeveloped children bear the operation of radical cure badly. When surgical interference is acceded to, precautions should be taken against contagious and infectious diseases. Children reduced in flesh by diarrhea or other diseases should be attacked cautiously with the knife. When a child begins to run about and still has a congenital or an acquired hernia, as a rule I advise an operation. There is no valid reason for delaying the operation until the school age is reached. Damage to the testicle may be initiated by procrastination. In consideration of the minimum risk to life, and the maximum good results ensured by the radical cure for inguinal hernia, there is no age at which it cannot be safely offered as a remedy.

All hernias of the inguinal variety in both sexes between two and forty or fifty years of age should be cured by operation, if circumstances and

physical conditions permit of it. No young man or woman is doing justice to his or her development and health by nursing a rupture during school and college life, let alone the many risks incidentally encountered on the playground and campus.

The wearing of a truss produces atrophy of the muscular and aponeurotic structures in the hernial region. It is the rule for hernias to become more and more unmanageable on account of the thinning out and destruction of tissue thus caused. Those who wear trusses are likely, sooner or later, to ask for surgical relief, either on account of the inefficiency of one truss after another, or owing to the increasing size of the hernia, and the tenderness at the seat of the rupture. Active young boys and girls and able-bodied men and women should be advised to submit to the operative treatment even when a truss is worn without comfort and efficiency, because after a time the rupture, in the vast majority of cases, will enlarge and become rebellious to a truss.

Men between fifty and seventy years of age, or older, depending on their physical condition, need no longer hesitate to undergo an operation for rupture, providing their vital organs are normal. It is occasionally admissible to perform the radical operation for hernia at the same time that a prostate is being removed, and such double operations as herniotomy and appendectomy; herniotomy and salpingectomy; herniotomy and hysterectomy, etc., through the same incision, are not uncommon in my practice.

In operative procedures generally the routine of the operation should be done rapidly; in fact, almost automatically, while one should "hasten slowly" when handling and dealing with the most important structures. It must be remembered, however, that it is worse to be criminally rapid than to be criminally slow. Be speedy at common technic and even tedious, if need be, for safety.

Occupation.—The more laborious the occupation of the ruptured, the more advisable it is to recommend an operation. Let them live, and live in bodily comfort. The exertions at toil or sports increase intra-abdominal pressure and force a rupture, inevitably, to increase in size. Considering the extensive clinical services now universally afforded to the public, no person, be he ever so poor, need continue to be partly or completely disabled by a hernia. The well-to-do and wealthy classes can well afford to be surely and safely relieved of their hernial afflictions. It is not many years ago that an operation for the radical cure of hernia was accompanied by many dangers, complications, relapses and fatalities. It is a proud achievement of surgery to chronicle that now deaths are less than one-quarter of one per cent., complications seldom occur, and relapses are exceedingly rare.

It is not uncommon for men in middle life, who are the subjects of one or two inguinal hernias, to present themselves for advice. Let us say that they are small, reducible, and controllable hernias, with but slight inconvenience resulting from the wearing of a truss, and that their work is not muscularly laborious, and the dangers of strangulation are guarded

against as much as possible. It must be remembered that no person who is wearing a truss is free from danger, for any extra exertion, as lifting, running to catch a car, jumping off and on conveyances, and a thousand other ways that could be mentioned, is liable to pop the rupture by the truss and strangulation occurs, probably for the first time. In consideration of this one fact, it is safer for such mildly herniated cases to spend a vacation in a hospital for two or three weeks in obtaining a cure, than to run the risks associated with an ocean voyage, a railroad journey across the continent or a hunting and fishing trip into the wilderness. Men occupied in the public service, especially in the army and navy, in whom an inguinal hernia develops, should be operated on without delay. It is certain that these acquired ruptures occur in men whose inguinal regions are congenitally deficient and weak. This predisposition being present, the exciting cause is furnished by the fatigue and labor inseparable from their calling in life. In this connection it would be interesting to ascertain how many old soldiers and sailors receive a pension solely on account of the presence of a hernia. Great care should be exercised in the physical examination of applicants for the army and navy, and also for life and accident insurance. The indication for operation on these individuals, when a hernia is found, has been generally conceded. Some insurance companies, to their discredit, have been lax in this regard.

Obesity.—The fact that a person is obese does not necessarily debar him or her from the benefits of an operation for hernia, but it does call for an early operation and a master hand. They are, of course, more difficult to operate on than those who are spare or muscular. In the first place, they usually take any anesthetic badly, and especially so when they are placed in the Trendelenburg position, which is often necessary to keep the bowels and great omentum well away from the field of operation. Owing to the amount of superimposed fat, a longer incision than usual is also required, in order to expose the aponeurotic and muscular structures. On exposing the internal ring, sac and cord, redundant fat is often found everywhere, sometimes in rolls. The sac itself may be fatty or have fat on, along or around it, making it difficult to differentiate the sac or suture it or tie it off. Fatty degeneration of the aponeurosis of the external and internal oblique muscles, and of the conjoined tendon, may be marked, which makes the structures more delicate and friable than usual. The fatty degeneration just mentioned does not exist so markedly in a man of active habits as it does in one who is sedentary.

This brings up the question of preparation for operation for hernia on the inactive obese. It is wise to reduce the flesh by exercise and proper diet, whenever circumstances and local conditions permit such a reduction. Let the patient eat less, walk, run or work more than usual. If he is a beer drinker, exclude the beer. In behalf of surgeons in general, and especially in the interests of the patient, I am constrained to advise the novice in surgery not to speak lightly of obesity in connection with the radical operation, or even to undertake the operation. The amount of fat to be removed; the proper coaptation of the structures to ensure the success of the opera-

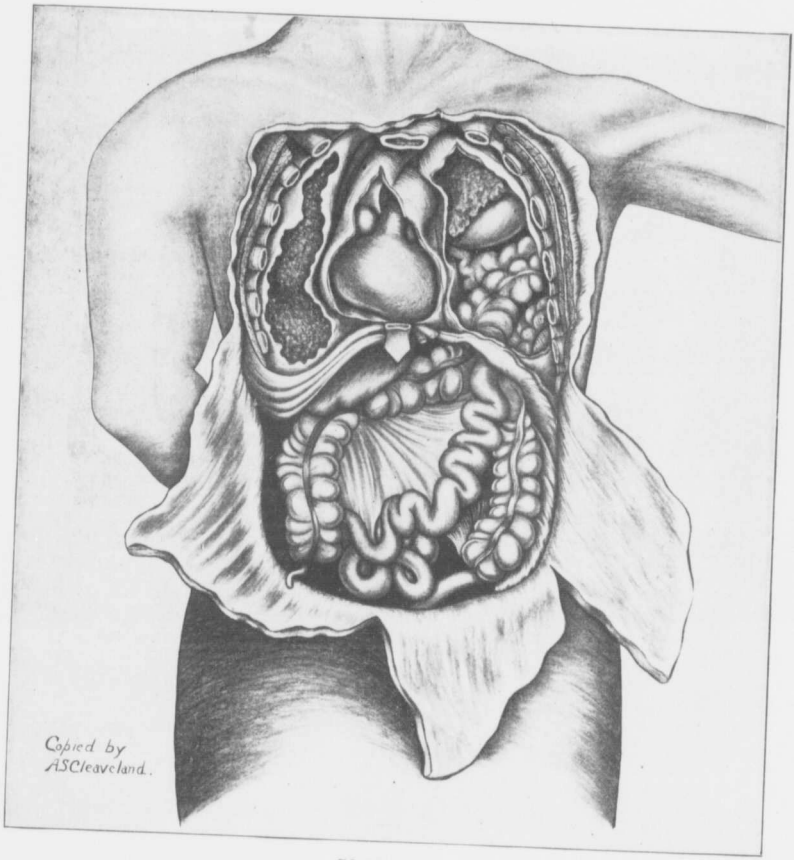

PLATE X.

Diaphragmatic Hernia.
(Peacock's Case.)
Transactions Pathological Society of London.

tion; the prevention of dead spaces; the final suturing; when and when not to drain; the application of a suitable dressing and the after-treatment all demand and tax the experience, skill and dexterity of a master surgeon. A doctor is not a surgeon and only becomes one by having a natural aptness for surgery, and by acquiring a painstaking application of his endowments. He must learn and have at his command a full and complete knowledge of all of the macro- and microscopic conditions demanding operation. He must then learn how to cut well, clamp nicely, tie quickly and safely, mop at the right time, and sew not too loosely, not too tightly, but just right. In surgery experience never teaches fools. I have seen the "would be" surgeons guilty of the same errors even when pointed out again, again and again, *ad infinitum*.

Conditions.—There are many conditions of an oblique hernia that demand operation without delay. These will be taken up more fully later on in this work. In the meantime it is well to enumerate them, as follows:

1. Unmanageableness.
2. Irreducibility.
3. Inflammation.
4. Incarceration.
5. Strangulation.
6. Rupture by a blow or fall.

In regard to the size of the hernia, I must say that sometimes a small, troublesome one is more dangerous than a large, quiet one. Quiet is a good adjective when the hernia is easily reducible and immediately returns, lying calmly in the scrotum without any pain whatever. The very large hernias, those extending down on the thigh to near the knee, are usually classed as inoperable. We sometimes are obliged to operate on them when they become strangulated, and then we succeed in curing the hernia. An experienced, expert operator very seldom refuses to operate on account of the large size of the rupture, even though it is incarcerated.

Cryptorchidism.—In *retentio inguinalis testis* a hernia is always present, and it ought to be cured by operation. When the testicle is retained within the abdomen surgeons differ as to whether or not an attempt should be made to bring the organ down into the scrotum, even though a hernia is not present. In my own experience, a congenital deficiency in the inguinal region has always been present in the cryptorchid, hence I have not hesitated to enter this region, bring the testicle to its normal position, and cure the hernia, even though it may have been of small size.

It is in this connection that I make use of the Fowler operation for oblique inguinal hernia, with the exception of incising the peritoneum behind the cord. The peritoneum is dissected away from the transversalis fascia and sutured, or tied separately. This allows the vas deferens a shorter route than normal between the seminal vesicles and the testes.

It must be recognized that heretofore operations on the non-descended testicle have not been very satisfactory. Failures in bringing down the testicle were frequent and about fifty per cent. of the hernias relapsed, consequently surgeons avoided the operation. Now that plastic procedures

can be used to strengthen this congenitally weak region, recurrences are exceedingly rare. No relapse has occurred in any cases of hernia complicated with cryptorchidism on which I have operated in the past seven years.

DIRECT INGUINAL HERNIA.

The indications for operating on a direct inguinal hernia are practically the same as those given for the oblique variety, but inasmuch as a truss does not well retain this form of hernia, the sooner the operation is performed the better. A congenitally weak Hesselbach's triangle is weakened still more by the application of a truss, and when this condition is permitted to exist for years the conjoined tendon becomes obliterated almost entirely. In order that this region may be strengthened, the surrounding structures are made use of, such as the rectus muscle on the one side or the sartorius muscle on the other.

UMBILICAL HERNIA.

Umbilical hernia in children under two or three years of age is often practically cured by the application of a pad or truss. If, at any time, the hernia becomes unmanageable, there is no valid reason for delaying operation. If the operation is not performed early in these cases, the diastasis of the recti muscles constantly increases, and when the operation finally is undertaken it is a much more radical and grave procedure.

The radical cure of a small umbilical hernia is a very simple procedure, consisting merely of the removal of the umbilicus, an omphalectomy, and splitting the sheaths of the two recti muscles, obliterating the linea alba above and below the umbilicus.

No umbilical hernia should be allowed to become incarcerated. Just as soon as it is irreducible, whether the hernia is small or large, operation should be advised. All active young persons the subjects of an umbilical hernia should be operated on at the earliest possible moment.

Women who are bearing children and who have an umbilical hernia, even a large one, need not be operated on until the child-bearing period is passed, provided the hernia does not give rise to any dangerous symptoms. Umbilical hernias giving rise to pain, intestinal disturbance or symptoms of strangulation should be operated on without delay. Since the overlapping operation of Mayo and Blake, and modifications of these operations, have been devised, excellent results are obtained. Even obesity is not a contra-indication to operation for umbilical hernia. A large amount of the abdominal fat may be removed at the same time and the patient thus made more comfortable and placed in better physical condition.

Hernia into the umbilical cord (funicular hernia) is of very rare occurrence, the author having seen only one case. It should be operated on at once, because the child will surely die if operation is not done.

Supra- sub- and para-umbilical hernias when small may be cured without removing the navel.

FEMORAL HERNIA.

Of all the hernias of the anterior abdominal wall, the femoral or crural hernia is the most dangerous because of its tendency to become strangulated. A femoral hernia is not easily controlled by any form of truss or mechanical device. It usually slips from under the truss several times a day until the patient becomes discouraged, leaves off the truss, and perhaps the very next day the hernia becomes strangulated. Therefore, on account of the clinical history of femoral hernia, operation should be advised in every instance.

VENTRAL HERNIA.

Ventral hernia, in mid-line, below the umbilicus, almost invariably follows an abdominal section or an operation on the bladder. These hernias should be operated on as soon as they are detected. If possible, it is better to remove the entire old scar tissue, split the sheaths of the recti muscles and bring like-to-like structures in careful approximation.

In this region there are so many ways in which material can be used to strengthen the abdominal wall that the surgeon need have no hesitation in recommending operation. Inasmuch as adhesions between the great omentum and the abdominal scar are always present, care should be taken not to denude the peritoneal surface in dealing with them. It is here that Downes' electro-thermo-cautery is of great value. A strip of tissue is cooked and severed in its center and both the proximal and the distal stumps are allowed to drop back into the abdominal cavity, without the fear of adhesions forming later on. However, a practical surgeon can always cover over any raw surfaces so as to prevent these adhesions from again forming. It is rare for a ventral hernia to develop in the linea alba below the umbilicus, but when it does arise, operation is the only means of cure.

Ventral hernias through the recti muscles are very rare. They always follow a trauma. These hernias are cured easily and there is no contra-indication to operation. Hernias following gall-bladder and stomach operations are seldom encountered.

HERNIAS FOLLOWING APPENDECTOMY.

These hernias sometimes are very difficult to handle on the operating table. Unless the patient is in a condition to stand a prolonged anesthesia, of an hour's duration at least, he should not be operated on unless an operation is demanded because of the existence of strangulation of the bowel. In a case operated recently by the author the chief indication for operation was pain extending down to the testicle. At the operation it was found that the cecum, the ascending colon and several loops of small intestine and some omentum were adherent to the ureter, kidney, liver, gall bladder and stomach.

EPIGASTRIC HERNIA.

These hernias are usually quite small and consist of fat, although occasionally a small knuckle of stomach or bowel is found in the hernial sac. If they give rise to any considerable inconvenience, they should be treated

surgically. It is very seldom that the transverse colon, omentum or stomach form the contents of the hernial sac, except when the protrusion is immediately above the umbilicus.

OBTURATOR, ISCHIATIC AND PERINEAL HERNIAS.

(Downward Hernias.)

So far as indication for operation is concerned in the case of these hernias, they are the same as those given for the internal hernias, diaphragmatic hernia, hernia through the foramen of Winslow (foraminal), through the jejunal fossa, the sigmoid fossa and through the ileo-cecal fossa. The usual indication for operation in all these forms of hernia is the appearance of symptoms of partial or complete obstruction of the bowel. The abdomen should be opened without delay, the obstruction sought and the condition rectified.

A few cases of obturator hernia have been diagnosed before operation and cured without an abdominal section by cutting down on the femoral region, going through the pectineus muscle, reaching the hernia in that way and producing reposition of the bowel.

DIAPHRAGMATIC HERNIA.

Diaphragmatic hernia, the acquired variety, produces symptoms referable to the thoracic cavity, which makes the diagnosis comparatively easy. An operation should be performed without delay in all these cases, provided there is not a marked contra-indication, such as disease of the stomach, intestines, peritoneum, kidneys or heart.

Lumbar hernia is diagnosed easily, but as it does not usually cause any feeling of distress or discomfort, an operation is not urgently demanded.

VESICAL HERNIA.

The urinary bladder may protrude through Hesselbach's triangle alone or together with other abdominal viscera. An operation is always indicated in this form of hernia, provided the patient is otherwise in good health.

Hernia of the bladder into the rectum is exceedingly rare. The author has seen one case, and no case is recorded in the literature.

INTERNAL HERNIAS.

The indications for operations on hernias through the abdomen are made most clear after the abdominal cavity has been opened or a post-mortem has been performed. It is not in accord with the science of surgery to rely entirely on these two sources for reasons why an operation should be performed. It does not appeal even to the ordinary sufferer to be told that the diagnosis of his case will be made after the abdomen is opened. If we cannot make a diagnosis of these ruptures without exposing the abdominal contents to sight and subjecting them to handling, it is because of our ignorance of the multiple relationship between concealed hernia and its symptoms and signs. I must admit that our present position on this question is that too often we can only declare that our experi-

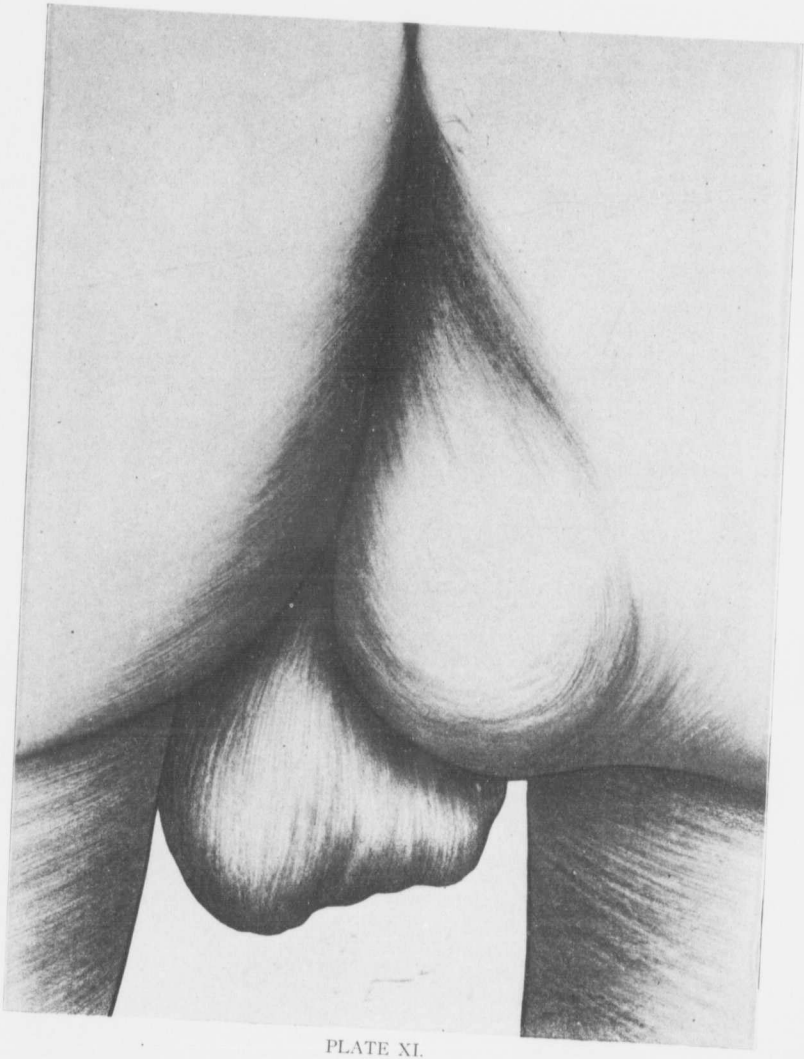

PLATE XI.

Ischiatic Hernia.

Parks' Surgery of American Authors.

ence and knowledge are too limited and scant to enable us to make a positive and accurate diagnosis; hence we advise an exploratory incision. How can it be otherwise?

The exploration of the abdominal cavity should only be recommended when by other means of investigation we have failed to clear up the case and the patient is in imminent danger of losing health, if not life, from want of surgical attention. While it is of great value to the surgeon to hold a post-mortem on a person dead of an internal hernia without an operation which should have been performed with the probability of having been discovered and cured, it is clear, however, that no benefit whatever is given to that particular patient by a study of the changes that caused his death. It is often more difficult to obtain the consent of relatives for an autopsy than it is to secure that of a sufferer for an operation. To operate on all obscure intra-abdominal conditions is more praiseworthy than to let a single person die because of failure to operate. The former may add something valuable to our knowledge and may save life, while inactivity casts a reflection on the surgeon, and on his profession, and begets lack of confidence in medicine and surgery in the minds of the general public.

When an abdomen is opened an object-lesson is at once presented, in which are found conditions that are coupled with the symptoms and signs previously complained of and manifested. If the patient recovers, the subsidence of the manifestations of the disease affords us proof of the justification of the operation. During the operative procedure the etiologic factors are caught red-handed, so to speak, and the living pathologic conditions are revealed, each stage having reflected its shadowy symptoms and signs, and the real cause is before our eyes and in our hands. Advantages are here afforded for the development of a newer pathology and the application of bacteriology. In the abdominal surgery of hernias too many instances of deaths from lack of a prompt and true interpretation of the indicia are recorded in our annals. The strategy of the surgeon has more scope in the abdominal field than elsewhere in the body, on account of the many important organs within one cavity that are interdependent in health and in disease. A bird's eye view, as it were, of the condition of the patient, and especially of the affected region and organ, must be taken by a general surgeon, or surgeon general, before he can advise wisely and act strategetically.

Pain is an important symptom in the diagnosis of intra-abdominal conditions, and is present in almost every ailment. It is increased by pressure in inflammation of any part of the body. Pressure on an over-distended gallbladder, appendix, Fallopian tube, or internal strangulated hernia, increases the pain. When it is "stitch-like" or "lancinating" in character, the peritoneum is invaded, or a cancer may be present.

What is termed "reflected" and "radiated" pain is misleading. The irritation of one branch of a sensory nerve may be referred (reflected) to another branch of the same trunk and felt at its distribution, or may be referred to all the terminations of all the branches of the main nerve.

The best illustration of a "radiated pain" is seen in connection

with the trifacial nerve. A dying or inflamed nerve pulp of a tooth in the upper jaw may cause pain to be referred to a tooth in the lower jaw, or to all the teeth in both jaws, or finally to the entire distribution of all the branches of the main nerve. In the abdomen the pain of an inflamed appendix is often referred to the whole abdomen; that caused by obstruction of a ureter to the testicle; that of an obstructed cystic duct to the back and epigastric region.

Pain produced by a stone in the pelvis of one kidney and referred to the other kidney is explained by the irritation causing congestion of the gray matter across the cord which forms a connection with the innervation of the other kidney. When a nerve trunk is primarily irritated, peripheral pain is felt of a neuralgic character, e. g., neuralgic pain in the distribution of the genito-crural, ilio-hypogastric, ilio-inguinal and anterior crural nerves, and this is indicative of pressure on or irritation of the lumbar plexus by a perinephritic abscess or a tumor of the kidney.

In suppuration the pain is "throbbing," and in superficial inflammation it is "burning" or "scalding." The older writers described no less than forty-four different kinds of pain, in accordance with the sensations expressed by various sufferers.

Pain is conspicuous in intestinal obstruction and in obscure hernias. It is caused by the trauma to the peritoneum. Peristaltic action tries to overcome the obstruction and increases the suffering. It comes and goes with irregular contractions, and is known as 'colic." The colicky pain of internal hernias when obstructed is griping, twisting or dragging in character, and is recognized by the patient to be in his bowels. During the paroxysm he describes it as "fearful." Something is felt to raise, distend and move within him, which always becomes arrested at a certain point. He knows and feels that the bowels are obstructed. A firm conviction is expressed that if flatus could be passed the pain would at once be relieved. This description is characteristic of early and incomplete obstruction, but when it becomes complete the pain abides constantly. The progress of the malady can be fairly well judged by the pain becoming more and more continuous as the obstruction increases.

In the early stages the abdomen may be thoroughly manipulated and pressed without much exaggeration of the pain. In fact, firm pressure is often grateful to the patient. The coincidence of tenderness, pyrexia and tympanites bespeaks the onset of peritonitis. A time comes toward the termination of a fatal case when the pain is markedly diminished in severity. It may mean that perforation has occurred; the sensorium has become less active; or paralysis of the intestine has come on from over-distention or peritonitis. If the bowel has ruptured, and its contents are poured into the general peritoneal cavity, great collapse is present, but when the escape is into some other part, the collapse may not be at all marked. When the pain is increased by taking food, or after an enema or a rectal examination, it shows that peristaltic movements are still capable of reflex excitation.

While in obstruction of the pylorus and large bowel the pain may be accurately located by the patient at the seat of trouble, it is not so when

the affection is in the small intestine. Distal, medial and proximal coils of small bowel which lie side by side are constantly changing position, and inasmuch as they are not supplied with special nerves, it is impossible for the patient to locate his painful sensations. When the pain of a strangulated hernia is associated with a tender and fixed spot early in the disease, depend upon it that the constriction is in bowel. But when the strangulated loop becomes inflamed and then fixed, a tender and a fixed spot is to be found. The referred initial pain in intestinal obstruction is usually in the region of the navel, which corresponds to the great nerve center of the abdomen—the solar plexus. Whether a loop of jejunum is strangulated in the duodeno-jejunal fossa, in the iliac fossa, or down deep in the pelvis, the first pains are usually referred to the umbilicus. Sometimes the early pain of obstruction of the bowel is referred to the opposite side corresponding somewhat to the inferior mesenteric plexus.

Powerful intestinal contractions may cause unbearable pain, the sufferer doubling up spasmodically and crying out. A few months ago I was called to the Chicago Hospital after midnight to operate on a strong young lady said to be suffering from obstruction of the bowels. A lady friend told her twenty-four hours previously to take a couple of ounces of cascara. She took it all in one dose, which produced a condition simulating intestinal obstruction. She was purged, of course; when I saw her she was passing some blood and mucus per anum. She was vomiting bile and the contents of the small bowel every few minutes. Both knees were drawn up. The abdominal muscles were retracted and extremely rigid. Paroxysms of pain, torturing in character, came and went concomitantly with vomiting, crying, increased muscular rigidity and straining to stool, with inability to pass flatus. At times the straining was not unlike that accompanying an abortion, and the fact that she was menstruating added to the complexity of the case. There was a constant diffuse pain in the abdomen as well. Her facial expression was that of extreme suffering during the paroxysm, but it was not anxious. The pulse, temperature, blood and urine were normal. It required chloroform during the paroxysms to relax the intestinal and abdominal contractions, in addition to large doses of morphine. The pain and spasms did not entirely cease for over three days. I stayed at her bedside for several hours, and were it not for the fact of the chloroform allaying the vomiting, muscular spasms and rectal tenesmus, and restoring mental quietude, which enabled me to make several careful examinations of the abdomen by palpation, percussion and auscultation (not neglecting to examine through the rectum and vagina), I should probably have diagnosed the case as one of intussusception or internal hernia.

Abdominal pains are often caused by extra-abdominal causes, such as those of Pott's disease, spinal diseases, malignant disease of the vertebræ, aneurysm of the thoracic aorta close to the diaphragm, and the abdominal, hepatic, gastric and renal crises of locomotor ataxia must be considered.

Colic and pain are associated with intoxications from impure ingesta, lead poisoning, uremia, morphin, etc. Hysterical abdominal pain simulates peritonitis, appendicitis, gallstones, intestinal obstruction, hernias, and many

other conditions. Pain is sometimes referred to the region of the appendix in the initial stages of pneumonia and pleurisy. In angina pectoris the pain is often felt below the ensiform cartilage. Pain arising from disease of the liver, pancreas, suprarenals, kidneys, spleen and pelvic organs is not infrequently referred to the abdomen. Osler (*Johns Hopkins Hosp. Bulletin*, July and August, 1904) has grouped certain cases as follows: 1. Those in which the colic occurs in connection with a pure angio-neurotic edema (Quincke's disease). 2. Those in which the skin lesion is simply an urticaria, and the pain supposed to be a colic may really be part of a nervous affection. 3. A class which develops arthritis with erythema, purpura and colic, defined by Henoch, and known by his name. 4. There are cases in which the lesions are multiform erythema with or without edema, associated with more or less redness and purpura. 5. A remarkable group of cases with only recurring colic.

The surgical and neurotic aspects of these conditions are worthy of serious consideration, in order to avoid a laparotomy for a case of doubtful abdominal colic.

Pain is the most common cry of distress from the outraged highest form of animate creation—man, and its meaning has been so frequently misinterpreted, especially in cases of hernia, when a diagnosis can be made only by abdominal section, that it claims the surgeon's most serious thought.

It is, of course, understood that abdominal pain of itself cannot be taken as an invariable indication to open the abdomen in these cases. Many other symptoms, as well as the signs of the condition, should be considered, such as tenderness on pressure, hyperesthesia, colic, tympany, nausea and vomiting, diarrhea, localized swelling, friction and gas sounds, increasing leucocytosis, collapse, fever, spasm, visible peristaltic action, meteorism, quantity of urine, indicanuria, and other symptoms too numerous to mention here, as well as the onset, duration and clinical behavior of the disease.

CHAPTER VII.

PREPARATION OF THE PATIENT.

Time. The time consumed for the preparation of the patient should depend on the emergency of the case and the constitutional condition of the patient. The emergencies met with in hernia cases are those which are associated with strangulation. As has been stated before, when strangulation exists the operation should be done at once, irrespective of whether or not the patient can be prepared properly. In the vast majority of cases twenty-four hours is sufficient time for proper preparation. When two or three days are required, it is to counteract some constitutional condition.

Diet and Drink. In robust and healthy men and women, the diet should be restricted for a few days before operation. A liquid diet is best and stimulants must be prohibited absolutely. If the patient has been in the habit of taking stimulants, sufficient time should elapse for the elimination of the alcohol. It is better to operate when the circulatory system of the patient is filled with water.

If the kidneys are not functionating properly, if the amount of urine excreted is scanty, or abundant, the amount of liquids ingested should be regulated accordingly.

Purgation. There should be neither too much nor too little purgation. When the patient is purged too much, the system is depleted too rapidly, and the endurance is lessened materially. When there is not enough purging done, the alimentary tract is not emptied completely, thus favoring auto-intoxication and bacillary infection. There are two varieties of bacilli in the alimentary canal that are likely to cause serious disturbance in the wound after operation. One of these is the colon bacillus, and the other is the gas bacillus. When the latter germ is present death of the patient usually ensues.

Two ounces of castor oil administered on the evening before operation is about as efficient and safe a purgative as can be given. The effect of the oil is largely mechanical. It incorporates the germs within itself, thus removing them from the intestinal tract.

If more than twenty-four hours have been required to prepare the patient, purgation can be carried out in two stages. Calomel is given seventy-two hours before the operation, and is followed by a saline. Provided no vegetables have been given the patient, any purgative may be used just before the operation; but if vegetables have been allowed, the bowel must be emptied thoroughly before the operation is begun. While the patient is being purged it is advisable to give one-thirtieth of a grain of strychnine three or four times daily.

Preparation of Hernia Area. In all cases of strangulation of the bowel the patient is taken to the operating room without previous preparation of

the hernial area, which is there cleansed thoroughly with soap and water, scrubbing vigorously, is then washed off with sterilized water, scrubbed again before shaving. The reason for preparing the skin so carefully before shaving is to obviate skin infection by the razor. After the parts have been shaved they are again washed with soap and water and gauze, care being taken not to use the brush too vigorously on the scrotum or labia, for fear of blistering the skin. The soap and water is then washed off with plain water, the parts dried with gauze, after which they are washed with 70 per cent. alcohol and a 1-1,000 bichloride solution, or some other suitable antiseptic such as carbolic acid or lysol. All this can be done by the operator while the patient is being anesthetized, and at the same time his own hands are undergoing the same process of disinfection as that to which the hernial area is being subjected. If there is no dearth of assistants it is just as well to relegate this process of disinfection to one of them.

In preparing the patient for a deliberate operation for hernia a general bath is given first, then the parts are scrubbed, shaved, and otherwise prepared as described above, and after being rendered as aseptic as possible, a compress saturated with a solution of bichloride, 1-2,000, is applied and left on over night. This wet antiseptic dressing is sufficient to disinfect the skin and to prevent sepsis through any abrasions that might have been made during the process of shaving. This is very important. Experience has shown that if use is made of a solution of bichloride stronger than 1-2,000, and this left on for twelve hours, a dermatitis is caused in many cases. Of course, this will interfere with primary union of the wound edges after the operation. The use of a solution of carbolic acid, 1-20, or of bichloride of mercury, 1-500, as is recommended by some operators, has, in my hands, proven to be very deleterious to the skin when applied for several hours by way of a compress. Alcohol, when applied to the external genitalia while the patient is awake, causes considerable stinging and smarting, but when the patient is asleep it can be used very freely and to good advantage. Ether, on the other hand, when used on the scrotum, causes a most excruciating pain due to the contraction of the dartos, and even when the patient is asleep, the irritation caused is sufficient to awaken him, unless he has been anesthetized profoundly.

Painting the parts with iodine, as practised by some operators, is also objectionable, because it produces a dermatitis which should be avoided. I am convinced that Harrington's solution is excellent for disinfecting the skin when the operation is an emergent one, but it is too strong and too irritating to be applied in the form of a wet compress left on over night.

On the following morning the patient is brought to the operating room, and while he is being anesthetized the compress is removed, and the field of operation is gone over again, choosing any one of three methods: (1) Soap, water, alcohol, bichloride; (2) Ether, alcohol, bichloride; (3) Harrington's solution. The patient is then ready for the operation.

Clothing. Some patients object very strenuously to adopting the clothing commonly used in a hospital, and I am firmly convinced that the nervous reaction caused by insisting on a complete change of raiment has often

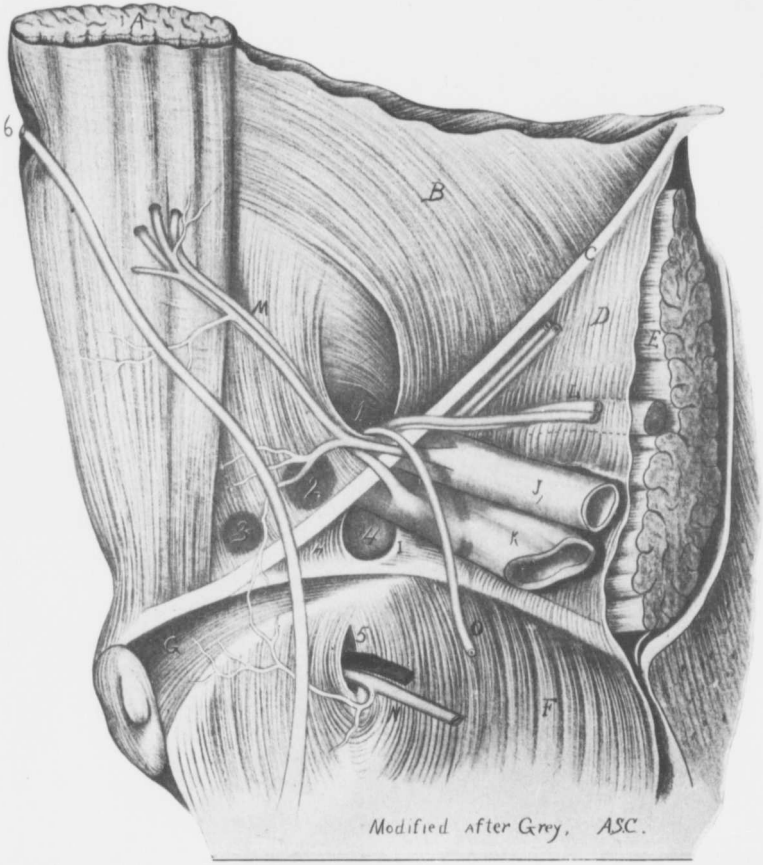

PLATE XII.

A. Rectus muscle. B. Transversalis fascia. C. Poupart's ligament. D. Femoral fascia. E. Psoas and iliacus muscles. F. Pectineus muscle. G. Pubic ramus. H. Gimbernat's ligament. I. Septum crurale. J. Iliac artery. K. Iliac vein. L. Spermatic vessels. M. Deep hypogastric vessels. N. Obturator nerve and vessels. O. Vas deferens.

1. Opening of internal oblique. 2. Opening for external direct hernia. 3. Opening for internal direct hernia. 4. Opening for femoral hernia. 5. Opening for obturator hernia. 6. Obliterated hypogastric artery.

interfered materially with a smooth convalescence after operation. I believe also that I can trace several cases of broncho pneumonia and lobar pneumonia to this cause. Therefore it is advisable to take into consideration the wishes and the habits of the patient in this regard, and if he insists on wearing his under-garments this should be permitted, but they must have been thoroughly disinfected first.

When everything is ready for the operation the patient should be informed of it, not too soon and not too late, however. As a rule it is preferable to set an indefinite time for the operation, so as to avoid undue excitement. Tell the patient that the operation will be proceeded with when everything is ready. In the case of a very nervous patient it is time enough to tell him on the morning of the day set for the operation, thus not depriving him of a sound and restful sleep. Many patients, if informed of the time of operation the day previously, spend a wakeful and restless night, and hardly are in condition to be operated on in the morning. Then, too, it does not give the patient a chance to procrastinate, as he usually is inclined to do if advised too soon of the time of operation.

The Operator. While the age of the surgeon does not *per se* always play an important part in the successful conduct of an operation, still it can be said that those who are too young in surgery are liable to rush in heedlessly and, on the other hand, those who are too old are sometimes over-confident in their ability, which breeds carelessness. In this country the surgeon works in the operating room sometimes to a very old age, when it is lamentable to see the shaking hand and to notice the incomplete attempts at surgical dexterity. While these men would be excellent consultants in an operating room, they are really no longer fitted to add to the advancement of the art of surgery. In England the age limit for the surgeon is placed at sixty; in Germany at seventy; in France at seventy-five, while in Scotland he operates as long as he is able. It must not be forgotten, however, that there are some men who are young in years and old in surgery, and that there are many old men who are still excellent operators.

The surgeon should have sufficient muscular strength to endure the hardships encountered in performing major operations day after day, and often night after night. Manual dexterity also is an essential requirement. Some individuals possess naturally what is called a surgical hand, although no person is endowed naturally with sufficient dexterity to do surgical work without having had a great deal of preliminary training. The training of the fingers to differentiate tissues is an acquirement which is of as much importance as is the training of the mind to know what to do and when to do it.

The skill, dexterity and manpilative ability of the surgeon should be acquired in the dissecting room, and not alone in the operating room. The herniotomist should be not merely a good general surgeon, he should have an accurate knowledge of surgical anatomy, especially the surgical anatomy of hernia.

The surgeon should always be in what is called the pink of condition.

He must take good care of his health, and keep his mind and body clean. While surgical cleanliness is of great importance, personal cleanliness also counts for much if he would be a successful surgeon. Right living is an essential to success in surgery. While in the hospital making his rounds, just before performing an operation, the surgeon should not go around and shake hands with everybody; in fact, it is better not to visit any patients at all.

The successful surgeon is he who observes all those small details which mean so much. He should change all his clothing just before operating, taking off not only the outer, but also the underclothing. All these things have a direct bearing on the successful healing of wounds, and on the ultimate result of the operation. After being thoroughly ascepticized, and properly clothed, the surgeon should not touch anything except the instruments and materials that are necessary for the performance of the operation.

At the operating table the surgeon should not stand stooped over his patient, breathing on to the field of operation. This increases the liability of infection. He should stand erect and as far away from the wound as is consistent with the work to be done. His assistants should be taught to stand erect and at arm's length from the table. Talking should be prohibited and all the breathing should be done through the nose. When it is necessary to make a request for something or to answer a question, the surgeon should select a time when it is safe for him to turn his face away from the wound. When these precautions are taken, it is not necessary to wear those hideous masks which soon become very foul, nor is there any need of tying up the mouth with gauze. If the surgeon prefers to wear a mask, it is advisable to change it several times during the operation.

Assistants, nurses and visitors should be prohibited from talking in the operating room, especially when they are near the patient. Unnecessary walking in the operating room also is conducive to infection.

In the amphitheatre the same precautions should be taken as in the private operating room. Of course, there is in this case some necessity for talking, because students are there for the purpose of being instructed. It is not enough for them to see; the steps of the operation must be explained. The conduct in the amphitheatre resolves itself into three parts: (a) Before the operation; (b) during the operation, and (c) after the operation. Before the operation a short lecture can be given on the nature of the case; the anatomical structures involved; the diagnosis; the selection of the operation; and the reasons for such selection. The operator can make the initial incision and then allow his assistants to pick up and ligate bleeding vessels while he explains to his audience what is being done. Then, turning to his patient, he continues with the operation until he reaches a point in the procedure where it is possible to stop for a few minutes to permit of further explanation. Finally, he completes the operation in its essential features, and then turns the patient over to an assistant, who carries out the final steps, such as suturing the skin wound and applying the dressing.

Surgical coolness is an admirable quality. Recklessness often is mistaken for it. Nervousness of the surgeon during an operation is inimical to

good surgery. There are surgeons who are extremely nervous before an operation, but who during the operation are cool and collected. The surgeon who always is under great mental and bodily strain while performing a major operation should give up the work entirely. Anxiety and concern for the welfare of the patient are all well and good, but the surgeon should not carry them to the extent of getting rattled. It is rather ludicrous to see a surgeon of international reputation perform an operation for the radical cure of hernia and become so confused as not to be able to differentiate the vas deferens, the conjoined tendon, and most of the important structures in that area. Not long ago such an exhibition was given in one of the large cities of this country when the surgeon spent fully half an hour trying to push back the omentum and bowel with his fingers, forgetting completely that these structures would recede of themselves by merely placing the patient in the Trendelenburg position. Not until this was suggested by the anesthetist was it done.

As a rule, the instruments for the operation are selected by the surgical nurse, the assistant, or the senior interne. While this lessens the labor of the surgeon and saves time, it not infrequently leads to embarrassment when the surgeon calls for an instrument and finds that it has not been prepared. For this reason the surgeon should always look over his instruments before commencing an operation.

The surgeon should learn to handle his own instruments during the operation, so that he can get along without an assistant. By this means he will arrive at a system in the operating room which will lessen the number of assistants and nurses required during operation.

The surgeon of to-day is quite a different individual from his prototype of twenty-five years ago. He gets better results. He does not operate on a time limit nor does he dash off a herniotomy without taking the time necessary to examine into the case and determine the conditions to be encountered. He does not perform his operations by routine, but adapts the operation to the individual case. The most brilliant results can be obtained if the surgeon is painstaking and operates only under proper conditions.

Any visitors who may be present during an operation should be so gowned that no part of the body, except the head and feet, is exposed. The writer uses for this purpose a sleeveless gown, a sort of bag, that slips over the head with a drawstring at the neck. It reaches down below the knees and completely covers the body and prevents the use of the hands.

The Operating Room. At Home.—In the home the kitchen is usually the most suited for an operating room. It is well lighted and is also the cleanest room, unless one of the other rooms in the house has been prepared specially. Therefore emergent operations performed at home should be done in the kitchen. If there is sufficient time to prepare for the operation any room can be gotten ready. Then the furniture and hangings of all kinds should be removed, and the walls, floor and windows scrubbed and then gone over thoroughly with a 1-500 bichloride solution. The night before the operation the table to be used and the other furniture needed dur-

ing the operation are gone over in the same way. During the night the room should be fumigated with formaldehyde. A second room also should be made reasonably clean. Here most of the preparatory work is done, such as the sterilization of sheets, towels, and water; but the instruments and materials to be used during the operation, the sponges and the dressings, should be prepared in the hospital.

The patient should not be carried into the operating room until he has been anesthetized. If the room is large enough a bed may be put into it on which the patient is placed after the completion of the operation, and allowed to remain until he has recovered from the effects of the anesthetic. Then he is carried to the room which has been specially prepared to receive him.

In the Private Hospital. The room which is to be used for an operating room should be selected very carefully. Inasmuch as all the deliberate operations are performed in the morning, there is no objection to selecting a room with a west exposure. Nor is there any objection to selecting one with a north exposure, except that it usually is more difficult to keep this room warm in the winter. South and east exposures should never be chosen.

The operating room should be properly constructed and ventilated, but above all things it should be kept clean—that is, surgically clean. It should be scrubbed and made aseptic every day with a bichloride solution. The same thing should be done between operations, if more than one operation is done on the same day, and especially after a septic case has been operated on. For these reasons, as well as for many others, it is advisable to have two operating rooms in a private hospital. Neither of these should be designated as the septic room, because if one room is selected for septic cases, and the other is reserved for aseptic cases, there is the danger of allowing the former to become foul, thus serving as a nidus of infection for the clean room. Both rooms should be cleaned every day, so that they may be ready at all times for any kind of an operation on any kind of a case. It is a good plan, however, to reserve a room in which medicines and dressings can be kept. This room may be situated between the two operating rooms, for the sake of convenience.

After the completion of a septic operation the operating room should be cleaned immediately and thoroughly disinfected with formaldehyde, so that it will be ready for use.

CHAPTER VIII.

SURGICAL BACTERIOLOGY.

Aseptic surgery is the ideal surgery. It assumes that before operation the tissues of the patient are free from disease-producing germs, and that the surgeon has destroyed the germs on his hands, instruments, ligatures, and other material used during the operation. The exhaled, vitiated breath is prevented from entering the wound by means of shields of gauze, called masks, which are placed before the mouth and nose. The air in the room should be dustless, in order to reduce to a minimum the possibility of infection occurring from the entrance into the wound of bacteria contained in the dust. There is no reason why there should be any inflammation, suppuration, septicemia, or pyemia, after operative procedures. Clean and careful surgeons have eliminated the two last-named from their practice, but inflammation and suppuration are still with us, although to a very limited degree.

Ideal aseptic surgery really does not exist, because, strictly interpreted, the term means that there are no germs, no infection, and no interference with the healing of the wound by germs. The air is laden with millions of germs; beneath the finger-nails, in the crevices and folds of the skin, even after vigorous scrubbing with soap and water for fifteen minutes, germs are abundant. Therefore, there can be no such state as asepticity of the skin. The wound is always exposed, more or less, to air, which may be the source of infection, to the contact of fingers, instruments, sutures, dressings, etc. If the surgeon keeps all fingers, except his own, out of the wound, the danger of infection is minimized, especially if he takes proper aseptic and antiseptic precautions. In fact, if it were not for two things suppuration of wounds would occur much more frequently than it does now. These are (a) the antiseptic properties of perspiration, and (b) the resisting powers of the patient.

I will not now refer to the assistants, internes and nurses in this connection, but will consider only the two parties involved primarily, the patient and the surgeon, because infection is due to one or the other of these two. The patient cannot help it, but the surgeon can. The surgeon should hold himself responsible for everything connected with the operation, for the work of the anesthetist and the mistakes of his assistants and nurses.

Long before the germ theory of disease was promulgated the advantages of moist dressings were recognized. They keep the wound surface clean and the secretions unsuitable as a culture medium for bacteria. Before 1866 Lister had as much sepsis in his practice as most other surgeons. During the subsequent five years he reduced his mortality in major amputations from 42.7 per cent. to 11.25 per cent. To-day the mortality

from infection occurring during the performance of major operations is practically *nil*. For a clear, accurate and vivid description of the surgery of those days, contrasted with the surgery of to-day, I refer the reader to Nicholas Senn's most excellent work on "*Practical Surgery.*"

The subject of bacteriology is so inseparable from the technic of modern operations for hernia and other general operative procedures, that the surgeon is no longer "a physician who operates," but he must be one who has specially prepared himself to do surgery, and no small part of his training must have been in bacteriology. As many excellent books have been written on the subject of bacteriology the author does not think it necessary to discuss the subject at any great length, limiting himself only to making such reference as will serve as a connecting link between bacteriology and clinical surgery.

When infection occurs following a herniotomy, it is the duty of the surgeon to determine the source and the cause of such infection. Cultures should be made from the discharges of the wound and from all materials, including instruments, that were used during the operation. If necessary, animal inoculation should be resorted to. As a guide in studying micro-organisms, the following classification of bacteria (*Zapffe's Bacteriology*) will be useful:—

First, as to their shape, we have three principal divisions or groups: I. Micrococci. II. Bacilli. III. Spirilla.

I. The *micrococci* are spherical or slightly oval in shape, non-motile, and do not form spores. They grow by binary division. This group is subdivided further into the following varieties:

Diplococcus: Two micrococci remaining attached to each other, or an imperfect division. They may be absolutely spherical or the contiguous surfaces may be slightly flattened or concave, the "biscuit" coccus or "semmelkokken."

Tetrad: A group of four cocci, the result of division in two directions.

Sarcina: A packet or cube of eight cocci, the result of division in three directions. This form resembles in appearance a bale of cotton or a dice.

Staphylococcus: The most common form, in which the cocci occur in irregular groups of varying numbers and without definite arrangement. The name is derived from the Greek and is given to this form because of its resemblance to a bunch of grapes.

Streptococcus: Chains of cocci. When division occurs in only one direction, with adhesion or attachment of the individual members, chains of varying length are formed. Some authors distinguish a streptococcus longus and a streptococcus brevis—that is, long chain and short chain; and a few, a streptococcus conglomeratus. When the chain is composed of diplococci, it is called a strepto-diplococcus.

Ascococcus and leuconostoc are two very unusual groupings of cocci. In the former the cocci are associated in globular or lobulated masses held together by a firm, gelatinous, intracellular substance. In the second variety the cocci grow in chains or masses, and are surrounded or enclosed by a very thick and tough gelatinous capsule.

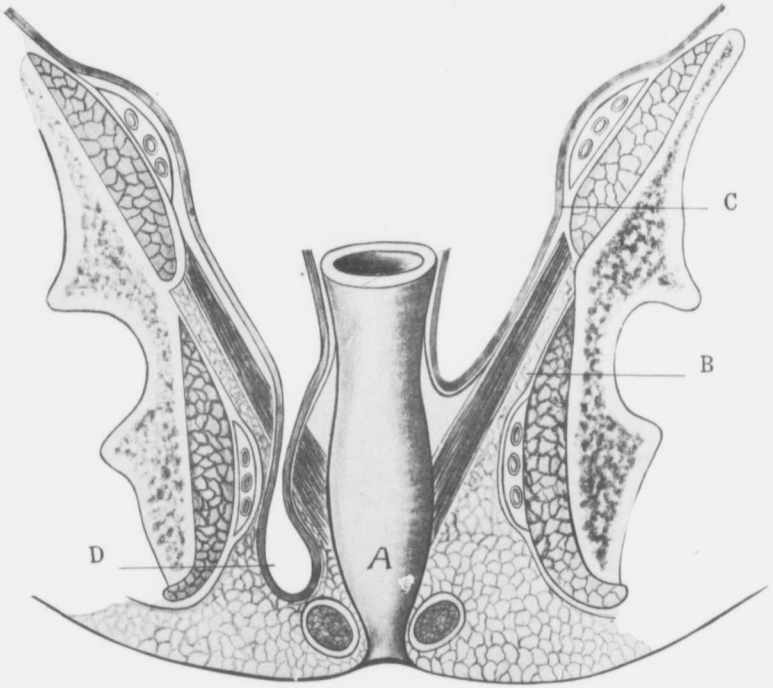

PLATE XIII.

Diagrammatic frontal section through the pelvis, exposing the rectum (A).

The pelvic diaphragm (B) is seen passing from the inner surface of the true pelvis to the lower end of the rectum. This diaphragm is perforated on one side by the protrusion of a hernial sac which is still situated within the ischio-rectal fossa.

Inferior Hernia (Perineal). A. Rectum. B. Pelvic diaphragm. C. Parietal peritoneum. D. Sac of a perineal hernia.

II. The *bacilli* are rod-shaped or filamentous bacteria, motile or non-motile, flagellated or not, reproducing themselves both by fission and sporulation. They are not subdivided into groups, but exhibit considerable variation of shape. Some are quite short and thick; others are long and slender; some very large and some very small. They may be so short as to resemble a coccus, hence the term oval coccus. Some have rounded ends; others pointed, squared or slightly concave ends. They may be spindle-shaped, rod-shaped, club-shaped, or of a clostridium shape. Their arrangement is in some instances characteristic. They may be seen to lie singly or in pairs, in parallel rows or in chains of varying length, sometimes interlacing freely. Very long, slender, and indistinctly articulated filamentous bacilli are known as leptothrix; when these filaments present pseudo-branchings, they are termed cladothrix.

III. The *spirilla* are curved or twisted rods of varying length, endowed with motility and a peculiar rotary movement, flagellated and reproducing themselves by both fission and sporulation. They may be very rigid or exceedingly flexible. The short, slightly bent rods resemble a comma so closely that they frequently are referred to as "comma" bacilli (cholera), or as a vibrio because of their vibratory motion. The extremely long and flexible forms are called *spirochaeta* (relapsing fever). A *spiromonas* is a ribbon-shaped spirillum. When sulphur granules are found in the protoplasm of the organism, it is called an *ophidomonas*.

Several higher forms of bacteria also are recognized. They approach the plant in structure and method of growth. Among these is the *streptothrix*, the only form which is encountered in animal pathology. The *streptothrix actinomyces* (ray fungus) is the type of this class. The tubercle bacillus and the diphtheria bacillus are included by some authorities in this class. The streptothrix presents true dichotomous branchings and forms very finely tangled masses. In the course of its growth many stages of the germ are seen. Occasionally the filaments break up and resemble chains of bacilli or cocci, or the free ends of the filaments form club-shaped masses, which may be an evidence either of degeneration or sporulation.

Depending on their environment and habits, bacteria are divided into *saprophytes* and *parasites*.

Saprophytes feed only on dead organic matter, and usually are not disease-producing bacteria, unless by absorption of the poisonous products formed by them from the breaking-down of proteids. Parasites always feed on living organic matter. An organism may, however, be both parasitic and saprophytic, but a saprophytic existence precludes parasitism.

According to the results of their vital activity, bacteria are *pathogenic* and *non-pathogenic*. A *pathogenic* organism is one which is capable of producing disease. A *non-pathogenic* organism does not of itself produce disease. Pure saprophytes are always non-pathogenic germs; whereas parasites are usually pathogenic.

The terms *obligative* and *facultative* are used to express the absence or presence of the ability of accommodation to surroundings. For example, organisms which may be either saprophytic or parasitic are said to be

facultative (typhoid and cholera bacilli). Obligative bacteria are those which must be either one or the other; as, for instance, the lepra bacillus, which is a strict or obligative parasite.

According to the products of their metabolism, bactaria may be classified as:

1. Aërogenic—gas-producers.
2. Zymogenic—fermentative bacteria.
3. Saprogenic—putrefactive bacteria.
4. Chromogenic—color-producers.
5. Photogenic—phosphorescent bacteria.

PYOGENIC BACTERIA.

Many bacteria are responsible for the formation of pus, but those which are classed particularly as pus-producing germs are the following:

I. Cocci.
   1. Staphylococcus pyogenes: (a) aureus; (b) albus; (c) citreus.
   2. Streptococcus pyogenes.
   3. Micrococcus gonorrhea (gonococcus).
   4. Diplococcus pneumoniæ (pneumococcus).
   5. Diplococcus meningitidis (meningococcus).

II. Bacilli.
   1. Bacillus pyocyaneus.
   2. Bacillus coli communis.
   3. Bacillus typhosus.
   4. Bacillus tuberculosis.
   5. Bacillus of Friedlander (pneumo-bacillus).

In connection with infection of wounds made by the herniotomist, it is well to direct attention for a moment to those micro-organisms which J. Collins Warren, of Boston, has named the surgical bacteria, because of the frequency with which the surgeon has to contend with them. First among these is the *staphylococcus pyogenes aureus*, an organism that is widely distributed in nature, and is always found on the surface of the body, beneath the finger-nails, in the saliva, in the dust of the street, on the floors and walls of houses and hospitals, in the air and in the water, and wherever it may have been deposited from a previous infection. The staphylococci are about one micron in diameter and have an arrangement resembling a bunch of grapes, from which they derive their name. The entire group of staphylococci grows readily on all the various culture media and at temperatures as low as 6° C., and as high as 44° C. The staphylococcus is an exceedingly tenacious germ, retaining its vitality for a long time under the most adverse circumstances. It is killed rapidly by exposure to live steam and by 3 per cent. solution of carbolic acid. All the staphylococci cause local suppurative inflammations, and while they exhibit but little tendency to spread, they occasionally are the cause of a fatal septicemia or pyemia. The aureus is the most common and also the most virulent of the staphylococci. The albus is the least virulent variety. The citreus is very uncommon and is always associated with the other varieties of staphylococci. The

staphylococcus epidermis albus, which was described by Welch, occurs constantly on the skin and in its deeper layers. It is believed to be an attenuated form of the albus. Two feeble pathogenic forms of staphylococci are the *staphylococcus cereus albus* and the *staphylococcus cereus flavus*. They are found on the skin and in the external auditory canal. The *staphylococcus viridis flavescens* is met with occasionally. The *micrococcus pyogenes tenuis* resembles the aureus slightly, both biologically and morphologically. It is very uncommon.

The *streptococcus pyogenes* is an exceedingly virulent germ, possessing but little vegetative power, and is the cause of almost all severe and rapidly fatal infective inflammations. It is of about the same size as the staphylococcus, but always occurs in the form of a chain, from whence its name. The germ has been found in hospital wards, in operating rooms, in the mouth, nose, pharynx, intestinal canal, vagina, urethra, on the skin, and in the infections caused by the germ itself.

The *bacillus pyocyaneus*, though not a pus-producing germ, is frequently found in pus, to which it imparts a blue or green color. It has been found on the skin, especially in the axilla, in the external auditory canal, and in the intestinal mucus. It grows very abundantly in culture.

An organism in the same class with the bacillus pyocyaneus is the *micrococcus tetragenus*, a germ that occurs in squares of four cocci, grows abundantly in culture, and is seen most frequently in specimens of tuberculous sputum. It is also present in the mouth. It is not believed to be pathogenic for man.

The *bacillus pyogenes fetidus*, which has been found on several occasions in the pus in abscesses, also belongs to this class.

The *bacillus coli communis*, although ordinarily a non-pyogenic germ, is not infrequently found in the contents of abscesses, especially in those abscesses that occur in the vicinity of the intestinal tract.

Many other germs have been found more or less often in the contents of abscesses, but without being necessarily pus-producers themselves. Other bacteria with which the surgeon may come in contact in connection with his operative work are the *streptococcus erysipelatus, bacillus tetanus, bacillus tuberculosis, bacillus mallei, lepra bacillus, bacillus of syphilis, bacillus of malignant edema, bacillus of pseudo-edema, bacillus anthracis, bacillus aërogenes capsulatus*, and the *actinomyces*, or ray fungus.

Asepsis and antisepsis have revolutionized surgery to such an extent that infection occurs very infrequently. In pre-antiseptic days, and during the period of time that antisepsis and asepsis were being developed, that is, before our technic was as perfect as it is to-day, wound infection was a common occurrence, and any one of the bacteria mentioned above might have been the cause of the infection. Particular attention is now paid to these germs because of this. Many patients who would have survived the operation died from sepsis. In other instances the patient was inoculated with the germ, such as the bacillus of tuberculosis, the bacillus of anthrax, or the bacillus of leprosy, which, though it may not have caused death immediately, produced severe systemic disturbances from which the patient

did not recover. Infection with the tetanus bacillus was dreaded particularly, and malignant edema, anthracosis and local tuberculosis have been reported many times as occurring after operations for the cure of hernia, as well as after other operations. I have also seen one case of actinomycosis caused by contamination of catgut which was used during the operation.

The occasional operator is much more likely to have infection because, as a rule, he is obliged to operate under the most adverse conditions. He cannot choose his operating room, nor can he choose the time of operation. Most of his work is emergency surgery, but if he will be reasonably careful in his technic, and allow nothing to come in contact with the wound that has not been sterilized, he can avoid infection in the majority of instances.

The rarer varieties of infection, those in which the bacillus of leprosy, the bacillus of syphilis, the bacillus of tetanus, are the causative germs, can be ruled out entirely. If the operator has come in contact with a case of erysipelas, he should exercise more than usual care, because, as has been pointed out above, the streptococcus of erysipelas, like all other streptococci, is a very virulent organism, and it is carried easily from one place to another on the clothing or any substance that may come in contact with the patient. Wound infection with the streptococcus is very likely to prove fatal. Therefore, when an operation has been arranged for, the surgeon had better not visit any cases of erysipelas on that day.

CHAPTER IX.

INFECTION.

By infection is meant the multiplication of certain microbes in wounds and in the body, causing local and constitutional disturbances peculiar to them. When these bacteria enter a wound they multiply and cause what is termed a local infection. A constitutional infection is said to occur when the health of the individual is disturbed by the absorption of bacteria and their products into the circulation. A blood infection, commonly called blood poisoning, takes place when the bacteria enter the circulation and multiply there. This always produces grave constitutional symptoms. Infectious diseases are those that are communicated from one individual to another by the particular germs that cause them.

Infection may occur not only with the vegetable organisms (that is, bacteria, moulds and yeasts), but also with the animal parasites, such as the ameba coli and the malarial hematozoon.

Infection is often referred to as being primary and secondary. It is primary when it occurs irrespective of other existing conditions. The infection of a wound is always a primary process. A secondary infection is one that is engrafted on a part of the body that already has suffered from the ravages of another organism. A good illustration of this is the invasion of a tuberculous abscess by pyogenic cocci.

The infection may also be local and general.

In the condition known as sapremia, or septic intoxication, the infection is due to the absorption into the tissues of the ptomaines produced by saprophytic bacteria (putrefactive bacteria), which, while not entering the blood themselves (i. e., remaining in the focus of infection), yet produce substances that are absorbed by the body and enter into the blood and lymph channels. The absorption of fibrin formed in a wound produces effects that are very similar to those produced by the absorption of these ptomaines.

By mixed infection is meant the presence in the tissues of more than one variety of organism at the same time. This is seen frequently in tuberculosis, pneumonia, and in wound infections.

A terminal infection is one occurring in an individual suffering from some chronic organic disease and which ends fatally. One infection may subside and another take its place.

When the poison is generated within the body itself as the result of faulty metabolism or the inadequate elimination of waste products and their subsequent decomposition, a form of poisoning occurs known as auto-intoxication or auto-infection. Several interesting cases of blood infection induced by latent infection becoming aroused by exposure to cold have been observed by the author.

Before it is proven that a certain germ is the cause of an infection, there are a number of conditions and requirements that must be met. These have been laid down definitely by Koch and by Henle, and are known as Koch's law. 1. The micro-organism must be found in the blood or lymph or in the tissues of the person infected. 2. The germ must be isolated and cultivated. 3. The infection or disease under investigation must be reproduced by inoculation of man or animals with the artificially cultivated germs. 4. The same bacterium must again be found in the tissues, blood or lymph, of the person or animal inoculated. When an organism meets these requirements, it is accepted as the specific cause of the disease or infection that is being investigated.

It is important for the operator to know of the sources from which infection may come. The easiest way to keep these in mind is by remembering the few tissues and organs in the body in which germs do not exist normally. Bacteria are not found in any tissues or organs that have no connection with the skin or with the mucous surfaces, such as the brain, spinal cord, nerves, muscles, bones, joints, ligaments, tendons, adipose tissue, heart, blood, lymph glands and vessels, lymph, peritoneal cavity, spleen, arteries and veins, and suprarenal bodies. There has been considerable controversy on this subject, some investigators claiming that they found bacteria in healthy normal organs and tissues, but it is now generally conceded that these are free from germs. Germs are not found in normal secretory organs, such as the salivary glands and their ducts, the liver, gall-bladder and its ducts, pancreas and ducts, kidneys, ureters and bladder, ovaries, uterus and Fallopian tubes, the mammary glands and their ducts, lungs, testes, vas deferens and prostate gland. While germs are not present, normally, in the sudoriferous glands (the perspiration being germicidal in its action), still the skin and its appendages, the sebaceous glands and hair follicles, are never free from bacteria.

SOURCE OF WOUND INFECTION.

Let us now enumerate the chief sources of infection of wounds made by the surgeon.

1. *The Atmosphere.* Bacteria of all kinds, pathogenic and non-pathogenic, are always to be found in the air. These germs being heavier than air are deposited on objects in the operating room, on instruments, dressings, sutures, as well as on the wound surfaces. Although the danger of infection from this source is not very great, yet the atmosphere in which patients are operated and cared for should be kept as free from dust as possible. Where there is obvious dirt, there is dust, and when one can see the dust in the air, or on articles of furniture, and other exposed objects, there are sure to be swarms of bacteria, sufficient to infect an open wound. An operation should not be performed under such conditions, if it is at all possible to avoid it.

2. *The Skin of the Patient.* The skin of the newborn babe is germ free (Nuttall), but it soon becomes covered with bacteria which, when they enter a wound, will cause suppuration and even death. These germs find

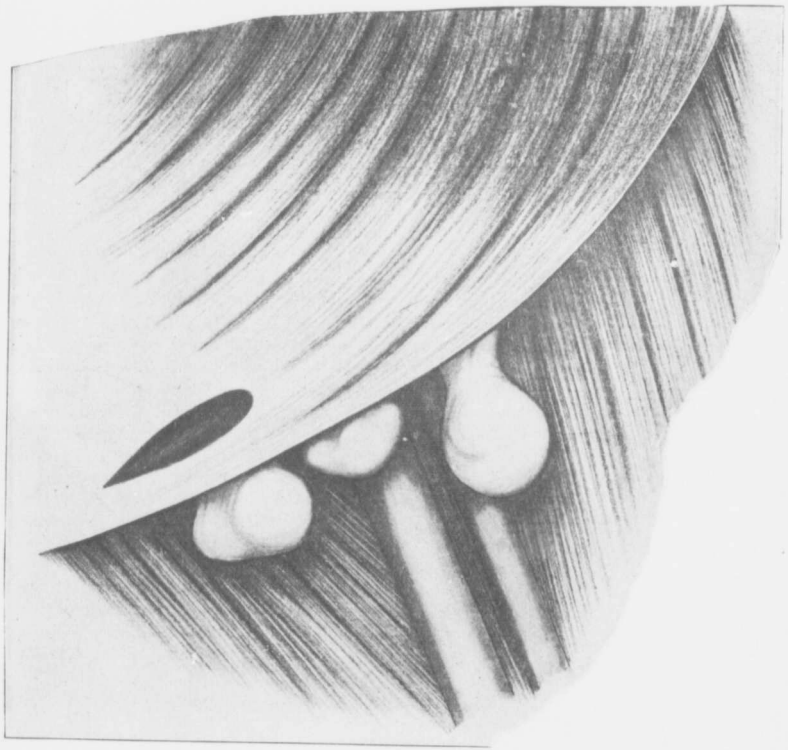

PLATE XIV.

Femoral Hernia. Internal, Anterior, External.

their way into the various folds, crevices and appendages of the skin, making the task of removing them mechanically with soap, brush and water impossible. Therefore, the patient's skin may be the source of his infection.

Different varieties of germs are found to inhabit various parts of the skin and they often produce infectious skin diseases that are peculiar to these parts. The skin of the pubis and of the groin is heavily laden with germs. The *staphylococcus epidermis albus* is always present everywhere on the skin. It is not pathogenic, but will cause pus. The odor of sweating feet is caused by the *bacillus graveolens*, also non-pathogenic. The red sweat of some individuals is caused by the *bacillus prodigiosus* (non-pathogenic).

3. *The Skin of the Hands* of the operator and of his assistants, especially beneath the nails, is never free from bacteria and is probably the greatest source of infection in hernial operations when these are performed with bare hands, that is without rubber gloves. No one should operate or assist who has an obvious infection of the hands, such as eczema or suppurating wounds. Internes and assistants coming in contact with suppurating cases must take every care not to touch pus. Nurses should not be in the operating room during menstruation, or while suffering from vaginal discharges, because under those conditions it is rather difficult for them to secure "surgical cleanliness" of their hands.

4. *Water.* There are too many bacteria present in ordinary tap water to use it with impunity at operations, except for the primary scrubbing of the hands. If even a trace of organic matter is found in it, bacteria are always present, but water free from organic matter may contain live germs. "Ordinary hydrant water usually contains from two to fifty bacteria per cubic centimeter; filtered river water from fifty to two hundred; unfiltered river water from 6,000 to 20,000; ground water may contain as many as 130,000" (Zapffe).

The bacteria in water are usually of the non-pathogenic variety. The two most important pathogenic organisms are the typhoid and the cholera bacillus. The bacillus coli communis is found in water into which sewage empties. The water obtained from deep artesian wells is free from germs. Water from lakes and rivers is septic. Even distilled water may contain germs. For surgical purposes the water must be sterilized, rendered free from pathogenic microbes, and kept in bulk, both hot and cold. While boiling is simple and efficient, it is a laborious process to cool and properly retain water that is fit for all practical purposes. A special water sterilizer should be installed in every hospital operating room.

Instruments and Materials Used at the Operation. These constitute a frequent source of infection when not rendered aseptic.

An aseptic *scalpel* becomes septic upon severing the skin when its follicles are crowded with bacteria. This scalpel should not be used again during the operation without being disinfected in carbolic acid and alcohol, for fear of carrying the bacteria into the deeper structures, and thus infecting them. I am indebted to Floyd W. McRae, of Atlanta, Georgia, for this

bit of surgical technic. It is not only a good plan to discard the scalpel, but also to antisepticize the edges of the skin wound with some efficient antiseptic solution. The most efficient solution is Harrington's, but it must be used sparingly by gentle mopping; in fact, one sweep with a pledget of gauze moistened in it is sufficient.

2. *Catgut* is a source of infection, and it must be rendered aseptic before using. (See Chapter XII.) When aseptic catgut is used to check hemorrhage and to coapt the deep structures in hernial operations (or in operations for other conditions), it may become infected in the application of such ligatures and sutures. It is during the operation that the germs are accidentally introduced, and hence Kocher calls this "implantation infection" (*Operative Surgery*, Trans. IV Ed., p. 33), and urges the use of antiseptic material for buried sutures and ligatures instead of that which is merely aseptic.

3. The manner of using the *needles* is sometimes a source of infection. When a cutting needle is passed from without inward and strikes a nest of germs in the hair follicles and sebaceous glands, they are undoubtedly carried by the needle and suture to sterile tissues. It depends upon the number, nature and activity of those germs whether suppuration follows or not. The late G. R. Fowler, of Brooklyn, N. Y., is credited with this observation.

4. The author holds the same objection to the *subcuticular suture*, because the needle and suture must pass through the deep skin where hair follicles, sebaceous and sweat glands abound and may be harboring pyogenic bacteria.

5. *Suturing the skin too tightly* is a frequent source of stitch abscess in the hands of many operators, by causing necrosis of the skin where the stitch is applied.

6. *Rough Handling.* When an operator lowers the vitality of the tissues by tearing, bruising, undue clamping, using too many ligatures, etc., a predisposition to infection is created. Infection supposed to have been caused by such rough handling of the structures has been called "lesion infection" by Travel, and "necrosis infection" by Kocher.

7. *Contact infection* is a great source of inflammation, suppuration and all infective diseases, from water, the skin of patient, hands of the operator, the instruments, solutions, vessels, sponges, ligatures, sutures, drainage tubes, dressing materials, and the mode of their application, drops of perspiration, dust and dandruff from the hair, mucus droplets from the mouth when talking, coughing, etc., the clothing of operator, his assistants and nurses, eye-glasses or spectacles, insects, visitors, etc., etc.

8. *Breath Infection.* The expired air is sterile (Tyndall), consequently the more respiration that goes on in a room, the greater the decrease in the number of bacteria in it, even when the room becomes stuffy. It has also been proven that micro-organisms are not given off from moist surfaces. The exhaled air does not carry with it the germs so numerous along the respiratory tract. From these two facts, (a) that the exhaled breath is sterile, and (b) that germs are not given off from moist surfaces

PLATE XV.

Congested—2 hours.

(Schimmelbusch), one can justly say that the surgeon, his assistants and nurses, and visitors cannot by the act of respiration infect a wound. There is, however, a breath infection, and that is from speaking, coughing, laughing, and sneezing, during which efforts it has often been proven that drops of mucus and saliva fly from the mouth, and particles of the secretions of the Schneiderian membrane come from the nose, all laden with non-pathogenic, pyogenic and pathogenic bacteria. No one who is suffering with a cough should operate or assist at an operation.

9. *Infected Wounds.* The discharges from infected wounds carried in various ways to clean wounds were at one time the most common sources of infection. Anyone dressing septic wounds, by the careful use of his hands, with or without gloves; by using dressing forceps, scissors, or other instruments, as the case may require; and by the complete sterilization of these instruments before and after using, should be able to reduce this source of infection to practically nothing.

10. *Excreta, Urine and Feces.* In hernia operations on children it is important to protect the wound against contamination with urine or feces. This may be done in several ways. A collodion dressing may be applied, but it may cause irritation of the tender young skin. A double dressing with rubber or oiled silk between, properly bandaged, affords a safe protection against infection from this source. The outer dressing can be changed whenever it is soiled without endangering the wound.

Obscure Sources. Inasmuch as there is no method of surgical technic that is absolutely proof against sepsis, we must not be over-sanguine in our powers, individual or combined, to always prevent infection of the wounds we make ourselves. Experience has taught that there is no known standard of the resisting powers of any person against the invasion of living germs. It is sometimes in the stalwart and robust that pyogenic germs find a suitable nidus for their multiplication, while the weakling is not assailed. In such a case the sepsis cannot be attributed to a "lowered vitality of the tissues."

There are some cases of infection caused by conditions which the operator appears to have no power to prevent. It may be in the fluids and tissues of the patient, or it may be the virulence of the germs in certain known conditions that when once introduced into the wound they cause acute inflammation, which, in turn, may cause septicemia and pyemia, as well as local suppuration. The surgeon has no control over the nature, number and virulency of germs that enter the blood by inhalation, ingestion, absorption from an infection elsewhere, or of the bacteria conveyed by insects and sometimes vermin. Nature is wondrous kind in disposing of even a marked constitutional infection from these sources without any interference with the healing of a hernial wound.

The egress of germs from the system is by the emunctories, the feces, urine, breath and perspiration, and many of the micro-organisms are exterminated by the living blood and tissues of the body. When local suppuration takes place in a wound, bacteria are eliminated with the purulent discharges.

PREDISPOSITION TO INFECTION.

This is both hereditary and acquired. It is well-known that some persons are more easily infected, locally and constitutionally, than others. There is a personality that predisposes to infection which is handed down from posterity, though not all the members of a family may show it. The person so constituted has no natural immunity or innate power to resist infections of some kind. It is strange that through animate creation one individual resists certain diseases and infections, and falls an easy victim to others. The negro does not easily take yellow fever, but smallpox or tuberculosis very swiftly overcome him.

The age of a person, which bears so clearly on the invasion of contagious and infectious diseases as to justify us in making a classification on this basis, viz., diseases peculiar to children, adults and to old people, has also a distinct bearing on the predisposition to infections of wounds after operations. It is noticeable that in young children and old people wounds heal with but comparatively little tendency to infection. In the case of the aged they possess thin skins, slow phagocytes, and feeble tissues. There appears to be a lack of something in the wound and tissues of a vigorous adult that is present in the wound of a child or an old man that predisposes to infection. This practical observation is not certainly explained by the "theory of phagocytosis", by Metchnikoff. It may be, however, that the tissues of the very young and the very old are more blessed, than those of the adult, with active germicidal properties in the form of alexins or protective albumins.

Although great progress has been made towards finding out the cause of natural immunity, it is still manifest that its phenomena are not wholly explained by either (nor by the combination) of the two theories now prevailing, viz., the (a) "phagocytic", and (b) "humoral."

The observations of Metchnikoff are accepted as correct as far as they go. There appears to be no doubt that the phagocytes are the scavengers that materially clean up an infected wound. He proved that

1. Certain cells (wandering phagocytes—mono—and polymorphonuclear white cells and connective tissue cells) first enclose, then digest, and eventually remove infective bacteria from the body.

2. Cells destroy germs in all forms of infection, and particularly in those instances tending to recovery.

3. Numerous leucocytes, either
   (a) Migrate towards the infected part (positive chemiotaxis), or
   (b) May avoid the infected area (negative chemiotaxis).

The cells are attracted by certain toxins and repelled by toxins of many virulent micro-organisms.

It has also been demonstrated that the fluids of the body have germicidal powers. Especially is this a property of blood serum. The fluids that manifest bactericidal properties have been named alexins or protective albumins. It is claimed also that the alexins are derived chiefly from leucocytes. There is no doubt but that one attack of inflammation pre-

disposes to another. There are a great many conditions which we cannot enter into here, as well as certain diseases, such as diabetes and scurvy, that render the tissues of the body weakened in vitality and predispose to infection.

CHAPTER X.

STERILIZATION AND DISINFECTION.

Because of the ubiquitous presence of bacteria in the air and in rooms, on articles of furniture and on the skin of the body, etc., and also because of the dangers consequent upon these bacteria entering wounds, a very important part of bacteriologic technic on the part of the surgeon consists in destroying these micro-organisms by sterilization and disinfection.

Sterilization is accomplished either by heat, filtration, or the action of chemicals. Usually the term sterilization is intended to imply destruction of bacteria by heat. Disinfection means the destruction of bacteria by the use of chemicals. Any substance which is capable of killing bacteria is called a germicide. One which inhibits the development of bacteria is called an antiseptic. An object is said to be sterile when it is entirely free from bacteria and their spores. An object is septic when it contains actively growing bacteria or their poisonous products. Aseptic is synonymous with sterile.

All bacteria have a thermal death-point, and the method of sterilizing and time of exposure are regulated accordingly. Culture media, fluids, and anything that can be subjected to it are sterilized by some form of heat.

Sterilization by Heat. This is accomplished by fire; dry heat or hot air; live steam; superheated steam, or steam under pressure; and boiling.

Fire. Sterilization by the actual flame is absolutely certain in its results, because it completely destroys all infected matter. Naturally that would limit its use considerably, but it is useful in surgical cases in or out of the hospital when delay is an element of danger to the patient.

Steel instruments, knives, needles and hypodermic needle, should not be held in the flame for any length of time, as it affects the temper of the metal. They can be passed through the flame a few times and then used.

When a surgeon is so placed that surgical dressings are not available, he can improvise sterile dressings by the use of fire. Cotton or linen fabrics (woolen, even straw or moss) may be burned and scorched, the burnt material to be applied next the wound, and that which is scorched as an external dressing. The author secured primary union of an amputation below the knee under a dressing prepared by fire, as above mentioned, two pillow slips and a sheet being utilized for that purpose.

Dry Heat. This also has a very limited application; a very high temperature is required, 150° C., and an exposure of at least one hour. This will kill all known bacteria and their spores. Its application is limited to the sterilization of glassware used in the operating room and in the laboratory. Articles made of rubber, wood, or crockery cannot be sterilized by dry heat.

The hot-air chamber is a single or double-walled sheet-iron or copper chest, having a door on one side and several removable shelves on the inside. The top of the chest is perforated by two holes, in one of which is placed a thermometer to indicate the inside temperature. The other opening is plugged with cotton. A large Bunsen burner is placed under this chest, which rests on an iron frame. In order to distribute the heat evenly, a piece of wire gauze is placed over the burner.

The articles to be sterilized are placed on the shelves within the chamber, but not until the temperature has reached 150° C., so that they will remain in the chest exposed to that temperature for one hour. Frequently the mistake is made of counting the time from when the tubes, etc., are placed in the chamber while it is still cold.

Steam. All woolen and cotton fabrics, gauze, and wood must be sterilized by steam. Steam is very penetrating, and is, therefore, a most effective sterilizing agent.

The Arnold steam sterilizer, or one patterned after it, may be used for this purpose. It is simple in construction, easily employed, and inexpensive. An exposure of one hour to 100° C. (212° F.) is sufficient to destroy bacteria, but bacteria which are in the resting-spore stage may resist the action of steam for hours.

As such a prolonged steaming would be impracticable, the intermittent or fractional method of sterilizing is used. The dressings, gauze, etc., are exposed to the action of the steam for thirty minutes on each of three successive days. The first sterilization will kill all the fully developed bacteria. Any spores which may have survived this sterilization will develop into bacteria in the course of the succeeding twenty-four hours, and these are killed by the next sterilization. After the third sterilization the materials can safely be said to be absolutely sterile.

Steam is available for sterilization in four conditions: (a) Plain steam or steam in equilibrium; (b) steam in active motion, called live steam; (c) steam under pressure—high tension steam; and (d) superheated steam. When steam (100° C.) is passed through over-heated tubes or chambers and its temperature is raised above 100° C., it is said to be superheated. This condition of steam is not very practicable for surgical purposes. When steam is used under pressure (high tension) in an autoclave, it is the most powerful and practical agent at our command to sterilize surgical dressings, etc., in hospitals. It is a more potent germicide than live steam, and live steam kills anthrax spores in less than fifteen minutes.

Sterilization by steam may also be effected by exposing the article to be sterilized to the action of streaming or live steam for one hour, or for thirty minutes to the action of steam under a pressure of fifteen pounds in the autoclave, which is sufficient to destroy the spores. The dressings are placed in the autoclave loosely, the top is screwed down firmly, and the escape valve left open until the steam has displaced the hot air. The valve is then closed and steam is generated for thirty minutes, or longer, if desired. Cooling must be allowed to take place gradually.

DISINFECTION OF INSTRUMENTS AND MATERIALS USED IN THE OPERATING ROOM.

Great care must be observed in the operating room. Everything should be absolutely sterile. Any instrument, towel, sponge, or ligature that falls to the floor or comes in contact with any unsterilized object should be removed at once and re-sterilized before it is again used.

Instruments may be sterilized by dry heat; but it is preferable to subject them to steam or to boil them in a one or two per cent. solution of sodium bicarbonate, which prevents rusting and does not dull the edge of sharp instruments. They can either be placed directly in the water or wrapped in towels or pieces of gauze. As soon as they are removed from the sterilizer they are immersed in sterilized or distilled cold water.

Boiling water, at 100° C. (212° F.), kills all forms of cocci in at least fifteen seconds, and anthrax spores in two minutes. The boiling point of water varies with altitude, and this must be considered in using boiling water for sterilization in high altitudes, for pressure to raise the temperature to 100° C. must be used, or the addition of sodium carbonate (one per cent.) to boiling water at 100° C. raises the temperature to 104° C., and increases its germicidal power, which effects sterilization in high altitudes. Boiling soda water is a convenient agent for sterilizing surgical instruments, suture and ligature material, but it may also be employed to sterilize towels, sheets, gauze sponges, dressings, gloves, caps and gowns. In the preparation for operations in homes and in the country, what I should call the *kitchen method of sterilization* is safe and efficient. It makes a profound impression upon the relatives and the friends of the patient to be operated upon to receive a demonstration for three days by the nurses of the sacred duties and responsibilities of nurses in safeguarding some of the portals of danger to the person compelled to go under the knife. We should on every available opportunity educate the people regarding the importance of scientific surgical work.

CHEMICAL DISINFECTANTS.

In the form and strength in which chemical disinfectants can be put to surgical purposes they are not to be compared with boiling water and steam for efficient and safe disinfection of inanimate materials. While they are valuable in the preparation of rooms, some kinds of instruments, certain suture and ligature materials, for disinfecting the hands and wounds, still they are not the best means of disinfecting dressings, bandages, gauze sponges, towels ,sheets, gowns, etc., in everyday use by the surgeon. In this connection the reader is referred to the chapter on "Antiseptics and Disinfectants."

The chemical disinfectants may be used either in a gaseous state or in solution. The best gases are nitric oxide, chlorine, sulphur dioxide and formic aldehyde vapor. The best of these is the last mentioned. Both nitrous fumes and chlorine have many practical disadvantages and objections which I need not mention. If sulphur dioxide is used, the room should be thoroughly moistened and about 4 pounds of sulphur burned to every

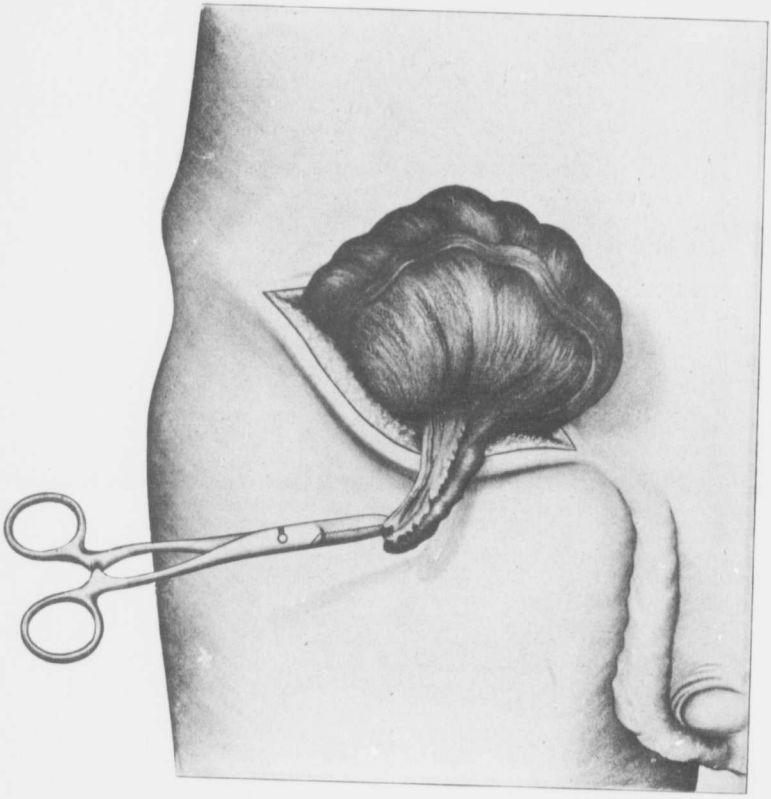

PLATE XVI.

Congested—4 days.

100 cubic feet of space. The formic aldehyde vapor is the most trustworthy known and its method of utilization has already been described.

Formaldehyde.—One of the most active disinfectants and germicides is formaldehyde. It is obtained in the market under the trade name of formalin or formalose, a 40 per cent. aqueous solution of the gas formaldehyde. The gas is extremely penetrating, and is very irritating to the mucous membranes. This limits its use to the disinfection of inanimate objects. A 15 per cent. solution at 150° C. kills anthrax spores in one and a half hours. Used as a liquid it does not possess any advantages over carbolic acid and similar preparations. When vaporized, it is vastly superior to all other agents. Robinson, of England, found that it will penetrate a mattress and kill test tube cultures placed within it. The gas is generated rapidly and continuously by any of the different styles of formalin generators on the market. It is used in the form of a spray; or sheets saturated with formaldehyde solution are hung up in the tightly closed room for twelve hours, after which the doors and windows are thrown wide open and the room thoroughly aired. The number of sheets required will depend on the size of the room. In a room 10x10 feet two sheets will suffice. All crevices, keyholes, etc., should be packed with cotton, so that none of the vapor will escape.

Novy's and the "Central" formaldehyde generator, and Schering's lamp, are exceedingly simple in construction and inexpensive. Others, like Trillat's autoclave, are complicated and expensive Either the apparatus is placed in the room, or the vapor is sent in through the keyhole by means of a supply tube. The temperature of the room should be about 21° C, and it should contain sufficient moisture

Sulphate of copper is an excellent and at the same time a very cheap disinfectant. It is not irritating in one per cent. solution, and has no odor. It is especially valuable for the disinfection of typhoid stools. A pound of the sulphate is dissolved in 2½ gallons of water, and a pint of this solution is kept constantly in the vessel which receives the discharges from both bowels and bladder. The poison is destroyed in fifteen minutes if the infected material is mixed thoroughly with the solution.

In cases of strangulated hernia occurring away from hospitals, where no antiseptics are available but "blue stone," after cleansing the operative area and hands with soap and water, the solid sulphate of copper may be efficiently used to disinfect the skin of the patient and the hands of the operator.

Harrington's Solution.—In this connection, the following excerpt from an article by Charles Harrington of Boston (*Annals of Surgery,* October, 1904) is of interest. He says:

"After thorough brushing with hot soapsuds, what agent can be relied on to kill the bacteria that have not been removed? Not corrosive sublimate 1-1000, if we soak the hands a quarter of an hour; not creolin, 1-20, if we soak them much longer; not lysol, nor solveol, nor bacillol, nor sulphonaphthol; not peroxide of hydrogen; not sublamin; not mercuric cyanide; not even formaldehyde in 5 per cent. solution, even though the skin could

stand it. All of these agents and several others I have tested under the most favorable conditions against the common pus organisms and all failed to kill within reasonable periods. A little more than a year ago I published the results of a series of experiments which demonstrated, among other things, that corrosive sublimate, 1-1000, requires more than ten minutes' contact to kill staphylococcus albus, and that weaker solutions (1-5000) act far more slowly. Recently I tried 1-500, which solution is too strong and irritating for general application, and found that it would kill staphylococcus aureus in from sixty to ninety seconds and the other pyogenic organisms in from forty to sixty seconds. With 1—100, I found that the aureus was killed after twenty seconds. Now, if 1—100 cannot destroy pus cocci in twenty seconds, and 1—500 can do so only after a minute, and 1-1000 only after ten minutes, what measure of disinfection does the surgeon attain who merely dips his hands into the solutions of corrosive sublimate in common use for only a few seconds and then rinses them off with sterile water or salt solution?

"The following table shows the number of minutes that the organism employed remained in contact with the several disinfectants without injury, and also the shortest exposure observed that was sufficient for its destruction:

Agent.	Strength.	Failed to Kill. (Minutes.)	Killed. (Minutes.)
Carbolic acid	1-40	3	4
Carbolic acid	1-20	1	2
Trikresol	1-40	2	3
Trikresol	1-20	1	2
Lysol	1-40	7	10
Lysol	1-20	2	3
Solveol	1-40	10	15
Solveol	1-20	10	15
Bacillol	1-40	4	5
Bacillol	1-20	3	4
Creolin	1-40	10	15
Creolin	1-20	10	15
Sulphonaphtol	1-20	30	45
Hydrogen peroxide	Full strength	4	5
Formaldehyde	1 per cent.	60	..
Formaldehyde	2 per cent.	30	45
Formaldehyde	3 per cent.	25	30
Formaldehyde	5 per cent.	15	20
Mercuric cyanide	1-1000	180	..
Sublamin	1-1000	10	..
Potassium permanganate	Saturated	10	15
Potassium permanganate and hydrochloric acid (Andrewes)	1 per cent. each	4	5

"My next endeavor was to find some preparation that will kill not in minutes, but in seconds. First, I experimented with a mixture which

would kill *staphylococcus aureus, albus, and citreus* and *bacillus pyocyaneus* in less than ten seconds. Then I tried weakening it, first as to one, then as to another ingredient, but always aiming to keep its limit of required time at about ten seconds. The ninth combination tried appeared to be as weak with respect to each of the active constituents as could be made, retaining that degree of efficiency—that is, to kill the pyogenic bacteria on silk threads, not in the skin—within ten seconds. I tried it against pus from a carbuncle and against two other specimens of uncertain origin, and at the same time I tried carbolic acid and trikresol, which had proved to be the quickest in action of the twenty-two solutions above mentioned.

"The carbuncle pus was killed by trikresol (1-40) in five and a half minutes and by carbolic acid (1-40) in four; my mixture killed it in less than a minute, though not in thirty seconds. The other specimens of pus were both killed by trikresol and carbolic in two minutes, and by my mixture in less than thirty seconds.

"I have repeatedly soaked my hand (without any preliminary scrubbing) for two minutes, and then have had plantings made from material removed from about each nail and from scrapings from the skin of each finger and from the palm. Occasionally, I got a growth; but, as a rule, every tube of bouillon remained clean and sterile. A young man, whose duties included the daily cleaning of cages in the animal room and whose hands were not the subject of much thought or care, soaked his hand (after ordinary washing) on ten different occasions for from two to five minutes; and each time each nail and finger was tested, *i. e*, ten cultures were made In seven of the experiments there was entire absence of growths; in one, a growth was obtained from one forefinger; in one, from one middle finger; and in one, from one thumb. That is to say, of 100 plantings only three showed growths.

"At the Boston City Hospital, Dr. Monks immersed his hands for two minutes without previous scrubbing; the skin of both hands gave negative results, but growths were obtained from the nails of the right hand; the nails of the left hand were sterile. Three of the assistants did the same thing, but after scrubbing. The hands of all three were sterile; the nails of the left hand of one assistant gave a growth.

"For my combination, I make no claims whatever, and no assertions that later might have to be recalled. To my hands and to those of my assistants, the mixture has caused no irritation beyond the same degree of biting that one notices when in contact with peroxide of hydrogen. Two of the surgical assistants reported slight exfoliation two days after trying it, but nothing more. I recognize that some skins may be more markedly irritated, and that not sufficiently numerous experiments have been made to warrant unqualified recommendation.

"The composition of the mixture is as follows:

Commercial alcohol (94 per cent.).....640 cubic centimetres
Hydrochloric acid ..... 60 cubic centimetres
Water .....300 cubic centimetres
Corrosive sublimate ..... 0.8 gramme

"This mixture, then, contains 60 per cent. absolute alcohol, 6 per cent. commercial (strong) hydrochloric acid, and 1-1250 corrosive sublimate. Now, 60 per cent. alcohol will destroy *Straphylococcus aureus* in four minutes; 10 per cent. hydrochloric acid is equally effective; and 1-1000 corrosive sublimate will kill it in three minutes. Why a combination containing all three substances, but with lesser proportions of the acid and the salt, is so much quicker in its action than any one of them alone, is an interesting question of physical chemistry."

CHAPTER XI.

ANTISEPTICS AND DISINFECTANTS.

It is impossible in the limited space at my disposal to enter into a detailed discussion of the antiseptic value of all the known antiseptics. I will, however, consider the most important and those commonly used.

Carbolic Acid.—On account of the great prominence that Lister gave to this antiseptic, it should be considered first.

Pure carbolic acid (phenol) is obtained from coal-tar oil by fractional distillation, and occurs in colorless crystals which have a melting point of 38.8° C. (104° F.). Carbolic acid crystals are soluble in water, 1 in 13; in glycerine, 3½ in 1; in olive oil, 1 in 2; in chloroform, 3 in 1; in ether, 4 in 1; in alcohol, 6 in 1.

Carbolic acid is usually used in a 20 per cent. solution. This is too strong for the hands of many operators without the immediate use of alcohol. It forms insoluble albumen compounds which interfere with its germicidal power. If, however, carbolic acid is combined with an equal amount of hydrochloric acid, its germicidal action is greatly increased. A 95 per cent. solution of carbolic acid applied to the skin acts as an anesthetic, giving a sensation of numbness and coldness with a loss of tactile sensibility. Moist dressings of 5 per cent. strength have been known to cause gangrene, due to the formation of thrombi in the arterioles. The absorption of carbolic acid into the system is first made manifest by the smoky appearance of the urine. If an overdose enters the circulation it is shown by pallor, cyanosis of the mucous surfaces, shallow breathing, dilated pupils, feeble pulse, sub-normal temperature and not infrequently delirium. If the dose is fatal, convulsions and coma usually follow. N. Senn has pointed out the danger of using strong solutions of carbolic acid, and mentioned a death following the injection of a few drops of pure carbolic acid into the sac of a hydrocele. It is remarkable that when 95 per cent. carbolic acid is swallowed in sufficient quantities to cause death coma is one of the first manifestations. I have made it a practice for years to use 95 per cent. carbolic acid on account of its excellent anesthetic, antiseptic, deodorizing and cauterizing effects without any deleterious results. If alcohol is used on the carbolized surface to neutralize the continued local action of the acid, there is practically no danger of carbolic intoxication. The objection to using carbolic acid on the hands in sufficient strength to insure complete germicidal action is that it corrugates and anesthetizes the skin.

The experiments made to determine the germicidal powers of carbolic acid are more or less contradictory. Sufficient evidence has been adduced to show that carbolic acid requires too long a time to sterilize

the skin of the patient or the hands of the surgeon. Solutions of carbolic acid and oil are inert, so far as being bactericidal is concerned, and solutions in alcohol and glycerine are less powerful than watery solutions. Carbolic acid is now chiefly used in antiseptic surgery for the preservation of materials previously sterilized, such as gauze-sponges, sutures, ligatures, etc., etc. It is no longer employed for irrigating purposes while operating, for it only irritates the parts, induces a copious flow of serum, and not infrequently causes superficial tissue necrosis. Ninety-five per cent. carbolic acid disinfects instruments that have been rendered free from fat almost instantaneously, and does not injure them.

Geppert demonstrated that anthrax spores lived in a 7 per cent. solution for 38 days; then they grew in agar-agar and finally killed guinea pigs. Christmas kept anthrax spores in a 20 per cent. solution of carbolic acid for a month without lessening their vitality. It was shown by Klein that anthrax bacilli are killed in five minutes by a 5 per cent. carbolic solution. Pyogenic cocci are more easily destroyed by carbolic acid than are the anthrax germs. The *staphylococcus aureus*, on the other hand, is destroyed in from two seconds to fifteen minutes by a 5 per cent. solution.

Other Coal-Tar Products.—Many coal-tar derivatives besides carbolic are used as antiseptics in the operating room. *Lysol* is a brown liquid, alkaline in reaction, made from tar-oils. It is used in solutions of one to two per cent. strength for cleansing the hands or skin. It has a soapy feel. I use it to aid in pulling on rubber gloves. When the gloves are filled with the lysol solution, the hands slip into them with comparative ease. It is a feeble germicide and not so irritating to the skin as carbolic acid. What remains of it in the gloves only renders the hands the more aseptic. Lysol is incompatable with acids. It is highly toxic.

Creolin, cyllin, izol and other coal-tar products are more useful as deodorizers than as disinfectants.

Alcohol.—Alcohol is used more freely than any other antiseptic. It is a powerful germicide in the strength of 70 per cent., but is of no value when pure (95 per cent.). In disinfecting the hands and the field of operation it removes epidermal scales and fat from the skin, abstracts water, acts germicidally and prepares the field for some other and more penetrating agent. In conjunction with corrosive sublimate or biniodide of mercury it is a most practical and efficient antiseptic.

Alcohol kills the tubercle bacillus after five minutes' exposure, and a 40 per cent. solution kills pus cocci in two hours. Sixty to seventy per cent. is the most efficient strength. It is useful for disinfecting instruments, basins, sutures and ligatures, and for preserving materials used in the operating room.

Corrosive Sublimate ($HgCl_2$).—Corrosive sublimate, also known as bichloride of mercury, mercuric chloride, and sublimate, is an excellent antiseptic and disinfectant. It is soluble in water, alcohol, ether and glycerine. It is soluble in water, 1 in 19; in absolute alcohol, 1 in 3; in ether, 1 in 6; in glycerine, less than 1 in 2. It is a powerful poison and may kill by absorption from the skin or mucous cavity. It forms an albuminate

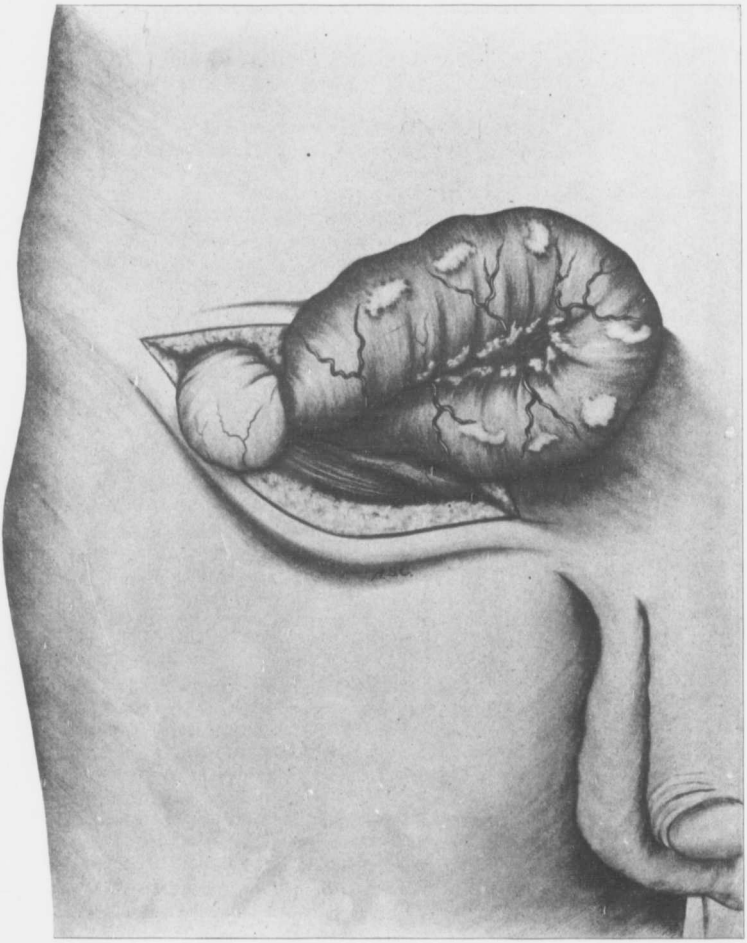

PLATE XVII.

Inflamed Hernia.

when applied to the tissues, rendering it inert. Even in aqueous solutions of 1 to 1000, it acts as a great irritant to the hands of some operators. It restrains the development of anthrax spores in as weak a solution as 1 in 30,000, and it kills them in from 5 to 10 minutes in the strength of 1-1000. A 1-1000 solution kills the tubercle bacillus in one minute. Growth of the pus cocci is restrained by a 1-30,000 solution; 1-1000 kills them in from five to ten minutes. Sternberg advocates its use as a general disinfectant in 1-1000 or 1-500 solution for spore-containing material, and in 1-5000 or 1-2000 for non-sporulating pathogenic bacteria. Its action is increased by the addition of hydrochloric, picric or tartaric acid.

Harrington, of Boston (as before stated), has demonstrated that in combination with hydrochloric acid and alcohol the germicidal action is greater than that of either one alone. The chief uses to which corrosive sublimate is put to-day are: (a) To disinfect the hands of the operator; (b) the skin of the patient; (c) to sterilize catgut, as well as in the preservation and preparation of other ligature and suture materials.

Solutions of corrosive sublimate are poisonous, sometimes cause dermatitis, lessen the resisting power of the tissues, destroy metallic instruments, are easily decomposed by serum and purulent discharges, and are incompatible with an alkali. Solutions of corrosive sublimate in distilled water become reduced in strength from the formation of an oxide.

Geppert found by precipitating the mercury with ammonium sulphide, thus getting the inert and insoluble sulphide, that pus organisms were not killed by the bichloride solutions as was formerly supposed, but that they frequently retained their vital powers of infecting animals. This was a revelation to those operators who so thoroughly relied on sublimate solutions as a disinfectant in conformity with the bacteriologic findings of former experimenters who asserted that staphylococci (yellow) were killed by 1-1000 corrosive sublimate solution in a few seconds. Since Geppert's experimental findings have been verified by Abbott in Welch's laboratory, and also by others, corrosive sublimate as a disinfectant is not considered as being infallible. Sublimate solutions are very toxic, and it is known that deaths have been caused by prolonged irrigation of wounds with these solutions. I recall seeing a case of sublimate poisoning in consultation where death followed the use of an intra-uterine douche (1-1000) for sepsis after a miscarriage in the third month. It is very dangerous to irrigate raw surfaces with this poison. Even if constitutional symptoms do not arise, local necrosis is sure to occur. In pus cases irrigation with bichloride solutions is often indicated. One may begin with a solution of the strength of 1-5000 and irrigate till one-third is used, and after that the solution is diluted rapidly to 1 in 20,000, and then the wound is irrigated with normal salt solution.

Corrosive sublimate as a disinfectant has stood a long practical test, and while we no longer wash fresh wounds with it, still, in combination with other agents, as Harrington's solution, it is the best practical germicide at our command for disinfecting the skin of the patient and the hands of the operator.

Sal-alembroth is an ammonic-mercuric-chloride. It is soluble in water to the extent of less than its own weight. While it combines with albumen, it does not do so as readily as does corrosive sublimate. It is used in the preparation of alembroth gauze, wools, antiseptic dressings, etc., but is very objectionable.

Biniodide of Mercury (Potassio-Mercuric-Iodide).—This substance is spoken of very highly as a disinfectant. Pearson (*Modern Surgical Technique in Operations*, page 76) says, "Biniodide possesses the following advantages as compared with sublimate: (1) It is a more powerful germicide; (2) it does not coagulate albumen; (3) it does not cause precipitation with blood, except when the latter is in excess; (4) it is less irritating to wounds; (5) it is much less irritating to the skin, save in exceptional cases; (6) it is more penetrating; (7) it is safer for washing out septic wounds and cavities, being less toxic; (8) it does not cause any immediate corrosion of metallic instruments".

Kanthack and other bacteriologists have pointed out that biniodide of mercury possesses superior germicidal powers than bichloride. It has one practical disadvantage, however, as compared with bichloride, and that is its much greater cost.

Biniodide Solutions.—Stock solution 1 in 1000.

Biniodide, 100 grams; potassium or sodium iodide, 1000 grams; distilled water, 1000 c. c.

By dissolving the potassium or sodium iodide in the water before adding the mercury salt a clear solution is obtained. If a precipitate is thrown down, the solution is not strong enough; then add a little more biniodide. The strength of the stock solution is about 1 in 600. If colored with eosin it will not be mistaken for other clear fluids. The agent can be obtained in tablet form. One tablet to a gallon of water makes a 1 in 1000 solution.

Alcoholic solution of biniodide, 1 in 500, is the one recommended (Pearson) for disinfecting the hands. It is made by adding one tablet to 5 ounces of water (distilled), and 15 ounces of 90 per cent alcohol, or methylated spirits.

A 70 per cent. alcoholic solution is obtained with the one, and 67.5 per cent. alcoholic solution with the other. A preserving solution, 1 in 1000, for the preservation of ligatures and suture materials, is made by adding 5 to 10 per cent. of sterile glycerine to the alcoholic solution.

Iodine.—Iodine is a very useful and efficient non-metallic element. It is a solid at the ordinary temperature. It is slightly soluble in water, but by adding a little potassium or sodium iodide it dissolves freely. It dissolves in alcohol, 1 in 10. When applied to the skin it produces a stain and acts as an irritant, rubefacient, disinfectant or vesicant according to the strength of solution used and the frequency with which it is applied. For complete information regarding iodine as a germicide I refer the reader to Senn's article on "Iodine in Surgery, etc." (*Journ. of Surgery, Gynecology and Obstetrics*, July, 1905). Senn maintains that aqueous solutions of iodine destroy: (1) Actinomyces (bovis) (a) 1 in 500, in fifteen minutes; (b) 1 in 200, in one minute. (2) Staphylococcus pyogenes

aureus, 1 in 200, in five minutes. (3) Streptococcus pyogenes, 1 in 500, in two minutes. (4) Anthrax bacillus and its spores, 1 in 100, in ten minutes. (5) Tubercle bacillus: (a) 1 in 200, in sixty minutes; (b) 1 in 100, in seven minutes.

Senn considers iodine the safest and most powerful of all antiseptics. He uses it to disinfect the nails as the last step (tincture). It is used in the preparation of catgut.

Iodoform.—In hernia operations iodoform has a place as a dusting powder, although not used nearly as much as formerly. It is soluble in ether, 1 in 7; chloroform, 1 in 14; alcohol, 1 in 120; olive oil, 1 in 30; glycerine, 1 in 100. When absorbed through wounds it produces poisoning. Locally iodoform occasionally causes a dermatitis, vesicles or acute eczema. It has many objections. It has a disagreeable odor, and it is a poor antiseptic and does not kill germs, except under special circumstances. In the tissues of the hand, in granulation tissue, especially in tuberculous tissue, iodoform decomposes in from 3 to 5 days in the absence of oxygen, and is then germicidal in its action, destroying staphylococci and streptococci. Heile (*An. of Surgery*, Dec., 1905) thinks the decomposition of iodoform in the presence of oxygen sets free di-iodo-acetylene—and that this is the germicidal agent.

Potassium permanganate, in 5 per cent. solution, kills anthrax spores in twenty-four hours. The dilute solutions used for irrigating septic wounds are absolutely worthless so far as their antiseptic action is concerned. They are usually employed hot, and to the heat must be ascribed their much vaunted value as germicides. Potassium permanganate is decomposed easily by wound secretions, and it is too slow in action for the operating room.

Silver nitrate destroys anthrax spores in twenty-four hours in a 1-10,000 solution. Behring says it is superior to mercuric chloride. It is very irritating, and combines with chlorides and albumins to form insoluble silver salts, which have no germicidal value. The various other silver salts (organic) now on the market do not combine with the albumins, and are less irritating than the nitrate, but the clinical reports are so contradictory that it is impossible to determine their antiseptic value with any degree of positiveness. Hardly any two men favor the same compound.

Boric acid is practically worthless as a disinfectant. A saturated solution fails to kill pus cocci in two hours. It is a very weak antiseptic. A 5 per cent. solution failed to destroy anthrax spores in five days (Koch). It is used very widely as a dusting powder on wounds, but is sometimes injurious. It is a good solution in which to keep soft rubber sterile catheters, etc.

Pyoktannin.—Many of the anilin dyes are germicides, especially blue pyoktannin or methyl violet. The pus cocci and anthrax bacilli are killed in thirty seconds by a 1-1000 solution; the typhoid bacillus in thirty minutes. Malachite green possesses even greater germicidal value than pyoktannin. The objection to these dyes is that they stain and discolor the tissues. The author employs them to stain fistulæ and sinuses.

Chlorine.—All the haloid elements are active germicidal agents. Chlorine combines readily with hydrogen and liberates nascent oxygen. It is most active in the presence of moisture. A moist atmosphere, containing the gas in the proportion of 1-2500, kills the anthrax bacillus in twenty-four hours. In the proportion of 1-200 it kills the tubercle bacillus in an hour. It is very irritating to the tissues.

Hydrogen Peroxide.—The solutions on the market are extremely variable in strength and the results of their use uncertain. They deteriorate very rapidly. Peroxide is used principally for cleansing suppurating wounds, as it possesses the power of liberating nascent oxygen, which oxidizes the purulent secretions.

In order to carry out the principles presented in this chapter, special requirements must be met before aseptic surgical technic can claim superior results quite apart from the operator's skill in surgical procedures and his knowledge of hernias. These requirements are the sterilization and disinfection of everything that may come in contact with the wound. The first, if not the most important, is to render the hands and forearms of the operator and his assistants surgically clean. The hands are always covered with bacteria while performing their everyday functions. It is true that a surgeon who knows the dangers of infection can and does keep his hands out of abscesses, and does not handle septic cases without rubber gloves, or examine the mouth, vagina or rectum with bare hands; but in spite of all ordinary precautions that he can possibly observe against coming in contact with virulent pyogenic organisms his hands will get dirty and in that dirt lurk the sources of inflammation and all that inflammation implies.

It is a very difficult task to destroy all the germs and their spores on the hands, under the nails, and in the follicles of the skin without destroying the skin at the same time. Indeed, so discouraging has this task been that many authorities consider it hopeless to try to render the hands completely aseptic (Needham-Green *"On the Sterilization of the Hands,"* 1904), realizing that a person can go so far and no farther. Year by year a little more information has been gained until now we can say that the hands of some persons at least may be disinfected so thoroughly in a few minutes as to fail the detection of germs. A man who operates almost every day and uses antiseptic reagents, such as mercuric chloride, has his skin impregnated thoroughly with the drug. It is easy to see that his hands are less liable to implant pus germs into the wound than are the hands of one who operates only occasionally. In evidence of this sublimated condition of the deep skin let me say that if such an operator will rub lanolin into the skin of his hands and forearms for fifteen minutes, he will suffer the symptoms of salivation. This observation I verified on myself.

THE TOILET OF THE HANDS AND FOREARMS.

Keep them clean. Avoid scratches or abrasions by wearing gloves when driving, fishing or hunting. If you receive scratches, disinfect them and apply collodion for protection. Ungual tags should be removed and pro-

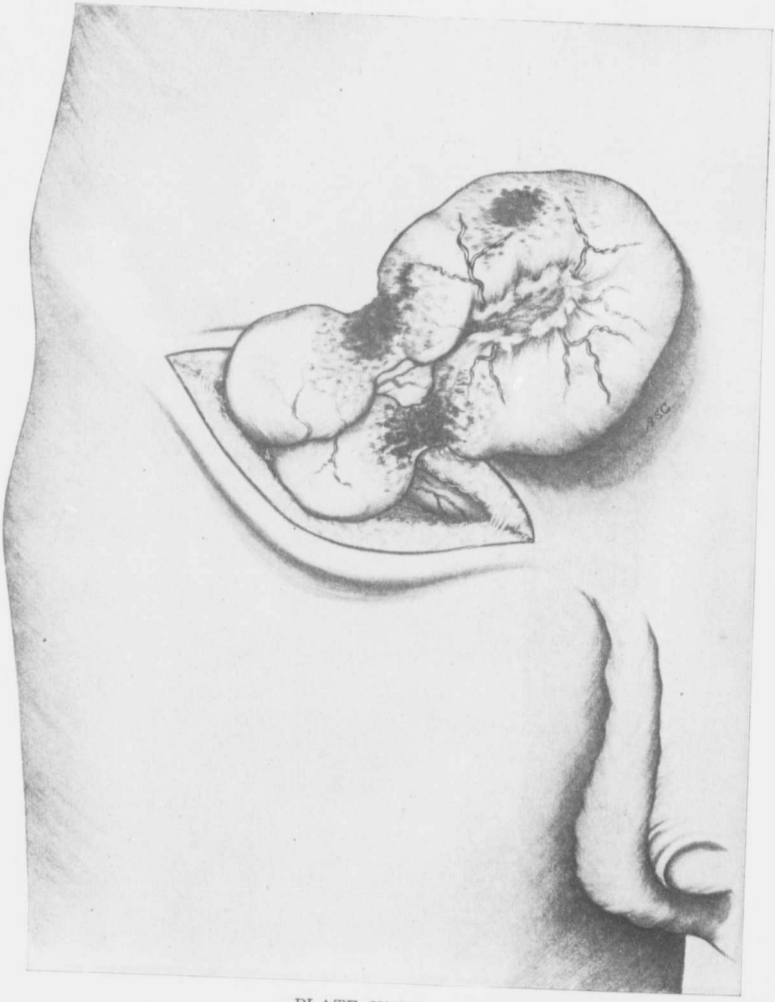

PLATE XVIII.

Ulcerated Hernia.

tected in the same manner. Any one who has a pustule or suppurating wound, be it ever so small, should consider himself incapacitated from operating or assisting at an operation. The wearing of rubber gloves does not excuse him for operating. The nails should be kept short to prevent the accumulation of extraneous matter and to enable one to have free access to the subungual spaces for their disinfection.

The forearms should be kept free from hair by shaving them every few weeks. It always gives me a shudder to see a hairy arm enter the abdominal cavity. There is no reason why this precaution should not be practised. Rough and horny hands require more time for their disinfection than those with smooth and flexible skin. A good plan to train assistants, internes and nurses to take the time required to scrub the hands in soap and water in order to remove gross dirt, is to ask each of them before scrubbing first to anoint the hands and forearms with an ointment of powdered charcoal. It will teach them that it requires much more time, patience and perseverance to rid the skin of black dirt than they anticipated. If germs were visible to the naked eye, what an interminable job it would be to scrub them off!

One secret of preventing the hands from cracking is to scrub them carefully after each operation in order to remove all traces of blood, and then rub any ointment that is sterile and feebly antiseptic into the crevices and follicles of the skin, and with sterile towel rub off the redundant ointment. I find this to be an excellent aid in keeping the hands in a cosmetic state. If called in consultation, and it is deemed best to examine septic places on or in the body, which would undoubtedly befoul my hands if not protected, and if rubber gloves are not available, I feel that some security is obtained by smearing the hands with sterile vaseline, or some cerate, before making the examination.

While scrubbing the hands with soap and water preparatory to performing an operation, care must be exercised not to reinfect the hands by touching septic brushes, towels, water taps, etc. In every well-furnished operating room an automatic arrangement is provided to turn the water on and off without the use of the hands.

The simple technic of scrubbing the hands is so frequently faulty in aseptic precaution that I am constrained to dwell on it. In training amateurs in surgical technic I have frequently given no instructions whatever, but simply ask them to scrub up. Each in turn picks up a sterile nail brush in one hand and a chunk of soap in the other and at once begins a vigorous scrubbing of the one and then of the other hand. Is not this the usual way to begin the scrubbing process? Yes, but it is wrong, and there is danger of autoinfection from the germs beneath the nails and on the skin being forcibly rubbed into an abrasion created by the brush or into a raw surface previously present. It is only recently that an able surgeon lost his life from auto-streptococcic infection received in this way.

The skin of the hands should be softened by washing them in soap and water in the old-fashioned way before applying the brush. This process not only renders the skin less liable to injury from a stiff bristle in the

brush, but it also removes the gross source of infection. This I call a primary scrub, and it should be done with warm sterile running water in a room used for this purpose. One may at once poke his fingers deeply into the soapdish; another sticks to the same brush throughout the entire process, or reinfects his nails with his penknife taken from his pocket, or touches spectacles, or even wipes them with a clean (?) pocket handkerchief, after finishing his scrubbing. A sterile nail file should be used not after the cleansing process with brush, soap and water, but somewhere in the middle of the process. The nail file removes softened masses not as yet reached by the brush and thus its use should not be left to the last.

In order to receive the greatest benefit from soap and water cleansing with brush, about fifteen minutes should be consumed in the operation.

1. Five minutes with soap and warm water.
2. Five minutes with fresh sterile soft soap, sterile brush and flowing water.
3. Use nail file or scalpel.
4. Five minutes with fresh sterile soap; fresh sterile brush and water flowing freely on the forearms and hands.

It must be remembered that one man is capable of doing more cleansing in five minutes than another does in double that time. It has been proven bacteriologically that the hands are not freed from dangerous bacteria by scrubbing with soap and water, and in respect to this fact some chemical germicidal reagent must be used to destroy the remaining bacteria on the skin. The nails should be manicured once a week. Any abrasion caused is at once protected with a drop or two of equal parts of iodine and collodion.

Methods of Hand Disinfection:—

Pearson's Method.

1. Scrubbing with soap and water and changing brushes for five minutes.
2. Methylated spirits rubbed on hands, nails and forearms for three minutes.
3. Spirituous solution of biniodide (1 in 500) for two minutes.
4. Biniodide wiped off with methylated spirits.

In the case of one whose hands are well cared for the process may be accomplished in seven minutes, viz: "Washing stage three minutes; alcohol stage, two minutes; biniodide stage, two minutes."

Kocher's Method.

1. Wash the hands thoroughly with soap and brush under steaming hot water.
2. Wash off the soap with flowing warm water.
3. Scrub with alcohol (85 per cent.) inch by inch.
4. Wash off alcohol with stream of warm sterile water.

This process is for hands cared for surgically. For highly infected hands he recommends an additional scrubbing and bathing with sublimate solutions of 1 in 500, or 1 in 1000, in strength.

Fürbringer's Method.

1. Scrub with soap and water for three minutes.

2. Immerse hands and forearms in 95 per cent. alcohol for one minute, using the scrubbing brush to remove fats, etc.

3. Wash hands and forearms in sublimate solution 1 in 1000

In regard to the use of alcohol as a disinfectant, it has been shown that 70 per cent. alcohol is more germicidal than 95 per cent. Harrington has proven that a sublimate solution, 1 in 1000, is not as potent a germicide alone as when it is combined with 70 per cent alcohol and 6 per cent. hydrochloric acid.

Permanganate of Potash and Oxalic Acid Method.

This method does not stand the bacteriologic test, and is only mentioned to be condemned. (See experiments of Leedham-Green and Harrington.) It has been used extensively in Johns Hopkins' Hospital and for a time most American surgeons employed it.

Chlorinated Lime Method.

This process is cumbersome, but is practised more or less. It consists of the following steps:

1. Scrub as usual.

2. Take a handful of chlorinated lime and make a paste of it with warm water.

3. Take another handful of crushed, crystalline washing soda and mix it with the lime paste between the hands, and then thoroughly rub it into the skin until the roughness of the soda is no longer felt but a sensation of heat is felt, due to the liberation of chlorine gas.

4. Rinse the hands in a two per cent. solution of ammonia to remove the odor.

Rubber Gloves. After the hands are sterilized the operator may use rubber gloves for two purposes, (a) to keep the hands aseptic, and (b) to guard against infection of the wound from the hands. In hernia operations and in all aseptic surgical procedures the latter is the prime consideration. That they obtund the sensibility of the fingers there is no reason to doubt and the thicker the glove the greater the loss of normal tactile sense.

In consideration of the uncertain asepticity of the hands obtained by scrubbing and by disinfectants, especially in the case of surgeons, assistants and nurses who have not studied bacteriology to any great extent (and these include the vast majority of persons who operate or who assist at operations), and also in view of the rapidity with which gloves on the hands may be rendered aseptic with 95 per cent. carbolic acid, 1 in 200 bichloride; pure lysol, etc., it is reasonable to conclude that less infection of wounds occurs during operations when rubber gloves are worn. When the hands are not aseptic, the gloves are reinforced in pulling them on.

In cases demanding surgical interference so emergently that there is no time to scrub up, an assistant may put the gloves on the septic hands of the operator. If the gloves are not sterile and speedy action is a life-saving element, then it is admissible to put the gloves on dirty hands and sterilize them immediately as already mentioned. On more than one occa-

sion I have thus performed what might be called a cyclone operation aseptically, saved my patient's life and secured primary healing of the wound. It is the man who knows most about the science of surgery who generally carries out the best operative technic.

Rubber gloves were first used in America by Halsted. They are now used by surgeons in almost every clinic room in this country. There is no doubt in my mind but that the most recent data regarding hand disinfection will materially limit their employment.

Gloves should be worn when operating on septic cases and also when dressing so-called pus cases. The assistants should wear gloves for the same reasons. When the operator or his assistants have any abrasions on the hands, it is to their own interest to wear rubber gloves while handling or operating on an infected case. The gloves must be thin, as thin as is consistent with durability, and they must fit. They should be boiled in a 1 or 2 per cent. solution of soda, and before being put on the hands they are filled with an aqueous solution of lysol in order to continue the disinfection and to prevent their being torn. The objection to a dusting powder within the gloves and on the hands is that it is an additional obstruction to the sense of touch. Most operators strip the gloves over the fingers as they would a leather glove, but it is much better to use a soft hand brush for this purpose.

The gloves when torn may be repaired very readily either by means of a rubber cement or by applying a small patch. The cement is used for very small tears and for punctures, while the patch is used for the repair of larger tears and welded with the Paquelin cautery.

Although it is not quite as satisfactory to operate with the hands covered by rubber gloves as it is to operate without gloves, yet the interests of both patient and operator outweigh the inconvenience that is caused by the wearing of the gloves. Their use insures greater cleanliness, thus minimizing the danger of infection. The operator protects himself from infections of all kinds, particularly from syphilitic infection, a matter of considerable importance.

CHAPTER XII.

STERILIZATION OF CATGUT.

Raw catgut is always infected. It has been demonstrated by Lockwood and others that when catgut is prepared for surgical ligatures and sutures only with carbolic acid, juniper oil or chromic acid, growths of bacteria from many specimens occurred in gelatine and agar-agar. Carbolic acid in oil loses much of its germicidal power and therefore carbolic oil is no longer relied upon to sterilize catgut. The idea of employing antiseptic suture and ligature material that is absorbable is indisputably the correct one, but care must be taken to render the material sterile at the same time. While raw catgut cannot stand steam sterilization or boiling in water with impunity, it may be made sterile by boiling it in oil, such as cumol, and after being prepared in formalin or chromic acid it will even stand fractional sterilization in boiling water.

The catgut employed for ligating vessels and suturing in the performance of operations for the cure of hernias must, first, not be a source of infection; second, it must not be absorbed before nature's healing tissue (fibrous tissue) is developed and is sufficiently strong to prevent an intermediate breaking open of the wound by yielding to intra-abdominal pressure. To forestall these two calamities the raw catgut must be sterilized so that it will not infect the wound, and so that it will not be hardened or its condition changed to withstand the action of the tissues for the required time to prevent relapses of the hernia.

It is not my intention to present all or nearly all that has been developed in the line of catgut sterilization, but I wish to describe the best and most practical methods in vogue. We have the following at our command:

I. *Aseptic catgut* produced by
   1. Dry heat sterilization.
   2. Cumol (Krönig) method.
   3. Alcohol.

II. *Antiseptic catgut* prepared by
   1. Carbolic acid (now discarded).
   2. Bichloride of mercury (Esmarch).
   3. Biniodide (Lockwood).
   4. Bergman method.
   5. Iodine (Claudius).
   6. Chromic acid.
   7. Ochsner's method.
   8. Heat and iodine (Bartlett).
   9. Formalin (Hofmeister).
   10. Formalin and chromic acid (Ferguson).

Dry Heat Sterilization.—Benekiser and Boeckmann have successfully sterilized catgut by dry heat. I consider Boeckmann's method the better of the two. The catgut, cut in suitable lengths, is wrapped in paraffin paper and is then tightly sealed in small envelopes. A special box is filled with these little envelopes placed on edge and is then packed in the sterilizer. The temperature of the sterilizr is gradually raised until it reaches 284° F. to 300° F., and it is maintained there for at least three hours, which renders the catgut entirely free from germs and spores. For very thick catgut, such as No. 5, the process is repeated. Plain dry sterile Boeckmann catgut has been used for over a dozen years by many of the most prominent surgeons in the United States and Canada.

Pyoktanin dry catgut (Boeckmann) is a later production. Small sizes of Boeckmann's dry catgut are absorbed easily and for ligation of deep-seated vessels in sterile localities this catgut is ideal. The smaller the strand the shorter the time for its absorption. I have used it for several years and have learned to respect the small sizes and to fear the larger ones, either for ligatures or sutures. In my clinic at the College of Medicine of the University of Illinois pyoktanin catgut has been used in all kinds of hernial operations for several years with universal satisfaction.

The Alcohol Method.—A strong metal cylinder with a closely fitting screw cap is half filled with absolute alcohol. The catgut is cut in suitable lengths, rolled and put into the cylinder with the alcohol. The cap is screwed on very tightly and then the cylinder thus prepared is placed in boiling water (100° C.), where it is kept for half an hour. Inasmuch as the boiling point of alcohol is 78.3° C., and the heat applied is 100° C., the alcohol in the vessel is heated under pressure, which is said (Jellett) to kill anthrax spores. When catgut prepared by alcohol is left in the tissues of the body, the alcohol soon leaves the catgut and then it is practically an aseptic catgut. The same objections that hold good for the one pertain to the other.

Esmarch's Method.—Raw catgut is freed from fat by (a) brush, soap and water, and then water to remove the soap, or (b) by ether. When wound on glass spools it is sublimated (1:1000) for 12 hours; it is then transferred to sublimated alcohol, 1 to 200, for 12 hours, and finally is preserved dry in closely fitting glass vessels. Just before use it is placed in sublimated alcohol, 1 to 2000.

Lockwood Method.—Catgut wound on a board is treated as follows:

1. Scrub with soap and water and remove the soap. 2. Submerge in ether to insure removal of fat. 3. Keep in an aqueous solution of biniodide of mercury, 1 to 250. This catgut is not to be used until it has been soaked in water for 72 hours.

Von Bergmann's Method.—This is described in detail by Schimmelbusch. The essential features of it are the following:

Raw catgut is wound on glass and is placed in ether for 24 hours. It is then allowed to lie in the following solution for 48 hours, the solution being changed at the end of the first 24 hours:

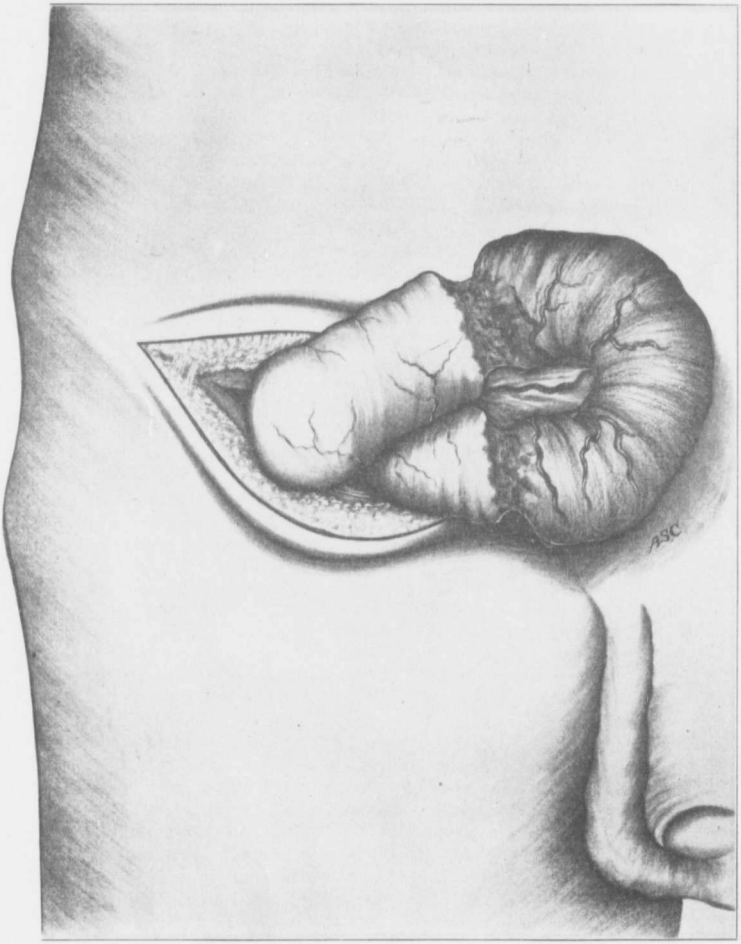

PLATE XIX.

Gangrenous Hernia.

Bichloride of mercury 10
Absolute alcohol 800
Distilled water 200

The gut is kept in absolute alcohol if a hard product is desired, or in alcohol (80 per cent.) and glycerin (20 per cent.) if a soft gut is wanted. This preparation of catgut has stood both the experimental and clinical test in Von Bergmann's clinic.

Cumol Method.—Krönig's method is the boiling of catgut in cumol to effect its sterilization. Clark and Miller modified the process. The catgut is cut, wound in loops and slipped into test tubes. The gut is gradually heated up to 80° C., maintained for one hour; is then placed in cumol and the temperature raised to 165° C., and there maintained for an hour, when the oil is poured off and the gut dried, either by the heat of the sand-bath, or in a hot air oven for two hours. It has not found general favor, especially in operations for hernia, and it is only mentioned to be condemned. The same objections hold true to it as to other forms of aseptic catgut.

Iodized catgut is prepared after the method of Claudius. The "raw" catgut, rolled on a glass tube, is immersed in the following solution for eight days:

Iodine, 1 part; potassium iodide, 1 part; water, 100 parts.

First make a solution of K I, gr. i to m. j., to which finely powdered iodine and then the 100 parts of water are added. Commercial catgut kept in this solution for a week will be antiseptic and ready for use. It is preserved in this solution or in an alcoholic solution of the same strength.

Abbott's chromic-iodized catgut is very simply prepared. The raw gut is immersed in 1-2000 aqueous solution of chromic acid for 24 hours, and is then iodized for eight days after the method of Claudius. It is then transferred to 95 per cent. alcohol, in which it remains ready for use.

Moschcovitz, of New York, transfers the iodized (Claudius) gut at the end of eight days to a dry sterile jar, which prevents it from becoming brittle. It is used dry from the jar. The advantages claimed for the iodized catgut are:

(1) Absolutely sterile (dry); (2) not infectable; (3) not deleteriously irritating; (4) not impaired in tensile strength; (5) prepared easily and cheaply; (6) absorbable after serving its purpose.

Abbott's Iodized Catgut.—Abbott, of Minneapolis, has pointed out that half the quantity of iodine used by Claudius will readily sterilize the raw catgut, and that it is less brittle and irritating. He uses only two sizes, fine and medium, and these may be used for sewing the skin, the fine thread lasting for a week. An excellent test of the antiseptic properties of catgut prepared with chemicals is that it may be used in sewing skin without the formation of stitch abscesses.

Abbott's Chromic Catgut.—Raw catgut is immersed for 24 hours in a 1-2000 aqueous solution of chromic acid, after which it is sterilized in the iodide solution (Claudius). After eight days transfer to 95 per cent. alcohol and use from that medium. Brittleness is avoided by preparing smaller

batches which will last a short time. After two years' experience Abbott is perfectly satisfied with it.

Ochsner's Method.—After immersion in sulphuric ether for one month, the catgut is placed in strong commercial alcohol in which gr. i to ℥i of corrosive sublimate has been dissolved. The solution is renewed once during the month. It is then preserved indefinitely in the following solution: Iodoform, 1 part; ether, 5 parts; commercial alcohol, 14 parts.

This catgut remains intact in the tissues for from seven to ten days, according to the size used. The above is used as a ligature and suture everywhere, except in bone and hernia operations, for which purposes Ochsner employs chromicized catgut, which lasts from 15 to 30 days, according to the size used. It is prepared as follows:

Ochsner's Chromicized Catgut.—The catgut is immersed in ether for one month, then in a solution prepared in the following manner: (A) Chromic acid, 1 part; water, 5 parts; dissolve carefully. (B) Take of solution A 1 part; glycerine, 1 part.

Soak the catgut in solution B for forty-eight hours or more, according to the resistance wanted. Catgut soaked for forty-eight hours will resist absorption by the tissues for fifteen days, whereas catgut soaked for ninety-six hours will resist absorption for thirty days.

(C) Take catgut out of B solution, rinse quickly but thoroughly in sterilized water; wind on rods or slides at least three inches in length, and preserve indefinitely in the following solution:

(D) Carbolic acid, 95 per cent, 1 part; glycerine, 5 parts.

The catgut may remain in this solution for many months without depreciating in quality, or it may be kept for an indefinite period of time in the same solution as the ordinary catgut:

Iodoform, 1 part; ether, 5 parts; strong alcohol, 14 parts.

The jar containing the ether in which the catgut is kept for one month should be filled only about one-half with the loose coils of ligature, and then it is filled with ether. The jar should be shaken in an inverted position every day or two in order to wash off any substance which may accumulate on the surface of the coils. At the end of two weeks the ether should be replaced by fresh ether. The same precaution should be taken with the solution of corrosive sublimate in alcohol. It is especially important not to wind the catgut tightly before it is placed in these solutions, because this may prevent the solutions from penetrating all parts of the material. One precaution is necessary in the use of catgut prepared in this manner—it must be placed in water before it is used at the time of the operation.

The Bartlett, or Heat and Iodine Method.—1. The raw catgut, thirty inches, is coiled on itself; several coils are strung together and hung in a beaker glass, not touching sides or bottom. A thermometer enters the beaker through a hole in the pasteboard covering it; liquid petrolatum is now poured into the beaker sufficient to immerse the catgut and bulb of the thermometer and the preparation for sterilization is complete.

2. The prepared beaker is now "set upon a pan of sand under which is

placed a tiny gas flame of merely sufficient intensity to raise the temperature of the oil to 212° F. within one to two hours". This temperature is maintained over night (a variation of a few degrees does not matter). "The heat is then increased to the extent that the temperature will run up to 300° F. in the course of an hour; then the gas is turned off and the temperature of the oil allowed to return to about 212°". The sterilization by heat is thus completed.

3. The catgut coils are lifted out of the beaker, the oil is allowed to drop off, and then for chemical sterilization and preservation the coils are dropped into the following mixture:

Columbian spirits, 100 parts; iodine flakes, 1 part.

It is ready for use and will not deteriorate. When it is desirable to make catgut last longer than usual, Bartlett recommends hardening the catgut as above prepared in formalin vapor. He suspends the coils a few inches above a 10 per cent. formalin solution in an air-tight vessel for twenty-four hours. This process is simple and the catgut requires no washing. It is stated that No. 2 catgut so treated will last in muscle for from two to three weeks. (*American Practice of Surgery*, Vol. I, p. 733.)

Formalin Catgut (Hofmeister).—It appears that formaldehyde effects a change in raw catgut which enables it to withstand boiling in water, without lessening its tensile strength. It also endows it with a property of resisting phagocytosis. Formalin catgut may be sterilized fractionally by boiling. This renders it absolutely sterile.

According to Pearson, whose method is a modification of Hofmeister's, the formalin catgut may be prepared somewhat as follows: Raw catgut is wound in single layers on large frames so that the formaldehyde may have free access to it from all sides. It is then immersed for from 12 to 48 hours, according to the size of the catgut, in formalin solution, varying in strength from 2 to 4 per cent. In order to rid it of the formalin, which is too irritating for the tissues, a stream of cold water is allowed to pass through it for 24 hours. The gut is then wound on glass reels or slides, and is boiled in water for from 10 to 25 minutes, according to the thickness of the gut. It is then preserved indefinitely in alcohol. If an aseptic catgut is desired, instead of preserving it in alcohol, it is preserved in sterile glass vessels.

Formalin Chromic Catgut (Ferguson).—For the last seven or eight years I have used a catgut known by the name of "Chromoform" catgut, or Hollister's catgut, for which Mr. Hollister received testimonials from many of the best surgeons and gynecologists in Chicago and the West. It was prepared after my direction and gave great satisfaction. It was first put through the formaldehyde process and was then subjected to chromic acid solution, ½ of 1 per cent., for 24 hours, then transferred to alcohol in glass tubes, which were permanently sealed. This was rendered both aseptic and antiseptic catgut in its preparation.

When a tube of this catgut was broken and only one or two ligatures or sutures were used, the remainder could withstand boiling two or three times with but slight diminution of its tensile strength.

CHAPTER XIII.

THE WOUND.

In operations for the relief of hernia the wound is always an incised one, and is made deliberately by the operator. It may be defined as a solution of continuity of the several structures necessarily encountered and severed in hernia operations. When a wound is made under proper aseptic and antiseptic precautions, it is called an aseptic wound, and it heals by primary union. All wounds that are made with instruments not sterile, or in skin not disinfected may be considered infected wounds.

If the surgeon implants living organisms into the wound by accidental contact, and suppuration ensues, the wound is said to be primarily infected, and this may be either superficial or deep. When an aseptic wound is undergoing primary repair, and becomes infected accidentally through a shifting of the dressings, or because of the patient passing his hands over the wound surface in order to feel of the cut, infection is said to be secondary.

As already pointed out in a previous chapter, wound infection may be autogenetic or heterogenetic. A diseased wound is one in which some pathogenic bacteria find a suitable pabulum for their multiplication, as, for instance, in tuberculosis. The bacillus of tuberculosis must be lodged in the wound before the disease manifests itself. A closed wound is one in which the coaptation of the severed structures has been accomplished by sutures. An open wound is one in which the edges have not been approximated. It is usually packed with gauze. Many other appellations are given to wounds according to their appearance and condition, such as a healing, granulating and suppurating wound.

The terms femoral, inguinal, and umbilical are applied to a wound because of its location.

The Incision.—It requires considerable art to make a correct incision in the various hernial regions. Any one can slash, but it takes an artist to cut. No matter what variety of hernia is being operated on, the primary incision should be ample enough so that the operation can be completed without tearing or bruising the edges of the wound. The skill of the operator always is made manifest by the manner in which he handles the knife, and the judgment he displays in deciding on the length and depth of the primary incision.

The first stroke of the scalpel should carry it through the skin only, and for the full length of the wound (Figs. 23 and 24). Until the operator has gained sufficient knowledge of the requirements of the various incisions, and until he gains by experience the force required to cut

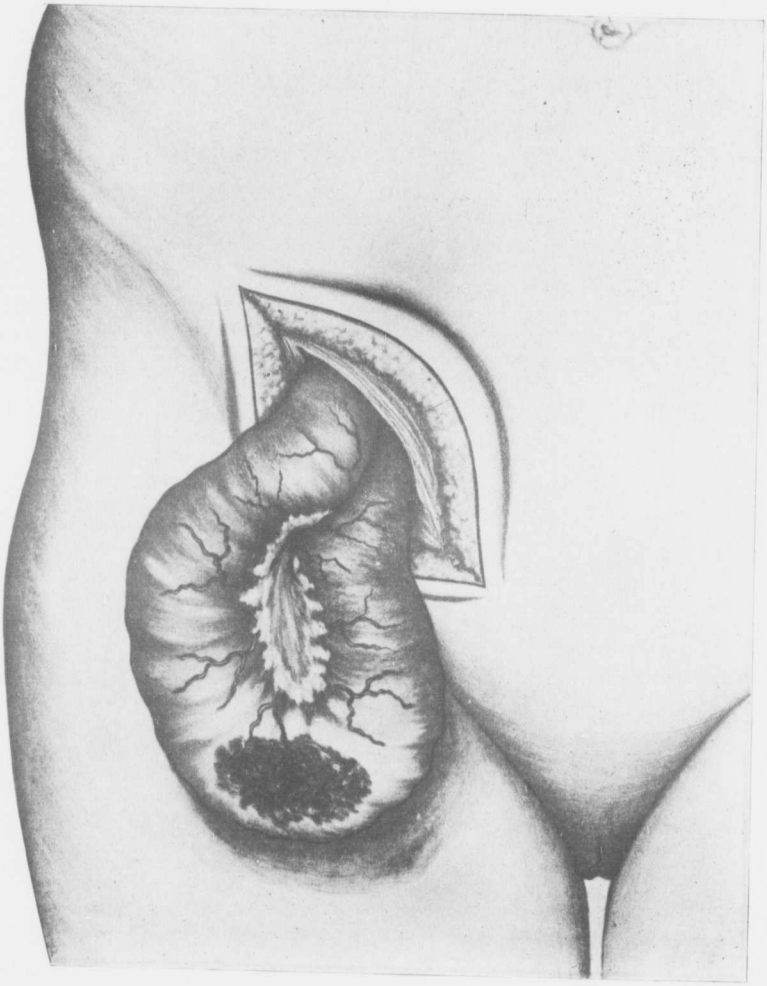

PLATE XX.

Gangrenous (Littre's) Hernia.

through the skin that is loose or taut, thick or thin, it is a good plan first to outline the skin incision with the sharp point of the scalpel. Then an assistant puts the skin on the stretch, while the operator makes his incision in the line of the scratch previously made.

After performing this act two or three hundred times, the operator may venture to cut loose skin and make a proper incision with one sweep of the knife. It is, however, difficult to accomplish this. To cut more than the skin with the first stroke of the knife shows a lack of surgical knowledge and skill. It is not brilliant to sever all the structures down to the hernial sac with one stroke. I have seen men of limited experience so foolhardy as to attempt this, the result being that they cut through the bowel.

An ordinary scalpel has performed its function during the operation when it has incised the skin. Of course, this depends to some extent on the quality of the blade, but usually making the incision dulls the knife so that it is not fit for further use until sharpened. Another reason for not using this scalpel again during the operation is that in passing through the appendages of the skin it may become septic.

In operations for the cure of hernia, great care should be exercised not to do anything that will tend to lower the vitality of the structures that have been cut. Powerful retraction and forcible tearing of the tissues with the fingers, with gauze or with the tissue comb must be avoided. Frequent mopping of the wound with gauze also injures the tissues, and it is quite unnecessary, provided the surgeon is careful in his hemostasis. Clean cutting and clean dissection traumatize the tissues but little, thus favoring primary union.

Exposing the Deep Structures.—The deep structures that must be considered in these operations are situated immediately around and within the sac. In oblique inguinal hernia care should be taken not to injure the spermatic cord, the deep epigastric vessels, the internal iliac vessels, or the deep abdominal muscles. Having split the aponeurosis of the external oblique, the deep abdominal muscles can be exposed easily by locating the conjoined tendon, and then the cremaster fibers may be dissected away from the lower border of the internal oblique muscle.

The sac is best exposed at the internal ring by picking up its neck with tissue forceps. It is then severed. It is not often that the cord is in front of the sac. It is usually situated behind or to the side of it. Before opening the neck of the sac the vas deferens should be located and injury to it avoided. In stripping the sac from its surrounding structures gauze must be used if the tissues have become blood-stained. If the surgeon is careful, however, this tearing with gauze is avoided. Once a clear line of cleavage next the sac is obtained, it should be followed to the limit.

The deep epigastric vessels are situated immediately behind the root of the cord. When exposing these vessels the cord must be drawn to one side and the transversalis fascia severed. This will at once uncover these vessels, which, however, is not usually necessary. The point to remember in exposing the deep structures outside of the sac is to do the work in such

a manner as to differentiate clearly every structure that is encountered. The deep structures inside of the sac, the intra-abdominal structures, are cared for according to the condition of the sac contents and the relationship existing between the sac and these structures.

If the hernia is strangulated, partially strangulated, or incarcerated, the grooved director should never be passed underneath the strangulating band, because it may penetrate the bowel and it also bruises the tissues because of its being forced underneath the constricting band. This band should be severed carefully by cutting from without inwards. If any adhesions are present at the neck of the sac, the sac should then be opened above the constricting band rather than below it.

Similar precautions should be taken when dissecting out the deep structures in cases of femoral, obturator, umbilical or other forms of hernia.

Hemorrhage.—The control of hemorrhage during operations on hernia, no matter whether the hemorrhage is arterial, venous or capillary, is not a difficult matter in normal subjects. The hemorrhage that comes from beneath the skin should not be allowed to stain the structures, even at the expense of somewhat lowering the vitality of these tissues. It is good surgery to clamp the bleeding vessels with the mosquito forceps represented in Fig. 22. Ligatures should be used as little as possible in hernia operations. In oblique inguinal hernia it is permissible, at times, to ligate the superficial vessels. I have frequently, however, operated on an oblique inguinal hernia without making use of a single ligature, except that which surrounds the neck of the sac. The angiotrypsic forceps shown in Fig. 22 is sufficient to arrest all bleeding, but I should not advise clamping the deep epigastric vessels and trust to the crush thus made for permanent hemostasis. These should be tied with catgut. Hemorrhage from the omentum must also be checked by means of the ligature, or the vessels may be cooked with the electro-thermic hemostat (Downes). Accidental injuries to the larger vessels must be dealt with on general surgical principles.

Before attempting to close the wound, the operator must assure himself that there is no oozing from any vessels. The arrest of primary hemorrhage must be complete in order to get the best results. The application of styptics of any kind is to be deprecated. I have, however, used an antiseptic dusting powder, such as iodoform, in order to arrest capillary hemorrhage by favoring rapid coagulation of the blood by means of a substance that is feebly antiseptic. Experience has taught me that an antiseptic powder which is feebly antiseptic, applied in small quantities, does not interfere with primary union. If the wound is not carefully closed and dressed, hemorrhage may take place, and this is particularly liable to occur when the scrotum has been opened during the operation.

Closing the Wound.—The first structure to be closed is the peritoneum. The sac is usually ablated below the ligature. In some hernias it is preferable to suture the peritoneum exactly as is done in closing an ordinary abdominal section. The principal point to be remembered in clos-

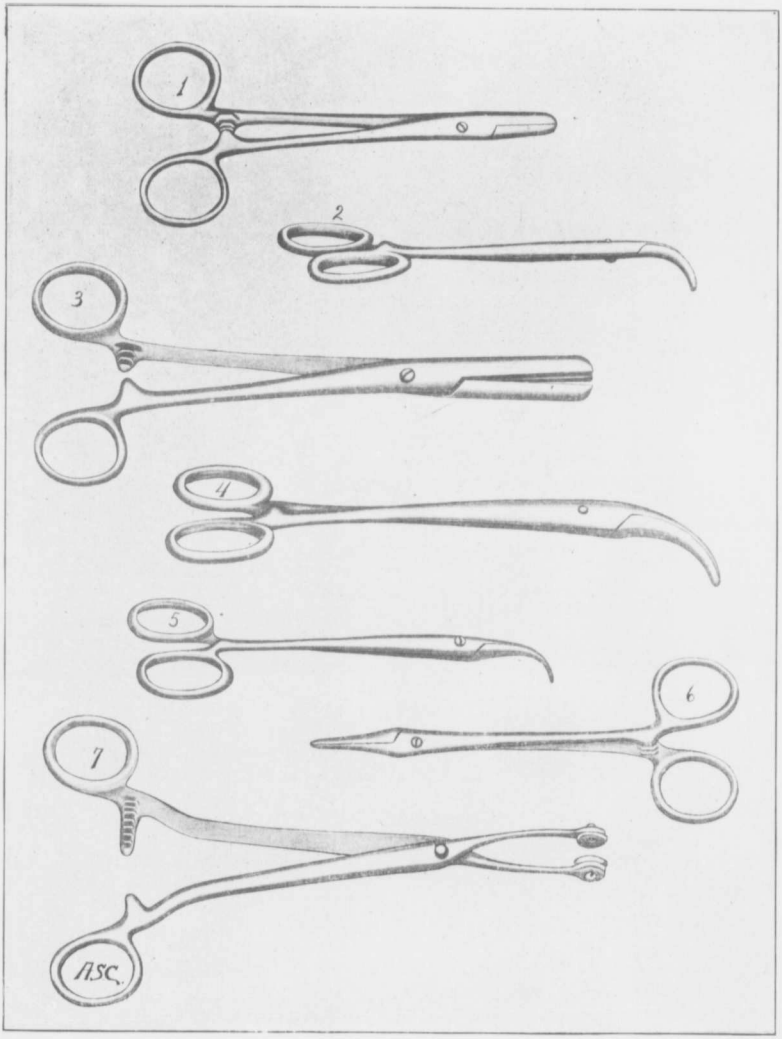

PLATE XXI.

1. Ferguson's angiotripsic straight forceps. 2. Ferguson's angiotripsic curved forceps. 3. Ferguson's angiotripsic straight clamp. 4. Ferguson's angiotripsic curved clamp. 5. Halstead's curved forceps. 6. Halstead's straight forceps. 7. Barrett's bowel holder.

ing the peritoneal wound is that smooth surfaces must be brought in contact, so that the raw edges are turned outward. Inasmuch as union of the peritoneum depends, in the main, on the amount of traumatism inflicted, the sutures should be placed closely together. It is preferable to use a continuous suture. The rest of the wound may be coaptated in one of two ways: First, by means of through-and-through sutures; and, second, by the insertion of deep and superficial sutures.

No matter what method of suturing is adopted, care should be observed that no dead spaces exist after the wound has been closed. A through-and-through suture in hernia operations was long ago found wanting and it has been practically discarded, with the exception of the through-and-through retention suture, which is fastened to buttons or rolls of gauze placed at some distance from the incision.

In ventral and umbilical hernias occurring in very stout people, these through-and-through retention sutures lend security to the deep and superficial sutures.

The deep structures are either brought together edge-to-edge or they are overlapped. Often in bringing them together edge-to-edge there is more or less crowding of the tissues so that they form a ridge. When union by first intention takes place these structures practically are as strong as normally. Overlapping of the tissues is to be deprecated, except when they can be imbricated without tension.

All the structures may be approximated either with absorbable or non-absorable suture material. When the absorbable material, such as catgut or kangaroo tendon, is used, it is safer to insert an interrupted suture than a continuous one. If a continuous suture gives way under the influence of overstraining caused by vomiting, or if it becomes absorbed too rapidly, the breaking at one point will loosen the entire stitching. The interrupted sutures, on the other hand, support one another, which is a decided advantage. If one suture gives way, the adjoining sutures will still keep the tissues in approximation.

The skin may be closed with chromic catgut, pyoktannin or formalin catgut, or a combination of these. All catgut that is used for the skin must be antiseptic or so hardened that it is not absorbed too rapidly. For closing the skin wound I prefer to use horsehair in the form of a continuous buttonhole stitch. In fleshy people it is always necessary to coaptate the fat by means of retention sutures because otherwise there will be a large dead space between the sutured skin and the aponeurotic structures beneath the fat. If non-absorbable suture material is used to close the wound throughout, the sutures must be applied in such a manner that they can be removed easily after union has taken place.

The subcuticular wire or silkworm gut suture I do not favor at all for the reasons already mentioned.

The wound should be closed as rapidly as possible, because the longer it is exposed to the air, the greater is the danger of infection, and a prolonged anesthesia is very likely to cause an irritation of the kidneys.

Drainage.—It is not very often that drainage is necessary after hernia

operations. When it is, tubes of any kind should not be used. When it is evident that the tissue will be overtaxed in the absorption of primary and secondary wound secretions, a drain should be inserted. A capillary drain usually is all that is required to meet this indication. In very large scrotal hernias, when a large sac has been dissected out of the scrotum, and large raw surfaces are left, the cavity readily becomes filled with blood serum. Here we have an indication for capillary drainage, and silkworm gut, chromic catgut, horsehair or wire may be used for this purpose. The drain is inserted in the lowest part of the wound, and is passed down and out through the most dependent portion of the scrotum, thus securing perfect drainage without interfering with the dressings in any way. If the wound becomes septic, drainage may have to be resorted to, and maintained by tubes or gauze.

Dressings.—Experience has taught us that after having completed an operation for hernia, it is necessary to place a dressing on the wound, (a) to prevent decomposition and infection, and (b) to support the parts and keep them at rest while repair is in progress. For the simple protection of the wound a collodion dressing usually fulfills all the indications. When the wound is not being drained and when there is no oozing of blood serum, before the collodion dressing is applied the skin must be wiped off with ether or alcohol, so as to obtain an absolutely dry surface to which the collodion can adhere. This dressing it is well to intermix with thin layers of cotton or gauze or both, but care must be exercised that the dressing is not too thick, for otherwise irritation and even vesication of the underlying skin may take place. If the dressing does not extend some distance, at least a couple of inches, beyond the edge of the incision, it may become loosened and thus furnish an avenue through which infection may enter the wound. If the collodion dressing does become loosened, it should be removed at once. I sometimes use a sterile antiseptic powder in conjunction with the collodion. Equal parts of collodion and iodine may be applied to the wound and the surrounding skin as a primary application. This antiseptic may prevent the formation of stitch abscesses and suppuration underneath the collodion dressing.

Even in all those cases treated primarily with the collodion dressing an external dressing of gauze pads should be employed to support the abdomen for a few days at least until all tendency to retching and vomiting has subsided. While the dressing is being applied it is important that the patient should be kept sufficiently under the influence of the anesthetic to prevent any struggling and to minimize the effect of intra-abdominal pressure. The supporting dressings of gauze pads and so forth should be of such a nature as to also protect the wound from infection. I use either plain sterile gauze or gauze that is impregnated with some antiseptic agent. It is then known as an antiseptic dressing gauze. Dressings, therefore, are either aseptic or antiseptic.

Nearly all antiseptic dressings have a tendency to irritate the skin. I have seen an extensive dermatitis follow the use of iodoform gauze, carbolized gauze, and even bichloride gauze, but I have never seen dermatitis

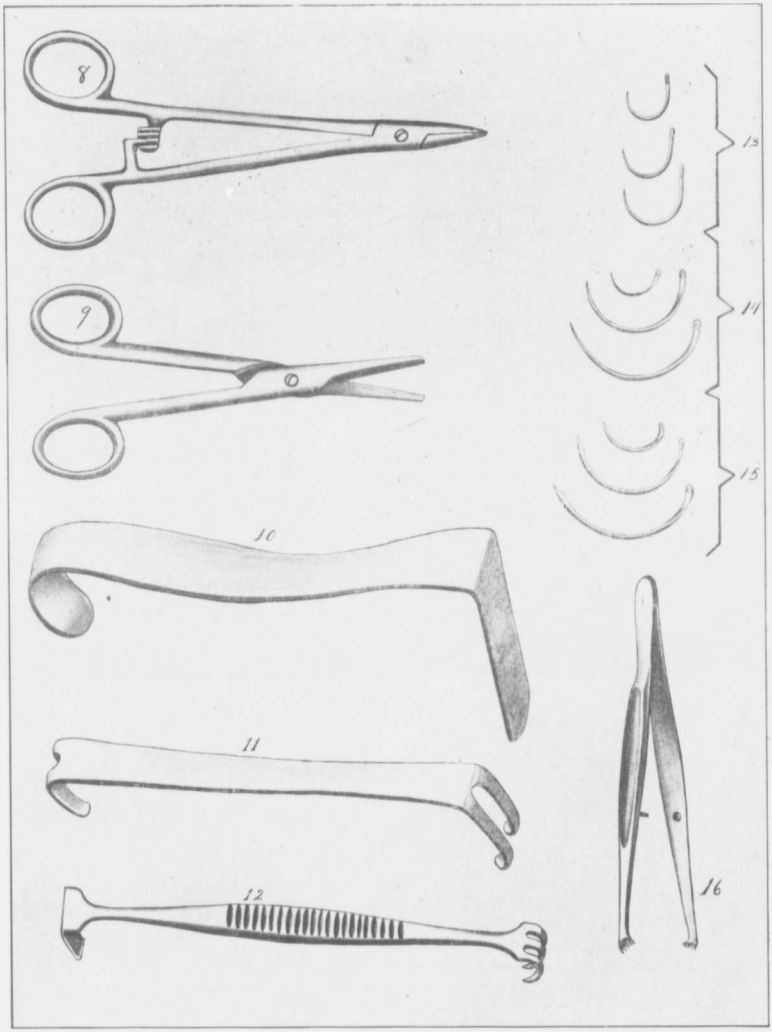

PLATE XXII.

8. Needle holder (Ferguson). 9. Mayo's dissecting scissors. 10. Byford's retractor. 11. Mayo's retractor. 12. Ferguson's retractor. 13. Intestinal needles (Mayo). 14. Ferguson's round needles. 15. Ferguson's needles with cutting edge. 16. Tissue forceps.

follow the use of gauze prepared according to Lister's method, the so-called cyanide of mercury gauze. The skin is never irritated if only plain sterilized gauze is used.

When dressing hernia wounds in the region of the groin, especially in children, I invariably place several layers of antiseptic gauze, preferably iodoform gauze, over the sterile gauze that is placed next to the skin. The manner in which the gauze dressing is applied has both a practical and a scientific bearing. The first three or four layers of gauze should cover the wound only. The next few layers should extend slightly beyond the edges of the wound, and so on with each succeeding layer, until the wound is covered by a pad of gauze from one-half to three-fourths of an inch in thickness, and extending beyond the edges of the wound for four or five inches. The reason for placing the gauze in this manner is that absorption cannot take place from the periphery of the gauze directly into the wound. Secretions of any kind are taken up by the upper layers which override the lower, thus protecting the wound itself for a considerable period of time from the irritating action of these secretions.

This gauze pad is then covered with an antiseptic dressing which most effectually prevents infection of the wound even though the dressings become soiled from within or from without.

In order to prevent this gauze dressing from shifting, a combination dressing must be applied which extends completely around the thigh and two-thirds around the body.

To prevent the wound from being injured by strain of any kind, it is advisable to protect this external dressing with broad adhesive straps so arranged as to receive the bulk of the force from within, just as a truss gives support to a hernial region. Take, for instance, a case of oblique inguinal hernia. An extra pad is placed over the inguinal region and an adhesive strap is applied, passing across the abdomen below the anterior superior spines of the ilia, exactly in the truss line. This strip of plaster will receive the force at the internal ring. Another strip of plaster should extend from the ribs down over the line of incision, fitting closely the fold of the groin, passing backward along the gluteal fold, and then forward again across the upper portion of the leg, and over the inguinal region immediately in front of the internal ring. This strap should extend upward, crossing the umbilicus and ending on the opposite side of the body, just beneath the ribs. Over these straps I wind a roll of broad gauze which completes the dressing.

In children rubber tissue or oiled silk is placed over the dressing so as to keep it dry. Some operators apply a plaster cast over the dressing, but this is too heavy, and it may cause pain by pressing on bony prominences, and when the edges of the cast become soiled they are exceedingly irritating to the skin and the cast must be removed.

The dressing may remain in place for two or three weeks, if necessary, but inasmuch as it becomes rather uncomfortable, and as the stitches may have to be removed before that time, it is advisable to change the primary dressing inside of a week. If drainage has been established

the dressing should be removed within three days. Even though the dressings may be saturated with blood serum within twenty-four hours after operation, it is not necessary to remove them because of any danger of infection occurring. Of course, it must be borne in mind that some bacteria travel along the skin more rapidly than others, and I have in mind now particularly the streptococcus.

After the primary dressing has been removed, any drain that may have been inserted should be withdrawn carefully. Silkworm gut drains are cut off at the lower angle of the wound and are then withdrawn from the opposite angle, so that contamination of the wound surfaces cannot take place.

The same precautions are taken in the application of the primary dressing in the femoral region, or in any other hernial region. In ventral and umbilical hernias, before the adhesive straps are applied, I place two rolls of combination dressing, one on each side of the wound, running in its long axis, so that the pressure is exerted laterally instead of centrally. In very large ventral and umbilical hernias, instead of passing the adhesive straps two-thirds around the body, I pass them completely around, overlapping the straps in the center, in which position they give a better and a more rigid support.

The technic of removing the primary dressing is one of considerable importance. The dressing should be removed in such a manner as not to expose the wound to contamination any more than is necessary. With this end in view all the dressings are removed, except the primary gauze, which was placed immediately over the wound. The skin surrounding this dressing is then bathed with alcohol, or bichloride solution, or Harrington's solution. Then sterile towels are placed around this area and not until then should the wound be exposed by the removal of the primary dressing.

The wound is now inspected carefully; stitch-hole infections are looked for. If the wound is found to be in perfect condition, a second dressing is applied with the same care as the first. It is left in place four or five days, after which a pad of gauze and a spica bandage is all that is necessary.

Removal of Sutures.—Catgut sutures that are not causing any irritation may be allowed to remain in place until they are absorbed. Silkworm gut sutures should be removed from the skin inside of twelve days. Half of the number of stitches may be removed at the time the primary dressing is changed, and the other half when the second dressing is taken off. If these sutures are allowed to remain in the skin a longer time than this, they begin to cut through, cause irritation, and favor the development of stitch abscesses.

Subcuticular stitches of wire should be removed at the end of a week, unless they are not loosened sufficiently at that time, when they are left in place a few days longer. Deep wire and silkworm gut stitches that are removable should be left in place for about three weeks, until wound healing has progressed to the stage of fibrous tissue formation. If these stitches are removed too soon, while the wound is still granulating, a very

slight degree of intra-abdominal pressure is sufficient to cause separation of the wound edges.

The antiseptic dusting powder may be used freely over the stitch-holes, so as to prevent abscess formation. If infection has occurred, two things must be done, (a) irrigate and wash the stitch holes with some antiseptic solution, and (b) cut the stitch at a point where it has been buried and then withdraw it from the other side.

Horsehair sutures are removed at the end of a week.

CHAPTER XIV.

TREATMENT OF WOUNDS.

Wounds are either aseptic or septic, and the treatment required for each is quite different.

Aseptic Wounds. A wound that is aseptic will heal by first intention, if the treatment employed is such as to prevent secondary infection. The sole aim of the treatment, therefore, is to prevent secondary infection. The dressing must be applied properly as is pointed out under the heading of Dressings. The wound and surrounding parts must be maintained in a state of physiological rest, the stitches must not be tied too tightly and the tissues of the patient must be in a healthy condition, and he must have sufficient natural powers to carry on repair. If the dressings bear too tightly on a wound immediate repair is delayed. If, on the other hand, the dressings are too loosely applied they are liable to shift and expose the wound, which is an indication to renew the dressing.

If the patient has passed the hand underneath the dressings, immediate disinfection of the wound should be carried out, and new dressings applied. If the patient complains of great discomfort and tenderness in the region of the wound at the end of forty-eight hours the wound should be inspected. This pain is not infrequently caused by an accumulation of blood serum beneath the skin or in the tissues. If such is found to be the case the blood serum should be allowed to escape and the wound dressed aseptically and antiseptically, and a new dressing applied. If the dressings become saturated with blood and blood serum, at the end of twenty-four hours, it is better to change the external dressings. But a wound is not in danger of infection from this source for about three days, when all the dressings should be renewed. If the dressings become soiled from without by extraneous matter, urine, etc., that is an indication for their removal.

In hernial cases, where a large semilunar flap is made at the time of the operation, an accumulation of secondary wound secretion is liable to take place beneath it, unless the dressings are properly applied. If such a secretion is present at about the end of a week, when the first dressing is changed, it should be allowed to escape through an opening made by the removal of a stitch, and then the dressing applied so as to exert some pressure on the flap.

After the removal of the stitches the wound is cleansed with a disinfectant, and the new dressing is applied. Whereas all hernias recently operated on require support to the region for several weeks, it is best to keep the wound protected with the dressing, even though there may be

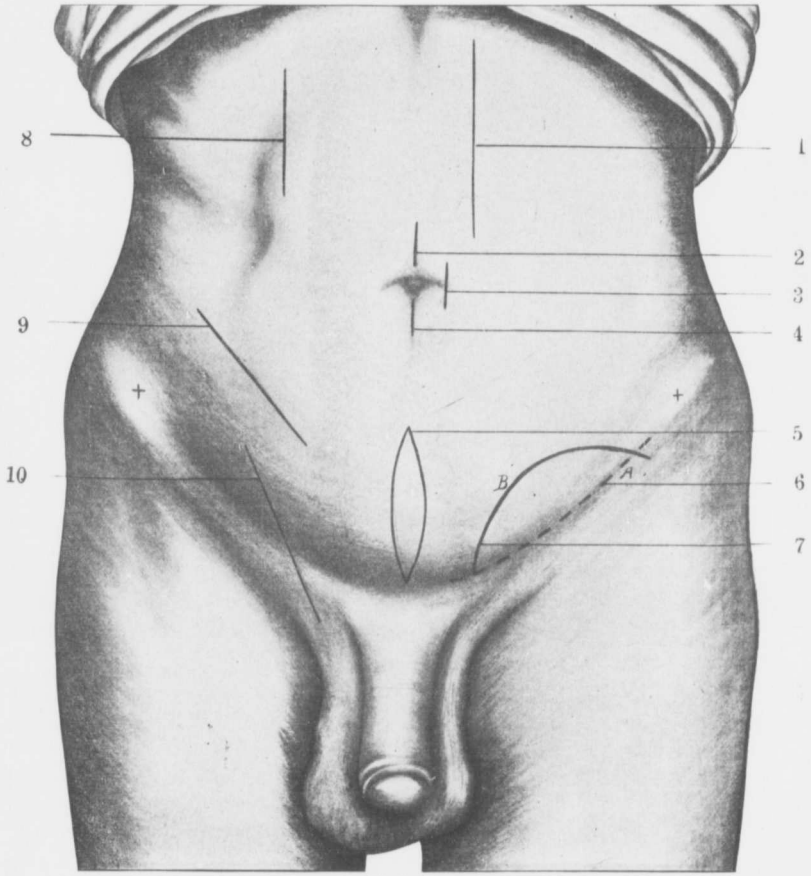

PLATE XXIII.

Incisions.

1. For diaphragmatic hernia. 2. "Supra" umbilical. 3. "Para" umbilical. 4. "Sub" umbilical. 5. For ventral hernia following supra pubic cystotomy. 6. For inguinal, downward curve (Fowler). 7. For inguinal, upward curve (Ferguson). 8. For hernia following gall bladder operation. 9. For hernia following appendectomy. 10. Straight incision for inguinal hernia.

no avenue of infection visible, for about three weeks, when fibrous formation is fully established.

Septic Wounds. The infection of a wound is either primary or secondary, and the infection may be superficial or deep, mild or severe. If on the removal of the first dressing the edges of the wound and the stitch-holes look angry and red, and are tender to touch, the wound is said to be infected superficially. If this occurs on the third or fourth day, there may be no suppuration, but stitch-hole abscesses are sure to develop unless counteracted by treatment. This treatment should be antiseptic in character.

The inflamed parts should be irrigated, preferably with bichloride of mercury, 1 in 1000, or Harrington's solution, and then a wet compress of gauze moistened in 1 in 2000 bichloride, should be placed over the wound and new dressings applied. This cleansing and dressing of the wounds should be repeated every day for three days, when it will be found that the inflammation has been subdued. If the dressing is not changed until between the fourth and the eighth day, and if stitch-hole abscesses are present, cultures should be made and the nature of the infection determined. The treatment to be carried out under such circumstances is the same as that already mentioned, with the exception that when the infection is severe the irrigation and dressing may have to be done twice a day until suppuration has ceased, then once a day until granulation tissue is healthy, after which no antiseptics should be used on the healthy granulating surface.

If this superficial infection is found to extend deeply into the wound, it should be opened sufficiently to allow free drainage, and the wound packed with iodoform gauze. If the suppuration is present for some time, then the antiseptic solution used for irrigation should be changed. If a sublimate solution is used in a strength of from 1 in 1000 to 1 in 5000, and is continued for several days, an intolerable burning pain will often arise in the wound. Then the irrigating solution should be changed to an iodine or normal salt solution.

The temperature of the irrigating fluid should not be less than 105° F. and not more than 115° F.

There are many other antiseptic solutions that can be used, such as lysol, permanganate of potash, carbolic acid, salicylate of soda, the silver salts, etc.

Wounds that are deeply infected from a primary source usually give rise to constitutional symptoms between the third and fourth day. There may be a temperature ranging from 99° F. to 103° or 104° F., with chilly sensations, accompanied by pain, tenderness, rapid pulse, etc. If at the end of seventy-two hours these symptoms are present, there is a clear indication for inspection of the wound, and if there is any undue prominence or tenderness, the deep wound must be explored with all aseptic and antiseptic precautions, and if an accumulation is found the same should be drained.

If the infection is saphrophytic in character it subsides under this

treatment within a couple of days. But the pyogenic and pathogenic organisms are harder to kill. If the infecting germ is the streptococcus, every effort should be put forth to prevent a dangerous blood infection by frequent or continued irrigation of the wound. And the entire wound should be laid wide open from top to bottom, removing all the stitches and treating it most uncompromisingly. Any extension of the inflammation into the cellular tissue should at once be followed and drained. If lymphangitis arises, local applications of glycerine and ichthyol, 10 per cent. iodine, Credè ointment, or formalin and glycerin, may be applied. If the constitutional symptoms continue, the administration of the antiseptic streptococcic serum may be considered.

CHAPTER XV.

COMPLICATIONS INCIDENT TO THE RELIEF OF HERNIA.

SHOCK.

After an operation for the radical cure of hernia, shock is not, in the usual run of cases, a common complication. In large incarcerated hernias, whether inguinal or umbilical, where the bowel sometimes has to be handled, adhesions liberated or the abdomen explored, more or less, shock must be expected, and it is sometimes present to a dangerous degree. A series of shocks are caused on the operating table by the occasional rough handling or tearing of the structures by the operator and his assistants. Surgical literature is replete with "shock"—(descriptions of)—but there are so many misconceptions of shock that scientific and practical data are difficult to obtain. The Cartwright prize essay for 1897, by G. W. Crile, of Cleveland, "An Experimental Research into Surgical Shock," is the best on the subject. Every surgeon should read it.

Any form of shock is due to injury or insult to some part or to the whole of the body. In hernia operations it occurs either during or after the operation and sometimes so suddenly and so rapidly increasing in gravity as to be called a sudden collapse. The term collapse (impending dissolution) means more danger than is ascribed to shock. It not infrequently comes on at the termination of a major operation, several minutes after the withdrawal of the anesthetic and at about the time that the patient should begin to revive. It really seems as if when all reflexes are being aroused the afferent impulses take on an avalanche action and tend to overpower all efferent response.

The causes of shock are undue traumatism while operating; protracted anesthetic; exposure of the intestines and omentum; and prolonged operation. Hemorrhage is a very rare cause of shock in this class of work, because important vessels are not severed by careful operators.

Shock is more marked in operations for the cure of umbilical and ventral hernia than in those for the inguinal or femoral variety. This observation is supported by the experiments of Crile. If in abdominal procedures the omentum is made to cover the viscera less shock occurs. When a person is being operated on and the pulse increases rapidly (15 to 30 beats) the skin gets pale and cold, blood in the wound becomes more venous in character than normal, with a decrease of the temperature, shock may be said to be established.

Shock on the operating table must be differentiated from chloroform asphyxia. In the latter the onset is sudden, respirations cease, the pulse early become imperceptible, the face assumes a pale-yellowish hue and the

pupils dilate. By lowering the head, pulling out the tongue, compressing the chest wall for fully one minute before inhalation is allowed to occur, thus expelling the chloroform from the respiratory tract, and then by inducing artificial respiration, the effect is soon overcome, and the patient begins to struggle.

The condition of the patient is often rendered more serious by the improper establishment of artificial respiration. The very first effort to be made is to force an inspiration by raising the arms above the head,—the column of uninhaled chloroform in the trachea and bronchial tubes is forced into the circulation and the poisoning thereby deepened. The chest should first be compressed for a minute, then the arms slowly raised, taking the time required to count deliberately up to three, and then hold the upper extremities above the head with an upward and outward extension, counting 1, 2, 3, and again bring the arms flexed at the elbows down forcibly on the costal arches which sends the air out of the lungs with a whizz; then again count 1, 2, 3, and so on. Artificial respiration is thus continued until reaction sets in. If artificial respiration is carried on too rapidly the respiratory center becomes more than satisfied with oxygen and respiration is suspended.

In overdoses of chloroform not considered serious, the passing of the index finger behind the epiglottis and raising the larynx up and forward will quickly induce respiratory acts. In many cases this is all I have done to re-establish respiration.

One dram of ether, given hypodermically, is a powerful, safe and useful stimulant for resuscitation from chloroform poisoning, and the ether is usually at hand. When ether is the anesthetic administered an additional quantity given hypodermically would, of course, do harm.

Shock is often delayed in very major operations, operations performed swiftly and well, where all means were taken to forestall a knockout on the table with the hope of saving a life. There is in every person a limitation to the amount of bowel that can be removed with impunity, and the number of adhesions that may be broken down with safety to the patient's life. The extent of work done in a given time varies vastly with different surgeons, and this is no mean factor in causing primary and secondary shock.

Crile, in his experiments, noticed that "On incising the skin over the testes there was frequently a considerable fall in the pressure in keeping with the phenomena attending injury of this organ." And again, "All the observations tend to show that the more specialized and abundant the nerve supply to a part the more will it contribute to the production of shock when subjected to injury."

Cutting through muscles and fascia has very little or no effect on the heart. On reaching the peritoneum, contact, touch, or tear of it causes more or less disturbance indicative of shock. "The more severe the injury, the greater extent of contact and exposure, the more quick and rapid was the decline of the blood-pressure." (Crile.)

In regard to the testicles, Crile showed by experiments that "Cutting

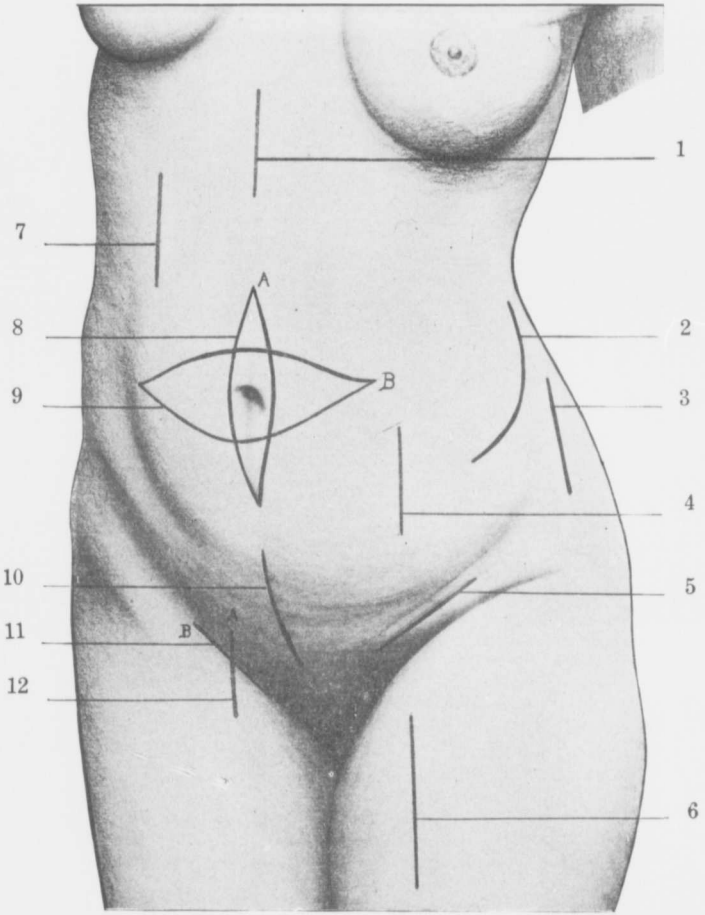

PLATE XXIV.

Incisions.

1. Epigastric hernia. 2. For hernia after nephrotomy. 3. For lumbar hernia. 4. Semilunaris hernia. 5. For direct inguinal. 6. For obturator. 7. Ventral (rectus muscle). 8. aLongitudinal. 9. bTransverse (Mayo). 10. For ventral. 11. bOblique (Ferguson) for femoral hernia; 12. aLongitudinal (Ochsner) for femoral hernia.

the testicles, spermatic cord, tunica vaginalis, caused in most instances a fall in the blood-pressure appearing after a short interval."

Latent or delayed shock is the depressed condition that occurs some time after the operation. What probably has happened is that a ligature has slipped and hemorrhage is taking place. This is not considering mental shock caused by bad news, etc.

Treatment.—Strychnin sulphate, gr. 1-10 to 1-30, should be given every 1, 2, 3, or 4 hours, according to the urgency of the case. It raises and sustains the blood pressure.

Artificial respiration is demanded to supply oxygen to the blood and to stimulate the heart to contract. If the patient becomes restless and shock continues, gr. 1-16 of morphine and gr. 1-120 of atropine, hypodermically, every six or eight hours, acts splendidly by regulating the reflexes and calming the patient, while gr. ¼ of morphine would likely kill the patient.

Nitroglycerine, gr. 1-150, every two hours, is of service as a rapid cardiac stimulant. Camphor and musk I have found of very little use. It is true I have only employed them when other drugs had failed, and in only twelve cases (not hernia). Remember to apply heat, but do not burn the patient. Boiling water poured into cans or rubber bags and placed near the skin of the person will surely burn. The temperature of the water should be about 120° F. In one instance (pylorectomy done in 1893) I kept my patient on a hot water rubber bed for seven days. This aided materially in preventing, and at the same time in treating, the shock which was well pronounced. Dry rubbing of the skin is of benefit, but rubbing with alcohol does harm. The foot of the bed should be raised and, if necessary, the lower extremities should be bandaged. If shock is accompanied by hemorrhage 1000 c. c. of normal salt solution should be given beneath the skin and repeated every four, six or eight hours p. r. n. If, however, hemorrhage is not an element in the production of the shock 500 c. c. is about the proper quantity. If very rapid action is demanded the saline solution may be administered into a vein while the patient is still on the operating table. The temperature of the normal salt solution is important. It should not be less than 110° F. and not higher than 118° F. as it enters the circulation. The temperature of the water in which the flask containing the normal salt solution stands should be kept at 120° F., which will insure the proper temperature for the salt solution. According to the mode of administration it loses 1, 2, or 3 degrees before it enters the blood.

If salt infusion is given at a temperature of 100° to 103° F., as is often recommended, shock is invariably deepened. "The combination of and frequently repeated hypodermic injections of strychnine, together with saline infusion is most effectual." (Crile's experiments.)

Predigested nutrient enemas should be administered without delay (milk, egg, coffee, brandy, etc.), every six hours. It is well to remember that in shock absorption by the stomach does not take place to a great degree, and for this reason only teaspoonful doses of hot water should be

injected about every half hour. If the stomach is partly filled with liquid, it should be washed out.

HEMORRHAGE.

In operations for the cure of hernia, hemorrhage, both primary and secondary, may be alarming.

Primary Hemorrhage. When operating on hernias, primary hemorrhage must be guarded against carefully, and when it does occur it must be controlled absolutely in order to obtain ideal results from the operation. The vessels that may be injured and that give rise to dangerous hemorrhage when operating on inguinal hernia are the deep epigastric and iliac arteries and veins. Of course, it is impossible to avoid injuring the superficial vessels, but hemorrhage from these is controlled easily by means of the clamp and ligature. In Fowler's operation for hernia the deep epigastric vessels are exposed, clamped, cut and tied, which last must be done very carefully and securely. Any injury to these vessels produces quite a flow of blood and no time must be lost in checking the same.

In hernias of long-standing, where there is a bulging out of the entire inguinal region, the deep epigastric vessels sometimes override the sac. They are then tied deliberately and cut.

Hemorrhage from the vessels of the cord, no matter how slight it may be, should be checked by the application of the ligature. If the iliac vessels are grasped carelessly by the needle, or if they are torn while dissecting out the sac, the injury is a dangerous one even though it is the result of a blunder. In twenty-five years I have seen two such cases in consultation.

In large hernias of long standing, occurring in persons who have very stiff arteries, persistent oozing may take place and unless the wound is drained with silkworm gut the blood will accumulate in the deeper tissues and probably cause serious disturbance later on. In cases in which it is necessary to incise the scrotal tissues, hemorrhage is quite likely to prove troublesome. It must be checked before the wound is closed, and a capillary drain had best be inserted.

When it is necessary to liberate a strangulated hernia we no longer do the old-fashioned herniotomy, using a knife and cutting on a grooved director. Wounding of the vessels in the region of a femoral hernia is an occasional accident. The vessels that are endangered most during an operation on a femoral hernia are the long saphenous vein, the femoral vein, and the obturator artery when it pursues an abnormal course along the outer border of Gimbernat's ligament. When the obturator artery is injured it is advisable at once to sever Poupart's ligament near the pubic spine, exposing the artery at or near its origin. Let me say, however, that Gimbernat's ligament may be severed carefully with the sharp point of the scalpel on its under surface so as to avoid the obturator artery.

When operating for the relief of an obstruction of an obturator hernia, the obturator vessels are in danger of being wounded. After passing through the pectineus muscle and having exposed the hernia, the con-

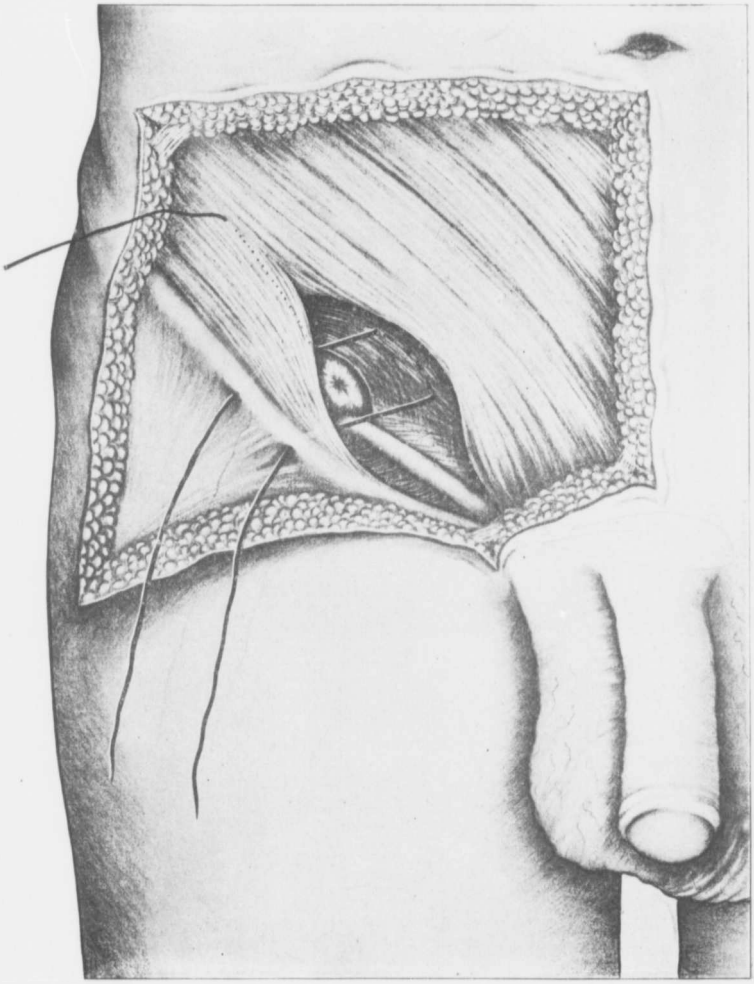

PLATE XXV.

Macewen's Operation for Inguinal Hernia.

striction is most safely severed without injury to the vessels by cutting upward. They are injured occasionally, but by retracting the wound edges, which can be done in a moment, the vessel may be caught and ligated.

Two sets of vessels may be wounded when operating on an ischiatic hernia, (a) the gluteal vessels when the hernia protrudes through the great sciatic notch above the pyriformis muscle, and (b) the sciatic vessels when the hernia protrudes from beneath this muscle.

Secondary Hemorrhage. Sometimes it is extremely difficult to recognize a secondary hemorrhage, because there are so many degrees thereof, and evidence of its presence is dependent on the source and rapidity of the bleeding. In nearly every instance the hemorrhage is the result of some error in the technic, such as tying a vessel improperly or too loosely; pulling the ligature after it has been applied; severing the ligature too close to the knot; leaving too short a stump of tissue outside of the ligature; trusting too large a vessel to angiotrypsic pressure; extensive capillary oozing, or the tissue, if edematous, may shrink so that the ligature no longer compresses the vessels. These causes of secondary hemorrhage may be met with in connection with the ablation of a gangrenous omentum. When the blood becomes overcharged with normal saline solution, or when the solution is administered too hurriedly or in too large quantities, serious and sometimes uncontrollable secondary hemorrhage may occur.

The best means of controlling capillary oozing from a loop of bowel that has been strangulated but possesses sufficient vitality to permit of its being returned within the abdomen, is to dust its surface freely with sterile subgallate of bismuth. This powder, which is slightly antiseptic and slightly astringent, checks the oozing from raw surfaces on the peritoneum anywhere, and prevents adhesions from taking place. It favors rapid coagulation of the blood, and the feeble astringent action which it possesses is not harmful to the tissues.

Fine sewing with catgut, using figure-of-eight or circular stitches on the raw and bleeding surface, is an excellent means of checking hemorrhage, where it can be applied. It may be utilized in cases of hemorrhage from the surface of the large bowel, stomach, bladder, liver, spleen, and other abdominal viscera. It cannot, however, be applied successfully on the bleeding surface of a friable small bowel. The principal oozing points may be picked up superficially with adjacent peritoneum by means of fine catgut. A number of such circular stitches may be inserted advantageously, the surface then being dusted over with subgallate of bismuth.

If there is a persistent oozing from a loop of bowel, or from the omentum, the bleeding surface may be wrapped up in a dry dressing of gauze, being first dusted with the powder, then proceeding with the operation. When it is time to close the wound it will usually be found that the raw surface that formerly bled is now dry. The electro-thermo-cautery (Downes) is an excellent hemostat in cases where it can be applied, as on the omentum. The actual cautery is practically useless for this purpose, and so is hot water.

When the pulse quickens, the temperature falls, respiration becomes

labored, the skin and mucous membranes become pale and cold, and there is vertigo and restlessness, with tossing of the arms and legs and a desire to get out of bed, it may be too late to save the patient suffering from a secondary hemorrhage or its effects. Never hesitate, however, even in the face of these signs of death, to check the hemorrhage and institute treatment to save the life of the patient, because sometimes you will be agreeably surprised.

TEMPERATURE.

When complications, such as collapse, shock, hemorrhage, or death, are impending, the temperature, as a rule, becomes subnormal. The depressing effect of the anesthetic cools off the surface of the body. A subnormal temperature occurring while the patient is on the operating table is a sign of shock. If, after the patient is placed in bed, the temperature falls suddenly, it is a sign of hemorrhage. If the temperature rises during the course of the operation, it is an ill omen. A slight lowering of the temperature after the operation and then a gradual or even a sharp rise may not mean any complication; but if the temperature does not subside by the third day, the wound should be inspected and an infection looked for.

VOMITING.

Vomiting may be so persistent as to demand attention. If the patient vomits while taking the anesthetic, it may mean, (a) food or liquids in the stomach, or (b) an overdose of the anesthetic. Whenever a semi-conscious patient begins to vomit profusely, there is danger of his being suffocated by inhalation of the vomitus. Be ready to open the trachea, if necessary.

Nausea and vomiting are two great objections to the use of ether and chloroform. I recall operating on several patients three or four times, on separate occasions, who nearly died from vomiting, no matter what anesthetic had been used. The ingestion of large amounts of liquids or food soon after operations often induces vomiting. In such cases I have frequently and to great advantage allowed the patient to drink hot water freely, with about five grains of bicarbonate of soda added to each ounce of water. If it is retained the nausea soon ceases; if it is ejected, the stomach is thereby washed out. It is difficult to make patients understand that vomiting is increased by the drinking of liquids, and that drugs are of no avail to relieve the vomiting. When vomiting occurs in the operating room, it is a good plan to wash out the stomach after the operation has been completed. I am convinced that less stomach disturbance follows when this is done, especially after hernia operations.

Owing to the strain to which the stitches in the wound are subjected, it is possible for the wound to burst open. Some time ago I operated on a small umbilical hernia, removed the navel, and brought like structures together with plain catgut (the supply of chromic catgut being exhausted) and silkworm gut. through-and-through stitches were inserted to insure success. On the eighth day, contrary to orders, the silkworm gut stitches were removed and the wound was dressed. About half an hour after-

wards the patient began to vomit, and she continued to retch and strain for about three hours, when the entire wound burst open and coils of intestine appeared beneath the dressings. The vomiting was induced by the removal of the stitches when the stomach was full of food, and probably was continued by the irritation of the wound and compression of the intestines while they were being forced through the opening. Re-suturing with silkworm gut, without the use of an anesthetic, completely relieved the condition. The lessons to be learned from this case are obvious.

Straining and vomiting are very deleterious to wounds made during a hernia operation, even though the field of operation be well dressed and strapped down with broad adhesive straps. When vomiting persists for twenty-four hours, it is advisable to wash out the stomach because a certain degree of acute gastrectasis may be present which is not easily overcome without the assistance of a stomach tube. After washing out the stomach no food or liquid should enter it for at least twelve hours. Even the holding of ice in the mouth and gargling with water induces nausea and vomiting. In the vast majority of cases the administration of bismuth, creosote, a few drops of chloroform or of capsicum, and iced champagne does harm. Persistent vomiting after an operation for strangulated hernia calls for stomach lavage repeatedly, and after each lavage sufficient morphine (beginning with 1-16 grain, with 1-200 atropine, hypodermically, and continually increasing the dose, if necessary) should be given to control stomach peristalsis. When the bowels have been obstructed and then handled by the surgeon, slight pathologic changes and local shock suspend peristalsis for several days, and the gastro-intestinal contents can receive no aid in passing through the portion of the intestine whose function is thus suspended. The consequence is that anything that is forced into the stomach is quite likely to be forced back.

A stomach with residual contents after emesis should be washed out. One of the alarming signs in connection with vomiting is the appearance of blood in the vomitus—the naked eye appearance being like coffee. In cases with no residual contents, or blood in the material vomited, a sedative, such as morphine, is indicated to allay action of the stomach, and after being washed out once with a feeble solution of permanganate of potash, absolute rest should be enjoined. If, however, the stomach is dilated, the act of vomiting being insufficient to empty it, and blood appears in the ejecta, the stomach must be washed out at once, but no morphine or other sedative should be thought of, let alone administered, because the dilatation of the organ would only be increased and leakage of blood from the capillaries be favored. This very condition is caused by overdosing with morphine a patient suffering from shock. It is strange, but true, that even doctors suffering from the effects of a major operation not infrequently prefer to be relieved by morphine at the risk of death, than to suffer and struggle for life during one night. Along with this condition we usually find some other grave complication, involving the heart, kidneys or liver, which carries the patient off.

Bile in the ejecta may mean (a) a retro-peristalsis due to the suspension

of normal peristalsis in some portion of the intestines on account of the operation, or (b) when colicky pains are in the abdomen at the same time more significance must be given to the appearance of bile—suspicion of obstruction. Should, however, bile and fecal matter be vomited, associated with colicky pains in the abdomen, obstruction of the bowels is almost sure to exist. No time should then be lost in examining the wound in the abdomen and exploring. Prompt action is a life-saving agent.

When vomiting is associated with tympany only, paresis of the bowels is present, and stimulating enemata, hot turpentine stupes over the abdomen and large doses of strychnine are indicated, but no morphine or any sedative. Associated with vomiting we sometimes find not alone tympany, but a temperature as high as 102° to 104° F., with or without chilly sensations, chills, rigors or thirst: Then peritonitis is the most likely cause of all the symptoms and signs.

TYMPANITES.

Nourishment by bowel should be commenced immediately after all major hernia operations.

Over-distention of the intestines with gas is a complication no less distressing to the patient to endure than to the surgeon to treat. It is, of course, a sign of something being wrong. It may arise after the most simple operation for hernia and greatly disturb the patient and all in attendance. If no temperature is associated with it, and although slight, it must be treated. It is a common complication of operations for strangulated hernia, and, too, when the hernia was only incarcerated. The distention of the abdomen causes not merely an extensive sensitive feeling of the abdomen, coterminous with its boundaries, due to overstretching, but also the pressure on the stomach and diaphragm interferes with digestion and impedes respiration, much to the patient's discomfort.

Kelly, of Baltimore, has seen two deaths seemingly due to paralysis of the diaphragm caused by excessive tympanites. The heart, kidneys and liver are equally affected by tympany, but the heart and kidneys most markedly. The heart begins to palpitate and becomes irregular in its action, on account of the pressure. Tympanites alone is usually of no serious significance, no more than is a fast pulse, fever, constipation, or vomiting, and may be relieved easily, but when associated with these evidences it is one of the prominent signs of peritonitis. When tympany appears soon after an operation for hernia I look upon it with grave suspicion, for it may indicate that the bowels are obstructed.

In extreme tympany occurring within twenty-four hours after operation, which is not relieved by a rectal tube, stimulating enema and purgation, and which causes vomiting, no time should be lost in reopening the abdomen and searching for the cause. If you wait for an elevation of temperature your patient will be beyond relief.

I recollect traveling fifty miles from Winnipeg, in 1887, in a sled, when the temperature was 45° F. below, to reduce a strangulated right oblique inguinal hernia. Under chloroform anesthesia the reduction was effected

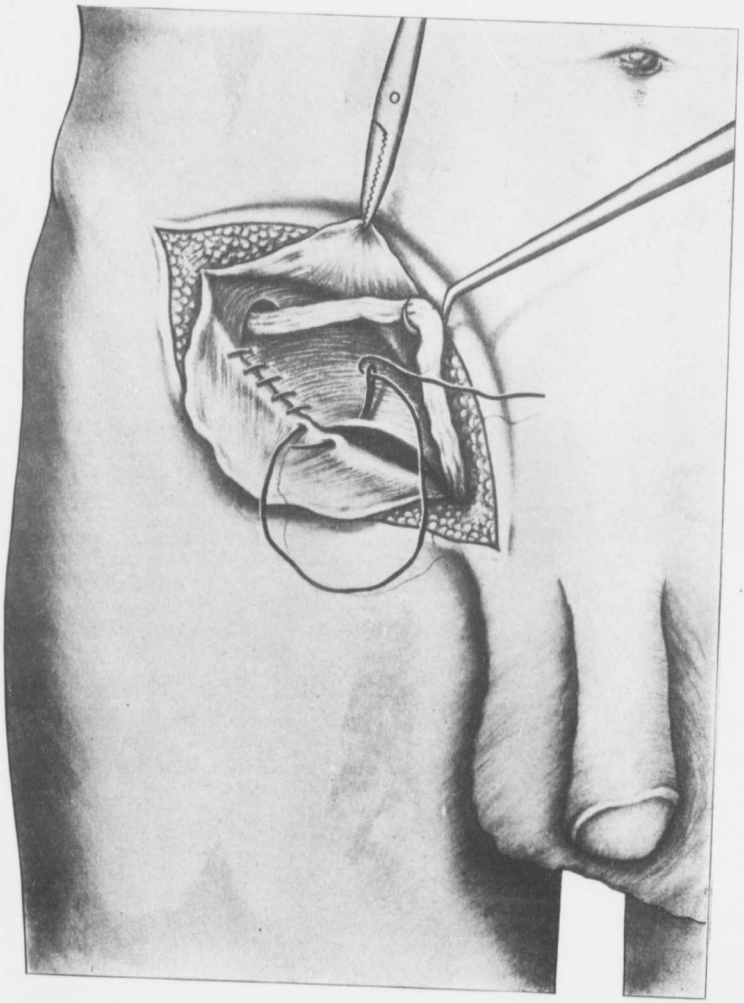

PLATE XXVI.

Bassini's Operation for Inguinal Hernia.

to my own satisfaction, and to the apparent relief of the patient. Within an hour I started on my homeward journey, but when twenty miles distant a telegram overtook me and I had to return, on account of "sudden bloating" and the bad condition of the patient, who, by the by, was at one time a barefooted schoolmate of mine. Upon returning I immediately opened the abdomen in the right inguinal region, and found that the bowel and omentum, although both were reduced within the abdomen, were obstructed to a considerable degree. The band was severed, the omentum and bowel liberated, and the wound brought together with through-and-through stout silk sutures, the best material at hand. A life was saved and a cure of the hernia effected.

If no other sign except tympanites is present after an operation, it is good practice to apply turpentine stupes to the entire abdomen (one in twenty), changed every half hour to three hours, according to the protection afforded to the stupes, care being taken not to blister the skin.

Instead of using the ordinary rectal tube, which, on account of its size, gives rise to rectal contractions and discomfort, I insist on using a No. 8 male self-retention bladder catheter. It carries off the gas and is too small to irritate the sphincter of the rectum so as to cause it to contract. The patency of the catheter should be tested occasionally by forcing air through it. A good-sized dose of castor oil, with the addition of twenty drops of turpentine, carries off the effete material causing gas. For gas pains we usually begin by passing the rectal tube; that failing, we use a 1, 1, 1 enema (one ounce of glycerine, one ounce of sulphate of magnesia, and one ounce of water). If this fails, we double the quantities (2, 2, 2 enema). This not being a success, an enema is given, consisting of an alum solution, one ounce to the gallon. This last has often succeeded when the glycerine and magnesium sulphate failed.

The late L. M. Sweetnam, of Toronto, directed patients suffering from tympanites to assume the knee-chest position and then passed the rectal tube. Kelly says (*op. cit.*, 87): "I gave her complete relief by putting her under chloroform and introducing, in the knee-chest position, one of my long rectal specula; the bowel was collapsed until the speculum reached the sigmoid flexure, when the gas began to escape freely, and she recovered."

Rather than allow a patient to die from tympany I have, under local anesthesia, performed an enterostomy and saved my patient.

PAIN.

The temperament of the patient has much to do with the amount of pain complained of after an operation for hernia, the highly nervous suffering the most, and those of a phlegmatic nature the least. Self-control enables a person to endure any amount of suffering without complaint. The most wonderful example of self-control in a child I met in the case of a boy one year old, on whom I operated for mastoid suppuration, referred to me by Dr. J. C. Cook. For some time afterward he was brought to the hospital for dressings. While the packing was being removed, the wound washed, etc., he would tightly grasp the hands of the nurse and never com-

plain, even though the perspiration would roll off him. In explanation of his excellent behavior, Dr. Cook told me that it was entirely due to the training he received during the last three months from a nurse who makes a specialty of training unruly children with kindness.

The pain resulting from a herniotomy usually subsides in twenty-four to forty-eight hours, and no morphine or other anodyne should be given for it. Pain of itself need cause no alarm, and it often subsides after the sufferer is assured that recovery will be faster if morphine is not taken. When the pain disturbs the patient to the extent of preventing sleep at night for several hours, then toward morning I give ⅛ grain of morphine, with 1-200 of atropine hypodermically. After this sleep is usually obtained and no more is required for at least twenty-four hours.

There are exceptions, however. I have seen some patients whose lives were saved by morphine. One case comes to my mind now. A man, whose cecum I removed suffered so severely from pain in the right iliac region, which was constant and excruciating, that he went into a collapse, became cold, pale and pulseless. In this collapsed condition he complained of "that awful pain." I then gave morphine, gr. ¼, hypodermically. This eased him; his pulse returned; color returned to his skin, and he felt well. In four hours' time the pain returned and he began to get bad again, but for two hours thereafter no morphine was given, not until it was clear to everybody that he would die if the morphine was withheld. After this the morphine had to be given regularly for four days. I am convinced that the morphine saved his life.

Hyoscine-hydrobromate acts well for nervous disturbances other than severe pain. Codeine should be tried for the pain first. A good, strong, kind, sensible nurse can enable the patient to gain self-control and practically lull her or him to sleep, even though suffering. A nurse whose nature runs counter to that of the patient should at once be removed, especially if the patient is nervous or hard to control.

SKIN COMPLICATIONS.

At the time of the operation the skin near the rupture may be the seat of an abscess, or an abscess may have formed in connection with strangulation. Last year I had to operate synchronously on a suppurating lymphatic gland in the groin, caused by truss-pressure, and on a strangulated hernia on the same side. The incisions were not more than two inches apart, and primary union of the hernial wound occurred. I attributed this excellent result more to the method of dressing the two wounds than to any particular asepticity carried out at the time of the operation. In order to prevent infection of the clean wound, I formed a long ridge about one inch broad and one inch high, extending midway between the two wounds, composed of collodion, cotton and iodoform powder. The cotton was first permeated with the iodoform powder and then soaked in collodion. It acted as an antiseptic and a mechanical barrier to spreading contamination.

In neglected and maltreated cases of strangulated hernia the skin may become inflamed, edematous or even gangrenous, manifested by redness,

pitting on pressure and crepitation. These skin complications may follow violent taxis or come on slowly. They usually bespeak infection from the condition of the contents of the hernia. At first the skin becomes tense, red and tender, and finally edematous, but with the lapse of time nature tires of fighting pathologic changes, innervation ceases to register the condition of dying or dead structures, and toxemia soon rules the entire economy; then the swelling lessens, the pain practically ceases, and the patient, unconscious of his perilous condition, sleeps his last sleep. What an object lesson to the student who was negligent in college!!

Eczema of the skin, or a burn caused by the application of hot fomentations, may complicate operative procedures. The skin over an umbilical hernia thins out and is most liable to infection, sometimes causing ulceration and sloughing.

CHAPTER XVI.

COMPLICATIONS INCIDENT TO THE RELIEF OF HERNIA (Continued).

SAC.

The sac is tense and full of straw-colored fluid at first, but as the strangulation becomes sufficiently advanced to cause death of the contents of the sac, the fluid becomes bloody, grumous or purulent in character. The sac at the same time becomes correspondingly changed in color and constituency; it may be inflamed, ulcerated and gangrenous. In some instances the sac is ruptured by taxis. The sac is not infrequently firmly adherent to surrounding structures, and its contents are often adherent to its inner aspect, all of which must be taken into consideration when dealing with it surgically.

OMENTUM.

The omentum is either free or attached to the sac or to the bowel, or to both. It may be inflamed or gangrenous in strangulated cases.

BOWEL COMPLICATIONS.

The condition of the strangulated loop is the most important to observe. It may be simply congested (Fig. 15), without destruction of any of its coats. In this condition the peritoneum is red and smooth, the vessels engorged to their limit. If the small bowel is constricted the state of congestion is of short duration, while a large bowel may remain congested for several days (Fig. 16) without permanent damage ensuing to the loop. Sooner or later, however, the bowel becomes destroyed by inflammation (Fig. 17), ulceration (Fig. 18), pressure atrophy (Fig. 19), or gangrene (Fig. 20). The more hernias I see in consultation, and the more hernias I reduce by taxis, the more I am impressed with this danger. I have practically come to the conclusion that with rare exceptions taxis should no longer be practised. As so ably pointed out by Maurice H. Richardson, of Boston, its dangers are

1. Rupture or bruising of the sac or intestine.
2. Tearing of adhesions.
3. Reduction *en bloc*.
4. Fatal delay.

ILEUS.

Ileus coming on after operations for hernia may be temporary or permanent. In the former a simple twist of a loop of bowel occurs, and when peristalsis begins it uncoils itself and the patient is relieved of the colic and

obstruction. In permanent ileus the simple loop does not straighten out, or a loop becomes obstructed in one of many ways, such as by a kink and adhesion at an acute angle, coils adherent to coils and bowel to raw surfaces, or a loop gets behind an adhesion, or through a hole in the omentum. It sometimes happens that the vomiting due to the anesthetic forces a loop of bowel into another hernial opening and strangulation occurs. Such an instance occurred in my practice. I operated in the forenoon on a woman, 53 years of age, for a strangulated right inguinal hernia. She vomited furiously in the middle of the afternoon, when she screamed and told the nurse that her intestines were down again, and so persistent was she about it that I was called hastily. Upon removing the dressings, a tense femoral hernia was very prominently present. She then told us that the rupture would sometimes come down on the thigh, but usually the bulging was higher up. I used taxis in vain, but only for a short time, just before operating. Even in this short time there was fluid in the sac, and the small bowel, which it contained, was intensely congested, much more so than the small bowel and omentum found in the inguinal hernia, although strangulated for about twelve hours.

The usual clinical picture of ileus is that of distress and suffering. The patient usually knows that his bowels are obstructed and can point out the exact spot where the pain began and where it has repeatedly returned in paroxysms every two or three minutes since then. Nausea and vomiting are distressing from the beginning of the pain. The patient first vomits the stomach contents, then bile, and finally the contents of the small intestines. The abdomen is flaccid at first, except the region of localized pain; here it is tumefied and tender on pressure, and as the pain returns the abdominal wall here becomes more and more tense and rises like a ball, and has the feel of a semi-solid tumor. It is not many hours, however, before the bowels become exhausted, dilated proximal to the stricture, and the abdomen becomes generally swollen, tympanitic and tender.

URINARY BLADDER.

Irrespective of hernias of this viscus complications affecting the bladder are liable to arise in the course of, or following, operations for the cure of inguinal, femoral and ventral hernia. Retention of urine is a very frequent complication following any operation done in the vicinity of the bladder. This is easily corrected by means of the catheter and by altering the reaction of the urine, giving alkalies, as is usually indicated.

In operations done for the relief of the direct form of inguinal hernia, the bladder, on account of its close attachment to the peritoneum in this region, is likely to be partly extruded with the hernia; indeed, a portion of the bladder may form part of the sac wall. It is in conditions like this that the bladder is likely to be injured during the operation. I have seen this viscus opened by accident, and in one case, seen in consultation, a portion of the bladder had been tied off with the sac, leaving a urinary fistula which had to be remedied by a second operation.

It is my belief that hernia of the bladder in the inguinal or femoral re-

gion is exceedingly rare, and that many of the cases that have been reported as instances thereof are really instances where the bladder has been dragged into the field of operation. It is a fact that surgeons who have the greatest experience in this work meet with fewer hernias of the bladder than do those whose experience is limited.

C. B. Lockwood (*Trans. Lond. Clin. Soc.*, Vol XXXI) reports a case of incomplete inguinal hernia on the left side. Four months previously, while operating on the opposite side for hernia, another surgeon had opened a finger-like extension of the bladder which was closed with sutures. Later two phosphatic stones which had formed on the sutures were removed by lithotrity.

Verhoef (*Jour. de Chir. et Annales de la Soc. Belge de Chir.*, No. 2, 1903) reported two cases of accidental wounding of the bladder during operations for hernia. In one of the cases a portion of the bladder was in the sac; in the other it was not.

J. B. Harvie (*American Medicine*, April 4, 1903) reported a case in which the entire bladder was found in the hernial sac. Before operation it was thought that the condition was one of strangulated hernia complicated by hydrocele. The upper part of the mass was very tender to touch. The patient had had a reducible hernia for ten years, but had never worn a truss. The hernia became irreducible during an unsuccessful attempt to evacuate the bowel. Attempts at urination were frequent from this time on, but only a few drops of urine were passed at a time. Subsequently all the symptoms of a strangulated hernia appeared. When the sac was opened about seven inches of gangrenous intestine were found and resected, the anastomosis being made with a Murphy button. A small opening made in the gangrenous mass showed it to be the bladder. Considerable difficulty was experienced in reducing this organ, but it was finally accomplished.

In ventral hernias the bladder occasionally has been found to protrude immediately above the pubic bone, a position in which it is extremely likely to be injured during the operation.

A urinary fistula may result from injury of the bladder wall made during an operation for hernia. I have had occasion to close two such fistulas, one in the suprapubic and the other in the inguinal region.

Cystitis may follow hernia operations, although it is in no way the result of this particular operation. When it does occur, the treatment usually employed for this condition should be carried out.

INJURIES OF THE CORD.

When the vessels of the cord are accidentally injured, the testicle is likely to become congested and hyperplastic, eventually undergoing atrophy. The gland may also become gangrenous.

Even when the vas deferens is injured it is not always necessary to remove the testicle. In the fall of 1897, while operating for the relief of a strangulated right-sided hernia, I injured the vessels of the cord to such an extent that castration was the only recourse. This operation was done in a kitchen, at about two o'clock in the morning, with a very poor light.

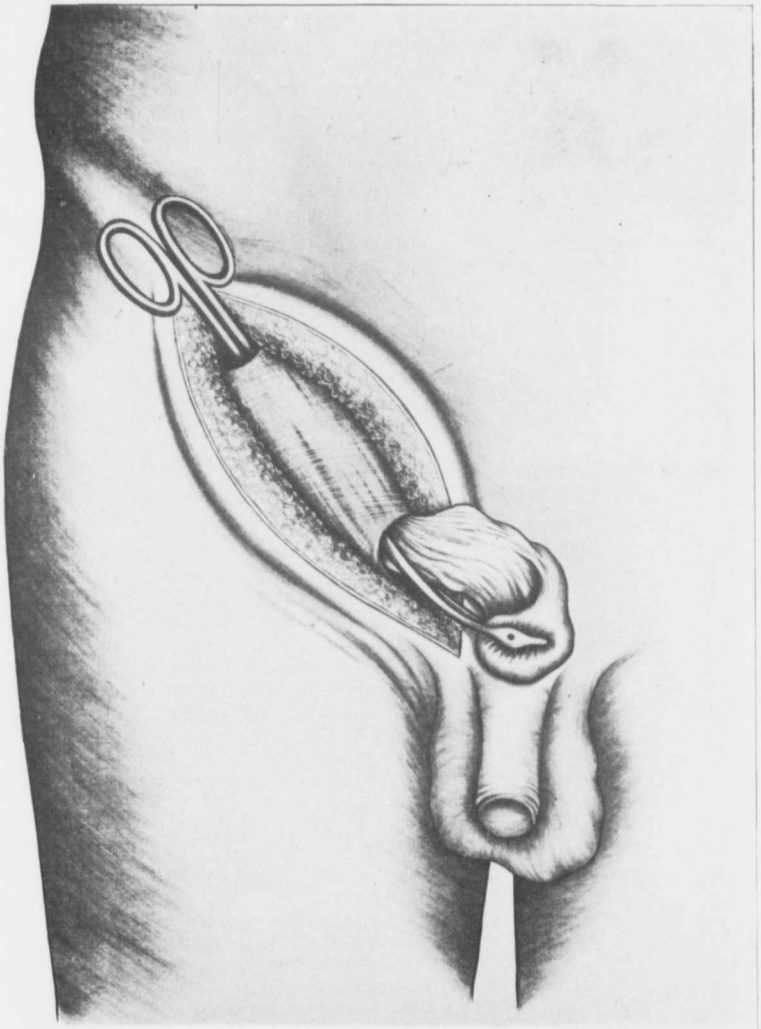

PLATE XXVII.

Kocher's Operation for Inguinal Hernia—second step.
(*Saunder's Medical Hand Atlas.*)

Otherwise it would not have been possible to have produced such an extensive injury. In another case I injured the vas deferens while operating for a non-descended testicle and hernia, but I did not think it necessary to remove the testicle on this occount. The outcome of the case justified the decis.on.

COMPLICATIONS INVOLVING THE TESTICLE.

Atrophy of the testicle has occurred much more often after Halsted's operation for oblique inguinal hernia than after any other method of procedure. In sixty-one cases this complication occurred ten times (16.39 per cent.). Retraction of the testicle occurred four times in 269 cases (1.5 per cent.). I have had two cases of retraction of the testicle after Bassini's operation. In another case gangrene of the testicle followed removal of the vas deferens. In both the cases of retraction of the testicle the gland eventually returned to the scrotum. In three of Bloodgood's cases referred to above the testicle returned to the scrotum.

I encountered one case of atrophy of the testicle following an extensive suppuration of the glands in the groin, which had extended to the cord. In these cases there was not a hernia present.

Hydrocele of the tunica vaginalis testis has occurred in 10 per cent. of the cases following Halsted's operation, where the vas was removed.

SECONDARY WOUND SECRETION.

I have met with this complication in operations for the cure of inguinal, femoral and extensive ventral hernias. This complication can be obviated easily by seeing to it that no dead spaces are left when the wound is being sutured, and by the proper application of the primary dressing. In large hernias where a sac has been removed from within the scrotum and no drainage is inserted, the scrotum is liable to be filled with a secondary wound secretion. This is prevented by drainage with silkworm gut.

In performing extensive plastic operations for the relief of hernia anywhere in the abdominal wall, dead spaces are very likely to be left. The surgeon must use his judgment in deciding when and when not to drain in order to prevent secondary wound secretion. When it does occur, the fluid should be withdrawn at once, because its presence in the tissues predisposes to infection.

INFECTION.

Infection has been thoroughly described in previous chapters, so it will not be necessary to take up this subject extensively at this time.

Infection should not occur more frequently than in one per cent. of the cases. Before the use of rubber gloves infection did occur in about ten per cent. of the cases. Halsted reported 42 cases out of 446 (9.5 per cent.). By the use of rubber gloves the occurrence of infection was reduced to about 1.8 per cent. In looking over my own statistics, and those of other surgeons, I find that they compare favorably with those of the Johns Hopkins Hospital. During 1902 and 1903, at the Heidelberg clinic, 31 cases of infection occurred in 198 cases (15.6 per cent.).

PERITONITIS.

Traumatic Reaction or Repair. In performing an operation for the cure of hernia, the peritoneum is always opened and handled, and thereby it is subjected to the complications caused by trauma and by bacterial invasion. Strangulated hernia carries its own infection with it, and if not relieved sooner or later, the occurrence of peritonitis is inevitable, local or general, or both. Until such time when a clearer distinction between repair (traumatic or plastic peritonitis) and a disease (peritonitis) caused by bacteria is generally adopted, I am constrained to uphold the modern conception of the disease, viz., that germs are the cause of peritonitis.

It is commonly stated in textbooks that the peritoneum has great powers of forming adhesions. This is a mistake. The normal peritoneum has no tendency to adhere to normal peritoneum, or to any raw surface unless that surface is inflamed. The omentum and bowels slide over and lie in contact with the raw peritoneum of the ovary month after month and year after year without forming adhesions. Why are adhesions within the abdomen frequently eradicated by merely breaking them down? Simply because raw surfaces do not always happen to stay approximated, on account of changes in locality of loops of bowel and omentum, but if a raw surface stays only a short time in contact with another raw surface, repair (plastic) takes place. It is just the same as occurs after the coaptation of the raw surfaces of any wound in the soft parts of the extremities.

The redeeming attributes of the peritoneum are its power of rapid absorption and its smooth and slippery protection. Following exposure and handling of abdominal viscera, even in what we call clean cases, it is amazing the adhesions that may form within a week, and that are demonstrable when the abdomen has to be opened for some other complication, such as the "vicious circle" following a gastroenterostomy. I have seen new adhesions in the form of bands at the end of three weeks (normal time for their development), and they had to be cut with a knife. At the end of one week they are friable and easily broken down.

I recall operating on two cases of hernia that a few days later demanded appendectomy. The first patient was a boy, aged 18, with an uncontrollable (by truss) right oblique inguinal hernia. The omentum was firmly adherent to the inner surface of the sac and to the small bowel. A portion of omentum was amputated and the stump rolled within omental folds. On the third day (60 hours) after the herniotomy the typical symptoms of appendicitis developed suddenly. I opened the abdomen (McBurney's incision) at once, and found the inflamed and almost ruptured appendix, but the end of the omentum and peritoneum at the site of the herniotomy presented no adhesions whatever.

I mention this case in contrast to the second one. A woman, aged 32, mother of three children, had an umbilical hernia that had been strangulated for six hours. Bile and chyle were being vomited. Omentum filled the umbilical sac (incarcerated), while small bowel (strangulated) occupied the sub-umbilical hernia. The abdominal wall was lax. The woman

was not obese. The operation was neither difficult nor prolonged, and a beautiful coaptation of the peritoneal surfaces was secured.

The omentum was dealt with by means of Downes' electro-thermo-cautery, and nearly the entire omentum was removed. On the fourth day after the herniotomy a fourth recurrent attack of apendicitis came on. I opened the abdomen through the right rectus muscle and removed a non-adherent gangrenous appendix. I then had an opportunity to explore the internal aspect of the seat of the herniotomy. There were no adhesions at the scar nor of the omental stumps, but the bowels were glued together pretty thoroughly, and distended. Upon pushing the sigmoid (which was over on the right side) back to the left and upward(gas began to escape per anus. A rectal tube was inserted to facilitate the emission of the gas, and with the manipulation of the most distended section of bowel it was soon emptied. I broke down many adhesions and feared the outcome, but the patient made a perfect recovery.

The agglutination of the bowel was no doubt due to plastic material thrown out on the surface of the peritoneum to repair the damage done to it by strangulation and by the handling it received at the operation. When the exudate is sterile there is no peritonitis present but the condition known as traumatic inflammation does exist and certainly predisposes to an infective peritonitis. I presume every surgeon of experience in the surgery of the peritoneum has demonstrated by operation the fact that sometimes extensive peritoneal adhesions vanish by absorption.

Primary intestinal agglutination gives rise to distressing and even dangerous symptoms. The vomiting is more persistent than that usually caused by the anesthetic, but is less persistent than that of peritonitis, and bile is rarely ejected. The temperature is higher than normal, 99° F. to 101° F., but rarely higher; the pulse is accelerated but remains regular and of good volume. Tenderness on pressure and tympanitis are less severe and extensive than in peritonitis, the bowels functionate and the patient lacks the facial expression and mental anxiety present in peritonitis. Leucocytosis is not marked, if present at all.

When the distended bowel presses upon the diaphragm, dangerous respiratory and heart symptoms may arise and temporary ileus occasionally occurs caused by the pressure of the tympanitis. The lymph is absorbed in from 2 to 4 days,—in just about the same time that a traumatic swelling and edema of the hand or foot subsides. Indeed the traumatic exudates subside sooner in the peritoneal cavity than in the hand or foot, unless the skin is freely punctured to allow drainage. When recovery takes place the tympanitis gradually subsides, the pain lessens, the temperature falls and the patient feels more comfortable.

So closely do the symptoms caused by plastic or traumatic exudates resemble those of peritonitis that no one can positively differentiate the one condition from the other during the first three days after the operation. It is the prevention of the so-called "traumatic peritonitis" that should concern the surgeon. The minimum exposure and handling of the peritoneum, omentum and bowels; the covering of raw surfaces; the exclusion of anti-

septic solutions from the peritoneum; absolute control of hemorrhage and proper purgation of the patient before operation are the main prophylactic measures.

While it is generally admitted that free saline purgation is the treatment *par excellence* of traumatic (peritonitis) exudates interfering with the alimentary canal, still when it is used at the wrong time much suffering is inflicted upon the patient. It is a good plan to give three or four grains of calomel three hours before the operation; wash out the stomach on the operating table, if it is dilated, and then even before the patient is fully awake administer citrate of magnesia. If purgation is not commenced immediately after the operation, it is folly to attempt it during the second and third days because the bowels are in a splint and purgatives do not produce peristaltic action until the muscular coats of the bowel are more or less liberated by the absorption of the traumatic exudates through the peritoneum and blood vessels. Purgation during those two days usually causes vomiting and adds to the distress of the patient. Beginning at the end of the third day, small doses of calomel, gr. 1-10, every 20 minutes, till gr. ii are taken, and then citrate of magnesia, two hours after the last dose of calomel, is a practical mode of dealing with the bowels in this condition. This does not exclude the passing of a rectal tube or a large self-retaining, male, soft rubber catheter to carry off flatus. If it is deemed wise, and it usually is, administer nutrient enemata alternately with stimulating enemata, and colonic flushings every 6 or 8 hours. (See Tympanitis.) Assafetida, turpentine, glycerin, alum, etc., serve a good purpose, as soon as the tympany begins, in preventing extreme bloating. The aseptic chemical inflammations are not inflammations at all, only an attempt on the part of nature to repair the damage done by the destructive power of the drug.

PERITONITIS IN HERNIA.

Infection of the peritoneum is followed by peritonitis. The germs causing this are the same as those that infect wounds in other parts of the body. William H. Welch says, "It is apparent that while there is no reason to doubt that pyogenic cocci are specific agents of infection, the effects which they produce depend upon a variety of conditions, such as the source, the number and the virulence of the micrococci, the accompanying toxic substances, the part of the body invaded, the readiness of absorption, the presence of foreign bodies and the pathological products, the general state of the patient and the condition and handling of wounded tissues."

The peritoneum is capable of destroying a larger dose of infectious micro-organisms than are most of the tissues of the body. Great as is the resistant power of the peritoneum, the vital resistance of the individual generally plays such a marked rôle in practical surgery that no surgeon can give a guarantee that infection will not occur after any operation for the relief of hernia; but, on the other hand, the peritoneum more often escapes inflammation than does the wound itself, especially in inguinal and femoral hernias.

Every patient should be placed in the best possible physical condition

PLATE XXVIII.

Kocher's Operation for Inguinal Hernia—fourth step.
(*Saunder's Medical Hand Atlas.*)

before the operation is done. Inasmuch as the individual is more prone to peritonitis after operation when suffering from any chronic disease of the heart, liver or kidneys, and inasmuch as he is also more likely to have a post-operative pneumonia, the surgeon should always examine into the condition of the internal organs of the patient before any operation is done. In spite of all care, micro-organisms enter the wound every time the peritoneum is opened.

All consideration should be given to (a) the condition of the patient, (b) complete sterilization, and (c) the technic employed. In connection with a hernia, the greatest factor in the causation of peritonitis is strangulation of a loop of bowel within the sac or, more rarely, intra-abdominal necrosis.

Symptoms.—The symptoms of post-operative peritonitis are both local and general, and they vary in degree according to the severity of the infection. The onset may be insidious or the condition may be ushered in with symptoms of shock. Kelly reports two deaths from peritonitis. In one case the symptoms were so severe that the case was mistaken for one of secondary hemorrhage and shock, when in reality it was one of streptococcus infection. I have seen the same thing occur with extension of the peritonitis after other abdominal operations, but I have never seen a case of peritonitis following an operation for the relief of hernia when strangulation was not present.

Pain.—The first symptom to manifest itself is pain, which may be referred by the patient to the site of the operation. If the affection is fulminating in character, the pain at first generally is something like that existing in the early stages of a severe appendicitis. The pain usually is remittent in character. There are periods of calm and periods of unrest, according to the direction taken by the inflammation and the structures involved. It is not uncommon to have the pain disappear from its original seat by the time the peritonitis has become general.

When the patient is at the point of death the pain sometimes ceases. The pain met with in strangulated femoral hernia, or a hernia of the Littré variety where only a part of the lumen of the bowel is shut off, is very deceptive. Death of the bowel takes place so rapidly that the patient complains of very little or no pain. When the peritonitis extends to the neighboring tissues, then there appears the characteristic pain of peritonitis.

The pain of peritonitis following an operation must not be mistaken for pain in the abdomen caused by other conditions, such as the referred pain of pleurisy or pneumonia, angina pectoris and aneurism, or the radiating pains of locomotor ataxia, and of many other conditions.

Tenderness.—Associated with the pain is tenderness. This is usually local, but becomes general when the inflammation extends. The tenderness is greatest at the point where the inflammation is most active. Light stroking of the skin will sometimes cause great inconvenience. The tenderness may be superficial or deep.

Muscular Rigidity.—Associated with this tenderness is muscular rigidity. When the pain and tenderness disappear, the muscles relax, and this,

in many instances, may be taken as a sign of approaching dissolution. All the abdominal reflexes are increased during the spread of the disease.

Vomiting.—Vomiting is one of the early signs of peritonitis, but usually it does not come on until about three days after the operation. Vomiting resulting from the administration of the anesthetic usually passes off at about the time that the vomiting which is associated with peritonitis makes its appearance. If the operation is done for the relief of an umbilical or epigastric hernia, or any hernia in the upper abdomen, and peritonitis follows, the vomiting comes on very early, on account of the close proximity of the inflammation to the stomach. The vomitus after a time becomes green in color, then dark, and finally it becomes fecal in character.

Pulse.—The rapidity and the high tension of the pulse are very characteristic of peritonitis, so much so that the older surgeons still refer to the hard and wiry pulse of peritonitis. The pulse rate varies from 110 to 150. The frequency of the pulse lessens as soon as the spread of the inflammation is checked. Its frequency increases as long as the peritonitis is active. Then acceleration of the pulse and the persistency of this acceleration are more characteristic of peritonitis than is any other single symptom met with in this disease. The pulse and respiration are increased in frequency and the temperature rises, maintaining a physiologic ratio while the inflammation is spreading. As soon as the inflammation becomes limited or general the temperature and respiration may vary in proportion to the pulse rate.

Temperature.—The temperature increases for about three or four days after the operation. In cases of so-called traumatic peritonitis, in which an infection is grafted on the peritonitis, the temperature of the one condition merges into that of the other . There may be gangrene of the bowel and extensive peritonitis with a subnormal temperature. The temperature of peritonitis is rather deceptive and considered alone cannot be relied on as a pathognomonic symptom.

Shock.—Shock is always present to a greater or less degree in peritonitis. In cases where the onset is sudden and severe, shock may be very marked.

Increased Peristalsis.—Increased peristaltic action is present early in the disease, but is soon put in abeyance, so that the bowels become perfectly motionless. At the margins of the inflammatory area peristalsis is most active. If the inflammation invades the intestinal tract from below upward, retroperistalsis is established, which produces nausea and vomiting, even when the inflammation has not extended to the stomach.

By listening over the abdomen with a stethoscope one can usually locate the most active area of the inflammation by the friction sound that is heard. At the margins of the inflammatory area there is always more or less peristalsis, and it is here that one can hear the various noises that are produced by the intestinal contents working to and fro in the lumen of the bowel.

Tympany.—Tympany is present with inflammation of the peritoneum. The distention of the bowels becomes greater until eventually the abdomen is like a drum, and a resonant percussion note is elicited. This distention is present even when there is no inflammation.

The facial expression of one suffering from post-operative peritonitis is that of great anxiety. The mind remains clear until exhaustion occurs, or when the temperature becomes high the patient may be found to be delirious between the intervals of sleep. When the final collapse comes and the patient is dying, he usually is unconscious.

Blood.—An aid to the early diagnosis of post-operative peritonitis is an examination of the blood. The leucocytes are increased in number, especially the polymorphonuclear variety. The coagulability of the blood is also increased. The presence of leucocytosis is not to be relied on too firmly, however, as a diagnostic aid.

TREATMENT.—The treatment of post-operative peritonitis is both *medical* and *surgical*. The only medical treatment that is of any benefit at all is that which drains the alimentary canal by means of cathartics, carrying away the germs and their products, or the administration of opium, which lessens the pain, prevents peristalsis, and also, to a considerable degree, the spreading of the inflammation. During the early development of abdominal surgery Lawson Tait instituted and practised free catharsis, beginning it immediately after the operation, as a prophylactic against post-operative complications, such as peritonitis. Cathartics are of no avail, however, once the inflammation is established. When peristalsis cannot take place the administration of cathartics may do harm.

Opiates are indicated for the relief of suffering and also to prevent the spasmodic contractions of the alimentary canal. If it is decided to give opiates in the treatment of peritonitis, they ought to be pushed to the extent almost of poisoning the patient so that no tenderness is felt.

The medical treatment is also local in the form of turpentine stupes and other methods of applying heat and moisture, these being very grateful to the patient by relieving him of his suffering. The ice pack is indicated early in the disease and then only for a very limited time.

The large bowel should be kept empty by means of colonic flushings. Much relief is also afforded by stomach lavage, and it is a good routine practice to wash out the stomach regularly. Patients who have had their stomach washed out will frequently ask to have the procedure repeated because of the relief it gives them. The medical treatment usually is just as successful as is the surgical.

In post-operative peritonitis the infection that causes the peritonitis has been carried into the abdomen either by the operator or his assistants, or by the materials that were used during the operation. The only surgical treatment in this condition is to open the abdomen and drain. When the patient has a temperature and complains of local pain in the wound and tenderness in the abdomen, with muscular rigidity, a rapid pulse, and a flushed face; on about the third day after the operation, the wound should be explored by removing a stitch or two and inserting the gloved finger into its very depths. The peritoneum is thus given an opportunity to take care of the germs that are invading it, provided they are directed into another channel, and that is outward by drainage.

Of course, this procedure will have a tendency to nullify the radical

operation for the cure of hernia, but infection is one of the causes of recurrence of the hernia and when it is present it is well to recognize the fact that drainage is imperative, even at the risk of having a recurrence of the hernia.

The most dangerous form of peritonitis associated with hernia is that which affects the loop of bowel that was strangulated after it is returned within the abdomen and the rush of blood into it is so great as to cause a local peritonitis which, according to the nature of the germs causing it, may or may not become general. In the case of a peritonitis that comes on after an operation for a hernia that was not strangulated, I cannot see very much to justify opening the abdomen, washing out the peritoneal cavity, breaking down adhesions, thus spreading the inflammation and hurrying the death of the patient, unless it is done before the expiration of the first three days of the disease, because after that any interference is useless.

I recollect operating on a young woman in the Winnipeg General Hospital, in 1889, removing a dermoid cyst. The operation was a simple and an easy one, and I had no anxiety whatever about the case, but immediately following the operation severe gastro-intestinal disturbances manifested themselves. Within forty-eight hours the temperature rose to 103° F., the pulse was 120, the face was flushed, there was vomiting and distention, and all the characteristic symptoms of peritonitis rapidly coming on. I inquired about the materials that were used during the operation, and learned that two extra sponges had been used, the asepticity of which could not be vouched for. At two o'clock in the morning I opened the abdomen again, and found the intestines congested, with flakes of lymph floating in the fluid present inside of the abdomen. The small intestine immediately above the brim of the pelvis was involved quite extensively. The peritoneum was not yet denuded. I washed out the abdominal cavity with a considerable quantity of plain sterile water, and finished the flushing with a couple of pitchers full of normal salt solution. I left the abdomen full of the salt solution and closed the wound with through-and-through sutures. Six hours afterward the lady was free from pain and the abdomen was flat. All the fluid had been absorbed and the temperature had fallen to 100° F. Immediately after the washing out of the abdomen the temperature rose to 105° F., but fell subsequently, as stated. The patient made a perfect recovery, the reason being, of course, that the peritoneum was not destroyed by the inflammation.

The simple irrigation of an infected peritoneal cavity is worthless. If anything at all is to be done in the nature of cleansing the peritoneal cavity it must be done by flushing, pouring the fluid from a pitcher or carrying it to the furthest parts of the abdominal cavity through a tube an inch in diameter, and to be of benefit this must be done early in the course of the disease.

The practice of evisceration and flushing for the treatment of peritonitis is accompanied by a great deal of shock. It lessens the vital powers of the patient very much, and it should not be done in cases of post-operative peritonitis.

If the abdomen is opened and accumulations of fluid or pus are found in different parts of the cavity, the patient should receive the benefits of drainage of those parts, Douglas' pouch, Morrison's pouch, the kidney re-

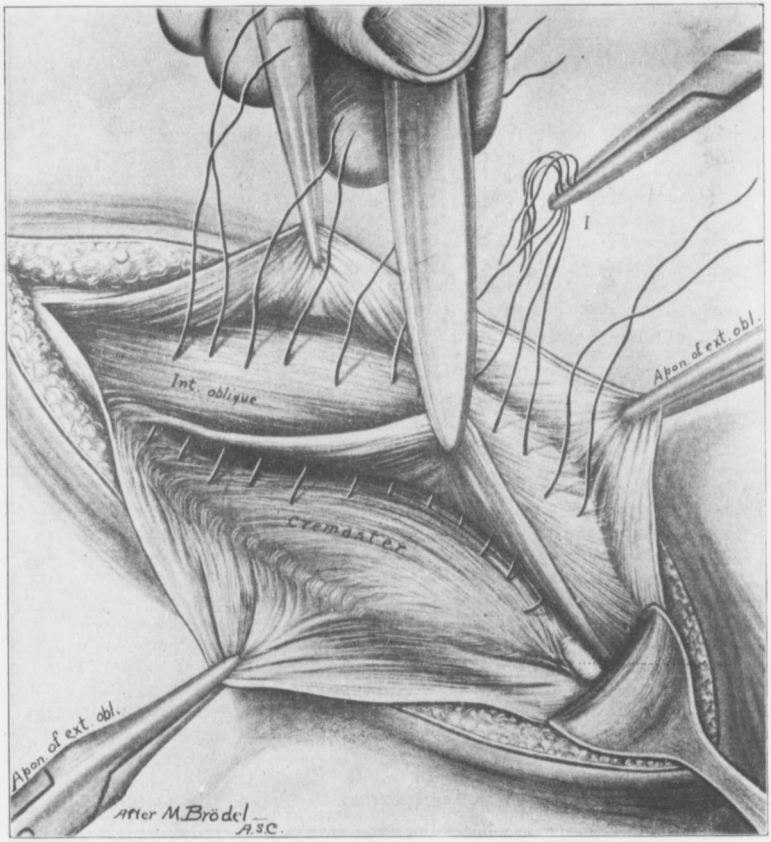

PLATE XXIX.

Halsted's Operation for Inguinal Hernia.

gion, or wherever the accumulation happens to be. A drain should be inserted through a separate incision in the abdominal wall, taking the most direct route.

Strangulation of the bowel following a localized peritonitis, post-operative or otherwise, should be treated by laparotomy, if the patient's condition will permit of it. If not, the bowel may be drained, a simple enterostomy being performed on the most distended portion. This can be done under local anesthesia. A self-retaining catheter is pushed through an opening in the bowel and circular stitches are applied. If there is any complication in which the surgeon is justified in doing anything, it is peritonitis, and everything that promises the slightest opportunity of improvement to the patient should be employed.

Immunizing injections for the prevention of peritonitis have been practised. This is a step in the right direction. When resection of bowel is demanded in hernia, fatal peritonitis occasionally developes in spite of all precautions and the degree of the infection overcomes the resistance of the peritoneum. Since we cannot be certain of asepticity in intestinal anastomoses, it would appear that should something be found that would, when injected into the circulation, aid the peritoneum in overcoming the bacteria invading it a very valuable advance would be made.

It has been observed (Salieri) that normal saline solution injected in small quantities increases the normal resistance of the peritoneum from seven to sixteen fold against *bacillus coli* infection. Mikulicz-Radecki (*West London Med. Jour.*, July 1, 1904) first demonstrated that hypodermic injections of 0.5 per cent. neutralized nucleinic acid produce artificial hyperleucocytosis of bactericidal value, and increase the normal resistance of the peritoneum from sixteen to twenty times. When repeated injections were made intra-peritoneally, the increase was as high as forty times the natural resistance. Robson (*International Medical Annual*, 1906, p. 361), as a preparatory measure for operations on the gastro-intestinal tract, says, "As a rule 50 c. c. of a 2 per cent. solution was used. The adult man received about 1 gram of nucleinic acid to 75 kilos of the body weight. Fifty-eight cases were treated in this way. In fifty-five the operations were abdominal. In four cases the operations were postponed so that they did not take place until more than thirty-four hours after the injection was given. As in animals there was constantly observed in man a hyperleucocytosis in the blood, mostly preceded during the first hour or so by hypoleucocytosis. The operations were mostly performed in from thirteen to nineteen hours after the injection. The optimum for nucleinic acid injection is reached in animals in seven hours, but it seems to occur in man considerably later. Twelve hours is the time fixed by experience, which enables the surgeon to operate on the rising tide of leucocytosis."

On page 362, he says, "The general impression gained from this method is that while it gives no absolutely certain immunization, it increases the natural immunity and that the cases treated by it have given more favorable results both as to ultimate recovery and smooth convalescence, than cases where the operations were performed without this preparation."

Arndt (*Centr. f. Gyn.*, March 5, 1904), after three years' experience, recommends eserine salicylate, 0,001 gram hypodermically, for post-operative intestinal paralysis. He has not used more than 2 mg. in 24 hours. If the drug is not effective microbic infection is most likely present. It begins to cause peristalsis in from 15 to 30 minutes, as is evidenced by borborygmi and, finally, in about an hour by the passage of flatus. Eserine may be used in doses of 1-40 of a grain. It is a spinal depresso-motor and counteracts the inhibitory reflexes of the splanchnics present in intestinal paralysis following operations. Manipulations of the intestines necessarily carried out at operations stimulate the splanchnic nerves to produce reflex inhibition along the whole intestinal canal and paralysis is the result.

PNEUMOCOCCUS PERITONITIS.

This may occur after operation involving the peritoneum. Mathews (*Ann. Surg.*, Nov., 1904) reports five cases. Jensen records 106 cases of pneumococcus peritonitis. Several observers have seen about half a dozen cases. It may be much more frequent than is supposed. The only way to determine the special cause of peritonitis is by means of a bacteriological examination of the inflammation products. The pneumococcus infects other structures of the body more frequently than it does the peritoneum. In persons dying of pneumonia (pneumococcus) Netter, Flexner, and others, have regularly demonstrated this germ in cover-slip preparations from the peritoneum and no evidence of peritonitis. In peritonitis the pneumococcus was found in 7 per cent. (2 cases in 140, Netter). It is more frequent in children (2 to 1). Mixed infection is rare.

The pathologic appearance is characterized, as in empyema, by an extremely fibrinous and odorless greenish yellow exudate. Large loose masses of fibrin are often found floating in a liquid or semi-solid exudate. When the inflammation is general the thick, fibrinous lymph covers the entire surface of the peritoneum. The usual tendency of the process is to terminate in localized abscesses with very thick walls. Some of them have been known to rupture spontaneously even through the skin. Robson declares that 80 per cent. of the patients may be expected to recover when the disease has become localized. If the other form (diffuse) is present there is no hope.

The majority of cases of pneumococcus peritonitis have been primary. As might be expected pneumonia has developed secondarily. Although the diagnosis has not been commonly made until the termination of the disease, still its symptoms and course are quite different from other forms of peritonitis.

Symptoms. Much prominence is given by observers to the sudden onset, early high fever, with vomiting, pain, tenderness on pressure and distention. The muscular rigidity, pain, and tympany are not comparatively marked. In three or four days the vomiting usually stops, the temperature falls and diarrhea, if not present from the start, as it sometimes is, comes on with the amelioration of the above mentioned symptoms and signs.

Marked evidence of intra-abdominal exudates resembling a tense cyst or cysts is next found. The high temperature returns, with morning and

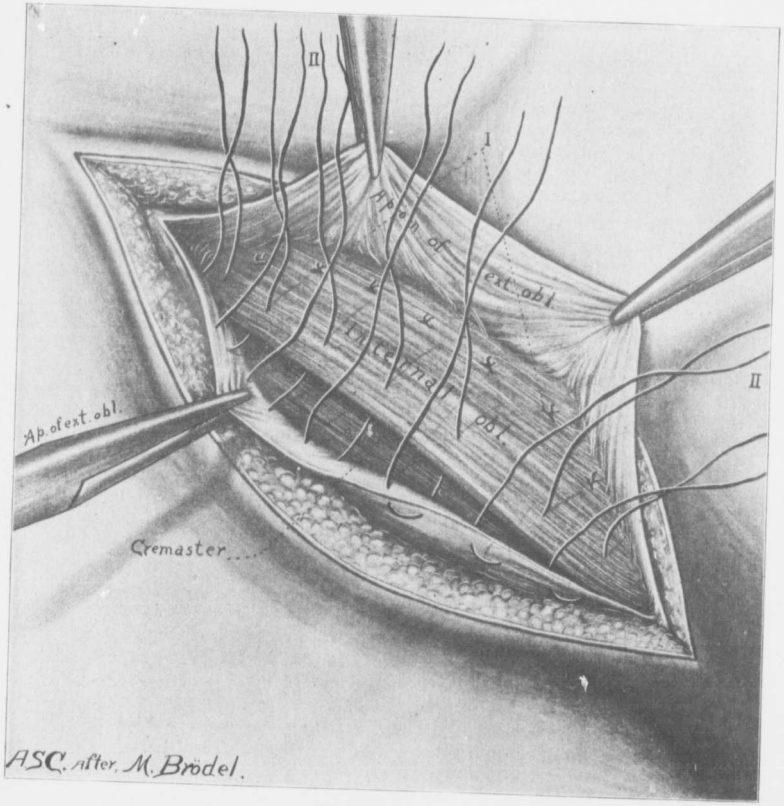

PLATE XXX.

Halsted's Operation for Inguinal Hernia.

evening remissions. The inflammation becomes localized. The surgeon should not hesitate to at once drain the abscess or abscesses, as the case may be, There are many avenues of infection. In one case the infection entered through the wound, following a hernia operation (Jensen). Through the intestinal tract secondary to intestinal ulceration (Flexner) or ulcer of the stomach is another method of invasion; or through the blood, or through the diaphragm by extension from the thorax.

POST-OPERATIVE PYREXIA.

Post-operative pyrexia often occurs when bacteria are not an etiologic factor. There are two distinct periods after operations when there may be an elevation of temperature. One period is between the first and third days and the other between the eighth and tenth. During the first period there occurs what I call the *primary fever*. Von Bergmann and others designate this as fermentation fever. It comes on soon after the operation and terminates spontaneously within two or three days. I have seen an elevation in temperature occur during the operation on cases of extensive hernia with incarceration, or where there was much manipulation of the bowel. The same thing occurs when extensive adhesions must be broken down. It is certain that in cases such as these fermentation could not have taken place. The fever must, therefore, be due to the absorption of fibrin and other proteid substances.

An examination of the blood does not, as a rule, reveal any marked leucocytosis, nor are bacteria found, either microscopically or in culture.

SECONDARY FEVER.

Secondary fever comes on usually about the eighth to the tenth day after operation, especially in cases in which the omentum was removed extensively, or adhesions broken down, or vessels of considerable size ligated. Apparently for no reason whatever the patient becomes feverish, his temperature rises to 99° or 100° F., or even up to 103°. Within twenty-four to forty-eight hours the fever subsides spontaneously.

This elevation of temperature is usually ascribed to an indiscretion in the diet, to exposure, to too much mental excitement, etc., but secondary fever occurs in patients when no cause whatever is discoverable.

An examination of the blood fails to reveal any bacteria, but sometimes a marked leucocytosis is present; so that some other explanation of the fever must be sought for. I am of the opinion that the fever is due to the absorption of thrombi and emboli which are undergoing fatty degeneration. The organization of a clot is often accompanied by an elevation of the temperature. This phenomenon is not always accompanied by chills or by other symptoms of inflammation.

SEPTIC INTOXICATION.

Patients suffering from strangulation of the bowel, local peritonitis, or abscess may have an increased temperature during the operation. This temperature is due to the absorption of pus either by the peritoneum or by the

wounded tissues. This septic intoxication is very noticeable in gynecologic surgery.

Although auto-intoxication may be said to be a variety of septic intoxication, there is a difference between the two, particularly in cases of strangulated hernia, although these terms are used interchangeably. The patient may die from the absorption of toxins in the alimentary canal, even though there may have been no peritonitis following the operation. Particular stress was laid on this by the late Greig Smith.

Auto-intoxication from this cause may occur either immediately following the operation done to relieve the strangulated bowel, or it may not be manifested until the end of a week or ten days, when the bowel again becomes active.

Sapremia may follow a hernia operation, and the germs causing it may have been implanted in the wound by the operator. This condition is also known as septic or putrid blood poisoning. It is invariably caused by the entrance into the blood of the toxins produced by putrefactive bacteria. There are no germs to be found in the blood. Leucocytosis, if present at all, is slight. The patient usually recovers within a day. There are cases on record, however, where the poisoning is so violent that the patient succumbs.

SEPTICEMIA.

Septicemia has also been known to occur after hernia operations. It is caused by the absorption into the blood of pathogenic bacteria and their products. The condition is manifested by chills, fever, sweating, rapid pulse, increased frequency of respiration, flushing of the face, etc. Except when the causative germ is extremely virulent, when death occurs within twenty-four to forty-eight hours, there is always a leucocytosis. Although the germs are always contained in the circulating blood, it is not always possible to find them, except when cultures are made.

The most severe forms of septicemia are those caused by the streptococci, because they continue to elaborate their toxins in spite of the bactericidal action of the blood serum.

Septicemia may also be caused by other bacteria such as the *staphylococcus pyogenes aureus* and the *bacillus aërogenes capsulatus* (Welch), which is the specific cause of a particularly virulent form of septicemia almost invariably causing death of the patient. The pneumococcus and the members of the colon group of bacilli are not so fatal in their results.

The treatment of this condition consists in thorough and speedy elimination by kidneys, bowels and skin, and supporting the strength of the patient with stimulants. The antistreptococcus serum so far has proven a failure for obvious reasons.

PYEMIA.

Pyemia is a form of septicemia with the accumulation of necrotic material in different parts of the body in sufficient quantity to cause the formation of local abscesses.

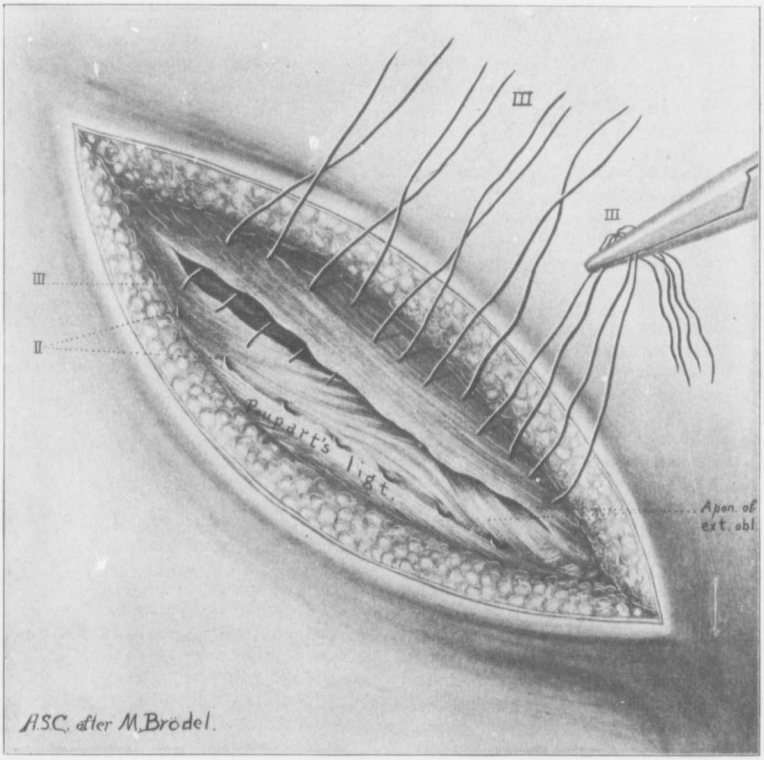

PLATE XXXI.

Halsted's Operation for Inguinal Hernia.

PLEURISY AND BRONCHITIS.

Pleurisy and bronchitis are two conditions that have been known to follow operations for the cure of hernia, but not any more frequently than after operations done for the relief of other conditions.

PNEUMONIA.

A number of operators have pointed out that pneumonia occurs not infrequently after operations done for the relief of hernia, especially when ether was the anesthetic used. Kelly met with only one case of pneumonia following chloroform anesthesia, but he has seen six cases following the use of ether. Bull reports five cases of pneumonia with one death. Other operators have informed me that they have met with post-operative pneumonia in about the same proportion of cases.

In looking over my operative work of all kinds done since 1887, I find that I have seen only one case of post-operative pneumonia. This occurred in a man, 65 years of age, who had a double hernia, one side being strangulated and the other incarcerated. He had also been the subject of a very severe bronchitis for a number of years. I have always made it a rule to give my patients the best of care before, during and after the operation, and to this, I think, may be ascribed the infrequency of the occurrence of post-operative pneumonia in my work.

Post-operative pneumonia is due to (a) exposure, which lowers the vitality of the patient; (b) the irritating effects of the anesthetic, particularly when ether is used; (c) the inspiration of mucus, blood or other fluids, producing what is known as an inspiration pneumonia, and (d) septic embolus, which produces a form of pyemic pneumonia.

Many other septic complications have been met with in connection with the surgery of hernia, such as phlebitis of the leg, abscess of the parotid gland, dysentery, acute otitis media, erysipelas, infection of a hydronephrosis, etc.

NEPHRITIS.

Nephritis is one of the post-operative complications which often proves fatal. Before operating on a hernia the condition of the kidneys should be ascertained. A very excellent article on this subject by Flexner appeared in the *Journal of Experimental Medicine*, Volume I, No. 3, 1896, in which was presented a statistical and experimental study of terminal infections. In 793 autopsies Flexner found that 255 subjects had had chronic heart or kidney diseases, or both. Of this number, 213 were due to bacteria, the infection being either local or general.

In anticipation of a disturbance of the kidney function after operation, we frequently resort to hypodermoclysis of normal salt solution during the operation. If before the operation the amount of urine secreted is less than normal, and if the urine contains albumin and a few hyaline casts, it is advisable to extend the time of preparation, postposing the operation until such time as the urine is again normal. Of course in cases of strangulated hernia this cannot be done. The operation must be performed irrespective of the condition of the kidneys.

After the operation has been performed, the function of the kidneys must be watched carefully. If suppression of urine takes place, and is persistent, it is advisable to do a nephrotomy on one kidney. Then the anuria cannot continue. I have seen a patient live without any kidneys at all for ten days. The woman had only one kidney and it became necessary to remove that. I am convinced that some patients who die with symptoms simulating those of uremia are really suffering from an infection, the uremic symptoms being due to the inability of the kidneys to eliminate the infection.

URINARY FISTULA.

A urinary fistula is the direct result of an injury to the bladder. Not a few cases are recorded in which the bladder was injured during an operation for the relief of an inguinal, femoral or a ventral suprapubic hernia. These fistulas should be repaired immediately. There is no justification for delaying the repair of a fistula. Any operator of ordinary skill and ability can close one. I have had two cases referred to me for operation, and I saw one case in consultation where the urinary fistula caused extravasation of the urine with peritonitis and death.

FECAL FISTULA.

The occurrence of a fecal fistula after a hernia operation is sometimes unavoidable, especially when the hernia has been strangulated. When a loop of bowel is strangulated to the extent that its viability is in doubt, the rule is to return the bowel to the abdominal cavity, because it is more likely to live there than inside of the sac. It is surprising how many of these doubtful loops of bowel cause no symptoms whatever after they are replaced in the abdominal cavity. But when such a loop of bowel is returned to the abdominal cavity, the wound should not be closed, and in these cases it is better to leave a considerable portion of the sac protruding beyond the skin. This forms a nice funnel for packing the wound with gauze, and it also serves as an exit for fluids and other material. If the loop or a portion of it dies, a fecal fistula forms. It is a well-known fact that the loop of bowel does not wander away from the field of operation until such time as peristalsis returns. We consequently take advantage of this and leave the suspicious loop of bowel immediately beneath the opening. This does not prevent the operator from inserting all the necessary sutures for the closure of the abdomen a few days later.

A fecal fistula occurring in this manner in connection with a strangulated hernia is unavoidable. Indeed, a fecal fistula may occur in connection with resection of the bowel and anastomosis either by means of mechanical appliances or with the needle and thread. If, after resecting the bowel, symptoms arise pointing to a perforation, and these occur usually on the third or fourth day, the wound can be opened, the loop of bowel always being easily accessible. In this way the occurrence of a general peritonitis is prevented, and the life of the patient may be saved.

A fecal fistula may also be caused by the accidental wounding of the bowel during operation, either because the surgeon is not sufficiently

familiar with the conditions present, or because he is not possessed of sufficient skill.

ACTINOMYCOSIS.

In the autumn of 1898 I operated on a case of double oblique inguinal hernia with strangulation on the right side. For sutures I used catgut which was furnished by the hospital authorities. About two or three weeks after the operation the ray fungus appeared in the scar. The interne mistook it for an ordinary skin infection and dressed the wound for several days before calling my attention to it. The peculiar appearance of the wound and its secretion at once aroused my suspicion and a microscopic examination showed the infection to be one of actinomycosis. I immediately operated again and removed all the diseased structures, leaving only the peritoneum and transversalis fascia to protect the bowels. I also gave the patient rather large doses of iodide of potassium.

In spite of all I could do, the infection extended to the bowel, and a small fecal fistula developed. I repaired the fistula, but it reappeared later. The man was sent to the almshouse, with a large pad over his abdomen, and for four or five years afterward, whenever I went there to operate, he would be one of the first to greet me, show me the fistula, and tell me that it was my fault. When I last saw him he still had a small fistula from which there came a slight discharge of fluid, but there was no evidence of the presence of the actinomyces.

The source of the infection in this case is still a mystery to me, but I have always suspected that the catgut sutures used during the operation were responsible.

COPROSTASIS.

Obstruction of the fecal flow during the existence of a hernia is not uncommon, especially in old, incarcerated cases. The onset of the obstruction is usually insidious. The patient may notice that the hernial tumor is slightly increased in size, and on manipulation it feels quite doughy. The hernia continues to increase in size until a regular train of symptoms makes its appearance, such as meteorism, colic, nausea, vomiting, and local tenderness. The vomiting may become fecal in character. The local application of hot fomentations, gentle massage, and emptying the lower bowel may re-establish the fecal flow, and the patient is then in the condition in which he was before this complication occurred. Sometimes, however, strangulation may occur, and an operation be necessary.

Besides these more common complications, others are met with occasionally. For instance, Neugebauer (*Centralbl. f. Innere Med.*, Nov. 21, 1896) reports a care of incarcerated inguinal hernia in which he discovered a temporary glycosuria. The sugar was present both before and after the operation, although the patient denied ever having had any symptoms of diabetes. The glycosuria was present for only twenty-four hours. Experiments on animals showed that incarceration or obstruction of the duodenum or jejunum or other part of the intestine from any cause, may produce a temporary glycosuria.

CHAPTER XVII.

GENERAL COMPLICATIONS FOUND AT THE OPERATION.

The complications that have been encountered during operations for hernia are so numerous that space forbids mentioning more than a few of them. Every surgeon has encountered these complications, although reference is not always made to them in the literature.

W. G. Spencer (*Lond. Clin. Soc. Trans.*, Vol. 30) reports two cases in which there was an absence of the internal ring, the deep epigastric artery lying in front of the hernia. Above the pubic spine there was an extra-peritoneal protrusion of the bladder which was closely adherent to the sac. In both cases the hernia was quite separate from the cord and testicle. One patient was aged three years, the other nineteen. Both were males. In the first case the sac contained fluid and omentum. The site of the internal ring was occupied by a slit-like opening extending into the abdomen the whole length between the pillars. The sac was separated easily from the cord, but attached to it on one side appeared a translucent swelling which in the attempt to separate it from the sac was ruptured, and urine escaped. It was composed of mucous membrane except at its neck, through which the finger was passed into the bladder. The bladder pouch and the hernial sac were ligated and cut away and the wound filled with gauze. The patient recovered. In the second case the sac contained omentum, which was firmly adherent to the inner surface of the sac. No internal ring or line of demarkation could be found between the sac and the abdominal cavity.

C. Goulding Bird (*Trans. Clin. Soc. of Lond.*, Vol. 17) reports two cases of hernia *en bissac*.

The first patient, aged 47, apparently had a strangulated hernia on the right side. The tumor occupied the upper part of Scarpa's triangle, like an ordinary femoral hernia, but from it a diverticulum passed down into the adjacent labium. Both sacs were dissected out and found to have a common neck. The second patient, aged 60, had had a left inguinal hernia for twenty years. She wore a truss for ten years, when, thinking herself cured, she discarded the truss. For eight years she had attacks of vomiting. She then noticed a swelling in the left iliac region, which increased in size, causing considerable discomfort, but no constitutional symptoms. Examination revealed two tumors, one protruding from the left external abdominal ring, of small size, and a large mass extending four inches above Poupart's ligament subcutaneously. The two sacs had a common neck at the internal abdominal ring. Nothing could be differentiated of the aponeurosis of the external oblique in front of the large hernia, it having been destroyed, apparently, by the pressure of the her-

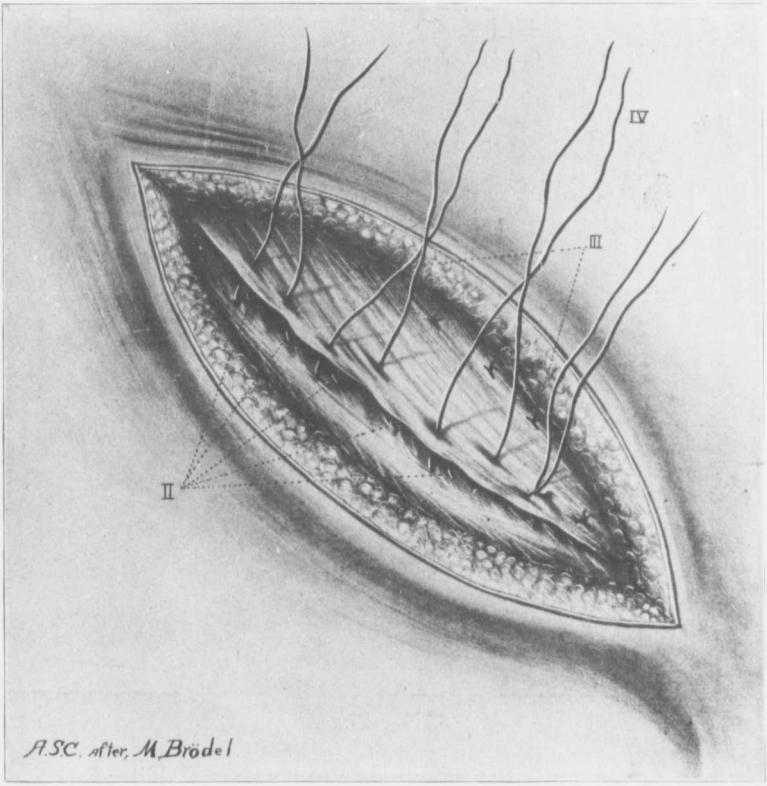

PLATE XXXII.

Halsted's Operation for Inguinal Hernia.

nial sac which lay external to it. The patient died in two days. No cause of death was discovered.

T. H. Kellock (*Lond. Clin. Soc. Trans.*, Vol. 33) reports a case of stricture of the small intestine following a strangulated hernia in a boy who had been suffering from an irreducible left inguinal hernia of about the size of an orange. The hernia did not extend into the scrotum. The right testis was in the scrotum, but the left could not be felt. The sac did not contain fluid, but was occupied by a small piece of discolored omentum, and about four and a half inches of small intestine, which was almost black. The testicle was small and undeveloped. There was a good deal of fluid in the tunica vaginalis which did not communicate with the abdominal cavity, or with the sac of the hernia. The cord was ligated and the testicle removed. The inguinal canal was closed with two silk sutures and the skin wound united with horsehair. Thirteen days after the operation the abdomen was a little distended and slightly tender. These symptoms disappeared after proper catharsis. During the next three weeks the boy suffered at times from pain in the epigastrium, and on several occasions vomited undigested food. It was thought the trouble was due to adhesions about the bowel. One month afterward the abdomen was opened, and a distended, hypertrophied intestine presented immediately. There was no peritonitis. Lying in the right iliac fossa was a loop of small bowel to which a tongue-shaped piece of omentum containing large vessels was closely adherent. A lateral anastomosis above and below the stricture was made by Halstead's method. The patient died fifteen hours afterward. The loop of the intestine which the anastomosis was designed to put out of action was gangrenous. On opening this part of the bowel an annular stricture was found at the apex of the loop almost completely obstructing the lumen and involving about half an inch in length of the bowel. The tongue-shaped piece of omentum was adherent to the bowel immediately distal to the stricture. The hernia in this case appeared to be an acquired one.

Marshall examined the records of ten thousand cases of hernia and found that nine hundred of them had been complicated by an undescended testis. Coley found four hundred such cases among 9,859 cases of hernia. Eccles found 854 instances among 48,000 cases of hernia.

According to Odiorne and Simmons, sarcoma of the testes occurred in 11 per cent. of the cases.

The conjoined tendon has been found obliterated in 27 out of 366 cases, or 7 per cent. In 12 cases in which the conjoined tendon was absent, recurrence of the hernia took place in 7, or over 50 per cent., thus emphasizing the importance of knowing where the conjoined tendon is and how to protect it.

Obliteration of the conjoined tendon occurs in the female about once in 38 cases; in the male, in about 50 per cent. of the cases.

Bloodgood records having met with the following complications: Albumin and casts; obstruction, temporary and permanent; scrotal abscess; atrophy of the testis; hydrocele; emphysema of the wound.

Although resection of a portion of the bowel often is necessary in operations on hernias, it is not to be considered as a complication in the true sense of the word. However, every now and then one meets with a case where a large portion of bowel must be resected before it is possibl to reduce the hernia. The bowel in these instances is normal in every respect. For instance, A. B. Mitchell (*British Medical Journal*, Sept. 27, 1902) reported the case of a man, aged 57, who was operated on for a long-standing, irreducible hernia, which had given rise repeatedly to symptoms of obstruction. Because of its size the hernia could not be reduced. Mitchell resected all of the intestine contained in the sac, which was found to measure six feet.

Monprofit (*Revue de Chirurgie*, November, 1899) reported a case of inguinal hernia where during the operation it was found impossible to separate the hernial contents and reduce the mass. He resected seven feet and six inches of the small intestine, and thirty-two inches of the large intestine, the resected piece consisting of ileum, cecum, ascending colon and half of the transverse colon. A curious fact in this case was that after the patient recovered he was unable to digest meat.

Many similar instances have been recorded, but these two will suffice to direct attention to the fact that in order to reduce a hernia it may be necessary to resect a portion of the bowel.

Perforations of the bowel contained in the sac of a hernia have occurred quite frequently, and this emphasizes the importance of examining carefully all the intestine contained within the sac before it is returned to the abdominal cavity.

Corner (*Trans. Lond. Clin. Soc.*, Vol. 36) reports a case of cellulitis of the round ligament which was mistaken for a strangulated hernia. For four or five days the woman complained of pain in the left groin, and a small tumor was palpable. The pain increased in severity and there was some vomiting and constipation. The tumor became exceedingly tender to touch. It was situated over the external abdominal ring and gave an impulse on coughing. There was a healthy round ligament at the internal ring, but no sac. The round ligament in the canal was very much thickened, and evidently inflamed. Examination of the incised mass disclosed a lymph gland breaking down in the center, with surrounding cellulitis.

Corner (*Id.*) also reported a case of atrophy of the testis following a kick in the groin which gave rise to cellulitis with thrombosis in the veins of the cord. The case was mistaken for one of strangulated hernia.

A. E. Halstead, of Chicago, reported a case of hydrocele of the canal of Nuck, which simulated a hernia. Of course, this is not a complication of hernia, but it is quite possible that it might give rise to hernia, and hydrocele may exist with a hernia.

Another very interesting case is the one reported by F. R. McCreery (*Medical Record*, Sept. 9, 1906), where a suppurating omentum was mistaken for hernia. About five or six months after the patient had been kicked by a horse in the right lower quadrant of the abdomen, a lump appeared in the right inguinal region. When McCreery first saw the pa-

tient he diagnosed the case as one of irreducible omental hernia with a scrotal abscess distinct from the hernia and of unknown origin, but possibly tuberculous. At the operation a number of small collections of pus were found. The pus was odorless and no tubercles were observed. The entire mass of omentum seemed to be riddled with abscesses. About six months after the operation a small hernia presented at the internal ring. It was operated on successfully.

CHAPTER XVIII.

RESULTS OF HERNIA OPERATIONS.

It is difficult to accurately estimate the ultimate results following operations for the cure of hernia. The skill and the diagnostic acumen of the operator count for so much in determining these results. It is obvious that the results of a poor operator cannot be as good as those of one who is skilled. Furthermore, the operation done in a given case may not have been the operation that was most suited to the case or that was indicated. Thereby the results would be influenced very markedly. The results of any one operator are insufficient to draw conclusions from, because the same operation done in similar cases by another surgeon would not be followed by the same results. Therefore, in attempting to draw any conclusions as to the value of an operation, it is necessary to consider the results obtained by very many operators with all kinds of operations done on all kinds of cases. A mass of statistics is often misleading.

Hilgenreiner (*Beiträge zur Klinische Chirurgie*, 1903-4, Bd. 12) reports 828 operations performed in Woelfler's clinic at Prague, from 1895 to 1902, on 770 patients. Of this number, 471 were free hernias, and 357 were strangulated. For the non-strangulated inguinal hernias, 446 operations were performed on 397 patients, while for femoral hernia 15 operations were performed on 13 patients.

The wound was closed in various ways. In 33 cases the cord was transplanted into a slit in Poupart's ligament (Frey's method); in 17 cases a simple approximation suture (Czerny-Banks) was used; in a very few cases Bassini's method was employed and all the remaining cases were operated on by Woelfler's method. Hilgenreiner points out the difference between the technic of Woelfler's operation and that of Bassini. It is surprising with what facility some surgeons, from a lack of due consideration of the principles involved, make unsupportable statements regarding operative procedures. No less an authority on hernia than William B. Coley, of New York, says (*Progressive Medicine*, June, 1905, page 25) that "In 125 cases the cord was not transplanted, but brought out at the lower angle of the wound, and the external oblique being sutured to Poupart's ligament, exactly the same as in inguinal hernia in the female. This method is known in Germany as Woelfler's method without transplantation of the rectus muscle. In this country it is frequently known as Ferguson's method. Woelfler's cases were not reported until 1895; Ferguson's in 1899." Let us follow this statement farther.

On page 514, Vol. IV, *System of Practical Surgery*, by E. von Bergmann, the only mention made of Woelfler's operation in connection with

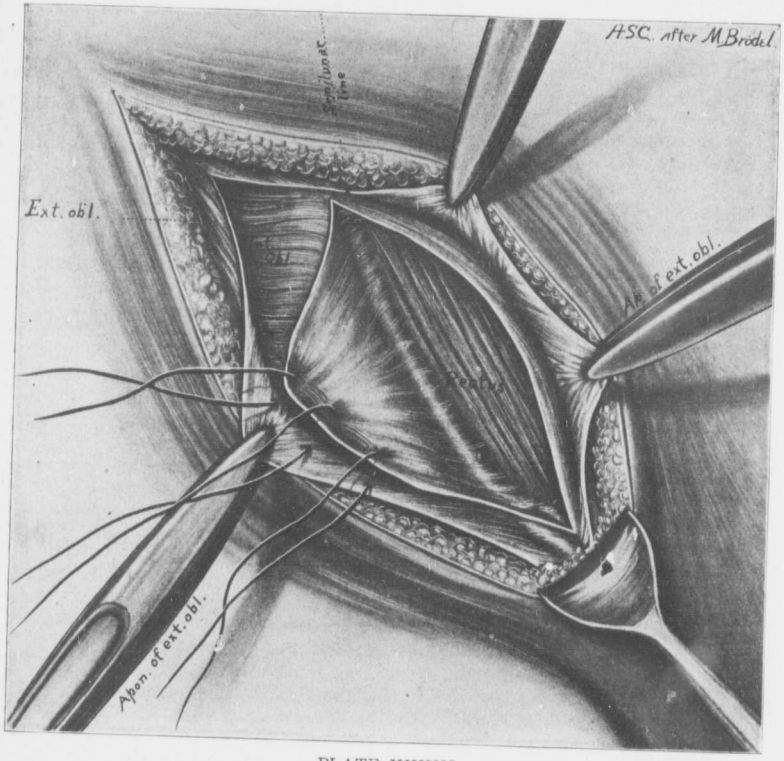

PLATE XXXIII.

Halsted's Operation for Inguinal Hernia.

hernia is, "In the course of time Woelfler passed the testicle through the space between the two recti muscles."

No other author, even in Germany, makes any mention of Woelfler's operation in connection with the cure of oblique hernia.

In the *Reference Handbook of the Medical Sciences*, Vol. IV, page 674, 1902, in speaking of Bloodgood's method, this statement is made: "This method is superior to Woelfler's in that Woelfler slits the ventral sheath, thus destroying the insertion of the internal oblique and transversalis muscles at that point."

If what Coley says is true, then his procedure and that of Woelfler are the same as mine, but I have failed to find a corroboration of Coley's unqualified statement.

I believe that since 1902 Woelfler does not transplant the cord, but leaves it in its normal position, strengthening the anterior wall of the canal by utilizing the rectus muscle. I do not do this for oblique hernia when there is a normal conjoined tendon.

In the 33 cases reported by Hilgenreiner that were operated on according to the method of Frey and Czerny-Banks, there were 7 relapses, and in 94 cases operated on by the Woelfler method, without the use of the rectus, there were eight relapses. Coley does not appear to grasp the vast difference between the principles and practices involved in the Czerny-Banks operation (leaving the cord in its normal bed) and my operation (also leaving the cord undisturbed).

Transplantation of the cord is ably dealt with by Connell (*American Journal of the Medical Sciences*, March, 1905), who considers the author's view the correct one—namely, that the cord should not be raised out of its bed. Halsted, of Johns Hopkins Hospital, has discarded the transplantation of the cord. It is stated by Connell that Woelfler, in 1892, was probably the first to suggest that a radical cure might be effected without transplantation of the cord. E. W. Andrews, in 1895, suggested such an operation, but did not recommend it. In 1899 the writer presented his method, which he had performed 64 times during the previous eighteen months.

Connell gives his reasons why the cord should not be transplanted, while Coley (*Progressive Medicine*, June, 1906) tries in vain to offset these. In support of his views, Coley says that the only reason why the Bassini operation should be discarded in favor of that of the author would appear to be "the final result". Coley says that at the Hospital for Ruptured and Crippled Children, in New York, there was only one per cent. of relapses in over seventeen hundred cases operated on. This is the best apparent result ever obtained following Bassini's operation, and the reason is that nearly all these operations were done on children under fourteen years of age, and by one operator. The results obtained from the writer's operation are superior to those quoted by Coley, and this is particularly noticeable in view of the fact that the results are obtained after operations done on both the young and the old by more than one operator.

In 446 cases operated on by the Bassini method and reported by Goldner, there were 7.1 per cent. of relapses, all of them in adults. In 1,713

cases operated on by the same method and reported by Pott, there were 9.9 per cent. of relapses. In 450 cases of inguinal hernia occurring in adults and reported by Coley, there were 7 relapses, 1.4 per cent. Banister reports 3 per cent. of relapses in 100 cases.

Pott collected the statistics of 151 operators who employed the methods of Bassini and Kocher, and operated on all kinds of hernias and found that there were 96.4 per cent. cures. He gives a mortality of 0.7 per cent. in 2,401 cases operated on since 1895. In 86 cases Halsted had 9.3 per cent. of relapses, 8 of these occurring at the position of the cord. The veins were not removed in these 86 cases. In 712 cases operated on according to the Bassini method (*Lancet*, April, 1906), there were 2.9 per cent. relapses. De Garmo reports 2.4 per cent. of relapses in 250 cases, while Hutchison reports 6.5 per cent. of relapses in 500 cases. Thus it will be seen that in 4,257 cases operated on by the Bassini method, there were 5.3+ per cent. of recurrences.

Deanesly (*B. M. J.*, June 17, 1905) believes that the real cause of hernia lies in a congenital or pre-existing sac, and that the operation that effectually removes the sac is followed by radical cure in 95 per cent. of the cases. He believes that the method of Kocher is the simplest, the most rapid and the easiest to perform, and it is the method he employed in the majority of his 142 personal cases. The ages of his patients varied from three months to 70 years. There was one death, exclusive of strangulated cases, occuring in an infant of eighteen months. Eleven of the operations were for femoral hernia. Six relapses were noted, all within twelve months after operation.

Of 299 cases traced by Hilgenreiner (*Beitr. z. klin. Chir.*, Bd. xli, p. 373) that is, 77 upward of one year, the remainder from two to seven years, 266 were permanently cured. In 28 a relapse was noticed. Among 33 patients operated on according to the methods of Frey and Czerny there were 7 relapses. Among 94 patients operated on according to Woelfler's method, without transposition of the rectus muscle, there were 8 relapses. Among 163 patients operated on by Woelfler's method with transposition of the rectus, 11 recurrences were noted. Of 4 Bassini operations done, 2 resulted in a relapse. Counting only the cases of those patients traced upward of two years operated on by Woelfler's method with transplantation of the rectus, there were 98 with seven relapses, about 7.1 per cent. Ivy's method was employed successfully without relapses in 15 cases of non-strangulated femoral hernia.

W. T. Bull and W. B. Coley (*Medical Record*, March 18, 1905) reported 53,686 cases of inguinal and femoral hernia observed during the period of fourten years, from 1890 to 1904. Of these, 50,961 were inguinal, and 2,725 were femoral hernias. One-third of these, 15,375, occurred in children under fourteen. They performed fifteen hundred operations for the radical cure of hernia. *With the exception of twenty operations, all have been in children under the age of fourteen years.* The operative cases, it is claimed, represent the worst cases of rupture, the largest, and those of longest duration. There were 4 deaths in the 1,500

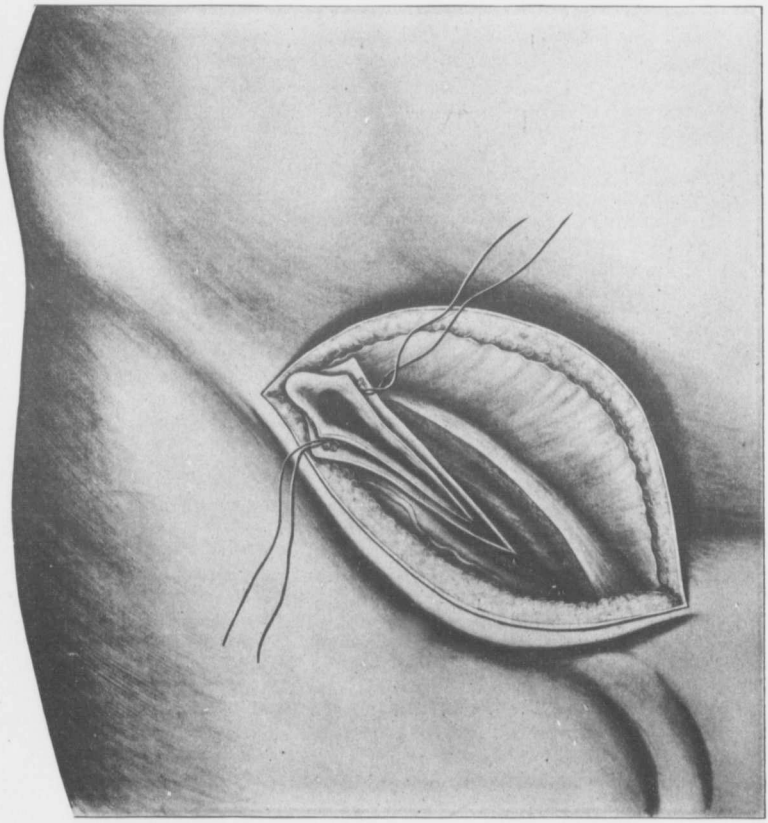

PLATE XXXIV.

Fowler's Operation for Inguinal Hernia.

Deep epigastric vessels ligated and posterior wall of inguinal canal divided.

operations, or a mortality of less than three-tenths of one per cent. Of the 1,500 operations, 1,435 were for inguinal hernia, 39 for femoral, 13 for umbilical, 8 for ventral, 2 for congenital hernia of the umbilical cord, 2 for epigastric, and 1 for lumbar hernia; 13 were strangulated, and 1,487 were not strangulated. The great majority of operations for inguinal hernia were performed according to Bassini's method, with the substitution of absorbable suture, kangaroo tendon, for silk. There were 6 relapses among 1,076 Bassini operations, and 5 in 125 cases in which the cord was not transplanted.

From a study of 91 operations done for various forms of hernia, O. Horwitz concluded that no one method of attempt at radical cure is applicable to every variety of hernia. The Bassini method is suitable to a large majority; the Bloodgood method in cases in which there is present a large abdominal ring, or a weak or atrophied conjoined tendon. He says that the relief of special forms and conditions depends on the ingenuity of the surgeon in selecting the operation indicated by the conditions present.

John O'Connor (*Lancet*, May 31, 1902) reported 350 operations, 140 of which were done according to Halsted's method, 12 according to Kocher's, and 90 by Bassini's and other methods. He observed that atrophy of the testes and orchitis frequently followed the Halsted method, and he thinks the transplantation of the cord is very questionable surgery. In his experience Kocher's method has given the best results.

In the *Johns Hopkins Hospital Reports*, Vol. VII, Bloodgood reports on 459 operations done from 1889 to 1899. Of 268 cases in which a typical Halsted operation was done, 242 healed by primary union. The result was perfect in 208 cases, and there were only 6 recurrences and one death. There was slight weakness and scar in four cases, and 25 were not traced. There was only one complete recurrence after Halsted's operation where primary union took place.

Of 39 cases of inguinal hernia in the female operated on at the Johns Hopkins Hospital, 11 were lost sight of, and in the remainder there was only one recurrence. Between 1891 and 1900, Coley operated on 119 cases of inguinal hernia in the female, 71 of which occurred in children under fourteen years of age, and not a single relapse was observed.

W. B. De Garmo, in 1901, stated that among 611 operations for inguinal hernia by Bassini's method, there were only 8 recurrences. In Carle's clinic, from 1889 to 1899, 1,120 operations were done according to Bassini's method, 280 according to Kocher's method. Of 840 cases that were traced, only 48, or 5.71 per cent., showed a recurrence.

Galeazzi collected 1,334 cases operated on by Bassini's method, with 2.16 per cent. recurrence. Erdmann (*Jour. Am. Med. Ass'n.*, March 12, 1904) reported 26 cases of strangulation in inguinal hernia, with 5 deaths, and G. T. Vaughan (*Medical News*, December 24, 1904) reported 25 cases with 6 deaths, a mortality of 24 per cent. At The Johns Hopkins Hospital 64 operations for strangulated hernia were performed from 1889 to 1899, with 19 deaths, or 29.68 per cent. mortality. Gibson in his collective sta-

tistics covering ten years, from 1888 to 1898, reported 226 resections of gangrenous intestines, with a mortality of 26 per cent.

As regards permanent results, that is, sound at least two years after operation, O. Pott's statistics (*Deutsche Zeitschrift für Chirurgie*, November, 1903) show 82 per cent. for inguinal hernia, 70.5 per cent. for femoral hernia, and 55 per cent. for ventral hernia.

Matanowitsch (*Beiträge zur Klinische Chirurgie*, 1902) publishes a very interesting table of comparison of results of observations done by Bassini's and Kocher's methods respectively. Of 2,032 cases operated by Bassini's method, 74 relapsed, 3.6 per cent. Of 528 cases operated by Kocher's method, 19 relapsed, 3.8 per cent.

S. Goldner (*Archiv f. Klin. Chir.*, Vol. 68, No. 1) reports 800 operations done by Bassini's method. He found that in 466 of this number examined from two to six and one-half years after operation, there were 35 relapses, or 7.5 per cent. There were 3 deaths among the 800 cases.

W. B. De Garmo reported 110 femoral hernias, 28 of which were strangulated. Only 1 death occurred, the patient, a woman, aged 70, having a strangulated hernia and an intestinal perforation. Exhaustion was the cause of death. There was only one actual recurrence, eight months after operation, in a woman of 75. All of these patients were operated on according to De Garmo's method.

A study of the results obtained by operation on 500 patients led Hutchison to draw the following conclusions.

1. In all but the simplest cases in children it is best to open up the canal and to narrow it by deep sutures; 2, suturing the conjoined tendon to Poupart's ligament behind the cord by a series of interrupted sutures is probably the best method of narrowing the canal; 3, when the conjoined tendon is deficient, in all recurrent cases, and in inguinal hernia in women the canal should be obliterated; 4, kangaroo tendon is admirably adapted for the suture material, silver wire being probably the worst; 5, recurrence of the hernia *in situ* may possibly take place at any length of time after the operation, but if two years be adopted as the limit it should not occur in more than from 5 to 8 per cent.; and 6, the development of a hernia at another site after operation may be expected in a proportion of cases at least as large as that just given.

CHAPTER XIX.

RESULTS OF OPERATIONS FOR STRANGULATED HERNIA.

Weyprecht (*Archiv. f. Klinische Chirurgie*, No. 1, Bd. lxxi) reports observations made from June, 1890, to June, 1900, at the City Hospital in the clinic of Professor Körte. Of 402 cases treated, 70 were reduced without operation; 307 patients were operated on, 4 were admitted moribund and no operation was performed, and one patient died without operation, a small strangulated femoral hernia having been overlooked. There were 57 deaths among 397 cases of incarcerated hernia, a mortality of 14.4 per cent. Of 254 non-gangrenous cases, 230 (90.6 per cent.) were cured; 23 of the patients died (9 per cent,), and one patient left the hospital immediately after operation and was lost sight of. Of 73 gangrenous cases, 39 were cured (53.4 per cent.), and 34 patients died (46.6 per cent.).

Of 7 cases of strangulated hernia occurring in 5 males and 2 females, aged six months, there were 2 fatalities, 28.6 per cent. Among six patients, male, aged six months and ten years, there were no fatalities. Among 61 cases of strangulation, occurring in 30 males and 31 females, from 11 to 40 years old, there were two fatalities, 3.26 per cent. Among 250 cases, occurring in 60 males and 190 females, aged from 41 to 80 years, there were 52 fatalities, 20.8 per cent. Of three females, over eighty years of age, one died, a mortality of 33 1-3 per cent.

The total mortality after operation was 17.4 per cent.; 101 deaths occurred among men and 226 among women. Gangrene was present in 12 of the former and in 61 of the latter. The greatest number of deaths occurred between the ages of 41 and 80—20.8 per cent (52 deaths out of 250 cases); 7 cases up to six months with two deaths; three over 80 with only one death.

The fifth decade showed the largest number of operations—81, with 12 deaths—14.8 per cent. Incarcerated femoral hernia was observed more frequently in women than in men—174 against 18. Inguinal hernia occurred twice as often in men as in women—77 to 36. The right side was the seat of incarceration in 71 inguinal and 133 femoral hernias; the left in 42 inguinal and 70 femoral. Ninety-two (28 per cent.) of the patients had worn a truss, while 42 (12.8 per cent.) were not aware of the presence of a hernia until strangulation occurred. Strangulation of two hernias in one person was seen once. The duration of the incarceration always had an unfavorable effect on the result of operation.

With reference to the contents of the sac, omentum alone was found 37 times—in 17 inguinal and 20 femoral hernias. A loop of small intes-

tine was found in 126 cases; several loops were found in 7 cases: Meckel's diverticulum, twice; small intestine and omentum in 5 cases; large intestine, once; large and small intestine, six times; large intestine and omentum, twice; large and small intestine and omentum, once. Appendices epiploicæ caused strangulation in four cases. The vermiform process had become incarcerated in 12 cases. In nine of the latter the patients were over 57 years of age, and in all of these hernia had been acquired late in life. In 175 cases the patients made an uninterrupted recovery; in 32 complications arising from the respiratory organs were noted, with 5 deaths. Peritonitis was the cause of death in but 1 of 23 fatal cases. In the majority of the cases death occurred not as the result of the operation, but in consequence of concomitant and unavoidable bodily conditions.

Regarding the contents of the hernial sac in the gangrenous cases, the small intestine alone was found in 52 cases; small intestine and omentum in 15; omentum and large intestine, omentum, large intestine and small intestine, small intestine and bladder in 1 case each. The vermiform process was found 3 times.

Fuchsig and Haim (*Deutsche Zeitschr. f. Chir.*, Vol. lxix, No. 5 and 6) report 175 cases of strangulated hernia observed during ten years. Of these 97 were inguinal; 62 femoral; 14 umbilical and 1 each obturator and ventral. The presence of a congenital hernial sac could be proven in 17 cases of inguinal hernia. Of the inguinal hernias, 97 occurred in males and 7 in women; femoral, 62 in women and 5 in men; umbilical, 14 in women and only 1 in a male subject. Incarceration was noticed on the right side in 63 per cent. each of the inguinal and femoral hernias. In the great majority of the cases the strangulation was primary, although in 20 inguinal, 7 femoral and 4 umbilical, repeated incarcerations had preceded admission to the hospital. In only two (umbilical) had a radical operation been performed previously. Thirty-seven cases were cured by taxis. In 135 cases operation was performed, and in the majority of the inguinal hernias Bassini's method was employed. Primary resection was done 14 times with a mortality of 54 per cent. (17 cases). Peritonitis was the cause of death in all the fatal cases of resection. The total mortality was 20 per cent.—35 deaths in 170 cases. Of these 135 were operated on, with 32 deaths—23.7 per cent. Of the 37 cases in which taxis was employed 1 died. Three patients refused operation. There were 70 cases of inguinal hernia with 12 deaths (17.1 per cent.); 51 crural hernias, with 12 deaths (23.5 per cent.); 13 umbilical hernias, with 7 deaths (53 per cent.); one case of obturator hernia with one death.

O. Pott (*Deutsche Zeitschr. f. Chir.*, Nov., 1903) shows that the mortality of all radical operations for hernia thus far performed is nearly 1 per cent., 0.9 per cent., being the greatest in ventral hernia, while in inguinal hernia it is about the same as is the general mortality. The total mortality for the last seven or eight years is far more favorable, being but one-half of one per cent.; the operations for femoral hernia showing the greatest number of deaths. For inguinal hernia the mortality is two-

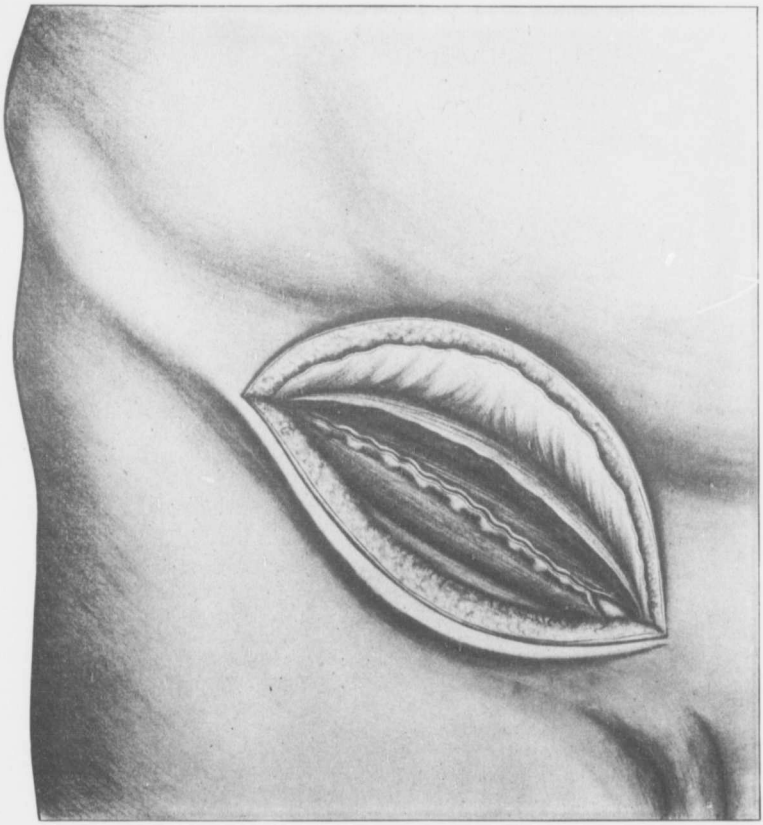

PLATE XXXV.

Fowler's Operation for Inguinal Hernia.
Cord placed in peritoneal cavity and gap sutured.

thirds of one per cent., instead of almost two per cent., as it was in the first two decades of modern surgery.

As regards the permanent results, that is, sound at least two years after operation, Pott shows 82 per cent. for inguinal hernia, 70.5 per cent. for femoral hernia, and 55 per cent. for ventral hernia. The results in children (up to 14 years), including all varieties of hernia, were 560 permanent cures, 84 relapses, 4 doubtful—96.4 per cent. In individuals over fifty years of age, there were 259 permanent cures, 173 recurrences, 10 doubtful—58.6 per cent.

As to the best method of operating, Pott shows Kocher's transplantation method and the Bassini method to be about equally efficient. In femoral hernia, ligature and extirpation of the sac and suture of the mouth of the hernial ring have given the best results—76.5 per cent.

W. Thorburn (*British Medical Journal*, April 25, 1903) analyzed 110 operations for strangulated hernia, in which the mortality was 24.54 per cent.

Kennedy (*B. M. J.*, Oct. 1, 1904) gives the results of operation in 103 cases operated on more than a year ago; 96 of the patients were males, 7 females. The youngest patient (for strangulation) was six months of age, the oldest 74 years. Twenty operations were done in patients from six months to three years of age. In 45.6 per cent. the sac was of the congenital type. Six cases were cecal hernias and one case was a hernia of the ovary. There was only one death, occurring six weeks after operation from tuberculous meningitis.

The older cases, 20 in number, were operated on after Macewen's method; 11 were traced, with two relapses. Seventy cases were operated on by Kenedy's method; 54 were traced from one to five years, with only 1 relapse.

The late Dr. T. H. Manley (*Phila. Med. Jour.*, March 16, and 23, 1901) reviews the literature of strangulated and gangrenous hernia. Heuser, of Paris, recorded (1861-1865) 227 patients operated on, with 172 deaths, a mortality of 75.08 per cent. Tschering, in 1888, reported 524 cases with a mortality of 29 per cent. McCready collected the cases operated from 1869 to 1888, showing that the mortality was 36 per cent.

Hennegeler, in 1896, reported 296 kelotomies with 23.02 per cent. mortality. Bouchard, in 1896, reported 86 kelotomies with 17.97 per cent. mortality. Hagedorn collected 170 cases, from 1883 to 1890, with 14 per cent. mortality. Gibson collected 226 cases of primary enterorrhaphies with 58 deaths, a mortality of 26 per cent.

Croft, in 1896, performed 13 colostomies, none of the patients dying. Czerny and Hahn found the mortality of primary resection to be 47 per cent.; Mikulicz, 32 per cent.; Bouchard, 36 per cent. Ziedler gives resection 49 per cent. and colostomy 74 per cent. mortality. Frank gives the mortality of resection as 48 per cent., and of colostomy as 80 per cent. Maydl gives 22 per cent. for resection, and Wallace gives 25 per cent., and 90 per cent for colostomy. The mortality for resection is given as 38 per cent. by Makins, 37 per cent. by Bouilly. Körte found the mortality of

colostomy 57 per cent.; Friederichshain, 76 per cent.; Poulsen, 86 per cent., and Lockwood, 88 per cent.

In 1894 the combined statistics of Czerny, Reidel, Kocher, Hagedorn, and Hahn gave 64 cases of primary resection with 32 deaths, a mortality of 50 per cent. Mikulicz had 94 cases of colostomy with 72 deaths, 76.6 per cent. mortality. Hofmeister had 167 cases, with 101 deaths, 60.5 per cent. mortality. Mikulicz had 68 cases of resection, with 32 deaths, 47.1 per cent. mortality; Hofmeister had 214 cases of resection with 99 deaths, 46 per cent. mortality.

In 280 herniotomies done by Czerny from 1877 to 1900, the mortality was 18.5 per cent. Arranged according to procedure, the mortality was, reposition of intestine intact, 216 cases, with 27 deaths, or 11 per cent.; colostomy, 22 cases, with 15 deaths, 67 per cent.; primary resection, 28 cases, with 9 deaths, 33 per cent. Adding to this list 2 cases of double resection with fatal termination, there are 52 gangrenous hernias with 26 deaths, a mortality of 50 per cent.

B. M. Ricketts (*American Medicine*, May 4, 1901) states that in inguinal hernia the average of recurrence for 34 operators will be 5.58 per cent. in 6,027 cases. He states that the preferred operations are the Marcy-Bassini, Macewen, Halsted, Ferguson, Andrews, Phelps and Blake.

CHAPTER XX.

RESULTS FROM FERGUSON METHOD.

PERSONAL RESULTS.

In twenty-four years (1892-1906) I have operated for the cure of hernia in twenty different hospitals by ten different methods and eight modifications of these methods. The evolution of my method—the typic or anatomic operation—for the cure of oblique inguinal hernia is based on an experience derived from the clinical study of 654 cases of hernia, 489 of which were of the inguinal variety. In these 489 cases I did 543 operations. There were 23 cases of direct inguinal hernia, and 466 cases of oblique inguinal hernia. These 489 cases can be further subdivided as follows:

(1) Congenital and acquired, 318 cases.

(2) Infantile, 2 cases.

(3) Interstitial, (a) preinguinal, 2 cases; (b) inguino-interstitial (Goyrand's hernia), 2 cases.

(4) Inguino-crural (Holthouse's hernia), 1 case.

(5) Traumatic, 2 cases.

(6) Post-operative (vasectomy for tuberculosis of the vas), 1 case.

(7) Sliding (a) sigmoid, one case; (b) cecum, 4 cases; (c) cecum and appendix, 2 cases.

(8) Incarcerated, 6 cases.

(9) Strangulated, 28 cases.

In this last series of cases there were five deaths: (a) suppurating at time of operation, 1 case; (b) gangrenous, colostomy done, 2 cases; (c) resection (double hernia), 2 cases, one patient operated on by the open method, and the other by McBurney's method.

(10) Twelve unclassified cases of inguinal hernia (early work, records not complete).

(11) Double inguinal, 46 cases (92 operations).

(12) Multiple hernias, 20 cases; (a) oblique inguinal and femoral, 8 cases; (b) oblique inguinal and umbilical, 2 cases; (c) oblique inguinal and ventral, 3 cases; (d) oblique inguinal, femoral and obturator, 1 case; (e) oblique and direct inguinal, 2 cases; (f) double direct, 2 cases; (g) 6 hernias in one patient; (h) ten hernias in one patient.

There were 44 cases of femoral hernia not including those in which both a femoral and an inguinal hernia existed. These cases were divided as follows:

(1) Saphenous, 26 cases.

(2) Anterior (Velpeau's), 2 cases.

(3) Ascending subcutaneous, 3 cases.

(4) Strangulated, 10 cases.

(5) Double femoral (6 operations), 3 cases.

There were 6 cases of epigastric hernia, 4 congenital and 2 acquired.

Fifty-two cases of umbilical hernia were divided as follows:

(1) Omphalocele, 42 cases.

(2) Funicular hernia, 1 case.

(3) Interstitial hernia; (a) subcutaneous, 4 cases; (b) subperitoneal, 1 case.

(4) Strangulated, 4 cases with two deaths.

There were 60 instances of ventral hernia, as follows:

(1) Hernia in the linea alba, 48 cases; (a) congenital, 1 case; (b) acquired, 2 cases; (c) post-operative, 45 cases.

(2) Hernia in the linea semilunaris; (a) acquired, 1 case; (b) post-operative, 3 cases.

(3) Hernia through the rectus muscle, traumatic, 1 case; post-operative, 7 cases; (a) following cholecystectomy, 1 case; (b) following appendectomy, 4 cases; (c) following salpingotomy, 2 cases.

There were only two cases of lumbar hernia and one case of obturator hernia in which there was also a femoral and an inguinal hernia. The obturator hernia was not discovered until after it had become strangulated.

There was one case each of the following varieties of hernia: Left duodenal hernia; hernia through the transverse meso-colon into the lesser cavity of the peritoneum; vesico-rectal hernia; vesico-inguinal hernia; diaphragmatic hernia, and one instance (referred to me by Dr. Albert Peacock) of hernia into Douglas' pouch.

In this whole series of cases there were 21 recurrences. (a) After the typic (author's) operation, new direct hernias, 4 cases; (b) after Bassini's operation and its modifications, 11 cases; after McBurney's operation, 1 case; after Kocher's operation, 2 cases; after other methods, 3 cases.

I have performed my own operation 356 times, with only one death, from nephritis. The patient, a male, 24 years of age, was feeble-minded and physically undeveloped. He had two enormous congenital inguinal hernias, both of which were operated at one sitting. He took the anesthetic very badly (first chloroform, then ether). He had suppression of urine immediately following the operation. There was no clinical evidence, nor anything in his personal history, that pointed to kidney disease. He never fully regained consciousness after the operation, and died on the fourth day.

In his case I found on the right side a very singular arrangement of the internal oblique muscle. Its fibers were directed obliquely upward and inward toward the umbilicus. There was a normal origin at Poupart's ligament, but its insertion at the border of the rectus muscle was at least two inches higher than the level of the internal abdominal ring. After ablating the sac and tightening up the slack in the transversalis fascia, so as to form a new ring, I sutured the free border of the internal oblique muscle to the edge of the rectus muscle, and then closed the wound as usual.

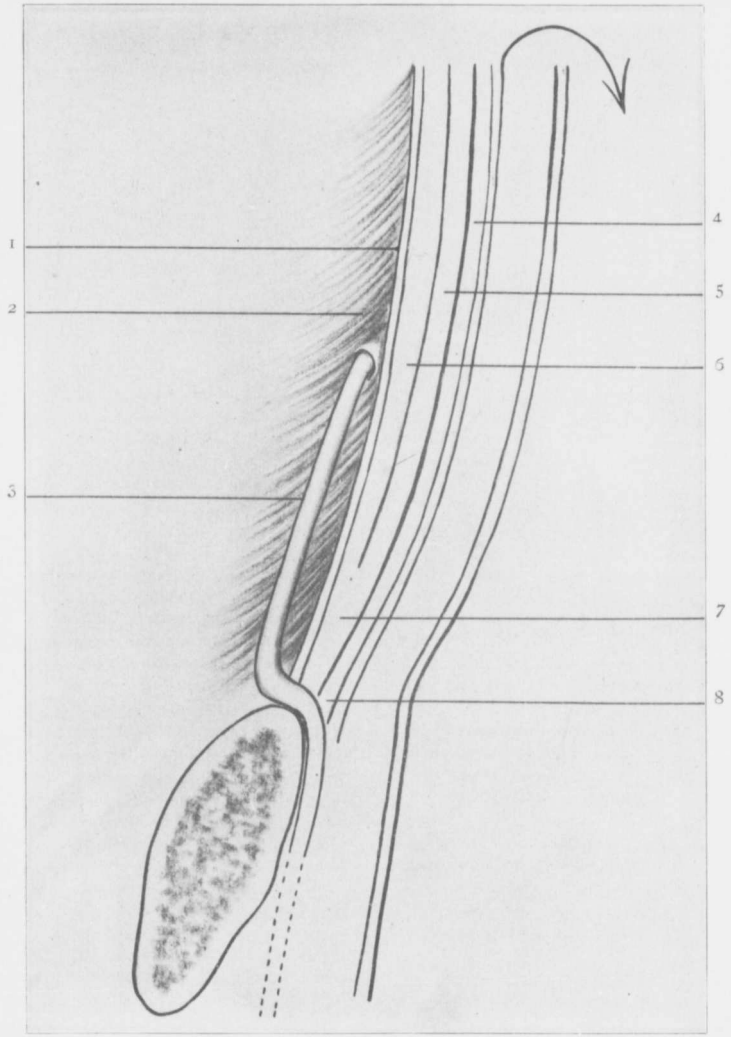

PLATE XXXVI.

Fowler's Operation for Inguinal Hernia.

Showing position of cord. *Annals of Surgery—Year Book*—Gould, 1899.

Fig. 30. Page 326.

1. Transversalis fascia. 2. Peritoneum. 3. Cord. 4. External oblique muscle. 5. Internal oblique muscle. 6. Transversalis muscle 7. Conjoined tendon. 8. Poupart's ligament.

It is a source of much satisfaction to be able to state that in the 356 typic operations performed by me there is no known recurrence after more than two years in 225 cases that I have been able to trace. Four patients returned claiming that the hernia had recurred, but on examination I found that there was not a return of the oblique inguinal hernia, for which the operation was done, but that there was in each case a hernial protrusion in Hesselbach's triangle—a direct hernia. To cure this condition I operated according to Bloodgood's method. If I had detected at the time of the original operation that the conjoined tendon in these cases was deficient, and had combined Bloodgood's method with my own, I am convinced that the direct hernia would not have occurred. When there is a weakness in the lower inguinal region, there is also a bulging of the internal inguinal fossa, either external or internal to the obliterated hypogastric artery—the two sites at which a direct hernia may form.

A weakness in this fossa is best detected by passing the index finger through the internal ring into the abdominal cavity and down into the fossa in the triangle of Hesselbach, and creating a forward pressure in the suspected weak place. The finger or fingers (I use two fingers for this exploration) will detect a laxness of the peritoneum and the transversalis fascia in this region when the conjoined tendon is deficient. This is reason enough for the surgeon to take some steps in his operative procedure to protect the lower as well as the upper angle of the wound.

The statistics of W. B. Coley, of New York, do not bear on this point at all, because children never have direct hernias. His statistics are based principally on operations done on children under fourteen years of age. And so far as relapses at the internal ring are concerned, it is rare indeed to have a recurrence after herniotomy in children, because of the muscular development. It is futile and unwise to give any consideration whatever to statistics, however honestly and faithfully compiled, based on one line of work on children in the determination of the most useful method of curing inguinal hernia by operation.

The method which is most applicable in the case of hernia in children is not always the most suitable one in the case of hernia occurring in the adult. At the same time, however, any method that is applicable for the cure of an oblique inguinal hernia in the adult will produce even better results in the case of children.

There are three methods by means of which the triangle of Hesselbach may be protected from becoming the seat of a direct hernia, either external or internal.

(1) By making use of the rectus muscle according to the procedure devised by W. S. Halsted, or that devised by John Bloodgood. The credit for suggesting this method is due Halsted. I prefer using the rectus muscle itself instead of its sheath.

(2) Anterior transplantation of the cord, either according to Bassini's or Halsted's method. It is immaterial, however, whether the cord is brought out above or below the aponeurosis of the external oblique mus-

cle. Either method is to be condemned. I have shown that anterior transplantation of the cord should never be performed.

(3) Posterior transplantation of the cord, either according to Fowler's method, where the cord is placed intra-peritoneally, or according to the author's method, in which the cord is placed between the peritoneum and transversalis fascia. In the case of either method the deep epigastric vessels must be cut and ligated with catgut ligatures. Either method is suitable when an oblique and a direct hernia exists, or when the hernia is complicated by a non-descended testis.

If the surgeon bases his technic of operation for the cure of inguinal hernia on the transplantation of the cord, it is well for him to transplant it backward instead of forward, thus saving himself the conviction of being the cause of at least six per cent. of recurrences at the upper angle of the wound.

COMPLICATIONS.

I have had three cases in which atrophy of the testicle occurred and one case of gangrene of the testicle. In one case the atrophy followed as the result of suppuration of the cord. Among the 356 operations done, there were only six cases of stitch-hole abscess and two cases of deep suppuration. There were two cases of hematoma and six of secondary wound secretion. In two instances it was necessary to remove the testes at the time of operation. These were cases of strangulated hernia. In three cases of strangulated inguinal hernia general peritonitis followed, and also in two cases of femoral hernia. These five patients died.

RESULTS OF AUTHOR'S OPERATION DONE BY OTHERS.

W. J. and C. H. Mayo have operated on 1,244 cases of inguinal hernia by the author's method. Of this number, 34 were strangulated and 3 deaths occurred. Of 125 femoral hernias, 10 were strangulated, and no deaths occurred. Of 82 ventral hernias and 114 umbilical, 7 were strangulated. They also operated on 12 sliding hernias, usually of the sigmoid or cecum, and 6 hernias containing appendix, ovary and tube, etc. In all cases of direct hernias they transplant the cord, doing a Bassini operation.

F. W. McRae, of Atlanta, Ga., since 1902, has operated on 30 cases of hernia, with only one return, in the case of a double hernia, at about the sixth month. The patient was very poorly developed physically.

J. Y. Brown, of St. Louis, operated on 350 cases, with only one return.

F. G. Connell, Oshkosh, Wis., operated on 50 cases, with no return, but a direct hernia developed in one case which he ascribes to faulty technic.

A recurrence took place in two other cases, but one of these was complicated by an undescended testis, and the other had been operated on for a recurrence after a Bassini operation.

A. J. Ochsner, of Chicago, has informed me that during the past four years he has done all his herniotomies according to the Ferguson method. For some time prior to that he performed the Bassini on one side and the

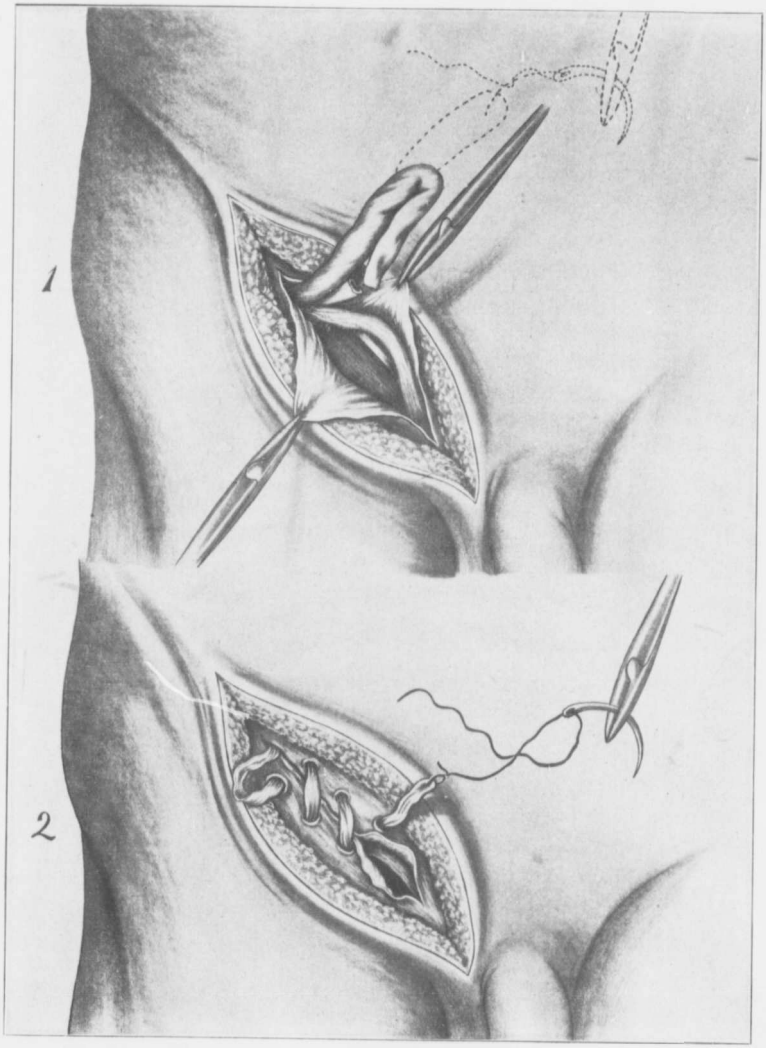

PLATE XXXVII.

Parks' Autoplastic Suture.

1. Sac dissected out. 2. Suture applied. (Courtesy of Lea Bros. & Co.)

Ferguson on the other in cases of double inguinal hernia, but finally he discarded the Bassini operation entirely.

Of 710 cases of hernia of all varieties, operated on by Ochsner in his service at the Augustana Hospital for the radical cure of oblique inguinal hernia, all the patients lived. There were few complications and very few recurrences. Ochsner had 740 cases of non-strangulated oblique inguinal hernia, and 33 cases of strangulated hernia. In 283 cases of oblique inguinal hernia operated on according to my method, no deaths occurred and only three recurrences. These recurrences were probably due to the presence of a deficient conjoined tendon. Nevertheless, there were in this series 1.06 per cent. of recurrences.

In Ochsner's series there were 51 cases of umbilical hernia, in 3 of which strangulation had occurred; 81 femoral hernias, 17 of which were strangulated; 62 post-operative ventral hernias, and 13 cases of hernia of the linea alba. Ochsner mentioned only those cases seen by him in his service in the Augustana Hospital. Making a general estimate of the total number of operations performed by him, it may be said that three or four hundred other cases may be added to this list, inasmuch as he has a very large surgical clinic at the College of Physicians and Surgeons, another at St. Mary's Hospital, and others elsewhere. If we include in this number the herniotomies performed by E. H. Ochsner, the number of operations done would be still greater. E. H. Ochsner's results compare very favorably with those of his brother.

Inasmuch as I am not in possession of complete information as to the number of patients operated on according to my method by other operators than those mentioned, it is impossible to present a complete report. But the results quoted above will serve for comparison with those obtained by other methods.

PART II.

CHAPTER I.

OPERATIONS FOR INGUINAL HERNIA.

In taking up the various operations that have been devised for the cure of hernia, it is not my intention to make any extended remarks in the way of comment. I merely propose to mention those procedures that can be designated as definite individual operations, and to describe briefly such of the modifications of these original procedures as have met with the favor of operators of experience. It will be noted that the list of operations is a long one, and if I have failed to mention any procedure, it is only because it was overlooked and not because of any intention on my part to slight the work done by anyone.

Many operations so-called are really merely modifications, some slight and some more extensive, of older operative procedures; but in some instances the modifications possess the merit that the original procedure lacks. I have not attempted to place these operations in any order, either as to value or precedence, but mention them as they have occurred to me. Whenever possible, I have elucidated the text with illustrations, which will be of considerable interest to the reader, inasmuch as they are reproductions of the originals given us by the authors.

MACEWEN'S OPERATION.

The method employed by Macewen for the radical cure of oblique inguinal hernia aims at leaving the structures in their normal position after the operation, the sac of the hernia being utilized to form a boss at the internal ring. The primary incision is made directly over the internal ring, commencing an inch or two above the ring, and extending downward over the hernia for three or four inches. This incision passes through the two layers of superficial fascia and the fat between them. The inguinal canal is then opened by cutting through the external ring, and separating the fibers of the aponeurosis of the external oblique, to a point above the internal ring. If the sac can be dealt with without making this latter incision, well and good. It can be dispensed with under such circumstances. Any rolls of fat that may be found around the cord or along the sac must be removed.

The sac itself is now dissected out carefully and is separated at its neck from the transversalis fascia, the finger being used, for the space of about an inch around the internal ring. If there is any question in the

mind of the operator as to the existence of omental adhesions, the sac is opened and inspected. If the sac is very large and redundant, a portion of its fundus is cut off. The sac is now ready to be folded on itself into a boss. Medium-sized chromic catgut is fastened firmly into the fundus or cut end of the sac, as the case may be, and with a non-cutting needle it is passed through the sac from fundus to neck in a zigzag fashion, the last two stitches being taken on a level with the peritoneal cavity. The finger is then passed between the transversalis fascia and the peritoneum under the upper border of the internal ring. Using the finger as a guide, the needle is passed in, is made to pierce the transversalis fascia, and the transversalis, internal and external oblique muscles, emerging subcutaneously at the upper angle of the wound. Traction being made on this puckering or folding stitch, the sac is drawn upward and inward so as to fold on itself until it comes to occupy the internal aspect of the internal ring. The puckering stitch is secured subcutaneously and tied.

The next step in the operation is to overlap Poupart's ligament onto the conjoined tendon, thus restoring the natural valve-like condition of these structures, leaving the cord in its bed.

Macewen uses a special needle for this purpose, but any needle without a cutting edge will do. The needle is passed through the conjoined tendon from without inward immediately above the pubic bone, and then is passed along the tendon posteriorly, emerging just short of gripping the deep epigastric vessels from within outward (Fig. 25). The free ends of this stitch (very stout chromic catgut) are then passed through Poupart's ligament, one opposite the internal ring, and the other an inch and a half or so below it, pulled tightly and tied. In this way Poupart's ligament is made to overlap onto the conjoined tendon. If there is any tendency of the sac to protrude, one or two stitches of finer catgut are inserted in the same manner, gripping the lower border of the internal oblique muscle and Poupart's ligament respectively; or, again, if there seems to be more space below the great mattress suture than appears proper, one or two stitches are inserted there for additional security.

The aponeurosis of the external oblique muscle is dealt with either by a simple continuous suture, or by overlapping the cut edges. In chronic cases overlapping is the preferable procedure, as revived by Andrews in his imbrication method.

The edges of the skin wound are brought together either by continuous or interrupted sutures. The wound is dressed and the patient is kept in bed for from four to six weeks. The dressing is changed as often as is required.

Macewen's operation was the first rational procedure presented to the profession for the radical cure of oblique inguinal hernia. It served me very usefully, because from it I worked out my present method, the typic operation for the cure of oblique inguinal hernia. While I have discarded utilizing the sac as a boss in the vast majority of cases, I still occasionally make use of it after the method of Macewen. I have performed the Macewen operation fifty-two times without a recurrence, so far as I know.

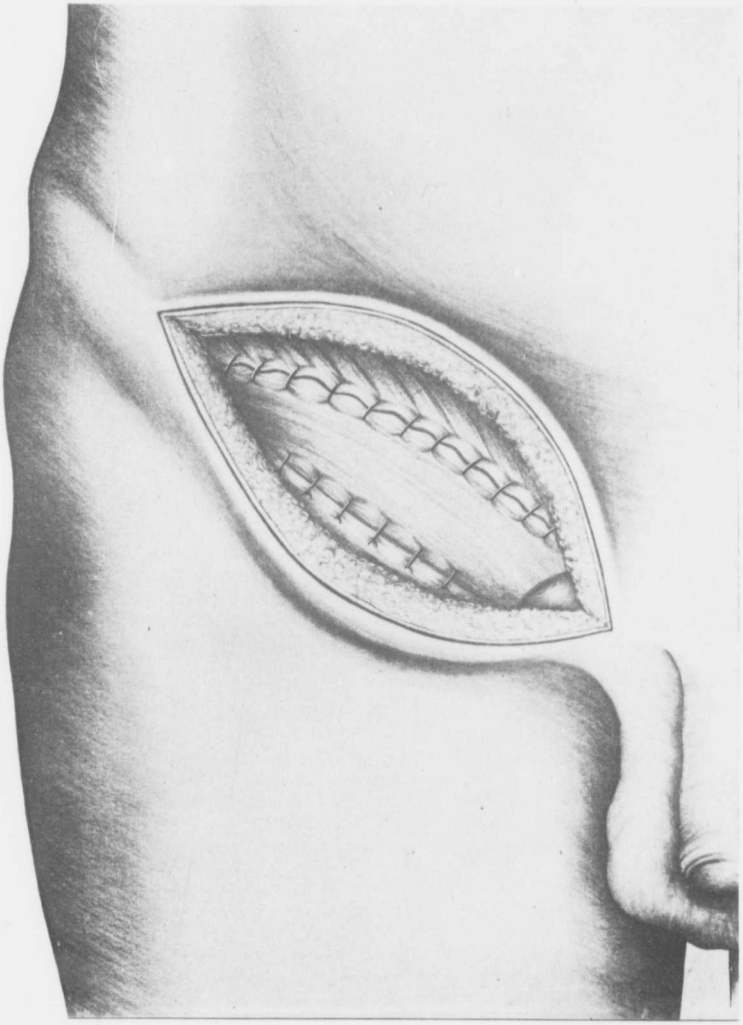

PLATE XXXVIII.

Bassini's Operation for Inguinal Hernia with Imbrication of Structures, as recommended by E. Wyllys Andrews.

There is very little danger of the sac dying and coming away as a slough, if care is taken not to injure its neck and not to pass a ligature around it at the internal ring, as has been done by some operators.

Macewen recognized that two conditions had to be rectified: (a) The anatomical infundibuliform process at the internal ring, and (b) the acquired funnel-shaped depression described by Sir Astley Cooper. Macewen aimed to do this by using the sac as a plug or boss.

It was my privilege some years ago (1889) to examine an anatomical preparation in the possession of Sir William Macewen which had been removed from a patient whom he had cured by his operation. The man had done heavy work for years afterward, although he did not wear a truss. The cause of his death was aortic aneurism. The specimen showed the inguinal canal closed tightly, and at the abdominal aspect of the internal ring the sac was folded on itself forming a cushion which absolutely prevented the possibility of a recurrence of the hernia. Macewen told me that the hernia had been one of long standing, and that the sac was a very large one, composed principally of mature fibrous tissue.

If the rupture be a recent one, and if the sac is composed of delicate elastic peritoneum, then I can readily understand the correctness of Bassini's observation that at an autopsy made ninety-five days after an operation somewhat like Macewen's, no trace of the tampon could be differentiated. That the tampon "must of necessity leave a hard, painful swelling, slow to disappear", as stated by Marcy, of Boston, has not been my observation in a single instance.

BASSINI'S OPERATION.

The Bassini operation is very dissimilar to that of Macewen. Bassini does not make any use of the sac, merely passing a ligature around the neck of the sac and cutting it off. The cord is raised completely out of its bed and is carried to the upper and outer angle of the wound, which displaces it about half an inch. Then the lower border of the internal oblique muscle and the conjoined tendon are sutured beneath the cord to the inner aspect of Poupart's ligament, care being taken to fit the cord at the internal ring as closely as is compatible with its safety (Fig. 26).

A number of operators have found it necessary to place one or two stitches above the cord between the internal oblique muscle and Poupart's ligament, experience having shown them that about six per cent. of the recurrences take place at this angle.

The aponeurosis of the external oblique muscle is then sutured carefully over the cord and the superficial skin wound is closed in the usual manner.

On account of the large number of relapses and complications occurring after this operation, seen by me and also by others, I set myself the task of devising an improvement. The returns of the hernia after Bassini's operation, and after modifications of it, in my experience were between six and seven per cent. in a series of 165 cases. (Eleven recurrences, all at the upper angle of the wound.)

KOCHER'S OPERATION.

Kocher makes use of the sac subcutaneously on the outside of the aponeurosis of the external oblique muscle instead of subperitoneally, as is the case in Macewen's operation. The external ring and the aponeurosis of the external oblique muscle in front of the inguinal canal are left intact by Kocher. A small transverse incision is made opposite the internal ring, passing through the aponeurosis of the external oblique muscle. The sac is dissected out very carefully and freed up to its neck, and after having made sure that its contents have been returned to the abdominal cavity, the sac is dragged through the small slit (Fig. 27), twisted vigorously on itself, and sutured in front of the inguinal canal in such a manner as to press on it.

In a second operation devised by Kocher, which is really a modification of the first, he ablates the sac after fastening it to the external aspect of the aponeurosis of the external oblique muscle (Fig. 28). This modification was devised because of the sloughing of the sac in the old operation. Kocher urges the use of his operation (1) on account of its safety in old subjects; (2) suppuration will destroy Bassini's results, but not his. Among 126 patients operated on by this method, there were only four relapses, about 3 per cent., while the former procedure was followed by a relapse in about 20 per cent. of the cases.

HALSTED'S OPERATION.

In 1893 W. S. Halsted devised an operation for the radical cure of hernia. Experience showed, however, that the operation was not as satisfactory as Halsted at first thought it would be, and therefore a new operation has been substituted for it. The cord is no longer raised from its bed and transplanted, nor are the abdominal muscles incised above the internal ring. This modification, which is very similar to my operation, was not published until three years after I produced my method.

The steps of this operation are so well shown in the illustrations made by Brödel, and reproduced by Miss Cleaveland, that a description is almost superfluous for those who consult the plates. The aponeurosis of the external oblique muscle is divided and the two flaps are reflected as in the Bassini-Halsted operation. The cremaster muscle and fascia are split, not directly over the center of the cord, but a little above it. The internal oblique muscle is dissected free as much as is possible. A little artefaction is often necessary. If the muscle cannot be drawn down to Poupart's ligament, without exerting too much tension thereon, it is advisable to make one or two incisions in the anterior sheath of the rectus muscle under the aponeurosis of the external oblique. This sheath serving, in part, as the aponeurosis of the internal oblique muscle, it can be seen quite readily that incisions into it, if properly made, will be of service. It is advisable, however, to postpone the making of these incisions until the suturing of the internal oblique muscle to Poupart's ligament is begun. Then the degree of tension present can be gauged, and the number, length and precise position of the incisions determined. A second reason for postponing

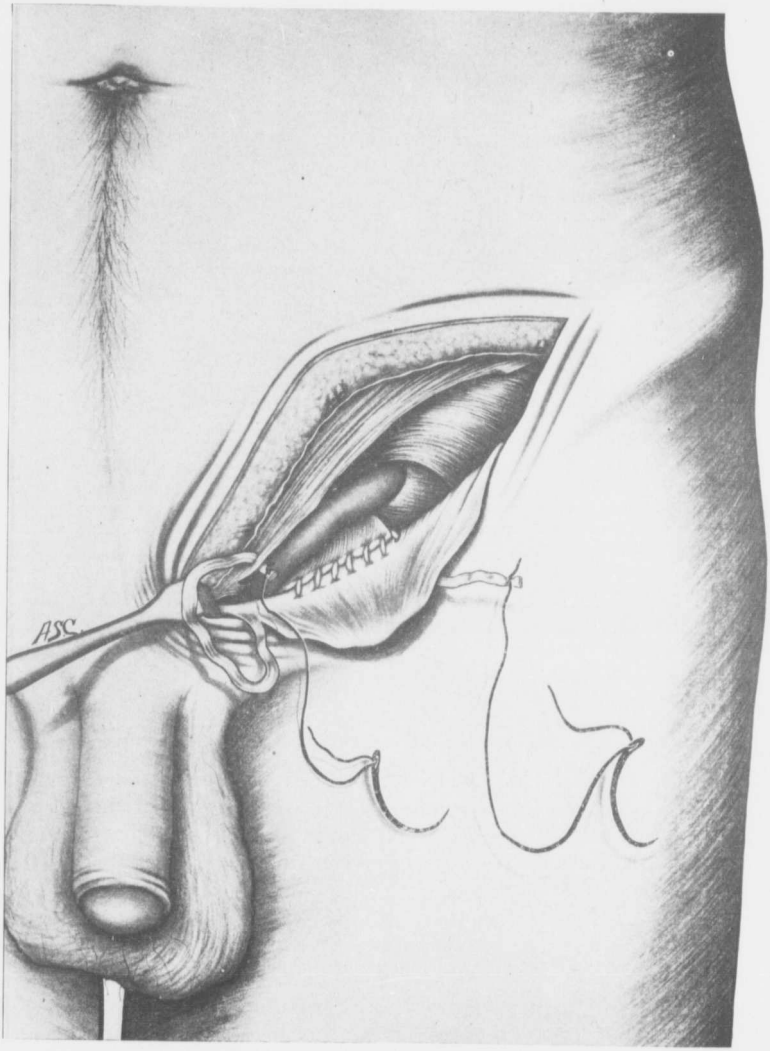

PLATE XXXIX.

McArthur's Autoplastic Suture used in Bassini's Operation.

these relaxation incisions, as they are termed, is that sometimes this portion of the rectus sheath is used for the purpose of closing the lower part of the inguinal canal (Fig. 33).

When the veins are very large, Halsted states they should be excised, but with very great care, so as to avoid even the slightest extravasation of blood into the tissues. The vas deferens should not be raised from its bed or even handled lest thrombosis of its veins occur.

The veins should be ligated as high up in the abdomen as possible. They are pulled down quite firmly just before the ligature (in a needle with a blunt end) is passed between them. In order to obviate slipping, two ligatures of fine silk are applied, one to the abdominal stump and the other to the proximal stump of the veins. The farther from the testicle these veins are divided, the better; provided, of course, that the stump is external to the external abdominal ring.

Ligation of the sac by transfixion or by purse-string suture at the highest possible point. Both ends of this suture, after tying, are threaded on long curved needles, then carried far out under the internal oblique muscle from behind forward, and, passing through muscle, about 5 mm. apart, are tied. The idea was suggested to the author by Kocher's operation, the principle being essentially the same.

The lower flap of the cremaster muscle and its fascia is drawn up under the mobilized internal oblique muscle and held in this position by very fine silk stitches, which, having engaged firmly a few bundles of the cremaster, perforate the internal oblique, preferably where it is becoming aponeurotic, and are tied on the external surface of the latter (Fig. 29).

The internal oblique muscle, mobilized, and possibly further released by incising the anterior sheath of the rectus muscle, is stitched (the conjoined tendon also) to Poupart's ligament in the Bassini-Halsted manner (Fig. 30). Catgut is usually employed for this suture. The aponeurosis of the external oblique muscle is overlapped, as in Andrew's method (Figs. 31 and 32).

The skin is closed with a buried continuous silver suture and the incision covered with five or six layers of silver foil. It is unnecessary to dress or examine a wound closed in this manner for two weeks, when the wire may be withdrawn. Patients are kept in bed from eighteen to twenty-one days.

Halsted says, "We hope to be able to publish very soon the results of the first 1,000 operations performed for the cure of inguinal hernia at the Johns Hopkins Hospital. Certainly more than two-thirds of the operations have been performed by my associates, Drs. Finney, Bloodgood, Cushing, Mitchell and Follis, for we are all much interested in the subject. Each operator has been at perfect liberty and is encouraged to perform the operation according to his best judgment. This fortunately furnished a little variety, but of late the operation has, in almost every detail, been performed just as the writer has described it."

FOWLER'S OPERATION.

The late George Ryerson Fowler, of Brooklyn, N. Y., described an operation for the radical cure of inguinal hernia which he termed an intraperitoneal transplacement of the spermatic cord with typical obliteration of the internal ring and the inguinal canal. In this operation the skin incision is curved and follows the course of Poupart's ligament. The sac and cord are exposed in the usual way, the sac is cut away, and the cord is raised from its bed. The deep epigastric vessels are tied twice, and then severed between the ligatures. The posterior wall of the canal is opened freely, the cord is transplanted within the abdominal cavity, and the wound is then closed.

The patient is placed in the Trendelenburg position, in order that the intestines may not embarrass the operator, subsequent to the opening and emptying of the hernial sac. The incision commences at the spine of the pubis, is carried parallel with the os pubis for about an inch, and then curved obliquely outward and upward on the line which marks the general direction of Poupart's ligament, until a point is reached corresponding to the level of the internal ring.

Skin, fat and fascia to the aponeurosis of the external oblique are included in the incision. The flap thus marked out is reflected when the entire region involved in inguinal hernia, including the inguinal or spermatic canal, as well as the site of Hesselbach's triangle, is exposed to view. The anterior wall of the canal is now split up to the site of the internal ring.

The cord and sac are first isolated together, the isolation commencing at the pubic bone, where the cord is usually easily identified and separated. these structures are now separated from each other, each being traced to the internal ring and thoroughly isolated from all structures in the neighborhood. The hernial sac is now opened, its contents reduced, if reduction has not already occurred, and the sac cut away to the level of the muscular layer of the abdominal wall. Its incised edges are grasped by forceps to prevent them from slipping away. The cord being held out of the way, the place of crossing the deep epigastric artery on the transversalis fascia is sought, and both the artery and vein are isolated and ligated in two places and divided between the ligatures.

The index finger is now introduced into the peritoneal cavity through the neck of the sac and the posterior wall of the canal, as well as the site of Hesselbach's triangle, lifted up on the palmar surface of the finger. With the latter as a guide, the entire intervening structures are divided, including, from without inward, the transversalis fascia, subperitoneal connective tissue, and the peritoneum (Fig. 34). The spermatic cord is now placed in the peritoneal cavity; the gap in the incised posterior wall in the inguinal canal is held apart by grasping the incised peritoneal edges with forceps. In those instances in which the internal ring is greatly enlarged in all directions and a large neck to the hernial sac exists, a slit may be made in the edge of the latter toward Poupart's ligament, in order to lead the cord easily into the peritoneal cavity. The edges of the open-

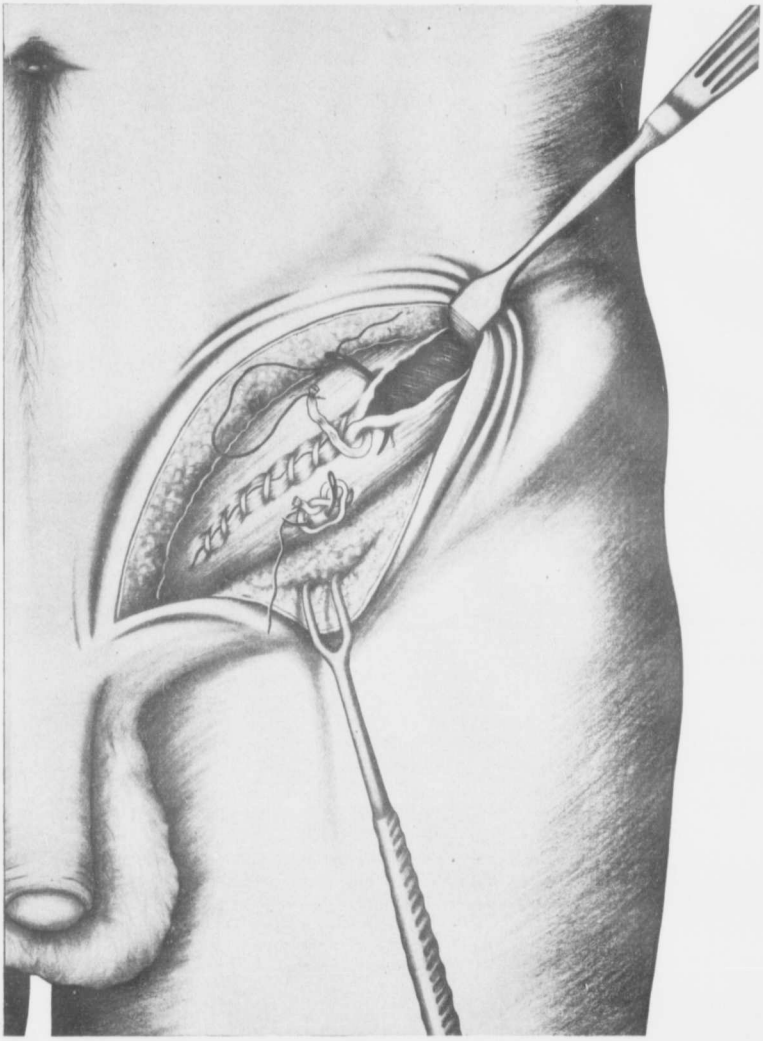

PLATE XL.

McArthur's Autoplastic Suture used in Bassini's Operation.

ing are now drawn forward so that a broad approximation of their serous surfaces is obtained. While held in this position, through-and-through sutures are passed from side to side (Fig. 35). By this maneuver any existing relaxed condition of this portion of the transversalis fascia is corrected. The suture is first passed above the site of the internal ring, and includes the transversalis fascia which is drawn downward and forward for that purpose. This serves to cover the point where the cord passes into the peritoneal cavity at the site of the internal ring, thereby obliterating the latter, the cord itself filling the small opening in the peritoneum. The position of the cord on the peritoneal surface of the abdominal wall is such as to act as a "shunt" carrying any intestine in the neighborhood away from rather than toward the original weak point.

The suturing is continued until the lower angle of the gap in the posterior wall of the original inguinal canal is almost reached. This angle should be made low enough to compel the cord to curve slightly upward and forward as it leaves its place of exit from the peritoneal cavity at the newly formed external ring. The cord should rest easily in the angle, and the suturing stop short of constricting it therein.

The inguinal canal, including the gap in the aponeurosis of the external oblique which represents the external ring, and the skin wound are now to be closed. The canal sutures include the conjoined tendon and the aponeurosis of the external oblique on the inner margin, and Poupart's ligament on the outer. The two sutures should include the outer edge of the pyramidalis, if this is present, and if not, the rectus muscle. The effect of this is to displace a portion of the muscular tissue to a situation to guard the point of exit of the spermatic cord (Fig. 36). A continuous suture is now applied in order to secure a more accurate coaptation of the margins of the aponeurosis of the external oblique muscle, the turns of suture passing in the space between the interrupted sutures. The skin wound is closed by a subcuticular or other appropriate suture, and proper sterile dressings are applied.

I have performed this operation, or a modification of it, forty-five times, usually in cases where the hernia was complicated by a non-descended testis. The operation gives the vas deferens a shorter route between the testes and the base of the bladder. I have also used the method in the treatment of both direct and indirect inguinal hernias, where the hernia protruded considerably and where there was more or less bulging of the posterior wall of the canal and the deep epigastric vessels. In certain conditions it is not necessary to cut the peritoneum, although the deep epigastric vessels are severed.

LANPHEAR'S OPERATION.

Emory Lanphear, of St. Louis, in operating for inguinal hernia, forms a flap and turn it down so as to expose the hernial sac and the inguinal canal. The sac is then isolated, opened, and its contents reduced. The opening in the abdomen is closed temporarily with a gauze pad, and the cord and testes are elevated out of their new position and wrapped in

iodoform gauze. From the hernial sac an artificial vaginal tunic is made into which the cord and testes are passed, the tunic being sutured in such a manner that not too much pressure is made on the cord. This mass of tissue is pushed into the abdominal cavity and anchored by catgut sutures. Next, he closes the incision in the peritoneum and then the opening in the scrotum. The abdominal wall is sutured in layers so as to obliterate the inguinal canal.

The objection to the operation is that in case there occurs suppuration of the testes or an epididymitis, it would be necessary to open the abdomen in order to give operative relief.

GIRARD'S OPERATION.

Girard splits the skin and the aponeurosis of the external oblique muscle somewhat after the fashion of Bassini's operation, but he preserves a strip of the muscle, about the width of a finger, at its attachment to Poupart's ligament. A purse-string suture being passed through the neck of the sac, the sac, of course, having been cut off, it is dropped back into the abdominal cavity. The internal oblique and transversalis muscles are sutured to the underside of Poupart's ligament, a running catgut stitch being used. The external oblique muscle is then likewise sutured to the underside of Poupart's ligament and then the strip of muscle is passed in under the ligament and sutured to the aponeurosis of the external oblique muscle, so that for a certain distance this aponeurosis is doubled, an opening is left at the lower angle of the exit of the cord. The skin is closed with a continuous suture.

PARK'S AUTO-SUTURE (SAC) OPERATION.

Roswell Park recently devised a new method of utilizing the sac. The sac having been exposed and isolated, is emptied of its contents and freed of all superficial fat. It is separated from the cord and made to appear as a distinct separate structure up to the level of the internal ring. The abdominal aponeurosis is penetrated with forceps at a point opposite the internal ring, and the forceps introduced through this opening is made to appear lower down in the inguinal canal, the sac is seized, and is withdrawn together with the forceps, thus bringing it out at the punctured point.

Instead of cutting off the sac outside the point where it is fastened, Park utilizes it as a band of suture material with which a coarse strong suture is made binding together the lateral margins of the inguinal canal (Fig. 37). Of course, much depends on the thickness and length of the sac. Old and large sacs are far too cumbersome for this purpose, and short sacs cannot be made to serve as sutures when twisted into a cord. These difficulties are overcome easily either by reducing the sac, cutting out a strip which can be made to serve as a suture, or by lengthening the strip by division, so that a suture five or six inches long can be obtained from a short sac.

The sac having been prepared, it may be used in one of two or three

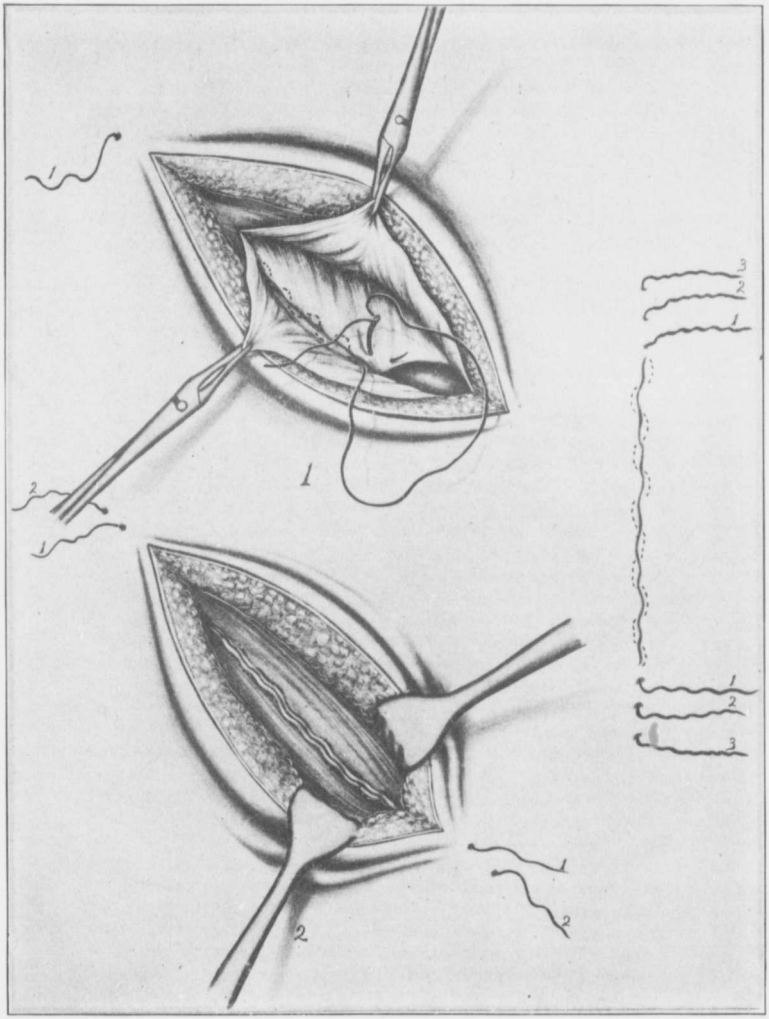

PLATE XLI.

M. L. Harris' aluminum bronze wire suture used in Ferguson's operation.

ways. A very large needle may be threaded with the suture or a Cleveland ligature carrier may be used, passing it through the tissues on either side as if it were an ordinary needle, then grasping the end of the sac and pulling it back through the openings thus made as the instrument is withdrawn. Sometimes Park passes into the end of the sac a silk suture, threading it into a larger needle, and making it serve as a means of traction, the procedure varying a little with the density and strength of the sac wall.

In certain cases the portion of sac used may be divided into halves, making two tapes which can be used in the form of a shoelace suture of the pillars of the ring by either of the expedients mentioned. The ends are drawn down at the lower end of the ring, where they are tied and fastened with a suture.

The method is not applicable to all cases, nor is it likely to displace other procedures. It should not be employed unless the operation can be performed deliberately and only in the absence of infection.

WULLSTEIN'S OPERATION.

Quite recently Wullstein (*Centralbl. f. Chirurgie*, No. 38, 1906) proposed a new method for the cure of inguinal hernia. The incision starts at the pubic spine and makes a bow-shaped curve upward and outward, running from one to two finger-breadths above Poupart's ligament and extending to the neighborhood of the internal inguinal ring. The skin flap is reflected downward to Poupart's ligament. The sac is isolated in the usual way and the aponeurosis of the external oblique muscle is split as far as the internal ring. The sac is then tied off at the neck and cut away. The cremaster fibers are separated from the cord, but are allowed to remain in connection with the external oblique muscle and Poupart's ligament. The transversalis fascia is split almost to the internal pillar of the external ring, and the cord is dislocated backward so as to lie between the transversalis fascia and the preperitoneal fat. The external oblique, internal oblique and transversalis muscles and the transversalis fascia are united to the posterior surface of Poupart's ligament by interrupted sutures as far as the external inguinal ring. In order to restore normal tension, the sutures are placed a little nearer the middle line in Poupart's ligament than in the abdominal wall.

A plastic flap is then constructed. The skin is pulled inward in order to expose the rectus muscle. The outer two-thirds of the anterior rectus sheath is cut transversely across immediately above the level of the symphysis, thus exposing both the rectus and the pyramidalis fibers. The cut is continued upward and outward until it ends opposite the pubic spine, but about four centimeters above it. This gives a tongue-shaped flap which is freed from the muscle and reflected outward to the outer edge of the rectus muscle. The fibers forming the inner pillar of the external ring prevent a complete reflection of the flap, and these fibers are now cut across close to Poupart's ligament. The remainder of the hernial opening is closed by suturing the abdominal muscles to Poupart's ligament.

The purpose of the flap is to be placed behind the rectus muscle. The

three sutures used to transpose the flap also serve to fix and carry the cord into its new bed. The sutures are of the mattress type, the lowest being placed horizontally, and the upper two vertically. They all pierce the rectus muscle and enter the fascial flap some distance away from its free edge. When the sutures are tied the aponeurotic flap is pulled behind the rectus muscle, the cord assuming a course running well behind this muscle, and then curving outward and downward to reach the scrotum. It is surrounded on all sides, except below, by rectus muscle, which is also sewn to Poupart's ligament. The gap in the rectus sheath is repaired simply by stitching the two edges together. The cord thus is made to lie in a new canal behind the rectus muscle, so that straining or coughing merely presses aponeurotic flap to muscle.

Wullstein has used this method with perfect results in 19 cases of direct and indirect, reducible and irreducible hernia.

NICHOLL'S OPERATION.

Nicholl's operation (*Annals of Surgery*, Jan., 1906) is really a modification of other operations. The hernial sac is treated as before, but it is lodged over the internal aspect of the internal inguinal ring as a pad, resting between the parietal peritoneum on the one hand and the fascia transversalis on the other. With blunt retractors the round ligament, or the cord, is pulled upward, and Poupart's ligament downward. An incision is carried along the superior aspect of the pubic ramus. Its limits are the pubic spine and the femoral sheath. This divides the iliac fascia, the origin of the pectineus and the periosteum. "Slightly detach both margins of the periosteal wound, and drill the bone near its upper margin, as before, somewhere between the pubic spine and the femoral sheath, the position of the holes varying with the shape and size of the hernial aperture. Pass a stout absorbable ligature in the form of a large mattress suture through the internal pillar of the hernial aperture; pass the ends of the suture out through the holes drilled in the bone and either in front of or behind the spermatic cord as seems best to secure firm closure of the canal without undue compression of the cord. Tie the ends of the two loops of the ligature separately. The tightening of the knots brings the internal pillar down into the periosteal incision and lodges it firmly against the bone. The knots may be placed either above or below Poupart's ligament."

The operation is completed by lifting Poupart's ligament to the anterior surface of the internal pillar and fixing it there by interrupted sutures of stout catgut or other absorbable material which should penetrate, at least, the external and internal oblique muscles.

BECK'S OPERATION.

Carl Beck, of New York, makes an incision down to the internal surface of Poupart's ligament and alongside the rectus muscle. The lower third of this muscle is exposed down to the shelf of Poupart's ligament. The sac is isolated, ligated and cut off within the internal ring. The cord is held away, and the divided aponeuroses are dissected back.

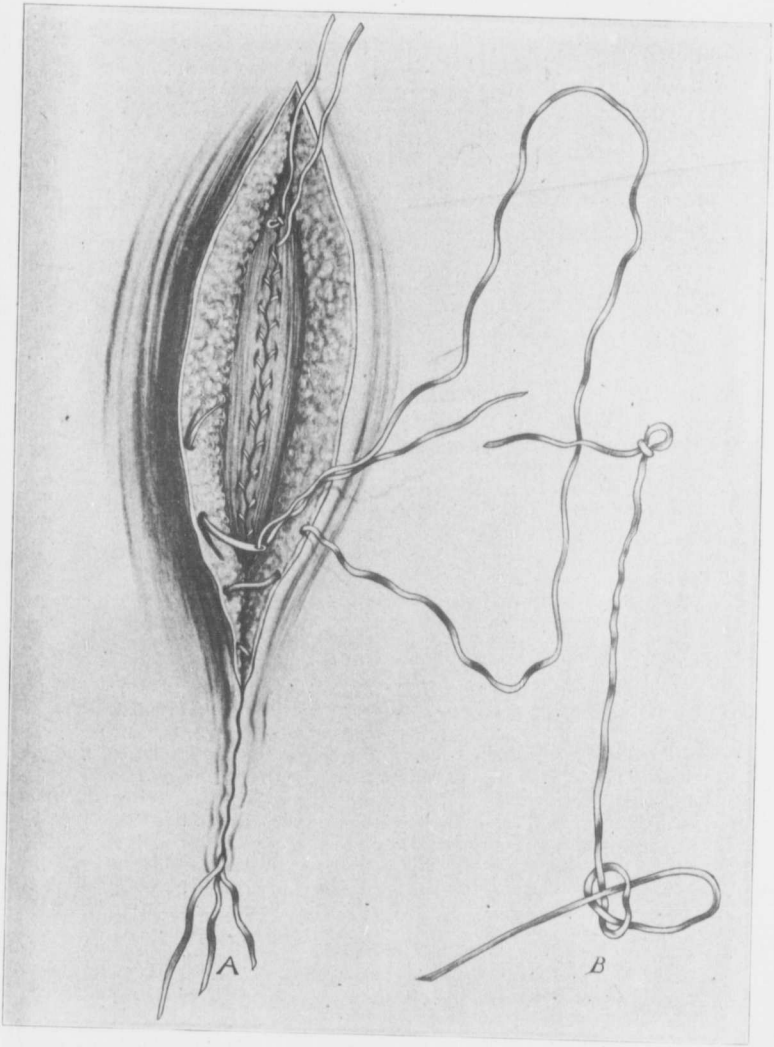

PLATE XLII.

Davison's Removable Silkworm Gut Suture.

An oblique incision is made which divides the lateral fibres of the rectus transversely, somewhat below the lower third of the muscle and for about one-third of its width. The incised fibres are cut from the remainder of the muscle so that when the upper portion is turned downward it will reach Poupart's ligament. The muscular flap is then sutured on one side to the conjoined tendon and on the other side to Poupart's ligament. Formalin catgut is employed for this purpose. The sutures are tied after the cord has been placed on the transplanted muscle flap. The gap caused by transplanting this flap is closed by suturing the outer margin of the rectus to the broad abdominal muscles. The divided aponeuroses are sutured above the cord by a continuous suture.

In my opinion, the severing of the fibers of the rectus muscle is uncalled for in an operation for the cure of hernia. Without doubt, the transplanted flap strengthens the inguinal region considerably, but why resort to such a complex procedure when a more simple one will meet all the indications?

STINSON'S OPERATION.

J. C. Stinson makes an incision parallel with and one-half inch above Poupart's ligament, extending from the external ring to half an inch above the upper angle of the dilated internal ring. The skin, subcutaneous tissues, and the aponeurosis of the external oblique muscle are divided by this incision. The aponeurosis is elevated and freed from the structures beneath until the outer border of the rectus muscle and the shelving edges of Poupart's ligament appear in the field.

The sac is isolated, opened, and its contents cleared out, all the altered omentum being removed. All adhesions are separated. The sac is cut off as high as possible and the cut edges of the serosa are closed with continuous sutures. The rings and canal are cleared out. The dilated internal ring is sutured, commencing at the upper angle.

The inner and outer borders of the transversalis fascia are brought accurately together with continuous sutures, leaving only sufficient room at the lower angle, close to the pubic bone, for the cord. The internal ring is re-enforced and the canal closed by uniting with continuous sutures, the internal oblique and the transversalis muscles and their conjoined tendon to the shelving edge of Poupart's ligament, leaving only room enough next to the pubic bone for the cord. The cut edges of the external oblique and the pillars of the external ring are sutured and made to embrace the cord. The skin is closed without drainage. Sterilized gauze is held firmly in place by long strips of adhesive plaster, then a layer of cotton and over all a firm spica bandage.

HERRING'S OPERATION.

E. K. Herring advocates the following procedure for curing hernias in children: The operation is said to be a very simple one and can be performed in a few minutes. The sac is cut down on and into in the usual manner, and having dealt with its contents it is pulled down, that is, out

from the abdomen, sufficiently to insure subsequent retraction. The incision is extended in the sac up to the margin of the ring, and then the upper portion of the sac is turned inside out through the incision, so as to expose the peritoneal surface. Then, with a knife or a pair of scissors, the peritoneum is cut across transversely. The proximal cut edge retracts into the abdomen and it should be caught here and there with catch forceps as the peritoneum is cut. These catch forceps are arranged so as to draw the cut edge of the peritoneum into a straight line, and the two edges are stitched together by a catgut suture. The forceps are then removed, and the tissue immediately retracts. The opening is closed with a subcuticular or other stitch and is then sealed.

Nothing further is absolutely necessary. When there is a large lax abdominal ring, or when the little patient has a cough, it may be advisable to put one or two stitches through the pillars as a temporary support. The contents of the inguinal canal are practically not disturbed. The sac is left in the canal to shrivel up; the cord has not been touched nor pinched; the testicle has not been dragged out and exposed; no vessels have been cut, so no ligatures are left behind, and the chances of sepsis are very slight.

BENJAMIN'S OPERATION.

In 1903, Benjamin described an operation for the radical cure of oblique inguinal hernia which possessed several distinguishing features. An ordinary incision was made, as in the Bassini operation, and then the aponeurosis of the external oblique muscle was slit up to a point opposite the internal ring. The fibers of the internal oblique and the transversalis muscles were divided carefully by blunt dissection, thus opening the inguinal canal. The aponeurosis of the external oblique was carefully and thoroughly removed from the internal oblique. The lower portion was dissected down to Poupart's ligament, and the transversalis muscle separated from the peritoneum.

The cord is now raised and silkworm gut sutures are introduced to the outer side of the incision, passing through the skin, Poupart's ligament, the internal oblique and the transversalis muscles, on the inner side of which the loop is made. The needle, re-entering the transversalis and internal oblique muscles, passes through Poupart's ligament and comes out through the skin to the outer and lower side of the cut near the point of entrance. From three to five sutures are similarly introduced. These sutures pull the internal oblique and the transversalis muscles below the shelving edge of Poupart's ligament, thus creating a firm barrier against any internal force.

The sutures are then tied over rolls of sterilized gauze. The cord then rests on the internal oblique, the external oblique being closed over the cord. Interrupted figure-of-eight sutures are introduced, bringing the external oblique muscle in apposition with Poupart's ligament. They also approximate the skin and are tied over a gauze roll.

This operation, according to Benjamin, completely closes the breech

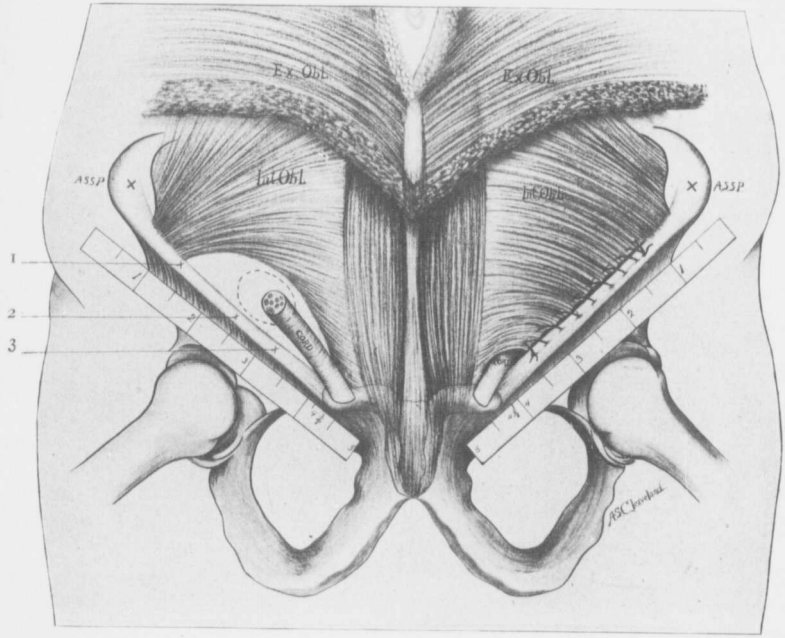

PLATE XLIII.

Showing Deficiency of Internal Oblique at Poupart's Ligament.
1. Usual deficiency. 2. Normal for male. 3. Normal for female.

and makes a firm wall. There are no sutures for the tissues to absorb; no buried, non-absorbable sutures left, to irritate the tissues and cause further trouble; no necrosis from tight sutures; therefore, few, if any, stitch-abscesses. All sutures, after serving their purpose, are removed, leaving only the natural supports, while the gauze rolls act as elastic cushions which prevent scars from the sutures.

SCHWARTZ'S OPERATION.

When Schwartz first described his method for the radical treatment of hernia, he called it hernial myoplasty. It was applicable both to inguinal and to femoral hernias. The incision is a vertical rather than an oblique one. After having exposed the hernia, the sac is isolated, and having tied it as usual the sheath of the rectus muscle is opened by a longitudinal incision six to eight centimeters in length. The aponeurotic folds are held back by a fine Kocher's forceps. A muscular flap with the pedicle below is separated, using especially the channeled sound; the muscle above is seized *en masse* and tied with catgut and cut. The flap is about four to five centimeters long, after retraction, and about a centimeter to a centimeter and a half wide. All this can be done without causing any hemorrhage, and generally without tying a single ligature.

Lifting the internal pillar with a Kocher's forceps, the sheath of the rectus muscle is opened below the pillar with a bistoury passed flat and the flap is looked for as it is made to pass through the opening as low as possible. The incision in the sheath of the rectus muscle is closed with a few sutures. When this has been done, the muscular flap is drawn into the hernial region and sutured above to the lower border of the inferior oblique and transversalis muscles, and below to the crural arch. The hernial pillars are sutured above it, and the operation is completed as usual. In this way the inguinal orifice, or, rather, the hernial opening, and all the region surrounding it, is closed by a solid flap of muscle which constitutes a natural barrier.

WOELFLER'S OPERATION.

The principle of this method is the closure of the hernial opening by suturing the internal oblique and transversalic muscles to Poupart's ligament. Woelfler also removes the rectus muscle from its sheath and sutures it to Poupart's ligament. At one time he made use of a method of transposing the cord, which did not, however, prove very satisfactory. It consisted in removing the testes from the scrotum by severing the gubernaculum of Hunter. He then severed the transversalis fascia at the outer border of the rectus muscle and separated the subserous fascia from the recti muscles. The testis is then pushed in through this opening, and out between the two recti muscles. It is brought down in front of these muscles and transferred to the scrotum, where it is again sutured to the gubernaculum.

Naturally, serious complications often followed this method of transposition, because the cord was very likely to be compressed by the con-

tracting recti muscles or the formation of scar tissue, and the result was atrophy of the testis. Gangrene might also ensue. The method was practised but little by Woelfler himself, and rarely by any other operator.

BALL'S OPERATION.

Charles Ball operates on reducible inguinal hernia as follows: An incision one inch in length is made over the neck of the hernia. The sac is exposed and opened, and the finger is introduced to detect adherent omentum. The sac is then separated. If the hernia is congenital the sac must be divided circumferentially, leaving the lower portion, but peeling off the upper portion from the cord. The sac is cleared up to the external ring and is twisted with forceps. A curved needle threaded with stout silk is carried up one inch into the subperitoneal space along the guiding finger, and then directed forward through the muscles and skin of the abdominal wall. The other end of the same piece of silk is passed to the other side of the twisted sac and brought out through the abdominal wall. The ends are tied together over a lead plate.

The sac now lies in the inguinal canal and along with the spermatic cord is pressed with the finger backward toward the abdominal cavity, while deep sutures are passed which take hold of the lateral structures of the canal and also back up the twisted sac. If the sac is large a portion of its fundus should be excised. The skin wound is closed by continuous sutures.

LEVINGS' OPERATION.

A. H. Levings (*American Journal of Surgery and Gynecology*, February, 1905) employs an operation for the cure of congenital hernia in the canal of Nuck, which is practically the same as the operation recommended by me. The incision is made parallel to the inguinal canal, extending one-half an inch internal to the external ring, and passing along the course of the canal to the region of the external ring. The aponeurosis of the external oblique muscle is divided to the upper border of the internal ring. When practicable, the peritoneal process should be separated from the cord up to the internal border of the internal ring, where it is ligated and cut away.

If it is found difficult to separate the peritoneal sac from the tissues of the round ligament, all of these structures may be dissected up to the internal ring, where they are ligated and cut away. In these cases a stout catgut suture should be carried through the pillars of the internal ring and the stump of the cut cord and sac so as to fix the cord in this position and give anterior support to the uterus. Three or four heavy sutures of catgut should be passed through the shelving portion of Poupart's ligament and made to pick up the internal oblique and transversalis muscles in the form of mattress sutures, thus bringing down the internal oblique and transversalis muscles and closing the internal oblique and inguinal canals. In closing the incision in the aponeurosis of the external oblique, the sutures should take up at the same time a portion of the internal oblique muscle, so as to make of all three layers one solid mass of tissue.

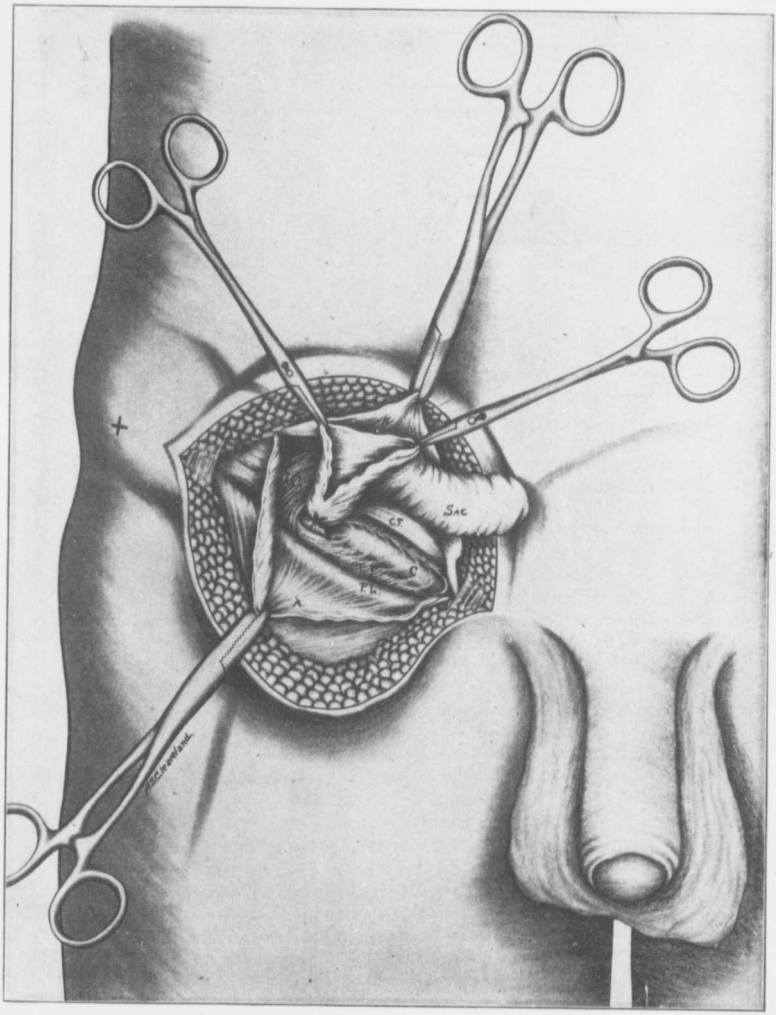

PLATE XLIV.

Ferguson's Operation for Inguinal Hernia.

T. F. Transversalis fascia. I. R. Internal ring. P. L. Poupart's ligament. I. O. Internal oblique muscle. A. Aponeurosis of external oblique. C. Cremaster muscle. C. T. Conjoined tendon.

POULLET'S OPERATION.

J. Poullet (*Lyon Medicale*, No. 24, 1901) brought forward a method for the radical cure of hernia, which does away with the necessity of rest in bed. In this method the peritoneal cavity is not opened, nor is there any dissection of the sac, a single cut of the bistoury being all that is necessary to incise the skin. The rest of the operation is done with the fingers, a tubular needle, and a large metallic thread. This thread takes the place of the subcutaneous truss. Poullet has operated over four hundred times by this method. At first there were some recurrences, but these have become more and more infrequent. In no case did the operation aggravate the patient's condition.

Poullet operates without any assistance; he has never ligated a vessel, and as a rule the operation requires about fifteen minutes. The wire he uses is steel, three-tenths millimeters in diameter, 39 inches weigh 1 gram, 7 or 8 inches are required for each case, and the same method is used whether the hernia is inguinal, femoral or umbilical in type.

The skin incision having been made, the neck of the sac is isolated with the fingers, and a long forceps is placed on the sac to prevent its descent. A fine tubular needle is passed through the neck of the sac five or six times, below the forceps, the metallic suture is placed through the needle, not including the vas deferens or the vessels and nerves, to the cord. In the second stage of the operation the two ends of the suture are made to traverse the whole abdominal wall, except the skin, from within out to about fifteen millimeters from the upper border of the external ring. To do this, the left index finger is introduced deeply into the inguinal canal and the needle passed between it and the abdominal wall which it perforates from within, thus implanting the two ends of the suture an inch apart. The third step is to close the canal by means of the two ends of the same suture. The finger still remains in the canal to guide the curved needle which perforates the abdominal wall from within out, or from without in. This needle brings each suture successively through the two fibro-muscular borders of the opening to be closed, each border is traversed three or four times, according to the size of the opening. Poullet advises not to tighten the suture at the bottom until the last insertion has been made below the ring in the fibro-periosteal tissue near the pubic spine.

The two ends of the suture are brought together, not pulling on the suture, nor trying to bring the pillars in contact. They are brought closer, but not in contact, the wire being the barrier. The two ends are twisted together and a perforated shot is placed on the ends so that the tissues will not be lacerated.

DUPLAY AND COZIN'S METHOD.

Duplay and Cazin about ten years ago devised an operation for the cure of hernia in which buried sutures were discarded entirely. They tied the sac on itself, split its distal portion, tying a series of knots, or the sac was divided primarily and one-half tied to the other. The wound was closed with silver wire, which was removed after union had taken place.

SYMONDS' OPERATION.

In the *Lancet*, Feb. 2, 1901, T. H. Wells describes an intra-peritoneal method for the radical cure of inguinal hernia performed by Symonds. The operation is divided into seven stages: (1) An incision two and a half inches long in the linea semilunaris, ending over the external ring and passing through the skin, fat, superficial and deep fascia; (2) deepen the upper one and a half inches through the abdominal muscles, transversalis fascia and subperitoneal fat, and having arrested all hemorrhage, open the peritoneal cavity; (3) explore the sac with the finger and replace the intestine; (4) insert forceps along the palmar surface of the finger, seize the apex of the sac and invert it, bringing it out into the upper wound; (5) stitch the sac, after giving it a couple of twists on itself to obliterate its cavity, through the peritoneum; (6) stitch up the external ring and, (7) close the wound by bringing the structures layer by layer into accurate apposition.

Symonds claims for this operation that it is expeditious; the neck of the sac is obliterated high up; the inverted sac aids in forming a firm scar; the sac and contents can be explored and, if necessary, the sac opened below quickly and safely; the incision allows any method of closing the inguinal canal and external ring.

TOREK'S OPERATION.

Franz Torek (*Annals of Surgery*, May, 1906) describes an operation which he has employed in cases where an appendectomy was necessary at the same time that operation was done for the relief of a hernia.

An imaginary line is drawn from the anterior superior spine of the ileum to the umbilicus. A point on this line at a distance equal to one-quarter of its length from the iliac spine marks the beginning of the incision, which is carried down from here to the external inguinal ring. The aponeurosis of the external oblique is exposed throughout the length of the incision. This fascia is then incised in the direction of its fibers, as is customary in the gridiron operation for appendicitis, exposing the internal oblique muscle; but the incision is prolonged downward so as to terminate at the apex of the external inguinal ring.

The aponeurosis of the external oblique is pared off from the underlying parts in the usual manner, on the outer side exposing Poupart's ligament. Then the hernia operation is proceeded with up to the point where the sac is cut off. Here the hernia operation is intermitted and attention turned to the appendix.

The fibers of the internal oblique and transversalis muscles are separated bluntly in the usual manner, the peritoneum is opened, and the appendix removed; then the peritoneum, transversalis fascia and muscles are closed again. The appendicitis operation is completed, except that the aponeurosis of the external oblique is still left open. Next the internal oblique and transversalis are sutured to Poupart's ligament, according to any of the approved methods, and finally the aponeurosis of the external oblique is sutured in the entire extent of its incision, so as to close both the appendicitis and the hernia operation. Lastly the skin is sutured.

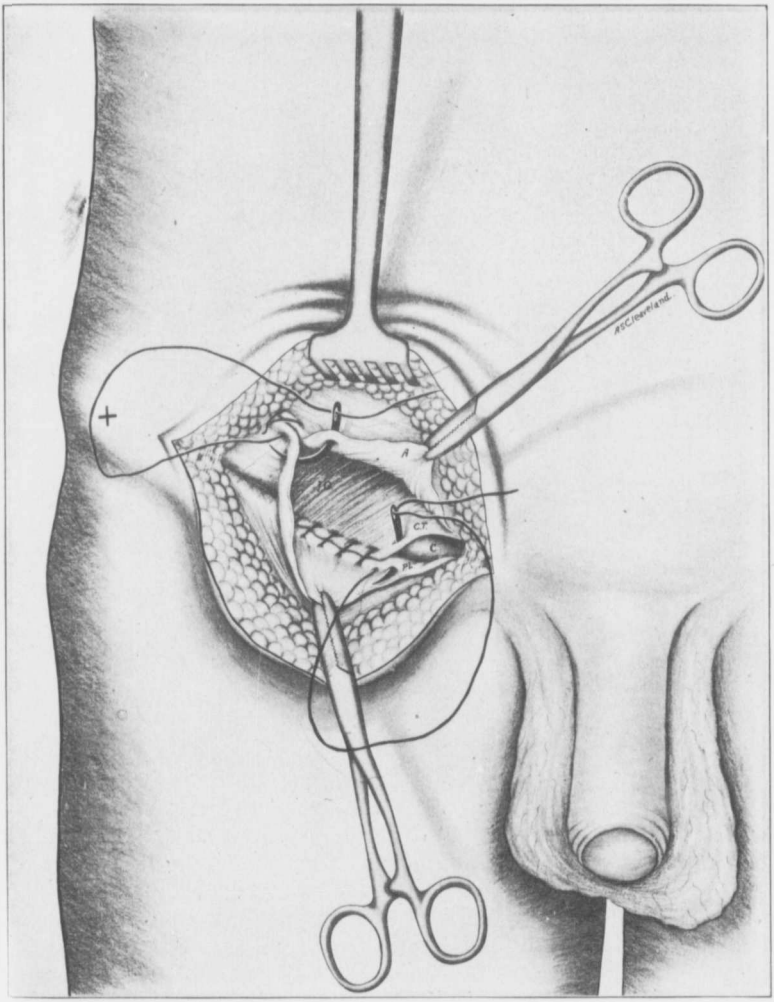

PLATE XLV.

Ferguson's Operation for Inguinal Hernia.

A. Aponeurosis of external oblique. I. O. Internal oblique. C. Cord. C. T. Conjoined tendon. P. L. Poupart's ligament.

Torek claims that the combined operation has decided advantages over the performance of the two operations at separate sittings. It saves the patient one operation and it takes only very little longer than the hernia operation alone would require. Furthermore, there is greater firmness of the abdominal wall, as it is certainly better to have one incision in the aponeurosis than two.

I have frequently removed the appendix in the course of a herniotomy. For some time past I have made it a practice to explore the abdominal cavity by passing my hand and arm in through the hernial incision in cases where disease of internal organs was suspected. Sufficient room to accomplish this is obtained by separating the internal oblique and the transversalis muscles from Poupart's ligament. When the patient is suffering with chronic appendicitis and also has a hernia, I prefer to make a single incision, that for the hernia, to deal with both conditions.

CHAPTER II.

OPERATIONS FOR INGUINAL HERNIA.

(Continued.)

BUTLER'S OPERATION.

C. A. Butler has devised a modification of the Halsted operation. A skin incision is made parallel to Poupart's ligament and three-fourths of an inch internal to it, extending from a point slightly beyond the internal abdominal ring to the spine of the pubes. The subcutaneous tissues are divided in their turn the full length of the skin incision. The external oblique is first incised parallel to the direction of its own fibers, then the internal oblique and transversalis are cut, and finally the transversalis fascia having been divided, the spermatic canal is fully exposed from the internal to the external abdominal ring, thus bringing into view the cord. The vas deferens is isolated and if there is any tendency to enlargement of its accompanying veins all but two or three are ligated, above and below, and dissected out.

The subcutaneous incision is extended five-eighths of an inch or more beyond the internal ring, in order to release the constriction and to get firm, fresh tissue from which to build the new exit for the cord. Following this the sac is opened, its contents carefully examined and replaced within the abdomen.

A ligature of catgut is now passed around the neck of the sac close to the internal ring and the sac is cut away. The ends of the ligature which have been left long are threaded separately through long curved needles, passed eye-end first through the abdominal opening alongside of the stump of the sac and brought out a quarter of an inch apart through the internal oblique muscle at a point one and one-half inches internal to the upper angle of the incision, where gentle traction is made to draw the stump of the sac away from the field of operation, when, by tying the ligature, the stump is held in a permanently displaced position. Any cicatricial mass or tissue of questionable vitality is dissected away from about the old internal abdominal ring. Each muscular layer is sutured separately, allowing the edges to overlap as much as the tension will allow, until the external oblique is reached.

Instead of suturing the aponeurosis of the external oblique in a direct line, as in case of the other layers, a strip one-half inch wide and one and one-half inches long is cut from the internal border of the external oblique at a point directly opposite the site of the new ring, leaving the upper end of the strip fast and passing the loose end under the cord and suturing it to the superior surface of Poupart's ligament. This gives a firm ring with the fibers running crosswise to the direction of greatest

strain. The remainder of the aponeurosis is sutured below this loop in the same manner as the underlying structures, using silk or fine silver wire. Butler says that this portion of the method was employed by the late W. V. Morgan, of Indianapolis, for two years prior to his death and since that time by himself, together in more than fifty cases, with uniformly good results.

The hernia now having been reduced, the stump of sac displaced away from the operative field, the cord located on its new bed and the hernial opening obliterated, all that remains to be done is to suture the skin with kangaroo tendon and to apply a dry dressing.

TREVES' OPERATION.

Treves performs an operation which is a modification of Macewen's. The sac is twisted on itself and a part of it is cut away and passed beneath the conjoined tendon. It is brought out through an opening made near the median line, and is fixed by sutures.

BISHOP'S OPERATION.

In selected cases Bishop invaginates the sac and turns it into the abdominal cavity inside out, fixing it at the internal ring so as to form a boss.

SMITH'S OPERATION.

A. C. Smith employs the following method for the radical cure of congenital inguinal hernia: After forming a tunic for the testis out of the lower end of the sac, the remainder of the sac, except the strip which lies immediately on the vas and its vessels and nerves, is trimmed away close to the abdominal cavity. The simple wound of the peritoneum is closed with a continuous suture, one extremity ending at the cord. The transversalis fascia is sutured either with the peritoneum or separately, and the operation is completed according to the Bassini method. The strip which is left attached to the cord, consisting of peritoneal membrane, does not interfere with the closure of the openings in the sac.

WHITE'S OPERATION.

J. W. White, believing that some of the failures following Bassini's operation might be accounted for on the ground that union failed to occur between two muscles or the edges of muscular tissue unless the edges are freshened, suggested cutting out an inverted V-shaped piece of tissue in the external oblique muscle, which makes this muscle re-enforce the weak place in the abdominal wall at the internal oblique muscle and Poupart's ligament. He suggested a variety of methods to be used to close the hernial openings with muscular tissue.

In cases in which the muscular walls have been stretched and are very lax he suggests raising the edge of the internal oblique and exposing the outer edge of the transversalis. An inverted V-shaped piece of this muscle is excised, making a round opening for the cord to pass through; a

piece is also cut out of the transversalis. The cut edges are united with sterile catgut. This will make tense the lower edge of the transversalis muscle, drawing it down and closing the opening of the internal wound with muscular tissue. The lower edge of the internal oblique is replaced and the cord raised; the sutures are then inserted into the internal oblique and Poupart's ligament, as in Bassini's operation, thus making a combined operation.

DAVIS' OPERATION.

G. G. Davis (*Annals of Surgery*, January, 1900) presented a modification of the operation usually done for the cure of a direct inguinal hernia. In cases of oblique hernia the cremaster fibers are sometimes quite abundant, and may be utilized to close the canal, but in direct hernia these fibers are apt to be too scanty to be of any service. When the hernia is an old one, he divides the sac transversely and overlaps these two parts, suturing the apex of the lower flap to the base of the upper, and then bringing down the upper flap and suturing it in place, as is done in the Mayo operation for umbilical hernia, but without dissecting off the peritoneum, which is firmly blended with the other tissues and adds considerably to the strength of the flap; whereas alone it is too weak to be of much service. When the peritoneum is not adherent to the conjoined tendon and intercolumnar fascia in front, but has a layer of fat between, the fat may be scraped away and the two laid together and treated as a single layer and overlapped.

Davis believes that the overlapping plan has been found to work satisfactorily in cases of oblique inguinal hernia and umbilical hernia and that it also will be found of value in certain cases of direct inguinal hernia.

DENTU'S OPERATION.

Dentu's method is very similar to Bassini's. The primary incision is made exactly the same way. The aponeurosis of the external oblique is carefully exposed, but not divided. The sac is separated from the cord and other attachments as high up as the internal ring. A small opening is then made in the aponeurosis at one side of the internal ring, and through this is passed a long forcep which grasps the fundus of the sac and draws the latter through the opening. The neck of the sac is then ligated and returned to the abdomen and included in the mattress sutures which close the opening in the aponeurosis. The redundant anterior wall of the canal is folded on itself parallel to its long axis and secured in this position by mattress sutures.

KENNEDY'S OPERATION.

In Kennedy's operation the sac is dealt with by Kocher's latest method. It is invaginated into the abdomen and brought out through the abdominal wall. The ligature is then cut off and the internal oblique and transversalis are stitched to the deep aspect of Poupart's ligament, but without cutting the external oblique tendon. The cord is not transplanted. Among fifty-

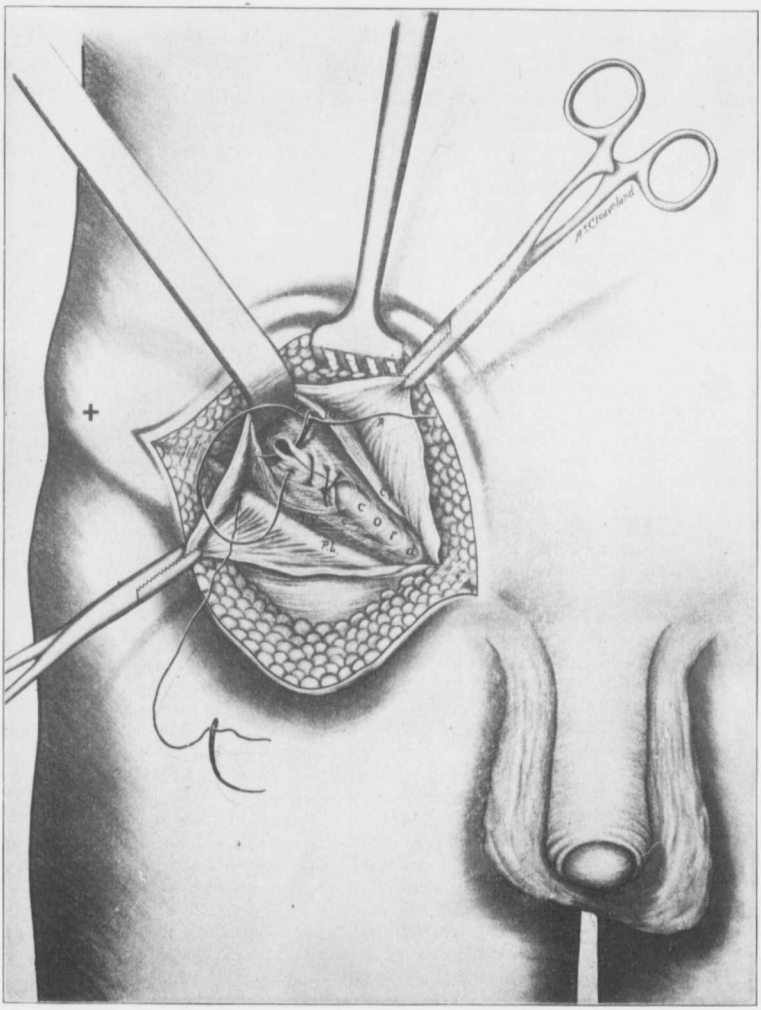

PLATE XLVI.

Ferguson's Operation for Inguinal Hernia.

A. Aponeurosis of external oblique. P. L. Poupart's ligament. I. O. Internal oblique. T. F. Transversalis fascia. C. Cremaster muscle.

four patients operated on by Kennedy according to this method there was only one case of relapse.

OWEN'S OPERATION.

The operation performed by Owen to cure inguinal hernia occurring in boys is a good deal like that of Mitchell-Banks, except that Owen passes the sutures deeply through Poupart's ligament, and the muscular inner wall of the inguinal canal, so as to keep them in permanent contact. The stitches cause the deposit of a large amount of plastic exudation, which in the course of time is replaced by fibrous tissue which makes a splendid barrier.

No doubt Owen, whose experience has been very extensive, is aware of the fact that almost any operative procedure will cure a hernia occurring in boys, provided the muscular development of the patient is normal.

BARNHILL'S OPERATION.

J. U. Barnhill has devised an improvement of the Bassini operation, which, in my opinion, is as irrational in principle as is the operation which it is intended to modify. In Barnhill's operation the skin and superficial fascia are divided from the spine of the pubis to slightly beyond the internal abdominal ring. The external oblique aponeurosis is divided to about the same point, leaving the lower flap of fairly good width. The sac is then carefully separated from the cord, opened to free it of intestine, transfixed, ligated high up, and excised, when it will retract through the internal ring. If there are varicose veins in the spermatic cord the largest are ligated and excised. The cord being held up out of the way, the transversalis fascia and internal oblique, including the conjoined tendon, are then stitched to the shelving portion of Poupart's ligament, two stitches being placed in the internal oblique muscle above the opening for the passage of the cord to gather up the muscle and fascia, with a view of obliterating the inguinal fossa, care being taken to bring the cord well down to the lower border of the internal oblique, thus giving it considerable obliquity in passing beneath these muscles. Mattress sutures are then passed through the lower flap close to Poupart's ligament—that is, in the lower portion of the outer flap—catching the margin of the internal oblique and its fascia and the lower margin of the upper or internal flap. Three such mattress sutures are placed in the upper part of the incision over the muscle and cord, the other four being passed beneath the cord.

A small incision, sufficient to make an opening large enough for the passage of the cord, is made in each flap; in the upper one at a point an half inch below that at which the cord passes out through the internal oblique, and the one in the lower flap at the junction of its lower and middle third. The mattress sutures are then tied and the cord passed through the opening in the upper flap. The lower flap is then carried upward over the cord and stitched to the upper flap above the cord, except the lower third, which is passed beneath the cord and stitched in like man-

ner. Both layers of the superficial fascia are then approximated and the wound closed with a subcuticular silkworm-gut suture.

DEAVER'S OPERATION.

John B. Deaver, of Philadelphia, prefers to use a combination of the Macewen and Bassini operations. The anterior wall of the inguinal canal, excepting the lower fibers of the internal oblique muscle, is divided, the sac freed, and replaced at the internal ring after the manner of the Macewen operation. The canal is then closed as in the Bassini operation.

CHAPTER III.

OPERATIONS FOR INGUINAL HERNIA.
(Continued.)

ANDREWS' IMBRICATION METHOD.

E. Wyllys Andrews, of Chicago, advocates overlapping the aponeurosis of the external oblique muscle in the case of large hernias where there is a marked anatomical defect, and in cases of long-standing, where the aponeurosis is redundant and where it is better to imbricate than to remove or plicate it. The internal lip of the cut aponeurosis is sutured to Poupart's ligament under the cord, and the lower flap of the aponeurosis is brought up over the cord and fastened to the anterior surface of the aponeurosis along the inner border of the cord. Andrews overlaps these structures (Fig. 38), no matter whether the Bassini operation or that of the author is performed. The overlapping can be done in front of or behind the cord, or the cord may be placed between the flaps. The imbrication gives broad surfaces for union and by this means an opening of any size can be covered with a stout fibrous layer.

While I fully agree with Andrews that imbrication of the aponeurosis of the external oblique muscle is desirable to obtain additional strength in the inguinal region, and I have always practised it in suitable cases ever since I saw Macewen do it in 1889, still in a rational operation sight must not be lost of (a) the slack of the transversalis fascia at the internal ring and its correction; (b) the arched up and often deficient internal oblique muscle and its restoration to its normal position; (c) the normal position of the cord and that its removal from its bed invites a relapse of the hernia; and (d) we must not leave a weakened conjoined tendon unprotected. It is not indicated to overlap the flaps of the aponeurosis when undue tension is required to hold them in the imbricated position.

NOBLE'S OVERLAPPING OPERATION.

C. P. Noble has for some time made use of an operation in which the peritoneum is first closed with a continuous suture of fine cumol catgut. The fat is then dissected from the upper surface of the aponeurosis of the transversus muscle on the left side of the wound over one-third to one-half inch. The aponeurosis on the right side of the wound is then separated for an equal distance from the rectus muscle. The muscle and fascia are then sutured by means of a medium weight chromicized catgut suture.

The suturing is begun at the lower angle of the wound on the left side, the suture being passed from above downward through the aponeurosis and rectus muscle. Then the separated bundles of the rectus muscle are united with a continuous suture until the upper angle of the wound

is reached, when the suture is passed from below upward through the aponeurosis on the left side of the wound. The suture is then passed from below upward through the aponeurosis on the right side of the wound and an additional suture is taken above this point to fix the suture and to take the strain off that part which has brought the muscle into apposition. The aponeurosis is then closed from above downward by catching the aponeurosis over the left side of the wound after the manner of the Lembert intestinal suture, and then passing the needle from below upward through the aponeurosis on the right side of the wound. When this suture is drawn taut, it slides the aponeurosis of the right side of the wound on the aponeurosis of the left side. The process is repeated until the upper angle is reached, when the two ends of the suture are tied.

In long wounds two or more mattress sutures are placed to take the tension off the lines of continuous suture. The fat is closed with a continuous suture of fine cumol catgut. This is also used to close the skin by means of the intra-cuticular method. In 1898 Noble abandoned silkworm gut sutures, and the continuous chromicized catgut suture for the rectus muscle and for the aponeurosis was substituted. This method is employed for celiotomies, herniotomies and the Alexander operation.

FREEMAN'S OPERATION.

The operation employed by L. Freeman is really a new method of suturing. Before the operation is begun two or three needles are threaded with long loops of silkworm gut or silver wire. Two pieces of stiff silver wire are taken, long enough to reach the entire length of the inguinal canal. The internal ring is exposed; the sac is ligated and cut off, and the cord is held out of the way. One of the silkworm loops is passed from without inward through the muscle tissue on the umbilical side of the ring, well back from the margin, and tolerably close to the point of exit of the cord. The loop is then carried through Poupart's ligament from within outward. Another loop is inserted near the pubic end of the opening.

One of the pieces of prepared wire is run through the loops, which are pulled tight enough to hold it in place. The other wire is laid along Poupart's ligament between the free ends of the loops which are tied firmly over it. The wires are thus approximated. To facilitate the removal of the wires they are bent upward at their pubic extremities so as to protrude through the external incision. The cord is dropped in place over the line of union and the aponeurosis of the external oblique muscle is united above it, the upturned ends of the wires passing through the external ring. This aponeurosis can be sutured either with removable suture or with catgut because this structure is not subjected to tension.

In uniting the skin the free ends of the loops and the ends of the wires are brought out through the incision between the stitches. In from ten days to two weeks the wires are removed. This frees the loops, which are likewise extracted.

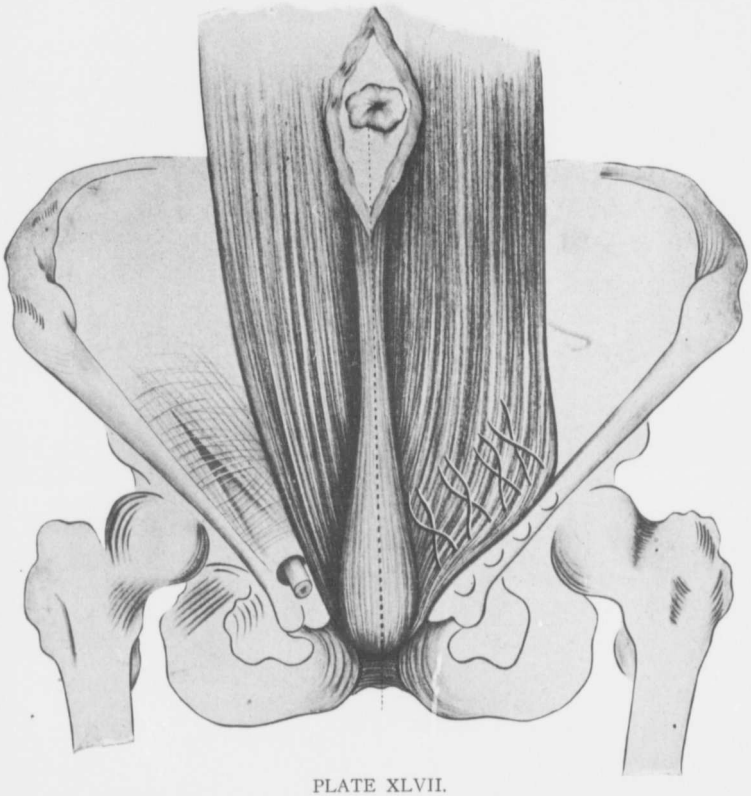

PLATE XLVII.

Diagram of the position of the transplanted rectus muscle, demonstrating the slight change in the direction of its fibers.—Bloodgood's operation. (*Johns Hopkins Hospital Report. Vol. VII.*)

M'ARTHUR'S AUTOPLASTIC SUTURE.

L. L. McArthur, of Chicago, takes his suture material from the aponeurosis of the external oblique muscle. He claims that the grafted suture remains as fibrous tissue, or if it dies and becomes absorbed after a primary union has taken place, it accomplishes all that is accomplished by foreign suture material; whereas, if the suture lives, as his experiments seemed to prove was the case, it remains to offer a permanent resistance to future stretching (Figs. 39 and 40).

The skin and fat having been cut by the usual incision exposing the external ring, the latter is prolonged upward in the usual manner, but to its commencing muscular insertion. Special care is taken to parallel the tendinous fibers. This divides the aponeurosis into an external and internal flap, each of which can be readily separated from its contact with the internal oblique.

The sac having been treated as the operator deems best, a bundle of those white fibers which enter into the formation of the internal pillar of the ring is then split off, from below upward, from the edge of the internal flap of the aponeurosis of the external oblique, quite up to its termination in the muscle belly. Above it is cut loose, but left attached to the pubic spine below. This strip should vary in width from one-eighth to three-sixteenths of an inch, according to the development of the tendon. An identically similar strip, beginning in the external pillar of the ring, is taken from the outer flap of the external oblique. At this stage the suturing is to be done.

The operation is completed, according to the choice of the operator, by the Bassini, an Andrews imbrication, or Girard method, using these strips as suture material for a running stitch. As a convenient means of handling, and for the purpose of avoiding infecting the graft suture, a needle threaded with No. 3 silk is tied by a single knot to its free end, and by it the tendon graft is drawn through the tissues to be united. Using the graft ending in the internal pillar for the first or deep suture, the surgeon draws the internal oblique and transversalis down to the inner aspect of Poupart's ligament, as shown in the drawing, suiting his convictions as to raising or not raising the cord. If he raises the cord (Andrews), then no opening is left below for an external ring; if the cord is not raised (Ferguson, Bassini), then the first stitch determines the fit of the external ring around it.

The edges of the external oblique are then sutured with a running stitch, using the graft made from an external pillar of the ring when a Bassini is being done; to the surface of the external oblique when an Andrews or Girard is done. The ends of the suture strips can be fixed by a simple knot in it, or by one or two stitches through and back, as a tailor fixes his thread, or by a fine catgut stitch with the graft end caught in its knot.

The deep suture penetrates the external oblique muscle for final fixation after the new internal ring has been made. The skin and fat are approxi-

mated according to the preference of the surgeon. McArthur emphasizes the importance of liberating these strips of aponeurosis from below upward, and not from above downward, because the fibers often curve outward around the external ring, when followed in the latter manner.

HARRIS' WIRE SUTURE.

M. L. Harris, of Chicago, claims that wire suture can be employed advantageously in all hernia operations (Fig. 41). The operation is performed in the usual manner up to the stage of the ablation of the sac. Harris claims that the advantages of the wire used by him, aluminum bronze, Nos. 26 and 27, are its greater tensile strength, so that a smaller wire can be used, and the fact that it does not kink so readily. The wire can be easily, quickly and certainly sterilized by simply placing it in boiling water with the instruments. In closing a median incision through the abdominal wall, three wire sutures are used, one closing the peritoneum, one in the sheath of the rectus muscle, and one in the skin.

The sutures are introduced in the following manner: A No. 27 aluminum bronze wire is threaded directly in a nearly full-curved round needle with a specially constructed eye for carrying wire so that it will not slip in the eye. The needle is made to enter the skin in the midline, 1 to 3 cm. from the angle of the incision, and penetrates obliquely all the tissues down to the peritoneum, where it should appear at the angle of the peritoneal incision. The peritoneum is now taken up with the needle, parallel with and quite near to its edge, first on one side and then on the other, constantly in an advancing manner until the entire length of the incision has been traversed. The grasp of the needle should not be more than a centimeter in length, and the point of entrance of one grasp should be opposite the point of exit of the last grasp. The suture is then brought obliquely to the surface about the same distance from the cutaneous angle as at its point of entrance.

The second suture, wire, No. 26, enters in the midline, but a little nearer the angle of the incision. It penetrates as far as the sheath of the rectus muscle, where the edges of this fascia are taken up longitudinally in exactly the same manner as has just been described for the peritoneum. No sutures are applied to the recti muscles. At no point in the midline do the recti muscles lie in contact with one another; hence, in closing a median incision, it is unnecessary to suture together the recti muscles with the expectation of obtaining union between them. The dense, thick, conjoined fascia of the linea alba in the upper part of the abdomen or the firm anterior layer of the muscle sheath below Douglas' fold is the all-important layer to be sutured. This is the layer in which the most perfect apposition, edge to edge, should be secured. The third suture is the usual subcutaneous or subcuticular suture. The wire enters and leaves at the angles of the incision, running along in the corium, in and out, in the same manner as has been described for the other two. It does not appear on the skin at any point, except where it enters and leaves. After

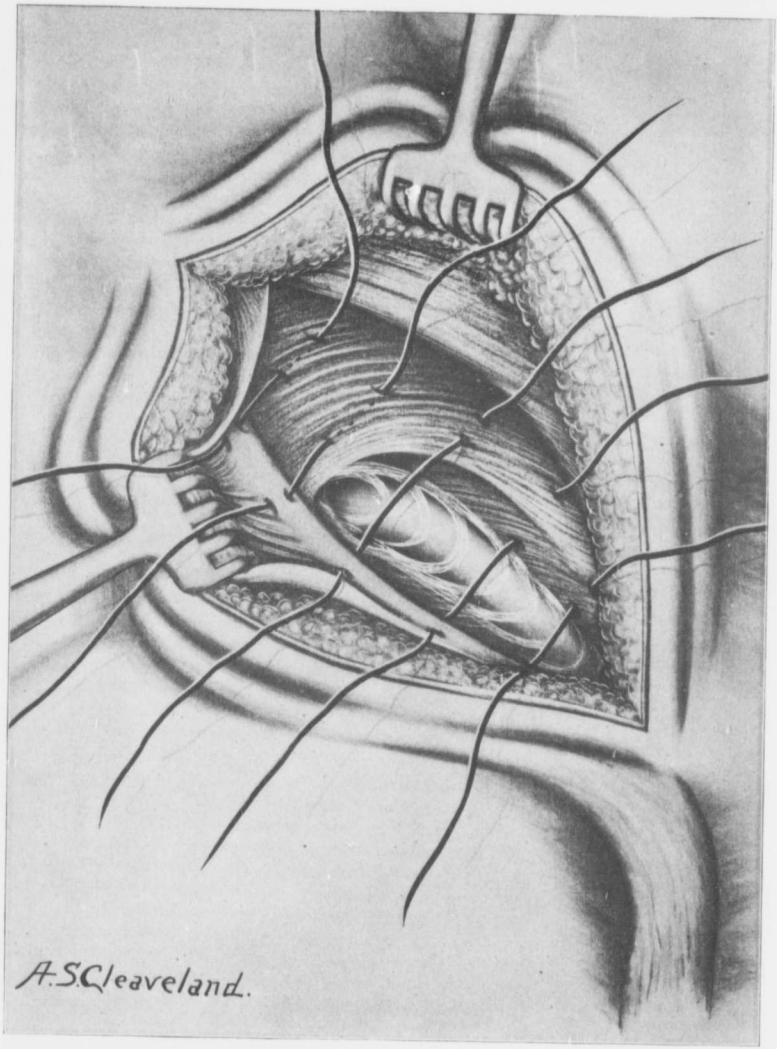

PLATE XLVIII.

Ferguson's Operation for Inguinal Hernia.
(*Ochsner's Clinical Surgery.*)

the wires are introduced they are drawn back and forth until they are perfectly straight and move easily through the tissues.

The wound may now be dressed in any manner one chooses. The method Harris uses is to seal the line of union with silver foil, after the method of Halsted. On this he places a compress of a few layers of plain sterile gauze, over which are folded the ends of the wires, which should be left long. On these is placed another similar compress, followed by the usual dressing of plain sterile gauze and cotton. The wires are usually allowed to remain two weeks. To remove the wires, they should be drawn back and forth gently until loosened in the tissue, then one at a time cut close to the skin and withdrawn. They are easily removed with scarcely any pain. Care should be taken not to break the wires by pulling suddenly before loosening them. In closing the muscle-splitting incision in interval operations for appendicitis, one wire parallels the fibers of the internal oblique and transversalis, entering and leaving the skin some distance from the cutaneous incision, and crossing it almost at right angles. Another wire parallels the fibers of the external oblique, and a third forms the subcuticular suture.

In cases of inguinal hernia the suture is applied in the following manner:

The needle enters the skin from one to two centimeters from the inner angle of the incision, passing directly down to and taking up a "bite" of the beginning of the inner edge of Poupart's ligament. A "bite" about one centimeter in length is then taken directly opposite, including the external oblique and the internal oblique and transversalis, or so-called conjoined tendon. Then a "bite" in Poupart's ligament, passing back and forth until an opening only large enough to permit the passage of the cord remains at the outer angle. Passing the wire beneath the cord, it is brought out through the external oblique and skin about one or two centimeters from the outer angle of the incision.

The wire should be pulled back and forth until it is perfectly straight and moves easily in the tissues. This wire is very easily introduced by paying a little attention to a few points. Place a snap forceps on the free end of the wire to keep it taut. Draw each stitch taut at once. Enter at a point directly opposite the point of the last stitch. Take each "bite" parallel with the edges to be brought together. Do not make an over-and-over stitch, as it will not pull out. Do not allow the wire to kink.

After the wire is in, the cord is laid along its bed and the lower flap of the aponeurosis of the external oblique covered over it and sutured by wire introduced in the same manner as the first (Fig. 41), but passing from the outer to the inner angle of the incision, leaving an opening at the external abdominal ring just large enough to give exit to the cord. The cutaneous edges are now brought together by a third wire on a cutting-needle passed in the corium, a so-called subcuticular suture. The incision is sealed with silver foil, a pad of several thicknesses of gauze placed on the first one, and the whole held in place by a couple of strips of adhesive plaster. The wires are removed at the end of two weeks.

There is one criticism that I wish to make in regard to the manner in which the first wire is used with the cord raised out of its bed, and that is this: The danger of injuring the cord at the upper and also the lower angle of the wound, where the wire hugs it closely. This danger is obviated by not raising the cord out of its bed at all, and insures a radical cure even better than the method of Bassini and its modifications.

REMOVABLE CONTINUOUS SUTURES.

L. Gratschoff employs a method of closing the inguinal canal which he believes offers special advantages. He uses a piece of steel wire about 13 cm. long, terminating in a small perforated ball at each end. Two small hooks to hold the silk thread are soldered to the wire, which is drawn up into the shape of a bow after it has been introduced into the inguinal canal. After the hernia has been taken care of, one end of the wire is introduced through the incision and a stout silk thread is fastened to one of the hooks and passed through the end of the wire bow and then around the internal and then the external pillar, and again around them, until enough stitches have been taken. The needle is then brought out through the skin and the silk is drawn taut and fastened to the other end of the wire bow. Both wire and sutures are removed by the end of the week. He has thus treated 44 patients with gratifying results.

WITHERBEE'S REMOVABLE SUTURE.

O. O. Witherbee inserts a figure-of-eight suture which he claims cannot be adjusted with sufficient tension to stop the circulation if properly inserted. It has the additional advantage of being removable, and consequently it does not overburden the power of absorption nor does it tend to cause sloughing. To insure proper fixation and to relieve the skin from undue pressure, a U-shaped plate is employed to the arms of which are attached the sutures after they emerge from the skin. Witherbee claims that four silkworm gut sutures thus introduced will effectually approximate both layers of Poupart's ligament with the external and internal oblique, the transversalis and the rectus muscles, if necessary, maintaining their approximation for an indefinite period, or, at least, until firm union has taken place. Witherbee also advises leaving the cord alone and sparing the tissues all unnecessary manipulation.

REMOVABLE CONTINUOUS SUTURES.

Charles H. Davison, of Chicago, employs a suture for the closure of all laparotomy wounds that are not drained, a removable, continuous, longitudinal, silkworm gut suture, which approximates each layer. Although the suture was not devised especially for the closure of hernial wounds, yet it may be used for this purpose (Fig. 42). The suture in the fascia of the abdominal wall is fastened by terminal bowknots on the upper surface of the fascia, and the free ends of the suture are allowed to protrude from the wound. The bowknots are untied by traction on the exposed ends, and the suture removed at the completion of the process of healing.

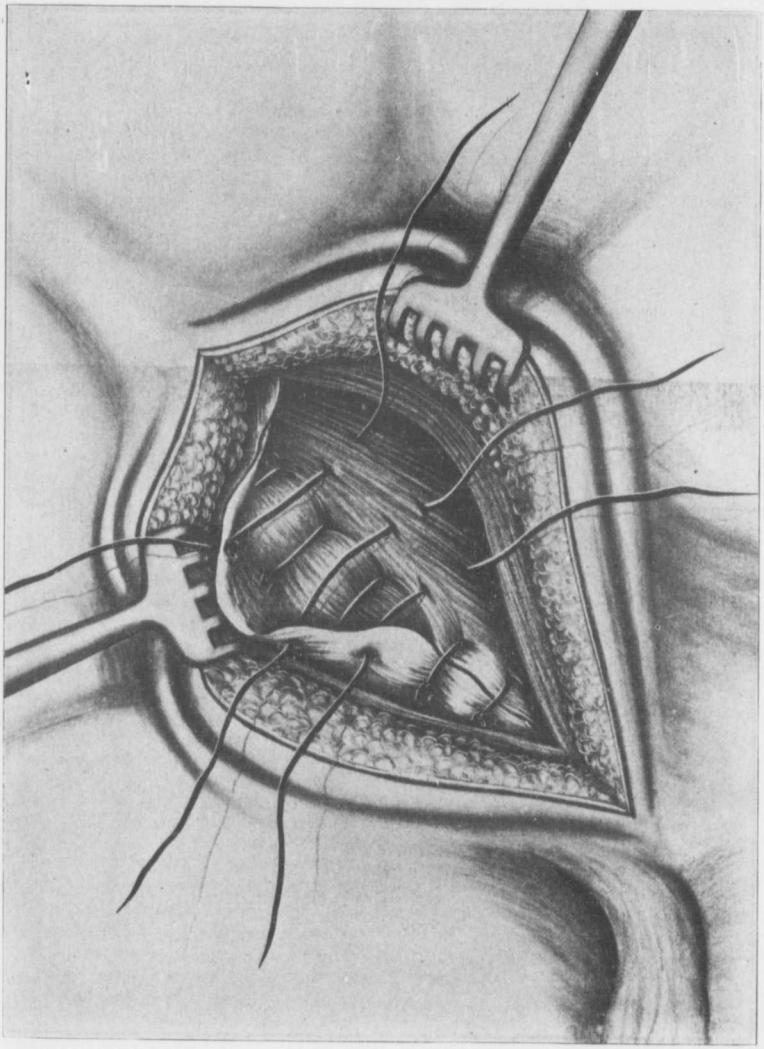

PLATE XLIX.

Ferguson's Operation for **Inguinal Hernia.**
(*Ochsner's Clinical Surgery.*)

The technic of the suture of the wound in a median laparotomy is as follows: All hemorrhage in the wound in the abdominal wall is stopped by sponge pressure, by forcipressure or by torsion; no catgut whatever is used. The edges of the peritoneum are caught with forceps, and are held up, away from the intestine, by an assistant, and the peritoneum is approximated by a continuous ringbone suture. The suture is lightly shirred to take up all the slack, and the ends are left hanging out of the angles of the wound, temporarily held out of the way by snap forceps. In a median laparotomy the linea alba is the strong layer of the abdominal wall, and if this layer be fastened securely there can be no spreading of the wound. The edges must be accurately approximated. The fat must be cleaned away, so that there shall be no interposition of tissue between the edges of the fascia, as that would weaken the line of union and predispose to ventral hernia. For this suture a perfect strand of silkworm gut, soft and pliable from recent boiling, is selected. A small reverse bowknot is loosely tied 10 or 12 cm. from the end of the strand. The edges of the fascia are caught with forceps and held by an assistant. The suture is introduced in a firm place in the fascia back from the angle of the wound and drawn up to the knot, and the fascia is approximated by a continuous herring-bone suture. The needle perforations in the fascia are placed about ½ cm. from the edge and 1 cm. apart.

At the last stitch the suture is shirred up tightly, grasped by a smooth (serrations filed off) dissecting forceps at its exit from the fascia, held by an assistant, and another reverse bowknot tied below the point of the forceps. In tying the knot around the forceps the strand must pass under the forceps, and the loop must pass up from below, or no knot will result. The greatest care must be used not to crush or fray the silkworm gut with the forceps at the knot, for such a defect might cause the strand to break at that point at the time of removal. As the bowknot is intended only to form a body to obstruct the passage of the sutures through the fascia, it should be tied loosely, to make a larger obstruction, and to facilitate its untying at the time of removal. The ends of the tied suture must not be held out of the way by snap forceps, as their weight might untie the knots, The linea alba, being securely fastened, takes all the tension from the other layers, and the unfastened sutures in the other layers do not tend to pull loose.

The skin is closed by the Halsted subcutaneous stitch. If the patient is very fat, an extra running suture can be placed to approximate the fat and to avoid a dead space. If the wound is too long to close with a single silkworm gut strand, it is closed in sections, by repeating each suture. Lateral celiotomies are closed by suturing each layer of fascia with a tied strand of silkworm gut, not allowing muscle or fat to be included in the suture.

SINGLE TIER SUTURE.

J. R. Eastman (*Annals of Surgery*, Jan., 1906) describes a method for closing all the layers with a single tier of easily removable non-buried

sutures which coapt all the layers either according to Bassini's method or the method devised by the writer. In six cases operated according to this method Eastman used a heavy Pagenstecher celloidin linen. The incision is carried down to the aponeurosis of the internal oblique muscle, so as to expose both the external and internal rings. The overlying superficial tissues should be wiped with gauze, so that Poupart's ligament may be exposed freely. After reduction of its contents the sac should be twisted on itself as advocated by C. H. Mayo. The suture, bearing a needle on each end, is first passed through Poupart's ligament from without inward, one inch from its free margin. It is then passed through the outer border of the internal oblique and transversalis muscles and brought back through the ligament about one-third of an inch nearer its margin than the first point of passage. The needle is then made to overlap the free margin of Poupart's ligament and the aponeurosis of the external oblique by carrying the linen through in the form of a simple running mattress suture.

The needle is next passed through the superficial fascia, fat and skin emerging about one-eighth of an inch from the skin wound margin on the side opposite Poupart's ligament. The needle on the tail of the suture is brought up through the subcutaneous fat and skin on the side of the ligament when traction is made on the two ends of the suture. No kinks or curls remain, and the suture is tied as a simple loop which may be drawn out with the slightest traction.

The method is said to be applicable in practically every case of radical operation for inguinal hernia in children. In small hernias in adults the simple tier method is applicable, and in very large hernias, with a wide separation of the conjoined tendon and Poupart's ligament, this suture is not efficient.

SILVER WIRE IN INGUINAL CANAL.

About seven years ago A. M. Phelps, of New York, conceived the idea of introducing silver wire into the inguinal canal in cases where the hernia was unusually large. He used a very fine wire that had been sterilized carefully, then immersed in carbolic acid and passed through the flame of an alcohol lamp just before using. He claimed that from twenty-five to a hundred feet of wire could be inserted without causing any disturbance, and in one case he introduced as much as three hundred feet of the wire. It was not necessary to remove the wire subsequently.

ELECTRICITY IN HERNIA.

In August, 1899, H. Lane reported his results obtained from the use of electricity for the cure of hernia. He introduced a needle into the inguinal canal and passed a current of electricity of the strength of twenty milliamperes for twenty minutes. A truss was then applied, which the patient was instructed to wear for two months, at the end of which time a cure is effected.

BICYCLING IN HERNIA.

Some years ago Championniere stated that bicycling was of benefit in the treatment of hernia because it tended to strengthen the abdominal muscles and to improve the general health. The use of the bicycle should be begun soon after the patient recovers from the operation.

CHAPTER IV.

THE TYPIC OR ANATOMIC (FERGUSON) OPERATION.

This operation was devised by the author January, 1898, presented to the profession in May, 1900, at a meeting of the American Medical Association, at Columbus, Ohio, and published in the *Journal of the Association*, July 1st, of the same year.

On page 644, "*Handbuch der praktischen Chirurgie*," by Bergmann, Bruns and Mikulicz, III B. I. T., appears a cut illustrating what is called Girard's operation, in which the internal oblique muscle is sutured to Pourpart's ligament. In this particular, and in that the spermatic cord is not dislodged, the operation resembles the typic operation of the writer. The Girard operation was first published in the October, 1900, number of the *Archives Provinciale de Chirurgie*. It would not be necessary to refer to what has been erroneously called Girard's operation, were it not that errors of omission and commission on the part of certain American surgeons have recently manifested themselves at discussions on the subject of hernia.

C. Hoffman (*Centralblatt f. Chirurgie*, October, 1903) describes an operation which embodies the principles governing the typic operation. In it the sac, the transversalis fascia, the internal oblique muscle, and the aponeurosis of the external oblique, are dealt with much the same as is done by the writer, only differing in minor matters of technic. A. J. Ochsner (*Centralblatt f. Chirurgie*, April 2, 1904) very kindly pointed out to the German profession that this is Ferguson's operation, published four years previous to Hoffman's article, which was no doubt inadvertently overlooked by him.

While the anatomic principles on which the typic operation is founded are as unassailable and as fixed as is the anatomy of the part itself, the technic, however, may vary materially according to the conditions encountered. Since the presentation of this operation to the profession, the writer has not found it necessary to make any material improvements or modifications. A few new aids to its performance will be offered in the text, and the number of illustrations for its demonstration is lessened.

The aim of the operative procedure is to imitate nature by fixing the various structures in their proper relationship, one to the other. Even when the anatomy is very defective (congenital or acquired), the surgeon who possesses a practical knowledge of the normal parts in the inguinal region, and who is an experienced operator, should have little difficulty in differentiating one structure from another, and executing a rational procedure which takes into consideration the function of each anatomic entity in this area.

It is admitted that over six per cent. of the recurrences in Bassini's operation occur at the upper angle of the wound. Why? Because the cord is

transplanted there and the internal ring does not receive full protection. This in itself is a sufficient reason for discarding that operation, especially when another (the writer's) can be selected, which is easier of execution, involves less manipulation of the structures, is anatomically and physiologically perfect, and, as far as its author knows, is without recurrences. Halsted says: "It was well worthy of note that all of the cases treated in this manner (cord undisturbed) remained cured." The writer, prior to 1898, observed that recurrences at the upper end of the wound were frequent, and in 1898 discovered a deficient attachment at Poupart's ligament of the internal oblique muscle. These observations led to the evolution of his typic operation.

At the writer's request, his assistant, who was also teaching surgical anatomy, made fifty dissections and some experiments on the cadaver. These supported the author's claim regarding the congenital deficient origin of the internal oblique muscle at Poupart's ligament. Inasmuch as every operation for the cure of hernia is a dissection on the living, accurate measurements made while operating will verify the above, which has been done by myself in almost every case for the last eight years.

Before proceeding with the description of the Ferguson operation, let us consider briefly some points in the etiology of hernia that are essential to a correct understanding of this operation.

Let the passive intra-abdominal pressure predisposing to rupture be what it may—elongated mesentery, large omentum, or what not—we cannot hope to lessen it to any great extent; but we can strengthen the abdominal wall at the seat of rupture in such a manner as not only to withstand the passive, but also resist the active pressure within the abdomen while straining, lifting etc.

The etiology of inguinal hernia is still a problem. While it is correct to say that the congenital oblique inguinal hernia is usually due to the nonclosure of the funicular process at the internal ring, it does not explain why this process remains patulous in some men and why it closes in others. When we consider the physiologic process by which the testicle descends from the abdominal cavity to the scrotum, it is not surprising that oblique inguinal hernia is five times more common in the male than in the female, and that over three-fourths of all abdominal hernias are of this kind. Imperfect closure of the internal ring is common. It is occasionally open, and no hernia protrudes; then it must be that the bowels and omentum are well suspended, and do not press unduly on the abdominal wall or valvular arrangement of the structures at the internal ring and along the canal, which is normal, and Cooper's fascia is strong and firm. In a perfect anatomic subject the internal ring is so smoothly closed over that an infundibular process of the peritoneum is very insignificant, or not at all perceptible; the valve formation of the internal ring and canal absolutely prevents a giving way at the internal ring, for the more the intra-abdominal pressure increases, the tighter the valve closes; provided, however, that a normal muscular and aponeurotic support is protecting it external to the transversalis fascia.

The two main structures that stand on guard to protect the internal

ring are the internal oblique muscle and the aponeurosis of the external oblique, the former being the active agent ready to contract instantly, the moment the ring is subjected to a sudden increase of intra-abdominal pressure, as in running, jumping, lifting, etc. The fact is that in oblique hernia the internal ring receives no substantial protection from the internal oblique muscle, for the reason that it is not attached to the internal aspect of Poupart's ligament sufficiently low down, and as it passes downward and inward from its deficient origin, it passes above the center of the internal ring; or the lower border of the muscle which forms the cremaster is not held down sufficiently to prevent a protrusion of the abdominal contents.

Indeed, the origin of this muscle may be entirely deficient at Poupart's ligament, and this affords an opportunity for a sausage-shaped protrusion of a hernial nature in the groin. Is it not probable that this congenital defect of the internal oblique muscle is accountable for the non-closure of the internal ring? If the internal ring is protected during the descent of the testicle, one would suppose that the muscular tonicity would soon close the course the testicle had taken behind the internal oblique muscle.

The key to the radical cure of oblique inguinal hernia is to suture the internal oblique muscle and its tendon to the inner aspect of Poupart's ligament, as low down as possible, without undue tension, after having ablated the sac and strengthened the internal ring with a few stitches above the root of the cord. Any operation for the cure of hernia that diverts the cord from its natural course favors return, endangers the testicle and is empirical, and empiricism is the very thing that thinking men through all the centuries have been trying to avoid. If all our work were done on the plan of expediency, the search for the truth in the science of surgery would lose its charm, and the art of imitating nature would lose its beauty.

In the anatomic or typic operation the sac is tied off. Why? To restore the rotundity of the peritoneum. The transversalis fascia is sutured nicely around the root of the cord. Why? In order to obliterate a pathologic infundibuliform process, and to make a new internal ring.

The internal oblique muscle is sutured to Poupart's ligament at least two-thirds the way down, which is the usual attachment found in the female. Why? That a congenital defect may be rectified, and the muscle may be allowed an opportunity to protect the internal ring; and the aponeurosis of the external muscle is then sutured and the skin coapted, for the reason that they may occupy their normal place in this region.

It will be noted that no step is taken without a valid anatomic reason. When the hernia is a direct one, or when the conjoined tendon is deficient or absent, an additional procedure is required, and that is to split the sheath of the rectus muscle, and sew it (rectus muscle) over to Poupart's ligament, across the weak point. If, however, the entire inguinal area is deficient, thinned out, atrophied, or degenerated, the writer has not hesitated to transplant a portion of the sartorius muscle to this region as well.

Operation.—After preparation begin the incision over Poupart's ligament, one and a half inches below the anterior superior spinous process of the ilium; extend it inward and downward in a curved (or straight) man-

ner, circumventing the internal abdominal ring, and terminate it over the conjoined tendon near the pubic bone. Cut carefully backward with a very sharp knife and expose the vessels. Pick them up with forceps before severing them, thus preventing blood-staining of the tissues. Having passed through the skin, two layers of superficial fascia, the fat between them and the superficial epigastric vessels down to the aponeurosis of the external oblique muscle, it will be noticed that it is not necessary to cut the superficial circumflex iliac, nor the superficial pudic vessels. Take a pledget of gauze, and with it turn the flap of skin, subjacent fat and fascia downward and outward over the thigh. This procedure brings into view the aponeurosis of the external oblique muscle, the external abdominal ring, with its pillars and intercolumnar fascia, the hernial sac, if it has descended through the external ring, the external surface of Poupart's ligament, the under surface of the flap covered by the deep layer of superficial fascia, and the superficial vessels.

Next cut through the external abdominal ring and the intercolumnar fascia; separate the longitudinal fibers of the aponeurosis of the external oblique muscle directly over the inguinal canal, beyond the internal ring, over the surface of the internal abdominal oblique muscle. Delicate transverse fibers are encountered and severed. Retract the two flaps of the aponeurosis of the external oblique muscle to each side, thus bringing into view the deep structures, viz.: The contents of the inguinal canal, the whole sac with its adhesions, the spermatic cord, ilio-inguinal nerve, internal abdominal ring usually enlarged, frequently an accumulation of subserous fat, the cremasteric muscle, conjoined tendon, internal oblique muscle, and its deficient origin at Poupart's ligament, transversalis fascia, and the internal surface of Poupart's ligament. (Fig. 43.)

The author considers the congenitally deficient origin (Fig. 43) of the internal oblique and transversalis muscles one of the most frequent and important causes of oblique inguinal hernia. Inspect these structures carefully, and determine whether the operation is to be typic or atypic. When the structures are well-defined and not too much weakened by pressure atrophy, a typical operation can be proceeded with.

At this stage of the operation deal with the sac and its contents: The cord, cremaster muscle, and subserous lipomata.

The sac is always opened (Fig. 44) preferably at its neck, at its junction with the general peritoneum, and then carefully dissected from the cord and internal ring, from above downward, its contents inspected and dealt with, and the sac is ligated high up, or sometimes sutured, or an internal purse-string thrown around it. If the sac is of congenital origin, divide it in two, the distal half to form a tunic for the testicle, and the proximal to be treated as above mentioned.

When omentum is found within the sac and is adherent to it, it is withdrawn, tied *en masse*, cut off, the stump is covered with its own peritoneum, or rolled beneath and within a fold of omentum, and there held by a stitch or two of fine chromic catgut.

The writer has, very many times, employed Downes' electro-thermic-

hemostat clamps for the removal of omentum, and inclines to the belief that they are safer than the ligature. When the omentum is redundant, or hypertrophied, its amputation decreases intra-abdominal pressure and lessens the tendency to a return of the hernia. If the omentum is not adherent it is usually not necessary to remove any portion of it.

When the sac is opened it is frequently found advantageous to place the patient in the Trendelenburg position to prevent protrusion of and injury to the intestines and omentum, and it also aids in the closure of the peritoneum, whether by ligature or suture.

The transplantation of the stump of the sac high up underneath the deep muscles, or twisting it and suturing it at the internal ring, has nothing special to recommend it. It must be remembered that when a new internal ring is made the stump of the sac is buried beneath the transversalis fascia, which must protrude it into the peritoneal cavity, and at its site a convexity is obtained.

The appendix should always be brought out and inspected. If by appearance, or feel, or the history of the case, disease of it is at all suspected, it had better be removed. When the patient is a female, the condition and position of the uterus and ovaries may be palpated, and any surgical intervention that may be deemed necessary can be carried out through an enlarged hernial incision.

When the patient has also given evidence of stomach, gall bladder, intestinal or other surgical intra-abdominal disease, the writer has not hesitated to enlarge the opening, pass in the hand and carefully explore the abdominal organs, with great satisfaction to himself and oftentimes with benefit to the patient. Gallstones, carcinoma of the sigmoid, uterine displacements, fibroids and ovarian cysts have been detected in this manner, and been treated surgically there and then.

In order to admit the hand and forearm through this opening it is necessary to make ample room by severing the attachment at Poupart's ligament, of the internal oblique and transversalis muscles, and extending the opening in the sac upward through the fascia and peritoneum; or when the conjoined tendon is deficient there is an indication to open the sheath of the rectus muscle in order to deal properly with the rupture, then it is preferable to extend the opening in this direction, and on reaching the border of the rectus muscle, open its sheath and extend the opening to the pubic bone; then cut through the sheath of the rectus transversely to the linea alba. The remaining structures, the peritoneum and muscular fibers of the muscle, will stretch, while the transversalis fascia and sparse fibrous covering on the posterior surface of the muscle yield to a little force.

While exploration of the abdomen through the groin is a subject somewhat irrelevant to this subject, still the writer feels that the value of the procedure in connection with hernia patients may, in a measure, justify him in deviating from the subject proper, craving the reader's indulgence.

The cord is not disturbed. The writer has never been satisfied with the raising and transplantation of the cord. In more cases than have been recorded the testicle has come to grief by this unnecessary procedure. Tear-

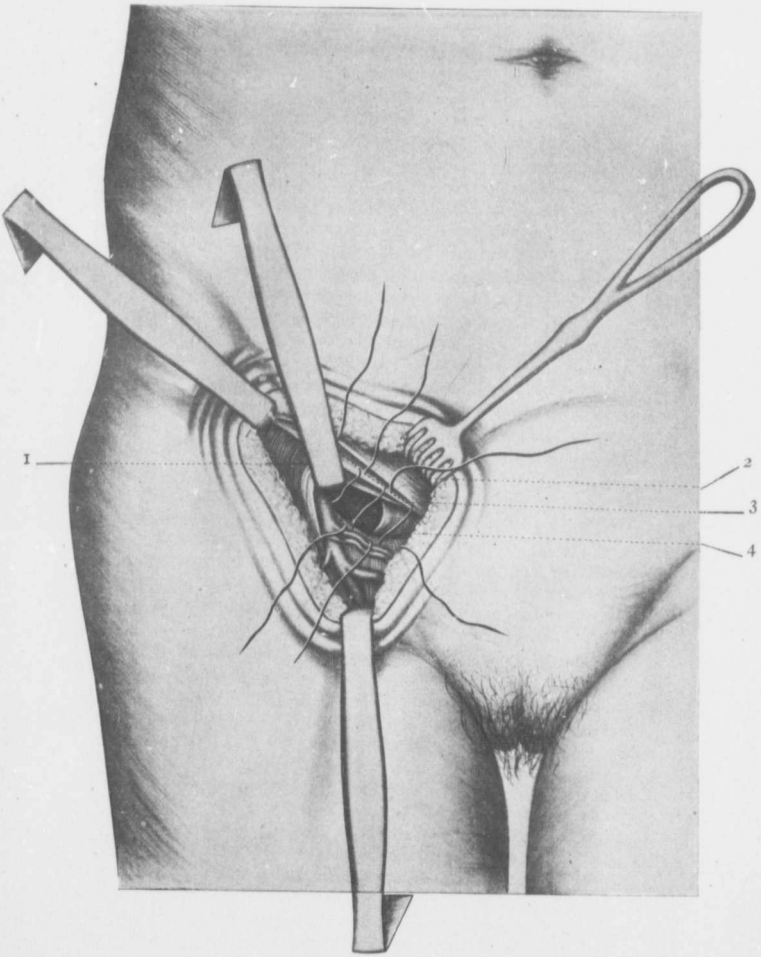

PLATE L.

Ferguson's Operation for Femoral Hernia.

1. Falciform process. 2. External oblique. 3. Poupart's lig. 4. Gimbernat's lig.

ing the cord out of its bed is without any anatomic reason to recommend it; any physiologic act to suggest it; any etiologic factor in hernia, congenital or acquired, to indicate it; or brilliant surgical results to justify its continuance. Let the cord alone, especially the vas deferens, for it is the sacred highway along which travel the vital elements indispensable to the perpetuity of our race.

The veins of the cord should not be disturbed. If a variocele complicates the hernia, deal with it in the usual way, but do not ablate the veins in the canal, for that endangers the testicle. When the veins were not ablated, the writer has not seen a hydrocele or an epididymitis follow.

The cremaster muscle is allowed to hug the cord and is reattached to the internal oblique muscle, for in this, its normal position, it is afforded an opportunity to resume its double function of (a) holding down the muscle from which it originally received its muscular fibers, and (b) by its contraction aid in emptying out the valveless veins in the cord. No part of the muscle should be removed, but its redundancy is taken up with the suturing of the transversalis fascia and internal oblique.

An abnormal quantity of subserous adipose tissue is sometimes deposited around the sac and cord and along Poupart's ligament. This is an etiologic factor in hernia, and if not removed tends to cause a return of the hernia. A systematic search should be made for fatty aggregations and the same removed. (See "Adipose Tissue an Etiologic Factor in Hernia," May, 1899, *Illinois Medical Journal*, by the author.)

The transversalis fascia forms the internal ring. In hernia its fibers have become more or less stretched above and around the cord. The ring, in consequence, is abnormally large and the fascia bulges. To rectify this condition take up the slack in the fascia and make an accurately fitting ring for the cord by means of a suture, interrupted or continuous. The writer usually takes up the slack in this fascia with the same sutures that sew the internal oblique muscle to Poupart's ligament. (Fig. 45.) Do not injure the deep epigastric vessels, nor pass the needle too deeply in the direction of the large iliac vessels.

Suture the internal oblique and transversalis muscles (Fig. 46) to the internal aspect of Poupart's ligament, and restore their normal origin. If you choose, take up the slack of the transversalis fascia and the cremaster muscle with the same suture. (Fig. 48.) The suturing is extended fully two-thirds down along Poupart's ligament, which is the normal origin of this muscle in the female. Take care not to split Poupart's ligament by grasping the same longitudinal fibers with the needle each time. It is surprising how easily these structures come together without the least discernible tension when the muscles are well liberated, and it is gratifying to observe how perfectly they cover and protect the internal abdominal ring. (Fig. 45.)

If the conjoined tendon is deficient or absent, or if a direct hernia coexists, the sheath of the rectus muscle is opened freely down to the pubic bone (Bloodgood, Fig. 47), and the muscle brought across the weak point to Poupart's ligament. The writer has observed a few direct hernias occur

after the cure, by operation, of an oblique inguinal hernia. In these cases the conjoined tendon was deficient and the rectus muscle was not utilized at the primary operation.

The external edges of the aponeurosis of the external oblique muscle are brought together in lateral folds (Fig. 49) or by overlapping, thus restoring the external abdominal ring. (Fig. 45.) In bringing the skin flap into normal position, be sure to coapt all its structure, like-to-like, especially the layers of the superficial fascia.

The different structures in the abdominal wall are placed in their normal relationship. The tying of the sac restores the normal rotundity of the peritoneum. The suturing of the transversalis fascia, forming a new internal ring, at the same time obliterates the hernial infundibuliform process. Sewing the internal oblique and transversalis muscle to Poupart's ligament secures a normal origin for them, and they then form a perfect protection of the internal ring, cord and canal. (Fig. 43.) The lateral or overlapping suturing of the separated fibers of the aponeurosis of the external oblique protects the underlying muscles and cord, while the skin flaps covers all. The lines of the sutures are not opposite each other, thus securing an overlapping of the weak parts (line of repair) by normal tissues.

The curved incision has advantages for purposes of demonstration. The hernial area is uncovered as in no other way, thus affording an accurate observation of structural relationship, etiologic factors and pathologic conditions. There is less tendency of skin infection extending to the deeper structures.

In cases of old scrotal hernias the large space from which the sac was dissected is drained with several strands of silkworm gut until the first dressing is changed.

We are gradually coming to the conclusion that after operation patients are usually kept in bed for too long a time, but the writer still enjoins three weeks in the horizontal position after an operation for the radical cure of hernia. A bandage and pad are worn for three months thereafter, but no truss.

For ligatures and sutures, Nos. 00, 0, and 1 of chromic catgut are used throughout the operation; No. 1 to tie off the sac, and the other sizes for the coaptation of the remaining structures. The author believes that the large-sized catgut used by other operators in many instances is accountable for suppuration and failure. The catgut should not be absorbed short of about two or three weeks.

Of all the methods of operating the author has employed, the anatomic is the simplest and easiest to execute. The results are all that could be wished, there being no known return in 2,500 patients operated on by different surgeons.

CHAPTER V.

RADICAL CURE OF FEMORAL HERNIA.

The radical cure of femoral hernia has not engrossed the attention of surgeons to the same extent as has that of the inguinal variety. One reason for this may be the comparative infrequency of femoral hernia, and another may be found in the belief that the operation is more difficult to perform than is that for inguinal hernia. However, a number of operations have been devised and some of them have been used extensively and with excellent results.

Sir Astley Cooper dissected out the sac and closed the femoral ring securely by means of sutures. Mitchell Banks placed a ligature around the neck of the sac, and then cut it away, but made no attempt to close the canal.

Ball and Houston twisted the sac, ligated it at its neck, cut it off, and closed the femoral canal with sutures. Barker removes the sac after having ligated it at its neck. The stump of the sac is then pushed under the femoral arch and the canal is closed with sutures which grasp the pubic portion of the fascia lata and Poupart's ligament.

Marcy cuts off the sac below a ligature and closes the canal by sutures of kangaroo tendon. McBurney used the open method, the sac being ligated, cut away, and the wound packed with iodoform gauze. Macewen, of Glasgow, employed the sac as a plug, much in the same manner as in his operation for inguinal hernia, the plug forming a prominence on the internal aspect of the peritoneal cavity. He completed the operation by stitching the falciform process to Gimbernat's ligament, thus restoring the normal valve-like condition of these parts. Harvey Cushing closes the femoral ring with a quilted suture, fastening the pubic portion of the fascia lata covering the pectineus muscle to Poupart's ligament before closing the saphenous opening according to Macewen's method.

In my operation I close the canal with three inversion sutures, seizing hold of the fascia and pectineus muscle, close to the pubic bone, and then grasping Poupart's ligament from above downward. (Fig. 50.) These sutures, when tied, cause the falciform process to recede behind them into the canal on a level with the deep crural arch. When the sac is small and slender, and if Poupart's ligament and the falciform process cannot be brought down sufficiently close to the pectineal fascia, to obliterate the femoral canal effectually, there need be no hesitation in raising a flap from the pectineus muscle, or from the periosteum of the pubic bone, and sewing either with quilt sutures to the deep crural arch, fastening the falciform process beneath it, as already described.

It is rather difficult to comprehend the reason for cutting off the sac, which can be utilized as a plug to the best advantage. The sac consists of

fibrous tissue, whereas when a mass of muscle is raised to form a plug, it means that this muscle must be converted into fibrous material. If the sac is very small or the canal very large, I believe that Cheyne's flap would aid materially in preventing a relapse. I have not seen this condition.

Josef Fabricius recommends ligating the sac and then cutting it off. He exposes the crural canal freely by division of the superficial layer of deep fascia and the removal of loose cellular tissue. The internal attachment of Poupart's ligament is divided, thus relaxing it, and it is then sutured to the pectineal fascia, the origin of the pectineus muscle, and to the periosteum of the horizontal ramus of the pubic bone. (Figs. 51 and 52.) The first stitch is applied next to the femoral vessels, being drawn by a blunt hook toward the ilio-pectineal eminence. This stitch prevents these vessels from returning to their normal position. Fabricius also recommends stitching the superficial layer of the deep fascia to the pectineal fascia along the femoral vein.

The objections to this operation are that it necessitates the division of Poupart's ligament, and the fact that so extensive an operation is not at all necessary to produce a radical cure of the hernia.

Bassini's method of operating on femoral hernia embraces the removal of the sac and then putting in two rows of sutures, one fastening Poupart's ligament to the pectineal fascia for the purpose of closing the femoral canal, and the other suture securing the falciform ligament to the pectineal fascia and muscle.

BALDWIN'S OPERATION.

For some years past Baldwin has made use of an operation which in his hands has proven uniformly successful in about twenty cases. He describes his method (*Lancet*, July 21, 1906) as follows:

"A curved incision about 1½ or 2 inches long is made over the saphenous opening. The sac is isolated and more or less cleared of fat. If not already back, the hernia is reduced. A slightly curved hernia director is now introduced up the crural canal in front of the sac and when its point is behind Poupart's ligament it is moved laterally so as for a short distance to strip off the peritoneum from the posterior surface of the transversalis fascia. The point of the director is now pushed farther upward and tilted forward so as to make the aponeurosis of the external oblique muscle project about half an inch above Poupart's ligament. A small transverse incision is then made through the aponeurosis, parallel to its fibers, on to the point of the director, which is now pushed up through the opening. The latter is only just large enough to allow of this being done. A sinus forceps, Spencer Wells forceps, or small nasal polypus forceps—the last, being slightly curved, is more convenient—is now introduced through the opening, passed behind Poupart's ligament, and made to project from the saphenous opening; as this is done the director is withdrawn; in its descent it guides the forceps and prevents it from catching. The fundus of the sac is now seized by the forceps, which is completely withdrawn, dragging the sac out through the opening in the ex-

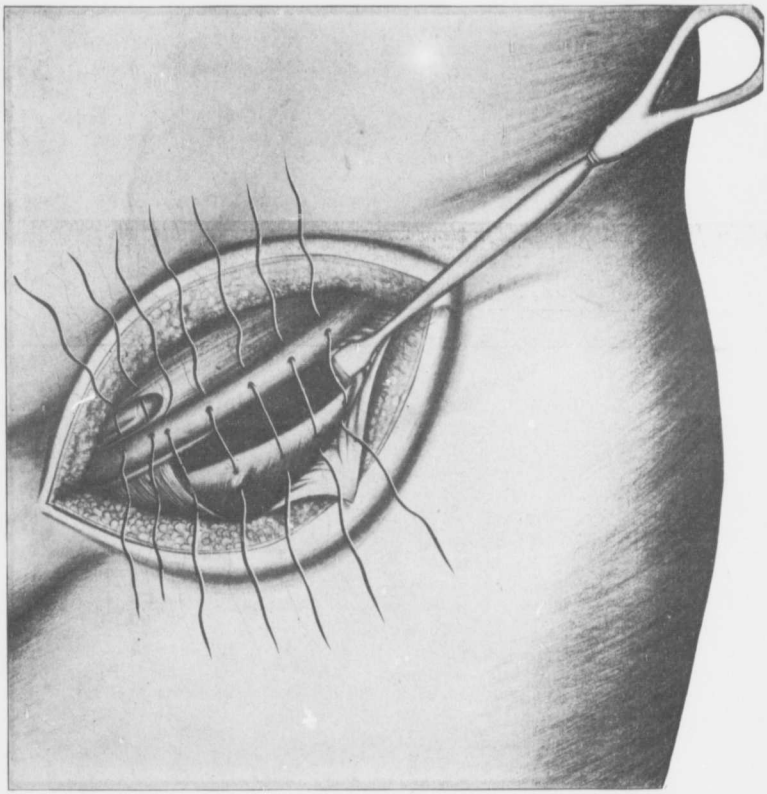

PLATE LI.

Fabricius' Operation for Femoral Hernia (Fowler).

ternal oblique aponeurosis. The sac is pulled out as much as possible and ligated at the top of its neck. By this maneuver no pouch is left in which recurrence may take place. A suture is then passed through the fundus of the sac, the suture is drawn through to its middle and then tied, thus leaving two free ends of equal length, or this may be done before the sac is pulled up through the opening in Poupart's ligament, the thread being seized by the forceps and used to pull up the sac. If the sac is large, however, the thread may tear out and time be lost. One end is threaded in a strong curved needle, one which will not rotate in the forceps which grasps it. The needle is now passed backward and forward through the sac several times, starting at the fundus and finishing at the neck, as described by Macewen, for puckering the sac. The needle is grasped in forceps, or a needle on a handle may be used, and its point is passed through the hole above Poupart's ligament, through the neck of the sac down to the transverse ramus of the pubes, then by a turn of the wrist the point is made to slide forward across the pubic bone, as close to it as possible, then to pierce the pectineus muscle and to appear through the inner part of the saphenous opening. The needle is pulled through, bringing its thread with it. By drawing on the thread and by tucking the sac back again through the hole above Poupart's ligament by means of a stout probe or similar blunt instrument, the sac disappears from view and comes to rest in a puckered-up condition behind the transversalis fascia and at the top of the crural canal, which it effectually roofs in. By this time the other end of the thread is hanging out of the opening above Poupart's ligament. It is tied rather firmly, but not too tightly, to the thread which projects from the saphenous opening; this fixes the sac in its place, and fixes Poupart's ligament to the pectineus muscle, so obliterating the crural canal. If necessary, a second suture may be put in for this purpose, but nearer the pubic spine. A suture is put in to close the hole above Poupart's ligament and the skin incision is closed. Thus there are three distinct checks against the recurrence of the hernia: (1) The sac is ligatured higher up than is possible by the ordinary method and leaves no peritoneal pouch; (2), the sac is used as a buffer or roof above the crural canal; and, (3), Poupart's ligament is approximated to the pectineus muscle and obliterates the crural canal. It may be urged that the sac will slough and cause trouble. This does not take place. It no doubt becomes vascularized, converted into granulation tissue, and ultimately into fibrous tissue.

In strangulated hernia, when it has seemed safe to leave the sac, and when time was precious, the author has modified the operation by pushing the sac up through the canal, after having made a little space for it as before, and then sutured Poupart's ligament to the pectineus muscle.

POLYA'S OPERATION.

The feature of Polya's operation is the obliteration of the femoral canal by plugging it with the entire thickness of the sartorius muscle (*Centralbl. f. Chirurgie*, Vol. XXXII, No. 18).

The incision is in the shape of a T or inverted L. The saphena is ligated and severed, and the hernial sac tied and buried if possible. The sheath of the sartorius is slit across below the level of the canal, and the sartorius muscle is cut a trifle above this slit. The proximal stump of the muscle is then worked through the saphenous opening above the large vessels and sutured, after being pushed as far into the canal as it can be made to go. Two or three stout catgut threads are passed through Poupart's ligament, the implanted sartorius and the sheath of the pectineus, and the muscle is pulled deep into the femoral canal as the threads are tied. A flap is made by cutting the fascia lata, and it is turned back and sutured to Poupart's ligament, to the sheath of the pectineus and to the sartorius below.

The operation has been performed a number of times with very satisfactory results. One of the patients operated on succumbed not long after to an intercurrent infectious disease, and the autopsy demonstrated the perfect anatomic results obtained by this technic.

MIKULICZ'S OPERATION.

C. Goebel (*Beiträge z. Klin. Chir.*, 1904) described a procedure employed by von Mikulicz, the principal feature of which is the utilization of the periosteum of the os pubis for the formation of a double flap. The technic consists, briefly, of the isolation, ligation, and submersion of the hernial sac. An incision is made extending down to the bone, from the tuberosity of the pubis to the vessels, in a frontal direction and slightly anterior to the crest of the pubis. An upper and lower periosteal (periosteal-muscle-fascia) flap is then formed out of the os pubis, if necessary with sagittal section across the bone at the outer and inner end of the frontal incision. Suture of the upper (inner) periosteal flap to the outer border of the ligament is the next step in the operation, and this is followed by a subcutaneous suture of the remaining fascia, and suture of the skin.

The advantage of this method is said to be that the turned-up periosteum joined to Poupart's ligament causes an ideal closure of the crural canal at its entrance at the very beginning of the femoral infundibulum. In May, 1895 (*Annals of Surgery*) I published a method of raising the periosteal flap.

KAMMERER'S OPERATION.

F. Kammerer (*Annals of Surgery*, June, 1904) discusses the various operations that have been devised for the cure of femoral hernia. He employed Lotheisen's method for a time and then abandoned it in favor of Salzer's method, but Kammerer includes in the flap a layer of muscular tissue taken from the pectineus muscle, which, in persons who have worn a truss, is quite firm. Up to the time of writing he had performed this operation ten times. In the only two cases that could be traced after the operation, one, a woman, aged 34, operated on in 1902, for a right reducible femoral hernia, and the other, a woman, aged 50, operated on also in 1902,

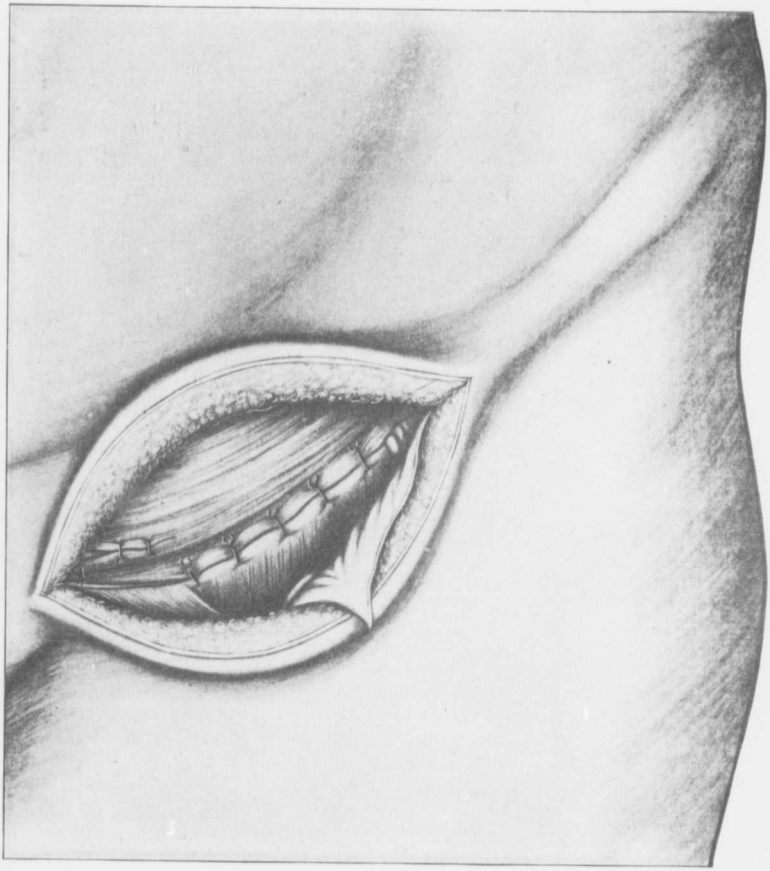

PLATE LII.

Fabricius' Operation for Femoral Hernia (Fowler).

for a double femoral hernia, neither patient has since worn a truss nor has there been a recurrence of the hernia.

In 1903 he employed Lotheisen's method in a case of incarcerated femoral hernia of very large size containing adherent omentum and a large knuckle of small intestine very much discolored. He divided Poupart's ligament immediately over the neck of the sac, cutting from within outward, as advised by Lotheisen. In five other cases of femoral hernia operated on the ligament was not divided. The result in all of these cases was good. Kammerer says that dividing the constriction from within in an outward direction is a procedure that should be relegated to the past. A cross section of Poupart's ligament from without, cutting down on the neck of the sac, is much more satisfactory when it starts from a previous incision into the aponeurosis of the external oblique. In the case mentioned above, he fastened the cut ligament to the internal oblique muscle after the latter had been sutured to Poupart's ligament.

NICOLL'S OPERATION.

The main feature of Nicoll's operation (*Annals of Surgery*, January, 1906) are (a) the employment of the sac to form an intra-abdominal buttress over the internal aspect of the hernial opening or ring; (b) the use of the pubic ramus as a point d'appui in the process of closure of the hernial canal, and (c) the additional security of closure obtained by the supraposition on the bone sutures of a plane of fascial sutures. A vertical or transverse incision exposes the sac, which is opened longitudinally in its middle line and emptied. The sac is separated from parts surrounding its neck for one inch around the abdominal aspect of the ring, and bisected longitudinally from fundus to neck. Make an aperture in one-half near the neck and interlock the halves by putting one through this aperture. Reduce the whole sac through the femoral ring into the extraperintoneal space previously cleared by detaching its neck from the abdominal aspect of the ring. The sac thus lies bunched up within the abdomen between the peritoneum and the transversalis and iliac fascia over the hernial aperture of the femoral canal.

The femoral ring is closed as follows: Carry a bone-deep incision from the femoral ring along the pubic ramus to the region of the pubic spine, dividing the pubic portion of the fascia lata, the origin of the pectineus and the periosteum. Detach the latter to a limited extent and retract it. Drill the bone near its upper edge in two places, one-half to one inch apart. Pass through one of the apertures a loop or stout catgut or other absorbable ligature, and divide the loop of the ligature. Thread one end in a large curved surgical needle and pass it as a mattress suture through Poupart's ligament. Repeat this procedure with the second end of the ligature at a higher level, avoiding the deep epigastric artery to the outer side, and, in male patients, the spermatic cord above. Withdraw both ligatures through the second drill-hole in the bone; tie the ends of each loop separately over the front of the bone, thus bringing Poupart's ligament down to the postero-superior surface of the bone, fastening it

firmly in contact with that surface, constituting what is in fact an extension outward of Gimbernat's ligament and absolutely closing the femoral ring to whatever extent may be desired. To make the closure doubly secure the operation is completed by uniting by interrupted catgut sutures the attached margin of the pectineal origin and the pubic portion of the fascia lata to the anchored Poupart's ligament.

DE GARMO'S OPERATION.

The technic of the operation employed by W. B. De Garmo (*Annals of Surgery*, August, 1905) is as follows:

The incision should be between two and three inches long, parallel with and to the inner side of the femoral vessels. The upper angle of the wound should be well up over Poupart's ligament and extend down over the saphenous opening. When the skin and the superficial fascia are incised, usually the sac and its subperitoneal fat will come into the wound with the appearance of an encysted lipoma and, before separating the sac, it is best that this entire mass should be lifted out of its bed by thumb forceps and blunt dissection, so that its neck where it passes under Poupart's ligament shall be entirely free from its surrounding. By traction on the sac and its superimposed fat this neck may not only be freed, but it will be materially lengthened, so that when it is finally ligated and cut off it will retract within the abdominal cavity, leaving the femoral canal free of foreign tissue. This is absolutely essential to a subsequent permanent cure. The sac should be opened, and where the omentum is found adherent it should be carefully ligated, cut away, and its stump reduced to the abdominal cavity. Adherent intestine will rarely be found, but when it is the adhesions must either be broken up or, if too firm, the adherent part may be cut out of the sac and left attached to the bowel. When in doubt the latter method is by far the safer. Adherent omentum is frequently found and should be cut away after careful ligation. The sac having been entirely freed of its contents, is tied off as high as possible, while it is being forcibly drawn down by an assistant. Great care must be used to insure the perfect freedom of the neck of the sac from protruding bowel or omentum while the ligature is being placed. After tying with strong catgut (a double strand of No. 2 plain is preferred), pass the needle, which has been previously threaded with it, through the neck of the sac and tie again. This gives a double ligature anchored by perforation between the two, and prevents slipping off. When the sac is cut away the stump should be examined to be sure that no bleeding vessels remain, and not until then should the ends of the ligature be cut. When the ligature is cut the stump usually retracts within the abdomen. If this is prevented by connective tissue which has not been broken it should be carefully pushed back, leaving the femoral opening absolutely free. This opening is closed by good-sized kangaroo tendon threaded in a strong, blunt needle by pressing the end of the finger firmly into the femoral opening under Poupart's ligament, and passing the needle through the ligament on the finger-point. This perforation should be well toward the outer

side of the canal and close to the femoral vein. The operator should assure himself, by pressure of the finger against the ramus of the pubes, that the vessels are out of the way, and pass the point of the needle fully down to the periosteum of the pubic bone, taking up all tissues over it. This constitutes the first stitch, but should not be tied until the others are in place. Others should then be placed in the same manner, every quarter of an inch apart, until near the spine of the pubes. Usually three or four will completely close the femoral opening. When tied down and the ends cut moderately close, the fascia should be closed in by plain catgut, to avoid a pocket in the tissues that otherwise may result, and the skin may then be closed by buried sutures of plain catgut. The wound is covered by collodion and a compress of sterilized gauze, held in place by a figure-of-eight bandage. In ten days the dressings are changed and a bandage for temporary support is applied. If healing has been complete, the patient is allowed to sit up on the tenth day and to leave the house on the fourteenth day after the operation. The bandage used after the first dressing consists of a pelvic belt, of three thicknesses of canton flannel, with a compress of gauze over the former site of the hernia, and a perineal strap to prevent its slipping up. This is to be worn for four weeks. No truss or other permanent support should be worn.

HERZEN'S OPERATION.

P. Herzen, after tying and removing the hernial sac, and reducing the stump, detaches the femoral vein, draws it to one side, and Poupart's ligament upward. He then dissects a flap of periosteum from the upper aspect of the pubis about the width of the femoral canal, and about one to 1.5 centimeters long, the base of the flap resting on the pectineus muscle. This flap is then detached from the bone and turned back downward. Two to four small holes are then drilled through the pubis in such a way that the drill emerges always in the part exposed by the raising of the flap. The two ends of a bronze aluminum wire are then passed from behind forward through Poupart's ligament and through two of these holes. By pulling on the wire the ligament is brought into intimate contact with the exposed part of the pubis. The flap of periosteum is then replaced and fastened with a couple of stitches. By this means the femoral ring is entirely closed, the ligament having taken its place and being re-enforced by the periosteal flap.

OCHSNER'S OPERATION.

For the past fourteen years A. J. Ochsner has used a method which has not been followed by recurrence in any one of the thirty patients that can be traced. The principle underlying the method is to change the femoral canal into an unlined circular opening, which will close spontaneously. In order to effect this Ochsner dissects out the hernial sac quite up into the peritoneal cavity beyond the inner surface of the femoral ring, ligates it high up (Fig. 53), cuts it off, and permits the stump to withdraw within the peritoneal cavity. Removing all the fat contained

in the femoral canal and simply closing the skin wound completes the operation. Ochsner claims that this method is applicable to all simple femoral hernias in which an actual femoral ring exists. The method is not applicable to cases of strangulated hernia in which the femoral ring has to be cut to permit of reduction of the hernia.

SOCIN'S OPERATION.

In Socin's operation the skin incision is made a little below and parallel with Poupart's ligament. The sac is then freed high up into the abdominal cavity and all the fat and loose tissue removed. The sac, after being pulled down by an assistant, is ligated and cut off high up, the stump being allowed to slip back easily into the peritoneal cavity. The skin incision is sutured according to the preference of the individual operator.

COLEY'S OPERATION.

W. B. Coley frees the sac well beyond its neck and then ligates it high up. A suture is then introduced through Poupart's ligament or the inner portion of the canal or crural arch, thence passed downward into the pectineus muscle or floor of the canal, outward through the fascia lata overlying the femoral vein, and upward through Poupart's ligament or the roof of the canal, emerging about three-fourths of an inch from the point of its introduction. On tying the suture the floor of the canal is brought in apposition with the roof of the canal and the femoral opening is obliterated. The superficial fascia is brought together with catgut or fine tendon, and the skin sutured with horsehair.

CURTIS' OPERATION.

Curtis closes the canal after the sac has been removed by introducing three superimposed circular purse-string sutures of catgut, the first at the internal femoral opening, the second one-third of an inch outside of this, and the third at the external surface of the canal. The method is said not to be suitable for large hernias.

LOTHEISSEN'S OPERATION.

In this method the external incision is made parallel to and a little above Poupart's ligament so as to divide the fibers of the external oblique and extend into the external inguinal ring. The neck of the sac is exposed by entering between Poupart's ligament and the internal oblique muscle. The sac is dislocated, if small, by pulling it into the opening above Poupart's ligament. In large hernias the skin is dislocated at the lower edge of the original incision so as to expose the external surface of the sac. The sac is then incised and the stump dislocated in the same manner as for small hernias. The edges of the transversalis and internal oblique muscles are sutured to Cooper's ligament. The incisions in the aponeurosis and the skin are sutured separately.

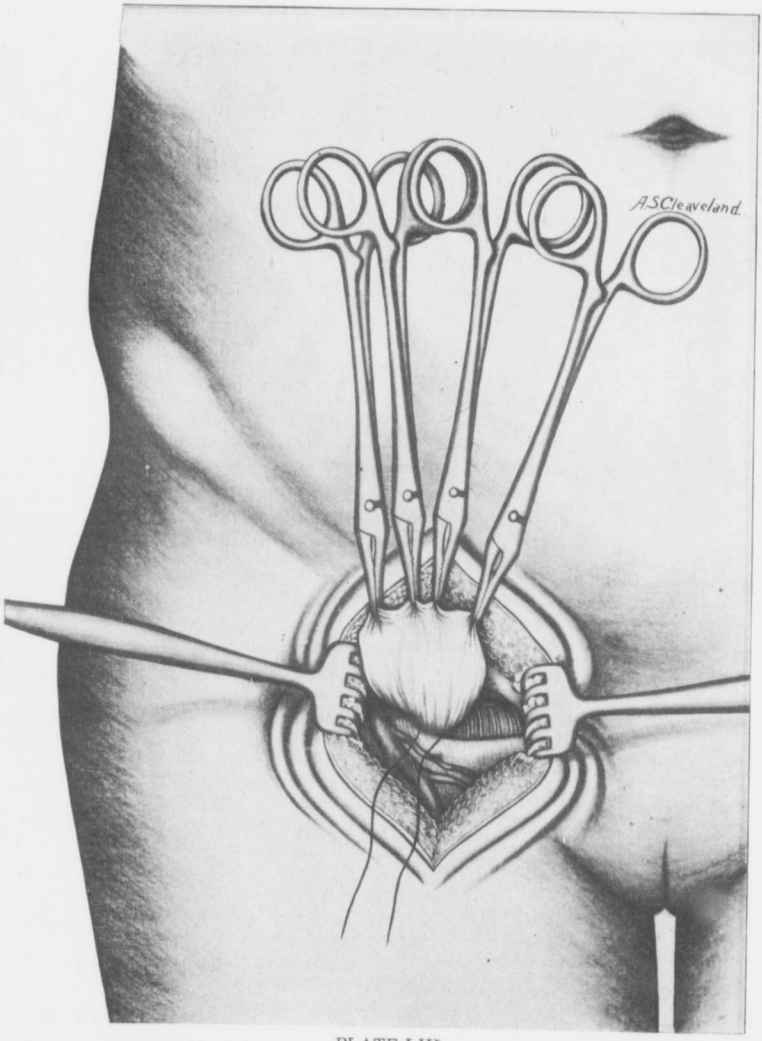

PLATE LIII.

Ochsner's Operation for Femoral Hernia.

HAMMESFAHR'S OPERATION.

After the femoral sac is resected and the stump reduced, three holes are drilled in the upper margin of the pubic ramus from the slant upward so that the inner opening is close beneath the edge of the crest. Strong silk is then passed around Poupart's ligament and then through the holes, and is tied firmly.

Salzer devised a method of closing the femoral canal which met with considerable favor because of the permanency of the result obtained. He employed a flap made from the fascia of the pectineus muscle. The flap was formed by making a curved incision, with the convexity directed downward, from the crista pectinea to Gimbernat's ligament. It was then turned upward and sutured with strong catgut to the lower margin of the inner third of Poupart's ligament. The sheath of the pectineus muscle was restored by a few buried, absorbable sutures.

SPRENGEL'S METHOD.

At the last meeting of the German Congress of Surgery, Sprengel proposed a new procedure for the treatment of certain femoral hernias in women, consisting of the closure of the internal ring of the femoral canal through the abdominal cavity. The operation consists of the following steps: 1. Free exposure of the sac by linear incision, opening and examination of the same, and clearing of the impacted contents. 2. Transrectus laparotomy on the side of the hernia, damming back of the intestines and the organs of the lesser pelvis. 3. Introduction of a Mikulicz forceps through the femoral canal into the sac, and invagination of the same into the abdominal cavity. 4. Firm rolling together of the sac and suturing of it over to the internal ring, together with pulling forward and suturing of the round ligament of the uterus lying in the immediate neighborhood of the inguinal canal. 5. Closure of the abdominal incision and the linear one over the femoral canal.

The method was tried in five cases, one being of ten months' duration, and gave a perfectly satisfactory result. According to Sprengel, the method is adapted particularly to old hernias of a large size and to recurrent cases. The method appears to be a very simple one, but it is impossible to judge of its value until a larger number of patients has been operated and more time has elapsed after the operation.

SCHWARTZ'S OPERATION.

For the cure of a femoral hernia, Schwartz takes a flap from the second or median adductor. It is raised, forced into the crural canal, and fixed by sutures to the surrounding cellular tissue and to the lower border of Poupart's ligament. This forms a true flap of muscle which fills the crural infundibulum and reaches to the ring itself.

CHAPTER VI.

RADICAL CURE OF UMBILICAL HERNIA.

Women are usually the ones who suffer from this form of hernia and as a rule they are obese, multiparas with very large hernial openings, the recti muscles are widely separated, and from long-continued pressure they become considerably atrophied. If an ordinary abdominal section is done in these cases, difficulty will be encountered in attempting to close the opening by bringing like structures in apposition, as is usually done, unless transplantation of the recti muscles is resorted to. However, this is neither necessary nor is it successful, except in the case of a small hernia, and then it is the operation of choice.

W. J. MAYO'S OPERATION.

In 1898 W. J. Mayo, of Rochester, Minnesota, called attention to the impracticability of covering in the defect left by the excision of a large umbilical hernia with muscle, and advocated the overlapping of the aponeurotic structures which are already at hand, thus securing a wide area of adhesions. Mayo described his operation (Fig. 54) as follows:

Transverse elliptical incisions are made including the umbilicus and the hernia. The surfaces of the aponeurotic structures are cleared two and a half to three inches in all directions from the neck of the sac. The fibrous and peritoneal coverings of the hernia are divided in a circular manner at the neck of the sac, thus exposing its contents. If intestinal viscera are present, the adhesions are separated and restitution is made. The omentum is ligated and removed with the sac of the hernia, without dissection of the adherent portion of the omentum.

An incision is made through the aponeurotic and peritoneal structures of the ring extending one inch or less transversely to each side, and the peritoneum is separated from the under surface of the upper of the two flaps thus formed.

Beginning from two to two and one-half inches above the margin of the upper flap, three to four mattress sutures of silk or other permanent material are introduced, the loop firmly grasping the upper margin of the lower flap; sufficient traction is made on these sutures to enable peritoneal approximation with running or interrupted suture of catgut. The mattress sutures are then drawn into position, sliding the entire lower flap into the pocket previously formed between the aponeurosis and the peritoneum above.

The free margin of the upper flap is fixed by catgut sutures to the surface of the aponeurosis below, and the superficial incision closed in the usual manner. In the larger hernias the incision through the fibrous

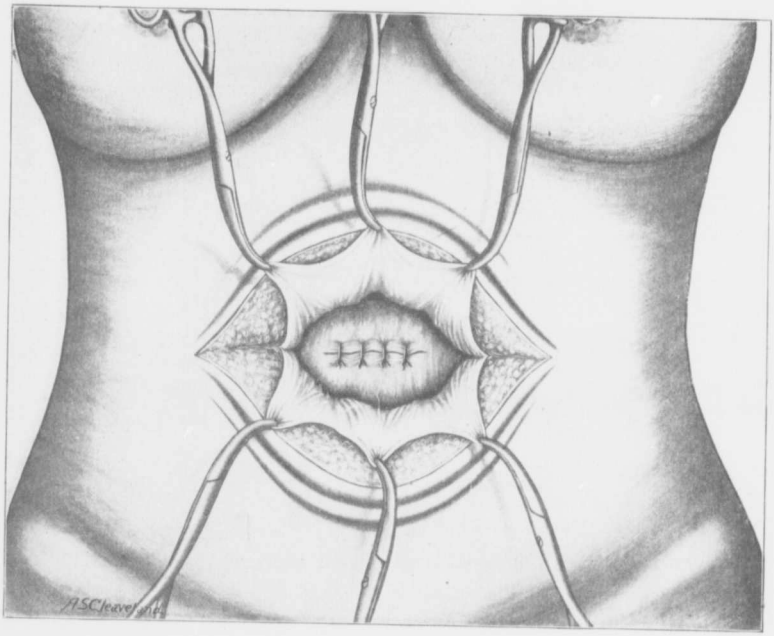

PLATE LIV.

Mayo's Operation for Umbilical Hernia.

coverings of the sac may be made somewhat above the base, thereby increasing the amount of tissue to be used in the overlapping process (Fig. 55).

In the very large protrusions in which part of the hernial contents is irreducible the patient should be kept in bed on a reduced diet and directed to manipulate the hernia, with the intention of replacing as much as possible. The irreducible portion must not be forced into the abdominal cavity after losing the "right of habitation." If this consists of omentum only, it is readily disposed of by excision; if intestine, enough omentum previously contained in the peritoneal cavity should be removed to allow of reduction of the bowel without pressure.

The patients should be kept in bed three or four weeks after operation and after getting about should not apply a truss, although most of them prefer to wear an abdominal supporter for a year.

Piccoli (*Centralblatt für klinische Chirurgie*, Jan. 13, 1900) reports a case successfully operated on in August, 1899, after the lateral plan, and refers to a case reported by Bonomo, operated on Dec. 9, 1899, with a favorable result.

J. A. Blake (Medical Ass'n of Greater New York, Jan. 14, 1901) reports several cases operated on by the lateral method during the year 1900, and refers to an article by Sapiejko (*Rev. de Chir.*, 1900, No. 2, p. 240) in which a lateral operation is described.

The writer (Mayo) had described and operated by the lateral overlapping plan several years before the cases reported by these authors and found the lateral a good operation, but it is not as good as the vertical method, in which the retaining structures are given a bearing point above the site of the umbilicus and intra-abdominal pressure thus acts to prevent separation instead of aiding it.

BLAKE'S OPERATION.

J. H. Blake claims that the method which is particularly applicable to the cases in which there is stretching of the linea alba with separation of the recti muscles is that of lapping the abdominal walls. This method consists of the division of the linea alba above and below the sac in the median line for the necessary distance, with or without excision of the ring and a portion of the linea alba. The entire wall on one side is then lapped in front of the other and there sutured, so that the ventral surface of the one side is in contact with the dorsal surface of the other (Fig. 56). Three patients were operated on after this method, with good immediate results. The suture material used was plain catgut for the peritoneum, No. 2 chromicized catgut for the aponeurosis and muscles, and silkworm gut and silk for the skin. Two points in the technic are emphasized, the absolute cleansing of fat from the rectus sheath, which is to be applied to the back of the opposite rectus, and the insertion of the mattress sutures, so that they will be in the course of the muscle fibers, and not strangulate them. It has been found more convenient to have the mattress sutures threaded on two needles. The sutures

include about one-third of an inch of tissue, and are placed about five-eighths of an inch apart. Some of the more apparent advantages of the method are the doubling of the abdominal wall at the hernial site; the breaking of the lines of suture; a broad surface for union; the obliteration of the separation of the recti, and the reduction in the size of the abdomen.

In applying the mattress sutures along the edge of the inner flap, and to the peritoneum, care must be taken not to leave a raw edge on the peritoneal aspect in order to prevent adhesions. If a little care is taken to fit the flaps properly at the upper and lower corners, a uniform pressure on the abdominal organs is obtained. In several cases I have liberated the recti muscles very freely after sewing the peritoneum and the aponeurotic structures, bringing the two recti muscles together in the mid-line (Figs. 57, 58, 59, 60).

BOECKEL'S OPERATION.

Boeckel makes an elliptical incision, removing the umbilicus with the sac. Chain sutures are inserted to close the peritoneum. The fibrous edges are freshened even to the muscular structures of the recti, if necessary. Kangaroo tendon or chromic catgut is employed to coapt the fibro-muscular structures.

DAURIAC'S OPERATION.

In this method both recti muscles are exposed through a median incision, or the incision may be made elliptical. The sac is ablated and then the peritoneum is closed. The next step in the operation is to cross a portion of the right rectus muscle over to the left side, and a portion of the left rectus muscle over to the right side, thus forming an X of muscular tissue, the center of the X being placed over the center of the spot occupied by the hernia.

This is done by dividing each muscle into two portions by two incisions, a longitudinal incision and a transverse incision, the former being placed nearer to the inner than to the outer border of the muscle. The transverse incision passes through the inner portions of the muscles transversely at their upper ends, including the corresponding part of the muscle sheath. In Greig Smith's operation the inner borders of the recti muscles are liberated by a free separation of the margins of the ring and they are sutured together with buried sutures.

Quénu recommends six layers of sutures coapting like structures, as follows: (1) Peritoneum; (2) fascia; (3) posterior border of the rectus muscle; (4) rectus muscle; (5) anterior border of the rectus muscle; (6) subcutaneous soft structures; (7) skin.

DEAVER'S OPERATION.

Deaver's operation differs slightly from the usual omphalectomy. The sac is disposed of in the customary manner. The recti muscles are exposed by incising the anterior walls of their sheaths near the linea alba on each side of the wound, and they are then brought together by sutures

which are passed through them and the anterior walls of their sheaths, from within outward.

Barker, Bennett, Keetley, Ball, Macewen, and McGill laid great stress on the importance of retaining the sac, twisting the stump and sewing the other structures in front of it.

OMPHALECTOMY.

This is the ideal operation for the cure of an umbilical hernia of moderate size, and in women with lax abdominal walls who have borne children, hernias of considerable size can be dealt with successfully by doing an omphalectomy, as was pointed out by Joseph Ransohoff, of Cincinnati, who in 1897, reported three cases of this kind in which the operation was entirely successful.

In the para-umbilical, sub-umbilical and supra-umbilical varieties, the conditions present must determine whether or not the umbilicus is to be removed. If the hernia is a very small one, the umbilicus need not be removed, but the rule is to ablate it.

WARREN'S OPERATION.

J. Collins Warren, of Boston, believes that in view of the fact that the vertical diameter of the opening in these cases is always shorter than the transverse, better results will be obtained by bringing the lower and upper margins of the ring together, rather than the lateral edges. He uses silk for his buried sutures. In one case, the patient being 46 years old, a case of recurrent hernia, the result was excellent ten years after the operation. The patient had worn a belt since the operation. Of eleven cases operated by this method, in only one was a recurrence reported during periods of from one to thirteen years, about 9 per cent.

WINSLOW'S OPERATION.

K. Winslow (*Annals of Surgery*, Feb., 1904) states that the aponeurotic coverings are the chief supporting structures of the abdominal walls and that their approximation by overlapping in doubling the strength of the aponeurotic layers doubles the strength of the abdominal incision. His technic for the prevention of abdominal hernia by overlapping the aponeurosis is described as follows:

The integument and subcutaneous tissue are incised down to the aponeurosis. This is bared by reflecting back the skin and fat for the space of an inch and a half on the side of the incision. The aponeurosis is then incised in the same line and directly beneath the skin incision, and the two flaps, one on each side of the incision, are raised from the underlying muscle by blunt dissection. One flap of aponeurosis is freed for an inch or so from its cut margin and the other for about half that distance. The incision through the rest of the abdominal wall is completed as usual. In closing the peritoneum is approximated by continuous suture. In weak, fatty walls it is wise to introduce two or three retention sutures placed well back from the margins of the wound and penetrating the layers

above the peritoneum. The muscle, if well developed, is coaptated by interrupted sutures, then the cut edge of the aponeurotic flap which was but slightly freed is stitched to the base of the opposing flap by interrupted or mattress sutures. The free margin of the opposing flap is lapped over the other one and stitched down to the surface of the aponeurosis by interrupted or continuous suture. A drain of gauze wrapped about with rubber tissue, or a roll of rubber tissue alone, emerging from the lower angle of the wound, should be inserted between the fat and aponeurotic layer in cases where there has been much manipulation or where the adipose tissue is thick. The skin may be coaptated with the Mitchell clamp, buried silver wire or other suture. The retention sutures are of silkworm gut. Medium catgut is used for the lower layers, plain in the case of the peritoneum and chromicized for the muscle and aponeurosis. The retention sutures, if used, are employed merely to support the wall until the dangers of vomiting and meteorism are passed and union has begun.

GRASER'S OPERATION.

Menge was very much opposed to cutting into the anterior sheath of the recti muscles. He advised incision of the posterior sheath, so as to effect the release and suture of these muscles as high and as low as possible. E. Graser performed this kind of operation four times in cases of large umbilical and abdominal hernias, with most excellent results. However, the operation is a serious one; it is a tedious one, and the numerous imbedded sutures favor the occurrence of sepsis.

The principal incision is made transversely over the highest point of the abdominal tumor, its length varying from 35 to 50 centimeters. The sac is opened, adhesions of the intestine are freed, and the trimmed part of the sac is brought to the hernial ring. A separation of the sheaths of the recti muscles into an anterior and a posterior flap is absolutely necessary. The anterior sheath is divided transversely as far as the external border of the rectus muscle, often widely displaced laterally, and then the entire aponeurotic flap is lifted up. Where a separation is not possible, the commissure of the rectus sheath is to be split along the inner border, care being taken to avoid injuring the anterior layer. Above and below, where the recti muscles approach each other but do not touch, a longitudinal incision is made, near the linea alba, so that the fibrous structure of this remains in contact as a stiff ligamentous layer.

The flap having been prepared, the peeling out of the rectus muscle is effected, the loosening being done very carefully both from the anterior and the posterior sheaths, with preservation of the nerves. When the loosening is completed, the suturing of the omentum is proceeded with, and best simultaneously with closure of the posterior sheath of the rectus. On account of the tension, stay sutures are generally necessary. Above and below the union can only be made in vertical line on account of the linear incision. Transverse seams may be added to diminish the gaping.

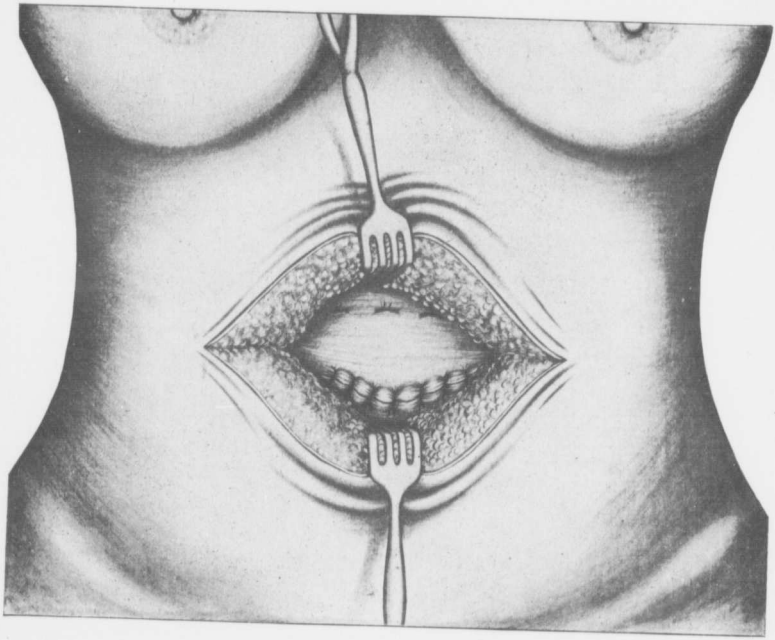

PLATE LV.

Mayo's Operation for Umbilical Hernia.

Now follows, and likewise in vertical direction, the union of the rectus muscles by interrupted sutures, some of which are passed deeper; others above these draw the edges somewhat over each other. The edges of the anterior aponeurosis are trimmed and approximated by a right solid row of interrupted iodized silk or catgut sutures. If the tissue is redundant, one flap can be pushed under the other, thus doubling the line of union.

C. A. Wheaton, of St. Paul, advises operation in all cases of umbilical hernia, no matter what the size of the hernia, and also advises reducing the body weight of fleshy patients by a systematic course of treatment carried out for a few weeks before the operation is done.

Terrier, Czerny, Reverdin, and others removed the hernial sac, resected the omentum, reduced the contents of the sac, sutured the borders of the hernial ring in layers, and closed the skin by a separate layer of sutures. The results were not very satisfactory.

Condamin opened the abdominal wall at the periphery of the hernia and continued the incision until the peritoneal cavity was reached. Thus the sac, superfluous skin and umbilicus were removed in one portion. Omphalectomy and closure of the wound in separate layers as in an ordinary laparotomy completed the operation.

Gersuny dissected free the edges of the recti muscles, uniting them by suture. The skin wound was tamponnaded with gauze and allowed to remain open for a few days, after which time it was closed by superficial sutures.

Championniere sutured the edges of the aponeurosis of the peritoneum, placing a second and sometimes a third row of sutures in the aponeurosis, —superposition of rows of sutures.

V. Pauchet recommended prolonged fasting before operating on large hernias in obese subjects. He laid down the following regimen: Warm or cold water is to be drunk at discretion at least four quarts during the twenty-four hours, either pure or in the form of lemonade, or slightly salted decoctions of herbs. If the patient is moderately active or continues at his work, an ungarnished salad at noon and an apple morning and evening, or four or five oranges daily, may be taken. On this diet the patient is reduced to his proper weight in six weeks or three months.

HERNIAS OPERATED ON BY LAPAROTOMY.

On ten occasions I operated on and cured femoral hernias by the abdominal route, the primary indication for the laparotomy being fibroids of the uterus in two cases; ovarian cysts in two cases; inguinal hernia in three cases, and appendectomy in three cases. In each one of these cases the sac was turned inside out and cut off. The internal aspect of the crural canal was exposed and the canal closed with two sutures of chromic catgut passing through Poupart's ligament and the periosteum of the pubic bone. The peritoneum was then sutured in such a manner as to turn the raw edges outward.

In treating femoral hernia by the abdominal route, the technic of the

operation is greatly facilitated by placing the patient in the Trendelenburg position.

When it becomes necessary to open the abdomen of an individual who has a femoral hernia, there is no need for performing any of the special operations for this condition.

A laparotomy is the only means of treating epigastric, certain umbilical, ventral, vesical, lumbar, and urachal hernias, and also for those hernias, either congenital or acquired, that occur through the rectus muscle, linea alba, and linea semilunaris.

The special indication for laparotomy is the occurrence of the so-called internal hernias, such as (1) diaphragmatic hernia; (2) hernia into the duodeno-jejunal fossa (posterior internal hernia of Treitz); (3) Winslowian (a true internal hernia into the foramen of Winslow); (4) hernia into the inter-sigmoid fossa; (5) into the mesocolic fossa; (6) omental and mesenteric hernia; (7) pelvic hernias—obturator, sciatic, vesico-rectal, perineal, and hernia into Douglas' cul de sac.

CHAPTER VII.

REPAIR OF LARGE DEFECTS IN ABDOMINAL WALL.

A number of operators have devised methods for repairing large defects in the abdominal wall following operations for hernia and abdominal sections done for various purposes. Notable among these methods are those devised by Phelps, Meyer and Bartlett, in which a metal filigree is employed. Witzel was the first to suggest the idea of embedding in the wound a ready-made filigree. He drew the edges of the wound together as much as possible with heavy silver sutures, which penetrated muscles and fascia; then, after these had been tied, he ran slender wires in every direction across the opening which remained.

Willy Meyer, of New York, used a network consisting of wires crossing at right angles and equidistant from one another, resembling the ordinary mosquito netting. In the *Annals of Surgery*, November, 1902, he reports three cases in which a silver filigree was used with excellent results. The first patient was a man, aged 55, who had previously been operated for strangulated hernia. For several years the defect in the abdominal wall was left unprotected until finally a large ventral hernia developed, accompanied by severe pain. The opening was closed with silver wire netting, and although a fistula developed, which alternately closed and opened, the man was perfectly able to atend to his heavy work. The patient died two years after the operation from general peritonitis following the lifting of a heavy cake of ice and the production of a complete intestinal obstruction at the site of an incomplete obstruction due to manifold old-standing adhesions between coils of the small intestine. The wire netting had no relation to the trouble.

The second patient, a woman of 43, following a laparotomy, developed a large, irreducible, omento-intestinal hernia, the aperture being about midway between the symphysis and the umbilicus. Following a first unsuccessful attempt at cure of the hernia, a second operation was done with the help of the silver wire netting. It was successful. Several months later a severe trauma tore the continuous wire suture causing one of the corners of the filigree pad to come loose.

The third patient, woman, aged 31, had what appeared to be an irreducible, inflamed umbilical omental hernia. It was finally reduced after the inflammation had subsided and a radical operation was performed with implantation of the silver filigree.

Willard Bartlett, of St. Louis, introduced a form of filigree (*Annals of Surgery*, July, 1903) which depends for its efficacy on the fact that all but one of its wires run across the long axis of the scar and penetrate for a distance of one or two inches between the tissue layers, where they

are firmly anchored, not by sutures, but by newly-formed scar tissue which Bartlett says fills out the opening of each loop while the patient is in bed after the operation. He purposely bends each of these cross wires into the form of a loop in order that there shall be no sharp irritating ends anywhere, and he lays great stress on the fact that each of these loops should be entirely separated at the free end from its neighbor. Thus the minimum of stiffening is imparted to the tissues by the single longitudinal twist which binds the several loops together in the median line of the contrivance. The last-named wire strand appears necessary to prevent the possibility of a hernia between two of the cross wires, which might easily be forced slightly apart if they were not fastened together at all.

In cases that allow of no accurate determination beforehand, as to the size of filigree desired, Bartlett uses a net which differs slightly in its construction from that just described. No median wire twist binds the cross loops together; however, Bartlett compensates for this by sewing the filigree in place with a continuous suture of fine wire, being careful to loop the suture around each point of crossing in the filigree.

J. Wiener, Jr. (*Annals of Surgery*, April, 1906) reports seven cases in which he used Bartlett's filigree. The first patient, a man, aged 34, had a ventral hernia. The gap was filled in with silver wire sutures passed from side to side so as to make a filigree. Sixteen months after the operation there had been no recurrence and the patient was perfectly comfortable. The second patient, a man, aged 30, had an oblique right inguinal hernia for three years and a left sided hernia for one year. The wide gap was bridged over by a continuous suture of silver wire so as to make a sort of figure-of-eight filigree. The operation was successful. The third patient, a man, aged 53, had a large right inguinal hernia which recurred after operation. A silver wire filigree was sutured over the inguinal canal, and the superficial fascia and skin were brought together with interrupted sutures. Death occurred on the sixth day and was undoubtedly due to the fact that the abdominal cavity could not accommodate itself to the large amount of intestines which had been in the sac.

The fourth patient was a man, aged 37, who had a large ventral hernia in the left iliac fossa the result of a severe trauma. A silver wire filigree, 2x 2½ inches, was placed between the peritoneum and the transversalis muscle; the external oblique was approximated with a running suture of silver wire and the skin with silk. The man made a perfect recovery. The fifth patient, a woman, aged 24, had a large ventral hernia following appendectomy. A hernioplasty was done with resection of gut for gangrene and the abdomen was closed with silver wire. The patient recovered and has been doing arduous housework since the operation.

The sixth patient, woman, aged 30, had a large umbilical hernia of five years' standing which became irreducible. The sac was filled with omentum and one loop of small intestine. The intestine was replaced and the omentum resected. Sutures of silver wire almost completely obliterated the diastasis at the neck of the sac. Three months later, during a severe attack of bronchitis, the patient developed a small hernia below the

umbilicus. Meyer is convinced that if he had put in a filigree in addition to the wire sutures this recurrence would not have happened.

The last patient, a woman, aged 27, had a tumor of the rectus muscle removed. A filigree was placed in the depth of the wound and a second filigree through the oblique muscles. Recovery was uneventful.

CHAPTER VIII.

DIAPHRAGMATIC HERNIA.

Having made the diagnosis of diaphragmatic hernia, abdominal section through the left upper half of the rectus muscle should be undertaken at once, except when the hernia is of the congenital variety and occurs early in life. Symptoms of intestinal strangulation are often the first indication of the existence of a diaphragmatic hernia, and the cause of these manifestations often is not discovered until the abdomen has been opened or during an autopsy.

As a matter of fact, the presence of a diaphragmatic hernia seldom is discovered during life. In but seven of 266 cases reviewed by Lachner was the diagnosis made ante-mortem. Maragliano also reported a case (1897) in which the diagnosis was made during life. In this instance the hernia developed suddenly during a fit of coughing. Air was pumped into the rectum, and it was noticed that thereby the size of the left side of the chest was increased and palpation elicited a tympanitic note. With each insufflation a sound was heard in the fifth intercostal space. Water was then injected and it produced an area of dullness where there had been tympany before.

The abdomen having been opened, a sandbag is placed beneath the shoulder-blades so as to tilt the diaphragm. The intestines, stomach or omentum, as the case may be, are drawn out from the thoracic cavity and the opening in the diaphragm is sutured. Rochard, Schwartz, Perman, Treves, and others advise attacking the hernia through the pleural cavity by means of a resection of the costal arch of the ninth rib. If the hernia is incarcerated, I believe that the thoracic route is the preferable one, but in cases where the hernia is inflamed, ulcerated, strangulated, or gangrenous, when a resection of the bowel must be done, the thoracic route insures less tendency to infect the peritoneal cavity. The bowel is clamped off readily above the diaphragm, and the resection is done speedily. An end-to-end anastomosis completes the operation. The pleural cavity must be drained freely.

Before undertaking the operation for the cure of a diaphragmatic hernia, it is absolutely essential that the stomach be washed out, because otherwise there exists the possibility of the patient becoming drowned in his own vomitus. This precaution should never be neglected in any case of intestinal obstruction.

F. W. McRae (*Trans. South. Surg. and Gyn. Assoc.*, 1894) reports the case of a man who was stabbed in three places, in the back below the scapula, and in the left side, four and one-half inches from the axillary line between the fifth and sixth ribs, three and one-half inches from the

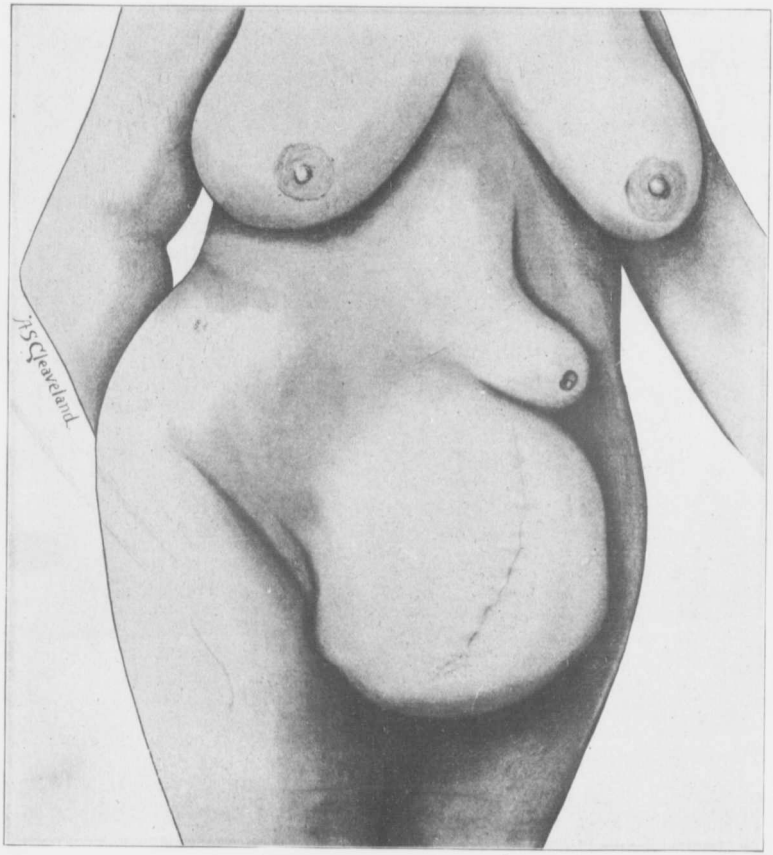

PLATE LVI.

Large Umbilical and Post-operative Ventral Hernias.

(Author's Case.)

nipple. The third wound passed through the tissues and entered the thoracic cavity. The patient was unable to lie down on account of the pain in his side. The wound was closed carefully. The patient recovered from the injury, but the pain continued, and finally, eight months after the injury, hiccough and stercoraceous vomiting set in. To the right of the wound there was an enlargement about the size of a small hen's egg. The diagnosis made was that of hernia or telescoping of the bowel. At the operation the opening in the diaphragm was readily located, and the colon was found completely strangulated. McRae found in the thoracic cavity the entire stomach and greater omentum, about one foot of the small intestine, and the whole of the transverse and a part of the descending colon. All these structures were gangrenous. The wound was closed. The patient died about seven hours afterwards. The strangulation in the case had existed for five days, and McRae is of the opinion that an early operation might have served to prolong the life of the patient.

A second case seen by McRae was a woman, 37 years old, who was taken sick suddenly with severe pain in the left lower quadrant of the abdomen. The abdomen was swollen and tender. The temperature was elevated slightly. Repeated enemata were given, without results. On the third day the patient vomited mucus and fecal matter. At the operation part of the large intestine and a portion of the stomach were found protruding through the hernial opening in the diaphragm on the left side. Breathing became very poor, as soon as air was admitted into the thorax, and mucus, mixed with a little fecal matter, began to run from the nose and mouth. There was general peritonitis. During the closure of the abdomen the patient vomited a large quantity of matter, and "drowned."

Hale and Goodhart (*Trans. Lon. Clin. Soc.*, 1892) report a case of diaphragmatic hernia which was diagnosed as cancer of the stomach, and in which death was caused by vomiting. The patient, a man, aged 49, the subject of a double inguinal hernia, complained of bringing up mouthfuls of a dark, clear mucus, and about every week or ten days he vomited enormous quantities of fluid of a similar character. He had a sensation of heat and pain at the ensiform cartilage. Bowels were obstinately confined. He had been losing flesh for some time. A tympanitic resonance was found posteriorly as high as the middle of the left scapula. There was retraction of the abdomen. The post-mortem revealed a piece of the splenic flexure of the colon entering the thorax through an aperture between the crura of the diaphragm beneath the liver. A portion of the stomach and transverse colon also entered through this opening. The stomach was enormously dilated. A large portion of it was free in the bottom of the left pleura. The sac contained two-thirds of the stomach, a large portion of the transverse colon, the lesser omentum, and the greater part of the pancreas and the duodenum.

In 1900, Funck-Brentano reported a case of congenital diaphragmatic hernia which was discovered at the post-mortem. The patient died from convulsions when fifty-five days old. There was a free communication between the thoracic and abdominal cavities. The left pleural cavity was oc-

cupied by the spleen, and a large part of both the large and small intestines. The lung on that side was compressed to about the size of a bean, and the heart was displaced to the right of the medium line.

I. A. Abt (*Chicago Medical Recorder*, August, 1900) also reports a case of congenital diaphragmatic hernia, occurring in a child born dead. The diaphragm on the left side was almost completely absent, the left thoracic cavity being occupied in large part by the liver. The greater curvature of the stomach occupied the space normally filled by the apex of the lung, and a considerable portion of both the small and large intestines occupied the thoracic cavity.

Walker (*Internat. Jour. of Surg.*, September, 1900) reports a case of diaphragmatic hernia occurring in a man, aged 29, who was injured by a falling tree. There was severe pain in the left chest, which was aggravated by coughing and deep inspiration. Respirations were shallow and rapid; pulse, 145; bowels could not be opened and fecal vomiting ensued. The abdomen became distended. Examination of the left chest showed diminished expansion, amphoric breathing and a tympanitic note at the base of the lung; succussion sounds were heard when the patient was shaken. The apex of the heart was displaced two inches to the right, and the seventh and eighth ribs were fractured on the left side. At the operation a piece of small intestine was found firmly held in a rent in the diaphragm. The bowel was withdrawn and the opening partially closed. Patient recovered.

Klaggs (*London Lancet*, Aug. 6, 1904) collected 53 cases of diaphragmatic hernia of the stomach, including three of his own. Of the whole number, 20 were congenital, 21 were traumatic, and 12 were acquired. The symptoms varied and were irregular. Usually there was disturbance of respiration and digestion, with signs of obstruction and strangulation, and especially tetanus. The physical signs were indefinite.

Stomach and intestinal murmurs were heard in the thorax. The heart was displaced. A murmur was often elicited by passing air into the stomach. Other signs were interference with pulmonary murmur and resonance; alteration in the shape of the thorax; sanguine expectoration and inability to lie on the right side. The lesions found at autopsy were adhesions, ulcer, dilatation and strangulation of the stomach, and obstruction caused by volvulus of stomach or torsion of lesser omentum.

H. B. G. Newham (*Lond. Lancet*, Dec. 24, 1904) saw a man soon after a fall of thirty feet which had caused extensive bruising but no apparent fracture. The stomach and part of the colon occupied the left half of the thorax, displacing the heart to the right. The tear in the diaphragm was supposed to have been produced by sudden and violent muscular contraction. The patient survived two days in spite of much precordial and abdominal pain.

In dealing with this class of hernias, the operator must bear in mind that over ninety per cent. of them have no sac. Grosser studied 433 cases, only 40 of which had a sac. They are, therefore, either true or false, congenital or acquired. The whole left half of the diaphragm may be thinned out and protrude upward, giving rise to symptoms and signs that simulate

a hernia of the diaphragm. This condition was designated by Cruveilhier and Thoma diaphragmatic eventration.

In 1898, at the Chicago Post-Graduate Hospital, I was induced to expose the diaphragm of a young man for a supposed hernia of that muscle on the left side. This young man had what has been termed the operation habit. His appendix had been removed, his gall bladder had been explored, the right kidney had been drained, and an exploratory laparotomy had been done on him. I operated on him for a post-operative hernia following the appendectomy. Nine months afterward he was referred to me again for this supposed diaphragmatic hernia. Knowing of his habit, I observed him for about three days, and then came to the conclusion that he did not have a hernia.

Three days afterward he appeared at a medical meeting and the physician in charge made a positive diagnosis of a left-sided diaphragmatic hernia. The patient was referred to me for operation. I explored the entire lower surface of the diaphragm and demonstrated that no hernia existed, but that the diaphragm was very much thinned and arched much higher than normal. The patient left the hospital two weeks afterward in good condition, having been relieved of many of his supposed symptoms.

I kept this young man under observation for a number of years. He died in a neighboring city of general peritonitis following an operation done for a supposed intestinal obstruction. I was informed that a long and tedious operation failed to reveal any obstruction.

Early in my professional career I delivered a woman of a fully developed boy. The next day the infant began to vomit, and became bloated. He died on the fifth day, with symptoms of obstruction of the bowel. The post-mortem revealed a loop of jejunum passing through the central tendon of the diaphragm.

The surgeon should familiarize himself with the places in the diaphragm where hernias have been found. Irrespective of gross congenital deficiencies, and also apart from injuries of the diaphragm, hernial openings have been demonstrated in the following places: (1) Central tendon (most frequent); (2) muscular portion (posterior inferior); (3) sterno-costal fissures; (4) esophageal opening; (5) lumbo-costal fissures; (6) sympathetic trunk opening; (7) aortic opening; (8) psoas muscle opening, and (9) the opening through which the quadratus lumborum muscle passes.

A diaphragmatic enterocele is shown in Fig. 10, and an epiplocele in the pericardium is shown in Fig. 9.

The results following operation for diaphragmatic hernia are not very encouraging when strangulation has occurred. The mortality is about 95 per cent. It is said that cases have been operated on successfully by Humbert, Leisrink, Postempski and Mikulicz.

CHAPTER IX.

INTERNAL AND INFERIOR HERNIAS.

HERNIA INTO DUODENO-JEJUNAL FOSSA.

Hernia into the fossa of Treitz (duodeno-jejunal) is an indication for the performance of an abdominal section. There are two varieties of this hernia: (a) Right, and (b) Left. In the former variety the superior mesenteric artery lies in front of the sac, and in the latter the superior mesenteric vein is in front of the sac. The incision through the abdominal wall should be made a little above and to the left of the umbilicus.

Although these hernias are always twisted, they are not difficult to liberate, except when adhesions have formed or strangulation has occurred. Then the edges of the ring may be nicked carefully and the opening dilated.

After withdrawing the intestines into the peritoneal cavity, a few stitches of silk or catgut should be inserted to obliterate the ring and prevent a recurrence. The sac may be opened, if necessary, to facilitate the reduction of the hernia.

This form of hernia is comparatively rare, but quite a number of instances are recorded in the literature, and the following citations will serve to explain the nature of these hernias, the method of treatment that is usually adopted to correct them, and the results that may be obtained. It would be useless to cite all the cases that have been reported.

Bingel (*Archiv f. Pathologische Anatomie*, No. 1, 1902) reports a case of hernia into the fossa duodeno-jejunalis occurring in a woman, aged 28 years, which proved fatal in twenty hours. At the autopsy the abdomen contained a large quantity of blood-stained fluid and the coils of the intestine on the right side were distended, infiltrated with blood and covered with a thin, fibrous exudate. The left side of the abdomen was occupied by a tumor reaching from the diaphragm to the pelvis. This tumor proved to be a large peritoneal sac containing enormous coils of intestine and their mesentery. Strangulation was brought about apparently by the escape of a coil of intestine from the sac.

L. L. McArthur (*Surg., Gyn. and Obs.*, January, 1906) cites a case of hernia in the fossa of Treitz consisting of an incarcerated loop of jejunum of which an accurate diagnosis could not be made before laparotomy, and then only after a most exhaustive search through the abdomen. After a careful study of the history of the case it appeared probable that there existed an acute intestinal obstruction, which might be due either to a mechanical or to an infective inflammatory cause. In favor of the mechanical nature of the obstruction was the somewhat gradual onset of the obstructive symptoms, without high fever, and with the appearance of blood

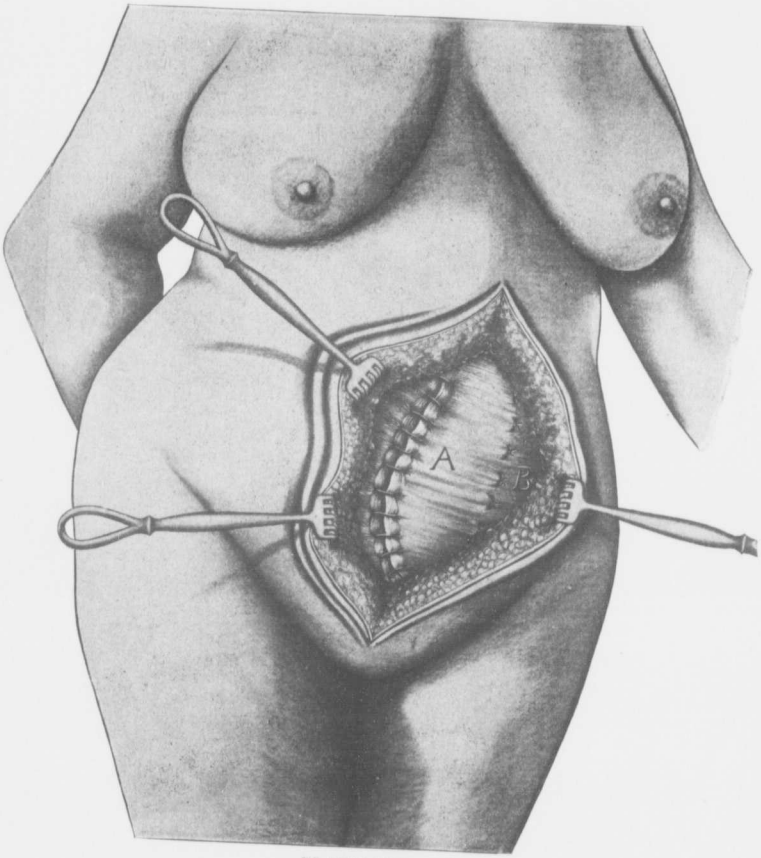

PLATE LVII.

Blake's Operation for Umbilical Hernia Completed.
(Author's Case.)

and mucus in the stools; the blood count, while elevated, not being high enough to be convincing as to the presence of pus. Because of the tenderness over the whole abdomen, the sudden sharp exacerbation of the pains on the second day, and some rise in temperature, attention was directed to the appendix, but without other corroborative signs. Following the eviscerations in the endeavor to find the point of obstruction, almost the entire small intestine was removed from the abdomen before a small loop was found which led to the discovery of the cause of the trouble. The patient made an uneventful recovery.

Two cases of left duodenal hernia are reported by L. Freeman (*Trans. Am. Surg. Assn.*, 1903).

In the case of one of these hernias the sac contained the entire small intestine, the cecum, and a portion of the colon, which was strangulated. The patient, a man, aged 47, following an attack of diarrhea lasting three weeks, developed a severe ileus, with the usual symptoms of acute intestinal obstruction. On opening the abdomen, the cavity was occupied by an immense tympanitic tumor, resembling an ovarian cyst. The small intestine could not be seen, but the colon was felt below and to the right side. The sac was opened, and then was found the entire small intestine, together with the cecum and some six or eight inches of the adjacent colon. There was also considerable foul and bloody serous fluid. In attempting to relieve the condition, it was necessary to resect the cecum, which was gangrenous, together with some six inches of the large intestine and a considerable portion of the small bowel.

The patient's resisting powers were so poor and the operation was so complicated and extended, that death resulted. The entire colon lay in folds on the right side of the abdomen—a congenital condition.

The second case was seen at autopsy. The patient died of gangrene of the small intestine, accompanied by a severe hemorrhage arising from thrombosis of the mesenteric and portal veins. The patient had been subject to indigestion and occasionally experienced slight pains and uneasiness in the abdomen. The sac filled the entire left side of the abdominal cavity, and was well over to the right of the median line. It contained all but six inches of the small intestine, the transverse and descending colon being spread out on its upper and left outer surface, leaving the cecum, colon and sigmoid in their normal position. The mouth of the sac was round and smooth, and easily admitted three fingers. From it emerged the lower end of the ileum to join the cecum in the right iliac fossa. The opening was just to the right of the vertebral column, on a level with the crest of the ileum and toward the dorsal and inferior portion of the sac. There was no strangulation of the bowel or mesentery.

In December, 1906, I had a similar case in private practice. The patient had not been well for a number of years, but complained most of recurrent attacks of pain over the region of the gall bladder. She said that she felt as though something was slipping away behind the stomach. Inspection of the abdomen was negative. Palpation elicited tenderness over the gall bladder and also over the appendix. The gall bladder was enlarged. On

the whole the physical examination did not furnish much evidence on which a diagnosis could be based.

I made an incision through the right rectus muscle, exposing the region of the gall bladder and the hepatic flexure of the colon. The gall bladder was adherent to the right upper border of the great omentum, which in turn was adherent to the lesser curvature of the stomach. To the right of the bladder was a Riedel lobe, extending two and a half inches below the gall bladder. On separating the adhesions between the stomach, gall bladder and omentum, a knuckle of bowel was felt to protrude above the lesser curvature of the stomach. It could be pushed back behind the stomach, but would return immediately. On passing two fingers through the foramen of Winslow, it appeared to be blocked by a resilient mass, which I took to be a hernia. I withdrew the great omentum and transverse bowel out of the wound, disclosing a loop of the upper portion of the jejunum, extending behind the stomach above the duodenum into the lesser cavity of the peritoneum. The bowel was not strangulated, which accounted for the feeling described by the patient of something slipping away from behind the stomach. The sac of the hernia consisted of the posterior layer of the transverse meso-colon. The mouth of the sac easily admitted two fingers.

I pulled the sac out and inserted a circular suture in such a manner as to pucker up the sac on itself, thus obliterating the cavity of the sac, as well as its mouth.

A short time ago Dr. H. W. Gentles referred a case of this kind to me for operation. On opening the abdomen I found a perforation of an ulcer of the stomach near the pylorus on its anterior surface, and a hard mass near the pylorus which was thought to be a carcinoma. (Evidently not the case according to later history.) On attempting to do a gastro-enterostomy the bowel was found to be congested and I also discovered a left complete hernia of the small intestine through the jejunal fossa. The hernia was reduced and the opening in the stomach was closed by a circular suture and strengthened by sewing the falciform ligament as a flap over the seat of perforation. The patient's condition did not warrant performing a gastro-enterostomy. He made an uneventful recovery.

WINSLOWIAN HERNIA.

In this form of hernia the bowel passes through the foramen of Winslow into the lesser sac of the peritoneum. The hernia may be composed of small bowel (Treitz), transverse colon (Majoli), cecum, or the entire ascending colon and a part of the transverse colon (Treves). My own experience with this class of hernias being *nil*, I cannot do better than extract from a recent article by Faure (*Bulletin et Mem. de la Soc. de Chir. de Paris*, No. 12, 1906) who, in a report on a case of intestinal strangulation at the foramen of Winslow, communicated by Jeanbrau and Riche, gives an instructive review of the diagnostic and therapeutic aspects of this rare form of internal hernia. In three-fourths of the recorded cases the strangulated mass consisted of small intestine; and in the remaining fourth of transverse colon which, it has been found, may drag with the ascending

colon and even the cecum, which extension, however, is hardly possible, except in connexion with certain arrests of development, and with persistence of a mesentery common to both small and large intestine. In two cases the great omentum formed part of the herniated mass. The clinical phenomena are those of intestinal obstruction with epigastric or umbilical pain. The sole really important symptom in regard to the diagnosis of the localization of the obstruction is the presence of a swelling in these regions. Hitherto, Faure points out, a precise diagnosis has never been made before the performance of laparotomy, and, it is added, it has often been found difficult even after exposure of the abdominal contents.

Attention is directed to the anatomical researches of Jeanbrau and Riche, made with the view of devising some effectual method of relieving, by incision of the margin of the foramen of Winslow, the intestinal constriction. It has hitherto been assumed that the numerous difficulties in affording such direct relief are insuperable, as incision of the margin of the foramen is rendered impracticable by the contiguity of the vena cava behind, of the portal vein in front and on the left, of the common bile duct in front and on the right, and the Spigelian lobe above. Jeanbrau and Riche have suggested a method of dilating the foramen by attacking its lower boundary in the interspace between the vena cava and the portal vein. Faure, regarding the procedure of these surgeons as complicated, dangerous, and ineffectual, suggests one which, though simple in theory, is not unlikely in its practical application to be found very difficult. He proposes to incise the peritoneum along the descending portion of the duodenum to the level where the membrane passes from the posterior abdominal wall to the second portion of this intestine. By means of the finger introduced through this incision the vena cava can be separated from the duodenum, the head of the pancreas, and the portal vein, and the inferior margin of the foramen of Winslow be thus relaxed. If in a supposed case of strangulated hernia through the foramen of Winslow, and, indeed, in other varieties of internal strangulation, the patient be in an alarming condition, and the intestine much distended, Faure would abstain from prolonged exploration and free handling of the abdominal viscera, and would establish a false anus above and as close as possible to the umbilicus. If the patient recovered, a second operation, should such be required, could be performed under much more favorable conditions for the removal of the obstacle and the reduction of the herniated intestine. Such procedure, though less brilliant, would, it is argued, be more successful than that proposed by Jeanbrau and Riche of making an incision in the wall of the distended intestine for the discharge of its contents, and then proceeding to explore and, if possible, to dilate, the seat of the constriction.

(*Rev. de Chir.*, XXVI, No. 5) contributes an article based on personal clinical experience in one instance, and eighteen cases found in the literature.

When the patient is examined soon after the occurrence of the hernia, a round, circumscribed tumor is noticed in the epigastrium or at the umbilicus, but it soon blends into the increasing general distension of the entire abdomen. This early tumefaction is important for the diagnosis. It may

be directly in the center or more toward the right, and its center may coincide with the umbilicus or lie considerably above it, but always below the costal arch. In none of the cases on record was the trouble correctly diagnosed. In some it was overlooked even at the laparotomy. The small intestine is generally involved. The stomach is forced forward and the afferent loops of intestine are distended and held immovable under the liver, high up to the right. No hernial sac is visible except in the rare cases in which the intestine has slipped between the two sheets of the great omentum. When the finger is able to trace the course of the incarcerated intestine, the pulsations of the large hepatic artery can be perceived. In the 11 cases in which an operation was undertaken it proved to be too late to save the patient in all but four instances. An incision into the intestine should be made to evacuate it, after which reduction of the hernia is easy. There is a sheet of loose cellular tissue, between the vena cava and the duodenum, through which it is easy to expose the lower part of the foramen of Winslow after incising the anterior sheet of the lesser omentum over the upper duodenum, parallel to its longitudinal axis.

Delkeskamp (*Beitr. z. Klin. Chir.*, XLVII, No. 2) relates the particulars of a case of intra-abdominal hernia through the foramen of Winslow. Immediately after a normal child-birth in a woman, aged 22, signs of intestinal obstruction developed, the symptoms growing progressively worse. The abdomen was opened on the seventh day after delivery, and the hernia was reduced without much difficulty.

INTERSIGMOID HERNIA (POSTERIOR).

The intersigmoid fossa is not present always. Treves found it in 52 per cent. of 100 bodies examined. The fossa is located over the bifurcation of the left iliac vessels, and the sigmoid artery lies above and to the right side of it. The fossa extends upward along the left ureter.

According to Treves, only 4 cases of hernia into the intersigmoid fossa were reported up to 1899. Three of these were strangulated and proved fatal. The only treatment to be adopted is abdominal section, and this, too, affords the only means of making a diagnosis of this condition.

Fowler, in his *Textbook on Surgery*, quotes Jonnesco as saying that a hernia in this situation has been observed only twice. This statement does not agree with that made by Treves.

MESOCOLIC HERNIA.

A sharp line of differentiation must be drawn between intra-abdominal protrusions of the intestines and internal hernias. A loop of bowel protruding through a slit in the mesentery or omentum cannot be considered a hernia unless there is a sac. An exploratory laparotomy must be done in order to make a diagnosis, and also to carry out proper treatment.

Peacock, of London, England, reported two cases of mesocolic hernia, one occurring in a woman of thirty who died on the ninth day of an attack of illness which terminated by effusion on the brain. There were no symptoms referable to the abdomen. At the autopsy the whole of the small in-

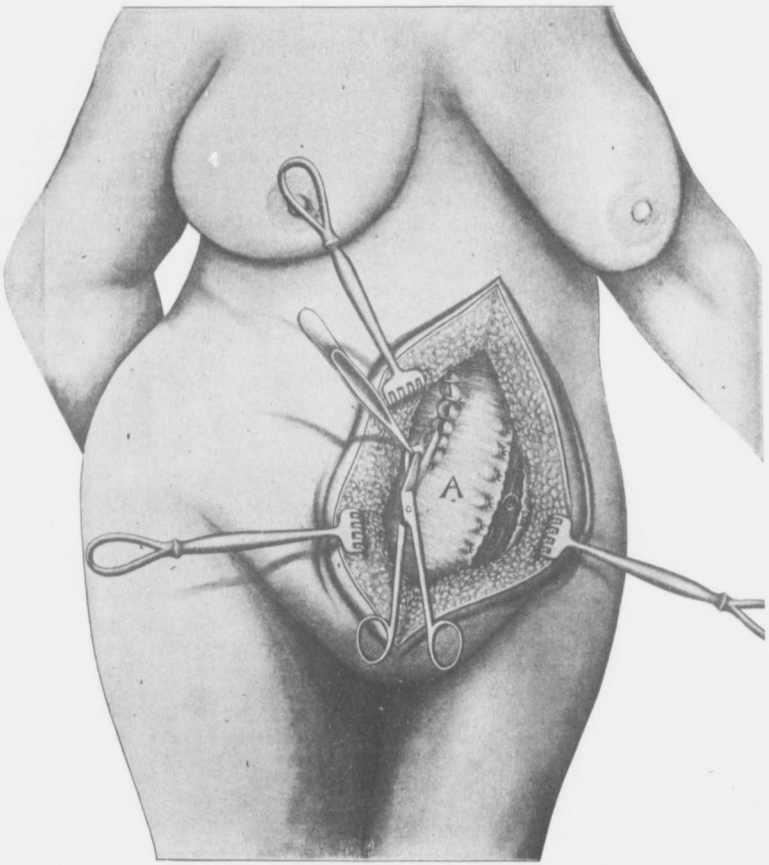

PLATE LVIII.

Ferguson's Modification of Blake's Operation in Suitable Cases.

(Author's Case.)

testine was found in a hernial sac, situated between the folds of the meso-colon. The left half of the transverse colon was found deflected in a longitudinal direction down to the middle line as far as the brim of the pelvis. The patient had had a large tumor which projected on each side of it. The jejunum entered the sac at the upper and posterior part, while the ileum passed out below, and on the right side, at a point about two inches above the termination of that intestine in the cecum. There was no appearance of any constriction having been exercised on the intestine.

In a second case, a man, aged 27, death resulted from strangulation of the intestines. The man had pain in the abdomen and vomited fecal matter. He died about forty-one hours after the onset of his symptoms. The descending colon was found on the left side of the cecum and the small intestines were contained in the sac formed between the two layers of the left meso-colon and situated on the left side of the descending colon. The ileum passed out of the sac about two inches above the cecum, and at that point the canal of the intestine was contracted, its coats thickened, inflamed, and gangrenous.

ILEO-COLIC HERNIA.

In the neighborhood of the appendix, cecum and termination of the ileum are fossæ which may be the seat of occurrence of a posterior hernia. Hernia into the ileo-colic fossa is so rare that Treves felt himself impelled to say that the ileo-colic fossa takes no part in the production of pericecal hernias.

E. R. Secord, of Brantford, Canada (*Annals of Surgery*, Nov., 1906) reports a case of ileo-colic hernia, the first to be placed on record. It may not be amiss at this time to report the case rather fully.

The patient, a white male, aged 40, complained of recurring abdominal pain, obstinate constipation, retching and some vomiting. The pain was spasmodic in character, recurrent, and becoming progressively more severe. The abdomen was slightly distended, especially on the right side. There was no board-like rigidity, but a feeling of resistance over the right rectus muscle, and general tenderness over the whole right lower quadrant. On observing the abdomen for a few moments, it was noted that with the onset of the pain an elevation or tumor, of about the size of an orange, became evident below and to the right of the umbilicus, which was doughy, tender, tympanitic, and localized in the one position.

The abdomen was opened by an oblique incision over the appendix region. What appeared to be the distended and markedly-congested cecum and colon appeared in the wound, which, however, on closer examination showed themselves to be covered by an additional layer of peritoneum; the parietal peritoneum had of course already been well opened. This additional layer of peritoneum was quite thin, fairly transparent, and easily movable over the subjacent bowel. External to this mass was another loop of what appeared to be colon. Following this latter loop upward it appeared to be continuous with the ascending colon, but on following it downward to the appendix region no caput coli or appendix could be discovered;

and on searching more inwardly a taut band was found running in an oblique direction downward and outward from the root of the mesentery, roughly, in a direction toward the anterior superior spine. The colon bulging out from beneath this band was without the additional layer of peritoneum noticed above and on slight traction being made on this loop of colon it slipped out from beneath the band, followed by the cecum with the appendix, and the terminal four inches of the ileum. These portions of the bowel were all distended and markedly congested, and in one area on the outer surface of the cecum the bowel-wall was ecchymotic, and in the center of this a small whitish slough was situated. This slough was looked for and found, since on withdrawing the bowel from under the above mentioned band, a fecal odor had immediately become noticeable.

The pouch of peritoneum left by the withdrawal of its contained intestines was shaped much like a rubber tobacco-pouch, with its mouth about an inch and a-half across, pointing in a downward and inward direction. When filled the size of the pouch would be somewhat greater than that of the folded fist.

The mouth of the pouch was closed by a single row of catgut, attaching the taut anterior fold to the anterior layer of the mesentery of the lower end of the ileum.

The patient recovered.

ILEO-CECAL HERNIA.

Aschoff (*Berliner Klinik*, Heft 100, Oct., 1896) reports one case of ileo-cecal hernia in which operation was successful. The patient was seized suddenly with pain in the right side of the abdomen. For twenty-one days symptoms of chronic intestinal obstruction manifested themselves, leading to a diagnosis of cancer. The abdomen was opened for the purpose of doing a right inguinal colotomy, when the ileo-cecal hernia of the small intestine was discovered. The hernia was reduced and the patient made a good recovery.

In 1846 (*London Medical Gazette*, page 125), John Snow described a case of this variety of hernia occurring in a young woman who died on the fourth day with symptoms of acute intestinal obstruction. A sac was found at the site of the ileo-cecal fossa, which admitted the finger for about two inches. Nasse and Riese have reported similar cases.

SUBCECAL HERNIA.

Jonnesco collected 11 cases of subcecal hernia, 7 of which were strangulated, the remaining 4 being reduced with ease. The treatment is early abdominal section with reduction of the hernia.

HERNIA OF PELVIC FLOOR.

After two attempts to correct a complete hernia of the pelvic floor, Crile finally succeeded by performing an operation which he describes (*Cleveland Medical Journal*, July, 1906) as follows:

With the patient in the Trendelenburg posture, a median incision of

good length was made; approximately one-fourth of the entire abdominal contents were withdrawn from the hernial sac, the pelvic floor steadied and the hernia reduced. The bladder was found well down in this cavity and totally prolapsed. An anteroposterior incision was made across the middle of the floor of the pelvis, dividing the vagina into two lateral halves. The vaginal mucous membrane of the part to be brought through the abdominal incision was removed. The bladder was separated from the vagina for some distance downward. It was then found that the vagina and the floor of the pelvis had been so stretched that they could easily be brought out through the abdominal wound beyond the surface of the skin. After making an incision through the abdominal fascia 4 cm. from the median line on each side, the fibers of the recti were separated and the peritoneum perforated. Each half of the split vagina with the attached uterosacral and uteropelvic ligaments and all the other structures of the floor of the pelvis, together with the round and broad ligaments, were drawn out through these openings on each side of the median incision.

While the parts were well up in place so that the top of the incised vagina presented closely against the under surface of the peritoneum, the latter was sutured in this position with plain catgut.

The original peritoneal incision, the muscle and the external fascia were then closed, the latter by continuous sutures of chromicized gut, after which the freed ends of the vagina and pelvic floor, which had been drawn up through the lateral openings in the peritoneum, recti and fascia, were united in the middle line by means of chromicized gut. The skin was then closed. The patient made a good recovery from the operation and was discharged in three and one-half weeks.

For some time after the operation the patient felt a sensation of dragging on the wound and experienced some pain. This passed away after several months. She has been doing her usual work, and at the present time, more than three years after the operation, there has been no recurrence of the hernia. Crile says the indication for this operation exists only in the cases of complete hernia (procidentia). In the minor degrees of prolapse it would be quite impossible to carry out this technic for want of sufficient length of ligaments and of vagina to reach to the external fascia.

CHAPTER X.

STRANGULATED HERNIA.

Strangulation of a hernia is by no means an uncommon occurrence, and it is not because of its frequency that a special chapter is being devoted to it. But every now and then the strangulation produces a condition which of itself is of sufficient interest as well as importance to the patient to warrant making special mention of it.

In looking over the literature I found a number of instances which it seemed to me could be cited with profit in this connection. For instance, Makins (Lon. Clin. Soc. Trans., Vol. 36) reports two cases of strangulation which led to gangrene. One patient, aged 87, had had an irreducible right inguinal hernia for sixteen years. It became strangulated. Six inches of intestine were very much inflamed, and there was one gangrenous spot with a small perforation in its center. On account of the condition of the patient, four Lembert stitches were inserted in such a manner as to invert the gangrenous area. The bowel was washed. The patient made an uneventful recovery.

The second patient was 9 years old. He had a scrotal hernia. There was no vomiting and no constipation. On opening the sac a foul-smelling, bloody fluid escaped. The bowel and omentum were found in the sac. The strangulated area, about three-fourths of an inch in diameter, was found to be gangrenous. This patch was invaginated by means of four Lembert stitches, and complete recovery followed.

A case of partial enterocele reported by C. T. Dent (*Trans. Lon. Clin Soc.*, Vol. 15, 1881) is unique, because the patient was a male. The symptoms corresponded with those described by Littré. The sac on being exposed was thick and inflamed, with a very slight stricture at its neck, which was divided. With very slight pressure the hernia was reduced. A few days after the operation persistent diarrhea set in and the patient died on the sixth day. The intestine, seven feet below the pylorus, showed a dark, semi-gangrenous ring, which had evidently corresponded to the neck of the sac and had been constricted by it. A portion of the intestinal wall only, corresponding to the centrally more healthy part included in the ring, had formed the hernia. A diverticulum sprang from the intestinal wall, remote from the attachment of the mesentery. Some four feet below this point there was evidence of an intense enteritis over a considerable extent and wholly unconnected with the hernia.

J. Hutchinson, Jr., (*Lon. Clin. Soc. Trans.*, Vol. 33) reports two successful cases of primary resection of a gangrenous small intestine during a herniotomy. The first patient, a woman, aged 40, had for two years had a hernia of about the size of a hen's egg, situated in the left groin, just below

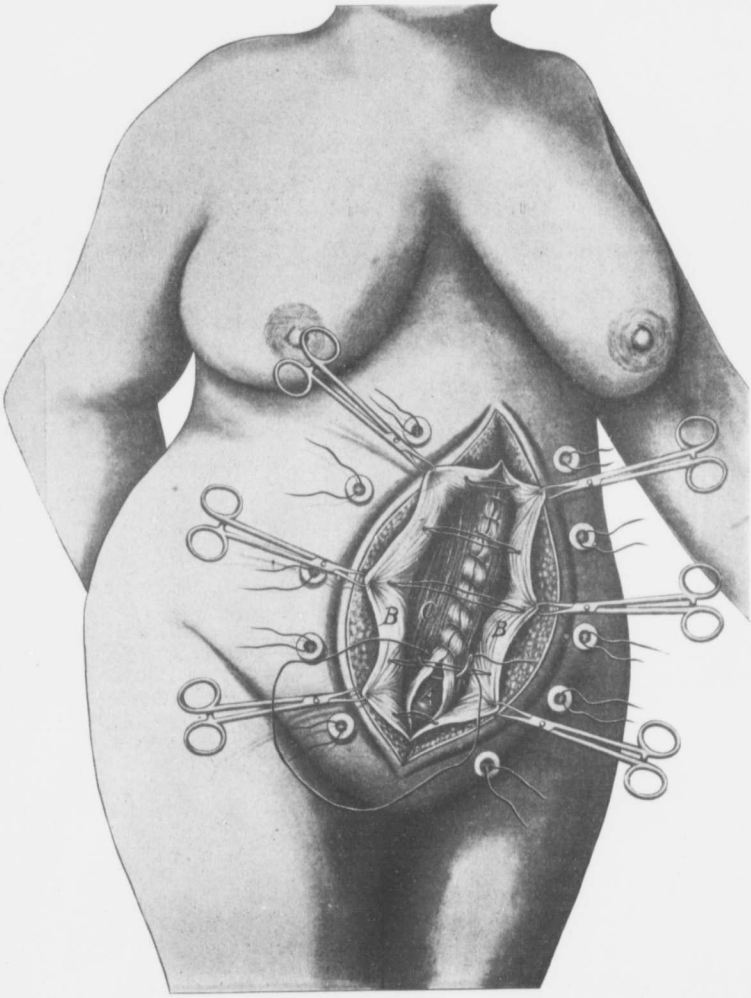

PLATE LIX.

Ferguson's Modification of Blake's Operation in Suitable Cases.
(Author's Case.)

Poupart's ligament, and external to the spine of the pubes. The tumor was irreducible. On opening the sac it was found to contain 6 or 8 drams of a reddish serum and a knuckle of small intestine. Owing to the condition of the bowel, the abdomen was opened, and five inches of gut were excised. The ends were united by a double row of sutures. The patient made an uneventful recovery. After six years there was a return of the femoral hernia, but it was controlled easily by a combination of plate and truss.

The second patient, a man, aged 29, had a strangulated right inguinal hernia. The intestine was black and in a state of beginning gangrene for about eight inches of its length. Ten inches of bowel were resected by Maunsell's method. Three years afterward the patient suffered from inflammation of the colon and died. The resected portion of gut did not show the slightest trace of a narrowing of its lumen. There were no adhesions.

McGavin (*Trans. Lon. Clin. Soc.*, Vol. 36) reports a case of strangulated inguinal hernia in which reduction *en masse* was effected by taxis, but the patient died. For nine years the man had a right inguinal hernia, which had always been reducible and never caused strangulation. The rupture suddenly came down and he was unable to get it back. A physician reduced it, whereupon he felt great pain in the abdomen and vomited immediately. On the following day the vomiting became stercoraceous. For six days neither flatus nor motion was passed. The patient died from general peritonitis. The post-mortem revealed the reduction *en masse* and the continuation of the strangulation.

In the *Northern Lancet* of November, 1889, I reported a case of strangulated hernia occurring in a man who had worn a truss for a number of years. The hernia became strangulated as the result of severe exertion. Efforts to reduce it by taxis proved unavailing. In addition to two or three ounces of bloody fluid, the sac contained a loop of bowel about ten or twelve inches long, very much congested and ecchymosed, but not gangrenous. The patient made a good recovery. It is particularly interesting to note in this case that the operation was not done until twenty-four hours after strangulation had taken place, the patient meanwhile driving thirty miles over a rough country road seeking relief.

Among twenty-five cases of strangulated hernia, reported by G. T. Vaughan (*Medical News*, Dec. 24, 1904) there were two of the properitoneal or interstitial variety.

J. C. Da Costa (*Annals of Surgery*, Feb., 1899) reports two very interesting cases. In one instance purulent clots were found in the accessory veins of the cord. A microscopic examination of these clots showed that they contained staphylococcus pyogenes albus. In the other case, that of a man who suffered from prolapse of the rectal mucous membrane, and who also had a reducible hernia on the left side, operation failed to effect a cure. The prolapse was finally excised and the mucous membrane sutured. On the evening of the third day while having a violent attack of coughing he was seized with pain in the abdomen and he then found that the rupture had come down. It was painful and irreducible. While attempting its re-

duction there was audible a crackling sound as though air was diffused through the tissue. The crackling could be traced from the left to the right side, apparently along the course of the colon.

An incision was made, the hernia exposed and the sac opened. The hernia was found to consist of the large bowel, and within the meso-colon was a collection of air which crackled when pressed on. The ascending, transverse and descending meso-coli were in the same condition. The wound was closed. On examination of the rectum there was found above the line of stitches an ulceration which had apparently followed the cauterization. When the bowel was pressed on air escaped from the ulcer in distinct bubbles. A tube was introduced through the opening and carried into the subserosa so as to permit of the escape of the emphysematous material, which occurred in about five days. The patient recovered.

The coils were evacuated by three separate incisions, and the incisions were closed by Lembert sutures. The sac was not removed because of the condition of the patient, but the peritoneal cavity was shut off from the external wound by means of a strong silk ligature, which was passed around the neck of the sac in the subperitoneal tissue in such a way that when it was drawn taut it closed the opening as the string of a bag closes its opening. The patient recovered.

Knaggs (*Annals of Surgery*, April, 1900) reports two cases of hernia in which strangulation was caused by volvulus.

C. A. Porter (*Boston Medical and Surgical Journal*, Oct. 10, 1901) reported a case of strangulated inguinal hernia which had been converted into a properitoneal or interstitial hernia by attempts made by the attending physician to reduce it. The sac and a portion of its contents were found between the parietal pertoneum and the transversalis fascia, having no relation to the inguinal canal.

A case of strangulated hernia complicated by volvulus is reported by Parker (*Trans. Lond. Clin. Soc.*, Vol. 17). The bowel was liberated and pulled down in making an artificial anus. The patient continued to retch and vomit after the operation, and no fecal matter passed through the colostomy wound, nor *per vias naturales*. A median incision revealed a volvulus involving six or eight inches of the bowel situated near the internal orifice of the femoral ring. The patient died.

A very unusual case is reported by Marsh (*St. Bartholomew's Hospital Reports*, Vol. 10, 1874). A boy, aged five months, had a strangulated inguinal hernia and was operated on, but died on the twelfth day from erysipelas of the scrotum and the abdominal wall. The strangulation occurred at the external abdominal ring, but when this was divided the bowel was returned easily without opening the sac. Everything went well until the erysipelas set in.

Marsh (*Trans. Lond. Clin. Soc.*, Vol. 30) reports another case, one of left-sided strangulated hernia, in which there was no fluid in the sac, but the included coils of small intestine were densely distended with a blood-stained serum, mucus and a small amount of fecal matter. The sac contained about two feet of small intestine.

That strangulation may occur as the result of trauma is shown by the case reported by T. M. Jones (*Central States Medical Monitor*, Aug. 15, 1906). His patient had a strangulated right inguinal hernia which extended half way into the scrotum. It had existed for about two years but never caused any trouble. The patient wore a truss. While playing polo, he was struck by a ball in the right iliac region. Two weeks later he began to feel a dull pain in the lower abdomen and on attempting to reduce the hernia he was unable to do so. The strangulation was relieved by operation but the condition of the patient did not improve. Shock continued and death ensued twelve hours after the operation. Autopsy showed complete strangulation of the small intestine in half a dozen places in the ileum and the jejunum by bands of fibrous tissue which closed the lumen of the bowel as completely as if it had been ligated. The adhesions doubtless were the result of the trauma of two weeks previously.

Clogg (*British Medical Journal*, October 20, 1906) collected 53 cases from the literature of strangulation of the appendix in a hernial sac. In the majority of these cases the appendix was the sole content of the sac. Only three cases occurred in males. I agree fully with the statement of Clogg that a correct diagnosis rarely is made in these cases, and that they are usually taken to be cases of ordinary strangulated hernia. As a rule, these hernias are of small size, and are easily reducible when the attempt at reduction is made early. Only rarely does the entire appendix lie in the hernial sac, the apex being usually the most advanced point. Adhesions are not common.

A case of displaced strangulated femoral hernia is reported by Bryant (*Trans. Lond. Clin. Soc.*, Vol. 35). The sac with its contents was displaced downward and inward, through an opening at the lower end of the femoral sheath, and in front of the adductor muscles on the inner side of Scarpa's triangle. The tumor was tender on pressure and the patient manifested symptoms of obstruction of the bowel. Although the patient was moribund, an operation was done, but proved fatal. It was found that the hernia was displaced into the fatty connective tissue of the inner side of the thigh, the seat of strangulation being an inch and a half below the femoral ring.

J. J. Buchanan (*Medical Record*, October 8, 1904) reports a case of umbilical hernia in which strangulation occurred that is interesting, not because of this fact, but because of the sequence of events and the final outcome of the case. The patient, female, aged 48, had had a large umbilical hernia for about seven years. For about one year it had been irreducible, and then suddenly became strangulated. In opening the hernial sac a small incision was made into the gangrenous bowel, and most of its contents were removed by expression. The opening was then temporarily closed with a ligature. The entire mass of intestine which was so large as to simulate the bulk of the gastro-intestinal tract, was in a state of complete gangrene. The hernial ring was divided, traction was made on the gangrenous contents in an effort to deliver the adjoining portions of bowel, but without avail. The peritoneal cavity was protected by a large quantity of iodoform

gauze packed around the base of the mass. The surface was covered with a gauze dressing. The patient improved at once.

At the end of a week the gangrenous mass, though collapsed, was still attached. A few days later the bulk of the mass was cut away. Examination showed that the mesenteric portion of a part of the bowel remained, due to the fact that the meso-cecum and the meso-colon of the splenic flexure were too short to permit the passage of the entire cecum and splenic flexure through the ring, and that the line of mortification had passed through the wall of these parts of the bowel longitudinally, leaving the distal part alive, and its mucous membrane forming the surface of the mass protruding from the ring. The destroyed intestine was the free surface of the cecum, the ascending and transverse colon, with the distal border of the splenic flexure. At a subsequent operation the ileum was implanted into the sigmoid by simple continuous suture. The patient made a normal recovery.

P. Leech (*Lancet*, June 6, 1903) reports a case of strangulated left duodenal hernia in which the symptoms of strangulation developed slowly. No cause could be found for the obstruction. Other treatment failing to give relief, a laparotomy was done. When the abdomen was opened the small intestine was seen to be under the mesentery and a diagnosis of retroperitoneal hernia was made. The sac looked obliquely upward and to the right. The anterior lower margin was thickened and rigid. The finger could be passed into the sac and about a foot of intestine was withdrawn. The abdomen was closed and the patient made a good recovery.

A case of strangulated obturator hernia is reported by J. Mason (*St. Bartholomew's Hospital Reports*, Vol. 27, 1891). The patient did not come to his notice until some months after the strangulation had occurred. For fifteen years she had noticed two swellings in the right groin which occasionally became very painful, and at these times she suffered considerably from vomiting and general indisposition. The symptoms usually began with bearing-down pains in the groin and down the thigh. On some occasions relief was obtained by enemata, on others without any treatment but rest. Suddenly symptoms of acute obstruction supervened. Under symptomatic treatment, such as the use of enemata and gentle taxis, followed by the application of a properly constructed truss, the patient made a complete recovery. Reduction was best effected with the limb very slightly flexed and everted, the outer side of the knee still resting lightly on the bed.

CHAPTER XI.

HERNIA IN INFANTS.

Quite a number of instances are recorded in the literature of operation for hernia done on very young infants. Audion (*Presse Medicale,* Dec. 30, 1889) reports a successful operation for umbilical hernia done on an infant one hour after birth. The hernia was reduced and three layers of sutures were inserted. Stolypinski also reports such a case. Benedict operated on an infant three hours old, and Hinkson operated ten hours after birth. Barton did a radical operation, which was successful, on an infant thirty-three hours old. All of these operations were done for umbilical hernias. C. MacLaurin (*Lancet,* May 5, 1900) reports a successful operation for strangulated hernia on an infant, fourteen days old, and E. D. Fenner (*New Orleans Medical and Surgical Journal,* September, 1899) and D. Power (*Lancet,* Sept. 30, 1899) each report a case of successful operation for strangulated inguinal hernia done on patients five months and three months of age respectively. J. O'Connor (*Lancet,* August 26, 1899) reports 150 cases of radical cure of acquired oblique inguinal hernia in infants, with one death and two recurrences. Fraenkel (*Centralbl. f. Chir.,* No. 47, 1900) cites the histories of 68 children, 16 of whom were nurslings, operated on to effect a radical cure of inguinal hernia. In order to prevent inflammation of the wound, he wraps the lower part of the body in a fixed bandage, and covers the wound with impermeable dressings until it has healed.

J. E. Briscoe (*Lancet,* Sept. 10, 1898) reports a successful operation for strangulated hernia done on an infant twenty-one days old. It is interesting to note in this case that the bowel was invested tightly by the peritoneal tube throughout the entire inguinal canal. The sac appeared to terminate abruptly at the inner ring, thus causing the physical signs to resemble those of an inflamed hydrocele.

Lilienthal (*Medical Record,* March 2, 1901) reports a case of strangulated inguinal hernia occurring in an infant eight days old. The contents of the sac consisted of sigmoid, ascending colon and appendix, together with a large part of the small intestine. The child was operated on successfully.

Kellock (*Lancet,* July 5, 1902) records a case of bilateral strangulated hernia occurring in an infant ten weeks of age. He operated, but two days later there developed an inguinal hernia on the opposite side. It was reduced easily. Fifteen days later, however, it became strangulated and an operation had to be done.

Reid (*New York State Journal of Medicine,* 1903) operated successfully on a case of strangulated hernia in an infant twenty-seven days old.

W. B. Coley has operated on 11 patients under two years of age, with only one death. Six were under one year of age.

Corner (*Lancet*, Aug. 20, 1904) believes in the curability of hernia in young children by means of a truss, except in cases of large, uncontrollable hernias, in irreducible or difficultly reducible or incarcerated hernias, and in strangulated hernias, when there is a congenital sac. Corner is not alone in this belief, which is held by many operators of large experience.

H. J. Stiles (*British Medical Journal*, Oct. 1, 1904) records 360 consecutive operations, 26 per cent. of which were done on infants under one year of age. Unlike Corner, Stiles does not believe in mechanical treatment. He says that in cases in which the hernia was supposed to have been cured by wearing a truss during childhood, strangulation is likely to occur in adult life as the result of a strain. Stiles had five deaths in his series. In 24 of his cases the cecum was found in the sac, and in 5 of the 36 cases of inguinal hernia occurring in girls, the sac contained the ovary and tube.

The operation employed by Stiles was practically the one devised by Banks, isolation and ligation of the sac at the neck on a level with the internal ring without splitting the aponeurosis of the external oblique muscle. To close the canal he says all that is necessary in the majority of the cases is to introduce a single catgut suture through the outer pillar of the ring close to Poupart's ligament across the canal, superficial to the cord, and then introducing it from within outward through the conjoined tendon and the inner pillar of the ring.

Schenk (*Prager Med. Woch.*, No. 1, 1900) reports a case of congenital lateral ventral hernia occurring in an infant. The hernia was about the size of a walnut, and was situated on the right side between the ribs and iliac crest. The abdominal wall at this point was weak, and the knee, when strongly flexed on the abdomen, fitted into the gap in the muscles.

CHAPTER XII.

UNUSUAL FORMS OF HERNIA.

Many unusual forms of hernia have been recorded in the literature by various observers. As a rule the diagnosis was not made until at the time of cutting down on the tumor. A number of these instances have been mentioned already in the first chapter of Part I, in connection with the contents of the hernial sac, and I will now cite from the literature a few cases that are of more than passing interest, not only because of the infrequency of their occurrence, but also because they are quite likely to be mistaken for some condition other than hernia. The old saying that "there is nothing new under the sun" often is exemplified in surgery, especially in the dislocation of a viscus.

Greenhow (*Trans. Lond. Clin. Soc.*, 1880) reported a case of intestinal obstruction caused by a hernia through the mesentery of a Meckel's diverticulum, which had retained its attachment to the umbilicus. The patient, male, 7 years of age, presented symptoms that pointed both to intussusception and to appendicitis. There was no evidence of the existence of a peritonitis until the day of death. Intestinal peristalsis was suspended, but there was not complete obstruction. The ileum was very much distended. Attached to the abdominal wall opposite the umbilicus was a fibro-fatty cord half an inch in length, which passed on to the extremity of a well-developed Meckel's diverticulum, which was nearly equal in calibre to the ileum from which it sprang. Except for its attachment at the umbilicus, this diverticulum was free for about two inches, but the remaining one and one-half inch, together with several coils of collapsed ileum, appeared to be included within the ring-like opening situated in the diverticular mesentery. The ring was formed by a loop-like, fibro-fatty cord passing from the diverticulum above to the general mesentery across the ileum, nine and a half inches of which had passed through the ring. Besides the diverticulum a knuckle of bowel had been forced through the ring, thus completing the strangulation.

One case of rupture of Douglas' cul de sac, with protrusion of the uterine appendages through the vulvar orifice is reported as having occurred in a woman, 50 years of age. I have also seen one such case, which I have reported elsewhere.

A. R. Moulton (*Philadelphia Med. Jour.*, March 16, 1906) reports a case of rupture of the rectum which was followed by hernia of the small intestine.

A rare case of strangulated recto-cecal hernia was reported by Marion (*Gaz. heb. de. Med. et Chir.*, April 11, 1901). The patient, a woman, had signs of intestinal obstruction, but on opening the abdomen the in-

testine was found engaged between the cecum and the iliac fossa. It was freed and the patient recovered.

An instance of a right cecal hernia complicated by hydrocele and suppurative appendicitis is reported by R. C. Turck (*Jour. A. M. A.*, April 26, 1902). The patient had had a right inguinal hernia for over sixty years, and a small hernia on the left side about twenty years. The appendix, testicle, hydrocele and hernial sac being agglutinated together, were removed *en masse*. The patient recovered.

The fourth case on record of extraperitoneal crural cystocele is recorded by S. Mercadé (*Gaz. des Hop.*, July 3, 1902). The patient, female, aged 53, had a small femoral hernia on the right side. A diagnosis of epiplocele was made, and at the operation a slightly pyriform body was found next to the omentum. On cutting into it a gush of urine showed it to be the bladder.

Two very rare forms of hernia, obturator hernia of the bladder and of the Fallopian tube, were noted by R. J. Gladstone (*Annals of Surgery*, December, 1901). On the right side a U-shaped loop of the Fallopian tube was found lying, together with a portion of the mesosalpinx, within a small peritoneal sac. On the left side a corner of the bladder wall anterior to the line of reflection of the peritoneum was found firmly fixed to the beginning of the obturator canal.

F. Flaherty (*American Medicine*, June 21, 1902) reports a case of traumatic hernia of the diaphragm following a wound of the thorax. The patient fell on a hay-knife, which penetrated between the seventh and eighth ribs, on the left side, at the anterior axillary line and emerged between the tenth and eleventh ribs close to the spine. He presented symptoms of obstruction of the bowel. Necropsy showed the stomach filled with gas, and filling the left chest except a small part above where the collapsed lung was found. The opening in the diaphragm was three inches in length, and in its passage through it the stomach carried along part of the great omentum.

C. E. Black (*Illinois Medical Journal*, Jan., 1904) reports a very remarkable case of hernia of the ovary, appendix and Meckel's diverticulum into an inguinal sac. The appendix was gangrenous and had ruptured, and six inches of bowel had to be resected, together with the appendix, tube and ovary.

W. A. Dennis (*St. Paul Medical Journal*, Oct., 1905) records a successful operation for traumatic diaphragmatic hernia following a severe contusion of the left thorax from the end of a buggy pole. The blow was received just behind the eighth chondro-costal junction, and while not penetrating was of sufficient force to confine the patient to bed for three months. The symptoms which led to the operative intervention did not manifest themselves until eighteen months after the reception of the injury. The hernia consisted of omentum, transverse colon and the greater part of the stomach.

M. Metzenbaum (*Journal A. M. A.*, Oct. 28, 1905) records a case of umbilical hernia perforating the abdominal wall. The hernia was never

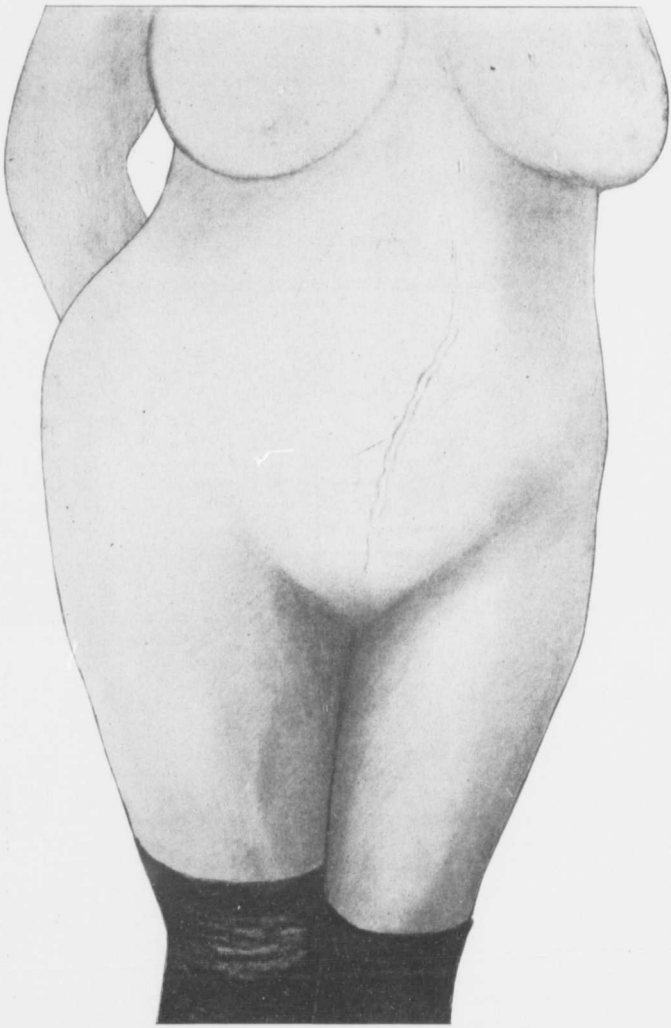

PLATE LX.

Final Result of Operation for Umbilical Hernia.
(Author's Case.)

reducible. At the operation it was found that nearly all of the small intestine, together with cecum and appendix and a large portion of the omentum, comprised the hernia. Loops of intestine were grown together with masses of the abdominal fat and omentum, and in many places were firmly adherent to the abdominal wall itself. It was for these reasons that the hernia was never reducible.

Another case of umbilical hernia containing a diverticulum of congenital origin is reported by A. J. Landman (*Lancet*, Nov. 11, 1905), as occurring in a child one day old. The tumor was of about the size of an orange, and its coverings consisted of the constituent elements of the umbilical cord. The sac contained small intestine, one part of which consisted of a blind diverticulum, and this was the part adherent to the sac wall.

Although Richter's hernia is believed to be of rather rare occurrence, V. W. Low (*Lancet*, Jan. 28, 1905) reports four cases under his care inside of a year. The patients were women who had right-sided femoral hernias.

Oliver (*Annals of Surgery*, May, 1901) cites three cases of properitoneal hernia. The first two cases belong to that group in which the hernia lies in the subperitoneal layer. The third case belongs to the group in which the hernia lies between the internal and external oblique muscles. One of the cases was not discovered until the necropsy.

L. J. Mitchell (*American Journal of Medical Sciences*, Nov., 1903) describes two cases of retroperitoneal hernia. Both occurred into the paraduodenal fossa.

C. T. Andrews (*Lancet*, Jan. 24, 1903) discovered one case on the post-mortem table.

A. E. Halsted (*Annals of Surgery*, May, 1906) reports a case of strangulated inguino-properitoneal hernia occurring in a man fifty-two years old, who had had a right inguinal hernia for six years. It finally became as large as two fists. A truss was worn with satisfaction. During a severe strain the hernia slipped from under the truss and attempts at reduction failed. Hot applications were made, and after an hour the hernia was reduced, but the swelling did not disappear, as on former occasions. The pain was lessened, but did not subside entirely. The large tumor had disappeared, but there was present in the inguinal region a small mass which was exceedingly sensitive to touch. The inguinal canal was empty. With the finger in the canal, a tumor could be felt above and to the inner side of the external abdominal ring, in the abdominal wall. After exposing the external abdominal ring, a sac was found extending from the ring down into the scrotum. The inguinal sac contained a small quantity of bloody serum. On pulling down on the inguinal sac the neck of the second sac was brought into view. It contained a small knuckle of intestine and a piece of omentum, dark in color and edematous. It was freed from the skin, drawn out beyond the point of constriction, ligated and cut off. The stump was pushed back into the abdomen. With the re-

placement of the omentum the knuckle of gut was freed and dropped back into the abdominal cavity.

The second sac was found to occupy a cavity between the peritoneum and the transversalis fascia. The cavity containing it was above and to the inner side of the inguinal canal. The sac opened by a common orifice with the first sac into the abdominal cavity. This sac was not as large as the first. The common neck of the two sacs was incised beyond the abdominal orifice, and the resulting opening in the peritoneum closed by suture. Recovery with cure of the hernia resulted.

The second case was one of left inguino-interstitial hernia, occurring in a man, aged 65, who had had a large inguinal hernia for about thirty years. A truss retained the hernia for part of this time. At the operation the hernial sac was found to extend from the external ring down into the scrotum. It was empty. The aponeurosis of the external oblique was incised from the external to the internal ring, exposing the neck of the second sac. This sac was about three and a half inches long, and communicated with the first or inguinal sac. Both sacs opened into the abdominal cavity by a common orifice, which admitted two fingers. The second sac lay beneath the aponeurosis of the external oblique, resting on the internal oblique. It contained a loop of intestine about six inches in length, which was not adherent and which was readily replaced into the abdomen. A purse-string suture was passed around the common neck of the two sacs, and these were removed. The abdominal cavity was closed by tightening the purse-string suture. The hernia was cured.

Other instances of interstitial hernia have been reported by Auvray, Mueller, Fredet, Bruno, and others.

F. T. Stewart (*Phila. Med. Jour.*, Feb. 9, 1901) reports a case of enormous ventral hernia occurring in a woman 40 years of age. The contents of the sac consisted of the lower half of the stomach, of all the transverse colon, the omentum and most of the small intestine. The sac was emptied under great difficulty, but the patient made a speedy recovery.

English (*Trans. Lon. Clin. Soc.*, Vol. 17, p. 270) reports a case of a man, aged 62, who presented himself for the relief of a very large abdominal hernia at the right semi-lunar line. It measured 16 inches in the vertical diameter and 13 inches in the transverse. It had existed twelve years.

In my own practice I had a case of hernia following vasectomy in a patient twenty-two years of age, from whom I removed the right epididymis, vas deferens, and seminal vesicles. On account of the persistent hemorrhage the cavity was packed very firmly from the internal abdominal ring down to the base of the bladder. The packing was removed at the end of a week and renewed. Within six months the patient returned with a hernia of that region. I operated after my method, and the man has remained cured for more than four years.

Two years ago I saw in consultation with Dr. Albert Peacock, of Chicago, a woman who was pregnant about three months. She complained of a vague pain in the pelvis, which I found was due to a knuckle

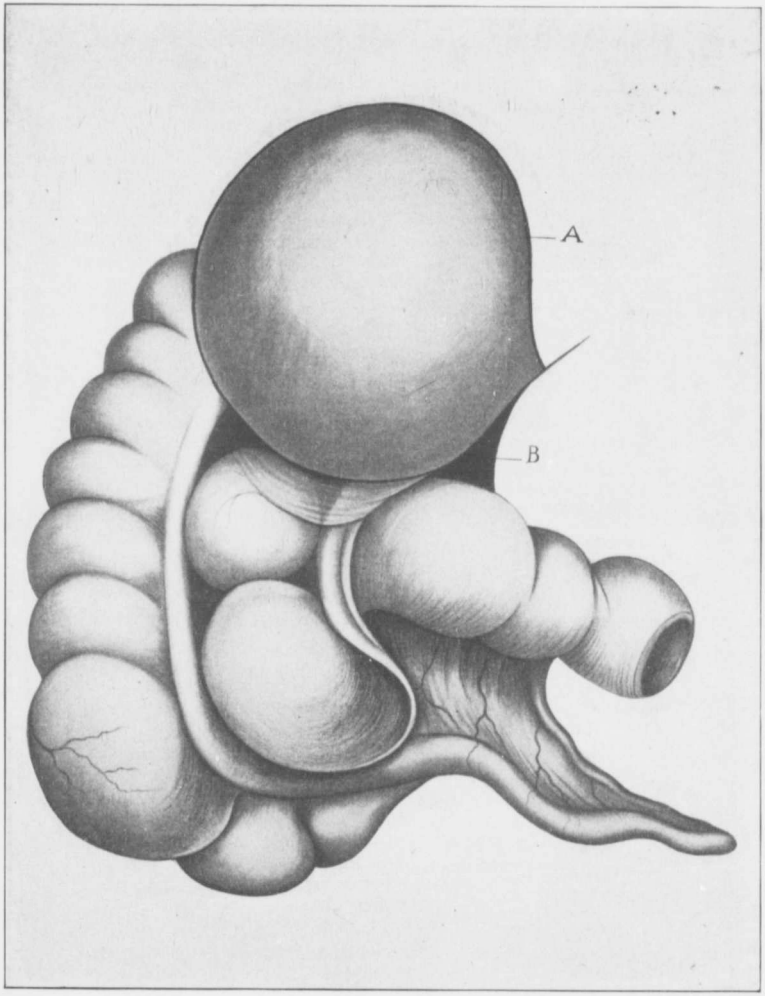

PLATE LXI.

Hernia Into Ileo-colic Fossa. (Secord's Case.)

A. Hernial sac. B, Mouth of sac.

of bowel descending behind the cervix through Douglas' pouch. It was covered on the vaginal side by a very thin membrane. It was deemed advisable to treat the patient on the expectant plan; therefore tampons of gauze were inserted so as to keep the bowel reduced until after parturition. The patient went on to the termination of her pregnancy without any further trouble. The hernia has not been noticed since, and the woman has not applied for any relief.

I have had two cases of right oblique inguinal hernia following a direct trauma. One of the patients, a young man, 28 years of age, was pitching sheaves when his hand slipped and the end of the pitchfork struck him in the right inguinal region, tearing the internal oblique muscle from its attachment to Poupart's ligament. The pain was so intense that the young man went to bed. On examination I felt a distinct deficiency in the inguinal region, and at the time of the operation, which was done immediately, I found that the internal oblique muscle had been torn away from Poupart's ligament, and that the internal ring had been enlarged to the size of the end of the pitchfork handle. I restored the parts to their normal position by suturing the redundant transversalis fascia over the slackened peritoneum, without opening the peritoneal cavity, and the internal oblique muscle to Poupart's ligament, closing the wound in the usual manner. The patient made a perfect recovery.

The other patient was walking around the barn in the dark and fell down, his inguinal region striking the sharp corner of a board. He remained in bed for about a week, when he felt sufficiently recovered to return to his work. Three months afterward he applied to me for relief from a hernia into the scrotum which he could not retain with a truss. I operated and found that the internal oblique muscle had been torn from Poupart's ligament almost up to the anterior superior spine. The internal abdominal ring was very much enlarged. The typic operation was done and a cure was effected.

Another case of traumatic hernia through the left rectus muscle occurred in a very strong man who was doing some work on the highway with a scraper. The implement inflicted a very severe wound opposite the umbilicus at about the center of the left rectus abdominis muscle, the force of the impact being sufficient to lift him bodily and throw him at the horse's feet. Although he complained of some tenderness in that region, the hernia did not develop sufficiently to be diagnosticated until six years afterward. At that time I opened his abdomen and found a hernial protrusion of the bowel through the left rectus muscle, at the site of the original injury. A cure was affected by laparotomy.

Another very curious case was that of a man who acquired an epigastric hernia as the result of carrying a flag, the end of the staff resting on his abdomen below the ensiform cartilage.

Another man developed an epigastric hernia from the use of a spokeshave, which he had employed for making shingles and ax handles for about twelve years. He attributed the injury to the fact that while making an ax handle the end of it was placed against the abdomen just above the

umbilicus, and the spoke-shave was drawn toward him. Both these cases were operated with satisfactory results.

I had one patient who suffered from six hernias (Fig. 1), two epigastric, one direct and one indirect inguinal hernia, one femoral, and one interstitial, subcutaneous hernia. The banner case is that of a woman who presented ten very distinct hernias, two femoral, two oblique inguinal, a large ventral hernia through the scar of an old hysterectomy wound, one ventral hernia following a nephrectomy, three forms of umbilical hernia external and visible, and one interstitial umbilical hernia extending between the transversalis fascia and the rectus muscle. This last-named hernia became partially strangulated, and gave the indication for the operation. I operated on all these hernias at one sitting, and the patient made an uneventful recovery.

The umbilical hernia had been operated on by the late John B. Hamilton some years previously, and when it returned, and several of the other hernias had developed, the woman went to him for advice. He refused to operate because she was syphilitic.

The hernias, with one exception, were comparatively small. The operation was done inside of two hours, and for two years at least she remained cured. Since then I have lost track of her.

Some time ago I saw a man who had been operated elsewhere for a double oblique inguinal hernia by the Bassini method. Both hernias recurred and there also developed two direct inguinal hernias. I performed the typic operation for the oblique inguinal hernias, and the lower angle of the wound was protected after the method of Bloodgood, transplanting the right rectus muscle.

I encountered a very unusual form of vesico-rectal hernia in a man, 27 years of age, who, while working in the field, allowed his bladder to become over-distended. He fell from a sheaf of wheat, striking the pubic region very severely. He had a very severe pain in the pelvis, and although he felt the desire to urinate, he was unable to do so. I saw him twenty-four hours afterward, and immediately catheterized, but failed to get any urine. I examined him per rectum, and found a large mass protruding into the bowel and filling the true pelvis. Suspecting this mass to be the bladder, I passed a silver catheter and removed more than a quart of urine. As the urine was being withdrawn, the tumor in the pelvis gradually diminished in size, until it completely disappeared.

With two fingers in the rectum, I pressed the sac back into the bladder and then inserted a self-retention catheter, asking the patient to leave it in place for three days, which he did. I saw him again on the fourth day, and found that he was able to retain and void his urine at will.

Eight years ago, at the request of Dr. Donald Macrea, Sr., of Council Bluffs, Iowa, I operated on a child, one week old, for a funicular hernia of the small intestine. The distended cord, which formed the sac, became gangrenous and ulcerated. The coils of intestine were agglutinated. I removed the entire umbilicus, released the agglutinated intestines, and returned them into the abdominal cavity. After flushing the peritoneal cavity

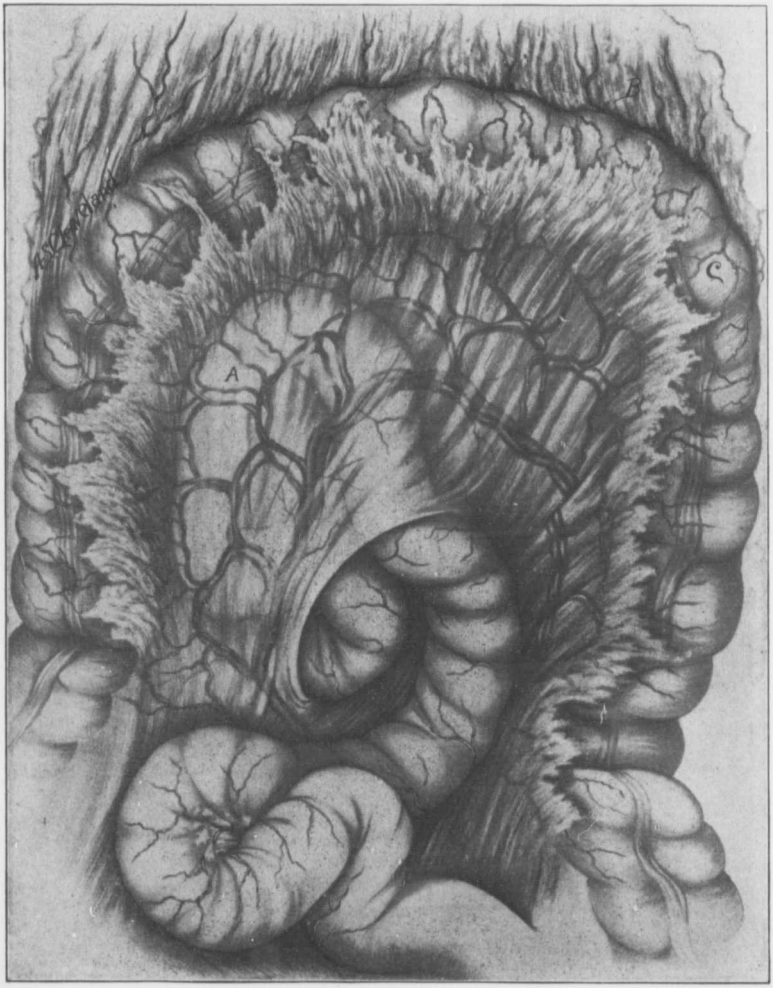

PLATE LXII.

A. Loop of jejunum into lesser cavity of omentum. B. Great omentum.
C. Transverse colon.
(Author's Case.)

with normal salt solution, the wound in the abdominal wall was closed with interrupted stitches of silkworm gut. Unfortunately, the child died of exhaustion about five days afterward. There was no evidence of peritonitis or of infection elsewhere.

CHAPTER XIII.

LOCAL ANESTHESIA IN HERNIA OPERATIONS.

Although I do not approve of the use of local anesthesia in operations for the cure of hernia, it is of more than passing interest to review in this connection the work that has been done by J. A. Bodine (*Medical Record*, October 21, 1905). Bodine has operated on 284 patients, with 300 hernias, under local anesthesia, without a death or suppurating wound. By means of Schleich's infiltration method the amount of cocain is reduced to a minimum and limited to a small area, producing acute local anemia, effectually retaining the fluid in one spot. Cocainization of a sensory nerve trunk, abolishing pain sensation in the region supplied by it, renders it possible to operate for hernia by its use. The operative area is superficial, and the region restricted by the anatomy of the parts. In strangulated hernia, local anesthesia does not increase the shock, while general anesthesia is often too great a load to be borne. The local anesthetic permits of the application of hot towels to a possibly gangrenous intestine for some time, in order to determine whether it will react. The operation does not give rise to the danger of injury to the nerve fibers. The danger to a line of deep sutures from vomiting is done away with. There is no danger of cocain poisoning with the small dose necessary—that is, one-half grain injected intermittently throughout an hour. Morphin given after the operation would act as an antidote were poisoning possible. The operation is more thorough because of the absence of haste and the lack of need to save the patient pain. There are no evidences of pain during the operation. The cocain solution should be made fresh. The solution is 0.2 per cent. for infiltration of the skin and nerve trunks, and for subdermic infiltration half this strength is used. The line of skin incision should be infiltrated throughout its extent sufficiently tightly to maintain the local anesthesia for an hour. The aponeurosis of the external oblique requires no infiltration. It should be incised over the situation of the underlying ring; the ilioinguinal nerve will be exposed by retracting the flaps, and its trunk is then cocainized by a few drops of the solution. The incision may be carried painlessly into the external ring, and the flaps reflected to expose Poupart's ligament and the conjoined tendon. The iliohypogastric, if found, may be cocainized. The margins of the internal ring are infiltrated. A line of infiltration along the long axis of hernial protrusion permits a clear cut through the hernial sac and coverings. The neck of the sac is infiltrated, dissected away from the underlying cord, ligated, and amputated. The genitocrural nerve is cocainized. The sac is dissected away from the cord, and the operation is completed.

Operation on the female is easier than on the male, because the round ligament is less sensitive than the cord.

J. H. Bloodgood has also made use of local anesthesia in hernia operations. He believes that it is especially indicated in cases of strangulated hernia, and in cases where the hernia is very large.

From 1897 to 1899, a period of two years, 49 herniotomies were performed at the Johns Hopkins Hospital under cocaine anesthesia. In the majority of these cases the administration of a general anesthetic was either deemed unnecessary or it was contraindicated.

In 1902 Frank Martin reported 4 herniotomies done under subarachnoid anesthesia. One of the patients was 68 years of age, a confirmed alcoholic, with marked cardio-vascular changes, chronic bronchitis, and nephritis. No ill-effects followed the operation.

Alexander Lyle did fifteen herniotomies under cocaine anesthesia, with most excellent results.

INDEX.

A

Page.

Abdominal cavity, exploration of ... 69
wall, repair of large defects in ... 315
wall, weak points of 9
Abscess of scrotum 197
prevention of stitch-hole 143
Actinomycosis, following herniotomy . 193
Adhesions, separation of 43
Age, influence of on herniotomy 33
Alcohol as an antiseptic 110
Alcoholism and herniotomy 34
Andrews' imbrication operation for inguinal hernia 267
Anesthesia, local, in herniotomy 358
Antiseptics 109
Appendectomy after herniotomy 172
Appendix, in hernial sac.....19, 20, 21, 22
retention cyst of in sac 21
strangulation of in hernial sac .. 341
Arms, disinfection of 119
Auto-intoxication 89

B

Bacilli, varieties of 85
Bacteria, biologic division of 85
classification of 84
pyogenic 86
where found in body 90
Bacteriology, surgical 83
Baldwin's operation for femoral hernia290
Ball's operation for femoral hernia... 289
operation for inguinal hernia 250
Banks' operation for femoral hernia .. 289
Barker's operation for femoral hernia. 289
Barnhill's operation for inguinal hernia 263
Bartlett's filigree 315, 316
Bassini's operation for femoral hernia 290
operation for inguinal hernia 229
operation, results from .....
.....202, 293, 204, 207, 208
Beck's operation for inguinal hernia .. 242
Benjamin's operation for inguinal hernia 246
Bicycling in hernia 279
Bishop's operation for inguinal hernia 259
Bladder, diseases of following herniotomy 167
diverticulum of in sac 19
hernia of into rectum 66
hernia of through pelvic outlet 19
injury of during herniotomy 168
in sac 19
Blake's operation for umbilical hernia 307
Bloodgood's method, results from ... 203
Blood pressure, observations on 150
Boeckel's operation for umbilical hernia 308
Boric acid 115
saturated solutions of 54
Bowel, perforation of 198
resection of 198
Bronchitis, post-operative 191
Butler's operation for inguinal hernia 258

C

Canal of Nuck, hydrocele of 198
Carbolic acid 109
acid solutions, preparation of..53, 54
Castration, following herniotomy 168
Catgut, Abbott's chromic 127
Abbott's chromic iodized 127
Abbott's iodized 127
as a source of infection 94
Bartlett's 128
cumolized 127
Esmarch's 124
Ferguson's 129
formalin 129
formalin chromic 129
iodized 128
Lockwood's 124
Ochsner's 128
preparation of 45, 46
sterilization of 123, 124, 127, 128
von Bergmann's 124
Cecum, hernia of 19, 22
Cellulitis of round ligament 198
Champonniere's operation for umbilical hernia 313
Chicago Hospital operating room technic 52
Chlorine 116
Chloroform poisoning, resuscitation in 150
Coley's operation for femoral hernia.. 300
Colostomy, results from 213
Condamin's operation for umbilical hernia 313
Constitutional diseases and herniotomy 37
Cooper's operation for femoral hernia 289
Copper sulphate 105
Coprostasis complicating hernia 193
Cord, anterior transplantation of 219
injuries of 169
posterior transplantation of 203
transplantation of 203
Corrosive sublimate 110

Cryptorchidism and herniotomy 63
Curtis' operation for femoral hernia... 300
Cushing's operation for femoral hernia 289
Cystitis, post-operative 168
Cystocele, diagnosis of difficult 19
extraperitoneal crural 346
Czerny-Banks method, results from 203, 204
Czerny's method, results from 204
operation for umbilical hernia 313

D

Dauriac's operation for umbilical hernia 308
Davis' operation for inguinal hernia .. 260
Deaver's operation for inguinal hernia 264
operation for umbilical hernia 308
De Garmo's operation for femoral hernia 298
Dentu's operation for inguinal hernia. 260
Diaphragm, hernial openings in 323
Disinfectants, chemical 102
Drainage 137
Dressing, removal of primary 142
Dressings, after herniotomy 138
after herniotomy on children 141
Duplay and Cozin's operation for inguinal hernia 253

E

Electricity in hernia 278
Enterocele 20
partial, in a male 336
Enterostomy for tympanites 163
Eserine salicylate in peritonitis 184
Exudates, traumatic 173

F

Fabricius' operation for femoral hernia 290
Fallopian tube and ovary, hernia of 25
hernia of 25, 26
Fasting, prolonged, before herniotomy 313
Ferguson's anatomic operation in inguinal hernia 280
method, complications following .. 220
method, results from 215
operation for femoral hernia 289
Fever, primary 187
secondary 187
Filigree, Bartlett's 315, 316
for closing wound 315
Meyer's 315
Phelps' 315
fecal 192
Fistula, urinary 192
Formaldehyde 105
Fowler's operation for inguinal hernia 234
Freeman's operation for inguinal hernia 268
Frey's method, results from 203, 204

G

Gauze, sterilized, preparation of 54
Gersuny's operation for umbilical hernia 313
Girard's operation for inguinal hernia 238
Gloves, rubber 121
rubber, when should be worn..... 122
Glycosuria, temporary, in hernia 193
Graser's operation for umbilical hernia 310
Gratschoff's operation for inguinal hernia 274

H

Halsted's method, results from 207
operation for inguinal hernia 230
Hammesfahr's operation for femoral hernia 303
Hands, care of 119
chlorinated lime in disinfection of 121
disinfection of 57, 116
disinfection of by permanganate of potash and oxalic acid 121
Fürbinger's method of disinfecting 121
Kocher's method of disinfecting ... 120
Pearson's method of disinfecting .120
Harrington's solution 105
solution, preparation of 54
Harris' wire suture operation in inguinal hernia 270
Heat, sterilization by 100
Hematemesis 159
Hemophilia and herniotomy 32
Hemorrhage, capillary 154
capillary control of 157
control of 40, 134
from vessels of cord 154
primary 154
secondary 157
treatment of persistent from loop of bowel 157
Hernia, absence of internal ring in... 196
anterior 14
cecal, complicated by hydrocele and appendicitis 346
classification of abdominal 13
classification of femoral 14
classification of inguinal 14
clinical varieties of 16
condition of sac in 15
congenital diaphragmatic .321, 322, 323
congenital lateral ventral 344
contents of sac of 15
diaphragmatic 318, 322
diaphragmatic, indications for operation 66
diaphragmatic, results following operation on 323
diaphragmatic, traumatic 346
direct inguinal, indications for operation 64
displaced strangulated femoral 341
en bissac 9, 196
enormous ventral 350
epigastric, indications for operation 65
femoral, indications for operation . 65
femoral, radical cure of 289

femoral, results of operation for. 202, 208
following vasectomy 350
frequency of occurrence in sexes.. 10
funicular, of small intestine 354
ileo-cecal 334
ileo-colic 333
indications for operation 32
inferior 15
influence of intra-abdominal pressure in 10
inguinal, following trauma 353
inguinal, of ovary, appendix and Meckel's diverticulum 346
inguinal, recurrence after operation 214
inguinal, results of operation for 202, 208
inguinal, without sac 22
inguino-interstitial 350
inguino-properitoneal 349
in infants 343
internal 15
intersigmoid 330
interstitial 339, 340
into duodeno-jejunal fossa 324
into paraduodenal fossa 349
lateral 15
Littre's, of cecum 21
meso-colic 330
mortality of radical operations 210, 213, 214
oblique inguinal, indications for operation 58
of bladder and oviduct 346
of cecum 22
of Fallopian tube 26
of female pelvic organs 25
of Meckel's diverticulum 22
of non-gravid uterus 25
of ovary 26
of ovary and tube 25
of ovary without tube 25
of pancreas 22, 25
of pelvic floor 335
of pregnant uterus 25
of seminal vesicles 25
of tube without ovary 25
of uterus 29
of vagina 29
peritonitis complicating 174
posterior 14
prevalence of 10
properitoneal 339, 340, 349
retroperitoneal 349
Richter's 349
strangulated 336
strangulated duodenal 342
strangulated obturator 342
strangulated rectocecal 345
strangulated, results of operation for 209, 210
strangulation caused by volvulus . 340
strangulation of as indication for operation 33
suppuration in wound as cause of relapse 32
strangulation of umbilical 341
subcecal 334
superior 15
through Douglas' cul de sac ..345, 353
through foramen of Winslow ... 328
through mesentery of Meckel's diverticulum 345
through rupture of rectum 345
traumatic 9
traumatic epigastric 353
umbilical, containing congenital diverticulum 349
umbilical, indications for operation 64
umbilical, perforating abdominal wall 346
unique case of femoral 22
unusual forms of 345
ventral, indications for operation .. 65
ventral, results of operation for.. 208
vesical, indications for operation .. 66
vesico-rectal 354
Hernias, eponymic 16
following appendectomy 65
inferior, indications for operation 66
internal and inferior 324
internal, indications for operation 66
multiple 354
operated on by laparotomy 313
Herniotomy and alcoholism 34
and appendectomy combined 254
and constitutional diseases 37
and cryptorchidism 63
and mental conditions 37
and obesity 60
and occupation 59
and syphilis 37
and tuberculosis 34
bicycling after 279
cutaneous complications following. 164
electricity for cure of 278
femoral, Baldwin's method 290
femoral, Ball's method 289
femoral, Banks' method 289
femoral, Barker's method 289
femoral, Bassini's method 290
femoral, Coley's method 300
femoral, Cooper's method 289
femoral, Curtis' method 300
femoral, Cushing's method 289
femoral, De Garmo's method 298
femoral, Fabricius' method 290
femoral, Ferguson's method 289
femoral, Hammesfahr's method ... 303
femoral, Herzen's method 299
femoral, Houston's method 289
femoral, Kammerer's method 294

femoral, Lotheissen's method 300
femoral, Macewen's method 289
femoral, Marcy's method 289
femoral, McBurney's method 289
femoral, Mikulicz's method 294
femoral, Nicoll's method 297
femoral, Ochsner's method 299
femoral, Polya's method 293
femoral, Schwartz's method 303
femoral, Socin's method 300
femoral, Sprengel's method 303
indications for 58
indications for immediate 63
influence of age on 33
influence of habits and disease on. 34
influence of sex on 34
inguinal, Andrews' imbrication method 267
inguinal, Ball's method 250
inguinal, Barnhill's method 263
inguinal, Bassini's method 229
inguinal, Beck's method 242
inguinal, Benjamin's method 246
inguinal, Bishop's method 259
inguinal, Butler's method 258
inguinal, Davis' method 260
inguinal, Deaver's method 264
inguinal, Dentu's method 260
inguinal, Duplay and Cozin's method 253
inguinal, Ferguson's anatomic method 280
inguinal, Fowler's method 231
inguinal, Freeman's method 268
inguinal, Girard's method 238
inguinal, Gratschoff's method 274
inguinal, Halsted's method 230
inguinal, Harris' wire suture method 270
inguinal, Herring's method 245
inguinal, Hoffman's method 280
inguinal, Kennedy's method 260
inguinal, Kocher's method 230
inguinal, Lanphear's method 237
inguinal, Leving's method 250
inguinal, Macewen's method 225
inguinal, McArthur's autoplastic suture in 269
inguinal, Nicholl's method 242
inguinal, Noble's overlapping method 267
inguinal, Owen's method 263
inguinal, Park's auto-suture method 238
inguinal, Phelps' silver wire method 278
inguinal, Poullet's method 253
inguinal, Schwartz's method 249
inguinal, Smith's method 259
inguinal, Stinson's method 245
inguinal, Symonds' method 254
inguinal, Torek's method 254
inguinal, Treves' method 259
inguinal, White's method 259
inguinal, Woelfler's method 249
inguinal, Wiflstein's method 241
in hospital 80
intestinal complications following. 166
in the home 79
intraperitoneal 254
local anesthesia in 358
materials used by author 45
permanent results of 213
preparation of patient for 38
pulmonary complications of 191
radical, general discussion of 282
renal complications of 191
results of 202
shock following 49
special instruments for 44
umbilical, Blake's method 307
umbilical, Boeckel's method 308
umbilical, Champonniere's method 313
umbilical, Condamin's method 313
umbilical, Czerny's method 313
umbilical, Dauriac's method 308
umbilical, Deaver's method 308
umbilical, Gersuny's method 313
umbilical, Graser's method 310
umbilical, Mayo's method 304
umbilical, radical cure of 304
umbilical, Ransohoff's method ... 309
umbilical, Reverdin's method 313
umbilical, Terrier's method 313
umbilical, Warren's method 309
umbilical, Winslow's method 309
vesical complications in 167
vomiting during 158
when should not be performed...33, 34
Herring's operation for inguinal hernia 245
Herzen's operation for femoral hernia. 299
Hesselbach, triangle of, methods of protecting 219
Hoffman's operation for inguinal hernia 280
Horsehair, preparation of 50
Hospital, service staff in 57
Houston's operation for femoral hernia 289
Hydrocele following herniotomy 171
of canal of Nuck 198
Hydrogen peroxide 116

I

Ileus 166
due to tympanites 173
Immunity 98
Incision for herniotomy 132
how to make 133
Infection 89
following herniotomy 84, 171
mixed 89

obscure sources of 97
predisposition to 98
terminal 89
Instruments, disinfection of 102
special for herniotomy 44
sterilization by heat 102
used in hernia operations 39
Intestine, agglutination of 173
pathologic conditions of following herniotomy 166
resection of gangrenous during herniotomy 336
strangulation of following peritonitis 183
stricture of in strangulated hernia. 197
Intoxication, septic 187
Iodine as a disinfectant 114
Iodoform 115
emulsion, preparation of 53
gauze, preparation of 53

K

Kammerer's operation for femoral hernia 294
Kennedy's operation for inguinal hernia 260
Koch's law 90
Kocher's method, results from....204, 208
operation for inguinal hernia 230

L

Lanphear's operation for inguinal hernia 237
Laparotomy, indications for 314
Lavage, gastric, for vomiting 159
Leving's operation for inguinal hernia 250
Liver, congenital hernia of into umbilical cord 22
Lotheissen's operation for femoral hernia 300
Lysol 109

M

Macewen's operation for femoral hernia 289
operation for inguinal hernia 225
Marcy's operation for femoral hernia.. 289
Mayo's operation for umbilical hernia 304
McArthur's autoplastic suture operation in inguinal hernia 269
McBurney's operation for femoral hernia 289
Meckel's diverticulum, hernia of 22
Mental conditions and herniotomy 37
Mercury, biniodide 114
Mercuric chloride as an antiseptic 113
Meyer's filigree 315
Micrococci, varieties of 84
Mikulicz's operation for femoral hernia 294

N

Nephritis, post-operative 191
Nicholl's operation for inguinal hernia 242
Nicoll's operation for femoral hernia. 297
Noble's overlapping operation for inguinal hernia 267
Nurses, duties of 52

O

Obesity and herniotomy 60
Occupation and herniotomy 59
Ochsner's operation for femoral hernia 299
Omentum, amputation of 43
pathologic conditions of 166
suppurating mistaken for hernia .. 198
Operating room, at home 79
care of 53
in hospital 80
Operating sets 54
Operation, indications for 58
Operator, the 77
Ovary and tube, hernia of 25
hernia of 25, 26
Owen's operation for inguinal hernia .. 263
Oxalic acid for hand disinfection 121

P

Pagenstecher's thread as suture material 51
Pain as an indication for herniotomy 72
differentiation of causes of 70, 71
in hernia 69, 70, 71, 72
in peritonitis 177
post-operative 163
treatment of post-operative 164
Pancreas, hernia of 22, 25
Park's auto-suture operation for inguinal hernia 238
Patient, physical condition of before operating 32
Patient, preparation of for herniotomy 73
Peritoneum, injury of 43
Peritonitis, immunizing injections to prevent 183
in hernia 174
pneumococcus 184
post-operative 172
symptoms of 177
symptoms of pneumococcic 184
traumatic 173
treatment of post-operative 179
treatment of traumatic 174
Phagocytosis 98
Phelps' filigree 315
silver wire operation in inguinal hernia 278
Pleurisy, post-operative 191
Pneumonia, post-operative 191
Polya's operation for femoral hernia.. 293
Potassium permanganate 115
Poullet's operation for inguinal hernia 253
Pregnancy, tubal, within hernial sac.. 25
Pulse in peritonitis 178
Pyemia 188

Pyoktannin 115
Pyrexia, post-operative 187

R

Ransohoff's operation for umbilical hernia 309
Resection, results from 213
Respiration, artificial, in treatment of shock 150
Reverdin's operation for umbilical hernia 313
Richter's hernia 349

S

Sac, contents of 10
pathologic conditions of 166
removal of in radical cure 204
varieties of hernial 9
Sal-alembroth 114
Sapremia 89, 188
Schwartz's operation for femoral hernia 303
operation for inguinal hernia 249
Scrotum, abscess of 197
Septicemia 187, 188
treatment of 188
Service staff in hospital 57
Shock, complicating herniotomy 149
in peritonitis 178
latent or delayed 153
treatment of 153
Silk, as suture material 51
Silkworm gut, preparation of 50
Silver nitrate 115
Skin, diseases of following herniotomy. 164
Smith's operation for inguinal hernia.. 259
Socin's operation for femoral hernia.. 300
Spirilla, varieties of 85
Sponges, use of 54
Sprengel's operation for femoral hernia. 303
Steam, sterilization by 101
Sterilization, methods of 100
Stinson's operation for inguinal hernia. 245
Suppuration and bacteria 86
in wound following herniotomy ... 32
Surgery, aseptic 83
Suture, Davison's removable continuous 274
Eastman's single tier 277
Gratschoff's removable continuous 277
Harris wire 270
material, varieties and preparation of 45
McArthur's autoplastic 269
Park's autoplastic 238
removal of 142
Witherbee's removable 274
Symonds' operation for inguinal hernia 254
Seminal vesicles, hernia of 25
Sex, influence of on herniotomy 34
Syphilis and herniotomy 37

T

Temperature, changes in during herniotomy 158
in peritonitis 178
Tendon, obliteration of conjoined..... 197
Tendons, preparation of 49
Terrier's operation for umbilical hernia 313
Testes, atrophy of 197, 198
atrophy of following herniotomy.. 171
sarcoma of 197
undescended in hernia 197
Thread, celluloid, as suture material.. 51
linen, as suture material 51
Thrombophlebitis of accessory veins of cord complicating hernia 339
Torek's operation for inguinal hernia. 254
Treves' operation for inguinal hernia.. 259
Tuberculosis and herniotomy 34
Tympanites, death from 160
enterostomy for 163
post-operative 160
treatment of 163
Tympany in peritonitis 178

U

Uterus, hernia of 29
hernia of non-gravid 25
hernia of pregnant 25
subperitoneal fibroma of causing hernia of bladder 19

V

Vaginocele 29
Vomiting, complicating herniotomy.... 158
gastric lavage for 159
in peritonitis 178
treatment of post-operative 159

W

Warren's operation for umbilical hernia 309
Weight, reduction of before herniotomy 313
White's operation for inguinal hernia. 259
Winslow's operation for umbilical hernia 309
Wire, as suture material 49
silver, in inguinal canal 278
Woelfler's method, results from 202
operation for inguinal hernia 249
Wound, emphysema of 197
protection of from injury 141
Wounds, closure of 134
healing of aseptic 146
infection of 90, 147
secondary secretion in 146
sources of infection of 90
treatment of 146
treatment of infected 147
Wullstein's operation for inguinal hernia 241