HERNIA

HENRY O. MARCY
THE

ANATOMY AND SURGICAL TREATMENT

OF

HERNIA

BY

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WITH SIXTY-SIX FULL-PAGE HELIOTYPE AND LITHOGRAPHIC PLATES, INCLUDING EIGHT COLORED PLATES FROM BOUGERY, AND THIRTY-SEVEN ILLUSTRATIONS IN THE TEXT

NEW YORK

D. APPLETON AND COMPANY

1892
TO SIR JOSEPH LISTER

THIS WORK IS RESPECTFULLY DEDICATED.

IN COMMON WITH A GRATEFUL PROFESSION,
I WOULD ACKNOWLEDGE HIS MONUMENTAL LABORS,
WHICH HAVE REVOLUTIONIZED THE SURGICAL ART.
ESPECIALLY AM I INDEBTED FOR THE FAITHFUL PERSONAL TEACHINGS
WHICH WERE RENDERED TO ME, HIS FIRST AMERICAN PUPIL.
WITHOUT THE STIMULUS AND PROFIT RECEIVED FROM HIS INSTRUCTIONS,
THIS WORK WOULD NEVER HAVE BEEN RENDERED POSSIBLE.
PREFACE.

In offering the following work to the profession, the author has been actuated by the belief that there exists the necessity for the better instruction of the surgeon, as well as of the general practitioner, upon the anatomy and surgical treatment of hernia.

Nearly a century ago Sir Astley Cooper commenced his monumental labors for the better elucidation of this important subject, which resulted in his monograph, replete with illustrations, copies in full size of his anatomical dissections, made with the most painstaking care. This work was soon after followed by the scarcely less valuable treatises of Scarpa and Cloquet.

The student of to-day can consult only with great difficulty these valuable works, since even our large libraries are but exceptionally supplied with them.

The contributions of the last generation have added little of importance to the anatomical or pathological investigations of the subject, and a lifetime devoted to the purpose, under the most favorable circumstances, could scarcely enable one to duplicate the work so well accomplished by these distinguished authors.

I have felt that I could hardly render a better service than by furnishing well-executed copies of the magnificent illustrations contained in these rare volumes, the value of which will certainly be appreciated by every member of the medical profession. Even in the days of Mr. Cooper the expense of his illustrative artistic work exceeded five thousand pounds sterling. Owing to the liberality of the Messrs. Appleton, I have been able to reproduce, by the very best processes of modern art, whatever illustrations have seemed to me of especial value, including, besides the works of these famous masters, the beautiful plates from Camper, Darrach, Langenbeck, Bourgery, Blandin, Cruveilhier, Guthrie, Gay, and others.

The subject of hernia is invested with new interest owing to the revolutionary methods of modern surgery, which make operative measures comparatively safe when
undertaken with proper aseptic precautions, which were formerly fraught with the greatest danger.

The earlier efforts of the surgeon were necessarily limited largely to the relief of strangulated hernia; whereas now the processes of reparation are well defined, and the sufferer afflicted with a pronounced hernia may justly demand of the surgeon a cure of one of the most common and serious disabilities to which mankind is liable. It is not too much to insist that every practitioner of medicine, even if he declines the responsibility of surgical procedure, should carefully familiarize himself in detail with the subject, since the accidental complications incident to hernia occur so frequently that the most limited in practice is often called to the serious consideration of a life issue dependent upon his prompt recognition of the impending danger, and the delay of a few hours only may cause a fatal result. So important did this appear to Mr. Cooper, that he commenced his preface as follows: "No disease of the human body, belonging to the province of the surgeon, requires in its treatment a greater combination of accurate anatomical knowledge with surgical skill than hernia in all its varieties. Symptoms immediately threatening the extinction of life occur at times, and in situations that afford but little opportunity for consulting the authority of others, and demand in the surgeon a prompt resolution and decisive practice. Accurate anatomical knowledge is frequently required to detect the presence of this disease at that period at which alone the milder process of reduction is practicable; and still more is the combination of skill and intelligence necessary to enable the surgeon to meet all the occurrences which may happen when the use of the knife becomes the only method of saving the patient."

While I have availed myself freely of the labors of my predecessors, I give, I trust with judicial fairness, the proper credit to the various operative measures more recently advocated for the cure of hernia, and I have drawn largely from my own experience.

I have practiced and taught the methods advocated for the cure of hernia for the last two decades, and in repeated publications have, from time to time, presented my experiences to the profession.

I append the following brief notes of the early great masters, which can not fail to be of interest.

Henry O. Marcy.
PREFACE.

Peter Camper.—Incones Herniarum, Editæ a S. T. Sommerring, Francof., folio, 1801. These plates represent several important points in the anatomy of inguinal hernia, in the accurate and expressive style of delineation which was peculiar to Camper. It must be observed that, although they were not published till after the author's death, they had been engraved as early as the year 1757.

Astley Cooper, Bart.—Anatomy and Surgical Treatment of Inguinal and Congenital Hernia, London, folio, 1804; Anatomy and Surgical Treatment of Crural and Umbilical Hernia, etc., folio, 1807. This valuable work appeared for the second time in 1827, under the title of Anatomy and Surgical Treatment of Abdominal Hernia, in Two Parts, edited by C. A. Key, Esq., who has added several notes.

Richter.—At the time of its appearance, the work of Richter, originally written in German (Von den Brüchen, 8vo, Göttingen, two vols., 1778 and 1779, second edition in one vol., 1785), and translated into French by Rougemont (Traité des hernies, 4to, Bonn, 1788), was the most comprehensive that had been published on this subject. It will be always valuable for the clearness, good sense, and extensive research, which are conspicuous throughout, and particularly for the description of symptoms, and the practical directions, which derive great weight from the author's long experience. Of the anatomy of ruptures he was quite ignorant; and Scarpa alleges this circumstance as the motive for his publication, Sull'ernie Memoire Anatomico-Chirurgiche, Milano, 1809, in Atlas folio; second edition, Pavia, 1819; translated into French under the title of Traité pratique des hernies, ou Mémoires anatomiques et chirurgicaux sur ces maladies, Paris, 8vo, with Atlas, in folio; and into English, with reduced engravings, in 8vo, by Mr. J. H. Wishart, as A Treatise on Hernia, Edinburgh, 1814.

The expectations which the preceding publications of this consummate anatomist are so well calculated to excite, are completely satisfied by the anatomical accuracy, the taste, the masterly execution, and beauty of the original engravings, and the scientific clearness and simplicity of the accompanying illustrations. The plates of the French translation, although in smaller form than those of the original, are well executed, not only representing all the anatomical facts, but possessing something of the beauty, of those from which they were copied. As this and the English translation are in more common use than the Italian original, I have frequently quoted them in the present work; and for a similar reason I have referred to the French translation, instead of the original German of Richter.

Dr. F. K. Hesselbach, of Würzburg, published in 1806 a tract entitled Anatomico-Chirurgical Treatise on the Origin of Inguinal Ruptures. This was republished in 1814, in an enlarged form, under the title of Latest Anatomico-Pathological Investigations concerning the Origin and Progress of Inguinal and Femoral Ruptures, with
fifteen plates, 4to. It describes shortly but correctly the natural structure of the inguinal region, and the anatomy of inguinal and crural herniae; these subjects being clearly and faithfully represented in the engravings. Although not to be compared, in copiousness of detail and illustration, to the productions of Cooper and Scarpa, the work is creditable to the talents and research of the author, if he was ignorant of the facts previously ascertained and published by those justly celebrated men.

The last-mentioned work of Hesselbach, written in German, was translated into the Latin, and published at Würzburg in 1816, under the title Disquisitiones Anatomico-Pathologicae de ortu et progressu Herniarum Inguinalium et Cruralium, cum tab. xvii, aeneis. The two additional plates contain delineations of an instrument designed to assist the surgeon in detecting the source and arresting the progress of haemorrhage when arteries are wounded in the operation for strangulated hernia.


Recherches anatomiques sur les hernies de l'abdomen; with four engravings, 4to, Paris, 1817. This inaugural dissertation gives a short and clear description of the parts in which inguinal and crural herniae take place; of the cremaster; of the peritoneum, and its prolongation in front of the spermatic vessels; illustrated by several interesting figures.

M. Cloquet.—The Recherches sur les causes et l'anatomie des hernies abdominales, with ten lithographic plates, containing seventy-eight figures, 4to, Paris, 1819, was the thesis produced and published by M. Cloquet in the Concours pour la place de chef des travaux anatomiques. This very instructive and interesting work is founded on researches for which the large hospitals and dissecting-rooms of Paris afforded unrivaled opportunities. The ingenious and indefatigable author had made five hundred examinations of ruptures on the dead body, and more than six hundred drawings; and he had represented two hundred anatomical preparations of herniae to the Faculty of Medicine in Paris. The subjects embraced in this memoir are: The Causes of Herniae and the Mechanism of their Formation; The Hernial Sac in its various States; The Several Modes of Reduction, and some of the Means employed by Nature for the Cure of Ruptures; and The Principal Diseases of the Hernial Sac. The full and clear manner in which these points are treated, and the abundant information which the author displays on all parts of the subject, make us regret that he should not have found leisure to execute the general work on hernia which he seems to have had in contemplation.

Commentarius de Peritonaei Structura, Testiculorum Tunicis, Corumque ex Abdo-
mine in Scrotum Descensu, ad Illustrandam Herniarum Nidolem; 8vo, cum tab. xxiv, æneis in folio, Göttingen, 1817. In the numerous well-selected and well-executed figures of this work the zealous and indefatigable author, who, as Professor of Anatomy and Surgery at Göttingen, so ably sustains the reputation of that celebrated university, represented most of the important points in the natural and pathological state of the parts which are the seat of inguinal, crural, and congenital ruptures.
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PLATE I.*

MUSCLES, APONEUROSIS, VESSELS, AND NERVES OF THE ANTERIOR INGUINAL AND FEMORAL REGIONS.—ADULT.

1. Inguinal Region.

Preparation.—The superficial fascia removed, the aponeurosis of the great oblique, uncovered, is cut in the longitudinal diameter of the inguinal ring so as to show the interior parts.

A. Interior of inguinal ring.

1, 1. Superior segment of the aponeurosis of the great oblique muscle turned up.

2. Inferior segment of the aponeurosis of the great oblique turned back upon the thigh.

3. Cremaster muscle likewise turned back from below.

4. Muscular arch of the transverse and external oblique in part dissected from above.

5, 5. Especial envelope of the spermatic cord, the anterior segment of which has been removed to show the interior of the canal.

6. Spermatic cord and vessels inclosed in the fibrous cylinder of their special envelope.

7. Portion of the aponeurosis of the external oblique preserved so as to close the external inguinal ring.

8. External inguinal ring, giving exit to the cord.

9. Internal pillar of the ring.

10. Free subcutaneous portion of the sheath of the spermatic vessels enveloped by the dartos.

B. Aponeurosis of the external oblique.

C. Inferior extremity of the external oblique muscle.

D. Portion of integuments and of the subcutaneous adipose tissue.

2. Femoral Region.

E. Aponeurotic layer which covers the femoral vessels in front, the exit of which is shown upon the surface. This layer adheres by its posterior face to the vascular sheath, from which it results that in the physiological sense there is no femoral canal.

11, 11. Fibrous loop formed by the femoral aponeurosis, and which surrounds the passage of the internal saphenous vein.

12. Internal saphenous vein.

13. Point where it crosses the aponeurosis so as to unite with the deep femoral vein. It is this disposition which necessitates the formation of the loop of the femoral aponeurosis (11), and the fibrous layer which covers the vessels.


15. Inguinal abdominal arteries and veins.

F. Internal surface of the thigh covered by the enveloping femoral aponeurosis.

G. Fibro-cellular sheath of the sartorius muscle.

16, 16. Femoral vessels accompanied with their nerves and seen through a translucent layer behind the muscle, which is cut in a diagonal direction.

17, 17. Vessels for the nutrition of the sartorius muscle.

18. Long branch of nerves peculiar to this muscle.


H. Muscular partition of the fascia lata with its vessels and nerves.

I. Muscular partition of the anterior right of the thigh with its vessels and nerves.

K. Portion of the femoral aponeurosis which covers the cut superior extremity of the anterior right.

L. Aponeurotic fascia lata.

M. Portion of the vastus internus.

ANATOMY AND SURGICAL TREATMENT OF HERNIA.

CHAPTER I.

GENERAL CONSIDERATIONS ON HERNIA.

There can be little excuse among the members of the medical profession for a lack of interest in the subject which we present for consideration, since no condition of life, either rank, age, or sex, is exempt from this affliction. On account of the frequency of its occurrence and the variety of forms it presents, hernia demands the most minute and careful investigation into its history and treatment. This is especially true, since impairment of usefulness does not occur so often from any other anatomical defect as that of hernia; and when portions of the abdominal viscerae protrude, for any reason, through the movable wall that incloses them, the condition becomes at once one of great surgical importance, oftentimes fraught with the gravest dangers and most serious results.

It is only by a continual zeal of perfecting our knowledge by means of careful investigations and repeated observations that progress is gained in any department of science. No disease, perhaps, to which the human race is subject, requires a more accurate anatomical knowledge and prompt surgical skill than hernia in all its varieties. The surgeon must be familiar not only with the normal condition of the structures involved and their relation to each other and the surrounding parts, but also with the pathological changes and the many complications which accompany them, as well as the various methods of treatment.

Although the anatomy of the human body was most carefully studied and well known to the surgeons of the earlier time, yet it has been only from the great number of pathological studies and observations upon the dead body, aided by microscopical investigations, that we have learned the true relations between the inguinal ring and the hernial sac, between the sac and the viscerae contained in it, as well as between the coverings of the testicle and the spermatic cord, and thus im-
proved the methods of surgical procedure in hernia. Abdominal hernia is produced by the protrusion of the viscera contained in the abdomen through the natural or accidental apertures in the parietes of that cavity. The considerable variety of conditions under which this disease occurs has led to the classification of hernia according to the opening through which the abdominal contents have been forced.

I. Inguinal or Suprapubic Hernia.—In this variety of hernia the contents issue by the inguinal canal. When small, especially if concealed by escape into, rather than through, the parietal wall, it is called bubonocele; when they descend into the scrotum, scrotal hernia; if they extend to the labia majora, vulvar or pudendal hernia.

II. Crural or Femoral Hernia.—When the contents protrude through the femoral canal and penetrate under Poupart's ligament, forming a tumor at the inner and upper part of the thigh, it is termed femoral or crural hernia.

III. Infra-pubian Hernia.—When the viscera escape through the opening which gives exit to the infra-pubian vessels at the foramen ovale of the pelvis, it then takes the name of the aperture, and is termed hernia foraminis ovalis, or obturator.

IV. Ischiatic Hernia.—Sometimes a hernia takes place by the protrusion of the viscera through the sacro-sciatic notch, projecting by the side of the sciatic nerve, under the glutei muscles, and then it is called, from the aperture, ischiatic hernia.

V. Umbilical Hernia.—This variety of hernia is formed at or near the insertion of the umbilical cord.

VI. Epigastric and Hypogastric Hernia.—When the hernia is occasioned by the protrusion of the viscera above or below the umbilicus in the linea alba, we have this variety of hernia.

VII. Perineal Hernia.—Sometimes the abdominal contents descend between the bladder and the rectum, or through the levator ani, and appear at the perinæum, constituting a hernia of the perinæum.

VIII. Vaginal Hernia.—If the viscera pass between the uterus and the rectum, forming a tumor in the parietes of the vagina, it is termed vaginal hernia.

IX. Ventral Hernia.—The term ventral is applied to all those protrusions of the abdominal contents that pass through openings in the abdominal muscles or their aponeuroses; they occur more commonly between the two recti muscles above the navel, when not the sequence of laparotomy.

X. Diaphragmatic Hernia.—This variety of hernia is not so common, but when it does occur it protrudes through the diaphragm.
Herniae are likewise named from their contents, as enterocele, epiplocele, etc. Herniae are also described as old or recent, reducible or irreducible, incarcerated, strangulated, etc.

Abdominal herniae are of frequent occurrence, owing to the mobility and varying bulk of the viscera, the pressure to which they are subjected in all considerable efforts and motions of the body, from the muscles which, in great part, surround and inclose them; and the natural openings from the abdominal cavity greatly facilitate the origin of such misplacements.

The importance of any given hernia is dependent upon the contents, the pressure exerted, and especially the impairment of intestinal function, which may indirectly arise when the intestinal canal itself is not included. When intestinal obstruction occurs from any cause, life is imperiled, almost in a geometric ratio to its duration—a fact which can not be too greatly emphasized.

**Frequency.**—The frequency of hernia is much greater than is usually supposed. It has been variously estimated by surgeons of great experience in the treatment of ruptures that from one eighth to one sixteenth of the human race is afflicted with this complaint.

From the United States census report for 1880, under the head of vital statistics, we find, out of 756,893 deaths taken at large, one death in every 600 was from hernia. In 1,286 deaths from hernia, 141 were children less than one year of age.

In the city of Philadelphia alone 450,000 trusses are manufactured yearly.

From the elaborate tables of the late Dr. J. H. Baxter, Surgeon-General, U. S. A., we learn that the results of the examination of 334,321 “recruits, substitutes, drafted and enrolled men of various nativities,” gave hernia as the cause of rejection in 16,901 cases, as seen in the following table:

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<th>Disease</th>
<th>Number rejected</th>
<th>Ratio rejected</th>
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<td>Hernia, umbilical</td>
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<td>Hernia, ventral</td>
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<tr>
<td>Hernia, left inguinal</td>
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<td>Hernia, double inguinal</td>
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<tr>
<td>Hernia, right femoral</td>
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<tr>
<td>Hernia, left femoral</td>
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<tr>
<td>Hernia, double femoral</td>
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<td>0,102</td>
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<tr>
<td>Total for hernia of all kinds</td>
<td>16,901</td>
<td>59,554</td>
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</table>
**ANATOMY AND SURGICAL TREATMENT OF HERNIA.**

**Chart I.**—Hernia in its Relation to Social Condition, Complexion, Age, Height, and Nativity.

Showing the number examined, and the ratio rejected per 1,000 examined.

<table>
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</tbody>
</table>
"From this statement it appears that inguinal hernia was the cause of about eighty-two per centum of all rejections on account of hernia, and that the cases of right inguinal hernia exceeded in number all the rest. Other tables confirm, in a most conclusive manner, this latter indication, to wit, that inguinal hernia of the right side is far more prevalent than that of the left. The cases of umbilical and ventral hernia were about equal, but inconsiderable in number as compared with right inguinal."

**Chart 2.—Hernia in its Relation to Locality.**
Showing the number examined, and the ratio rejected per 1,000 examined.

<table>
<thead>
<tr>
<th>STATES</th>
<th>Number examined</th>
<th>Ratio rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>All States</td>
<td>501,003</td>
<td>31.631</td>
</tr>
<tr>
<td>Minnesota</td>
<td>6,489</td>
<td>54.246</td>
</tr>
<tr>
<td>Vermont</td>
<td>7,244</td>
<td>43.951</td>
</tr>
<tr>
<td>Iowa</td>
<td>6,846</td>
<td>41.046</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>21,945</td>
<td>40.293</td>
</tr>
<tr>
<td>Illinois</td>
<td>81,126</td>
<td>38.398</td>
</tr>
<tr>
<td>Missouri</td>
<td>8,576</td>
<td>36.331</td>
</tr>
<tr>
<td>Maryland</td>
<td>16,920</td>
<td>34.043</td>
</tr>
<tr>
<td>Michigan</td>
<td>1,179</td>
<td>33.418</td>
</tr>
<tr>
<td>New York</td>
<td>95,576</td>
<td>32.738</td>
</tr>
<tr>
<td>Maine</td>
<td>20,479</td>
<td>31.398</td>
</tr>
<tr>
<td>Indiana</td>
<td>29,279</td>
<td>31.261</td>
</tr>
<tr>
<td>Dist. of Col.</td>
<td>6,954</td>
<td>30.947</td>
</tr>
<tr>
<td>Kentucky</td>
<td>16,023</td>
<td>29.760</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>12,686</td>
<td>29.667</td>
</tr>
<tr>
<td>New Hamp.</td>
<td>10,013</td>
<td>27.994</td>
</tr>
<tr>
<td>Ohio</td>
<td>37,700</td>
<td>27.995</td>
</tr>
<tr>
<td>New Jersey</td>
<td>13,188</td>
<td>27.359</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>36,380</td>
<td>26.823</td>
</tr>
<tr>
<td>Connecticut</td>
<td>11,017</td>
<td>25.414</td>
</tr>
<tr>
<td>Delaware</td>
<td>6,351</td>
<td>25.254</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>4,072</td>
<td>24.304</td>
</tr>
<tr>
<td>West Virginia</td>
<td>764</td>
<td>20.942</td>
</tr>
</tbody>
</table>

If we admit that the tables of Dr. Baxter afford any criterion of frequency of hernia in the United States, the sum total of the individuals afflicted with hernia is not less than three million. Since the tables were based upon the examination of about half a million men within the limit of age to bear arms, a considerable proportion of the same presenting themselves to be examined for this purpose, it may not be considered as an excessive proportion of the entire population.

Sex.—Malgaigne estimated the proportion of the whole population of France which is ruptured to be one out of every thirteen males, and one out of every fifty-two females; including both sexes, one in every twenty individuals.
There have been furnished no requisite data for comparison of the relative frequency of hernia in the two sexes. Anatomically, the structures favor the liability of hernia in the male; the more violent exercise and severer labors of the male are also predisposing causes. It is generally conceded that hernia occurs more frequently in the male.

Out of a gross total of 96,886 applications for trusses at the City of London Truss Society, the males were 78,394, the females 18,492. Several authors give the proportion as about double in the male.

**Frequency of Hernia at Different Ages.**—According to M. Malgaigne, in three hundred cases examined by himself,

- 26 occurred between the ages of 10 and 20 years.
- 45 " " " 20 " 30 "
- 66 " " " 30 " 40 "
- 163 " " " 40 " 80 "

This record is, however, to be explained by the statement that the ages are taken from the entry of the visit of the patient, giving his age then, rather than when he first knew the disease existed. Mr. John Croft reports a table of 2,401 cases of hernia, of which 472 were in children under five years of age. Mr. Kingdon, in the reports of the City of London Truss Society, for the years 1860 and 1861, tabulated 9,296 cases of hernia. Of these, 60.8 per cent commenced before thirty-five years of age, and 39.2 per cent after that age. Of the whole number, 2,516 were

<table>
<thead>
<tr>
<th>Age</th>
<th>1850</th>
<th>1861</th>
<th>Kingdom's tables, Reports of Truss Society, 1850 to 1862, Age at development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inguinal</td>
<td>Femoral</td>
<td>Inguinal</td>
</tr>
<tr>
<td>-----</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td>M.</td>
<td>F.</td>
<td>M.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 1 year</td>
<td>473</td>
<td>27</td>
<td>...</td>
</tr>
<tr>
<td>1 to 5 years</td>
<td>182</td>
<td>17</td>
<td>...</td>
</tr>
<tr>
<td>6 to 10 years</td>
<td>91</td>
<td>23</td>
<td>...</td>
</tr>
<tr>
<td>11 to 15 years</td>
<td>115</td>
<td>19</td>
<td>...</td>
</tr>
<tr>
<td>16 to 20 years</td>
<td>284</td>
<td>27</td>
<td>...</td>
</tr>
<tr>
<td>21 to 25 years</td>
<td>348</td>
<td>30</td>
<td>...</td>
</tr>
<tr>
<td>26 to 30 years</td>
<td>381</td>
<td>45</td>
<td>...</td>
</tr>
<tr>
<td>31 to 35 years</td>
<td>334</td>
<td>43</td>
<td>...</td>
</tr>
<tr>
<td>36 to 40 years</td>
<td>329</td>
<td>38</td>
<td>...</td>
</tr>
<tr>
<td>41 to 45 years</td>
<td>271</td>
<td>31</td>
<td>...</td>
</tr>
<tr>
<td>46 to 50 years</td>
<td>258</td>
<td>11</td>
<td>...</td>
</tr>
<tr>
<td>51 to 55 years</td>
<td>167</td>
<td>12</td>
<td>...</td>
</tr>
<tr>
<td>56 to 60 years</td>
<td>147</td>
<td>6</td>
<td>...</td>
</tr>
<tr>
<td>61 to 65 years</td>
<td>97</td>
<td>6</td>
<td>...</td>
</tr>
<tr>
<td>66 to 70 years</td>
<td>59</td>
<td>5</td>
<td>...</td>
</tr>
<tr>
<td>71 to 75 years</td>
<td>32</td>
<td>1</td>
<td>...</td>
</tr>
<tr>
<td>Totals</td>
<td>3,558</td>
<td>346</td>
<td>174</td>
</tr>
</tbody>
</table>
under five years of age. An analysis of the above table from Mr. Kingdon's report teaches that the percentage of hernia in children is less than would at first seem, and that, relatively, hernia is more common after thirty-five than before this age.

Occupation.—It is generally admitted that the laboring classes are more liable to hernia. However, any reliable data are wanting to determine this, since all statistics from our large public institutions are based entirely upon the application of those whose needy condition demands, in a measure, a public charity. The wealthier classes afford no opportunity for statistical knowledge. It is conceded that the general imperfect state of muscular strength and the lax condition of the tissues, dependent upon sedentary habits, render hernia more likely to supervene suddenly upon violent strain. Under such conditions, it is well known that herniae are very common, although a feeling of reticence makes reference to such suffering the exception.

Conditions.—Individuals suffering from hernia generally complain that they are much more troubled to retain the parts in position when weakened or debilitated by disease. The tissues are relaxed and less able to sustain strain. It is also commonly observed that persons deficient in general strength and tone, as age advances, become more subject to hernia. Another considerable class, in both sexes, after the middle period of life, where a tendency to overweight is marked, producing an increase of intra-abdominal pressure, become liable to hernia.

From infancy to old age the abdominal cavity must be subject to daily variations in size and contents. The gaseous and fluid distention of the intestinal canal is often excessive; the omental and parietal fat frequently increases with great rapidity; and these conditions, of necessity, cause a constant strain upon the abdominal walls, which must be elastic, and accommodative to movement. In women, the results of over-distention from pregnancy, violent muscular effort in parturition, a lack of proper tone and vigor of the parietal structures, which frequently ensues upon delivery, must also be considered as causes of hernia, especially umbilical and ventral.

If individuals vary greatly in construction and composition, as to strength and firmness of their tissues, it seems but a natural consequence that such conditions should have a tendency to be transmitted to their descendants, and, as will be seen later, congenital hernia is very common. A constitutional weakness, especially of the parietal peritoneum and of the mesenteric ligament, has been advanced, even by some of our prominent authors upon the subject, as a cause of hernia. This is based upon the assumption that, otherwise, the small intestines could not be dragged down so as to
reach below the rings, or into the scrotum. My own large experience in laparotomy teaches me that the small intestines are, as a rule, normally quite free to be carried below any possible escape through the base of the pelvis.

Herniae have sometimes been classified as external and internal, complete and incomplete: the former, when the abdominal contents protrude to form a tumor, obvious upon ordinary inspection; the latter, when some portion of the abdominal viscera is so displaced as to impair function—as, for example, when the bowel passes through an opening in the diaphragm, or into some cavity formed by peritoneal folds, or confined by bands of adhesion. These changes are often attended with very grave dangers, since they are not easy to define, and may as surely obstruct the intestinal canal as when the viscera escape through an opening externally.
CHAPTER II.

INGUINAL HERNIA. ANATOMY OF THE PARTS INVOLVED.

Since every method for the surgical relief or cure of hernia must be dependent upon an accurate anatomical knowledge of the parts involved, it is necessary to enter into a careful study and consideration of their structural relations; and as inguinal hernia is the more frequent variety, it may be well to select this for primal investigation. In the dissection of an inguinal hernia, it is desirable to have a male subject, since this variety is more common in men than in women; and when choice can be made, a body which is rather thin is preferable, if the muscular system is well developed.

Position of the Subject.—In order that the abdominal parietes may be rendered tense, the knees are bent and the inferior extremities are rotated outward. It is sometimes advantageous to inflate the abdominal cavity through a small punctured wound in the linea alba. Commence the dissection by an incision which is to be carried across from the crest of the ileum to the linea alba, where it should terminate a little below the umbilicus; from this point continue the incision downward on the median line to the root of and along the dorsum of the penis. The triangular flap thus included should extend only through the skin, but should be dissected carefully, beginning at the angle nearest the umbilicus, and detaching it from the subjacent layers of connective tissue, until opposite the crural arch, or, perhaps better, upon the upper part of the thigh. This portion of the dissection should be conducted with care, in order to show well the superficial fascia of the abdominal parietes.

The superficial fascia which is thus exposed, covering the lower part of the abdominal parietes, consists of two distinct layers, between which the superficial vessels and a few small lymphatic glands are found. The external layer, to which the skin was attached, consists chiefly of loose-meshed connective tissue, with more or less adipose material interposed, depending upon the corpulence of the subject. Over the body of the os pubis it is thicker than elsewhere, and this adipose tissue constitutes in the female the mons veneris. The external layer of the superficial fascia passes over the crest of the ileum and Poupart's ligament, to which structures it is only slightly adher-
ent, and blends with the outer lamella of the superficial fascia of the groin. In a thin subject, some small arteries and veins are observed distributed in various directions underneath the external layer of the superficial fascia, the most important of which are the superficial epigastric artery and vein. The artery is a branch from the common femoral, arising but a short distance below the crural arch. Through a small opening in the iliac portion of the fascia lata it ascends about midway between the anterior superior spinous process of the ileum and the symphysis pubis, in an oblique direction, upward and inward toward the umbilicus, and gives off branches to the integuments on either side of its course, some of which anastomose with the branches of the deep, or internal epigastric artery. The vein takes the same course of the artery from which it is named and empties into the great saphenous vein.

The external or superficial pubic arteries and veins cross over the spermatic cord, where it emerges from the external abdominal ring. They are distributed to the integuments of the hypogastric region and to the superficial investments of the cord and testicle. The external pubic vessels are very tortuous in their course, and care is required to dissect them without division. A few small lymphatic glands will be found lying between the two laminae of the superficial fascia, parallel with and immediately above Poupart's ligament.

PLATE II.*

This plate exhibits, on the left side of the subject, the integuments reflected upon the thigh, to display the tendon of the external oblique muscle of the abdomen, the fascia lata, and three adventitious fasciculi of fibers. On the left side a further dissection is made to expose the subjacent structure.

Left Side.

A. The reflected dermal and subdermal adipose tissue.

B, B. The subjacent cellular tissue, called fascia superficialis, reflected from the fascia lata, and tendon of the external oblique.

C, C, C. The fascia lata.

a, C, a. The portion of the fascia lata which covers the sartorius muscle, forming the anterior part of its sheath: it may, therefore, with propriety be called the sartorial portion.

b, b. The portion of the fascia lata which covers the pectineus muscle; to be called, therefore, the pectineal portion of the fascia lata.

c, c, C, c. The funnel-shaped portion of the fascia lata, being the external lamina of the sheath of the crural vein, artery, and nerve; and called the crural sheath, or the vaginal portion of the fascia lata.

3, 3. The branches of the vena saphena at its junction with the unsheathed crural vein.

4, 4. The cribriform surface of the crural sheath, called so, on account of the numerous small perforations made by the entrance of absorbent vessels. The fibers of this part of the sheath interlace with those of the pectineal portion of the fascia lata, the line of interlacement extending from the semilunar edge of this portion to within a few lines of the pubis.

5, 5, 5. Converging fibers of the sheath, forming a ligament-like process. This process makes an attachment to the edge of the pubis, immediately behind that made by the tendon of the external oblique muscle. In effecting this horizontal attachment, the process makes a sigmoid twist, in consequence of which a crescent edge is formed extending downward and obliquely outward. This edge is called the crescentic edge of the fascia lata: to distinguish it from the semilunar edge of the pectineal portion of the fascia lata, it may be termed the crescentic edge of the vaginal portion of the fascia lata.

d, d. A deeper-seated lamina of the fascia lata. It proceeds from the inner edge of the tendon of the external oblique, and is thence continued downward to contribute to the formation of the crural sheath.

6. A well-defined arched opening for the passage of the middle pair of anterior crural nerves, figured in the plate.

e, e, e. One of the three adventitious fasciculi of fibers above referred to. This fasciculus is evidently derived from the fascia lata; near its origin, the fibers are twisted into a cord; farther off, they diverge, so as to be scattered on the external and internal surfaces of the tendon of the external oblique muscle of the abdomen. As this fasciculus proceeds from the thigh, it may be called the crural fasciculus.

D, D, D. The tendon of the external oblique muscle of the abdomen.

The other two adventitious fasciculi of fibers above referred to. They are derived from the opposite side of the abdomen, apparently from the tendon of the internal oblique muscle.

From this origin, as it seems, they first appear on the outside of the tendon of the external oblique, then disappear, and, again issuing as two distinct converging fasciculi, pass over the split in the tendon of the external oblique; from this spot the fibers of the two fasciculi diverge, and, proceeding downward, they are continued over the reflected edge of the tendon upon the fascia lata, viz., upon its ligament-like process, 5, 5, 5, and its deeper-seated lamina, d, d. As this fasciculus proceeds from the abdomen, they may be called the two abdominal fasciculi.

h, h, h. The diverging termination of some of the fibers of the tendon of the external oblique, called the upper pillar of the abdominal ring.

i, i, i. The termination of other fibers, called the lower pillar of the ring.

k, k. The spermatic cord passing out at the oval opening, called the abdominal ring. This opening is made by the two pillars above noticed and the two adventitious fasciculi of fibers.

Right Side.

A. The reflected integuments.

B, B, B. The fascia lata.

a, a. The external lamina of the fascia lata, divided and reflected to expose the inner lamina (or layer) of the crural sheath.

b, b, b. The inner layer of the crural sheath, the upper part of which is exposed on the left side of the plate, and noticed under the letters d, d.

c, c. A portion of the sartorius muscle, also exposed by the reflection, together with the inner anterior nerves, and the destination of the middle anterior crural nerves.

C. The external oblique muscle reflected upon the thigh.

d, d, d. The portion of the tendon which interlaces its fibers with those of the sartorial portion of the fascia lata. It may properly be called the interlaced portion of the tendon of the external oblique muscle.

, , , c, c, c. The portion of the tendon which is reflected inward, and has its fibers inserted ulti-
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

mately into the pubis in radiating lines. This is called the reflected portion of the tendon; the edge made by the reflection is termed Poupart's ligament; the inner, or true edge of the tendon, is termed Gimbernat's ligament.

\[ f, f, f. \] The inner diverging fibers of the crural fasciculus, noticed on the left side of the place under \( e, e, e. \) They pass in at the arched opening marked \( \delta \) on the left side, are scattered on the inner surface of the tendon, and are united with other fibers coming from the medium line of the abdomen.

D. The internal oblique.

\[ g, g, g. \] The spermatic cord removed from its natural situation, covered with its cellular sheath, and connected with the cremaster muscle and nerve.

F, F. A muscular fasciculus, which is not intimately connected with either the internal oblique or transversalis muscles. Its tendon passes into the fibrous interlacement over the pubis. It seems to be an insulated portion of the internal oblique.

H. Another fasciculus of insulated muscular fibers belonging to the transversalis rather than to any other muscle, and having delicate tendons inserted into the pubis.

i, i, i. A few delicately formed but strong fibers, having an obliquely vertical direction; they embrace the pubal part of the funnel-shaped sheath.

k. A small portion of the fascia transversalis appearing in the midst of the three above-noticed parts.

m. The upper portion of the crural sheath; it may be called the abdominal portion, since it is situated above the lower edge of the tendon of the external abdominal muscle; or the transversalis portion, since it is interlaced at its upper edge (or brim) with the fascia transversalis.

After having demonstrated the superficial vessels and glands, the deep layer of the superficial fascia may be dissected. This is best effected by commencing at the angle nearest to the umbilicus, and, holding the fascia tense, the delicate connective tissue which unites it to the tendinous aponeurosis of the external oblique muscle is easily divided. Care is requisite in the dissection about the external abdominal ring that the thin membrane which passes from the margin of that opening downward may not be divided. This layer, the external spermatic fascia, may be demonstrated by holding the cord tense, drawing the testicle obliquely downward toward the opposite side. The deep layer of the superficial fascia is adherent to the linea alba at the interior surface of Poupart's ligament, especially its outer portion, where it is united with the fascia lata. It is attached to the pubic portion of the fascia lata in front of Gimbernat's ligament, and may be traced below the crural arch, covering the fascia lata of the thigh, and is closely adherent to the saphenous opening. The two layers of the superficial fascia of the abdomen are in marked contrast. The external lamella is formed of loose-meshed connective tissue, which is always more or less loaded with fat. The internal lamella is, on the contrary, very strong and elastic, and presents a smooth, compact, glistening appearance, the lower portion of which is developed into a strong, firm, connective-tissue sheath.

The superficial fascia of the abdominal parietes presents a noteworthy change as it descends over the spermatic cord to reach the scrotum, where it is free from fatty tis-
sue and assumes a fibrous structure. The vermicular movements and gradual contrac-
tions of the scrotum which occur when these parts are exposed to cold, are dependent
upon the contraction of these fibers. Described under the limitations usually given to
it by the distinctive name of dartos, it is continuous superiorly with the superficial
fascia of the abdomen, inferiorly and posteriorly with the superficial fascia of the per-
meum; its external surface is closely adherent to the thin skin of the scrotum, and it is
loosely joined, upon its internal aspect, by loose connective tissue, with the fibrous
sheath which invests the spermatic cord and the testicle.

There is prolonged from it an imperfect septum of connective tissue which sepa-
rates the testicles from one another. Fluids pass without much difficulty through this
sheath from one side of the scrotum into the other. It is beneath the dartos, into the
loose connective tissue which joins it to the fibrous sheath of the spermatic cord, that
serous fluid accumulates in the cedema of the scrotum and penis, frequently observed in
certain pathological conditions. Blood in considerable quantity is often extravasated
underneath the dartos in consequence of injury. Urine is frequently effused into this
loose-meshed connective tissue, producing enormous scrotal distention, followed by
most serious consequences unless properly recognized, consequent upon the ruptured
urethra a little anterior to the triangular ligament.

The Aponeurosis of the External Oblique Muscle.—The tendinous expansion of
the external oblique muscle, which has been exposed by the foregoing dissection, is now
to be carefully studied. It will be observed, that in the hypogastric and iliac regions
firm bands of connective-tissue fiber replace the muscle, so as to weave its lower border
into a strong tendinous structure. This is so important that I transcribe the excellent
original description by Scarpa: "While a little below the umbilicus, the more particu-
larly about four fingers' breadth from the femoral arch and from the inguinal ring, the
aponeurotic fibers of this muscle are much stronger and thicker than those which are
observed above the umbilicus; and in the dead body, after the integuments are
removed, and left for some hours exposed to the open air, the lower portion of the apo-
neurosis of the external oblique appears opaque and dense, while the rest of the apo-
neurosis, in the vicinity of and above the umbilicus, preserves its transparency, and
allows the fleshy fibers of the subjacent abdominal muscles to be seen through it. At
the distance of about an inch and a half from the os pubis this more compact and elas-
tic portion of the aponeurosis of the external oblique divides into two parts; the supe-
rior is larger than the inferior portion, and is inserted into the margin and upper
part of the os pubis, where it appears to form an intersection with that of the opposite
side, and to intermix with the ligamentous substance connecting the osa pubis to-
gether, from which substance the suspensory ligament of the penis derives its origin.

"The other portion of the aponeurosis of the external oblique, the inferior part is
narrower, but more dense and elastic than the upper, runs obliquely from above down-
ward and from behind forward, above the femoral fossa, of which it forms the arch,
and is inserted by a firm tendon into the tubercle and spine of the top of the os pubis,
where it is likewise lost in the ligamentous substance which unites these bones. By
the divergence of these two portions is formed that aperture called the inguinal ring, in
an oblique direction from the side to the pubes; it is more of a triangular than elliptical
form. In the male, the spermatic cord, covered by the cremaster muscle, passes through
it, and in the female the round ligament of the uterus. In general, the aponeurosis of
the external oblique muscle seems to be formed by a series of small bands, disposed in
so many parallel lines, running from above downward and from behind forward, or in
the same direction with the fleshy fibers of the external oblique; from which circum-
stance this aponeurosis has the appearance of a simple web. And this interweaving
is observed in the whole extent of the aponeurosis, except at the place where it begins
to diverge for the formation of the inguinal ring. At this place it has no longer the
appearance of a mere web, but rather of a texture, intersected by several other tendi-
nous bands, crossing in a different direction from the first; the greater part of the latter
are detached from the femoral arch, extend over the top of the inguinal ring, and are
lost in the internal side of that ring. This intersection of the tendinous fibers of the
aponeurosis of the external oblique muscles, has some resemblance to the interweaving
of the tendinous bands which is observed in the aponeurosis of the diaphragm around
the tendinous opening through which the ascending vena cava passes. There can be
no doubt that the aponeurosis of the external oblique muscle, being denser and more
elastic in the lower region of the abdomen than in the upper one, and applied in
the manner of a belt, acquires a still greater degree of density and elasticity in the
vicinity of the lower margin of the abdomen and around the inguinal ring than in
any other place, from the additional covering and intersection of the above-mentioned
tendinous band; studying its function, one would be led to infer that by means of
it Nature had intended to fix the limits of the inguinal ring, and to oppose the
further divergence of the tendinous pillars laterally. Indeed, no other intersection of
tendinous fibers similar to this, at least so far as regards the number and size of the
bands, is met with in any other part of the aponeurosis of the external oblique muscle, nor in the subjacent aponeurosis of the internal oblique and transverse muscles. Winslow thought that the tendinous strips just mentioned, which he called lateral, do not exist in children; and, following him, some authors have doubted whether a similar structure can be shown in woman. I can affirm that I have met with it in children, and in women, whenever I have investigated it carefully."

Sir Astley Cooper emphasizes the importance of the aponeurosis of this muscle as follows: "This tendinous expansion is provided in man to defend him from the accidents to which his erect attitude would naturally subject him. In quadrupeds, to whom the horizontal position is natural, the weight and pressure of the viscera are diffused over the whole of the abdominal parietes; but in the human subject, when the abdominal muscles and diaphragm are combining their powerful efforts to fix the ribs, to enable the muscles of the upper extremities to act to the greatest advantage, the viscera being forced to the lower part of the belly, muscular fiber would prove but a feeble barrier, and hernia would probably be the inevitable consequence of muscular exertion. This tendon rarely allows an intestine to escape between its fibers; strengthened by an interlacement of texture, it supports the weight of pregnancy and of dropsical accumulations, resists the pressure arising from excessive obesity and from muscular contractions, and would altogether have exempted man from the occurrence of inguinal rupture, were it not for the existence of two openings in it about to be described."

PLATE III.*

This plate is intended to show the insertions of the external oblique muscles, the formation of the abdominal rings, and two of the fascia which are connected with Poupart's ligament, as well as the course of the spermatic cord under the edges of the internal oblique and transverse muscles before it reaches the abdominal ring.

*a. Symphysis pubis.

b, c. Anterior and superior spinous process of the ileum.

c, c. External oblique muscles.

d. Linea alba, extending down to the symphysis pubis, and formed by the union of the tendinous fibers of the two oblique and transverse muscles.

e, e. Linear semilunares, formed by the union of the tendinous fibers of the external and internal oblique and transverse muscles.

f, f. The abdominal rings, formed by the separation of two columns of tendinous fibers; the upper inserted at a into each os pubis, the lower inserted into the pubes at b, after passing behind the spermatic cord.

g. The origin of some tendinous fibers which proceed from the anterior spinous process of the

ileum, and, crossing the columns of tendon, assist in uniting them above the abdominal ring.

i. Poupart's ligament, or the crural arch, which is extended from the anterior spinous process of the ileum at \( \lambda \), to the pubes at \( \kappa \), receiving the lower column of tendon, which forms a part of the abdominal ring, and which passes behind the cord to be inserted from the spinous process to the crest of the pubes.

\( \kappa \). The fascia lata of the thigh, which is continued from Poupart's ligament, and seen turning in under the femoral vessels near the middle of the fore-part of the thigh.

\( \lambda \) Is the saphena major vein of the leg going through the fascia to enter the femoral vein.

\( m \). Another part of the same fascia which arises from Poupart's ligament, and joins with the fascia lata, which it assists in forming.

\( n \). The tendon of the external oblique muscle cut open to show the parts which are situated behind it.

\( o \). The internal oblique muscle; its lower edge, which arises from Poupart's ligament, is raised and turned to show the parts behind it. It is inserted into the pubes behind the upper column of tendon which forms the abdominal ring.

\( p \). The transversalis muscle; its lower edge also arises from Poupart's ligament, but is here raised and turned up. In its natural state it runs over the cord to be inserted into the pubes behind the abdominal ring, which it serves as a valve to close posteriorly.

\( q \). A fascia, connected with Poupart's liga-

tment, which runs upward to the transversalis and unites itself to the posterior part of the transverse muscle and its tendon, and thus prevents the bowels from slipping between the lower edge of the muscle and Poupart's ligament, or between the fibers of the muscle itself. That portion of the fascia which is placed between the spinous process of the ileum at \( \lambda \) and the hole \( r \) is strong; but that between the hole \( r \) and the pubes is often little more than condensed cellular membrane, as that part is strengthened by the tendon of the transversalis and by the epigastric artery. A portion of the fascia is fixed in the pubes and another part of it passes behind Poupart's ligament to unite with the femoral vessels.

\( r \). The place at which the spermatic cord goes into the abdomen. The fascia situated on its outer side and lower part is of considerable density, but becoming thin upon its inner side, so as to show the epigastric artery and vein behind it; from the edge of the fascia a thin layer is sent off which unites itself to the spermatic cord, which fascia in this dissection has been removed.

\( s \). The epigastric artery and vein, situated behind the fascia transversalis, at first on the inner side, and afterward behind the spermatic cord. The epigastric artery is shown here by cutting the fascia transversalis parallel to it.

\( t, t \). The spermatic cord, nearly two inches of which are above and to the outer side of the abdominal ring, and still not in the abdomen; it is also seen below the ring, running to the testicle.

**The External Oblique Muscle.**—The external oblique muscle arises from the eight lower ribs, passes toward the front of the abdomen, and joins in a broad tendon anteriorly. This union in a broad aponeurosis extends from the ensiform cartilage to the pubis, partly on the side from which it originates, and partly on the opposite side; it is also inserted into the spine of the ileum.

As the fibers of the lower and thicker part proceed obliquely downward and forward, they separate, about an inch and a half from the pubis, into two distinct portions, which constitute the pillars or columns of the abdominal ring. The upper and inner of these, which is broader than the other, is attached to the upper edge of the pubis, near the symphysis; some of its fibers descend and decussate with those of the opposite side, being fixed to the fibro-cartilage which unites the two bones. The lower and
outer, which is narrower but at the same time thicker and stronger than the other, runs obliquely from above downward and from behind forward, to be fixed by a strong tendon in the spine or tubercle and crest of the pubis.

The portion of the aponeurosis which extends between the anterior spine of the ileum and the spine of the pubes is a broad band, folded inward, and continues below with the fascia lata, Poupart's ligament—sometimes called the crural arch.

The portion reflected backward and inward from Poupart's ligament to the pectineal line is called Gimbernat's ligament. The triangular opening formed by the two tendinous columns at their insertion is known as the external abdominal ring. Through this the spermatic cord passes in the male, the round ligament in the female. The opening is directed obliquely upward and outward, corresponding with the course of the fibers of the aponeurosis. The crest of the pubis is the base of the triangle, the two pillars form its sides, the juncture of the pillars the apex, which is strengthened by connecting fibers, curved from above downward. These crossing, interlacing fibers are sometimes particularly strong in old herniae, and are better developed in men than in women. Although this opening is called a ring, it is not a ring unless dilated by a hernia. In its longest diameter it measures about one inch; from one tendon to the other only about half an inch. The center of the opening is about one inch and a quarter from the symphysis. A very delicate fascia originates from the tendon of the external oblique at the upper margin of the ring, passing over it and uniting with the spermatic cord, which it accompanies in its descent into the scrotum, and to which it is closely adherent. There is frequently considerable variation, as might be supposed, in the exact relationship of the parts. The distance of the ring from the symphysis pubis is oftentimes much less than an inch and a half; and it has been observed so far from the median line as to be situated almost opposite the anterior superior spinous process of the ileum. Occasionally another opening is to be found through the tendon which is situated above and to the inner side of that which forms the external abdominal ring, and through it the fleshy fibers of the internal oblique muscle may be clearly distinguished, as they are only covered by some of the fibers of the intercolumnar fascia.

The Internal Oblique Muscle.—The internal oblique muscle arises from the outer half of Poupart's ligament, the crest of the ileum, and the lumbar fascia. The lower edge of this muscle passes over the spermatic cord and blends with the transversalis
to form the conjoined tendon of these muscles. It is inserted into the six lower ribs, ensiform cartilage, and linea alba. The conjoined tendon of the internal oblique and transversalis muscles is inserted into the crest of the os pubis and pectineal line immediately behind the external abdominal ring, and serves to protect what otherwise would be a weak point in the abdominal wall. Sometimes the pressure is so great from within upon this tendon that it fails as a support, and is carried in front of the hernial sac, through the external ring, and then forms one of the coverings of direct inguinal hernia.

At the linea semilunaris the tendon of the internal oblique muscle divides into two layers, one of which passes in front of, and the other behind, the rectus muscle, reuniting at its internal edge, where it enters into the composition of the linea alba. In this manner the sheath of the rectus muscle is constituted. This division of the tendon, however, can be traced only from the ensiform cartilage to about midway between the umbilicus and the symphysis pubis. Below this point the whole of the tendon passes in front of the rectus, leaving that muscle separated from the peritoneum only by the fascia transversalis and subserous connective tissue. The tendinous aponeuroses of the muscles of each side are united with one another throughout the entire extent of the linea alba.

The portion of the internal oblique muscle which arises from the outer part of Poupart's ligament merits especial description. These fibers pass obliquely downward and inward nearly on a line with Poupart's ligament, and end in a tendinous aponeurosis opposite the outer border of the lower part of the rectus muscle. Some of the most inferior of these fibers are very much curved as they pass over the spermatic cord, in the upper part of the inguinal canal, and, becoming tendinous, descend behind the cord, where it is contained in the lower part of the canal and the external abdominal ring, to be finally inserted along the similar fibers of the transversalis muscle, into that portion of the pectineal line of the os pubis which is situated behind the ligament of Gimbernat.

PLATE IV.*

This plate exhibits, on the right side, the fascia transversalis, the crural sheath, and the mode of their connection with each other; and, on the left side, the ligament-like process of the fascia lata, showing its manner of attachment to the pubis, and the seat of crural hernia.

INGUINAL HERNIA. ANATOMY OF THE PARTS INVOLVED.

Right Side.

A. The reflected integuments of the abdomen and thigh.

B. The reflected fascia superficialis.

C. The reflected external oblique muscle of the abdomen.

a, a. The lower portion of its tendon, divided in order to show that all its fibers are inserted into the pubis more outwardly than has been generally believed, and that none of them, therefore, can possibly contribute to form the seat of crural hernia.

D. The internal oblique muscle of the abdomen.

b, b. A section of the muscular fasciculus which sends its tendon into the suprapubial fibrous interlacement. Some of the fibers of this tendon seem to be continued through this interlacement, and to become the abdominal fasciculi, figured under 33, 33, 33 in Plate II.

E. The transversalis muscle of the abdomen.

c, c. Some muscular fibers, originating at the place of exit of the cord, and inserted into the pubis by long, tendinous threads. These fibers are represented in Plate II under the letter II.

F. The cremaster muscle, detached from the spermatic cord, and reflected upon the thigh, originating from the fascia lata, within the interlacement of this fascia with the tendon of the external oblique and outside the fascia transversalis, separated from the transversalis muscle by the circumflex iliac artery.

d, d, d. The fascia transversalis, showing the oblique and longitudinal direction of its fibers; their interlacement with the upper edge of the crural sheath on each side of the spermatic cord, and the place of exit of the circumflex iliac artery.

e, e, e. The conical part of the cellular sheath of the spermatic cord. It is continuous with the cellular tissue found between the fascia transversalis and the peritoneum. At the under part of it, two curved lines are exhibited, formed by the vas deferens and the epigastic artery, which last is traced by a dotted line.

f, f, f, f. The abdominal or transversalis portion of the crural sheath, showing its connection with the fascia transversalis by means of a strong interlacement.

The space bounded by the margin of the sheath and the edges of the two portions of the fascia transversalis, on each side of the conical cellular sheath of the spermatic cord, is called the internal abdominal ring. It is an aperture presenting three strong fibrous edges, two of which are longitudinal, made by the fascia transversalis, and one horizontal, made by the crural sheath. Through this deep-seated triangular opening the bowel, covered by the peritoneum, passes from the abdominal cavity into the cellular sheath of the spermatic cord, to become an inguinal hernia. By it also, in some instances, the bowel is strangulated.

g, g, g. The crural sheath below the tendon of the external oblique.

h, h. Absorbent glands with their vessels, which pass into the pelvic cavity through an opening in the crural sheath.

i. An incipient ventro-inguinal hernia found in one of the dissections.

Left Side.

A. The reflected integuments.

B. The reflected fascia superficialis.

C. The sartorial portion of the fascia lata.

D. The vaginal portion of the fascia lata.

a, a. A superficial layer of fibers, dissected from this portion to show the line of separation between the sheath of the crural vessels and that of the sartorius muscle.

b, b. Branches of the vena saphena entering the ensheathed crural vein by a common trunk.

d, d, d. The crescentic edge of the vaginal portion, or crural sheath.

d, d, a. The ligament-like process of the vaginal portion of the fascia lata, the true seat of stricture in crural hernia. (See Plate II, 5, 5, 5, and the description.)

E. The pectineal portion of the fascia lata.

e, e. The semilunar edge of the pectineal portion.

e, e, e. The deep fissure between the pectineal and the vaginal portion of the fascia lata.

g, g, i, i. Divided and displaced portions of the tendon of the external oblique, showing, first, that the portion i, i is interlaced with the fascia lata (see d, d, d in the description of Plate II); second, that the portion g, g is more outwardly inserted into the pubis than the ligament-like process of the fascia lata, thereby demonstrating again that no part of the tendon of the external abdominal muscle contributes in any degree to form a seat of stricture in crural hernia.

k, k, k. The abdominal or transversalis portion
of the crural sheath, showing its origin from the iliac portion of the fascia lata.

m. m. A portion of the fascia transversalis, exhibiting its connection with the part k, k, k of the crural sheath, and its change into cellular membrane as it ascends upon the abdomen.

n, n, n. The spermatic cord.

G, G, G. The peritoneal sac.

p, p. The distended bladder.

r, r, r. The brim of the pelvis.

s, t. The crural vein and artery, with their principal branches situated behind the fascia transversalis, and dipping into the crural sheath.

The space bounded by the crural veins, the brim of the pelvis, r, r, r, and the ligament-like process of the fascia lata, d, d, u, is a small conical or thimble-like cavity, into which the end of the little finger may be thrust. This will be hereafter named the ventro-crural passage. Through it the bowel passes in crural hernia.

The Cremaster Muscle.—The principal fibers of the cremaster muscle arise from the middle portion of Poupart’s ligament, between the internal oblique and transversalis muscles, and from this point extend nearly to the external abdominal ring. On the outside of the ring the cremaster muscle spreads its fleshy serpentine fibers in various directions, until they all terminate in a tendino-membranous aponeurosis, which, in the manner of a sheath, includes within it the spermatic cord with the cellular substance surrounding it, along with the vaginal coat of the testicle. The distinguished anatomist and surgeon, M. Jules Cloquet, devoted especial attention to the mode of formation of the cremaster muscle, and formed the opinion, after many dissections, that the cremaster does not exist in the foetus before the descent of the testicle into the scrotum; but that it is produced by the gubernaculum testis and testis itself contracting adhesions, as they descend through the inguinal canal into the scrotum, to the middle portion of the muscular fibers forming the lower edge of the internal oblique muscle, and that, by thus dragging these fibers along with them in their descent, a series of inverted loops are formed by the gradual displacement and elongation of their intermediate and more movable portion.*

The cremaster branch of the epigastric artery furnishes the blood-supply to the muscle, and the principal division of the external spermatic nerve is distributed to its fibers. This muscle is generally wanting in the female, yet the lower fibers of the internal oblique muscle are, in some instances, loosely distributed over the round ligament of the uterus, where it lies in the lower part of the inguinal canal. Cloquet observed that oftentimes an oblique inguinal hernia is formed in the female. The anterior surface of the hernial sac derives a partial investment from the inferior fibers of the internal oblique, which are displaced and dragged downward by the sac,

as the hernia is gradually protruded through the inguinal canal, very closely imitating the mode of formation of the cremaster muscle by the descent of the testis in the male. Some individuals are possessed of a considerable voluntary power over the contractions of the cremaster muscle, and are enabled to retract the testes as high as the external abdominal ring, and in some instances even to withdraw them into the lower part of the inguinal canal.

The Transversalis Muscle.—The transversalis muscle, in its lower portion, arises from the outer third of Poupart's ligament and the crest of the ileum, and is inserted into the linea alba. The lower fibers curve downward, and are inserted, together with those of the internal oblique muscle, into the crest of the os pubis and pectineal line, forming the conjoined tendon already described. The triangular ligament is a band of tendinous fibers, which is continued from Poupart's ligament at its attachment to the pectineal line upward and inward, beneath the inner pillar of the external ring, to the linea alba.

PLATE V.*

ANTERIOR PARIETES OF THE TRUNK.—ADULT.—NATURAL SIZE.

Right side of the subject; great oblique and femoral aponeurosis. Left side; small oblique and superior part of the muscles of the thigh.

A, A. Anterior and superior ridges of the iliac bones.

Right Side.

B. Ridge of the pubis.
1. Inferior muscular fibers of the great oblique.
2, 2. Aponerousis of the same muscle.
3, 3. Section of the aponeurosis of the linea alba.
4, 4. Ligamentous small bands for strengthening, which form at their extremity the pillars of the inguinal ring.
5, 5. Folds of the aponeurosis, or Poupart's ligament.
6. External pillar of the inguinal canal.
7. Its internal pillar intercrossed upon the pubis with that of the opposite side. Deeper, there is a vascular aponeurotic slit.
8. Opening of the inguinal ring.

9, 9. Oblique fibers, arising from Poupart's ligament, which, crossing the direction of the aponeurosis, close above the opening of the ring, and, together, bind its two pillars.
10. Superficial layer of the fascia-lata aponeurosis, in front of the crural canal.
11. Falciform fold of the aponeurosis, forming the free edge of the inferior orifice of the same canal.
12. Section of the saphenous vein which passes through this orifice.

Left Side.

From 13 to 13. Inferior muscular fibers of the internal oblique muscle.
14. Arcade, formed above the cord of the spermatic vessels, by the last fibers, of which some detach themselves in order to concur to the formation of the cremaster muscle.

* Bourgery, Plate LXIX.
15. Aponeurosis of the small oblique muscle.
17, 17. Aponeurosis of the great oblique in-
verted.
18. External pillar.
19. Superior attachment of Poupart's ligament,
or internal inguinal ligament.
20. Internal pillar. Between the two pillars,
the opening of the internal ring, crossed by the sper-
matic vessels, is seen. Above the internal pillar is
the aponeurotic slit indicated on the other side.
22. Fascia lata.
23. Anterior left of the thigh.
24. Bundle of the psoas and iliaca.
25. Pectineus.
26. First abductor.
27. Penis.
28. Cord of the spermatic vessels.
29. (Right side). Fascia-lata aponeurosis, un-
der the insertion of the same name.

The Transversalis Fascia.—The transversalis fascia covers the space between the
lower border of this muscle and Poupart's ligament. This fascia lies between the
transversalis muscle and the peritoneum. It is a part of the fascia which lines the
interior of the abdominal and pelvic cavities, with which it is directly continuous.
In the inguinal region this fascia is thick and dense, and is attached externally to
the femoral vessels and to the posterior margin of Poupart's ligament. It also forms
the anterior wall of the crural sheath of the vessels as they descend into the thigh.

Since the transversalis fascia was first pointed out by Sir Astley Cooper as ex-
ercising a most important physiological function, the value of which is greatly empha-
sized in its relation to the cure of hernia, by the restoration of the obliquity of the
inguinal canal, the original description of it by Mr. Cooper is of sufficient interest
to transcribe: "When the lower portions of the internal oblique and transversalis
muscles are raised from their subjacent attachments, a layer of fascia is found to be
interposed between them and the peritoneum, through which the spermatic vessels
emerge from the abdomen. This fascia, which I have ventured to name fascia trans-
versalis, varies in density, being strong and unyielding toward the ileum, but weak
and more cellular toward the pubes. Midway between the spine of the ileum and
pubes, the opening will be seen which is now generally known as the internal ab-
dominal ring; the edges of it are indistinct, on account of its cellular connections
with the cord; when these are separated, the fascia in which it is formed will be
found to consist of two portions; the outer strong layer, connected to Poupart's
ligament, winds in a semilunar form around the outer side of the cord, and bounds
the aperture by a distinct margin, from which a thin process may be traced passing
down upon the cord. The inner portion, which is found behind the cord, is attached
to, but less strongly connected with, the inner half of the crural arch, and may be
readily separated from it by passing the handle of a knife between it and the arch.
It ascends behind the tendon of the transversalis, with which it is intimately blended, passes around the inner side of the cord, and joins with the outer portion of the fascia above the cord, being at length firmly fixed in the pubes; the inner margin

Fig. 1.—The woodcut represents the funnel-shaped sheath of the fascia transversalis laid open upon its front aspect, so as to show the manner in which it incloses the structures which constitute by their union the spermatic cord; 

a. The rectus abdominis muscle of the left side dissected.  
b. The pyramidalis muscle.  
c, c. The tendinous aponeurosis of the external oblique muscle, dissected from its attachments, and reflected downward upon the upper part of the thigh.  
d. The internal and superior pillar of the external abdominal ring, cut from its connections with the body of the os pubis, and reflected downward with the rest of the aponeurosis of the external oblique muscle, of which it forms a part.  
e. The corresponding portion of the internal and superior pillar of the external abdominal ring, occupying its natural position in front of the body of the os pubis.  
f. The outer border of the tendon of the rectus muscle, where it is continuous with the inner or pubic portion of the fascia transversalis (g).  
g, g, g. The fascia transversalis, where it lines the inguinal region.  
h. The fascia transversalis blended with the posterior edge of Poupart’s ligament, so as to form with it the floor of the inguinal canal. The fibers of the internal oblique and transversalis muscles have been dissected from their attachments to the iliac portion of the crural arch and wholly removed.  
i. The funnel-shaped sheath of the fascia transversalis, laid open in front to display the component structures of the spermatic cord, which it incloses.  
j. The funnel-shaped sheath of the fascia transversalis, where it invests the spermatic cord, between the external abdominal ring and the testis; behind this portion of the cord are observed some oblique fibers, which constitute the triangular ligament of the inguinal canal.  
k. A portion of the great sac of the peritoneum.  
l. A tubular process of the peritoneum, which is frequently to be found as a fibro-cellular band in front of the rest of the structures composing the spermatic cord; it consists of the obliterated portion of the original processus vaginalis peritonaei.  
m. The epigastric artery, as it passes deeply into the subserous cellular tissue, betwixt the fascia transversalis and the peritoneum, and along the pubal side of the internal abdominal ring.  
n. Dotted lines, which serve to indicate the course of the epigastric artery, as it ascends in an oblique direction behind the fascia transversalis in its way toward the umbilicus.  
p. The spermatic veins.  
q. The spermatic artery.  
r. The vas deferens.  
s. The triangular ligament of the inguinal canal.

of the ring is less defined than the outer, the fascia transversalis being doubled inward toward the peritoneum, to which it is firmly attached. Thus, then, it appears that the internal ring is not a circumscribed aperture like the external abdominal
ring, but is formed by the separation of two portions of fasciae, which have different attachments and distributions at the crural arch; the outer portion terminating in Poupart's ligament, while the inner portion will be found to descend behind it, to form the anterior part of the sheath that envelopes the femoral vessels. The strength of this fascia varies in different subjects; but in all cases of inguinal hernia it acquires considerable strength and thickness, especially in its inner edge; and if these parts had been formed without such a provision, the bowels would, in the erect posture, be always capable of passing under the edge of the transversalis muscle, and no person would be free from inguinal hernia. The fascia transversalis may be traced as high as the diaphragm; and on the inner side it passes behind the rectus muscle, where it begins to assume the character of cellular tissue."

These observations of Sir Astley Cooper were confirmed by Hesselbach, who published his studies upon the subject in 1806, only two years after the appearance of Mr. Cooper's work, and very likely were made as original studies entirely independent of the views of this master. Scarpa and Cloquet, somewhat later, demonstrated the conditions described by Mr. Cooper, and emphasized their important physiological value. Reference is frequently made to this fascia by subsequent writers, naming it after Mr. Cooper.

The funnel-shaped sheath of the fascia transversalis, as it descends downward upon the cord, is very clearly shown in the accompanying woodcut from one of Morton's dissections. (Fig. 1.)

The Conjoined Tendons of the Internal Oblique and Transversalis Muscles.—The lower border of the transversalis and the internal oblique muscles blend in an interwoven connective-tissue sheath, called the conjoined tendon. This connection is so intimate that it is absolutely impossible to separate it, and is very properly considered as one of the most important factors in the anatomical study of hernia, and is worthy of minute description. These tendons are in part situated in front of the pyramidalis and lower portion of the rectus muscle, being inserted into the linea alba and crista of the os pubis. The inferior fibers are somewhat spirally reflected downward and outward, to be inserted behind the ligament of Gimbernat, into the inner part of the ileo-pectineal line of the os pubis, passing behind the spermatic cord, as it lies in the lower part of the inguinal canal. This distribution of the conjoined tendinous fibers closes up a considerable portion of the space which is included between the epigastric artery and the outer edge of the rectus muscle, thus consti-
INGUINAL HERNIA. ANATOMY OF THE PARTS INVOLVED.

In tuting a principal part of the posterior wall of the inguinal canal. This distribution of these fibers aids materially in the formation of the obliquity of the canal, which is an important factor of surgical consideration, to be noticed further in the surgical measures for the restoration of the oblique direction of the inguinal canal, so important to maintain for the permanent cure of hernia.

PLATE VI.*

Anterior Parietes of the Trunk.—Study of the Inguinal Canal.

A, A. Anterior and superior spinous process of the ilium.
B, B. Tuberosites of the pubes.

Left Side.
1. Inferior extremity of the great oblique.
2. 2. Its aponeurosis.
3. Shreds of the aponeurosis, inverted to show the interior of the inguinal canal.
5. Cut of the small bands, from whence the internal pillar proceeds.
6. External pillar, implanted upon the spine of the pubis.
7. Small band, whence the internal pillar proceeds.
8. Internal pillar. Between the two pillars is the inguinal ring.
9. Internal inguinal ligament.
10. Extremity of the internal pillar of the right side.
11. First band of insertion to the pubis, separated from the internal pillar by the arcade of passage to the ilio-scrotal nerve.
12. Extremity of the aponeurosis which closes the ring preserved in the form of a stay.

Right Side.
14. Aponeurosis, thrown back upon the thigh.
15. Its tie, forming the external pillar.
16. Aponeurosis of the little oblique, in front of the great right.
17. Left Side.—Last ties of this muscle in the gutter of Poupart’s ligament. The arcade which it forms is raised up by a hook to let the transversal be seen.
18. Right Side.—Extremity of the fibers of the little oblique inverted within, to let the aponeurosis of the transversalis be seen.
20. Idem.—Last ties of this muscle in the gutter of Poupart’s ligament.
21. Idem.—Summit of the arcade which it forms above the internal orifice of the inguinal canal.
22. Aponeurosis of the transversalis.
23. Inferior tie of the pubis. It is the same aponeurosis which is seen through the orifice of the left inguinal ring.
24. Of the Two Sides.—Thick edge of the fascia transversalis which limits the superior orifice of the inguinal canal outside, and then unites itself with the gutter of Poupart’s ligament.
25. Very fine portion of the same fascia, which forms the internal edge of the orifice. Behind a fibro-cellulous sheet are seen the epigastric vessels which ascend parallel to the internal edge.
26. Ellipsoidal internal orifice of the inguinal canal.
27. Right Side.—Superficial aponeurotic sheath, applied upon the crural vessels.
28. Idem.—Section of the internal saphenous vein, which crosses the femoral aponeurosis (inferior crural ring), in order to join the femoral vein.
29. Left Side.—Sartorius muscle.
30. Idem.—Fascia lata.
31. Idem.—Reflected mass of the psoas and iliac.
32. Idem.—Pectineus.
33. Idem.—Anterior right.
34. Idem.—First abductor.
35. Idem.—Penis.
36. Idem.—Penis.

* Bourgery, Plate LXX.
Mr. Morton* demonstrates very clearly the mode in which the conjoined tendons of the internal oblique and transversalis muscles form the lower part of the posterior wall of the inguinal canal, in the following manner: "Let the tendinous aponeurosis of the external oblique muscle be reflected, together with the spermatic cord, upon the upper part of the thigh, so that the whole of the triangular space which is included between the epigastric artery and the lower portion of the rectus muscle shall lie fairly exposed to view. The index-finger of the left hand may now be placed upon this space, a little above and parallel with Poupart's ligament, while with the other hand traction is made alternately upon the lower fleshy fibers of the internal oblique and transversalis muscles, which for this purpose should be separately detached from their respective connections to the crista of the ileum and ligament of Poupart. When these instructions are observed, the finger which rests upon the posterior wall of the inguinal canal will be elevated, at every movement of the muscular fibers held in the right hand, by the tension of tendinous fibers belonging to each muscle. It will be perceived, at the same time, that the tendinous fibers belonging to the transversalis muscle are more curved in their direction, and extend farther outward from the border of the rectus than those appertaining to the internal oblique muscle."

The development and disposition of the fibers of the conjoined tendon are subject to considerable variation. Indeed, it is sometimes difficult to demonstrate their presence in that portion of the posterior wall of the canal which they ordinarily greatly strengthen and support. However, in such instances compensation is usually found in the fascia transversalis, which has developed to a greater extent than ordinarily. It will be observed that the conjoined tendons, being thus located behind the external abdominal ring, form the chief obstacle to the direct protrusion of the viscera through this part of the posterior wall of the canal, forming, as it were, a buttress which tends to prevent the development of a direct or internal inguinal hernia.

The Internal Abdominal Ring.—The circumscribed space beneath the lower margin of the transversalis muscle was named by Sir Astley Cooper the internal abdominal ring. It is situated in the fibrous membrane of the transversalis fascia, already fully described in the quotation from Mr. Cooper. It penetrates the transverse fascia midway between the anterior superior spine of the ileum and the spine of the pubis, and about half an inch above Poupart's ligament. It is oval in shape, and varies in

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size in different individuals, being much larger in the male than in the female. It is limited above by the arching fibers of the transversalis, and internally by the epigastric vessels. About its circumference, a thin, funnel-shaped membrane is formed from the transversalis fascia, which is continued around the cord and testes and incloses them in a distinct sheath.

In an oblique inguinal hernia this fascia forms one of the coverings of the sac. This fascia is loosely connected with the peritoneum, and in fleshy persons a layer of fat is here often found.

**PLATE VII.**

**The Parts concerned in Inguinal Hernia on the Left Side.**

1, 1, 1. Integument.
2. Fascia superficialis.
3. External oblique muscle.
3 a. Its aponeurosis turned down on the thigh.
3 b. Poupart's ligament.
3 c. The insertion of the external oblique into the os pubis.
4. a. The internal oblique muscle passing across the abdomen to assist in forming the sheath of the rectus.
4 b. A portion or slip of this muscle separated from its attachment, and hanging down outside the spermatic cord.
5. The superior fibers of the transversalis muscle passing above the cord to their insertion into the pubis.
6. The inferior fibers of the transversalis muscle passing below the cord, forming the lower edge of the internal or superior opening of the inguinal canal, and inserted into Poupart's ligament up to the pubes. The fibers marked 6 are all muscular; in some instances they are tendinous and aponeurotic; in others they are either wanting or so indistinct as scarcely to be distinguished from the fascia transversalis.
7. The cremaster muscle given off from the internal oblique, and partly from the transversalis muscles seen lying upon the cord at 7 and passing under it from 7 to 8.
8. The portion of the cremaster usually considered as a second origin, but which is in fact its insertion after its fibers have proceeded the whole length of the spermatic cord and testis, forming in this way a sling partly muscular, partly tendinous, whereby it may be drawn up toward the abdomen.
9. The rectus muscle, its sheath having been turned up.
10. The pyramidalis muscle.
11. The spermatic cord.
12. The cremaster artery, a branch of the epigastric.

**The Inguinal Canal.**—This name has been given to the oblique passage in the iliac region of the abdominal parietes, through which in the male the spermatic cord, and in the female the round ligament of the uterus, descend from the interior of the abdomen to reach the structures with which they are connected externally. It is about an inch and a half in length, and extends obliquely downward and outward, parallel with and a little above Poupart's ligament. Through the internal abdominal ring it communicates with the abdominal cavity, and terminates below at the ex-

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*Guthrie, G. J., F. R. S., London, 1833, Plate I.*
ternal ring. In its entire length it is limited, in front, by the aponeurosis of the external oblique; in the outer third, by the internal oblique; behind, by the conjoined tendon of the internal oblique and transversalis muscles, the triangular ligament, and the transversalis fascia; below, by the union of this fascia to Poupart's ligament. Oblique inguinal hernia always follows the line of this canal.

In the developmental processes of intra-uterine life, it is usually accepted that the gubernaculum testis, contracting, carries with it the testicle, the portion of the peritoneum which is to form the tunica-vaginalis, and the lower fibers of the obliquus internus which constitute the cremaster.

Between the fifth and sixth months of intra-uterine life the gubernaculum testis attains its development. It completely fills the inguinal canal, and lies behind the peritoneum, anterior to the psoas muscle. According to Mr. Curling, the gubernaculum divides below into three processes: the external and broadest is connected with Poupart's ligament in the inguinal canal; the middle process descends along the inguinal ring to the bottom of the scrotum, where it joins the dartos; the internal one is firmly attached to the os pubis and sheath of the rectus muscle; some fibers are also reflected from the internal oblique muscle on to the front of the gubernaculum. About the sixth month the testis descends to the iliac fossa and the gubernaculum is shortened. During the seventh month the testis enters the internal abdominal ring, carrying before it a pouch of the peritoneum, the processus vaginalis. During the last month of pregnancy the testis descends into the scrotum, and the lengthened pouch of the peritoneum is still open, communicating with the peritoneal cavity.

Usually, at birth, the upper front of this pouch has become closed, and the obliteration extends gradually downward to within a short distance of the testis. This remains through life as a closed serous sac, the tunica vaginalis, which invests the outer surface of the testis and epididymis, and is reflected over the inner surface of the scrotum. During the descent of the testis the muscular fibers of the gubernaculum are gradually everted, forming a muscular layer, which becomes placed external to the process of the peritoneum, surrounding the gland and spermatic cord, and constitutes the cremaster.

In the female, a small cord, corresponding to the gubernaculum in the male, descends to the inguinal region and ultimately forms the round ligament of the uterus. A pouch of peritoneum accompanies it along the inguinal canal, analogous to the processus vaginalis in the male, and this is called the canal of Nuck.

In the majority of new-born infants some portion of the unclosed canal still remains,
“In twenty-one cases, Seiler found four in which it was open on both sides, five in which it was open on the right side, and four on the left. In fifty-three new-born infants, Camper found twenty-three open on both sides, eleven on the right and six on the left. Schreyer found in thirteen infants that the canal was open on both sides in eight. Paletta gives the rule that the complete closure of the vaginal canal takes place from the twentieth to the thirtieth day after birth.”

When closure does not take place, the condition known as congenital hydrocele exists—i. e., the fluid from the peritoneal cavity gravitates into the non-closed tunica vaginalis, which becomes distended in a limited degree, as in hydrocele. The fluid gradually returns when in a recumbent position. This is rare, but one well-marked case has come under my notice, where this condition had persisted from infancy, and the canal was permanently closed from the inflammation caused by a hard-pad truss. Some time later, after a bath, in pulling himself, hand-over-hand, up into the port-hole of a ship, the young man produced a hernia, which, however, was easily retained by a light truss. The hydrocele did not recur.

As we have seen, the inguinal canal is not an open but a closed passage through the abdominal walls—a passage for the transmission of important vessels, but so fortified by fascia, muscle, and tendon as to hold its walls normally in close apposition, bringing intra-abdominal pressure to bear, not in line with its opening, but at a wide angle to it. Pressure thus disposed can never make an oblique inguinal hernia, but rather will close the canal. A beautiful illustration of this is seen in the passage of the ureter through the bladder wall.

“A simple contrivance gives a very clear idea of the manner in which the inguinal canal is formed. Let one take two slips of paper and cut two small holes in the center of each. Let him then lay these holes opposite each other, and pass through them a quill or pencil-case. When he has done this, he has a very good plan of the state of the parts about the groin in the foetus. If he now holds the papers opposite him and pulls to one side the one nearest to him, he will find by so doing that he comes to lay the quill between the pieces of paper in the same way, that the spermatic cord, by the extension upward and outward of the internal orifice of the ring, comes to be lodged in the canal. He will also see that the length of the canal must vary according to the greater or less extension of its posterior side. Elsewhere the author has expressly

stated that the inguinal and femoral canals are not properly canals, unless distended by hernia. In a normal state they are simply flattened passages."

As described by Dr. Darling, the inguinal canal has the following boundaries:

- **Structures in front**
  - Skin.
  - Superficial fascia (two layers).
  - External oblique (entire length).
  - Internal oblique (outer third).

- **Structures behind**
  - Conjoined tendon of internal oblique and transversalis.
  - Transversalis fascia.
  - Triangular ligament.
  - Subperitoneal tissue and fat.
  - Peritoneum.

- **Structures above**
  - Fibers of internal oblique.
  - Fibers of transversalis.

- **Structures below**
  - Poupart's ligament.
  - Transversalis fascia.

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**Figure 1.**

The right side of the same individual whose left side is shown in Plate VII. The drawing from which the engraving was taken was made by Mr. Clift. Sir Astley Cooper dissected the internal parts, to show how far they accorded with the view of them given in his work, and which is Fig 3.

- **A.** Poupart's ligament.
- **B.** The tendon of the external oblique turned toward the linea alba.
- **C.** The spermatic cord.
- **D.** The cremaster muscle.
- **E, E.** The internal oblique muscle: at the upper part its anterior surface is shown; at the under part it is separated from the transversalis, a little raised and turned upward and inward so as to show the under surface of the muscular fibers at E.
- **F.** The transversalis muscle partly exposed and raised in a similar manner; the under surface is shown by the line extending from F; the outer surface of the same muscle is shown by the line extending from I.
- **G.** Fascia transversalis, outer division.
- **H.** Peritoneum.
- **I.** The inferior fibers of the transversalis.
- **J.** The femoral vein.
- **K.** The femoral artery.

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**PLATE VIII.†**

**Figure 2.**

A. The inferior and united edges of the internal oblique and transversalis muscles, horizontally directed across the abdomen to the linea alba.

B. The crural arch, or Poupart's ligament.

C. The fibrous expansion detached from around the inguinal ring—i.e., the ring exposed by the removal of the intercolumnar fascia.

D. The internal or superior pillar of the ring.

E. The external or inferior pillar of the ring.

F. Muscular nooses or arches formed by the cremaster muscle on the spermatic cord, and derived from the inferior border of the internal oblique and transversalis muscles.

G. This is S in the original, and is described as the aponeurotic fascia transversalis, which forms the posterior wall of the inguinal canal in a spot where, of the three muscles of the abdomen, only one is found, viz., the external oblique. This is internal to the cord.

H. This represents the same thing, but external, or to the outside of the cord.

I. The spermatic cord.

1. The femoral vein, situated on the inside of—

2. The femoral artery.

3. An opening made in the external part of the crural canal (sheath of the vessel), to show

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† Guthrie, Plate II.
the anterior crural nerve, situated immediately on
the outside of it, and lying on the cellular struc-
ture covering the psoas muscle.
4. Saphena majora vein.
5. A lymphatic gland and vessels.
6. Falciform or semilunar fibers situated at
the junction of the vena saphena with the femoral
vein.
7. The anterior wall of the crural canal, or
sheath of the vessels, opened and turned outward
and inward to show the canal.

Figure 3.
A, A. Poupart's ligament.
B. Internal oblique muscle.
C, C. Transversalis muscle, arising from Pou-
part's ligament and passing around the spermi-
cord at the internal ring, so that the fibers of this
muscle appear behind as well as before the sper-
matic cord, and thus the inguinal canal is rendered
a muscular canal. This is a most important pro-
vision in preventing hernia, and when hernia ex-
ists it is often the cause and seat of the stricture.
D. The cremaster muscle, arising from Pou-
part's ligament between the internal oblique and
transverse muscles, and receiving fibers from the
transversalis behind the cord.
E. The rectus muscle.

F. Its sheath from the internal oblique and
transverse muscles.
G. Superficial fascia of the cord.
H. Spermatic cord.
I, I. The internal ring. By a mistake, the
line running from I rather appears to stop at the
cremaster muscle at D, than to go to the inner
ring.
K. The external ring.

N. B.—The difference between F and G of
Fig. 2, when compared with F and I of Fig. 1, is
remarkable; it is no less so when compared with
C, C of Fig. 3 of the same plate, or with Nos. 5
and 6 of Plate VII.

The French anatomists generally appear to
consider that formation of the transversalis mus-
cle to be the more natural one in which it runs
across to the linea alba, without being inserted
into Poupart's ligament, when the spermatic cord
will be found lying on the fibrous layer of the
fascia transversalis, as in Fig. 2, Plate VIII, at G;
and in order to show the loops formed of the cre-
master by the testis in its descent into the scrotum,
they sacrifice the insertion of those fibers which
do not take this appearance, as seen in Plate VII,
No. 6. Anatomists only can judge which descrip-
tion is most correct, and which formation is most
commonly met with.

The Subserous Connective Tissue.—Between the inner surface of the transversalis
fascia and the peritoneum there exists a layer of loose connective tissue which is fre-
cently of considerable thickness, especially in corpulent persons, in whom it is so much
loaded with fat as to resemble the omentum in a remarkable degree, and for which
it may be mistaken during operations for strangulated hernia. The spermatic cord
receives an investment from this connective-tissue layer which extends into the scrotum.

The sac of an oblique inguinal hernia often descends into this loose structure, and
may cause a separation of the component parts of the cord. It is well to bear in mind
that fatty tumors may develop here—although of rare occurrence—and be mistaken
for hernia. Considerable accumulations of serum are sometimes met with in this con-
nective-tissue layer and along the line of the cord, known under the name of encysted
hydrocele.

This was called by Mr. Pott, who first described it, "hydrocele of the cells of the
tunica communis." He reports a case, as an extreme instance of this disease, from
whom he drew off eleven pints of water.
The Spermatic Cord and Vessels.—The spermatic vessels, placed behind the peritoneum, descend from the loins over the surface of the psoas and iliacus internus muscles, and are connected to them and to the membrane by loose connective tissue, and extend to the division between the two portions of the fascia transversalis. Here they are joined, at an angle more or less acute, by the vas deferens, and the spermatic cord which results from this junction, making a sudden bend inward, passes into the inguinal canal through its upper or inner aperture. The vas deferens is placed in the canal behind and toward the inner side of the vessels, and consequently under the fleshy margin of the obliquus internus and transversalis muscles, the exact situation of its passage being marked by a slight depression of the peritoneum. The cord thus goes obliquely downward and inward, between the fascia transversalis and the aponeurosis of the external oblique, being increased in size by the addition of the muscular fibers, called the cremaster muscle, derived from the lower edge of the internal oblique and from the crural arch. The cord finally emerges through the opening in the tendon of the obliquus externus, and then turns suddenly downward, lying not so much on the bone, between the two columns of the rings, as on the outer column itself, so as to cover the insertion into the pubes.

Thus the vessels of the testicle, making two remarkable turns, pursue three different directions in the successive parts of their course. "They descend, inclining at the same time a little outward, from the loins to the opening in the fascia transversalis. Then they bend inward and forward, between that fascia and the aponeurosis of the external oblique, making a curve, of which the concavity is turned toward the pubes; the vas deferens makes a sharp angular turn at that part. The spermatic cord makes a second turn, with its convexity toward the pubes, and lastly descends straight to the testicle." *

The cord, besides the vas deferens, is made up of arteries, veins, nerves, lymphatics, a membranous sheath, and the cremaster muscle. The spermatic artery is given off from the aorta a little below the superior mesenteric branches. Opposite the middle of Poupart's ligament it passes from the lower part of the abdomen and joins the cord running to the testicle.

The spermatic vein, arising from the testis, returns along the cord to the abdomen. Two small arterial branches are also generally a part of the cord: one, from the internal iliac, accompanies the vas deferens; the other, a branch of the epigastric.

* Lawrence on Ruptures, p. 160.
INGUINAL HERNIA. ANATOMY OF THE PARTS INVOLVED.

The Epigastric Artery.—An accurate knowledge of the course of the epigastric artery is essential in operations for hernia, since it is situated so near the spermatic cord. This vessel arises from the iliac artery, behind Poupart's ligament, and passes upward and inward close to the under and inner side of the cord, between it and the symphysis. Here it gives off a branch to the cord. For nearly two inches of its course it lies posterior to all the abdominal muscles, beneath the peritoneum. It ascends obliquely and upward to the margin of the sheath of the rectus muscle. In its course it lies behind the inguinal canal, to the inner side of the internal abdominal ring and immediately above the femoral ring.

The epigastric varies considerably in its origin and branches. The position of the artery concerned in hernia is the beginning of its course, close to the inner and under side of the spermatic cord, where the latter issues from the internal ring. Here the artery is generally three inches from the symphysis pubis, and is at the same distance from the spine of the ileum.

The artery is accompanied by veins, of which the largest is constantly found on the inner side of the artery. They end by a single trunk in the iliac vein.

PLATE IX.*

INGUINAL REGIONS OF THE FEMALE.

Figures 2 and 3. Female Basin.

They are numbered alike. In Fig. 2 the right side shows the inguinal ring and the aponeurosis intact; on the left side the aponeurosis of the great oblique is cut and inverted; the inferior part of the transversal is taken away in order to exhibit the passage of the inguinal canal. Fig. 3 forms a third view on the right side; it shows the manner in which the transversal terminates inferiorly, and its relations with the round ligament of the uterus.

1, Fig. 2. Aponeurosis of the great oblique.
2, Figs. 2 and 3. Inguinal canal.
3, Figs. 2 and 3. Internal pillar.
4, Figs. 2 and 3. External pillar.
5, Figs. 2 and 3. Transversal fibers of union of the small fibrous bands.
6, Fig. 2. Left side; and Fig. 3, aponeurosis inverted. The circumference of the ring is preserved.

7, Figs. 2 and 3. Arcade of the small oblique. It is hooked upward in Fig. 3.
8, Figs. 2 and 3. Internal orifice of inguinal canal.
9, Figs. 2. Fascia transversalis.
10 and 11, Fig. 3. Very dense intercrossed bundles (formed by the transversi), which prevent, in woman, the production of inguinal hernia. They are composed of a mixture of muscular and aponeurotic fibers, and are separated in order to give passage to the round ligament. 10. Superior bundle, which passes in front of the other and inserts itself into the pubis.
11. Inferior bundle, which disengages itself from under the first and returns to implant itself in the aponeurotic gutter.
12, Fig. 3. Round ligament of the uterus maintained by a hook.

* Bourgery, Plate LXXXII.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

The Nerves and the Lymphatics.—The lymphatics of the testicle and spermatic cord are very numerous, and by anastomosis form trunks of considerable size which ascend along with the spermatic veins, and terminate in the lymphatic glands which are situated upon each side of the aorta, in front of the lumbar vertebrae. The nerve-supply of the cord consists of branches of the lumbar plexus, filaments from the mesenteric, renal, and hypogastric plexus of the great sympathetic—conditions which explain the intimate relation of sympathetic disturbance which is often shown, where injury to the testicle is followed by nausea, etc.

PLATE X.*

Muscles of the Anterior Inclosure of the Trunk, seen on their Posterior Surface.—Inferior Extremity of the Abdominal Muscles of the Two Sides.—Natural Size.

From a to a. Vertical section of the coxal bone, which falls in the middle of the cotyloid cavity.

a. Oblique section, which goes into the horizontal branch of the pubis to exhibit the crural ring.

a1. Plan of the vertical section of the pubis.

b. Segment of the cotyloid cavity.

c. Anterior and superior iliac spine.

d. Portion of the iliac fossa, behind the section of the iliac muscle.

e. Spine of the pubis.

f. Birth of the descending branch of the pubis.

g. Pubian symphysis.

Right Side.

1. Inguinal ring.

2. Small bands, which are crowded together to form the external pillars of the ring.

3. Their superior extremity, where they proceed from the great oblique.

4. Small band of the internal pillar.

5. Its superior extremity.

6. Superior band, separated from the preceding by a small arcade.

7. Transversal fibers of connection to the small hands.

From 6 to 6. Shred of the fascia transversalis, which forms the posterior covering to the gutter of the ligament of Poupart.

9. The same shred, inverted under the last insertions of the little oblique and of the transversal (15).

10. Ligament of Gimbertat.

11. Internal inguinal ligament.

12, 12. Aponeurosis of the great oblique.

13. Inferior extremity of the great oblique muscle.

From 14 to 15. Inferior insertion of the little oblique and of the transversal in the gutter of Poupart's ligament (fold of the aponeurosis of the great oblique and of the fascia transversalis).

16. Gutter which the fascia transversalis and the fascia iliaca form; it goes as far as the crural ring.

17. Crural ring (superior internal).

18. Inferior extremity of the pyramidal. This muscle has been removed for some few lines in order to let the internal inguinal ligament be seen, and continues higher up.

19. Portion of the aponeurosis of the little oblique which adheres to that of the great oblique.

20. Cut extremity of the great right.

21. Inferior portion of the linea alba.

22. Triangular ligament which forms its pubian tie.

Left Side.

23. Fascia transversalis upon the transversal muscle and its aponeurosis.

24. Internal and superior orifice of the inguinal canal (internal inguinal ring).

25. Its internal edge.

* Bourgery, Plate LXXI.
**INGUINAL HERNIA. ANATOMY OF THE PARTS INVOLVED.**

26. Its external edge, both formed by the fascia transversalis.
27. Inferior extremity of the great right. 
28. Gutter of the fascia transversalis, and of the fascia iliaca. 
29. Its enlargement in infundibulum, above the crural ring. 
30. Crural ring. 
31. Ligament of Gimbernat. 

**Of the Two Sides.**
32. Fascia iliaca upon the iliac muscle. 
33. Plan of the vertical section of the psoas and iliac muscles. 
34. Section of the pubian tie of the pectineus. 
35. Cut of the abdominal muscles at their iliac insertion. 

The Structure and Relation of the Posterior Wall of the Inguinal Canal.—Before completing the anatomical study of the parts involved in inguinal hernia, it is wise that we examine the canal from the inner or peritoneal side. When the abdominal parietes of the inguinal region is held as nearly as possible in the normal position, there will be observed to be present in the peritoneum, upon each side of the median line, three distinct depressions which have been called the fossae of the peritoneum; the deepest of these is the most external, and is situated on the outer or iliac side of the epigastric artery, and corresponds with the upper aperture or inlet of the inguinal canal. It is just beneath this point that the spermatic vessels and the vas deferens unite as they bend over the epigastric artery, previous to their entrance into the inguinal canal, where they go to make up the spermatic cord. At this point the peritoneum readily yields under pressure, and may be pushed forward to form a small pocket, extending a little distance upon the anterior side of the spermatic cord, just within the upper part of the inguinal canal. This marks the situation of the original processus vaginalis of the peritoneum, which canal, in many subjects, is imperfectly closed, and occasionally a probe may be easily introduced downward and in front of the spermatic cord, or round ligament of the uterus. This sometimes remains open in the adult female, and is familiarly known to anatomists as the canal of Nuck. It occasionally happens, in the male, that a very narrow opening still exists, connecting the tunica vaginalis testis with the peritoneum, the processus vaginalis not having been completely obliterated.

In certain of the lower animals—the dog, for instance—this canal remains permanently open in the adult animal—a fact of little physiological importance in the quadruped, but which would manifestly become a source of inconvenience and suffering in man, because of the change of the axis of the body. When this canal remains sufficiently open to allow the passage of the abdominal contents, it is denominated congenital hernia. Under these conditions a considerable quantity of serous fluid may gravitate into the
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

tunica vaginalis, and then it is known as congenital hydrocele. Irregular constrictions are sometimes found in this imperfectly closed peritoneal pouch which are filled with serous fluid, producing small encysted hydroceles of the spermatic cord. This peritoneal depression, opposite the internal abdominal ring, is undoubtedly the weakest point of the abdominal wall in man, and is the most common site of hernia in the male.

The second depression of the peritoneum is less deep and important, and is situated upon the inner side of the epigastric vessels. The third peritoneal depression is the most internal, and is situated upon the outer edge of the rectus muscle, and it appears to follow the line of the obliterated umbilical artery. It is directly posterior to the external abdominal ring; and, should herniae develop in the line of either of these depressions, they would belong to the direct variety.

PLATE XI.*

MUSCLES OF THE ANTERIOR INCLOSURE OF THE TRUNK, SEEN ON THE POSTERIOR SURFACE.—
NATURAL SIZE.

Left Side: Small oblique and cremaster.
Right Side: Transversal; details of the inguinal canal; great oblique.

Of the Two Sides.

From a to a. Vertical section of the coxal bone which falls in the middle of the cotyloid cavity. 

a'. Oblique section which enters into the horizontal branch of the pubis, to let the crural ring be seen.

a'. Plan of the vertical section of the pubis.
b. Segment of the cotyloid cavity.
c. Iliac spine, anterior and superior.
d. Portion of the iliac fossa, behind the section of the iliac muscle.
e. Spine of the pubis.
f. Birth of the descending branch of the pubis.
g. Pubian symphysis.

Left Side.

From 7 to 2. Small oblique.
2. Last fibers of insertion under which the cremaster begins.
3. Aponeurosis of the little oblique.

4. Suture of the aponeurotic layer of the transversal which passes in front the great right.
5. Cremaster.
6. Infundibulum formed by its fibers round the spermatic cord.

From 7 to 7. Extremity of the transversal which is attached to the iliac crest in the gutter of the ligament Poupart.
8. Gutter of the fascia transversalis and of the fascia lata.
10. Crural ring.
11. Ligament of Gimbernat.
13, 15. Aponeurotic layer of the transversal which passes in front the great right.
14. Cut extremity of the great right.
15. Inferior portion of the linea alba.
16. Triangular ligament, which forms its pubian tie.

Right Side.

From 17 to 18. Transversal.
19. Its aponeurosis.
20. Pubian insertion. One portion of it is

* Bourgery, Plate LXXII.
cut outside, to let the superior contour of the inguinal ring be seen; the rest of it is hid by the inferior ties of the transversal and of the fascia transversalis.

27 to 24. Gutter of the fascia transversalis and the fascia iliaca. A little shred of the fascia transversalis is preserved throughout its entire extent.

27. Internal edge.

24. External edge, cut arbitrarily within side to let the interior of the inguinal canal be seen.

25. Superior orifice of the inguinal canal.

26. Anterior inclosure of the inguinal canal formed by the fillets of the aponeurosis of the great oblique, the cremaster muscle having been removed.

27. Orifice of the inguinal ring.

28. Tie upon the tendon of the great right, from the inferior extremity of the fascia transversalis.

29. Crural ring.

30. Ligament of Gimbernat.

31. Great right muscle.

32. Its pubian tendon.

On the Two Sides.

33. Plan of the vertical section of the iliac muscles.

34. Section of the pubian tie of the pectineus muscle.
CHAPTER III.

CONGENITAL HERNIA.

Before entering upon the description of the anatomy of the other varieties of hernia, it appears to be the best disposition of the subject to commence our researches with the varieties of hernia which are incident to the inguinal canal, while having distinctly in mind the anatomical relations of the parts involved.

The first to be taken into consideration, although far less common, is that termed Congenital Hernia. This, as has been already mentioned, follows the line of the unclosed tunica vaginalis testis; and, although the student often has the greatest difficulty in understanding its exact relations, yet viewed from the standpoint of the discussion of the peritoneum in a subsequent chapter, it is the easiest of comprehension of all the varieties. An unclosed peritoneal pouch, extending into the scrotum, is necessarily a cause of weakness, and, when sufficiently large, invites the descent of the superjacent abdominal contents.

The name congenital was first given to this form of hernia by Haller, who believed that it could happen only at, or near, the time of birth of the individual who became the subject of this affection, before the period at which the obliteration of the connection between the tunica vaginalis and the peritoneal cavity was usually closed.

The original studies of Percival Pott* upon congenital hernia have so much interest and value that I quote the following deductions which he made of the conditions that produce it.

1. "That the testicles of almost all children, though originally formed and lodged within the belly, yet sooner or later after their birth are found either in the groin or in the scrotum; that is, they are found on the outside of the abdominal muscle.

2. "That the scrotum has no communication with the cavity of the abdomen, but

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* An Account of a Particular Kind of Rupture frequently attendant upon New-born Children, and sometimes met with in Adults; viz., that in which the Intestines or Omentum is found in the same Cavity and in contact with the Testicle. By Percival Pott, Senior Surgeon to St. Bartholomew's Hospital. Second edition, London, 1763.
through the mouths or entrances of the membranous sacculi in which the testicles are included.

3. "That when the testicles are got into the groin, or scrotum, by having passed through the aperture in the tendon of the abdominal muscle, they are always found enveloped in a loose bag, in which they were not contained while they were within the belly.

4. "That the entrances from the abdomen into these sacculi containing the testicles are generally to be seen open in a new-born child.

5. "That, by laying these sacculi open, the testicles are found within them naked; that is, they are found in the same state with regard to covering as they were in while within the cavity of the belly. . . . If the testicles remain any time in the groin (a thing not very infrequent), the communication between the sacculi and the belly continues open all that time; at least I have always found it so, in all those whom I have examined. When the testicles are got below the groin into the scrotum, the sacculi which contain them assume a pyriform kind of figure, having their largest end lowest; they are connected with the membranes of the scrotum so very loosely in young subjects as to be separable with utmost ease.

"They still for some little time continue to communicate with the cavity of the belly, by a large orifice capable in a mature foetus, or in a child newly born, of admitting a common crow-quill. This the eyesight, the passage of a probe, or the descent of a fluid poured upon the mouth of the opening, will prove to the satisfaction of any inquirer; and if the sacculus be now laid open, either from its bottom upward into the belly, or from its orifice within the belly downward, the most clear and convincing proof will appear, that the membrane which constitutes the inside of it is a production of, or a continuation from, that part of the peritonæum which lines the abdominal muscles, and covers the spermatic vessels, etc. Upon this division of the sacculus it will also appear that the testicles and epididymis within it have no other covering than what they brought out from the abdomen, and that notwithstanding they are protruded into and apparently contained within the sacculus, yet they still are (as they were originally) behind the peritonæum.

"Whether it be by the weight of the testicle now become pendulous from the spermatic cord, or from the action of the abdominal muscles, or from what cause I know not; but soon after the testicles are got fairly into the scrotum, the orifices and passages to these sacculi are closed and obliterated in such a manner that neither a probe nor a
fluid will now pass from the belly into them, nor from them into the belly. The passage of communication becomes closed some way above the epididymis, and the bag by this means forms a cavity much larger than the testicle, which is loosely included in it, and kept moist by a fine lymph constantly found there. The time at which this communication is stopped by the passage being shut, is uncertain and various, for, though it most frequently happens some time after the testicles are got into the scrotum, yet it is not constantly so; I have seen them open at four years old, and in an adult, and others have seen them open at a time between these; but whenever they do close, they form those bags which are then called the tunica vaginales testium, from or to whose cavity there is no longer any passage."

Mr. Pott closes his interesting dissertation with the report of four cases, adults, where hernia of this character existed.

As we have already shown, in discussing the development of the inguinal canal, the processus often remains open for quite a period after birth.

Hesselbach reported a case where he found the processus vaginalis canal open on both sides in the body of a man, aged thirty-eight, but no protrusion of the abdominal contents had occurred.

Velpeau reported three cases of the congenital form of inguinal hernia occurring in the adult, in whom the testes had descended before birth.

The larger number of herniae, occurring in infancy, belong to the congenital variety, and this very rarely takes place in the female, even when the canal of Nuck remains unclosed. Only within the present year I operated upon a woman, aged thirty, assisted by Dr. R. Robinson, of Danielsonville, Conn., who brought the patient to me, where that which appeared as a cyst, of about the size of an egg, was shown to have direct connection with the general peritoneal cavity, through the canal of Nuck, the upper portion of which was nearly closed by a small plug of adherent omentum.

It should be borne in mind that the testes, while yet within the cavity of the abdomen, are firmly adherent to the peritoneum, and in their descent into the scrotum this portion of the peritoneum is still a fixed point, and enters into, and forms a part of, the tunica vaginalis.

Congenital hernia is much more common in subjects where the developmental processes are delayed, and, as a consequent, the testicle is interrupted or retarded in its descent into the scrotum. Pott and Lawrence each reported cases where it was believed that the congenital hernia was induced by a portion of the intestine becoming adherent.
to the testicle prior to its descent from the abdomen. This must certainly be very rare, and it undoubtedly generally happens that such abnormal connection, when observed, has taken place after the intestine had descended into the tunica vaginalis. (Fig. 2.)

The constriction in strangulated congenital hernia is commonly found at the neck of the sac and in the immediate vicinity of the internal abdominal ring. The coverings of a congenital hernia are of the same nature as those belonging to the ordinary varieties of inguinal hernia, with the exception of the peritoneal investment already carefully described.

As would naturally be expected, in congenital hernia, there is no marked depression to distinguish between the fundus of the hernial sac and the upper part of the testicle, as is observed in the other forms of inguinal hernia.

By special permission I have somewhat recently carefully studied all the specimens, illustrative of the various varieties of hernia, which are contained in the Museum of the Royal College of Surgeons of England; and, since this collection is especially rich in the possession of the specimens prepared by John Hunter and Sir Astley Cooper, I have felt that it would be of interest and profit to the profession to select freely from the catalogue the descriptions of the same, as valuable illustrations of the different varieties of the disease. The following series of specimens of congenital hernia can not fail to be of interest.

2668. The sac of a congenital hernia, in which the testicle was situated at the external ring. A small elongated growth of fatty tissue is attached to the upper part of the epididymis.—Presented by Sir William Blizard.

2669. The sac of a large congenital hernia. The exterior of the sac is uneven and sacculated, through
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

2670. The sac of a large congenital hernia, nearly full of healthy omentum, which is in several places adherent to its walls.—Hunterian.

2671. An inguinal hernia, from some large animal, with small intestine and omentum protruded into the cavity of the tunica vaginalis.—Hunterian.

2672. Part of the pelvis and abdominal walls of a young child, with the sac of an inguinal hernia, nearly two inches long, on the right side. The sac is formed by the elongated and dilated funicular portion of the vaginal process of the peritoneum; the testicle is directly below it, and the cavity of the tunica vaginalis is closed above, and has no connection with the hernial sac.—From the Museum of John Howship, Esq.

Arnaud reported a case where he operated for strangulation in which he found that the intestine was not covered by a peritoneal sac, although he made the dissection with the greatest care.

Scarpa observed, that "it is impossible to turn the bottom of the hernial sac upward in congenital hernia, as may be done in common hernia, leaving the spermatic vessels with the testicles in their situation; for it is not possible, in congenital hernia, to raise and invert the bottom of the vaginal coat, forming the hernial sac, without raising and at the same time turning the testicle upward and the spermatic vessels which are inserted into it. Upon which point I can not mention but with horror the injury which, from the want of this knowledge, was practiced upon the celebrated physician, Zimmerman, from the false persuasion under which the surgeon labored of being able to raise up the vaginal coat without removing the spermatic vessels from their situation, and to tie it at its neck, in order to prevent the return of the hernia, according to an erroneous and already antiquated notion."

A very rare variety of this kind of hernia is reported in the Medico-Chirurgical Transactions, vol. xlix, by Mr. J. W. Hulke, F. R. C. S., which is of sufficient interest to copy, and where it is quite too apparent that death was due to the improper use of taxis: "A man, aged twenty-seven, was admitted into the Middlesex Hospital, January 20th, with strangulated hernia. The right side of his scrotum was distended by a large globular swelling, which stretched upward along the groin to the anterior superior iliac spine. The inguinal and scrotal portions were separated by an intermediate narrow part, but an examination under chloroform—for there was too great tenderness to allow handling without anaesthesia—proved that they were portions of a common cavity. Except at its pubic end, the inguinal portion of the swelling was accurately definable—
the finger-tips could be dipped under its edge—which made it evident that it was not beneath the aponeurosis of the external oblique muscle, but superficial to it.

"In the left groin there was a similarly superficial oblong swelling, also reaching from the internal ring nearly to the anterior superior iliac spine. It was flaccid and painless, and felt coarsely granular. The penis was thrust toward the left, and nearly buried by the right hernia. Pus oozed from the urethra. Neither testis could be felt in the scrotum or groin. He lay on his back, with drawn-up knees, tossing restlessly, and crying out from the severity of the pain in the rupture and belly. Pulse small, quick, and compressible; face pale; beads of sweat rolling off his brow; features anxious. His extreme suffering made him so impatient of being questioned that I could only elicit the bare facts that he had been ruptured since childhood, and that each rupture had been reducible until that morning.

"The left was plainly an omental hernia, and not strangulated. Its deviation from the usual course of an oblique inguinal hernia was attributed to the non-development of the scrotum connected with arrested transit of the testis. But the nature of the right, the strangulated hernia, was not so evident. Supposing that the testis was in the scrotum, its concealment was consistent with congenital hernia, and, if inflamed and swollen (he had gonorrhœa), the testis, by preoccupying the scrotum, might have hindered the descent of the protruding gut, and in this way have led to the formation of the superficial diverticulum in the groin.

"The taxis in a hot-bath having been already tried by the house-surgeon, chloroform was given, and, reduction being still impossible, I operated at once, three hours from the beginning of the strangulation, making a cut an inch and a half long in the axis of the swelling, over the external ring. After dividing a little cellular tissue, the sac, thin and transparent as gauze, was exposed. I was obliged to open it in order to reach the ring, which lay deeply behind this part of it. After notching the external ring and cutting three deeper constricting bands, the finger slipped into the belly, and there was no other trouble in returning the gut than that occasioned by its great quantity.

"When the sac was empty I swept my finger round the under inner surface of the internal ring, in order to make quite sure that the extruded bowel was completely inside the belly, and in doing this I hooked something solid, which, being drawn gently down into view, proved to be the testis hanging from a mesorchium; it was replaced, and the wound closed. The contents of the sac were several feet of dark-red gut, blotched with extravasated blood, and some ounces of bloody serum.
"Next morning he passed two copious, very offensive, loose, bloody stools, and he died in the afternoon, the symptoms of acute peritonitis having continued unabated from the hour of his admission. His body was examined on the following day. The left hernia, that which had not been strangulated, was first dissected.

"When the skin and superficial fascia were reflected off the groin a lobulated, oblong, hernial sac, reaching from the superior iliac spine to the bottom of the scrotum, came into view. The upper and outer part of this sac lay upon the aponeurosis of the external oblique muscle, in front of the inguinal canal and Poupart's ligament, its descent upon the thigh being restrained by adhesion of the superficial and deep fascia along the line of the groin. It contained a large mass of omentum and some turbid serum. The great distention of the scrotum by the right hernia had masked the scrotal portion of the left hernia during life. When the external ring through which the sac extended, and the structures composing the front of the inguinal canal, had been slit, the testis was found behind the omentum in the canal, not fixed to the posterior wall of this latter, but hanging from a fold of peritoneum drawn from the parietal layer near the abdominal surface of the internal ring.

"The anatomical relations of the right hernial sac corresponded exactly to those of the left, the only difference being that the superficial diverticulum did not ascend quite so near to the iliac spine. The entire sac was inflamed, and it contained several ounces of turbid serum.

"On opening the belly the omentum was seen tightly stretched and gathered in a fan-like form to the left internal ring. The transverse colon was also pulled down to this latter, but not engaged in it. The abdominal cavity contained many ounces of turbid serum similar to that found in the hernial sacs, and the serous surfaces were everywhere inflamed. Ten and a half feet of small intestine had been strangulated; they were intensely congested and blotted with small submucous extravasations of blood, but the most careful scrutiny with the naked eye failed to discover any breach of the mucous surface—a feature of interest in connection with the copious bloody stools. There were several large extravasations of blood in the mesentery of this portion of bowel.

"The right testis hung freely entirely within the cavity of the belly, by a mesorchium drawn from the parietal peritoneum at the pelvic brim near the internal ring.

"In ruptures associated with malpositions of the testis, where this has remained at some point above the scrotum, the bowel has occasionally been found to have slipped
Plate XII.
by it into the scrotum, being in these cases received in the vaginal process of peritoneum when the testis or epididymis has entered the internal ring, but acquiring a sac when the testis or epididymis continues in the belly. More rarely the sac, on leaving the external ring, has been found to have ascended upon the aponeurosis of the external oblique muscle instead of passing into the scrotum, the commonly accepted explanation being the resistance to the descent of the sac offered by the undeveloped scrotum.

"The case which I have described combines both these irregularities—the ascent of the sac superficially along the groin, and its descent into the scrotum. Their occurrence is explainable by supposing that the undeveloped scrotum was sufficiently inextensile to retard, but not altogether to prevent, the descent of the hernia. The hernial sac on each side was an acquired one, and not a derivative of the vaginal process, since the right testis and epididymis were within the belly, and the left testis, although found in the inguinal canal, was not attached to it, but hung freely from a long mesorchium attached inside the belly."

**PLATE XII.**

This plate shows the hernia congenita under its usual appearance; also the variety of congenital hernia taken by Mr. Forster from a patient in Guy's Hospital. The other figures show different views of preparations of inguinal herniae, intended to show the mode of operating on each variety.

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**Figure 1.**
- a, a, a. Tunica vaginalis.
- b. Testis.
- c. Spermatic cord.
- d. Hernial sac within the tunica vaginalis.
- e. Mouth of the sac, which has been produced by an adhesion of the tunica vaginalis, opposite the abdominal ring.
- f, f. Intestine.

**Figure 2.**
- a. Strangulated intestine, the sac cut open.
- b. The adhesions of the tunica vaginalis to the mouth of the sac.

**Figure 3.**
- Hernia congenita.
  - a. Abdominal muscles.
  - b. Abdominal ring and cremaster muscles.
  - c. Fascia upon the tunica vaginalis.
  - d. Tunica vaginalis.
  - e. Spermatic cord.

**Figure 4.**
- i. Hernial sac below the abdominal ring.
- f. Hernial sac within the transversalis.
- d. Transversalis passing over the hernial sac.
- c. Internal oblique muscle and its tendon.
- b. Poapart's ligament.
- a. Abdominal ring.

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*Cooper, Plate XI.*
Encysted Hernia.—The encysted hernia of Sir Astley Cooper, sometimes called acquired congenital hernia, or the infantile hernia of Hey, is that where the ventral orifice of the sheath is occluded, but the canal remains open, continuous with the tunica vaginalis. The hernia is formed, as in the more common varieties, by the sac consisting of the parietal peritoneum, but it is forced with its contents into the open tunica vaginalis. I have not met with this form of hernia in operation, and, without dissection, it might not be diagnosticated.

Sir Astley Cooper reported the following case, which he had the opportunity of seeing under the care of Mr. Forster at Guy’s Hospital: “A man was admitted into the house with symptoms of strangulated hernia, which the usual means failed to relieve and the operation proposed and urged, but the patient would not permit, choosing rather to die. On examining the body, after death, a sac was found within the tunica vaginalis, descending from the abdominal ring toward the testicle. This sac contained a portion of one of the small intestines which had become gangrenous. The stricture was at the mouth of the sac.” (Fig. 3.)

In the normal development, the serous canal, through which the testis has passed, becomes closed and is obliterated; when this occurs, the hernia can no longer escape

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* Cooper’s Lectures, 1839, p. 382.
by this tract, and the sac is then formed by a yielding of the peritoneum over the protruding parts. This is by far the more common condition.

A rare form of indirect inguinal hernia is where the loose-meshed connective tissue about the internal ring extends down along the line of the cord, and the protruded peritoneal pouch descends into this tissue and carries the tunica vaginalis of the testicle in front of the tumor which is thus formed, instead of lying behind it, as is usual in other forms of scrotal hernia. It is important to keep this variety of hernial protrusion in mind, since otherwise the tunica vaginalis testis would be cut through, forming as it does, directly in front, a double layer over the sac. A considerable number of cases are on record as having been observed by competent operators. Though classed as a variety of infantile hernia, there is no especial reason to believe that it may not occur at any period of life. If the operator takes care to differentiate the testicle and its investment envelope from the hernial tumor, it will not be difficult to avoid injuring these structures. The operative procedures for this variety of hernia, when strangulated, or undertaken for cure, are not different from those of the more common forms of indirect hernia.
CHAPTER IV.

INGUINAL HERNIA—CAUSES AND CONDITIONS—FORMATION OF SAC.

Causes.—The construction of the abdominal walls is a beautiful example of Nature's marvelous adaptability of means to the end to be subserved. The abdomen must be always full, no matter how varied its contents, and subject to equable pressure. The amount of pressure varies with contents, position of the body, and muscular contractility of the abdominal walls. The anatomical relations of the mesentery to the intestine are primarily less those of support than of limitations in physiological action. The vessels and nerves are not put on tension, but lie without strain, with, of necessity, a certain freedom of motion. Remove the supporting power of the abdominal walls in any direction and, necessarily, the intestinal contents will follow. Were it otherwise, either a considerable percentage of the people of all countries must be congenitally malformed, or hernia is not caused, as commonly attributed, by overstrain, lifting, coughing, or any violent compression of the abdominal walls.

It is very probably true that a large proportion of the so-called immediate ruptures are preceded by a train of causes leading up to the giving away at last, suddenly, of the weakened ring; but even these could not increase the length of the mesentery, unless first the dimensions of the abdominal cavity were materially changed. In the so-called pendulous belly of multiparous women the intestines easily follow to the very base, when the patient is in the upright position; but I have yet to learn that the yielding of the recti muscles is supposed to be caused by the lengthening of the mesenteric ligament.

Constipation, dysuria, a harassing cough, are also direct as well as remote causes of hernia. It is the common experience of those ruptured to ascribe the cause as due to violent muscular exertion. The contents of the hernial sac are those portions of the abdominal viscera subject to the widest latitude of movement, and it may be owing to this that it has been assumed necessary to have first an elongated mesenteric attachment before the small intestine could form a part. Owing to this freedom of motion, portions of the omentum and small intestine, in the great majority
of instances, form the contents, although portions of every abdominal organ have occasionally been involved in hernia.

When the large intestine is involved, the part protruded is generally either the caecum or the sigmoid flexure of the colon, since these are less fixed than other portions of the canal. When the caecum, it occurs usually, as we should expect, upon the right side; when the sigmoid flexure, upon the left, yet cases of the opposite are on record, and also where both the caecum and sigmoid flexure have been included in an omental hernia. In fleshy and elderly people the omentum is generally heavily loaded with fat, and on this account the omentum is rendered more liable to become involved in hernia. Cases are on record where the bladder, uterus, ovaries, spleen, stomach, and kidney have been found in the hernial sac.

From the anatomical description already given of the inguinal canal, we can readily see that a modification of the intra-abdominal pressure, diverting it in the line of the opening, is necessary at its very inception. It is now much more generally accepted than formerly by anatomists and surgeons that, in a very large proportion of cases of inguinal hernia, taking the direction of the cord its predisposing factor is found in the defect of the imperfect closure of the peritoneal pouch which descends before the testis. As we have seen, this variety has been called congenital hernia. The irregular depression in the peritoneum thus left at the internal ring affords a slight obstruction to the free movements of the abdominal organs. Thus, little by little, the thin, yielding peritoneum is saccated, and a wedge-shaped pressure, at first slight and interrupted, is formed in the line of the canal.

This pathological factor having been established, it is easy to understand that a comparatively slight force is ample to separate the structures which make up the canal. The thin margin of the conjoined tendon yields, and then the force is brought to bear upon the external ring of the canal, protected posteriorly only by the aponeurosis of the fascia transversalis and the triangular ligament. Externally, the upper border of the canal, protected by its re-enforcing fibers, which give great support to resist forces acting from without, is yet imperfectly constructed to restrain an impinging force acting from above downward.

When the contents of the hernial tumor have thus distended and distorted the inguinal canal, the important barrier to its further progress is overcome. The peritoneal sac protrudes over the spermatic vessels, and separates them from the delicate fibers of the cremaster and superficial fascia.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

PLATE XIII.*

a, a. The inguinal ring of the left side.
b, h, h. Intersection of the collateral tendinous bands of the aponeurosis of the external oblique, in the vicinity of the inguinal ring.
c, c. Left femoral arch.
d. Suspensory ligament of the penis.
e. The os pubis.
f. An inguinal hernia of the left side.
g, g, g, g. Divergence of the fibrous bundles of the cremaster muscle.
h. Continuation of the membrano-aponeurotic sheath of the cremaster muscle, which envelopes the spermatic cord and the vaginal coat of the testicle.
i, i. The right inguinal ring.
j, j. Intersection of the tendinous fibers of the aponeurosis of the external oblique muscle of the abdomen in the vicinity of the right inguinal ring.
k, k, k. The sheath of the cremaster muscle laid open, on which, especially † at its outside, are seen the fibrous bundles of this muscle.
m. Soft cellular substance interposed between the sheath of the cremaster muscle and the hernial sac.
n. The hernial sac formed by the peritoneum.
o. Small loop of protruded ileum.
p, p. The aponeurotic sheath of the rectus abdominis muscle laid open for a certain space and drawn to each side.
q, q. Continuation of the aponeurosis of the external oblique muscle of the right side of the abdomen.
r. The right femoral arch.
s, t. The great sac of the peritoneum, through which are perceived the bowel.
t. Posterior ‡ portion of the aponeurotic sheath which incloses the rectus abdominis muscle.
u, u. The rectus muscle of the right side removed from its natural situation and drawn strongly toward the left side of the abdomen.

r. Remains of the muscular portion of the external oblique which has been cut away.
x. The linea alba of the abdomen.
y. The anterior* portion of the aponeurotic sheath of the rectus muscle, formed by the union of the aponeuroses of the external and internal oblique muscles, divided and turned outward.]

1, 1. The femoral artery on both sides.
2, 2. The femoral vein.
3. 3. The abdominal artery or circumflex iliac.
4. Continuation of the right abdominal artery.
5, 5. The epigastric artery of each side.
6, 6, 8, 9. Course of the right epigastric artery behind the rectus abdominis muscle of the same side.
10, 10. The origin of the epigastric vein of both sides.
11, 11. Continuation and distribution of the right epigastric vein.
12, 13. The superior external pudendal artery which crosses over the hernia immediately under the skin.
14, 14. The saphena vein.
15, 15. The anterior crural nerve.
16, 16. Two dotted lines, showing the direction which the viscer a sometimes take in the formation of internal inguinal hernia, or on the inner^ side of the epigastric, in which case this artery retains its natural situation.
A. The external oblique muscle of the abdomen.
B, B. The rectus muscle of the left side of the abdomen.
C. The transverse muscle of the right side.
D. Portion of the gluteus maximus muscle.
E. The tensor vaginae femoris.
F. The rectus femoris.
G. The sartorius.
H. The iliacus internus.
I. Tendinous origin of the second adductor femoris.

* Practical Treatise on Hernia, by Antoine Scarpa, Paris, 1812. Plate I.
† On its sternual and lateral aspect.
‡ Central.
* Peripheral.
† Peripheral.
^ Mesial.
Formation of the Hernial Sac.—Except in the rarest of instances, the hernial contents are inclosed in a portion of the parietal peritoneum, which is carried before them, and this constitutes the sac—a cavity continuous with that of the abdomen. At the outset, the size of the cavity is limited to that of the opening, which has generally a tendinous and comparatively unyielding border. Over the opening, however, the parts are usually soft and weak, often loose fascia and integument, and, little by little, the peritoneum stretches under the pressure into a bag of greater or less size and varying in shape, but communicating with its origin by the original opening, often not much changed, called the mouth or neck of the sac; the peritoneum at the mouth of the sac is intrasfolded or plicated.

When the contents of the sac can be returned, often the general functions go on unimpaired, the subject suffering only a limited weakness and inconvenience. Changes of vascularity and nutrition, however, usually soon ensue, the sac becomes thickened, adhesions of the contents follow, and a general increase in bulk takes place. So long as the contents of the sac can be returned, the hernia is called reducible. When the hernial contents can no longer be returned to the abdomen, although the suffering or inconvenience may not be extreme, it is termed irreducible. When, from pressure or constriction, the function of the contents is suspended, the hernia is then said to be strangulated, and the narrow surrounding portion, usually at the neck, is called the stricture.

The existence of a peritoneal covering, as a sac, is dependent upon the contents of the hernia being made up of organs within the abdomen proper, as the bladder might protrude entirely from below the peritoneal reflexion. Cystocele and rectocele, in a sense, are also hernial tumors, but without a peritoneal investing membrane.

Hernia also exists without a peritoneal investment in wounds—e. g., penetrating wounds of the abdomen—but, other than these, the peritoneum, more or less altered, is constant in hernia as the chief component of the sac. The definition, earlier given to hernia as rupture, was dependent upon the belief that a sudden giving away of the inclosing parts generally included also an actual lesion of the peritoneum.

The Peritoneum.—The peritoneum lines the cavity of the abdomen, and is reflected over all the organs contained in it, giving to each an external covering. This serous membrane is thin, semi-transparent, and perfectly smooth on its internal surface, and is lubricated by a fluid which not only gives it a polished appearance, but permits movement of the organs upon each other and the restricting walls without friction.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

The texture of the membrane is of connective tissue, disposed in obliquely crossing layers, which give it much strength and yet render it of a yielding character; this is further increased by elastic tissue entering, in a minor degree, into its composition. It is covered with a squamous epithelium, and is very rich in vessels, nerves, and lymphatics.

An interesting experiment is the dissection of a fresh peritoneum, and securing it tense, like a drum-head. In this manner it will support a considerable weight for some time, and upon its removal return to its original shape. If longer retained, it will relax as a depressed pouch, and a careful observation will show that the structure has yielded by an irregular separation of its component layers. The texture and strength not only differ in different individuals, but notably in different parts of the same subject. Where it lines the abdominal walls it is thicker, grayish-white, semi-opaque, and nearly conceals the color of the adjacent parts; over the mesentery, on the contrary, it is often nearly transparent. To the linea alba and the sheath of the recti muscles, the peritoneum is very closely adherent, but is loosely connected with the lateral abdominal parietes by a thin lamina of connective tissue. Its external surface is often rough and irregular.

Physiologically, the peritoneum is subject to extraordinary changes, which are of much importance, viewed from the standpoint of our present study, as evinced by the ever-changing peritoneal investment of the stomach, intestine, bladder, in their rapid expansion and contraction, and the uterus in pregnancy; also the development of the peritoneum over a rapidly growing ovarian tumor, or the distention of the abdominal wall to several times its original surface in abdominal dropsy. After pathological changes, the peritoneum is frequently restored to its former normal state. In cases of sudden, forcible distention, particularly where the membrane is thin and adheres closely to the abdominal parietes, or other surrounding parts, its texture yields partially, and undergoes a loosening, or species of laceration, such as in the case of silks, or other fabrics, we call fraying, the French éraillment; a kind of cicatrization follows, and leaves marks or lines behind, indicating the nature of the occurrence. "These éraillments," writes M. J. Cloquet, "happen particularly when the peritoneum, adhering to subjacent parts by a dense, close, cellular tissue, is dragged or displaced. Hence, this partial laceration is frequent in the situation of the linea alba, from the distention of the abdomen and the separation of the recti muscles; and I possess several remarkable specimens of this kind. In the part which has been thus frayed, the peritoneum is preternaturally
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thin, representing a network of slender fibers, leaving irregular interspaces, which are filled with an extremely thin, transparent pellicle. This kind of change is observed, not only in the peritoneum lining the abdominal parietes, and that which forms the hernial sac, where it is very common, but also in the serous covering of the displaced viscera, in the mesentery and intestine when they have been dragged and elongated in large ruptures.”—(Récherches Anatomiques, p. 48.)

“The locomotion or displacement, the extension or elongation, and the partial rupture or fraying of the peritoneum, account satisfactorily for the origin and increase of the hernial sac; and the two changes first mentioned explain sufficiently the great size which the bag sometimes attains. Scrotal ruptures may hang half-way down the thigh, and sometimes nearly reach the knee; yet the whole inner surface of the swelling, in which all the loose viscera of the abdomen may be contained, is lined by a continuation of the peritoneum without any laceration or interruption.”

M. Cloquet made many experiments upon the dead body, of much interest and value. “In some individuals the natural openings of the abdominal parietes are large and loose; if we push the finger through, the peritoneum is carried before it, forming a production which represents a hernial sac. Here the cellular tissue is not torn, but elongated. When the pressure is discontinued, the membrane gradually regains its original position. This experiment shows that the peritoneum is actually displaced in the formation of a hernial sac; that it leaves the neighboring parts to pass into the aponeurotic opening. The abdominal parietes lend the peritoneum which covers them to form the hernial sac. The membrane is hardly stretched, and it forms folds in the opening; in some instances it is both displaced and elongated, covering the finger closely. In other subjects the peritoneum resists more forcibly, because it adheres more closely to the parietes; the portion, however, near to the tendinous opening becomes stretched; its laminae separate and are partially torn, and may thus form a very thin sac, different from that in the former instance, which has the material thickness of the peritoneum. The displaced membrane in this case does not recover its former position, and we find partial laceration in the fundus of the sac.”

The peritoneal sac may be also formed by causes acting from without. It is a common occurrence, a number of marked instances of which have come under my personal

* A Treatise on Rupture, by W. Lawrence, p. 29, 1843.
† Récherches sur les Causes et l’Anatomie des Hernies Abdominales, 1819.
observation, where a large, unsupported hydrocele has, by its dragging weight, caused the depression of the peritoneum at the upper orifice of the inguinal canal to become deepened, and finally well-marked hernia ensued. M. Cloquet cites an interesting case of an old man with a large inguinal hernia. "The sac was five inches long; its orifice was large and rounded, its cavity was divided into two parts by a fibrous prominent ring. Below the latter the peritoneum was thick, whitish, and strongly adherent to the external coverings; above, it was thin and transparent, as in the abdomen. The descent of the thickened ring and the elongation of the sac had been obviously caused by the weight of a large hydrocele of the tunica vaginalis, which adhered firmly to the lower part of the hernial tumor. A convolution of the small intestine, two inches and a half long and unadherent, occupied the upper division of the sac."

Changes in the Hernial Sac.—In the protrusion of the peritoneum through an opening in the abdominal parietes, it at first passes unchanged through the tendinous ring, which is more or less firm and resisting. This ring supports the mouth of the sac and determines its form and size. Since it passes generally through unyielding tissues, the neck is relatively small, while the body of the sac, comparatively unrestricted, is usually much larger. The direction or axis of the sac varies in its course, dependent upon the obliquity of its openings. The form of the sac is necessarily modified by the opening through which it escapes, by the tissues surrounding it, and the resistance which is made to its progress. In consequence, the shape and size vary greatly, as in scrotal, femoral, or umbilical hernia.

When the canal remains circular and tendinous, the sac has an elongated and a somewhat cylindrical shape. This is generally true in inguinal hernia when it is confined to the sheath of the spermatic cord. Having passed below this, the sac expands, and may become globular or pyriform. On the contrary, when the sac has escaped through a direct opening in the abdominal parietes, the resistance is comparatively slight and equal in all directions, and the shape assumed is nearly spherical or somewhat flattened, as in umbilical hernia.

In an imperfectly formed inguinal hernia, or bubonocele, the sac will be irregular and flat, often escaping detection, unless the examination is made with care. While the size and shape of the hernial tumor thus varies under the modifying influences of the surrounding tissues, these, in turn, are changed under the pressure; the apertures of escape being altered in size, length, and direction. "The thickness of the neck of the sac varies much. In small ones of a conical figure, the peritoneum retains its natural
structure at this part, simply turning over and lining the aponeurotic ring. This is the least frequent case; more commonly, in passing through the narrow aperture, it is folded, puckered, contracted, and gains in thickness what it loses in extent of surface. The whole circumference of the neck presents fine folds, radiated wrinkles, more or less numerous and approximated to each other. If we distend these folds they are seldom completely effaced, as the two membranous plaits which form each of them become adherent; this puckering or gathering of the peritoneum necessarily increases the thickness of the neck of the sac. These folds are the rudiments of those which form when the mouth of the sac gradually contracts. It ultimately disappears, giving origin to radiated marks, disposed like the rays of a star, indicating the place of its former existence. . . . Sometimes the neck of the sac presents a rounded, whitish, almost fibrous, and very firm ring, either of uniform or varying thickness in different points of its circumference."

The changes which the neck of the sac undergoes are often very important in the consideration of operative measures for relief or cure. It is generally adherent to the ring through which it escapes; rarely it is attached at one side only; the peritoneal pouch then becomes irregularly saccated, even two distinct pouches may form and descend below the ring, having a common opening into the abdomen. A sac under the pressure of a truss may be kept empty, and become adherent and closed at its neck, and thus a cyst be formed.

**Figure 1.**

Shows a sac taken from the body of a person who labored under an inguinal hernia.

a. Its mouth.
b. The course of the vas deferens behind it.

c. Abdominal ring.
d. Poupart's ligament.

e. Iliac artery.
f. Femoral artery.
g. Epigastric artery, passing behind the mouth of the sac.
h. Spermatic cord, passing behind the sac and through the abdominal ring to the testis.
i. The testis.
j. Mouth of the hernial sac.
k. The fundus of the sac, which just reaches the abdominal ring.

**Figure 2.**

This gives a view of a hernial sac which has passed no farther than the abdominal ring, so that the whole of this sac is included between the abdominal ring and the place at which the spermatic cord quits the abdomen.

a. Abdominal ring.
b. Poupart's ligament.

c. Iliac artery.
d. Femoral artery.
e. Epigastric artery, passing behind the mouth of the sac.
f. Spermatic cord, passing behind the sac and through the abdominal ring to the testis.
g. The testis.
h. Mouth of the hernial sac.
i. The fundus of the sac, which just reaches the abdominal ring.

**Figure 3.**

Shows the hernial sac divided by several septa.

a. The tunica vaginalis testis.

* M. J. Cloquet, *op. cit.*

† Cooper, Plate V, Part I.
Figure 4.

Shows a hernial sac closed opposite to the abdominal ring, but open above the ring to the abdomen. I think that no inconvenience would arise from this, as the intestine could not descend into the scrotum, and strangulation would not probably take place above.

a. Tunica vaginalis.
b. Testis.
c, c. Spermatic vessels.
d. Mouth of the sac.
e. The place at which the sac is closed, which is opposite to the situation of the abdominal ring.
f. The fundus of the sac.

Figure 5.

A hernial sac, in which the spermatic cord has been divided by it, so as to place the spermatic artery and vein on the inner side and the vas deferens upon the outer side of the sac.

a. Abdominal ring.
b. Testis.
c. Femoral artery.
d, d, d. External pudendal artery.
e. Spermatic artery and vein.
f. Vas deferens.
g. Hernial sac.

Figure 6.

Hernial sac shut at the abdominal ring by adhesion, leaving a circumscribed bag, in which water was collected.

A closed sac, developed in this way, may become attached to a more recently formed hernia, and be itself carried down with the advancing tumor. These conditions are fortunately very rare, but it should be kept in mind that they do occur, otherwise when present they will greatly confuse the observer and render diagnosis of extreme difficulty.

The pathological changes which may take place in the sac are various; direct injuries, wounds, bruises, pressure from an improperly fitting truss, any violence may cause all the conditions usually ascribed to inflammation elsewhere. Serous, bloody, and turbid
secretions may occur. From a variety of causes the sac may become infected, and purulent collections ensue. The sac itself becomes thickened and changed, so as to lose all the appearances of a serous membrane. I have recently removed the sac in two cases where it was several lines thick—one, an old hernia, so slight as to give little trouble until, suddenly, strangulation of the intestine supervened by the escape of a loop through the ring. The second, a hernia of only three months' standing, and yet it was scrotal, and the omentum adherent to the much-changed walls of the sac. The great variety of changes to which the hernial sac is incident have been dwelt upon in greater detail, because of the importance which these pathological conditions have in relation to the operative measures for the cure of hernia. Within the last few years much has been written in regard to the proper disposition of the peritoneal sac, to which we shall have occasion to make frequent reference in the subsequent pages of this work.

I have made a large collection of deformed, distorted peritoneal pouches which have contained the contents of old large herniae. A very considerable number of these I exhibited at the American Medical Association meeting held at Newport, in 1889, some filling a quart-jar when everted and stuffed with cotton. Not seldom the peritoneal sac, in old herniae, may be seen with re-enforced bands crossing each other in a variety of directions, the interstices of which present only thin translucent pouches.

In illustration, I add the interesting description of specimens as given by the celeb rated surgeons Sir Astley Cooper and Dr. John Hunter.

2608. "The internal orifice of a hernial sac, to show its valvular appearance."—Hunterian M.S. Catalogue. The appearance is due to an angular thickening of the peritoneum nearly limited to the margin of the mouth of the sac, which is thus reduced to a much less diameter than any other part of the sac.—Hunterian.

2610. An inguinal hernia, of which the sac is contracted at the middle, so as to be nearly divided into two parts. Both its cavities contain omentum.

Mr. Hunter left the following account of this preparation:

"Winter, 1763.—We dissected a man who had a rupture of a particular kind, a sort of double rupture on the same side, and in the same passage, and in the same sac. It appeared to me as if produced at two different times: that the man had a small inguinal rupture for some time, the contents epiploon, and that the mouth of the sac had contracted a good deal, so that no return of the epiploon could be brought about. While in this state a second or new cause took place; and instead of dilating the old sac, by pushing into it more epiploon, it pushed down the old sac, and a new elongation of the peritoneum followed; so that here was a kind of second rupture produced. This last was by much the largest.

"It appeared at first to be two distinct bags; but there was the first contraction of the sac which kept up the communication between the two; and the epiploon passing through, forming a small neck there."—Hunterian M.S. Dissections of Morbid Bodies, No. 71, p. 101.
2613. An inguinal hernial sac, with the testicle, dried after the injection of their blood-vessels. The cavity of the sac is partially divided by a transverse crescent-shaped fold or partition from its posterior wall, which may have been formed and protruded like the more nearly complete partition in the preceding case.—From the Museum of Sir A. P. Cooper. (See Fig. 3, Plate XIV.)

2616. Part of a right inguinal region, together with the sacs of two oblique inguinal herniae on the same side, dried after the injection of the epigastric, spermatic, and other vessels. The anterior sac has a small mouth, is elongated, and measures four inches in length. The posterior sac is larger and nearly globular; its mouth is wider, measuring an inch and a quarter transversely, and is placed directly behind that of the anterior sac. The spermatic vessels and vas deferens are attached to the back of the posterior sac and the lower part of the anterior sac; and the epigastric vessels make a wide circuit, passing round and to the inner side of the necks of both sacs. The spermatic veins are varicose.—From the Museum of Sir A. P. Cooper.

The history of the case is published by Mr. Bransby Cooper, in the Guy’s Hospital Reports, vol. iv, p. 327 (London, 1839). The patient was sixty-eight years old. He had suffered pain in the abdomen and vomiting for three days, and constipation for two days, though frequent purgatives had been administered, when Mr. Cooper first saw him. He found the left inguinal region larger than the right, but this appeared to be due to the absorption of the fat on the right side, on which a truss had been worn for many years. A small hernia had been returned on the left side, and one could be made to descend on the right side by coughing, but could be at once very easily returned. But the symptoms of strangulation becoming urgent, the left inguinal canal was laid open. An empty sac was found therein, but no strangulated intestine. The patient died next day; and on the examination after death it was found that the small anterior and elongated sac shown in the preparation had been pushed into the abdominal cavity, together with a portion of intestine, strangulated by its neck. The reduction of this sac had probably been effected by the patient while reducing the intestine from the larger and round posterior sac.

PLATE XV.*

On the right side is seen an oblique inguinal hernial sac upon the anterior part of the spermatic cord. On the outer side of this hernia appears an artificial anus, formed from a second protrusion of intestine on the side of the former: at this opening the ileum had prolapsed, but in making the preparation it was returned into the abdomen. Both these herniae had passed through the abdominal ring, and were situated on the outer side of the epigastric artery, which has an unusual curve, produced by the long-continued pressure of the hernia. On the left side a hernial sac is seen, which has passed down on the inner side of the epigastric artery and spermatic cord.

a. Symphysis pubis.
b. Anterior superior spinous process of the ilium.
c, c. Abdominal ring.
d, d. Abdominal muscles.
e, e. Poupart’s ligaments.
f, f. Femoral arteries.
g, g. Course of the epigastric artery upon the right side.
h, h. Origin and course of the epigastric artery on the left side.
i, i. Spermatic cord on the right side.

* Cooper, Plate IX, Part I.
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j. j. Testes,
k, k. Vasa deferentia.
l. Spermatic vessels on the left side in a varicoce state.
m. Spermatic and epigastric arteries crossing upon the outer side of the left hernial sac.
n. The artificial anus, by which for eleven years the feces were discharged.
o. The sac of the inguinal hernia, which was the first that had descended in this man.
p. Hernial sac on the inner side of the epigastric and spermatic vessels, which will be found to have an inclination inward and upward toward the pubes, and not, as in the common inguinal hernia, toward the ilium.
q. The colon.

Of the Strangulation of the Intestine by the Peritoneum.* Stricture at the Neck of the Sac; its Intimate Adhesion to Intestinal Contents; Separation and Cure.—All surgeons of considerable experience have met with cases where the constriction is due to the thickened peritoneal investment at the mouth of the sac, which, under the effort at taxis, becomes disengaged from its attachment to the canal, and thereby deceives the superficial observer in the belief that the hernia is reduced. Instead of quoting from my own experience, I have preferred to select the following cases from the rare but always interesting work of Arnaud, which illustrate exceptionally well the danger, which the surgeon must ever bear in mind, from the difficulties and complications which may unexpectedly arise during the operation for the relief of strangulation. They are, moreover, among the earlier cases of this class which were clearly understood and carefully reported; besides, they have a quaint flavor of their own, and in the discussion of the instrumental procedures reveal a touch of the humanities as to the methods of a rival, repeated in the experiences of each generation, although perhaps not formulated in the works to be handed down to posterity: "A young man of eighteen years of age, employed in the drudgery business of the wax manufacture at Antoni, a little town about twelve miles from Paris, had been subject to a complete hernia from his birth, which had never been rightly kept up. January 28, 1738, he was seized with colics, nausea, vomitings, and a suppression of his stools. The surgeon of the place, who presumed that the disorder was a common strangulation of the gut, made use of all the ordinary means in such cases, and called me into consultation on the fourth day. Upon examination I found the tumor complete, very hard, and about the bigness of a turkey-hen's egg. I reduced it with great ease, but immediately it came down again; I reduced it a second time, and still it came down as before, without the least change in its size or hardness. When I had reduced it the third time, I followed it with my finger, to feel of what consistence it was, when

* Arnaud, Observation XIV, p. 408.
reduced; and, finding it then as hard as ever, I concluded there was a strangulation formed by the peritoneum, and proposed the operation, as the only means of relieving the patient. What I said seemed to surprise the surgeon-in-ordinary, who thereupon desired that some surgeons of the neighborhood might be called in, to which I readily gave my consent.

"Nothing could therefore be done till next day; and in the mean time the patient had a remission of three or four hours, and was so quiet when these surgeons came that they could scarcely believe that there was a strangulation in the case, especially when they found that the tumor could be reduced, and come down again with freedom, and that none of the usual bad symptoms appeared. I assured them they would find the symptoms return more violently than ever, when the remission was over; which accordingly happened. The patient fell into an excessive vomiting, his belly grew harder, his fever increased, etc., and then the operation was agreed to. I performed it in the presence of three consulting surgeons and the surgeon-in-ordinary. I had no sooner laid bare the sac, than they were all convinced of the truth of what I had advanced. There was an evident stricture of the hernial sac, reaching about a line below the ring. I pulled the tumor gently outward, in order to judge of the precise length of the stricture, which appeared then to be at least three lines. The whole tumor was shaped like a pear; that part which was in the ring, resembling the stalk, was about an inch in circumference, and, as I have said, three or four lines in length. My next intention was to open the sac; but it adhered so intimately with the whole surface of the intestine, that it was impossible to open it, in the common way, without the greatest danger of wounding the gut. In a case of necessity, indeed, I should not have regarded this circumstance, since I have frequently opened the intestine with success. But in the present case I knew I could avoid that accident by going a little out of the common road in operating. I dilated the upper part of the ring the length of four or five lines. I drew the tumor as much outward as I well could, and desired an assistant to hold it in that state; then I opened the peritoneum above the stricture, and introduced my probe-pointed bistoury through the wound I had made in the peritoneum first into the cavity of the belly, and then into the orifice of the sac. By this means, the dilation of the stricture was accomplished with all imaginable ease; and the intestine, though everywhere adhering to the surface of the stricture, and in a very tender state, being quite livid, was not injured by the bistoury, because its rounded blunt point served to separate the adhering parts, as I expected, indeed, it would, when I projected this method
of operating. What argument might I not raise, from this, against Mr. Le Dran's sophistry! But, to proceed: when I had thus dilated the stricture at the orifice of the sac, I separated the lips from the intestine with an instrument which I commonly use upon such occasions, the extremity of which is formed somewhat like a spatula; then, with the same instrument, gently worked my way down to the bottom of the sac, which made room for introducing a director, and cutting up the sac in its whole length. Then I proceeded to the separation of the sac and gut, which adhered all round. The adhesion was of that kind which I call agglutination, except in one place, about the extent of the nail of the thumb, where it was of the third kind, or that by incarnation. I was fortunate enough to complete the separation all round without injuring the gut. I returned the intestine, and dressed up the patient, who recovered perfectly in three weeks, without any sensible exfoliation from the gut."

**Strangulation at the Neck of the Sac.**—"In the year 1736 a man of a robust constitution, of thirty-eight or forty years of age, with an inguinal rupture of the right side, was seized with a strangulation of the gut. His surgeon-in-ordinary reduced the tumor on the first day, but, not finding the symptoms in the least mitigated, he thought proper, on the third day, to order a purging potion. Mr. Henry, the apothecary, who had some scruples about the matter, did not think fit to give it him till I had first determined the reduction to have been properly made. I waited upon this patient, attended by Mr. Romanin, and understood, from the patient's own mouth, that the rupture had always been a complete one, seven or eight inches in length, and that for above fifteen years it had never been kept reduced. However, he had worn trusses of various kinds, with an intention only, as he was told, of preventing the increase of the rupture; the ordinary cant of ignorant truss-makers, who know nothing of the nature of the distemper they pretend to cure. Mr. Romanin, as well as I, found the parts, in all appearance, so well reduced that he was at a loss how to account for the continuance of the bad symptoms. The patient's belly was extremely tense, his vomitings were violent, but not very frequent, and he brought up what is commonly taken for feces in such cases; he had no passage downward, not even for one drop of oil, though he had swallowed four pints. I told Mr. Romanin that I imagined the cause to be a strangulation, occasioned by a stricture of the peritoneum; and that the stricture must certainly be upon that part of the sac which

* Arnaud, Observation V, p. 371.
had sustained the pressure of the pads of the trusses he had worn. What led me to think so was the easiness with which, I was informed, the tumor had been reduced. In order to satisfy myself more thoroughly, I examined the ring (which was very wide), plunged my finger into it, upon the extremity of which I felt the resistance of a very hard tumor; I ordered some assistants to raise the patient, and desired him to make the proper efforts for determining the parts downward. By these means the tumor was brought nearer to the ring, and I could then more distinctly feel its resistance upon my finger, which was like that of a bladder distended with a fluid, the inseparable character of a strangulated rupture. As I was now fully convinced that the sac itself formed the strangulation, I proposed the operation as the only means of relieving our patient. It was put off till next day, and then I performed it in presence of my brethren, Messieurs Marsollan, Cadet, Foubert, La Faye, and Romanin. When I had laid the ring bare, I found it so large that I could not take hold of the lower part of the hernial sac; however, as the tumor seemed to be of a larger diameter than the ring, I judged it advisable to procure a little more freedom, by making two pretty deep scarifications. By this means I had sufficient room for opening the sac, which I did to the extent of about an inch. Then I attempted to bring the rupture out through the ring, laying hold of the two flaps of the sac with my fingers and pulling toward me; but in vain. I was therefore obliged to finish the operation in a much more laborious manner than would have been necessary had I been able to come at the tumor properly. I introduced my finger into the sac, in order to discover its depth, and to assure myself of the quantity and kind of the bowel which it contained; and wherever I could convey my finger I met with nothing but a portion of the intestine. The sac, however, was so deeply situated that I could not reach its orifice. I was therefore obliged to make a third dilatation of the ring. This incision was made through the middle of the tendinous arch which forms the upper part of the ring; and as it was finished without removing my finger, I had then room enough to carry my finger quite to the orifice of the sac. By this means I discovered that the intestine alone was fallen down; that it did not adhere to the sac, but was under a very violent strangulation from the orifice of the sac. I withdrew my hand, and desired the gentlemen called into consultation to examine and assure themselves of these facts, one after another, which they all did accordingly. We found that the tumor ran along the musculus rectus as far as within two small finger-breadths of the navel. It seemed to be nearly
two inches in diameter at the lower part, and became gradually smaller toward its orifice, so as to resemble a cone in figure. After we had made these scrutinies, I tried again to bring out the rupture, but with as little success as before; the adhesion which the sac had contracted with the contiguous parts upon which it lay, confined it so much that it could not be moved. I was therefore obliged to contrive a safe and sure method of cutting the strangulation; for this purpose, I introduced the middle finger of my left hand quite up to the mouth of the sac, and upon that carried in my probe-pointed bistoury, in order to dilate the stricture, which I did to the satisfaction of all the gentlemen present and the immediate relief of the patient.

"As this singular disorder was very different from all the others, both in its kind and in its situation, it was indispensably necessary to lay aside the common method of operating and substitute a new one. In most cases, it is no difficult matter to conduct the knife upon the forefinger; the surgeon never loses sight of the instrument: he places himself with his back obliquely toward the patient’s feet and his face toward the part affected, his elbow in the mean time resting upon the inside of the patient’s thigh. But in this case all these precautions were useless, since nothing could be done but by guess, though feeling only could safely conduct the operator. The depth of the sac, and its being filled with the gut, so as to leave little room for the introduction of the finger, were two circumstances, which obliged me to conduct my hand in a different manner from what is usual upon these occasions. My back was turned obliquely toward the patient’s head, my elbows were bended to a right angle, my hand was bended considerably at the wrist, and thus I introduced the whole of my middle finger in the sac. Though this posture may seem a little awkward, yet it is the only one which could possibly have been used upon such an occasion. Had I introduced my hand in the usual way, I should have dilated the ring rather than the orifice of the sac, by the incision, because in that position I could not have sunk my wrist enough. I introduced the bistoury, with its flat side toward my finger, in order to avoid a further dilatation of the ring. When the point of my bistoury had reached the stricture at the orifice of the sac, I carried it inward under the edge of that stricture, taking the advantage of a small vacuity left between the two portions of the doubled intestine; and in proportion as I pushed the bistoury forward, I followed it with my finger, in order to conduct it in such a manner as not to injure the intestine, and the better to judge when I had sufficiently removed the stricture. While I was employed in this part of the operation one of the as-
assistants, laid hold of the sac, and kept it fixed, that it might not yield so as to escape the knife. By the dilatation which I was obliged to make, I guessed that the contracted part of the peritoneum which formed the stricture might be almost half an inch in breadth. This operation being performed, every one present was satisfied, from the loose state in which we found the intestine, that the dilatation I had made was sufficient. As it was impracticable to introduce two fingers into the sac in order to return the intestine, I judged it advisable to leave the intestine to return of itself. Neither did I think it proper to attempt laying open the sac the whole way from its bottom to its orifice. This I knew was impracticable; besides, I was upon my guard against an accident which might have ensued, and which is common enough, though hitherto scarcely observed. Before the patient was quite dressed he had a free and copious stool; and the first time I had occasion to remove the dressing I found the intestine returned. From this time he daily went more and more freely to stool, had no bad symptom, not even a feverish fit, and in a month's time was perfectly recovered."
CHAPTER V.
DIRECT INGUINAL HERNIA.

By reference to the description of the peritoneum and its relationship to the parts involved in hernia, it will be observed that the second depression of the peritoneum is separated from the first by rather a firm connective-tissue band, called the umbilical ligament. Nature has re-enforced this portion of the abdominal wall by a strong fascia of connective tissue, called the triangular ligament, which serves greatly to strengthen the fascia transversalis. The conjoined tendons of the internal oblique and transversalis muscles do not usually extend beyond the umbilical ligament, so that this portion of the abdominal wall is dependent for its support upon the above-mentioned connective-tissue structures.

When the weakening of the abdominal wall occurs here, the opening from the abdominal cavity is obviously more direct than in the ordinary varieties of inguinal hernia. This was called by Hesselbach internal inguinal hernia, who pointed out that it was situated internal to (nearer the middle line) the epigastric artery. Sir Astley Cooper named this affection direct inguinal hernia, because, instead of following the oblique course of the spermatic vessels, it passes at once through the posterior wall of the inguinal canal, immediately behind the external abdominal ring.

PLATE XVI.*

In this plate a common inguinal hernia is shown upon the left side, taking its course through the abdominal ring on the outer side of the epigastric artery, between that artery and the spine of the ilium. The hernia upon the right side is that variety of the inguinal hernia which passes from the abdomen on the inner side of the epigastric artery, or between that artery and the symphysis pubis.

a. Symphysis pubis, b. Anterior superior spinous process of the ilium, c, c. The spine, d, d. The acetabula, e, e. Tuberosities of the ischia, f, f. Abdominal rings, g, g. Poupart's ligaments.

* Cooper, Plate VII, Part I.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

h. Linea alba.
i. Aorta.
j. Bifurcation of the aorta.
k. Iliac and femoral arteries.
l. Origin of the epigastric artery on the right side.
m, n. Course of the epigastric artery on each side, marked by dotted lines; the left side passing on the inner, the right on the outer side of the hernial sac.
P. Vena cava inferior.

Scarpe thought, on the contrary, that it should be considered a combination of the ventral and inguinal varieties, since, although direct, it passes through the external abdominal ring, along the line of the spermatic cord. There is a variety of the direct hernia which it is important to recognize. It has been already referred to under the name of bubonoccele. This latter, however, most often occurs when the hernial protrusion commences at the internal ring. The tumor thus formed is arrested in its further development by the firm aponeurosis of the external oblique muscle.

In corpulent individuals it is exceedingly obscure, and may be overlooked unless the parts are subjected to a most careful examination. It not infrequently happens, especially in females, that the cause of suffering, produced by a small portion of incarcerated intestine, is overlooked until too late to avert a fatal termination, and when the general symptoms of hernia, as evinced by local pain, nausea, vomiting, etc., occur, it is of the utmost importance that a careful examination be at once instituted to determine if hernia of this variety is the cause of suffering.

In direct hernia, as would be inferred, the spermatic cord is situated along the external and posterior side of the sac. Cases are reported by Cloquet, Todd, and others, where it is arched in front of the upper portion of the sac; and this would be important to determine first, since in this position the ordinary dissection would cause a division of the cord; indeed, this accident has occurred in some instances. It is necessary to bear in mind the anatomical differences which define this variety of hernia. The epigastric artery lies upon the outer side of the opening, and this, after all, may be considered as the most important anatomical landmark.

The tendons of the internal oblique and transversalis muscles are inserted into the pubes and connected with the fascia, which passes upward from the external oblique muscle at Poupart's ligament. Occasionally these structures are unusually weak and allow a protrusion of the abdominal contents quite nearer than usual to the median
DIRECT INGUINAL HERNIA.

line, and when hernia does occur in this locality it is situated upon the inner side of the epigastric artery. Usually a careful study of the conditions in direct hernia makes it not very difficult to distinguish from the indirect variety. The appearance of the tumor below the abdominal ring differs from that of a small indirect hernia in being situated nearer to the penis, and the spermatic cord passes on its outer side instead of its posterior part, particularly at and above the abdominal ring. Within the abdominal ring the sac may be carried directly upward, so that no part of it takes the usual external oblique direction, but rather, on the contrary, passes somewhat inward toward the linea alba. The dissection of a direct hernia, as given by Sir Astley Cooper, is as follows: "The sac first appears between the fibers of the tendon of the transversalis, nearly an inch directly above the ring, generally protruding before it the fascia transversalis. It then passes under the lower edge of the tendon of the internal oblique muscle. The epigastric artery runs upon the outer side of the hernial sac. The spermatic cord has no connection with it above the ring. The hernia then emerges from the abdominal ring, the spermatic cord being at its outer side, and it is covered with the fascia given off by the tendon of the external oblique, but not by the cremaster muscle."*

As would naturally be inferred from the character of the tissues through which the direct inguinal hernia makes its escape, this variety seldom acquires the large size so often met with in indirect inguinal hernia.

The cause of this variety of hernia is often found in indirect injury. Mr. Cooper instances one case which came under his observation in a lad, resulting from a kick given by a schoolmaster; also another case, which resulted from being thrown from a horse.

In old men, where the abdominal wall is weak, prostatic obstruction causing dysuria and great straining in micturition is a common cause of hernia. Mr. Cooper believed that the direct variety was quite likely to result from difficulties in micturition from any cause, and he gave, as a special illustration, Plate XVIII, taken from a specimen in his possession which contained six herniae, all of which are of the direct variety.

When a direct hernia is reducible, and operative measures for its cure are not advised, it is important to remember that the truss used for its retention should be espe-

* See Plates XVI and XVII, which give a view of this variety of hernia.
chially adapted for its purpose, since the opening through which the sac emerges from
the abdomen is, in the adult, about one inch and a half nearer to the median line.

If the hernia is double, a central plate well padded is better than the usual variety
of double truss. It is important for the practitioner to keep in mind the anatomical
relationships which differentiate this form of hernia when the attempt is made for its
reduction, since the direction of the pressure to be applied is upward and inward, in-
stead of outward, as in indirect hernia, and it will readily appear that during manipu-
lation the body and limbs should be so placed that the recti muscles may be thoroughly
relaxed.

When strangulated, and operative measures are to be undertaken for relief, it is of
the first importance to remember that the usual division of the constricting ring in an
outward direction greatly endangers the epigastric artery, since this vessel is usually in
close proximity to the neck of the sac for a considerable portion of its outer and upper
border. Cutting directly upward and inward, this accident will be avoided. The divi-
sion of the epigastric artery may occur without the surgeon being aware of the fact.
Mr. Cooper gives several cases, of which the following is an illustration:

"A patient of Mr. Sterry's, surgeon in Bermondsey Square, had been for three
days laboring under the symptoms of strangulated hernia. The hernia was scrotal, and
as it had resisted every attempt at reduction, Mr. S. requested me to see him; the
operation being agreed upon, I performed it precisely according to the rule usually
laid down for dividing the mouth of the hernial sac; that is, upward and outward.
As soon as the division was made, a quantity of arterial blood was seen flowing down
over the intestine within the sac, and the bowel being immediately returned, a consid-
erable stream of arterial blood flowed into the sac. Pressure was made upon the groin
in the situation of the epigastric artery, in order to prevent the haemorrhage, and appar-
tently with success; but, four hours afterward, Mr. Sterry was sent for on account of a
copious discharge of blood from the wound. He made a further pressure, but without
success, and the man died in ten hours after the operation, becoming gradually faint
after it, and the abdomen being distended with blood." In M. J. Cloquet's experience,
who it will be remembered made careful dissections of over five hundred hernial sub-
jects, he found the proportion of direct to oblique inguinal hernia as one to five. This
is a much greater proportion than is usually accepted. It is, however, without ques-
tion that in the living this variety of hernia is comparatively rarely differentiated.
DIRECT INGUINAL HERNIA.

PLATE XVII.*

An internal view of the same preparation as that of the former plate, showing the orifice of the hernial sacs, with the relative situations of the epigastric and spermatic vessels.

a. Symphysis pubis.  
b. Anterior superior spinous process of the ilium.  
c. The spine.  
d, d, d, d. Abdominal muscles drawn downward to show the cavity of the pelvis.  
e. The bladder.  
f. The rectum.  
g. Bifurcation of the aorta.  
h. The inferior cava.  
i, i. Spermatic arteries.  
k, k. Spermatic veins.  
l. Vas deferens.  
m, m. Epigastric arteries and veins.  
n, n. Origin of epigastric artery on each side.  
o, o. Peritoneum.  
p. Mouth of the hernial sac upon the left side, taking the usual oblique course of inguinal hernia.  
q. Mouth of the hernial sac on the right side, situated upon the inner side of the epigastric artery.

By this plate it will be at once seen that the division of the stricture upward and opposite the middle of the orifice of the sac will be in both species of hernia perfectly safe.

The definition of direct inguinal hernia is correct, although confusing; correct, in the anatomical sense, as to origin and development, but incorrect and confusing, since, unless its origin and development are kept clearly in mind, this comparatively rare variety of hernia will be confounded with that form of indirect inguinal hernia which, from the dilatation of the canal, has caused the obliquity of its course to be so changed as to be almost altogether lost. When these pathological conditions have become thus pronounced, it is equally proper to define it as direct hernia, since the protrusion of the abdominal contents has now made its escape by a direct opening. It will be readily observed that too much emphasis can not be made upon the distinctive anatomical differences of these two varieties of hernia, since in the latter and by far the larger proportion of the cases, the inguinal canal is the opening for escape along the line of the passage of the spermatic cord; while, in the variety under discussion in this chapter, the cord and its vessels have no association with the outlet except the one already referred to, where, in case of strangulation, it is important to differentiate the anatomical relations before division, in order that these important structures may not be injured.

It will be readily seen, from the foregoing, that operative measures for cure have a radical difference in the two varieties, dependent upon the component structure of the parts. In the direct hernia of Sir Astley Cooper, under consideration, after the disposi-

* Cooper, Plate VIII, Part I.
tion of the sac, the measures for which are the same, as elsewhere advised in the other varieties of hernia, the closure of the opening is made complete, as in indirect inguinal hernia in the female; whereas, in large old direct herniae which have formed along the line of the spermatic cord, the resultant cure must depend, in very large measure, upon the restoration of the obliquity of the inguinal canal. Observe carefully the internal relationships of the parts as seen in the following plate.

PLATE XVIII.*

This plate shows six hernial sacs, which were taken from a patient of Mr. Weston’s, surgeon, Shoreditch, who labored under a difficulty of discharging his urine, from a stricture and stone in his urethra. Two of the sacs upon each side were placed between the umbilical and epigastric arteries; and one on each side is situated between the remains of the umbilical arteries and the pubes. They passed between the tendinous fibers of the transversalis, which they had separated, and entered the abdominal rings, after which they were covered, as usual, by the fascia, which is extended from the external oblique muscle over the spermatic cords.

a. Situation of the symphysis pubis.

b. The muscle removed from the anterior superior spinous process of the ileum.

c. Abdominal muscles lined with peritoneum.

d, d. Spermatic cords.

e, e. Testes.

f, f. Remains of the umbilical arteries.

g, g. Epigastric arteries and veins.

h, i. Two hernial sacs on the left side, formed between the epigastric and umbilical arteries.

j. Hernial sac formed between the umbilical artery and symphysis pubis.

k, l. Two hernial sacs formed between the epigastric and umbilical arteries on the right side.

m. Hernial sac between the umbilical artery and the pubis on the right side.

* Cooper, Plate X, Part I.
CHAPTER VI.

INDIRECT REDUCIBLE INGUINAL HERNIA. INSTRUMENTAL SUPPORTS.

As we have already seen in the discussion of the subject of hernia, by far the larger number of those suffering from this affection are classed under this variety. Since the days of the early writers upon surgery it has been clearly pointed out, that the anatomical conditions which permit the escape of the spermatic cord through the abdominal wall, have caused this to be the weakest part of its structure, while for quite two thousand years the difficulties have been fully recognized which make the surgical attempt at cure so often result in failure. It is on this account that we invite the reader to a most careful consideration of the subject.

Reducible Inguinal Hernia.—Under this division may be included by far the larger number of the ruptured, the great army of semi-disabled, truss-bearing individuals of every generation and race. The protrusion, more or less marked, gives a sense of weakness and discomfort never absent, but varying greatly in degree. Every surgeon should familiarize himself with inguinal hernia in its earlier stages. It is generally true that his attention is not called to this condition until a small portion of the abdominal contents, omentum, or intestine has escaped through the external ring, and the patient in alarm discovers a soft protrusion or tumor in this locality. When this has taken place, the parts are usually easily reduced, and, in the horizontal position, in order to secure a relaxation of the structures, the surgeon readily invaginates a portion of the scrotum on the finger, carrying it directly into the lumen of the dilated canal. Under these conditions, although the internal ring is dilated, and the peritoneal sac has for a considerable period been in process of formation, the canal is not very much foreshortened, and its obliquity is still in a measure preserved.

The abdominal contents find ready lodgment within the gradually enlarging sac, and act daily as a wedge to dilate still further and deform the structures of the canal. Under these conditions the surgeon usually contents himself by sending the invalid to some instrument-maker with directions to be fitted with a truss, and feels that his duty is completed without further observation of the patient. In most of our large cities one
or more mechanicians are found who have made a special study of trusses and their application, as, for instance, in Boston, Dr. Benjamin Codman, of the firm of Codman & Shurtleff, and Dr. Nathaniel Greene, of the firm of Leach & Greene, both regular graduates of medicine, and especially skilled in the manufacture and fitting of surgical appliances. But by far the larger number of trusses are fitted by apothecaries and those who at the best know little of the subject. It is of the greatest importance that every physician, as well as surgeon, should make a careful study of the proper measures for the retention of hernia, if possible more important in its earlier stages, especially in the young, than when the disease is more advanced.

In the recumbent position, pressure upon the protruding parts causes them to be returned into the cavity of the abdomen. In the larger proportion of cases a properly fitting truss retains the hernia. Often, however, after some unusual exertion, the tumor becomes large, and its reduction is attended with difficulty. The individual with such infirmity lives in constant danger. Accidents in great variety, often from the most trivial causes, may produce strangulation of the prolapsed intestine, the consequences of which will be fatal, unless early relieved by skillful measures. To prevent this as far as possible, and make comfortable rather than to produce a cure, the truss has been devised.

**Instrumental Supports.**—It is not my purpose in this treatise to enter into a detailed description of, or especially to differentiate between, instruments of support. Although the variety of trusses seems almost infinite when the stock of a large dealer is examined, certainly confusing to the young or inexperienced, new patterns being constantly offered as possessing some hitherto unknown merit, little real advance in the art of truss-making has taken place since the days of Sir Astley Cooper, nearly a century ago. After discarding the use of all other supports and bandages, as of little value, often of damage, he describes the truss as follows:

“A steel truss is composed of a pad made of a supporting piece of iron, and stuffed so as to take a conical form, the apex of which immediately compresses the abdomen at the part whence the hernia threatens to descend. The pad is riveted upon a long flat piece, tempered to a great degree of elasticity and curved to the shape of the lower part of the body, which it embraces like a belt. The length of this steel should be sufficient to pass from the hernia round the region of the groin to about an inch beyond the spine behind, forming somewhat more than a semi-circle, but compressed. Both the pad and truss are quilted with leather. A strap of
leather proceeds from the hind-end of the truss, which passes round the body, completing the circular belt by fastening upon the pad. . . . Many surgeons, and almost every surgeon's instrument-maker, have thought proper to vary the form of the truss, and to prescribe different rules for the duration and force of the pressure, but almost all have agreed in determining that the pressure should be made upon the abdominal ring.

"This is precisely the circumstance, however, in which they are all defective; and, indeed, it is the frequent failure of the purpose for which they are designed, when made according to this principle, that has led to such a variety in the mode of their construction. The object in applying a truss is to close the mouth of the hernial sac and destroy its communication with the abdomen, and this object can never be perfectly fulfilled by any truss which is applied in the usual manner upon the abdominal ring, and extending from it upon the os pubis. In this case the cure must be incomplete, because a considerable portion of the hernial sac remains uncompressed toward the abdomen, which portion is that situated between the abdominal ring and the opening of the sac into the cavity of the belly."

Even when the truss has been worn, apparently successfully for some time, over the external ring, should this become closed under the pressure, the neck of the sac is left open to receive the wedge-like dilating force of the abdominal organs, and the supposed cure soon fails. Not seldom the pressure is directed so low as to injure the cord, interfere with the nutrition of the testis by disturbed or impeded circulation, and cause severe suffering. If cure is to be effected by a truss, it must prevent the peritoneal pouch from protruding through the internal ring, allowing the internal orifice to close, and the peritoneal sac, no longer holding a portion of the abdominal contents, to contract and possibly to disappear. If such conditions can be maintained, the inguinal canal becomes smaller and the connective-tissue structures in a measure strengthened. If, on the other hand, a considerable amount of pressure is maintained, quite toward the median line, absorption and atrophy of tissues ensue, and the abdominal wall becomes thin and weakened.

The surgeon should not only practically understand the proper method of fitting a truss, but should consider it a personal duty to see that the instrument is rightly applied, of suitable strength, a well-fitting pad, and should give the sufferer the requisite details of instruction as to its wearing. The skin in the region of the groin will need attention for some time, as friction and soreness ensue. Often a fold of
India silk, as, for example, an old handkerchief, under the pad, is of the greatest comfort. Individuals, after middle life, may not expect a cure, and should be taught to look upon a truss as a part of the impedimenta of subsequent living.

We can not do better than emphasize the direction of Sir Astley Cooper to make the pressure over the internal ring, and, as a rule, not with a large pad. A small, well-fitting pad, which the proper adjustment of the truss will allow to be retained over the exit from the abdomen, is the end to be attained. While the curve of the spring should be adjusted to the configuration of the wearer as far as practicable, it should lie above the region of the glutei muscles; otherwise their action in locomotion produces a constant movement of the pad.

Trusses may be divided into two general classes: the so-called French and German or English. The former has a very light but highly elastic spring, clinging closely to the body, and following up the retreating parts in every motion. Constant pressure is preserved by it. On the contrary, the German truss has a much heavier spring, shaped so as to conform to the outline of the body, and hence is less elastic and less comfortable. It resists with great power any strain brought to bear upon the parts in contraction, but presses only lightly, or not at all, when the body is at rest. American ingenuity has found a fertile field in truss construction, which of itself would make a chapter of much interest. The small hard pad of wood or ivory, with a spring constructed so as to carry the supporting force obliquely upward in the direction of the canal (the White truss), often serves a valuable purpose. This is a modification of the wood pad first devised and sold about 1833 as the Stagner truss. These were greatly improved by Dr. Heber Chase and others. The water-pad, invented by Dr. Nathaniel Greene, of Boston, made of rubber and filled with water, is also a valuable contribution to both comfort and convenience. Where a light pressure only is required, it is often of the highest value. An elastic rubber pad, filled with air, is a modification of the water-pad, and has the advantage over it of being lighter, and it is claimed to possess durability. This is a patented truss ("Rorick's air-pad"), and is well made by the Hastings Truss Company, of Philadelphia. These pads are adjusted to all the various styles of trusses. My own experience in the use of these trusses is very satisfactory, although limited to a few cases especially selected for trial. They are very comfortable, and when the pressure is required low down, the bearing upon the pubic bone is less painful and injurious than when the firmer pad is used. After a time the pad flattens and becomes far less serviceable.
Since we shall not again return to the subject of supports, it may be added that femoral hernia requires an instrument adapted to make the pressure quite lower than in inguinal hernia. In large, irreducible hernia, special supporting and constricting bags, lacing or otherwise, have been devised, and when, for any reason, operative measures are not advised, should always be carefully applied. Umbilical trusses are made also in considerable variety, but in all the one general object is to obtain a support to prevent the escape of the hernia, or, where this is impossible, to retain from greater enlargement.

We have elsewhere shown that Celsus was familiar with the surgical treatment of strangulated irreducible hernia, and that the surgeons of the Roman Empire considered that operative measures should be often advised for its cure. Bandages and compressors were in use for the retention of hernia. Galen devotes considerable space in his works to the description of supports and how to apply them. Pads of wood and iron attached to a non-elastic girdle are described as being in use in southern Europe six hundred years ago. The use of a soft iron girdle molded to fit the shape of the body and adapted for the support of the pad is attributed to Fabricius Hildanus in the sixteenth century, but it was not until the subsequent century that the elastic steel spring came into use. At a meeting of the New York Medical Society in 1889 the subject of hernia was freely discussed, and Dr. S. E. Milliken's paper, upon "What Special Mechanical Treatment has Proved most serviceable for each Variety of Reducible and Irreducible Hernia," was so concise and valuable that I quote as follows:

"Inguinal Hernia.—The great majority of cases being inguinal, my remarks will for the present be directed to this variety. For convenience and practicability I have divided it into three degrees, as follows: 1. A simple bubonecele, when the viscus remains in the canal. 2. The hernia is without the external ring, but the canal remains oblique or intact. 3. The canal is obliterated and the external ring is enlarged. This last degree is practically a direct hernia.

"The difficulty with which herniae of the first and second degrees are retained is usually not great when a truss is employed. The most satisfactory treatment has been the use of one of the following five forms of truss:

"1. The spiral spring, of which there are many modifications, and which is too well known to call for description. This style is especially adapted to patients that require perfect freedom of the abdominal walls, as only a leather strap is in front. In cases of
the third degree, it is often necessary to attach a perineal strap, and even with this procedure a few exceptionally difficult cases can not be retained.

"2. The 'Knight' truss, which has a band that is almost elliptical, and extends about three fourths around the body; on the end is attached a malleable shank, with a round or oval pad. The band should be so tempered that it can be fitted to the body after it is covered. The mechanism is very simple, and, with the proper adjustment of the shank, there are very few cases, even of the third degree, that are unmanageable. The addition of a perineal strap assists greatly in keeping the pad in position. A double truss can be made by attaching another shank about four or five inches from the band that crosses the abdomen.

"3. A form of truss which differs from the above only in having no shank. The 'Seeley,' which is covered with hard rubber, and the celluloid 'Pennfield,' are the most durable examples of this form. This truss is better suited to the first and second degrees, because the pressure does not have to be made so low. It is also applicable to the third degree, but is somewhat less efficient than the 'Knight.'

"4. A complete band, which is exemplified by the 'Hood.' This truss has a tempered bar on each side, that extends from the sacro-lumbar joint to the inguinal region, where it is attached to a slotted steel plate, which is connected with its fellow on the opposite side by a bar that is considerably heavier than those of the side. The pads being also slotted, allow the truss to be adjusted to suit nearly all forms of inguinal hernia. With a well-fitting band, the antero-posterior pressure can be regulated by the thickness of the pad. Only in extreme cases of the third degree does a large pad have to be employed.

"5. A truss with a complete band and a shank, which has proved quite efficient in corpulent cases with large rings. This is simply a combination of the 'Hood' and 'Knight' trusses. The band, which is a single piece of bar steel, is fitted to the pelvis and abdomen with the patient standing. It is especially important that the band should come just beneath each anterior superior spinous process, to prevent upward displacement. Although the band crosses the lower portion of the abdomen, it need not restrict its movements, because it can be arched forward without decreasing the usefulness of the truss. The shank has to be slightly longer than on the 'Knight,' but otherwise is the same. The band has about the same dimensions as that of the 'Hood.' The use of this truss has been limited to those cases in which the hernia was especially difficult to retain; and care has been taken to get a perfect fit in each
instance. But for the majority of cases of inguinal hernia it is quite unnecessary to make special trusses when such a variety of forms are ready at hand.

"Femoral Hernia.—As the anatomical relations are much less varied in femoral than in inguinal hernia, it is unnecessary to make any subdivision of this class of cases. It is very rarely difficult to retain these hernia, however simple the appliance may be. The two styles of truss that are best adapted to its treatment are the spiral spring and the 'Knight.'

"Umbilical Hernia.—The most satisfactory treatment of umbilical hernia in children has been with rubber adhesive plaster and a small pad. The plaster should not be changed more frequently than once a week, and should be allowed to remain two weeks if no excoriation is produced. In patients over three years of age a French umbilical truss can be applied, but difficulty is often encountered in keeping the pad in position. The percentage of incurable cases in children is very small, while in adults it is the reverse. As only palliative measures are usually attempted with the latter class, it is found that the abdominal supporter answers admirably.

"Irreducible Hernia.—In the majority of irreducible herniae of the inguinal and femoral types, operative treatment is advised, but there is a certain number of cases of epiplocele which present only slight symptoms, and which decline to be operated upon. In this class of cases the application of a simple spica, with a soft pad, reapplied every day, often accomplishes partial or complete reduction after a week or ten days. This method has been chiefly effective in cases of femoral hernia. Irreducible, umbilical hernia is almost exclusively met with in the adult, and more than palliative measures are rarely attempted. Should no symptoms of incarceration be present, the application of an abdominal supporter usually partially reduces the mass; and this can be still further assisted by the addition of a large flat pad."

When operative measures have been undertaken for the cure of hernia, such as are found recommended in another part of this work, too much emphasis can not be placed upon the undesirability of adjusting a truss. I can not help thinking that where, under the influence of the fear of the return of the hernia, a truss has been applied, great damage is often done to the newly formed structures by the continuous pressure. If, on the contrary, it is demonstrated that the hernia is commencing to reappear, a light truss may be wisely advised.
CHAPTER VII.

IRREDUCIBLE INGUINAL HERNIA.—SYMPTOMS AND COMPLICATIONS.

Quite a variety of causes produce this condition. Usually the history is given of a hernia which has existed for years, often not supported by a truss, or by one that fitted improperly and had been discarded. More commonly the omentum is the first troublesome factor; adhesions between it and the wall of the sac, and this again to the contiguous parts, prevent return; as the opening shortens and enlarges, a loop of intestine becomes a factor, and gaseous or fecal distention causes a further yielding of the weakened parts; often symptoms of obstruction and pain, constitutional disturbance, slight elevation of temperature, nausea, followed by vomiting, are the premonitory symptoms of danger which precede actual strangulation.

Not seldom, although the tumor can not be reduced, a careful manipulation may remove the temporary intestinal obstruction, the gaseous distention be overcome; and the history of such cases is that of invalidism steadily growing more pronounced. Rest in the recumbent position for some days, the hips higher than the shoulders, and the parts supported, hot applications locally, light diet, opiates, enemata, etc., are often demanded. In this way relief is obtained without manipulation or taxis, and when these measures are resorted to they should be conducted with the greatest care.

The size of the irreducible herniae is sometimes enormous. Often when the patient is about, the scrotal tumor becomes a deformity difficult to conceal. Birkett * reports the following: "The largest double rupture I have seen was in a bricklayer, fifty-five years old, whose bodily health, strength, and conformation in other respects were good. The left hernial tumor was the largest, although it had existed only about three years, while the right had been there twelve years. The lowest body of the tumor very nearly reached to a level with the patellæ. Its circumference in its largest part measured thirty inches.

* Holmes's System of Surgery.
IRREDUCIBLE INGUINAL HERNIA.—SYMPTOMS AND COMPLICATIONS.

PLATE XIX.*

Figure 1.
Two external inguinal herniae (enteroceles).
Male, aged forty-six.
(a) Tumor in the inguinal canal.
(b) Contraction or obstruction of the internal inguinal ring.
(c) Passage of the epigastric vessels under the tumor.
(d) Scrotal tumor.

Figure 2.
Double external inguinal herniae. That of the left side of enormous size. (Copied from a design of Dupuytren.) The right hernia is yet reducible. The left hernia, irreducible, contains the greater part of the intestinal mass. The abdomen, almost empty, is pressed down.
(a) External projection of the hernial sac.
(b) Section of the profile.

Figure 3.
Congenital external inguinal hernia (probably an epiplocele) in a child of seventeen months.

Besides the inconvenience of such tumors and their attendant suffering, the patient runs many dangers. The greatest is that of strangulation of the incarcerated intestine, although this is probably less than in reducible hernia, since the sac is nearly full and thus less readily admits of a sudden increase of its contents. Injuries are common from accidents. Mr. Cooper relates a case where death occurred in a few hours, after a fall, from rupture of a portion of the ileum. He also quotes a case from Mr. Norris, a contemporary surgeon, who showed him the specimen. "While running, and suddenly turning the corner of the street, he struck violently against a post. The middle of the abdomen was the part that received the shock, from the effects of which he soon appeared to have recovered, but on proceeding a little way he felt great pain in the belly, and became very faint, which obliged him to sit down on the steps of a door. In about ten minutes he was just enough recovered to be able to crawl to his home, which was about two hundred yards off. I saw him on the following morning. There was not the slightest appearance of injury on the part that had received the stroke, but in the course of the spermatic process on the left side, extending into the abdomen, there was a fullness and enlargement equal to a moderate-sized hernia. He vomited quite frequently, his pulse was quick and extremely feeble, his countenance was pale and expressive of the greatest anxiety, and he complained of acute pain all over his belly. The abdomen, however, was quite soft, and the contents of the tumor were easily returned into its cavity, but quickly came down again, when the pressure was removed. These symptoms continued with the most torturing pain till the even-

* Bourgery's Atlas, Plate XXXIV.
ing, when he expired. Having obtained leave to open the body, Dr. Yelloly and myself met the day after his death for that purpose. The tumor was now larger than before, discolored, and contained air, discoverable to the touch.

"The contents of the tumor were found, on opening it, to be air, blood, and water. On examining the abdomen a similar fluid, to the quantity of a quart, was found effused. An irregular aperture was perceived in the ileum, which readily admitted my finger, and through which everything that had descended into the stomach found a ready passage into the cavity of the body. No other injury of any kind to any of the contents of the abdomen could be detected."*

Foreign bodies, introduced into the stomach, may be caught and retained in the intestinal hernial loop, and serious trouble arise therefrom. Mr. Cooper reports a case of a boy, aged thirteen, sent to the hospital, where a quantity of feculent material was constantly passing from an irreducible scrotal hernia. Five weeks before, he had accidentally swallowed a pin. This was withdrawn from the scrotal opening, but, after a variety of efforts at cure, he was discharged, with the fistula still open. The case of Mr. Gibbon, the celebrated historian, is given by Sir Astley Cooper, as an illustration of possible danger. Its interest is quite sufficient for giving it entire:

"Mr. Gibbon had been for thirty years subject to a scrotal hernia on the left side, of which he made no complaint, and to which he applied no remedy to prevent its increase. But in the summer of 1793, finding it grew suddenly uneasy, he became alarmed, and consulted Sir Walter Farquhar and Mr. Cline. The tumor was then of uncommon size, reaching to his knees, and very large at its connection with the abdomen. As some water was perceptible at the lower part of the tumor, it was tapped in the month of November, 1793, and a large quantity of water was drawn off. In a fortnight after, it was again tapped and three quarts of water were evacuated, without any sensible diminution of the swelling. Six weeks after, the skin over the tumor having inflamed and shown a disposition to ulcerate, the tapping was again repeated, January 13, 1794, when six quarts of water were discharged. Two evenings afterward he began to complain of a pain in his stomach and soreness in the abdomen, and in the tumor on pressure. He passed the night restlessly, but the next morning when he rose he seemed in better health and spirits than usual. Soon after he became insensible, and expired about eleven o'clock.

* Sir Astley Cooper, second edition, Part I, p. 25.
"Mr. Cline asked me to accompany him to inspect the body. We found the abdomen nearly emptied of all the movable visera, no omentum remaining within its cavity, and of the intestines only the duodenum and cæcum. Even the pylorus was drawn down so low as to lie upon the orifice of the hernial sac, into which all the omentum, and all the intestines, except those I have just mentioned, had descended. They were all uncommonly loaded with fat, and slightly inflamed. The hernial sac extended nearly as low as the knee, its orifice was so large as to admit my hand within it. Below the sac appeared a separate bag large enough to hold several quarts of water, which, by its containing the testicle, proved to be the tunica vaginalis testis."

The practical questions arising from the consideration of irreducible hernia are those of treatment. Often it is exceedingly difficult to determine the exact condition of contents. If omental only, a truss may be fitted; if intestinal, the pressure of a truss would prove dangerous. A small loop of intestine may be concealed in the omentum, and not easily detected. If the truss proves painful, it should be worn with great caution, or better omitted entirely. When a hernia becomes irreducible, it is almost certain to grow worse steadily and endanger the life of the sufferer constantly. Operative measures were considered, until the establishment of aseptic surgery, altogether too serious and dangerous to be advised, even if the sufferer was willing to undergo the risk. The ingenuity of the mechanic was called into requisition in the adaptation of a great variety of supports for the tumor, and the best results were undoubtedly obtained by confining the invalid for a long period in bed, in the horizontal position, limitations of diet, and the maintenance of more or less steady elastic pressure.

Many ingenious mechanical devices have been invented, not alone for the support of the considerable tumors which are caused by irreducible hernia, as hollow pads or cushions, applied to force the hernia to re-enter the abdomen, but also to secure a radical cure by the slow separation of the adhesions and restoration of the displaced organs. One of the more ingenious of these methods is that of Dr. John C. Warren, of Boston, where the scrotal tumor, more or less large, has adjusted to it a proper receptacle, and graduated elastic compression is continuously applied for its reduction. Arnaud gives a long description of his method of retention and reduction of large old herniae, complicated by adhesions. Instruments were fitted by him with the greatest care, and these, together with what he calls proper medication, rendered it not alone possible to cause
the reduction of the tumor, however large, but oftentimes resulted in a permanent cure. In illustration I quote the following case: *

"Mr. Boudon recommended to my deceased father a man of forty years of age, and of very strong constitution. He was extremely fat, and six feet and an inch high (French measure). His name was Mr. Trogneux. He was an inhabitant of Clamsey, in the diocese of Auxerre. He had an hernia from his infancy, which had never re-entered. It was thirty-two inches in circumference at its lowest part, nineteen at the ring, and sixteen in length. For more than ten years his penis had been lost in the bulk of the tumor, so that the prepuce formed a kind of depressure like that of the navel; so that in making water, his urine was diffused over all the tumor, which was very troublesome to him. As he was a timber-merchant, his business obliged him almost every day to ride forty or fifty miles on horseback, which induced him to invent a large cavity in the fore-part of his saddle, in which he placed his tumor. Being at last reduced to such a condition that he could no longer follow his business, and being afraid that this disorder, no less terrible than insupportable, would soon put an end to his life, he determined to apply for relief. It was in 1726 that he was introduced to us. He found a great deal of comfort from the recent example which my father and I gave him of the cure of a similar disorder. He submitted to everything we prescribed, either for his relief or radical cure; but on condition, said he, that he should have a little to eat; for he was a prodigious glutton. Persons of this kind may observe a very strict regimen, even by eating a little. We may therefore recede from the general rule in their favor, without any fear of doing harm; for their great appetite requires this kind of liberty. He was blooded several times, then purged, and afterward used twelve or fifteen baths. Twice a day I made strong embrocations of his abdomen with oil of melleot, and covered the whole tumor with a plaister, composed of the emplastrum de Vigo, prepared with a good deal of mercury, of the diabotanum, and the mucilages; and this plaister I renewed every four days. We made him every morning take ten, twelve, fifteen, or twenty grains of mercur. dulc. He drank plentifully, and had four emollient and purgative clysters injected every day. Every four days we purged him with cassia, with an intention to evacuate the humors, and prevent a salivation. This method succeeded very happily; for the evacuations lasted sixteen days and were so copious, that they every day redoubled the patient's astonishment. The

* Arnaud, p. 292.
tumor during this time had lost three quarters of its bulk, and more than a half of the remaining quarter we made to re-enter by the taxis: so that the hernia, being thus reduced to an eighth part of its bulk, was in a condition to be contained in the hollow cushion of a truss. It afterward diminished insensibly for eight or ten days, during which time we took care to fill the cavity of the cushion, in proportion as the bulk of the tumor diminished. On the thirty-sixth day from the first venesection the parts re-entered all together, and the testicle also. We then used a convex instead of the concave cushion. The patient in a very short time resumed his strength and flesh, and followed his business with a great deal more vigor than ever he had done. The first thing he did at his return home was to render his wife pregnant, with whom he had had no amorous converse for ten years before. He quitted the use of the truss eighteen months after; that is to say, in 1728. Twelve years after, he had occasion to come to Paris, where he called for me immediately on his arrival, rather to testify his gratitude than for any other reason. But, as I did not know him, he put me in mind of everything that had happened in 1726. I examined the parts, which I found so firm and solid that one could have hardly imagined that he had formerly labored under an hernia. The skin of the scrotum was returned to its natural state, only it was very thick; and the bottom of the scrotum which had approached to the ring, on account of the herniary sac of the testicle, was fixed or glued over the ring. This portion of skin seemed to make a kind of stopper, which filled the cavity of it. But though the disorder had no appearance of a relapse, I ordered the patient to wear a truss by way of prevention—the reasons of which I shall afterward give in a particular instance."

Modern aseptic surgery should relegate the entire class, almost without exception, to operative measures for cure.

The peculiar complications which enter into the problem for the surgical cure of large, old, irreducible herniae are the adhesions, which unite the parts contained within the sac to it and each other. As will be seen in the consideration of operative measures for strangulated hernia,* where these complications are discussed in detail, the adhesions of the omentum to the sac and the fused state in which it itself is often found, are comparatively unimportant, since both may usually be removed with safety and advantage. On the contrary, loops of adherent intestine are to be treated always with the

* Chapter viii.
greatest care. When firmly united to the sac, it is better to snip portions of this freely away and return within the abdomen, rather than use too much violence in the separation of the adhesions.

The highest skill and judgment of the surgeon are often demanded in the safe and proper treatment of such complications.
CHAPTER VIII.

STRANGULATED INGUINAL HERNIA.

When the constriction of any portion of the contents of the hernial tumor is sufficient to impede or impair the circulation of the blood, and thus endanger the nutrition of the parts inclosed, arresting the passage of the fecal contents through the intestinal canal, the hernia is called strangulated. The neck of the sac is usually the seat of the constriction.

In Chapter IV, page 55, I have described in detail the physiological changes which in the end develop into a firm, thickened constriction at the neck of the sac. These plicated folds are caused by the resistance which the hernial tumor meets in its development as it passes through the inguinal canal. Although mentioned by many authors, the importance of the constriction thus made at the neck of the sac is still greatly underestimated, and the surgeon has too often in mind that the parts to be operated upon are only the anatomical borders of the more or less altered tissues which enter into the formation of the canal, rather than the deformed, pathological peritoneal covering of the tumor which, in its descent into the scrotum, has been folded over and over, and by inflammatory processes consolidated into a dense, unyielding, constricting ring. The formation of these plicated folds is very well shown in the accompanying woodcut.

"It was for a long time believed that all cases of strangulation in inguinal hernia
were owing to a constriction exercised by the ring upon the intestine. This erroneous opinion has more than once led to fatal consequences. Acting upon this principle, surgeons enlarged the inguinal ring, and restored the parts into the abdomen, thinking that they had removed the strangulation; but the bad symptoms persisted, became aggravated, and the patient perished without any evident cause for his death. These unfortunate results soon attracted my attention, and became the subject of reflection; presently, I was induced to think that the abdominal ring was not the only seat of stricture, and dissection has since proved to me that, in a great number of cases, the neck of the sac is the cause. Time has corroborated my views, and I believe that I may now affirm that, out of nine cases of strangulation, eight are owing to a constriction by the neck of the sac. This remark applies particularly to inguinal hernia; for this disposition is rarely met with in femoral and umbilical hernia. The structure of the parts explains the difference."*

It may, however, occur in any portion, and there may be more than one constraining band. The causes of strangulation are various. Obstruction may, and very likely does, frequently supervene upon changes in the circulation and nutrition of the intestinal loop within the sac. The venous return current impeded, there will ensue, even in an old hernia, an increased weight, a suspension of peristaltic motion, a retention of intestinal contents, resulting in an over-distention of the sac. It is probable that, in most instances, the changes commence within the sac and its contents, rather than in the constraining part. Once commenced, however, they mutually react to the injury of both. There is usually a limited quantity of serum in the sac of a strangulated hernia. This varies according to the character and duration of the constriction. At first it is pale yellow, clear serum, then changes in color, and later becomes turbid, with blood-cells freely mingled, even to the production of small clots; the serum may become of a dark coffee-color. Not seldom it has a fecal odor, and it is very probable that the fluid is often infected with bacteria from the intestinal contents, escaped through the imprisoned walls.

The tissues covering the tumor exhibit changes coincident with those of the contents. These are more marked nearest the constriction, and lessen toward the surface. Violent manipulation of the mass may, and often does, cause marked changes in the integuments, ecchymosis of the connective tissue, œdema, and redness of the skin.

* Lectures on Clinical Surgery, delivered in the Hôtel-Dieu, of Paris, by Baron Dupuytren, surgeon-in-chief, 1835.
a. A portion of the great sac of the peritoneum laid bare, by means of the division of the inguinal ring; the incision is extended upward into the fleshy part of the abdominal muscles.

b. h. The hernial sac formed by the peritoneum.

c, c. Constriction formed by the neck of the hernial sac, situated a little more inward than the inguinal ring.

d, d. Some rugae or bridles of cellular substance arising at different distances around the stricture formed by the neck of the hernial sac.

e, e, f, f. The cellular substance external to the great sac of the peritoneum, which accompanies the hernial sac and the spermatic cord, and is interposed between the proper sac of the hernia and the aponeurotic sheath of the cremaster.

g. A small portion of the hernial sac removed, within which is seen a portion of a fold of the ileum.

k, i, k, l. The external covering of the hernia, or the membrano-aponeurotic sheath of the cremaster.

m. The greater bundle of fleshy fibers of the cremaster.

n, o, p. Distribution of the bundles and serpentine fleshy fibers of the cremaster muscle.

q, q. The vaginal coat of the testicle laid open.

r. The tunica-albuginea of the testicle.

s. Part of the epididymis.

t, t. Varicose vessels of the spermatic cord, surrounded and included within the cellular substance—an incipient circocele.

u. The integuments of the scrotum.

v, v. The muscular parietes of the abdomen laid open for a small space.

x. A denuded portion of the rectus muscle of the abdomen of the right side.

y. Continuation of the rectus muscle of the right side within its aponeurotic sheath.

z. Crest of the os ileum.

**Symptoms.**—As generally observed, the first symptoms are local pain, a tumor more or less large, if none existed before; if an old hernia, a tenderness and increase of swelling, a dragging weight, and a sensation of uncasiness in the hypogastrium. This sometimes becomes so severe that it seems as if a cord was tied about the body. The mechanical obstruction to the intestine is soon followed by more marked nervous symptoms; pain and restlessness supervene, with nausea and vomiting; this may be accompanied by a desire to defecate, and straining at stool results in the passage of little except flatus. Sometimes these general reflex nervous symptoms are so prominent that the patient and physician both may fail to consider the cause as one of obstruction, or think of hernia.

If unrelieved the general symptoms become more marked, the nervous anxiety pronounced, the pulse small, hard, and quick, the temperature somewhat elevated, and the nausea and vomiting severe. There is a gaseous distention of the intestines, giving a tense, tympanitic abdomen. The vomiting becomes fecal, and no gas passes the anus.

When these symptoms have become marked, the obstruction is not only complete,
but has existed longer than is consistent with safety. Every practitioner should study the grouping of such symptoms and be early on the alert, since danger increases each hour almost in a geometric ratio. The intestinal canal, between the obstruction and the stomach, not seldom the stomach even, becomes by degrees distended with a dark-brown-colored fluid; this rapidly undergoes fermentation, and sets free gas, which greatly adds to the stretching of the intestine, causing a paralysis which is often slow in recovering. The mucous membrane is deeply congested, the villi are turgid and swollen, even the serous coat is much changed in color, and is often punctated, or striated in patches of deep red. The intestine, on the contrary, below the stricture, is decidedly pale, and contains little except mucus.

If the patient remains unrelieved, uncontrollable retching and vomiting ensue, prostration supervenes rapidly, and death from collapse occurs. Life may be prolonged until the constricted portion of the intestine ulcerates, and the escaped intestinal contents set up a rapid septic peritonitis. At the beginning stage of prostration the active nervous tension abates, the nausea, especially if the patient is partially narcotized, lessens or disappears. This should not quiet the attendants; on the contrary, it betokens grave changes, a depression of the vital force, from which the patient never rallies. The pulse, before full and rapid, is now slower and weak, the heart contracting with little force. The cutaneous surface is much lowered in temperature and becomes shriveled, the hands and feet cold and wet, the expression is one of anxiety and distress, the tongue dry and brown. The muscular system is relaxed, and the urinary secretion is greatly diminished.

The patient may continue for some time in this state—the very threshold of death—pulseless, scarcely seeming to breathe, yet with unclouded mental vision and able to converse; a slight change only, and death supervenes. When death follows, the local conditions often do not present changes sufficiently marked to have caused such a serious result, and the fatal issue is very probably dependent upon the extreme nervous exhaustion or collapse.

Although local pain is considered a sign of peritonitis, it is difficult to determine the inception of the peritoneal inflammation. It is often local, with a protective layer of lymph effused. When arising from perforation, the pain is usually severe, and death may follow from the shock to the nervous system, but usually from rapid infection, as a septic poisoning.

The pathological changes of the contents of the intestine are of interest. The
vomitus at first appears to consist chiefly of the ingesta; frequently of the substances last taken into the stomach. Then the fluids become changed in color, odor, and taste, by being mingled with the biliary secretions. The color changes from a greenish hue to brown, or even almost black, and later the odor becomes feculent—the well-known stercoraceous vomitus. Blood-cells may often be found, and the color of the serous fluid is deepened by that of the blood. Epithelium is constant in the ejected material, often in patches, and the quantity of fluid in the intestine and stomach, owing to the impaired venous return current, is often quite beyond expectation. In a case of operation for volvulus, where I easily freed the intestine, and had closed the wound, as the ether was removed, a spasmodic, continued vomiting ensued, and death occurred from impeded respiration, although the head was carried forward with tongue drawn out, and every effort made to clear the throat. It was estimated that the ejected fluid exceeded two quarts.

In strangulated omental hernia the symptoms are much less severe. The pain is often inconsiderable, the vomiting not marked, or is wanting, and the abdominal distention not pronounced. The intestinal function, although generally impaired, is not suspended, and passages from the bowel are obtained with greater or less difficulty. When fatal, death occurs from necrosis of the part, with subsequent general infection. The danger from strangulation is greater in femoral than in other varieties, since the constricting ring is less yielding, and the canal generally smaller.

Small recent herniae are also more liable to strangulation and more easily overlooked.

**PLATE XXI**

Represents on the right side a small oblique inguinal hernia, making its appearance at the internal ring, on the outer side of the epigastric artery; and on the left side a scrotal hernia, with its coverings displayed by dissection.

- *a.* Fascia superficialis coming from the external abdominal ring, and forming the external investment of the hernia; at its upper part the transverse fibers of the external ring are seen.
- *b.* Cremaster muscle thickened—seen descending under the margin of the external ring, and lost upon the tunica vaginalis at *d.*
- *c.* Hernial sac.
- *d.* Testicle.
- *e.* Spine of ilium.
- *f.* Tendon of the external oblique muscle, reflected to show the inguinal canal.
- *g.* Abdominal ring.
- *h.* Poupart's ligament.
- *i.* Internal oblique muscle.
- *k.* Rectus.
- *l.* Femoral artery.
- *m.* Femoral vein.

* Cooper, Part I, Plate III.
A variety of hernia called bubonocele, where the hernial tumor is retained within the canal, is often so small as to escape detection, unless specially sought, and may be, on this account, all the more dangerous. The late Dr. A. H. Wilson, of Boston, contributed a valuable paper upon this subject. He reported a case where death ensued from a concealed hernia of this character, which was not recognized until at autopsy. The possibility of obstruction arising from this cause should be held in consideration. Only very recently has the following case fallen under my observation:

F. B., age twenty-five, laborer; for some time subject to right inguinal hernia. Became strangulated November 7, 1891. Two physicians attempted its reduction, with supposed success. Intestinal obstruction continued, and the case was considered hopeless. Dr. John Couch, of Somerville, was summoned on the 13th, and I operated on the morning of the 14th with his assistance. It was found that a loop of the small intestine, still tightly grasped by the internal ring, had been forcibly carried within the abdominal wall, no evidence of an external tumor remaining. The division was made, the loop drawn out, and under the hot irrigation fluid the circulation slowly returned, although the peritoneal coat was quite abraded over the intestinal loop. The intestine was returned, and the wound closed for the purpose of permanent cure. Free dejections followed, and a rapid convalescence supervened. It is especially noteworthy that quite a week had elapsed, during which the obstruction had been complete, and for some days there had been a continuous stercoraceous vomiting. Such cases are instructive, but they certainly ought very rarely to happen.

PLATE XXII.†

Figures 1 and 2. External Inguinal Hernia in the Male.

Figures 1 and 2. External Inguinal Hernia in the Male.

Figure 1. The hernia is shown dissected. The aponeurotic contour of the external oblique ring, alone preserved, divides the tumor into two parts:

- the one, exterior or scrotal; the other, interior or inguinal, inclosed in the canal.
- a, a. Portions of the skin and superficial fascia.
- b, b. Portions of the aponeurosis of the great oblique.

* Journal of the American Medical Association, August 25, 1883.
† Bourgery, Plate XXXVIII.
STRANGULATED INGUINAL HERNIA.

Strangulated hernia, unless the tumor is reduced, is almost always fatal. In some instances the wall of the intestine becomes adherent; a small slough occurs, leaving an ulcerated opening through which a small portion of the fecal matter escapes, the larger part descending through the intestinal canal, as usual. In other instances the incarcerated loop sloughs, and an artificial anus is formed, through which all the fecal material passes. Such complication may result in hernia of the rarer varieties. Somewhat recently a patient entered the hospital with constantly recurring fecal dejections escaping through the vagina. About two weeks previous she had been delivered with great difficulty of a child at term, with a shoulder presentation. It was not recognized that the vagina had been injured until symptoms of intestinal obstruction supervened. After some days, fecal dejections came from the vagina. A loop of the ileum had escaped through a vaginal rent, become adherent, and sloughed. As death seemed imminent from starvation, after consultation an attempt was made at restoration by laparotomy. The general peritoneum was not involved; the intestine was freed from its attachment and withdrawn. The ulceration included about three fourths of the circumference. The edges were refreshed and reunited. Unfortunately, however, the patient sank and died from exhaustion the second day.

The prognosis of strangulated hernia must be determined, from the foregoing considerations, to be of a gravity dependent upon the character of the constriction and the time since it first ensued. It may be accepted that there are few dangers to which the race is liable that become so fearfully aggravated by delay.
CHAPTER IX.

Surgical Procedures in Irreducible and Strangulated Inguinal Hernia.

Operative Measures.—The dangers which follow after the proper performance of
the operation for strangulated hernia are in direct ratio to the complicated conditions
detailed in the preceding chapter. Birkett writes:* “We have never known an
instance of a patient dying in consequence of the bowel being liberated at too early a
period; but we have had to operate upon many whose chances of life were absolutely
sacrificed by the inexcusable delay which had occurred before the patient was submitted
to the operation. We make this assertion after a large experience, extending over
many years.” The statement of this eminent surgeon is in accord with the experience
of most operators. It is now generally conceded that the danger lies not in the opera-
tion, but in the conditions which demand it. It may be accepted that with proper
aseptic precautions the operation is practically safe. In an experience of over twenty
years, I have not had a single fatal case where the integrity of the intestinal canal was
not involved.

In this respect hospital statistics, as such, are of little value. The cases are sent in
late, often have been sadly neglected, and their condition rendered much worse by inju-
dicious and even violent efforts at reduction. The attendant is, at first, in the great
majority of cases, a physician little experienced in operative measures, and much val-
able time is lost in “watching the case,” the administration of drugs, and leading up, not
only the friends, but himself to the conclusion that the case is involved in serious
danger. What should justly precede operative measures is a question of important
consideration. First, the careful differentiation of the factors in the problem pre-
sented. This will notably consist of a consideration of the character of the hernia
in its anatomical relations—its kind and variety, its formation and duration, the
constitutional condition, the state of the tumor, and the treatment already em-
ployed.

* Birkett. Holmes’s System of Surgery.
**SURGICAL PROCEDURES IN INGUINAL HERNIA.**

PLATE XXIII.*

**Anatomy of an Inguinal Hernia of the Left Side.** (Dissection made in 1754.)

A man, aged forty, emaciated by disease to which he succumbed, had suffered from a large hernia of the groin.

**Muscles.**

A, B, C, D, E. External oblique muscle of the abdomen.

A, E, F, designate the insertion of this tendon into part E of the osa pubis; a part of which is covered by the abundant cellular membrane.

D. Another tendon of the same muscle going under the hernia and inserted into the tubercle of the osa pubis, forming the outer side of the ligament which is called Fallopian, is near to the aponeurosis or sheath of the thigh (the fascia lata) in the part of the ilium nearest to the bone, which is seen most plainly if the cellular membrane is separated with the skin. The muscles of these two tendons being divided, one after another, the ring E, D is formed.

F. Aponeuroses of the oblique muscles covering the rectus abdominis.

H, I, K, L. Psoas muscles going out from the common tendon L.

M, N, O. Iliacus internus.

P. Adductor longus.

Q. Gracilis.

R, S. Tensor vaginalis femoris.

T, T, T, U, V, W. Rectus abdominis; V, W, the broad tendon of which is inserted into the pubis.

**Bones.**

X, Y. Bone forming the pubic basin.

Z. Substance of the first lumbar vertebra.

C. Anterior extremity of the crest of the left ilium covered by the aponeurosis of the tensor vaginalis femoris.

16, 17, 18. Crest of the right ilium.

**Vessels.**

a, b, c. Branch of the external pudendal veins, which is always cut in the operation upon an incarcerated hernia, a fact which Le Dran mentions in his treatise upon operations. It arises under the skin of the penis and is separated by the adiposa membrana, c.

d, e, f, g, h. Epigastric arteries and veins proceeding from behind the spermatic cord i, k, communicating with the posterior portions of the recti muscles.

i, k, l. Arteries and veins and vas deferens, partly covered by the peritonæum m, n, Y.

M. Spermatic cord of the right side.

**Glands.**

21, 22, 23, 24. Inguinal glands adherent to the muscular aponeuroses and fatty tissue of the thigh.

x, y. Ligament of the penis.

z. Corpora cavernosa of the penis.

l, 2, 3. Penis.

3. Preputium.

4, 5. Skin of the scrotum and inguinal region turned back.


W, W. Corrugated skin.


13, 14. Thigh.

15. Femoral vessels visible on the right thigh on account of the emaciation.

**Peritonæum.**

m, n. Peritonæum enveloping the spermatic cord extending from the pelvis (c).

Y, o, p, q. Peritonæum covering the base of the bladder.

r, s. Portion of the peritonæum covering the abdominal muscles, this being especially designated.

**Diverticulum.**

t, i, s. Diverticulum into which the spermatic vessels penetrate. It may be questioned if the hernia had not existed upon that side in youth, or perchance in infancy.

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ANATOMY AND SURGICAL TREATMENT OF HERNIA.

Hernia.

E, D, 25, 26, 27, 28. Hernia covered by the cremaster muscle, shriveled; 9, 10, 11, 12, collapsed, skin for the most part removed. Thus it is shown that the ring is connected with the cremaster in part (7, D) and (E, 9). Surely it can not be separated without a lesion. Hence it is not improbable that the cremaster also has arisen from the external ring.

Taxis.—The dexterous manipulation of a hernial tumor, by which it may be displaced from its abnormal surroundings and restored to a normal condition, is termed taxis. It seems almost universally accepted that this is a simple measure, and should be resorted to without fear. Generally, when the physician is called, it is only after constitutional symptoms of some gravity have supervened, and almost always efforts, more or less persistent, have been made at reduction.

Often vomiting is present, and the tumor is swollen and tender. If this is the condition, taxis at first should not be attempted. Place the patient in a position to relax the muscles—on back, pelvis elevated, knees flexed, and tumor lifted—so as to relieve the dragging on the neck of the sac and aid displacement by gravity. Hot applications are sometimes of value; if the skin is red and tense, ice may be kept on often to great advantage, and the general condition improved by a hypodermic injection of morphia. Happily, a few hours' sleep and the hernia is, so to speak, self-reduced. If continued, use very gentle manipulation, and if this fail, no longer delay to be prepared for surgical interference.

Thus ready, thoroughly anaesthetize your patient. This is of the first importance in the proper use of taxis, since it causes a relaxation of the tissues, obtainable in no other way, and enables the operator to avail himself of every possible advantage of position, of both the tumor and the surrounding parts. With much tact and care, gently endeavor to reduce the tumor, remembering that a constricted intestine, after twenty-four hours, may be easily lacerated. If, for any reason, from the use of taxis, or violence of accidental character, it is feared that injury to the sac or its contents has ensued, let operative measures at once be undertaken.

Upon opening the sac, if the intestine is so discolored as to make it doubtful if necrosis has not already taken place, pull down the loop beyond the line of constriction, after the opening has been made sufficiently large, and carefully observe if the circulation is slowly restored. This assured, it is safe to return it and close the wound. If the intestine is injured, so that its integrity is in part or entirely destroyed, then give your patient the advantages which modern surgery has so marvelously wrought in the treatment of wounds of the intestine. The omentum, as well as the intestine,
The hernial sac may suffer from violence, either in being torn from its attachments and the tumor with its peritoneal investment returned en masse, or the sac itself may be ruptured under pressure, and the contents still further displaced into the subjacent parts. In the first instance, it is very probable that the constriction of the neck of the sac will still continue to surround and incarcerate the contents. Such cases are undoubtedly rare, yet sufficiently numerous in the history of surgery to render the study of such conditions interesting. They will be met with less often in the future, since the teachings of modern surgery cause operative measures to be less feared, and consequently efforts at taxis will not be as persistent. If there is evidence that such a complication has resulted, surgical interference should at once be entered upon.

When the sac has been ruptured and its contents in part displaced, it may be difficult to determine the exact conditions, especially if the surgeon has not previously seen the patient. The sac will be noticeably less tense, and the feel of resistance less, but the all-important condition of intestinal obstruction remains, and, when this is the case, operation must not be delayed. It may even, after the sac has been opened, be at times difficult to determine the exact relations of the parts, but these must be carefully differentiated, since life itself will depend upon the proper restoration of these to their normal condition.

Divide the constriction freely, pull down the intestine, and ascertain the exact point of exit from the abdominal cavity; thus the opening, or neck, of the sac is determined, and then there will be little further difficulty in enlarging it and restoring the intestinal contents. This done, as before recommended, dissect out the sac entire. Often certain portions of the surrounding tissues have been so much injured as to involve their integrity, and these should also be cut away.

Somewhat recently I operated upon a strangulated hernia of three days’ duration. The intestine, fortunately, was surrounded by omentum, and its integrity not destroyed; but prolonged taxis, the day previous to operation, had resulted in not only marked injury to the sac, but the tissues, for a considerable distance, were ecchymosed and so devitalized that the dissection was carried several lines outside the sac, and the bruised
tissues removed, as also a considerable piece of omentum. Recovery was rapid, and the cure at time of writing remains complete.

PLATE XXIV.*

This plate shows an external and an internal inguinal hernia, accidentally discovered upon the same cadaver by M. Demazeaux, who placed it at my disposal.

Figure 1.

Shows the exterior view of the two herniae covered with their envelopes after the removal of the superficial fascia.
A. External inguinal hernia, of moderate size.
B. Internal inguinal hernia, considerably larger.

Figure 3.

Shows the two herniae in the same relation as in Fig. 1. It shows the cavities of the hernial sacs, the contents removed.

The aponeuroses of the two great external oblique muscles are laid bare, showing the two bands, which circumscribe or inclose the external inguinal ring.

The internal and superior band (a) and the external and inferior band (b) are for the most part removed, so as to permit the escape of the viscera through the ring (c), the diameter of which is quadrupled, so that the space between the bands forms a large triangle where the descending oblique fibers, much thinned, are nevertheless strengthened by the transverse inguinal fibers, which are thickened and prolonged contrary to the ordinary condition within, where they intersect upon the linea alba. At the circumference of the inguinal ring they have considerable thickness, and form a very resisting aponeurotic arch.

Figure 1. Reducible External I nguinal Hernia.
A. The surface is formed by the disappearance of the cremaster, the fibers of which are chiefly seen below and externally.

Figure 3.

c. The aponeurotic arch.
h. The cavity of the hernial sac, in the dilated sheath, with that of the inguinal canal above. The peritoneum adherent everywhere to the envelopes, the intestine held by its mesocolon was completely irreducible, so that in order to cause the intestine (g) to enter artificially and to show the passage which it has taken, we have been obliged to make a section, the two layers being removed of its mesocolon (i, j); in this section the frayed vessels of the flattened spermatic cord are seen. The epigastric vessels k pass below and within the hernia in the thickness of an aponeurotic loop (l), which represents the inferior curve of the internal inguinal ring; the superior curve is shown below by the tendon m. The femoral vessels, dissected at the crural arch so as to show their relations, are seen under the peritoneum in the inguinal canal, with the origin of the epigastric artery.

Figure 1, B. Reducible Internal I nguinal Hernia.

B. External surface of the hernial envelope, where are seen, notwithstanding their thinness, a few fibers of the cremaster.

Figure 3, B*.

Interior of the hernial sac after the easy reduction of the intestine.

n. The orifice, three centimetres in breadth. It is limited by the tendon of the great oblique muscle; there is no properly so-called canal. The hernia was absolutely direct. A portion of peritoneum has been removed within and upon the posterior surface of the sac, in order to show the vessels of the spermatic cord disseminated behind and a little outward.

a. The epigastric vessels in their normal position external to the hernia.

* Bourgery, Plate XXXVIII. Bis.
In the chapter upon the formation of the peritoneal sac it was shown that it may rarely be double or multiple, and this complication should be borne in mind in the reduction of a hernial tumor. The contents may pass a stricture and enter the abdominal parietes, only to remain still without the abdominal cavity, the upper portion of the sac remaining as a pouch with constriction at its inner orifice. Symptoms of obstruction will continue, and these should determine as to operative procedures.

In all the foregoing conditions there can be but one rule—never assume, but determine upon positive knowledge, the actual conditions. When in doubt, consider it as a sacred duty you owe your patient to give him the benefit of it, and, if solved in no other way, by resorting to operative interference.

For a long period the profession generally have held that surgical measures were of such serious moment that they should be undertaken only as a last resort. This belief seems to have arisen from the wretched results which have followed the generally delayed operation. Certainly it is not the teaching of the early masters. Sir Astley Cooper recognized, even in his day, when the lack of anaesthetics and of the requisite knowledge of proper wound treatment rendered the operation truly formidable, the fatal error of delay. "The operation, if well performed in an otherwise healthy person, is attended with little if any danger, and it is therefore natural to inquire why it has so frequently been followed by the death of the patient. The great reason of want of success in this operation is its being performed too late, so that the protruded contents have proceeded to a state of gangrene, or so nearly approaching to the gangrenous condition that the long-inflamed parts are unable to recover their natural functions, or else that the inflammation has extended to the viscera in the cavity of the abdomen, continuing the consequence of the disease after the stricture which caused it has been removed. It can not be too much lamented or condemned that so much time is commonly lost before the operation is performed. To reduce the hernia, trial after trial is made; the same means are often repeated; the tumor, by being often compressed, becomes excessively tender, so that the mere cessation of the efforts at reduction gives a comparative ease, which flatters the patient and his medical attendant that a part of the tumor has disappeared; hopes are still entertained that an operation may be avoided, till the rapid progress of the symptoms of danger points out the fatal error of delay, and, when the operation is performed, too clearly demonstrates the impossibility of success."

What more graphic picture could be drawn to-day of the fatal errors of delay than by this great master of the early part of the present century? The sooner this error is eradicated from medical thought the better. Then shall we discover upon what fallacies we have founded our opinions. If I write for no other good than to bring the question of operative measures anew under a discriminating judgment, I shall not have labored in vain. When the errors of omission are judged equally with those of commission, then the serious responsibility of the adviser will be viewed in a new but just light.

HERNIOTOMY.

Preparation for Operation.—There may arise occasions where the necessity of operative interference permits only a very limited preparation. Under these conditions, the operation may be successful by the use of only knife and director, or even without this latter instrument. However, it is always far better to have trained assistants, if possible, and to make provisions for contingencies.

The instruments required are an ordinary scalpel, grooved director, artery and tenaculum forceps, a bistoury with blunt point, commonly called a hernia-knife (that devised by Sir Astley Cooper is still a favorite); needles, and reliable suture material.

In Heister's Surgery, first published in 1718, Le Dran's winged director is figured; which consists of a heart-shaped broadening or expansion upon the middle of the instrument, about two fingers in width, the intent of which is to protect the intestines from injury. There is figured also the bistoury of Le Dran, which is a hollow director, in which is concealed a small knife which can be elevated at pleasure by pressure of the thumb upon a lever. A steel spring immediately restores the blade to its sheath when the pressure is withdrawn. The director of Le Dran was highly recommended by Sir Charles Bell, and Le Dran's concealed knife is the prototype of a number of modern instruments. M. Arnaud and Le Dran,* both most distinguished continental surgeons, each devoted a large share of attention to the cure of hernia by operative measures. Arnaud invented the probe-pointed bistoury, which has continued in use until the present. The heated discussion of these champions in the advocacy of the respective merits of their instruments,† viewed from the lapse of more than a century and a half of time, invests the subject with the comic side-light of a drama, otherwise

* Heister's Surgery. Table XXIV, vol. ii. p. 44.
† A Dissertation on Hernias or Ruptures. George Arnaud, 1748, pp. 360–362.
seriously tragic, when we take into account the terrible sufferings of the poor patient, groaning under the agony of necessarily cruel and prolonged operations, performed without an anaesthetic.

A very ingenious hernia-knife has been devised by Dr. Allis, of Philadelphia. It is probe-shaped, with a movable sheath, directed by a nut to conceal or expose the cutting edge, as desired. The best which I have seen is that of the late Dr. Joseph H. Warren, of Boston, which combines the director and divider in a single instrument. By pushing a thumb-screw in the handle, a fine saw is carried through the groove, and the stricture is sundered in a very safe manner.

The patient, when fully under the influence of an anaesthetic, is placed upon a table in a good light. The head is slightly elevated, the limbs nearly parallel with the body, and the feet in a chair. An inflated rubber receptacle is placed under the hips to conduct the irrigating fluid into a pail. The bladder is emptied, and the parts carefully shaved and cleansed with a 1-to-1,000 solution of bichloride of mercury.

PLATE XXV.*

| a, a | The left inguinal ring. |
| b, b | Intersection of the collateral tendinous bands of the aponeurosis of the external oblique, in the vicinity of the inguinal ring. |
| c, c, e, c | The aponeurosis of the external oblique muscle of the abdomen, divided along the crest of the ilium and the linea alba, as far as the vicinity of the inguinal ring. |
| d | The left femoral arch. |
| e, e | The membrano-aponeurotic sheath of the cremaster muscle laid open. |
| f | Continuation of the sheath of the cremaster muscle, which contains the spermatic cord and the vaginal coat of the testicle. |
| g, g, g | The fibrous bundles of the cremaster muscle. |
| h, h | Soft, cellular substance, interposed between the sheath of the cremaster and the proper hernial sac. |
| i, i | The hernial sac formed by the peritoneum. |
| k, k | A portion of omentum protruded and descended into the hernia. |
| l, l | The aponeurotic sheath of the rectus muscle of the left side, opened and turned back. |
| m | The great sac of the peritoneum, with the intestines shining through it. |
| n | The posterior portion of the aponeurotic sheath, which inclosed the left rectus muscle of the abdomen. |
| a, a | The left rectus muscle of the abdomen laid bare, and turned very much toward the right side of the abdomen. |
| p | The internal oblique muscle of the abdomen of the left side. |
| q | A portion of the great sac of the peritoneum, which, after dividing the aponeurosis of the fascia lata and raising the Fallopian ligament, appeared externally under the left femoral arch. |
| r | The common integuments of the scrotum. |
| s | The femoral artery. |
| x | The femoral vein. |
| z | The abdominal or circumflex iliac artery. |
| y | The origin of the epigastric artery. |
| g, g, g, g | Continuation of the left epigastric artery, behind the neck of the hernial sac, toward the rectus abdominis muscle of the same side. |

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* Scarpa, Plate II.  † Central.  ‡ Peripherad.  * Dorsad of.
9. The origin of the epigastric vein.
10, 11, 12. Continuation of the epigastric vein behind the neck of the hernial sac, toward the rectus abdominis muscle.
13. The saphena vein.
14. The anterior crural nerve.
15. A curved dotted line, showing the oblique course from the side to the pubes which the visceras usually take in descending to form an inguinal hernia.

**Operation.**—Commence at the upper part of the external abdominal ring; extend the incision downward over the tumor, in length sufficient for free manipulation of the tissues, care being taken in extending the incision downward, so as not to open the tunica vaginalis testis. It is better not to attempt to differentiate the layers composing the coverings of the sac, since they are often much changed, and will be quite sure to confuse rather than aid the inexperienced.

Carefully divide the fascia upon a director, or dissect by the use of forceps. The only sure anatomical guide in the male will be the fibers of the cremaster, but these are of little importance. When the sac is exposed, by grasping the tumor posteriorly, fluid is generally perceived, distending it under the line of dissection. Also, when pinched between the thumb and finger, the surfaces of the sac may be made to glide upon each other; generally there is not much difficulty in determining the sac. Through a small opening made in it, insert the director, and divide freely downward and upward to the external ring. In small inguinal hernia the incision should be made parallel with Poupart’s ligament, dividing the tissues from below upward and outward to the internal ring; in femoral hernia, on the inner side, or over the crural ring, usually in a vertical direction. The sac, in recent herniae, is vascular, of a bluish-white glistening color; in old herniae, it is often thick and opaque.

After opening the sac, the division is first made from above downward, since the base of the sac is usually partly filled with serum, more or less changed, which serves as a protection to the intestine. The finger is introduced into the sac and carried gently to the ring. The exact diagnosis of the conditions can now usually be made, as well as a correct knowledge of contents. The obstruction is generally found at the upper border of the sac, near the internal ring. The finger, as early emphasized by Arnaud, is generally the only director required and by far the best, since it teaches the constric-
tion, its characteristics as to firmness, extent of thickness, and often the location of the neighboring arteries. The probe-pointed bistoury is carried on the finger flatwise through the stricture, which is divided by turning the edge of the knife against it.

I have often been surprised to note how little of the firm, tense band it is necessary to divide. Usually a few fibers yield, with a peculiar grating sound; an incision often only a line or two in depth is required, and the constriction is freed. Emphasis has been made very properly upon the possibilities of cutting the epigastric artery, but I can not help feeling that this danger is greatly overestimated. I have once seen it divided, but it was easily secured, and caused no trouble. The old rule, based upon very many special dissections, is a wise one—viz., to cut directly upward—since in an oblique inguinal hernia, the artery is internal to the neck of the sac; in direct hernia, external, and at times the canal is so much altered that it is difficult to determine the relation.

PLATE XXVI.*

*a, a, a.* The aponeurosis of the external oblique muscle of the abdomen of the left side, cut away along the linea alba and from within the inguinal ring, and then turned back on the pubes.

*b, b.* The aponeurotic sheath of the cremaster muscle, as seen from the posterior part of the hernia, and laid open in its whole length; then drawn upward from the bottom of the scrotum toward the side, and turned back upon the abdomen, along with the testicle of the same side.

*c, c, c.* Bundles of fibers of the cremaster muscle, which shine through the membrano-aponeurotic sheath of this muscle.

*d, d.* The vaginal coat of the testicle laid open.

*e.* The testicle.

*f.* The natural adhesion of the testicle, with the vaginal coat in which it is inclosed.

*g.* The epididymis.

*h.* The posterior side of the hernial sac formed by the peritoneum, behind which sac, or between it and the sheath of the cremaster muscle, likewise laid open and turned back, the spermatic vessels run, in their passage to be inserted into the testicle.

*i.* The bottom of the hernial sac.

*j.* The neck of the hernial sac.

*k.* Soft cellular substance, the continuation of that which accompanies the spermatic vessels, behind the great sac of the peritoneum along the posterior parietes of the hernial sac, and interposed between the sheath of the sac and of the cremaster.

*m.* Smooth cellular substance covering the left side of the urinary bladder, without the great sac of the peritoneum.

*n.* Prominence formed by the great sac of the peritoneum under the femoral arch, after dividing the aponeurosis of the fascia lata and raising the arch.

*o, o.* The great sac of the peritoneum, behind which are seen the convolution of intestines shining through.

*p.* The posterior portion of the aponeurotic sheath, which incloses the rectus muscle of the abdomen of the left side.

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* Scarpa, Plate III.
† On the mesial side of.
‡ Dorsal aspect.
* Dorsal.
¶ Dorsal of.
‖ Peripherad of.
◊ Dorsal.
§ Peripherad of.
\ Central and sacra of.
‖ Central of.
** Central.
q, q. The rectus muscle laid bare for a certain space, and turned very much over to the right side of the abdomen.

r, r. The internal oblique muscle of the abdomen of the left side.

s. The cellular substance of the scrotum.

t. The iliacus internus muscle.

u. The femoral artery.

v. The femoral vein.

w. The abdominal or circumflex iliac artery.

x. The origin of the epigastric artery.

y. A branch of the epigastric artery ramified over the margin of the pubes.

6, 7, 8, 9. The continuation of the epigastric artery * behind the neck of the hernial sac, to the left rectus muscle of the abdomen.

10, 11, 12. The spermatic artery.

13, 14, 15. The vas deferens.

16, 17, 18. The spermatic veins separated from the artery and from the vas deferens.

19. The divided extremity of the epigastric vein.

20. The saphena vein.

21. The anterior crural nerve.

Having freed the constriction, the contents of the sac are carefully examined. If lymph has been effused and adhesions formed, separate gently, and wash carefully in the warm sublimate before returning the intestine into the abdominal cavity; examine as to the returning circulation in the bowel, its integrity, etc. If omentum also constitutes a part of the contents, gently unfold its compressed layers; if its integrity is at all doubtful, remove, after having sutured across above the line of division. Thus secured, I have never seen trouble from hemorrhage. It is so vascular that separate ligation of the many bleeding points is very troublesome.

Having returned the abdominal contents, the subsequent treatment of the wound is to be conducted upon precisely the same principles as if the operation had been undertaken to cure a non-strangulated reducible hernia. The factors of cure are, however, less favorable for every reason, since the general and local conditions are often of the gravest character.

I have thought fitting to introduce one of M. Arnaud’s illustrative cases, taken from his now very rare book, which is reported in such an interesting manner as not only to be of value for the surgical lesson it teaches, but also as furnishing a most graphic picture of surgical operations as performed at this early period. They certainly evince a skill, boldness, and wisdom worthy of commendation in any age:

“In the month of November, in the same year,† I performed the same operation on a woman of sixty-seven years of age, in the same circumstances, in presence of Messrs. Vermont and Talin. The hernia was inguinal, and the intestine was not alter’d by gangrene; but it was so strongly adherent to the internal surface of the herniary sac, and especially at the part of the ring, that the ring itself, the sac, and the intestine

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*Dorsal of.

†1733.*
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seem'd to form only one body, which resembled an old, hard, and callous cicatrix. The membranes of the intestine were extremely thick in the part next to the ring. I made a longitudinal incision in the intestine with a straight history; I introduced my blunt history within it, and cut the intestine, sac, and ring at a single stroke. A small quantity of bilious matter was discharged, which gave me reason to believe that it would flow freely. I dress'd the wound as simply as it required. Next day I found the patient almost in the agonies of death, and there had been no evacuation since the operation, which I had perform'd the night before. Without searching for the cause of this, any other where than in my incision, I again convey'd my history into the incision as deep as I could, and enlarged the former incision. The bilious matter was forthwith copiously discharged, and continued to flow for three hours. In the evening I went to see the patient, and found her in as good a state as I could have wished for; the abdomen had totally subsided, and all the symptoms were alleviated; neither had I anything to struggle with, except the appetite of the patient, who incessantly call'd for food. The wound was entirely deterged on the fifth day, and Mr. Vermont, who was so good as to take charge of the patient, made a complete cure in twenty-five days. The patient, who during the whole of this time had not been at stool, by the anus, went to the close-stool two days after the perfect reunion of the intestine, and by means of a clyster discharged so large a quantity of gross faeces that it was judged they had remained in the colon during the whole of the disease. Such an instance of success seem'd as if it would have prolong'd the life of the patient; but she died on the fourth day after the reunion of the wound, in which there only remain'd a small ulcer, which was not so large as the nail of one's little finger, and which the patient dress'd herself with a small plaister. The cause of this woman's death proceed'd from the ignorance of Mr. Vermont's boy. She had a pressing necessity for going to stool; but, when there, could discharge nothing. She sent for Mr. Vermont, whose boy came in his stead. He imagined that her complaint proceed'd from this, that the excrements were no longer discharged from the wound. He therefore took a probe, with a design to reopen the intestine. He tore the cicatrix, and cruelly pierce'd the intestine thro' and thro', as was found in the autopsy which I made of the body. The bilious matter was extravasated into the abdomen by the wound of the intestine, which corresponded to the cavity of the abdomen. If he had known what he was about, he would have only simply renew'd the first wound of the intestine, tho' that was not necessary; but it might have been
cured as well as at first, as is easily perceived by the examples I shall afterward give in the cure of hernias with putrefaction.

"I found the cause of the difficulty the patient had in going to stool in the rectum, which was full of gross, dry, and indurated feces. A clyster or two would have been sufficient to have facilitated the evacuation of this matter."

PLATE XXVII.*

\[a.\] Hernial sac of an external acquired inguinal hernia upon the left side, leading into the tunica vaginalis communis.
\[b, b, b, b.\] Tunica vaginalis communis.
\[c, c.\] Peritoneum.
\[d.\] Urinary bladder.
\[e.\] Superior arch of the abdominal ring.
\[f.\] Upon the left side, an obliterated portion of the internal lamina of the peritoneum lying under the hernial sac.
\[g.\] Upon the right side, fibers of the internal oblique muscle.
\[h, i.\] Tunica vaginalis propria of the testis.
\[j, k.\] Vas deferens.
\[l, i.\] Femoral artery.
\[m, m.\] Femoral vein.
\[n.\] Epigastric artery extending from under the hernial sac of the acquired external inguinal hernia.
\[o.\] Epigastric artery of left side situated upon the internal side of the acquired external inguinal hernia.
\[p.\] Spermatic cord.
\[q, g.\] Internal wall of the inguinal canal, dissected to show its entire length.
\[r.\] Upon the left side, hernial sac of the internal inguinal.

The following cases illustrate various complications of strangulated hernia:†

2611. The sac of an inguinal hernia, with the adjacent parts and a portion of small intestine which, probably, was returned in an operation. The intestine (suspended above and separate from the sac) appears to have been constricted in only a part of its circumference, and has mortified; there is a considerable aperture in its coats, surrounded with thin flakes of lymph. The sac, of bilocular form, is contracted; all the tissues around are thickened and consolidated with it, and it is lined with lymph. The external ring has been divided, and a ligature tied on something at its side.

The following case, from the Hunterian MSS., corresponds closely with this preparation:

"Hernia.

"Mr. Roberts, watchmaker, had an inguinal hernia for many years, and wore a truss. It became so well that he often left the truss off.

"Tuesday, July, 1774, he was attacked with a vomiting, and a protrusion took place, with all the signs of a strangulated gut, although not very violent; for, although sick at stomach, he did not vomit. On Wednesday I saw him; no passage by stool could be procured. The

* Langenbeck, Conrad J. M. Handbuch der Anatomie, 1831-42. Plate XIII.
† Museum of the Royal College of Surgeons of England.
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appearance was very small, only about the size of the end of the thumb, which terminated all at once; but from that downward the spermatic cord seemed thickened. The parts were so tender that he could hardly allow one to touch them. It did not give way to any of our attempts.

"On Thursday, much the same; the pulse kept strong.

"On Friday I thought I had returned the part, for it had lost the sudden termination at the lower part, and only appeared to be a thickening of the spermatic cord, and thought we could feel the ring open and free. I imagined that I could get in my finger for a little way. The pulse kept strong, but he was extremely ill all day, and had no passage.

"In the evening the pulse had lost considerably of its strength; was become small and quick: he was much oppressed. It was now plain that all was not right respecting the rupture, and I was now for performing the operation, but he declined it.

"I saw him at six o’clock; found him very low, his hands extremely cold, and alarming pulse, hardly to be felt, and but little pain in the part, even upon pressure; and he could hardly draw his breath, excepting when he did it by force.

"Mr. Hawkins was sent for, and we were of opinion the operation should be performed, although but little could be expected from it. It was performed about eight o’clock: a small bit of gut was found in the sac; just as much of the gut as took in its breadth, so that there was a total stoppage. The moment the stricture was cut through, the contents of the gut above rushed down, and burst the part which lay within the sac. The parts were left in this situation and dressed. He died at five in the evening.

"Observations and queries on this disease and operation:

"To what was the deception owing? for there was certainly a decrease and change in the feel of the parts: was it owing to the protruded gut being (at) first full, and, by squeezing, its contents had passed the stricture and got into the gut within the belly; and, therefore, the gut when alone appeared like a thickening of the cord? How was it that we thought we could feel the ring, and that we could introduce a finger into it? Was it that the gut was softer there, and the ring felt hard all around, although there really was no passage? or was it that the inflammation below and close to the rings gave the feel of the ring, and the other part of the sac being natural, allowed of its being pushed into it, and caused the deception?"—*Hunterian M.S. Cases and Dissections*, No. 68.

2638. A right inguinal hernia. The sac is much thickened, and contains the cæcum, affected with colloid cancer, together with a portion of the ileum and a portion of omentum adherent in front and at the sides. The testicle and tunica vaginalis lie below the hernial sac, which can be separated from them.

From a man aged sixty-four, admitted into hospital in a moribund condition, from obstruction of the bowels, simulating strangulation. He had long been the subject of irreducible hernia, and had never worn a truss. For full history and drawings, see *MS. Notes*, vol. ii, p. 148.

—*Presented by John Guy, Esq.*, 1874.

2643. Part of the anterior wall of an abdomen, with a left inguinal hernia. It appears that, in an attempt to reduce the hernia, the sac was pushed back, with the intestine in it tightly strangulated by its neck. The sac, which is pyriform, and nearly three inches in its chief diameter, is now placed on the outer side of the internal ring, between the abdominal and iliac muscles and the peritoneum, part of it lying below the crural arch, and extending outward nearly as far as
the external iliac vessels. The sac thus forms a large tumor, projecting inward toward the abdominal cavity, but is not discernible anteriorly; it is laid open from behind, and contains dark-colored small intestines. The external inguinal ring is large, and so also is the spermatic cord.

The patient, a stout man, fifty-three years old, had a hernia many years, but, always wearing a truss, had suffered little inconvenience from it, and never had difficulty in returning it till one day, when, without evident cause, it became tense and painful. It appeared to be completely reduced by his surgeon, but the signs of strangulation increased, and on the fifteenth day from their commencement he died.—From the Museum of John Taunton, Esq.

2655. The parts concerned in a small oblique inguinal hernia, dried after the injection of their blood-vessels: from the left side of a woman. The aponeurosis of the external oblique has been divided nearly parallel to the crural arch, and its two portions are widely separated, the external ring being preserved. The lower margins of the internal oblique and transverse muscles are turned upward. The fascia transversalis is also in part turned upward, so as to show the inner border of the internal ring, and the neck of the sac passing through it. Part of the covering which the sac received from the intercolumnar fascia is left beneath that part of it which projects beyond the external ring.—From the Museum of Sir A. P. Cooper.

2664. The parts concerned in an oblique inguinal hernia, with a large hydrocele of the tunica vaginalis, on the right side. The hernial sac is nearly three inches in length, and its mouth is very wide; it has descended so as to come in contact with the upper part of the distended tunica vaginalis. The testicle, flattened and small, is in the lower third of the posterior wall of the distended tunica vaginalis; at the back, the vas deferens and some of the vessels of the spermatic cord are shown separated to nearly an inch from each other; large bundles of the cremaster muscle descend over both the hernial sac and the hydrocele. The epigastric artery and vein are shown winding under the neck of the hernial sac.—From the Museum of John Hovship, Esq.

2667. The lower part of the front wall of an abdomen, with an oblique inguinal hernia on each side, a hydrocele of the right tunica vaginalis, and varicocele of the left spermatic veins: dried after the injection of the blood-vessels. The inguinal canals have been laid open, and the lower borders of the internal oblique and transverse muscles are raised. By the pressure of the hernia, the rings on both sides are brought near each other, so that the sacs appear to have been protruded directly from the abdomen. The vessels of the cord are separated.—From the Museum of Sir A. P. Cooper.
CHAPTER X.

INGUINAL HERNIA (continued).

TREATMENT OF THE WOUND AFTER REDUCTION OF THE STRANGULATED PARTS.

Until the introduction and establishment of modern wound treatment upon a truly scientific basis, the surgical treatment of hernia was a problem little if any modified or improved by the experience of a century. The dread of inflammation, suppuration, and the terrible results supervening, when its locality was within the abdomen, gave to the name of peritonitis a signification of fear unknown to the younger members of the profession. Since the investigations and teachings of Mr. Lister, and the now well-formulated factors of wound infection, the revolutionizing of surgery seems nearly complete. In no operation is an aseptic condition of the wound more important and obligatory than in hernia; it is to be considered as a modified laparotomy, with always the possibility of peritoneal infection.

In Mr. Birkett's* masterly article upon hernia, the treatment of the wound after operation for strangulation is dismissed as follows: "The structures which have been cut and disturbed by the incision should be placed in relation to each other, and the divided edges of the integuments brought together with sutures. The number required may be left to the discretion of the operator, but no more need be used than sufficient to keep the upper two thirds of the wound united. For it is always advantageous to leave an opening at the lowest end to allow of the escape of the blood and discharges. A piece of wetted or dry lint may be placed over the incision, and a pad of folded lint is adjusted over it by some surgeons. However, a bandage is not required in every case, nor is it on any account essential."

Dr. Warren,† writing in 1882, states: "The wound is now drawn together by sutures, and the dressing completed by adhesive plaster, compress, and a spica bandage.

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* Holmes's Revised System of Surgery, 1881.
Morphine or opium should be administered, both to secure rest and also to protect the patient from that inflammation, always to be dreaded, peritonitis."

In 1884, Mr. John Wood, * of London, writes: "The edges of the wound are then brought together with sutures sufficiently close, a drainage-tube being placed along the bottom and out at the lower end of the wound, and the parts dressed and well padded with carbolized gauze, tow, or cotton-wool, the whole secured with a spica bandage and a support to the scrotum. . . . In favorable cases, with little damage to the hernial contents, I have for many years been in the habit, at the end of the operation for the relief of strangulation, both in inguinal and crural hernia, of taking away the sac after tying it with catgut, and closing the tendinous hernial opening by my wire operation, and with the best results, both without and with the spray and gauze treatment."

These quotations from the leading special authors upon hernia may be accepted as the expression of a too general practice of to-day. Many other more recent writers might be cited who repeat similar instructions; but these teachers devoted many years of careful investigation to the subject, and yet they wrote the above directions long after the establishment of the principles of antiseptic wound treatment. Although the end to be attained, when the hernial wound is imperfectly closed and a drainage-tube used, is the aseptic state, and for this purpose antiseptic dressings in considerable variety have been advised, it is generally admitted that few parts of the body are so difficult to maintain aseptic as the region of the groin. In a following chapter which is specially devoted to the history in detail of the different methods advised for the cure of hernia, a full description is given of the measures adopted by the most distinguished surgeons in the treatment of the wound in order to secure the safest and surest results. The conditions in the operation for the relief of a strangulated hernia, after the restoration of the contents of the sac, do not differ very materially from those where the operation is undertaken for permanent cure, and I am quite assured that it is the general opinion of the surgeons of to-day that he who feels the operation is finished in the restoration of the abdominal organs, without making the attempt at permanent cure, fails in the performance of an important part of the obligation which he owes his patient. The method which I do not hesitate to recommend, as giving the safest

and best result, is the outcome of many years of special study, and is in detail as follows:

Disposition of the Sac.—With one or two fingers of the left hand inserted into the base of the sac, carefully separate it from its adhesions to the surrounding parts quite within the internal ring. Having thus freed the sac, it should be drawn gently but firmly downward by an assistant, so as to make the parts tense. It is then sewed across its neck with a continuous double suture of fine tendon, and excised. The sutured base of the peritoneum is gently carried within the internal ring.

The advantages of resection of the sac, as compared with other methods of its disposition, will be discussed in a subsequent chapter. In congenital hernia it must be remembered that the sac is the dilated, non-closed process of the peritoneum which descended to form the investment of the testicle. Under these conditions the sac requires different treatment. It is sewed across to form the tunica vaginalis testis. The suturing is continued upward to close in upon the cord with its vessels, and the sac is narrowed at its abdominal outlet, to prevent pouching of the redundant peritoneum, and excised. The subsequent steps of the operation are conducted as in non-congenital hernia.

The index-finger of the left hand is introduced from above downward through the ring, the cord having first been gently lifted and carried upward toward the median line. A firm strong needle, set in a handle, is used, curved upon the flat, somewhat similar to the Hagerdorn needle, with eye near the point. The needle is threaded with tendon, and is guided by the finger in the wound in its introduction through the posterior edge of Poupart's ligament on the outer side, and carried toward the median line to emerge from behind forward through the thick aponeurosis of the fascia transversalis, with which often fibers of the transversalis muscle are blended, care being taken not to wound the epigastric artery. The needle is then unthreaded, threaded with the opposite end of the suture, and withdrawn. Stitches are repeated in this manner, about one third of an inch apart, until the internal inguinal ring is closed from below upward upon the cord, which is thus restored to its original point of exit from the abdomen. (See Plate XXXIX.)

In old, large herniae, where from dilatation the canal has become nearly direct, the tissues composing the posterior border are so thinned and relaxed that it is sometimes wise to modify the method of suturing by introducing several stitches before closing the neck of the sac. In this way the finger is carried directly within the abdominal
cavity, and the needle guided upon it, so as to include the redundant peritoneum, as well as fascia and relaxed muscular fibers, and thus intrafold and still further strengthen the tissues which go to form the posterior wall of the canal. When two or three stitches have been taken, they may be left quite loose until after the suturing of the neck of the sac and its resection. Then a stitch or two more completes the closure of the internal ring.

The suturing is for a double purpose—to close in and strengthen the weakened tissues about the large internal ring, but in doing this we accomplish a far more important object, which is to effect the restoration of the obliquity of the inguinal canal. Having thus reformed the posterior wall of the canal, we replace the cord and make a second and more superficial layer of sutures. The needle is introduced from without inward through Poupart’s ligament at a level with the reformed internal ring and carried through the firm muscular and tendinous structures upon the inner side of the canal. These stitches are continued downward and inward upon the cord, until the external inguinal ring is restored to its normal condition. The last stitch is knotted and cut close. The superficial tissues and skin are closed by lines of buried continuous sutures. This is best accomplished by the use of a curved Hagerdorn needle, carried from within, through the deep layer of the skin, from side to side; thus the edges of the skin are evenly coapted without the vestige of a stitch in sight. The surfaces are carefully dried and dusted with iodoform. Iodoform collodion is freely applied, into which are incorporated shreds of cotton.

The operation should be conducted under irrigation, with the greatest care to preserve the wound in an aseptic condition. This assured, drainage is not necessary. In my earlier operations I reduced drainage to the minimum, by the introduction of a few parallel-placed horse-hairs.

Even these, however, I have omitted for several years. Coapted surfaces, held aseptically at rest, tolerate readily the limited effusion which is utilized in the processes of local repair. The elimination of the drainage-tube renders the complete closure of
an aseptic wound possible, and prevents its further extraneous contamination. Repair ensues as in a subcutaneous wound. The advantages of this method in the treatment of the wound are the complete coaptation of the parts and the assurance of non-infection. By every method of antiseptic dressing with drainage, all surgeons admit the great difficulty, and in children the well-nigh impossibility, of retaining the wound aseptic.

As elsewhere stated, for quite twenty years I have used animal sutures in hernia and special operations, where re-enforcement of the parts seemed desirable, and for the last six years I have closed all aseptic wounds by the use of buried tendon sutures, the last layer including the skin only. The object which I at first had in view was twofold: that there might be no sutures to be removed, and that the so-called stitch abscesses might be avoided. If the animal suture was very fine, when taken through the skin in the usual way, either interrupted or continuous, it was observed that, if aseptic, the suture soon separated in the deeper layer of the skin, allowing the external portion to come away in a few days, attached to the collodion film which covered and protected the wound. I, however, often noticed that, notwithstanding the most careful disinfection of the skin, when primary union had occurred in the wound, there was occasionally still a slight suppurative point at the stitch opening, from which material bacterial cultivations could be easily reproduced. In order to avoid this and leave absolutely no external line of sutures, I devised the following method of suturing, which I most heartily commend for universal adoption.

Having closed the deeper structures, a fine Hagerdorn needle threaded with fine tendon is inserted through the skin at some distance from one angle of the wound. The needle is best held in the fingers, and is inserted into the deeper layer of the skin, parallel to the divided edge of the skin and two or three lines from it. It should penetrate through the cutis vera at quite a little depth from the edge of the wound. The needle is then inserted in a similar manner through the deep layer of the skin, beginning at a point exactly opposite the emergence of the suture from the other side of the wound, each stitch being usually about one quarter of an inch in length. The sewing is continued in this way through the whole length of the incision, the needle finally emerging at some distance from its opposite angle through the skin. If the suture is left loose, that portion between the stitches would be at right angles to the wound. When, however, the suture is drawn upon
carefully, it coapts the edges of the skin, quite after the manner of the lacing of a shoe.

There is an advantage in having each end of the suture free at a little distance from the angles of the wound, in order that coaptation may be carefully made by tension in opposite directions. Otherwise, slight folds or puckers are liable to occur, which gives the wound a wavy look. When carefully coapted the wound must be thoroughly dried, in order that minute blood-clots may not separate the edges of the skin. After this has been effected the coapted edges are sealed with iodoform collodion, which makes a germ-proof dressing. When this has dried, the distal ends of the suture are cut short and allowed to retract beneath the skin. An aseptic wound thus closed must remain aseptic. I have recently seen a beautiful demonstration of the probable cause of stitch-abscesses as usually taken. A very considerable number of cultures have been made, in the laboratory of the Johns Hopkins Hospital, from the epithelium of the skin after the most careful cleansing by aseptic measures, the use of hot water, soap, brushes, etc., in all of which the demonstration was complete, that, in the normal condition of the skin of healthy individuals, the dying yet firmly adhering epithelial cells were normally the seat of an active growth of the staphylococcus pyogenes albus, so universal as a habitat of the skin that it is worthy of being called pyogenes epidermidis albus, and hence the ready explanation of that which hitherto has been the unknown cause of the so-called stitch-abscesses. This is also the reason why the continuous, over-and-over suture, carried from without inward, is more likely to be infected than the interrupted suture, and infection follows the use of silk, as a loose-meshed, twisted structure, more commonly than cat-gut or tendon and least of all silk-worm gut or wire.

In the light of these experiences it is not difficult to understand why aseptic sutures, taken as a blind or concealed running stitch, through the deeper layer only of the skin, are invariably followed in an aseptic wound by primary union. A wound
thus closed has a double advantage over the ordinary method by the interrupted sutures, even when primary union supervenes. The patient is relieved from the anxiety caused by the knowledge that stitches are to be removed—a procedure never without something of suffering; and, that which in certain portions of the body is of primal importance, the minimizing of the cicatrix, which is oftentimes so slight, after a few months, as to be distinguished with difficulty.
PLATE XXVIII.

Muscles, Aponeuroses, Vessels and Nerves of the Inguinal, Inferior Abdominal and Femoral Regions.

1. Inguinal Region.

Preparation.—The crural arch is lifted from below by a hook so as to show the infundibulum of the sheath of the femoral vessels, the bands of the aponeurosis of the great oblique, and Gimbernat’s ligament.

A. The lower border of the aponeurosis of the great oblique, which forms the anterior fibrous crural arch.

1. Posterior border which forms the anterior segment of the crural arch under which pass the large vessels.

2. Ligament of Gimbernat, which is the insertion at the crest of the pubis of the aponeurosis of the great oblique muscle.

3. Fibrous infundibulum, which is composed in the anterior segment of the adhesions of the sheath of the vessels, with the fibrous contour of the crural ring.

B. External inguinal ring.

4. Internal pillar of the inguinal ring formed by little firm bands of corresponding shape; it is cut half-way of its breadth so as to free the portion of the sheath of the rectus muscle.

5. External pillar.

6. Cord and spermatic vessels cut at their exit from the inguinal ring.

2. Abdominal Inguinal Region.

C. Aponeurosis of the great oblique, the superficial fascia having been removed.

D. Inferior extremity of the rectus muscle invested in its sheath.

7. Portion of the posterior wall of the rectus formed by the posterior layer of the aponeurosis of the transversalis.

8. Inferior portion of the muscular investment covered by the subperitoneal fibro-cellular aponeurosis.


10. Anterior branches of the lumbar vessels.

11, 11. Anterior filaments of the lumbar nerves.

12, 12. Linea alba.

13. Umbilical ring.


15, 16. Section of the aponeurotic leaf of the small oblique (15) and of the great oblique (16) which cover the rectus muscle in front.

E. Fibro-cellular layer of the small oblique.—This muscle and the great oblique are cut in profile. The bottom of the layer is formed by the cellular aponeurosis of the transversalis and traversed by the recurring iliac vessels (17) and by the anterior branches of the lumbar nerves (18, 18).

3. Inguinal and Femoral Regions.

F. Femoral vessels inclosed in their sheath and united to the enveloping aponeurosis of the psoas iliacus. Lower, the sheath of the vessels dip down between the abductor and the vastus internus (G).

H. Aponeurotic sheath of the pectineus muscle.

19. Pubian attachment preserved.

20. Ramus of the pubis.

21. Nutritive vessels separated from the femoral vessels.

22. Obturator vessels and nerves seen behind the posterior aponeurosis of the sheath.

J. Muscular sheath of the first abductor.

25, 25. Nutritive vessels freed from the femoral artery.

24. Nerve branch of the same muscle furnished by the obturator.

25. Trunk of the obturator nerve seen through from behind the posterior sheath.

K. Superior extremity of the layer of the vastus internus.

L. Superior extremity of the sartorius.

M. Aponeurosis of the anterior right of the thigh.

26. Superior extremity cut at the point where it surrounds the exit of the iliacus.

27. Nutritive vessels furnished by the femoral vessels, and accompanied by a filament of the crural nerve and muscular vessels furnished by external collateral branches. We see in outline the external collateral vessels and their associated nerves.

N. Sheath of fascia lata, with its vessels and nerves.

* Bourgery, Plate VIII.
CHAPTER XI.
FEMORAL HERNIA.—SPECIAL ANATOMY OF THE PARTS.

The superficial fascia of the thigh is composed of two layers. The thick, dense upper layer is continuous with the fascia above, over Poupart's ligament, and downward with the connective-tissue layer covering the thigh. Inclosed between it and the deep layer are situated the cutaneous vessels, nerves, and the lymphatic inguinal glands. The deep layer is a thin but dense membrane, is closely adherent above to the lower margin of Poupart's ligament, and about one inch below is closely united, in its circumference, to the saphenous opening in the fascia lata. It blends with the posterior border of the sheath of the femoral vessels. In this locality it has been sometimes described as the cribriform fascia, since it is perforated by the internal saphenous vein and numerous blood-vessels and lymphatics, giving to it sieve-like openings.

The fascia lata, in a dense connective-tissue layer, extends as a uniform investment over the upper portion of the thigh. The passage of the internal saphenous vein gives the name to the opening through which this vessel penetrates. The fascia, on the outer side of the opening, is called the iliac portion. It extends from the anterior superior spine of the ilium downward over the anterior group of the muscles of the thigh, is attached the whole length of Poupart's ligament internally as far as the spine of the pubes, and joins with Gimbernat's ligament in the pectineal line, where it blends with the pubic portion. It is reflected, in an arched margin, downward and outward from the spine of the pubes, forming the outward boundary of the saphenous opening. This has been described as the femoral ligament of Hey, and it demands especial attention, since in femoral hernia it is the principal seat of the constriction. It has also been called the falciform process of the fascia lata. It has a well-defined, curved margin, and is adherent to the sheath of the femoral vessels. The pubic portion of the fascia lata is its continuation upon the inner side of the saphenous opening, and lies beneath the sheath of the vessels to which it is attached. The opening through
which the internal saphenous vein thus obliquely passes to join the femoral is oval, and measures about an inch and a half in length and half an inch in breadth. The inner boundary is less well defined than the outer, since it is behind the level of the femoral vessels.

Upon extension of the limb, or rotating it outward, the edge of the opening will be rendered tense. Flexion or inversion of the limb relaxes it, a fact to be borne in mind when attempting the reduction of a femoral hernia.

In the study of the anatomy of the parts involved in inguinal hernia, Poupart’s ligament was described as the lower border of the aponeurosis of the external oblique muscle, stretching across, in a strong tendinous band, between the anterior superior spine of the ilium to the spine of the os pubis and the pectineal line. It is slightly curved, with convexity downward. The posterior border has an arched form toward the pubes, in consequence of the expanded portion which is fixed into the pectineal line. This was called the crural arch by Gimbernat. We are indebted to this distinguished Spanish surgeon for the first accurate description of the parts, who published in Madrid, in 1793. The history of the anatomical researches of the structures of this part of the body and their relation to hernia constitute one of the most interesting chapters in anatomy. The importance of a correct anatomical knowledge of these parts was recognized by Albinus and Heister, and yet they describe the round ligament in the female as escaping through an opening in the oblique and transversalis muscles. This error was
corrected by Garengeot, who derived his first ideas from the celebrated anatomist and surgeon, M. Petit, who published his views in 1742. The sheath of the femoral vessels was at this time a subject of marked discussion, and was then called the cellular substance of Ruysch, who first pointed it out. This tissue, however, Heister considered as one of the two layers of membrane of which the peritoneum was commonly supposed at this time to consist. Gimbernat’s dissections were carefully made and clearly and accurately described. He pointed out that a lamina of the fascia iliaca passes over the pectineus muscle and is attached to the crest of the os pubis, where it is united with the ligamentous expansion which bears his name and terminates upon the same crest. His anatomical account of this sheath is as follows: “By this union is formed a species of ligament which passes along the crest immediately above the insertion of the superior extremity of the pectineus muscle; from this division of the crural arch an aponeurotic sheath arises at the top of the thigh, beginning at the crural arch itself, close to the body of the pubis, so that the expansion which has been described, and which is sent from the internal edge of the arch, passing behind the iliac vessels, forms the posterior wall of the sheath, while the anterior wall is formed by the external edge of the fascia lata.”

Sir Astley Cooper added materially to this knowledge by his investigations of the transversalis fascia, already referred to in the description of the internal oblique ring in inguinal hernia. He demonstrated that a process of the fascia transversalis, in forming the femoral sheath, constituting its front wall, passes immediately behind Poupart’s ligament, and forms a connection with its thin posterior edge. Mr. John

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**Fig. 8.—The anatomy of the femoral region, showing fascia lata and saphenous opening (Gray).**
Gay,* who made an exhaustive study of the anatomical relations in femoral hernia by the careful examination of over seventy subjects, states that "according to my ex-

aminations of this structure, both before and subsequent to maceration of the parts, it appears to be formed in the following manner: The inner portion of the fascia transversalis, being extended behind the crural arch downward into the thigh, in front of the femoral vessels, constitutes the front wall of their sheath, while lateral expansions of this process—each taking a converse direction in relation to the other—constitute the iliac and pubic walls. These unite behind the vessels, and in this manner complete the sheath. Thus, in the part of the thigh under consideration the sheath is wholly formed by an extension of the transversalis fascia."

FEMORAL HERNIA.—SPECIAL ANATOMY OF THE PARTS.

PLATE XXIX.*

This plate is intended to exhibit a view of the abdominal rings and of the crural arch in the female; the fascia lata of the thigh, the crural sheath, and the passage of the round ligament of the uterus, from the internal to the external ring.

a. Symphysis pubis.
b. Tuberosity of the pubes.
c. Anterior superior spinous process of the ilium.†
d. d. External oblique muscles.
e. Linea alba.
f. Linea semilunaris.
g. Crural arch, or Poupart’s ligament, extending from the spinous process of the ilium at c beyond the tuberosity of the pubes at h.
h. Tendinous fibers crossing the columns of tendon of the external oblique; they proceed from the spinous process of the ilium and the crural arch.
i. The abdominal ring on the left side; its upper column inserted into the symphysis pubis, and the lower into the tuberosity, but afterward extended forward toward the symphysis.
j. That part of the fascia lata of the thigh which proceeds from the crural arch, and which covers the muscles on the outer part of the thigh and femoral vessels.
k. The inner portion of the fascia lata covering the pectineus and triceps muscles, and united with the outer portion of fascia behind the saphena major vein.
l. Crural sheath cut open.
a. Femoral artery.
b. Femoral vein.
c. Three absorbent vessels within the sheath: the first on the outer side of the artery; the second between the artery and vein; and the third on the inner side of the vein, which last has the course of the crural hernia.
d. Saphena major vein.
e. Two absorbent glands sending forth the absorbent vessels of the sheath.
f. Arteria circumflexa ili.
g. Epigastric artery.
h. Tendon of the external oblique muscle laid open.
i. Inner oblique muscle turned upward.
j. Transversalis muscle turned upward.
k. Fascia transversalis seen passing from the crural arch behind the transversalis muscle.
l. Round ligament of the uterus descending through the opening in the fascia, in the inguinal canal, and through the abdominal ring, to be lost in the fat on the pubis.
m. Course of the epigastric artery seen through the fascia transversalis.

† I shall hereafter call this simply the spinous process of the ilium.

The space between the crural arch and the bone is almost entirely occupied by the parts which descend from the abdomen. On the outer side are the psoas and iliac muscles. On the inner side are the femoral vessels inclosed in a sheath. The oval-shaped opening, for the passage of the vessels, is the crural or femoral canal. Through this opening the abdominal contents escape in femoral hernia. The upper border of the canal is called the femoral ring, and is continuous with the cavity of the abdomen. It is larger in the female than in the male, and in its large transverse diameter measures about one half an inch. In front it is bounded by the deep crural arch of Poupart’s liga-

* Cooper, Plate I, Part II.
ment; behind by the pubes and the deep portion of the fascia lata; internally by Gimbernat’s ligament, the conjoined tendon, the transversalis fascia, and the deep crural arch; externally by the femoral vessels inclosed in their sheath. Poupart’s ligament separates the femoral from the internal portion of the inguinal canal; directly above it lies the spermatic cord with its vessels, in the male, and this may be divided in the operation for strangulated femoral hernia. The epigastric artery lies across the upper and outer angle of the rim, and is endangered by cutting freely in this direction, but is usually about one half inch from the neck of the hernial tumor. Upon the outer side of the ring is the femoral vein. The ring is, as it were, bounded in all directions by vessels, except posteriorly by the osa pubis, and internally by Gimbernat’s ligament.

The obturator artery holds an important relation to the femoral ring, when it arises, by a common trunk, with the epigastric artery. This is the more important since this is the condition in every three or four individuals. Occasionally the vessel curves along the margin of Gimbernat’s ligament as it passes to the obturator foramen, and when this occurs it is very likely to be divided in the operation for a strangulated femoral hernia.

A delicate layer of connective tissue closes the femoral ring, and is described by M. Cloquet as the septum crurale. It is a slight protection to a hernial protrusion; a small lymphatic gland usually lies between it and the peritoneum. It is perforated by numerous small openings for the passage of lymphatic vessels, and serves as much for their connection and support as for closure of the ring. Beneath this septum a layer of fatty tissue is usually found, lying directly upon the peritoneum. This is important chiefly, since it might be mistaken, in a hernial protrusion, for omentum.

It is easily understood, from a study of the anatomy of the parts, that the femoral ring, although re-enforced and protected in such a marvelous manner, must be a weak point in the abdominal wall. By congenital defect, laxity of tissue, or by long-con-
continued pressure, the peritoneal covering over the ring becomes puckered, and a lodging of abdominal contents serves as a wedge to force open the canal. The greater size of the canal in woman, together with the firmer character of the inguinal ring, renders this variety of hernia more common in the female.

PLATE XXX.*

INGUINAL CANAL AND CRURAL RING.

A. Portion of the thigh, seen outwardly.
B. Penis.
C. The testicles.
D. Hair of the pubes.
E, E. Portion of the anterior abdominal inclosure.
F. Anterior and superior iliac spine.
G. Right muscle in its sheath.
H. Pyramidal muscle equally in its sheath.
I. Aponeurosis of the great oblique.
J. Hook which lifts up a portion of the aponeurosis of the great oblique, detached over the crural arcade, where it forms the anterior inclosure of the inguinal canal.
K, K. Crural arch.
L. Inguinal ring crossed by the testicular cordon, and sending from its circumference a fibrous expansion upon the cordon.
M. Fibrous expansion detached from the circumference of the inguinal ring.
N. Internal or superior pilaster of the ring.
O. External or inferior pilaster of the ring.
P. Place where the crural arch continues with all the thickness of the fascia lata aponeurosis.
Q. Place where the crural arch adhered only to the superficial layer of the fascia lata, which here has been detached and overturned outside.
R. Sinus, open in the upper part, which the crural arch forms in continuing backward and above, with the fascia transversalis sinuus, which constitutes the inguinal canal.
S, S. Fascia transversalis aponeurosis, which forms the posterior inclosure of the inguinal passage, in a place where, of the three muscles of the abdomen, only the external oblique one is found.
T. Place where the fascia transversalis aponeurosis rises from the external edge of the right muscle.

V, V. Inferior edge confounded and horizontally directed from the small oblique and transversal muscles.
V, V, V, V. Muscular bundles of the cremaster muscle formed by an emanation upon the cordon of the inferior edge of the small oblique and transversal muscles.

X. Testicular cordon, in the middle of which are seen the fluxuosity of the testicular veins.

Y. Ileo-scrotal nerves of the lumbar plexus.
a. Cordon knotted upon the fascia superficialis aponeurosis, detached from the abdominal inclosure and turned back upon the thigh and the hip.
b, b, b. Tegumentary vessels of the abdomen.
c. Genital external superficial vessels.
d, d. Anterior inclosure of the crural canal, cut and turned back from inside to outside, to show the crural canal.
c. Large lymphatic ganglion, placed before the crural canal.
f, f. Openings of the anterior inclosure of the crural canal, which are crossed by lymphatic vessels.
g. External inclosure of the crural canal, formed by the deep leaf of the fascia lata, supported upon the psoas and iliac muscles.
h. Opening made in the external inclosure of the crural canal, in order to show the crural nerve placed immediately outside of it, in the sheath of the psoas.
i. Femoral artery, placed outside of the vessel of the same name.

* Blandin, Plate VI.
Femoral vein placed upon the inside of the artery. Internal saphenous vein.

I. Inferior opening of the crural canal, crossed by the internal saphenous vein.

The abdominal contents which make up the tumor carry before them the peritoneum, which forms the hernial sac. External to it are delicate investments of connective-tissue layers, derived from the subperitoneal fascia and the septum crurale. Sir Astley Cooper named the subperitoneal layer of connective tissue the *fascia propria*, and describes it as thicker than the peritoneum, close and firm in its texture, embracing the whole of the tumor to its very neck; more or less adipose tissue is interposed between this layer and the peritoneal covering of the tumor. Although these layers of fascia are important, and have been described by the earlier anatomists at great length, they are often so blended and fused as to defy distinction. It is well to remember that the investment of a femoral hernia should consist of peritoneum, fascia propria, septum crurale, crural sheath, cribriform fascia, adipose tissue, and integument, and yet all combined usually make a very thin covering of the tumor, and their dissection should be conducted with even greater care than in inguinal hernia.

The contents of a femoral hernia are similar to those of inguinal. Omentum, however, is usually less common and is rarely found unassociated with a loop of intestine. Sir Astley Cooper states that he met with omentum as the only contents of the sac but twice. Mr. Lawrence observes that he has seen it more frequently, and I have met it twice in my own experience. Hesselbach described a case where the ovary and tube formed the contents of a crural hernia of the left side. Femoral hernia is necessarily subject to comparatively few and unimportant variations. In rare instances the hernial sac is found on the outer side of the femoral vessels in front, or even behind them.

The tumor usually descends vertically, through the crural canal, along the inner compartment of the sheath of the femoral vessels, as far as the saphenous opening. Here the sheath is greatly narrowed and in close contact with the vessels; the superficial fascia and crural sheath are closely attached to the lower part of the saphenous opening, and by these obstructions the tumor is prevented from extending lower. In its further progress it is directed forward, carrying before it the cribriform fascia, and curves upward upon the falciform process of the fascia lata and lower part of the tendon of the external oblique muscle, retained only by the superficial fascia and integument.
FEMORAL HERNIA.—SPECIAL ANATOMY OF THE PARTS.

PLATE XXXI.*

A, A. External oblique muscle.  
B, B. Aponeurosis of external oblique muscle.  
C, C. Sheath of the rectus muscle.  
D. Linea alba.  
E, E. Poupart's ligament.  
F, F. Arch of the internal abdominal ring.  
G.Suspensory ligament of the penis.  
H. Penis.  
I, J. Arch of the external abdominal ring.  
K, K. Tubercle of the osa pubis.  
L, L. Abdominal ring.  
M, M. Spermatic cord.  
N, N. Fascia lata.  
O, O. Gimbernat's ligament.  
P. Internal aperture of the femoral canal.  
Q, Q. Anterior wall of the femoral canal.  
R, R. Falciform edge of the external opening of the femoral canal.  
S, S. Superior edge of the external opening of the femoral canal.  
T, T. Inferior edge of the external aperture of the femoral canal.  
U, U. Fascia of the pectineus muscle.  
V, V. Femoral artery.  
W, W. Femoral vein.  
X, X. Large saphenous vein.  
Y. Common trunk of the epigastric and obturator arteries, going out from the femoral artery.  
Z. Epigastric artery.

When in the canal, owing to its firm, resisting walls, the hernial tumor is small, but after escaping from the saphenous opening it may become of considerable size. "In the female it is generally very movable, and, being soft, and the skin not being discolored, it may have the appearance merely of an inguinal tumor of one of the absorbent glands; but in the male the skin is generally not so loose, the swelling not so distinctly circumscribed, and the tumor appears buried more in the substance of the thigh. The largest size to which I have seen the tumor arrive was in cases of which I have given plates in this work. The one was in the male, the other in the female; they were each of them about the size of the fist, and each occupied the whole of the hollow, from the anterior superior spinous process of the ilium to the tuberosity of the pubis. But my friend Mr. Thompson, Professor of Military Surgery, at Edinburgh, mentions a case of a woman, laboring under an old irreducible crural hernia, in whom the tumor extended half-way down the thigh. In this case the parietes of the abdomen were so thin that the peristaltic motion of the intestine could be distinctly perceived. Upon the whole, however, it is unquestionable that the crural hernia is comparatively smaller than the inguinal, and on this account it is the more dangerous."†

* Langenbeck, Table XI.  
† Cooper, op. cit.
The following measurements, from Sir Astley Cooper, are of value:

"Male.—From the symphysis to the center of the orifice of the sac, two inches; from the center of the orifice of the sac to the external iliac artery, one inch; from the center of the orifice of the sac to the center of the external iliac vein, three quarters of an inch; from the center of the orifice of the sac to the origin of the epigastric artery, three quarters of an inch; from the center of the orifice of the sac to the inner edge of the internal abdominal ring, one inch; from the tuberosity of the pubes to the center of the orifice of the crural hernia, one inch.

"Female.—Each measurement is from one eighth to one fourth of an inch more, where the female pelvis is large and well formed, than in the male."

PLATE XXXII.*

Contains Views of the Anatomy of the Groin and Upper Part of the Thigh in the Female.

Figure 1.

a. Symphysis pubis.
b. Spinous process of the ilium.
c. Abdominal muscles.
d. Abdominal ring.
e. Crural arch.
f, f, f. Fascia lata of the thigh.
g, g. Semilunar edge of the fascia lata.
h. Crural sheath or fascia inclosing the crural vessels.
i. Saphena major vein.
j. Place at which the crural hernia descends.

Figure 2.

Shows the insertion of the external oblique muscle into the pubes and its ligament, and the fascia iliaca, or Gimbernat's fascia.

a. Pubes.
b. Spine of the ilium.
c. Acetabulum.
d. Thyroid foramen.
e. Column of tendon.
f. Another column.
g. A third column, making together two apertures at the abdominal ring in the female, which is not uncommon.

h. Anterior edge of the crural arch, or Poupart's ligament.
i. Third insertion of the external oblique muscle.
j. Ligament of the pubes, into which the external oblique muscle is inserted.
k. Portion of fascia transversalis, and tendon of the rectus, passing behind the insertion of the external oblique.
l. Fascia iliaca passing from the crural arch over the iliacus internus muscle.
m. Orifice of the crural sheath, for the passage of the crural artery, vein, and absorbent vessels.

Figure 3.

Shows the crural sheath.

a. Pubes.
b. Ilium.
c. Abdominal muscles drawn up.
d. Transversalis muscle.
e. Its tendon.
f. Seat of the posterior edge of the crural arch.
g, g. Fascia transversalis.
h. Inner portion of the same fascia.
i. Fascia iliaca.

* Cooper, Plate II, Part II.
k. Femoral sheath.
l. Femoral artery.
m. Femoral vein.
n. Saphena major vein.
o. Anterior crural nerve.
p. Fascia lata turned back.
q. Tendon of the external oblique muscle, drawn down.

Figure 4.
Posterior view of the place at which the crural hernia descends, as it appears when the peritoneum is first stripped off.

a. Pubes.
b. Abdominal muscles.
c. Round ligament passing into the inner abdominal ring.
d. Femoral artery.
e. Femoral vein.
f. Epigastric artery.
g. Epigastric vein.
h. Depression at which the crural hernia first descends.

Figure 5.
Posterior view showing the mode in which the abdomen is shut from the thigh. The peritoneum is removed.

a. Pubes.
b. Ilium.
c. Abdominal muscles.
d. Rectus.
e. f. Junction of the fascia iliaca and transversalis behind the crural arch.
f. g. Round ligament passing from the abdomen through the fascia transversalis.
h. A portion of fascia or tendon passing from the pubes to join the rectus.
i. Fascia iliaca.
j. Iliac artery.
k. Iliac vein.
l. Epigastric artery.
m. Epigastric vein.
n. Anterior crural nerve.
o. Crural space, by which the crural hernia descends; it leads into the crural sheath.

Figure 6.
A similar view, but with a portion of the fascia transversalis raised.
a. Pubes.
b. Ilium.
c. Iliacus internus.
d. Psoas.
e. Fascia iliaca.
f. Rectus abdominis.
g. Junction of the fascia iliaca and transversalis at the edge of the crural arch.
h. Fascia transversalis.
i. Ligamentum rotundum, passing from the abdomen through the fascia transversalis.
j. Fascia transversalis, and portion of the tendon of the rectus raised.
k. Inferior column of the tendon of the external oblique.
l. The abdominal ring.
m. The third insertion of the external oblique.
n. Iliac artery.
q. Epigastric vein.
r. Circumflexa ili.
s. Absorbent gland receiving the different crural absorbent vessels.
t. Absorbent vessels passing through the crural space or ring which is seen situated between the third, or semicircular insertion of the external oblique muscle.

Figs. 5 and 6 were both drawn removed from the body as they appear in the plate, which accounts for the flatness of their appearance.

Figure 7.
Crural hernial sac removed to show the opening by which it descends in the female.
a. Seat of the pubes.
b. Crural arch extending toward the ilium.
c. c. Abdominal muscles.
d. Crural arch.
e. c. Fascia lata.
f. Semilunar edge of the fascia lata.
g. Third insertion of the external oblique.
h. Femoral artery.
i. Femoral vein.
j. Femoral sheath.
k. Femoral sheath.
l. Abdominal ring.
m. The orifice by which the crural hernia descends, formed on the outer side by the crural sheath, on the inner by the semilunar insertion of the tendon of the external oblique, and above in part by the crural sheath and in part by the semilunar edge of the fascia lata. The division
in crural hernia is made at the upper and inner
part.

Figure 8.
Posterior view of the same preparation.

<table>
<thead>
<tr>
<th>1. Abdominal muscles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Seat of the pubes.</td>
</tr>
<tr>
<td>b. Abdominal muscles.</td>
</tr>
<tr>
<td>c. Iliac vein.</td>
</tr>
<tr>
<td>d. Epigastric artery.</td>
</tr>
<tr>
<td>e. Epigastric vein.</td>
</tr>
<tr>
<td>f. Peritoneum.</td>
</tr>
</tbody>
</table>

In femoral hernia the location of the stricture varies. It may be found in the neck of the hernial sac. This, however, is rare; more commonly it is found at the junction of the process of the fascia lata with the edge of Gimbernat's ligament, or at the margin of the saphenous opening. The edge of the constriction is usually sharply defined, and its division, to the extent of two or three lines, is generally sufficient. The sac may be multiple, although this is much more rare than in inguinal hernia.

Symptoms.—Femoral hernia is recognized by the same general symptoms as inguinal hernia. When reducible, it disappears in the recumbent position, to return when erect; it is distended upon coughing. Its intestinal contents are elastic and uniform to the touch, and a gurgling sound is heard when it is returned into the abdomen. The surface is less equal, and has a doughy feel when the omentum constitutes the contents of the sac. Femoral hernia is usually diagnosticated without much difficulty, since tumors of the groin are much less common than of the scrotum. There are conditions, not infrequently, however, when the diagnosis is not easily determined. Cases are reported where the intestine was divided under the supposition that the tumor was a suppurating bubo; also where, under a similar supposition, poultices were applied, and death supervened from gangrene of the inclosed intestine. An enlarged gland may also complicate the conditions, occurring in conjunction with hernia. Cystic dilatation of a portion of the hernial sac may form a complication. I have very recently operated upon a woman of about forty years of age who had suffered from femoral hernia for twelve or thirteen years, much of the time wearing a truss. A portion of the tumor became irreducible, and the truss could not be tolerated. The sac was thick-walled, and the lower portion was occluded and filled with serum, making a tumor the size of an egg.
PLATE XXXIII.*

**Views of the Parts in the Groin of the Male, Intended to Show Their Anatomy.**

*Figure 1.*

Posterior view of the external oblique muscle, of the external iliac artery and vein, and of the fascia iliaca.

- a. Symphysis pubis.
- b. Spinous process of the ilium.
- c. Linea ilio-pectinea of the pubes.
- d. External oblique muscle and its tendon.
- e. Superior column of the tendon of the abdominal ring.
- f. Insertion of the inferior column of the ring into the tubercle of the pubes.
- g. The third insertion of the external oblique into the ligament of the pubis, whence it is extended toward the symphysis.
- h. Abdominal ring.
- i. The fascia iliaca extending over the iliacus internus and psoas muscles.
- j. The junction of the fascia iliaca with the posterior edge of the crural arch, and it is seen extending near to the external iliac artery.
- k. External iliac artery.
- l. External iliac vein.
- m. External iliac vein.

[These vessels pass through an oval space, which is the beginning of the crural sheath, and which is bounded internally by the third insertion of the external oblique muscle, externally by the fascia iliaca joining to the posterior edge of the crural arch, behind by the process of the same fascia, and before by the posterior edge of the crural arch.]

- n. Posterior edge of the crural arch extending from the pubes to the ilium. That part of it which is included between the two lines from n forms the posterior stricture in large crural hernia.
- o. Thyroidal foramen.

*Figure 2.*

A posterior view of the parts of the groin when the peritoneum is removed.

- a. Symphysis pubis.
- b. The seat of the spine of the ilium.
- c. Junction of the pubes and ilium.
- d, d, d. Abdominal muscles.
- e. Iliacus internus muscle covered by the fascia iliaca.
- f. Psoas muscle covered by a portion of the same fascia.
- g, g, g. Fascia transversalis lining the abdominal muscles, and descending to the crural arch.
- h. Poupart's ligament, or the crural arch, where the two fasciae join.
- i. A process of fascia passing upon the iliac artery and vein, uniting them to the edge of the crural sheath.
- k. Internal abdominal ring, or upper aperture of the inguinal canal.
- l. Spermatic cord passing through that aperture.
- m. External iliac artery.
- n. External iliac vein.
- o. Epigastric artery and vein.
- p. Third insertion of the external oblique into the pubes, covered, however, by the fascia transversalis.
- q. The space by which the crural hernia descends, the finger having passed into it before the drawing was made to push down the fascia which extends over it.
- r. The thyroidal foramen.

*Figure 3.*

An anterior view of the groin.

- a. Symphysis pubis.
- b. Spine of the ilium.
- c. Tuberosity of the pubes.
- d. Crural arch, or Poupart's ligament.
- e. The place at which the crural hernia descends.
- f. Superior column of the abdominal ring.
- g. Inferior column.
- h. Abdominal ring.
- i, l. Fascia lata.
- k, k. Semilunar edge of the fascia lata, somewhat larger in this subject than usual.†

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* Cooper, Plate III, Part II.
† To see this, it is necessary to cut away some fibers covering the crural sheath.
Circumflexa Crural Opening Crural Saphena to the lata and part's e, fascia salis. the raised. artery g. g. ligament h. k. h. i. c. a. m. i. b. a. k. n. I, 71. Shows Iliacus lata. to the hernia the hernia the sheath, and of the passage of the saphena transversalis for the hernia descends, and which is situated at the inner and upper part of the crural sheath. *

Figure 6.
Shows the crural sheath cut open. a. Pubes. b. Ilium. c, c. Transversalis muscle and tendon. d. Insertion of the external oblique turned down. e, e. Fascia transversalis at its inner part; the epigastric artery and vein are seen. f, f. Sheath cut open. g. Femoral artery. h. Femoral vein. i. Saphena major. k. Epigastric artery and vein. l. Circumflexa ili. m. Internal abdominal opening for the spermatic cord. n. Space between the crural sheath and femoral vein, showing the part at which the crural hernia descends.

Figure 7.
Artery and vein removed from the sheath. a. Pubes. b. Ilium. c. Fascia transversalis. d. Aperture in it. e. Fascia transversalis. f. Anterior part of the crural sheath cut open. g. Femoral artery. h. Femoral vein. i. Opening of the sheath from the abdomen. k. Iliacus internus. l. Fascia iliaca forming the posterior part of the crural sheath, and sending forward a process between the crural artery and vein.

* To make a similar preparation, it is necessary that the semilunar edge of the fascia lata should be raised, and the finger be carried behind the edge of the crural arch.
PLATE XXXIII A.
FEMORAL HERNIA.—SPECIAL ANATOMY OF THE PARTS.

Figure 8.
Anterior view of the crural arch, a hernial sac having been removed from it to show the orifice by which the crural hernia descends.

a. Seat of the symphysis pubis.
b. Crural arch.
c. Fascia lata.
d. Semilunar edge of the fascia lata.
e. Crural sheath.
f. Abdominal ring.
g. Spermatic cord.
h. Femoral artery.
i. Femoral vein.

k. Anterior column of the crural sheath, which requires division in the operation for the crural hernia.
l. Lower column of the same opening.
m. The hole in the side of the sheath by which the crural hernia descends.

Figure 9.
Posterior view of the same preparation.
a. Symphysis pubis.
b. Ilium.
c. Pubes.
d. Rectus muscle.
e. Other abdominal muscles.
f. Fascia transversalis.
g. Spermatic artery and vein going through the internal abdominal ring.
h. Femoral artery.
i. Femoral vein.
j. Fascia between these vessels.
k. Epigastric artery.
m. The aperture by which the crural hernia quits the abdomen.
n. The fascia forming the outer part of the stricture.
o. That forming the inner.
p. Fascia and posterior edge of the external oblique muscle forming that part of the stricture which requires division in the operation, if the division of the anterior column of the crural sheath k, in the former figure, is insufficient.

Varicosity of the femoral vein may be mistaken for a femoral hernia. Sir Astley Cooper reports a case in which he was consulted for a supposed hernia. "It was easy to detect the nature of the case, for, although it disappeared in the recumbent position, it was immediately reproduced, even if she continued in that position, by pressing upon the vein above the crural arch and retarding the return of the blood. She died of stricture in the colon; and, upon inspecting the body, I found that I could readily thrust my finger into the crural vein, but that she had no hernia."

A consideration of the anatomical conditions of the great vessels of the groin would lead to the inference that femoral hernia must be rare in early childhood. It is only after a considerable strain has been brought to bear for a long time upon the parts that the connective-tissue sheath, enveloping the vessels, yields, and this rarely happens until adult life. Kingdon states that he had met femoral hernia only once in the many thousand cases which he had examined, and that was in a girl of eleven years of age. Dr. De Garmo states that he had had under personal supervision a boy, eight years old, with femoral hernia, which is the only case in his experience, and he has not found record of its occurrence at so early an age.

I have lately been consulted in the case of a limited varicose femoral vein, more than an inch in diameter, where, upon standing, a differential diagnosis was not easily
made. I am, however, assured that this condition is rarely found. Psoas abscess and fatty tumors should also be taken into consideration as possible. Mistaken diagnosis, confounding a femoral with an inguinal hernia, is not so very rare.*

This is of less importance in general practice, although intelligent efforts at reduction must depend upon a diagnostic recognition of the anatomical relations, and a femoral hernia goes over into a dangerous constriction of the intestine more rapidly than an inguinal. Inguinal and femoral hernia are rarely found occurring in the same subject. Femoral hernia is more common upon the right than the left side. The following plate from Cooper illustrates beautifully the two forms of hernia occurring in the same subject.

PLATE XXXIV†

Exhibits an anterior and posterior view of two inguinal and a crural hernia in the same subject. The common inguinal truss may be applied for a small crural hernia; but in the larger, a truss which approaches the right angle is required, as the motions of the thigh displace the inguinal truss when put below the crural arch.

**Figure 1.**

Anterior view of a crural and two inguinal herniae.

*a.* Symphysis pubis.

*b.* Spinous process of the ilium.

*c.* Crural arch sending off the fascia lata of the thigh.

*d.* Semilunar edge of the fascia lata.

*e.* Saphena major vein on each side.

*f.* Abdominal rings.

*g.* Sac of the inguinal hernia on the left side.

*h.* Its fascial covering.

*i.* Inguinal hernial sac on the right, its cavity obliterated by adhesion.

*j.* Sac of the crural hernia.

*k.* Its orifice, which had been dilated inward in the operation for this hernia.

**Figure 2.**

Posterior view of the same preparation.

*a.* a. Seat of the spinous processes of the ilia, the upper *a* pointing to the abdominal muscles a little below the umbilicus.

*b.* The bladder contracted.

*c.* The uterus drawn to the right side toward the mouth of the hernial sac.

*d.* d. Ovaria.

*e.* e. Fallopian tubes.

*f.* f. Ligamenta rotunda.

*g.* Orifice of the sac of the inguinal hernia on the left side.

*h.* Orifice of the crural hernia.

*i.* Sac of the right inguinal, shut by adhesion.

*j.* k. Epigastric artery and vein.

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* "Verhegen’s reputed discovery of the difference between the seats of inguinal and femoral rupture introduced a new era in the annals of hernial surgery. ‘Alius huc vicinus locus est, ubi fuit herniae periculosus et sepe lethales; scilicet, ubi venæ et arteriæ iliacæ tendunt ad crura.’ Verhegen adds, adopting Pard’s explanation of the mode in which a rupture is formed, ‘Si quidem peritoneo paululum delato, aut quod rarissime contingit, rupto, descendet exigna pars intestini illi,’ but proceeds in advance of his predecessor, ‘hibidemque partibus vicinis accrescit, ex qua accrescentia vidi particulum intestini illi omnino ecclusam, et agrum miserere marientem,’ etc.

"In this passage there appears to be a dim recognition of a seat of stricture, which includes the neck of the sac, and parts contiguous to it, and of these parts the ligament of Fallopian or Poupart was supposed to be the principal."

—Gay on Femoral Rupture, p. 56.

† Cooper, Plate VI, Part II.
CHAPTER XII.

OPERATIVE MEASURES FOR STRANGULATED FEMORAL HERNIA.

Taxis.—In operative measures, a correct diagnosis is of the first importance. Fatal errors have been made, otherwise avoidable. Attempt at cure of femoral hernia has been far less common than of inguinal hernia, and operative measures have been instituted in rare instances, except to relieve intestinal obstruction. When strangulation has occurred, the sharp, unyielding edge of the ring produces a much more dangerous condition than in inguinal hernia, and calls for even more prompt measures for relief. Cases are on record where death has followed from strangulation within twenty-four hours after the accession of the symptoms. Not very rarely forty-eight to sixty hours of compression of the intestine will cause necrosis. This supervenes all the more rapidly in femoral hernia, since the size of the opening is small, and the edge of the ring sharp and firm.

If reduction can not be safely secured under ether, by taxis intelligently conducted, the thigh somewhat flexed and adducted, or rotated inward, operation must not be delayed. Having relaxed the tissues as much as possible, press gently directly downward upon the tumor. Pressure is to be kept up steadily for some minutes until the surface of the tumor is brought even with the line of the crural arch, and then the compression is to be continued upward and inward toward the abdomen. If, on the contrary, the pressure is first directed toward the abdomen, the tumor is carried over the arch, instead of under it, and the greatest danger may ensue from force thus applied.

PLATE XXXV.*

Figure 1.

(a) Globular swelling at the peritoneal orifice of the passage.

(b) Contraction caused at the external inguinal ring.

(c) Hernial tumor, which invades the large lip and pushes back the vulvar opening in the opposite direction.

* Bourgery, Plate XXXVI.
Figure 2.

Large crural hernia (entero-epiplocele in a female, aged seventy). The thin and lacel integuments allow the projections of the circumvolutions to be seen externally. This tumor, of which the characteristics are exaggerated, renders the diagnosis in some way very easy.

Figure 3.

Two crural hernias (enteroceles in a female, aged forty-nine). The form of these two tumors is of a more favorable kind than the preceding.

(a) Portion of the hernia inclosed in the accidental crural canal.

(b) Subcutaneous hernial tumor below and at the exit of the crural canal.

(c) Ileo-femoral vessels.

(d) Dilated internal saphenous veins.

Figure 4.

Sub-umbilical hernia (entero-epiplocele in a female, aged sixty-seven). This woman has had four children; the abdominal wall shows numerous trailllements in the circumference of the hernia. The extreme thinness of the integuments permits, as in Fig. 2, the intestinal circumvolutions to be seen.

The direction of the incision through the integuments may be somewhat varied, but usually it should be nearly vertical, and from two to three inches in length. It should extend downward upon the inner side of the neck of the sac, and be continued upward about an inch above Poupart's ligament. If the incision is slightly curved, the concavity should embrace the neck of the tumor. M. Dupuytren and Sir Astley Cooper advised two incisions, traversing each other either crucially, or meeting each other at right angles, in the reverse lines of the letter T, to meet at a point over the middle of the tumor.

Mr. Lawrence, however, advocated that the incision should run obliquely downward and outward, beginning about an inch above the ring. Mr. Gay, on the contrary, gives at great length his reasons for making the incision in an oblique direction, quite to the inner side of the hernial tumor, since this carries one with greater safety to the seat of the constriction.

This plan has certain manifest advantages, since by it the skin and hernial covering are divided over the seat of the constriction, and the division of the stricture itself is rendered easier. The method of incision advocated by Mr. Gay is that more generally accepted and practiced. After the division of the integuments and fascia, usually a well-defined membranous sac comes into view, and the landmarks to be especially sought as guides for the safe manipulation of the sac are Poupart's ligament above and in front, and Gimbernat's ligament at the pubic border upon the inner side. Expose clearly Poupart's ligament in the dissection, and determine with the finger the edge of Gimbernat's ligament upon the inner side of the neck of the sac, care being taken not to press upon the constricted portion of the intestine within the ring.
PLATE XXXVI.*

The hernial sac and parts, the subject of this drawing, were discovered in the course of a dissection. The tumor did not present those external indications that led to a suspicion of its existence, until the superficial and cribriform fascia had been cut through. The engraving was made from a cast and drawing of the parts taken by Mr. E. Wilson, and is well adapted to show the parts prior to their alterations by the processes of disease. The sac is denuded of its fascia propria. Any further description, but for the sake of junior students, would be superfluous.

a, a. Upper layer of the iliac portion of fascia lata.

b, b. Pubic portion of the same fascia, or pectineal fascia, forming the floor of femoral fossa. Plate II, l.
c. Falciform process, and portion of the border of the saphenous opening.
d. External or semilunar portion of the same border.
e. Burns's ligament, or pubic portion of the arch formed by the lower border of the same opening.
f. Inferior pillar of the external abdominal ring; or that portion of the crural arch which terminates upon the tuberosity of the pubis and adjoining portion of the ilio-pectineal ridge.
g. Spermatic cord.
h. Saphenous vein.
i. Hernial tumor.

A black line shows the situation and direction of the incision which is made through the integuments into the femoral fossa, for the new operation.†

The more common practice has been not to open the sac, but carry the hernia-knife, on the finger, carefully between Gimbernat's ligament and the neck of the tumor, and, cutting inward, divide a few of the fibers of the ligament. This done, usually, in very recent cases, the tumor can be reduced ev masses without opening the sac. The operation, thus conducted, is generally simple and safe, and may be selected if only relief from the intestinal obstruction is sought. Even then it must be determined that the stricture has been limited to a few hours, and that the intestine has escaped injury from taxis, and also that there is no further constriction of the neck of the sac, which is sometimes sufficient to cause serious complications, or even dangers resulting in death. Should it be preferred to operate in this way, the conditions justifying it would be manifestly exceptional, while under the protection of antiseptic measures little, if any, additional danger ensues from the major operation. I can not doubt the wisdom and great advantage of adopting, as the rule of practice, the opening of the sac before any attempt is made to divide the stricture.

* Gay, Plate I.
† See Plate XXXVIII, Fig. 2, e.
PLATE XXXVII*

Represents a hernial tumor and the adjacent parts of the thigh, as they are displayed by the removal of the superficial fascia and the contents of the femoral fossa. The crural arch and upper layer of the iliac portion of the fascia lata have been divided and turned back, to show the deep layer of that fascia and its relations to Hey's ligament. The knife is passed from the femoral fossa behind those seats of stricture which are here seen.

a. The hernial tumor with its cribriform covering.
b. The crural arch divided and turned back.
c. Pubic insertion of the tendon of the external oblique muscle.
d. Tendon of rectus.
e. Pubic attachment of the conjoined tendons of the internal oblique and transversalis muscles.
f. Portion of Gimbernat's ligament, formed by the outer pillar of the external abdominal ring.
g. Portion of Gimbernat's ligament, formed by the falciform process of the fascia lata.
h. Situation of the band of fibers belonging to the internal inguinal ligament of Hesselbach, below the under layer of the iliac fascia lata.
i. The femoral, or Hey's, ligament; or the deep crural arch.
j. Upper lamina of the iliac portion of the fascia lata, divided vertically and thrown back in order to display the deep lamina, with Hey's ligament, and its continuity to the arched margin of the internal oblique muscle.
k. The femoral fossa.
l. Process from the deep abdominal fascia which completes the upper arched border of the saphenous opening on the pubic side.

In the earlier days the danger of the division of the constriction with the knife was considered so great, owing to the injury supposed to follow the cutting of the crural arch, as well as wounding some of the large vessels by which it is nearly surrounded, that Thevenir † invented his two-branched dilator. Arnaud, ‡ for a similar reason, advocated dilatation, which he effected by a crochet-hook. Leblanc * revived the use of the dilator, which he applied to inguinal as well as crural hernia. Dilatation was advocated by means of the various instruments by the operators of this period, even as late as Richter and Scarpa. Breschet pointed out the dangers likely to ensue from the use of these instruments, and the failure which often resulted in the insufficient freeing of the constriction when dilatation alone was depended upon.

The dangers resulting from dilatation are manifest, since the ring constricts the parts equally in every direction, and the forced separation of this by a two-bladed divulsor must necessarily bring an equally increased compression upon the contents constricted as upon the ring itself. The superior genius of Arnaud recognized this fact, since the insertion of his hook into the ring would make the distention in one direction only, and properly applied in the hands of this master brought the force

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* Gay, Plate II.
A. Arnaud. On Hernia, 1743.
* Nouvelle Méthode d'opérer les Hernies. Par M. Hoin, 1767.
to bear away from the constricted intestinal loop. There was a still further gain in its use in a more prompt restoration of the parts to their normal state, since the constricting portions were supposed to be injured less by divulsion than by division. With a properly constructed knife, however, the cutting operation has many advantages, in freeing the constriction, over that of any other method.

PLATE XXXVIII.*

**Figure 1.**

a. The *front* wall of the femoral sheath, as displayed on the careful removal of the iliac fascia lata.

b, c. Its iliac and pubic walls.
d. The *angles* formed by the union of these walls.

g, h. The septa by which the sheath is divided.
i. The *upper orifice* of the crural canal or crural ring.

k. The venous compartment of the sheath.
l. Lines showing the direction of the septa of the sheath, the outer one being between the artery and vein.

m. The front margin of the lower orifice of the sheath.

n. The *crural canal*.

o. Dotted line showing the relative position of Hey’s ligament to the front wall of the sheath.

P. The band of fibers appertaining to the front wall of the sheath, described as the “fibre crassiores” of the internal inguinal ligament of Hesselbach; also seen in Plate II, h.

q. Tendon of the rectus.

r. The pubic margin of the *crural ring*; the septum crural had been pushed before a hernial sac, by which the canal had been occupied.

s. The terminal portion of the saphenous vein.

**Figure 2**

Represents the front view of the thigh, with a femoral rupture.

a. Dotted outline of the situation of the crural arch.

b. Dotted outline of the margins of the saphenous opening.

c. Situation of the hernial tumor.

d. The situation and direction of the first incision for the performance of the new operation.

OPENING AND EXCISION OF THE SAC.

As a rule, there can be no doubt but that in femoral hernia the sac should be opened and examined. This is even more important than in the other varieties of hernia, since, as we have shown, the sharp-edged narrow constriction sometimes causes a fatal intestinal lesion in less than a single day.

Divide the fascia propria on a director, or by lifting the tissues from either side by dissecting forceps, and a layer of fat will be exposed to view. This is important, since it might be mistaken for omentum. The peritoneal covering of the sac should be determined and opened with even greater care and caution than was emphasized when describing this part of the operation in inguinal hernia, since the tissues covering

* Gay, Plate III.
the tumor are usually thinner. Generally a little serum escapes, which further determines the anatomical relation of the structures. The division of the stricture must be subject to certain modifications, dependent upon the condition of the parts. It is manifestly clear, from the anatomical consideration of the subject, that the outer border of the ring is made up of the fascia, or sheath of the great iliac vessels, and that division in this direction endangers the great femoral vein. In the male it is to be borne in mind that the spermatic cord and vessels are usually found directly over the sac, but he who is familiar with his anatomy, as every operator should be, will remember that Poupart's ligament separates the cord and vessels from the neck of the femoral sac; however, injury to these vessels may occur from the confusing deformity of the pathological conditions, and the accidents which have happened from the division of these vessels have taken place at some distance from the ring.

When the conditions seem to indicate a danger to the cord or vessels, it should be emphasized that these are to be first exposed and removed from the direction of the incision.

If the line of the division is carried upward and outward, toward the spinous process of the ilium, the epigastric artery may be endangered, but this is usually quite half an inch from the seat of constriction, and if divided, is not by any means so serious a complication as has been generally supposed, since it can be easily secured and controlled. The distinguished surgeon, Mr. Hey, who pointed out the ligament sometimes called by his name, advised that the knife should be introduced upon the inner side of the sac, and the division be made directly upward. I can not myself, however, doubt that the greatest security, in the avoidance of danger to the blood-vessels and intestine, is generally maintained by introducing the knife into the middle part of the hernial sac, anteriorly, and dividing the stricture from below upward and inward in the direction of the umbilicus. If this course is pursued, the line of the incision will be quite parallel to the inner side of the epigastric artery, and although the division is a little deeper than if carried more externally, it does not seriously increase the complication of the operation by the enveloping folds of the intestinal loop, which may be retained within the sac and roll up about the finger. Some authors advocate the wisdom of division of the internal fibers, re-enforcing the pubic insertion of the tendinous attachment to the ossa pubis, still called after the Spanish surgeon Gimbernat, who dissected the parts with great care, and first pointed out that the firmest portion of the ring consisted of these re-enforcing fibers, and advocated their division in femoral
a, a. The femoral arch.
b. Part of the aponeurosis of the fascia lata, left adhering to the margin of the fallopian ligament.
c, c, c. Aponeurosis of the external oblique muscle.
d. The inguinal ring.
e. The spermatic cord.
f, f. Bundles of fleshy fibers of the cremaster muscle.
g, g. The hernial sac formed by the peritoneum. A femoral hernia.
h, h. The external † cellular coat of the peritoneum, which, together with the inguinal glands and the aponeurosis of the fascia lata, covered the hernial sac.
i. The loop of ileum protruded.
j. The external oblique muscle.
k. An incision made through the fibers of the internal oblique, and of the aponeurosis of the transverse, in order to expose the course of the epigastric artery, resting on the great sac of the peritoneum and running toward the rectus muscle.
m, m. Division of the aponeurotic sheath of the rectus muscle.
n. The external ‡ edge of the rectus muscle laid bare, and a little turned back.
o, o. The aponeurotic sheath of the rectus muscle.
p. The iliacus internus muscle.
q. Part of the external oblique muscle.
r. The femoral artery.
s. The femoral vein.
t. The saphenous vein.
u. The epigastric artery.
w, x, y. Continuation of the epigastric artery.
x. y. The abdominal or circumflex iliac artery.
z: The spermatic artery.
t. 10. A small branch of the spermatic artery.

The spermatic vessels are represented in this plate, raised by a hook. It is, however, quite evident that, if these vessels had been left to themselves, they would descend, as in their natural situation, to the vicinity of the edge of the fallopian ligament.

11, 12. The continuation of the spermatic artery.
13, 14. The spermatic vein divided into several branches.
15, 16. The vas deferens.
17. The anterior crural nerve.
18. The place where the spermatic artery is at the greatest distance from the edge of the fallopian ligament.

hernia as the safest and best means of reduction. Were the anatomical construction of the parts the only measures by which to determine surgical procedure, this view would be the correct one; but it must be remembered that the obliquity of Gimbernat's ligament is such that this portion of the constricting ring is more deeply buried within the tissues than any other, and consequently reached with greater difficulty. This alone increases the danger of injuring the intestine by the knife. While, again, in this form of hernia the intestine, in its escape from the abdomen, descends in an inward direction and the tension which it is necessary to make upon it, in order to withdraw it from the field of operation, may be sufficient to cause its rupture. This danger was pointed out by Sir Astley Cooper in the following illustrative case, which I quote from this author:

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* Scarpa, Plate VIII.                ‡ Peripheral.                ‡ Lateral.
"Mrs. Phillips, aged fifty years, was seized February 16, 1804, with symptoms of strangulation in a hernia to which she had been subject for twelve years, during which time it had been occasionally smaller or larger, but never completely reduced. On the day above mentioned it suddenly increased, during a violent exertion, became very painful, and produced much uneasiness in the bowels, with frequent vomiting. On the 24th Mr. Robert Kent was called to her, who advised her going to St. Thomas's Hospital, and she was admitted on the 25th.

The tumor was on the left side, its long axis passing in the direction of the crural arch or Poupart's ligament, anterior to which it was situated. It bore so strong a resemblance to an incipient inguinal hernia as to deceive several of the most intelligent pupils; but, on examining her, and drawing the tumor downward, I found the crural arch passing above the sac, and the tuberosity of the pubes on its inner side, which made the true nature of the case sufficiently obvious. The symptoms were not so urgent as might have been expected from the duration of the disease, for the tumor was not inflamed, the abdomen but slightly tense and painful, and the countenance did not show any remarkable sign of anxiety; her pulse, however, was quick and thready. After an unsuccessful trial of the taxis and a tobacco clyster, I proceeded to perform the operation.

An incision was made in the long axis of the tumor (transversely, therefore, to the neck of the sac), and the fascia which it exposed was next divided to bring the sac in view. This was next opened, and a little clear serum escaped. A director being introduced, the opening into the sac was extended up into its neck, which showed both intestine and omentum strangulated; the former discolored as much as is usual in these circumstances, but not to any remarkable degree. The intestine being drawn toward the spine of the ilium, which was obliged to be done to reach the stricture, a director was passed up into the mouth of the sac on its inner side opposite the pubes, and a common probed bistoury being passed upon this, the stricture was divided inward along the margin of the pubes. The intestine was then easily returnable; but, as the last portion of it was entering the abdomen, a small quantity of feculent matter escaped from the orifice of the sac, but too late to prevent the return of the intestine, which, had I observed this circumstance sooner, I should have done, and made a small suture upon it. The omentum was then returned, and the wound dressed. I saw her an hour and a half afterward, when she complained of violent pain in the abdomen, and was extremely restless. I removed the dressings, and saw feces discharged from the wound,
on which I ordered a poultice only to be applied. The pain and restlessness continued until her death, which happened within four hours and a half after the operation. On examining the body, I found the feces effused into the cavity of the abdomen, the intestine universally inflamed, the portion of gut which had been strangulated but little altered in color, but with a hole in it opposite to the stricture. Whether in this case the intestine gave way at the strictured part by drawing it aside, or was injured by the knife, it is impossible to determine, but I was resolved never again to cut inward, on account of the danger of tearing, as well as of cutting the intestine."

If the hernia is large or adherent, so as to demand a more extensive dissection, it is manifestly important not to extend the incision inward, since very little room comparatively can be secured by so doing. Another serious objection to extensive division inward is the very frequent disposition of the obturator artery, which often embraces very closely the neck of the sac upon the inner side. The division of this artery would be serious, because of the difficulty of securing it thus deeply situated.

However, it has frequently happened in my experience that it seemed the wise procedure to divide only the fibers of Gimbernat's ligament, and it is often surprising to note that the division of a few of these fibers is sufficient to double the capacity of the ring, and thereby liberate the imprisoned contents of the sac.

Enlarge the opening sufficiently to admit the finger, and, held in this way, carefully divide the constriction at its mouth, cutting inward and upward as little as is required to liberate the intestine. Then examine, and, if warranted, restore the abdominal contents. The next step is to free the peritoneal sac quite within the ring, and, making it tense, sew through its base evenly with a double continuous tendon suture, as
advised in inguinal hernia. Cut the sac away and return the sutured base within the ring. The subsequent steps advised for the completion of the operation are very similar to those recommended when operative measures have been instituted for the radical cure of non-strangulated femoral hernia. It will be referred to again more in detail when discussing the various methods adopted and recommended for the cure of this dangerous affection.

The following plate from Mr. Cooper's work shows admirably the conditions of development in the peritoneal sac of a pronounced femoral hernia. In Fig. 1 the peritoneum is greatly thickened and altered in appearance. The changes in the mouth of the sac are well marked in the constricted re-enforcement which is the result of the alterations consequent upon the plicated folds having become intimately blended with each other. It is noteworthy to observe that these alone are sufficiently firm to make a strong constricting ring entirely independent of the tissues which go to make up the femoral canal. It is also easily seen that a division upward and outward in any considerable degree must have divided the epigastric vessels.

Fig. 2 shows in a manner rarely observed the various layers of tissue which make up the covering of the tumor.

**PLATE XL.*

This plate exhibits three different views of the crural hernia in the male. Fig. 1 is preserved in the collection at Guy's Hospital. Fig. 2 is in my own possession.

*Cooper, Plate V, Part II.
h. The iliacus internus muscle.

The Femoral Canal.—The next step in the operation is the closure of the femoral canal. After having returned the sutured base of the peritoneum within the ring, protecting the femoral vessels with the finger by pressing them in their sheath gently outward, introduce a curved vessel, as directed in inguinal hernia, page 109, from below through the thick pubic portion of the fascia lata, forming the external lower border of the ring, avoiding the internal saphenous vein, upward through Poupart's ligament, as far outward as may be judged necessary to produce the proper coaptation of the parts upon the vessels; unthread the needle, rethread with the opposite end of the suture, and withdraw it. This makes a constricting loop, closing the outer border of the enlarged femoral canal upon the sheath of the vessels. A second continuous stitch is taken through the same tissues parallel to the first, from one third to one fourth of an inch nearer the median line; the third continuous stitch is introduced into the portion of the fascia lata, external and parallel to the saphenous vein, in the same manner as the first and is carried upward to include Gimbernat's ligament and such portions of tendinous structures as may have been divided. If the operation has been undertaken for strangulation, three stitches are generally sufficient; but a fourth or as many more may be taken as are required to close evenly and firmly the inner portions of the ring. By suturing in this manner, the margins of the ring are firmly closed, the peritoneal pouch is obliterated, and the thick re-enforced edge of the fascia lata is joined to the borders of Poupart's ligament. The lower part of the canal is obliquely elongated and reformed by drawing inward the weakened dilated upper and outer border of the saphenous ring, and attaching it to the firm pubic fascia. The folding over of the fascia in this way carries the saphenous opening quite a little to the inner side of its former site, while the femoral vessels are undisturbed in their sheath. The superficial tissues and skin are closely held in approximation by buried tendon sutures. The wound is
sealed with iodoform collodion without drainage. It is almost needless to remark that the strictest aseptic care is maintained during the entire operation, in which irrigation with a weak sublimate solution serves an important part.

There is but one rule, and it can not be too emphatically enforced: the aseptic suture must be aseptically applied in aseptic structures, and the wound must be maintained aseptic. The failure of either of the above-mentioned factors not alone endangers the result, but may be followed by the most serious consequences.

In many instances the incision and dissection will not be required to be made as extensively as above described. Experience will familiarize the operator with the anatomical relations, but the wound should be made sufficiently large to enable him clearly to determine the relationship of the vessels, and render certain the closure of the parts involved. The operation for the cure of femoral hernia is doubtless more difficult than that for the cure of inguinal hernia in the female, but less serious or complicated than inguinal hernia in the male.

When the operation has been performed for the relief of strangulation under proper precautions, the subsequent danger is very little if any increased by the resection of the sac and the closure of the wound as above directed.

Certain complications are likely to be met with in non-reducible or incarcerated femoral hernia, but these are for the most part unimportant, since the incarcerated portion is almost always omentum, and the lower part of the sac may be more or less distended with serum. I have operated in two cases where the objective feature in each was that of a small cystic tumor, the neck of the sac having been closed by adhesions. The omentum, when thus retained, is generally so changed that it is better to ligature or sew through its base, and resect it, returning the stump within the abdominal cavity.

I have operated many times for femoral hernia in this manner, with never a subsequent symptom indicating danger, and, so far as I have been able to learn, without a single recurrence of the hernia.

In the advocacy for the cure of non-strangulated femoral hernia much might be written. This, however, is unnecessary, since it is universally conceded that the sufferer from this variety of hernia is in greater or less constant danger from strangulation, a complication of the most serious character. This form of hernia is much less easily retained by means of artificial supports, and the individual obliged to wear a truss is subject to much greater inconvenience by this than in inguinal hernia. If it
can be demonstrated that femoral hernia is curable, then the advisability of the operation should be taken into consideration, and if it can be proved that the cure remains permanent, it adds much to the argument in favor of operative measures; but when it is demonstrated that, under proper precautions, based upon an accurate anatomical knowledge of the structures involved, the operation is not severe, does not cause long detention from active duties, does away with the punishment inflicted by the life-long wearing of a truss, and is almost, if not entirely, without danger, there remains no reason why all the sufferers from femoral hernia should not profit by surgical measures and demand to be restored to the ranks of active service.

The operation for the radical cure is obviously much more simple when the conditions pertaining to incarcerated or strangulated hernia are absent. The normal anatomical relationship of the parts is usually not much changed. The tumor is generally small, the omentum or intestine easily returned, and the sac may be so thin and small as to become an unimportant factor. The danger of infecting the general peritoneal cavity scarcely exists, even in the hands of an inexperienced operator. The wound does not usually require to be made nearly as large as where operation is undertaken for a strangulated hernia, yet it is well to err on the side of a free dissection. The operator must be sure of the anatomical relations of the parts. The femoral vessels must remain uninjured in their sheath. The greater danger attends the introduction of the first stitch, since this closes the canal on the side toward the vessels, and a puncture of the great femoral vein with the needle might result in the most serious consequences. However, this warning is of little moment to the experienced surgeon, since the sheath of the great femoral vessels is the first anatomical landmark to be located with exactitude.

The pathological conditions of femoral hernia in the female are well shown in the following plate. The different views show that the development of the sac may occur so as to produce a considerable variety of pathological conditions. Figs. 1, 2, 3, and 4, taken from the same subject, are in this respect extremely instructive, and I am quite sure few operators would find in these pathological factors material subservient for their use, either in whole or in part, from which to make a pad for the re-enforcement of the internal ring. On the contrary, this might be possible in cases illustrated by Figs. 5 and 6, although the peritoneum is much thickened and changed; while in Fig. 7 is seen the view of a small hernia where the reduction of the sac en masse and its fixation at the internal ring might be of advantage.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

In conditions as here shown it is probably of little importance whether the sac is returned or removed.

PLATE XLI.*

This plate is intended to exhibit different views of crural hernia in the female, in the order in which the parts appear in dissection.

**Figure 1.**

First dissection of the crural hernia.

- a. Symphysis pubis.
- b. Spinous process of the ilium.
- c. Situation of the crural arch, or Poupart’s ligament.
- d. Tendon of the external oblique muscle.
- e. Superficial fascia raised from the external oblique muscle.
- f. Saphena major vein, the superficial fascia being cut away to show it.
- g. A part of the superficial fascia attached to the crural arch.
- h. Abdominal ring and round ligament passing through it.
- i. Superficial fascia raised from the hernia.
- j. Fascia propria raised from the hernial sac.
- k. Hernial sac.
- l. Omentum within the hernial sac.
- m. Intestine within the hernial sac.
- c, c. Abdominal muscles.
- d. Crural arch.
- e. Abdominal ring.
- f. Ligamentum rotundum uteri.
- g. Fascia lata.
- h. Portion of the fascia lata over the pectineus muscle.
- i, i. Fascia propria, or protruded crural sheath, which covered the hernial sac after the sac in Fig. 2 had been removed.
- k. Attachment of the fascia propria to the sheath of the femoral vessels.
- l. A portion of the sheath covering the crural vessels, exposed by removing the semilunar edge of the fascia lata.
- m. The opening in the sheath through which the hernia had descended, above which is seen a dotted line which marks the seat of the anterior structure, and which is the part generally required to be divided.†

**Figure 2.**

Shows the form and contents of the hernial sac which has been removed from Fig. 1.

- a. Hernial sac.
- b. Neck of the hernial sac.
- c. Omentum within the hernia.
- d. Intestine within the hernia.
- e. Omentum at the mouth of the hernial sac.
- f. The intestine at the mouth of the sac.

**Figure 3.**

Shows the origin and appearance of the fascia propria.

- a. Seat of symphysis pubis.
- b. Spinous process of the ilium.
- c, c. Abdominal muscles.
- d. Rectus muscle.
- e. Muscles of the thigh.
- f. Posterior edge of the crural arch.
- g. Fascia iliaca.
- h, h. Fascia transversalis.
- i. Round ligament passing into the abdominal ring.
- k. External iliac artery.
- l. External iliac vein.
- m. Epigastric artery and vein.
- n. Obturator artery arising from the epigastric, and passing on the outer side of the crural opening.

* Cooper, Plate IV, Part II.
† This is the preparation on which for several years I have been in the habit of showing the bag which incloses the hernial sac, in my lecture on crural hernia.
OPERATIVE MEASURES FOR STRANGULATED FEMORAL HERNIA. 145

O. Meeting of the insertion of the external oblique into the ligament of the pubes with the fascia iliaca.

P. The crural orifice by which the hernial sac had descended, and a dotted line is extended from it, marking the situation of the posterior edge of the crural arch, covered by a fascia, which forms the posterior seat of the stricture.

Q, R. Fascia between the crural vein and mouth of the sac; this opening is, therefore, formed above by the sheath and the posterior edge of the crural arch, on the inner side by the semicircular insertion of the external oblique muscle, and externally by a fascia descending on the inner side of the crural vein, which is a process of the crural sheath.

Figure 5.
A small crural hernia dissected.

A. Seat of symphysis pubis.
B. Spinous process of the ilium.
C. Tendon of external oblique muscle.
D. Anterior edge of the crural arch.
E. Abdominal ring.
F. Superficial fascia turned from the external oblique.
G. Superficial fascia upon the fascia lata.
H. Crural vein.
I. Absorbent gland thrust down by the hernia.
J. Superficial fascia opened where it covered the hernia.
K. Fascia propria of the hernial sac.
M. Hernial sac unopened.

Figure 6.
The same preparation further dissected.

A. Seat of the symphysis pubis.
B. Seat of the spinous process of the ilium.
C. Tendon of the external oblique muscle.
D. Internal oblique and transversalis.
E. Fascia of the transversalis.
F. Tendon of the transversalis.
G. Inner portion of the fascia transversalis passing to unite itself with the tendon.
H. The crural arch.
I, J. Round ligament.
K. The round ligament passing into the abdomen.
L. Femoral artery.
M. Femoral vein.
N. Origin of the epigastric artery.

O. Course of the epigastric artery behind the round ligament.
P. Crural nerve.
Q. Superficial fascia.
R. Fascia propria of the crural hernia, the hernial sac having been drawn into the abdomen to show this fascia distinctly.

Figure 7.
A small crural hernia in the female, showing its passage through the crural sheath and its distance from the crural arch.

A. Seat of the symphysis pubis.
B. Spinous process of the ilium.
C. Crural arch.
D. Abdominal ring.
E. Fascia lata.
F. Semilunar edge of the fascia lata.
G. Portion of the crural sheath.
H. Saphena major vein passing into the crural sheath.
I. Hernial sac inclosed in its fascia, which is extremely dense, and is proportionally so as the hernia is small.
J. The opening in the crural sheath through which the hernia passes.

Figure 8.
A small hernia in the male, to show the origin of the fascia propria.

A. Seat of symphysis pubis.
B. A portion of the crural arch.
C. Insertion of the external oblique into the pubes.
D. Portion of the fascia transversalis descending to unite itself to the crural vein.
E. Portion of the crural vein.
F, G. Edge of the fascia lata cut from Poupart's ligament, and drawn downward to expose the parts behind.
G. Fascia lata wrinkled by its falling down.
H. Semilunar edge of the fascia lata.
I. Saphena major vein passing into the crural sheath.
J. The portion of the crural sheath which covered the crural hernia, and forming the fascia propria, the hernial sac having been entirely removed, will be seen in Plate VIII.
L, M. The aperture by which the crural hernia had descended from the abdomen.
N. A depression within the crural sheath, in which a process of the hernial sac was contained.
Mr. John Wood,* of London, perhaps the most celebrated operator for the cure of hernia of this generation, writes as follows: "When, under the spray, the sac has been opened, the stricture divided, the bowel and omentum drawn down and examined carefully, and the former found not essentially injured, with no ulceration at the strangulated part, and no appearance of sphaeculus, the operation should be concluded by tying up the neck of the sac by strong catgut at the level of the crural ring, and cutting off the sac just below. If the sac be large, the catgut should be made to transfix it, and should be tied tightly on either side. Then, after passing the needle through Poupart's ligament on the one hand, and through the pubic fascia lata and Gimbernat's ligament on the other, as above described, the needle should again be passed horizontally through the pubic fascia lata just below its insertion into the pectineal line, and the inner end of the wire hooked on and drawn through. Then the two ends of the wire should be twisted together, and the loop drawn up and twisted firmly down into the upper skin puncture. A drainage-tube should next be placed in the lower part of the wound, reaching as high as the closed crural ring, and two or three points of suture applied. Upon the protective a double pad of wet carbolized gauze should be placed, so arranged that a groove is left to lodge the end of the drainage-tube, and to give free exit for any discharge.

"Then the rest of the antiseptic dressing is to be applied, with plenty of loose padding, especially on the inner side, to absorb the discharge, and a spica bandage above all. If the discharge does not soak through, the dressing may be left for three days, when, if primary union has occurred, as is most likely, the stitches may be removed, and the drainage-tube cleansed and reapplied, shortened by about half an inch. In another three days the dressing should be changed and the wire removed, the tube, again shortened, being kept in until the next dressing in three or four days more. The tube will then generally require removal.

"I have operated for the radical cure of crural hernia by the wire operation directly after the operation of hermiotomy for strangulation in four cases, all in women. In the first two the spray was not used, but all the other antiseptic precautions were employed. In the last two the spray and Lister dressings were used. All the patients recovered without a bad symptom, each having a good, firm, resisting cicatrix; no return of the rupture has occurred, as far as known, up to the present time.

"We should, no doubt, be prepared to expect a higher rate of mortality in this operation than in that upon unstrangulated hernia. Very much will depend upon the care and judgment of the surgeon as to the condition of the bowel and omentum before venturing to return them into the abdomen, and upon his choice of cases in which strangulation is recent. With due caution we may expect confidently that no higher rate of mortality than is met with in ordinary crural herniotomy will be experienced; and, if so, it certainly seems to be a shortcoming in surgery not to take advantage of the open wound to cure, if possible the hernia by the same operation as that which is necessary to relieve strangulation. It is well known that by not doing so the hernia is left to become larger and more troublesome to retain, because of the crural ring being cut so as to be more open and unprotected than before the operation. To be successful, as a rule, cases must be operated on as soon as possible after a fair trial of the taxis, aided by inversion and anaesthesia, has been made. But this rule also operates favorably in an operation which is usually successful in saving the patient in inverse proportion to the amount of damage done, chances lost, and time misemployed by ill-directed and un-skilful use of taxis or other futile methods of treatment; and this especially in thin, feeble, female patients after the middle period of life."

The following case from Arnaud illustrates the danger which may arise from the reduction en masse where the constriction at the neck of the sac caused death: "The rupture was crural, and the tumor about the size of a common hen's egg, when the symptoms first appeared. About ten or twelve hours after the first pain, which the patient felt from the strangulation, I reduced the intestine, and during the two following days it was left at liberty to come down, which it did whenever the patient coughed, and sometimes went up again of itself with ease. But from that time during the remainder of the disorder, which lasted eight or nine days, it came down no more. The patient died on the ninth day, and on opening the body we found the bowels which had formed the rupture still included in the hernial sac, and the tumor was increased to more than two thirds of its first bulk. It was situated without the cavity of the belly, between the peritoneum and inside of Poupart's ligament."

"A woman, aged forty-five, who had long been troubled with crural hernia on the right side, was seized with symptoms of strangulated hernia. They had begun at eight o'clock in the evening, and (as she stated) were brought on by suddenly rising from

* Fig. 3 of the following Plate is the illustration of this interesting case given in detail by Mr. Cooper.
her chair. On the whole of the following day she vomited frequently, had great pain in the tumor, and her pulse was small and frequent. Eight ounces of blood were taken from the arm, and attempts were made to reduce the hernia by taxis, but without success. A tobacco clyster was thrown up, but that failed. At noon on the following day the operation was performed. The intestine, which was discolored, was found adhering to the sac; but these adhesions were separated without much difficulty, and the stricture at the mouth of the sac was divided inward, or toward the symphysis pubis; but several incisions were required before the aperture was large enough to allow of the return of the hernia.*

"As the intestine was about to be pushed back into the abdomen, its contents were seen to escape from a considerable opening in it. It was therefore confined to the mouth of the sac, and dressings being applied, she was put to bed. I saw her soon after the operation, when she was in most violent pain, and she died at seven o'clock on the same evening.

"Dissection.—Having obtained leave to inspect the body, I found feces extravasated in the cavity of the abdomen. The intestines were much inflamed, and, as usual, red lines appeared on them, passing longitudinally on the points at which they adhered. The portion of intestine which had descended into the hernial sac was discolored, and it was much inflamed above the parts; two openings were found in the portion which had been placed at the mouth of the hernial sac. One of these openings had been confined within the sac, but the other had escaped observation, and had been returned into the cavity of the abdomen. It was from this that the feces had been extravasated, and so speedily brought on a fatal termination."

Plate No. XLII, Fig. 4, from Cooper,† shows this too common complication, where the surgeon, if inexperienced, fails to understand the conditions until too late to save the life of the patient.

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* I was not present at the operation, but was informed of the particulars by two very intelligent witnesses.
† Cooper. Part II, p. 28.
Operative Measures for Strangulated Femoral Hernia

Plate XLII.*

Containing Different Views of Preparations Made after the Operation for Crural Hernia.

Figure 1.
Anterior view of a crural hernia operated on by cutting directly inward.

A. Symphysis pubis.
B. Spine of the ilium.
C. E. Abdominal muscles.
D. Crural arch.
E. Abdominal ring.
F. Lower column of the ring inserted into the tubercle of the pubes.
G. Fascia lata.
H. Saphena major vein.
I. Fascia propria, or protruded crural sheath.
K. Hernial sac included in the former.
L. Insertion of the external oblique muscle into the ligament of the pubes, divided in the operation.

Figure 2.
Posterior view of the same.
A. Symphysis pubis.
B. Spine of the ilium.
C. Ilium.
D. Iliacus internus.
E. Abdominal muscles.
F. Rectus abdominis.
G. Fascia iliaca.
H. Fascia transversalis.
I. Junction of the two fascia at the posterior edge of the crural arch.
K. Internal abdominal ring, and the round ligament passing through it.
L. Iliac artery.
M. Iliac vein.
N. Epigastric artery and vein.
O. Obturator artery passing from the epigastric, but taking its course on the outer side of the hernial sac.
A. Hernial sac.
G. The insertion of the external oblique muscle, which had been divided in the operation inward.

Figure 3.
A view of a preparation in which the intestine was divided by cutting inward.

A. Seat of symphysis pubis.
B. Crural arch.
C. Abdominal muscles.
D. Fascia lata.
E. Femoral artery.
F. Femoral vein.
G. Hole in one fold of the intestine.
H. Hole in the other fold.
I. Hernial sac.

Figure 4.
Preparation of the hernial sac which had been returned into the abdomen unopened.

A. Seat of symphysis pubis.
B. Seat of the spine of the ilium.
C. E. Abdominal muscle.
D. Muscles of the thigh.
E. Muscles of the outer part of the thigh.
F. Crural arch.
G. Femoral artery.
H. Femoral vein.
I. Large hole at the crural arch, by which the hernia was pushed back.

K. Fascia propria of the sac, which was also pushed into the abdomen.
L. Hernial sac.
M, M. Peritoneum.
N. Strangulated intestine.
O. Intestine above the strangulated part.
P. Stricture at the mouth of the sac remaining undivided.
Q. Mesentery.

Figure 5.
A large hernia which had been strangulated, and for which the operation was performed by cutting through the tendon of the external oblique muscle, drawing up the spermatic cord, and cutting the crural arch from the hernial sac.

* Cooper, Plate VII, Part II.
The following description of interesting pathological conditions incident to femoral hernia are taken from cases from the Museum of the College of Physicians and Surgeons of London:

2644. Part of an inguinal region, with the sac of a femoral hernia, which had been forced between the peritoneum and abdominal muscles, after the intestine which it contained had been returned into the abdominal cavity. It is of an oblong form and is not much thickened; it has been opened, to show that it contains much omentum loaded with fat, but little hardened or altered. Close to the neck of the sac, and internal to it, is the obliterated right hypogastric artery, which is shown joining the urachus above. The pouch between these two cords is well developed. Posteriorly the omentum may be seen, entering the neck of the sac.

Removed from the same patient as 2626. The sac lay immediately behind the femoral ring, into which it bulged; the crural canal was very wide, owing to the free division of constricting ligaments found necessary during the operation.—Presented by Dr. G. Granville Bantock, 1879.

2673. The parts concerned in a large femoral hernia in a man. The sac is nearly globular, but somewhat elongated transversely, measuring in that direction four inches and a half in diameter; its mouth is transversely oval, and upward of an inch wide. It contained part of the right colon, adherent, but not strangulated. Portions of the fascia superficialis and fascia propria are separated from the anterior surface of the sac; they are all thin, and appear healthy in texture. On the inner side, the spermatic cord has been pushed inward by the sac; externally, the sac overlaps the femoral artery and vein and extends to within half an inch of the anterior crural nerve. The epigastric artery is shown, running tortuously from the upper border of the sac, at the back of the preparation.—From the Museum of John Howship, Esq.

2676. An unreduced strangulated femoral hernia. The sac, of which the walls are much thickened, has been laid open; it contains a loop of small intestine with omentum. At the back of the preparation, the contraction of the intestine before the strangulated part, and the dilatation of that behind it, are well shown.

The following account of the case was left by Mr. Hunter:

"Mrs.——, aged thirty-five, had a rupture for several years, but it was occasionally reduced, though often with difficulty. At last she was attacked with it so severely that she could not reduce it herself, and sent for Mr. Thomson, surgeon, who found her with all the symptoms of a strangulated gut.

"He attempted to reduce it; but at first could not. It was fomented, and the smoke of tobacco was thrown up by the rectum. Cold sweats, a small, quick pulse, and hicchough came on; at last he reduced it, but the symptoms did not in the least abate, and the straining with
the vomiting produced the rupture again, which now became out of his power to reduce. He proposed an operation, but she would not consent to it. She died, and was opened.

"On opening the belly there was found a large quantity of the contents of the intestines lying loose in the cavity of the belly. On examining further, a portion of the ilium and a small portion of epiploon were found down in the hernial sac; and upon examination it was found that the same gut which had come down at first was not down now; and the gut which had been down first, and reduced, was (also) the ileum, which I found so much mortified as to have given way in some places, forming several holes in it, through which had flowed the matter which was found in the cavity of the belly.

"Here was a complicated case beyond all relief; for if the second rupture had not happened, she must have died; and, of course, if the operation had been performed for the second rupture, she would also have died of the consequences of the first.

"This case shows that when the symptoms of the rupture have gone very far, it is imprudent to reduce it, even if possible; but as it is impossible, perhaps, to tell when the mortification of the gut is gone too far for reduction, it will, in general, be attempted while life exists, with the hopes of a cure.

"Upon the other hand, it may be asserted, or supposed, that, if it is not reduced, the person must also die; but this is not so certain as the other, for the mortification of a gut simply does not kill; it only kills from its consequences; and there is a material difference between a mortified gut out of the belly and one within. The consequence of one within is absolute death; but the one without in general endeavors at a cure by producing inflammation and suppuration in the parts, which is producing a fistulous orifice or artificial anus.

"It is very curious to observe in hernias that, while the gut is in the sac, and alive, no inflammation of the sac or integuments takes place; but the moment the gut becomes mortified, or dead, the stimulus of an extraneous body takes place immediately: an outlet is then endeavoring to be made by the inflammation and suppuration of the sac, forming an abscess in it; which matter, with the contents of the gut, is brought to the skin. While this is going on, the sound gut within the abdomen, where it passes into the rings, adheres to those rings all around; so that when the abscess is formed, burst, or opened, and the mortified parts sloughed off, these ends of the gut open into the abscess, and not into the cavity of the belly.

"But although Nature is doing all this, yet she is seldom able to succeed; for the stricture which was the cause of strangulation and mortification remains so tight as hardly to allow a passage for the contents of the intestines. Perhaps it might be proper, even then, to dilate the rings."—Hunterian M.S. Cases and Dissections, No, 67.

The following case shows an irregular distribution of the vessels:

2678. The right side of a male pelvis, with blood-vessels and other parts injected and dried. The epigastric artery is given off by the external iliac, a quarter of an inch above the crural arch. About two fifths of an inch from its origin it gives off a branch nearly a line in diameter, which descends, winding round the inner margin of the femoral ring, in the course sometimes taken by the obturator artery, when (as in the specimen next described) it arises by a common trunk with the epigastric. After turning round the femoral ring, this branch passes under it; goes toward the foramen ovale, and joins the trunk of the obturator artery, which is of ordinary size
and passes, as usual, from the internal iliac. The junction of the two vessels takes place about half an inch previous to their united trunk leaving the pelvis.—From the Museum of Robert Liston, Esq.

2626. A portion of ileum, showing a constriction marking off a small segment of the intestines, which is narrower below than above the constriction. The mesentery is quite normal, and the serous coat of the intestine perfectly smooth.

From a woman, aged sixty-nine, on whom an operation for femoral hernia was performed forty-eight hours after the commencement of symptoms of strangulation. Before these symptoms the patient had never noticed any hernia. At the operation, Gimbernat's ligament and the fibers of the "deep crural arch" and the falciform process of Burns were divided, and the intestine was easily reduced without opening the sac. After the reduction, the patient passed flatus freely, but occasionally vomited, and fifty-four hours after the operation became suddenly faint and died. The constricted portion of the ileum, here shown, lay free in the abdominal cavity; it was not highly congested. The sac was found to have been itself reduced, lying behind the femoral ring. It is preserved (No. 2644), and contained omentum.—Presented by Dr. G. Granville Bantock, 1879.

2614. The parts concerned in a femoral hernia. The preparation shows the small, recently protruded hernial sac in the usual situation of a femoral hernia, with the larger closed old sac below and inclosing it, and two or three smaller closed sacs near its sides. The mouth of the recently protruded sac is shown at the back of the preparation; and, about an inch from it on its outer side, directly over the femoral vessels, there is an appearance of another small peritoneal protrusion; its orifice is on the inner side of the epigastric artery, and occupies the position of the internal abdominal ring.

The hernia was operated on by Mr. Hunter, who left the following record of the case:

"June, 1782.—A woman came into St. George's Hospital with a strangulated femoral rupture. She had had formerly the same disease in the same part; but it had been reduced, and she afterward had no further trouble with it till now.

"After every attempt to reduce the present rupture, and failing, the operation was thought to be absolutely necessary.

"When the tumor was laid bare, and Poupart's ligament exposed, I divided the ligament from without, that I might return the contents of the sac without cutting into it; but I found still that the contents would not move. I then made a wound into the lower part of the sac, which appeared there to contain some fluid, and when this was exposed, it proved to be a circumscribed cavity, and that the present hernia was the upper part of the tumor.

"I did not open into the recent sac, which contained the protruded part, but attempted to take off the remaining stricture, for it only consisted of the cellular membrane, etc., that line the parts behind Poupart's ligament. When this was divided, the contained parts easily slipped up into the abdomen. The wound was dressed with a pretty thick compress of lint, to press the two sides of the sac together, that they might adhere.

"She became extremely low; a kind of cold sweat came on; she took some cordials, a gentle opiate to prevent the necessity of acting, and a calypt of warm water to soften, warm, and soothe the bowels; but, about six hours after, she died.

"On opening the body I observed the following appearances:

"The piece of gut which had been drawn into the sac was the ileum, near to the cæcum.
The quantity was just so much as took up the diameter of the gut. It was of a darker color, and appeared to be more pinched at the part inclosed by Poupart's ligament than where it had got below into the sac; this part adhered to the mouth of the sac by a slight adhesion, viz., that formed in the six hours; therefore, not mortified.

"The intestines above the strictured part were distended, below they were of the natural size.

"There was not sufficient visible cause for the woman's death.

"The case had been the following: She had had formerly a rupture in the same part, which had been reduced, but not the sac, and the mouth of the sac had united, while the sac itself had continued separate; but a new effort, or strain, taking place, a new rupture was produced at the same part, and the old sac was pushed down further into the thigh."—Hunterian MS. Cases in Surgery, p. 473; and Cases and Dissections, No. 56.
CHAPTER XIII.

OBTURATOR, OR HERNIA OF THE FORAMEN OVALE.

The obturator artery passes forward below the brim of the pelvis to the groove in the upper border of the obturator foramen, and escapes through this opening from the pelvic cavity. The oblique canal thus formed by the horizontal branch of the pubes above, and the arched border of the obturator below, is rarely the site of hernia. It has been described under various names—as obturator, after the canal; the hernia of the foramen ovale; the thyroid or sub-pubic femoral.

The hernial sac is never wanting, and consists always of a portion of the parietal peritoneum carried before the contents through the canal. The sac is generally formed slowly, because of the firmer attachments of the parts, and a careful history will usually elicit symptoms of localized pain, cramps, and derangement of the functions of the intestinal canal. When the canal is distended, the pain over the course of the obturator nerve, from pressure upon it, is at times a very diagnostic symptom. The canal almost never dilates to the extent found in other varieties, and in the great majority of cases reported the condition was not discovered until after death, since an external tumor is exceptional.

Mr. Birkett, who has especially studied the subject, writes: * "After passing along the obturator canal, the hernial tumor emerges upon the thigh, below the horizontal ramus of the pubes to the inner side of the capsule of the hip-joint, behind and a little to the inner side of the femoral artery and vein, and to the outer side of the tendon of the adductor longus. The tumor formed by the protrusion is covered by the pectineus muscle. It may be distinguished, therefore, from crural hernia, by observing the relative positions of the horizontal ramus of the pubes and of the femoral artery. These structures occupy, in fact, a position between these two kinds of hernia. In obturator hernia they are in front of the tumor, in crural hernia they are behind it. In the former, then, they are easily felt, in the latter they can not be without difficulty—not perhaps until the hernia is reduced.

"In those cases in which either a fullness, slight hardness, tumefaction, or swelling exists, coupled with well-marked indications of obstruction or strangulation in some part of the alimentary tube, the difficulty of diagnosis is not so very great; but how much embarrassment arises when those symptoms which betoken strangulated bowel exist and a tumor is nowhere to be felt, let the numerous cases on record attest in which the rupture has only been found after death!"

PLATE XLIII.

Hernia of the Foramen Ovale.

A poor woman of La Salpêtrière, aged about eighty, entered the infirmary on the 25th of October, 1832, with an obstinate constipation, otherwise in excellent health. A clod of two ounces of castor-oil was administered on the 27th; during the succeeding night the patient was seized with every symptom of stoppage. M. Piédagnel had the kindness to send me word, and I went to the patient, who indeed had all the symptoms—miserable pulse, cold extremities, large belly, but hard; continued vomiting. She vomited in my presence, the liquid coming from the small intestine, which is improperly designated under the name of fecal matter.

There were two inguinal herniae, the left the largest, which were easily reduced, and could not be considered as the immediate cause of the symptoms. The patient was in full possession of her senses, and yet was unaware of her danger. She died at one o'clock in the afternoon.

Opening of the Body.—The right inguinal hernia contained serosity and an intestinal convulsion. The left was nothing but a herniary bag, whose orifice was puckered. The stomach was very ample, excepting toward the pylorus, where it was abruptly contracted, and was reduced for about the distance of an inch to the dimensions of the small intestine; it contained a great deal of fixed air and a muddy liquid. A peculiar disposition of the intestine attracted our attention; four great circumvolutions were directed obliquely downward from the left to the right. I unfolded the bowel, beginning at the pylorus, and I soon discovered that this oblique direction was due to an intestinal loop which was engaged in the sub-pubian canal of the right side. The displaced portion was situated at the union of the two upper thirds with the lower third of the small intestine.

Figure 3 represents the manner in which the intestine was disposed behind the sub-pubian hole; \( I, G, S \) is the upper end, which was distended by a great quantity of liquid; \( J, G, L \) is the lower end, which was contracted; \( M' \), the mesentery; \( S, P' \), the pubian symphysis; \( C, C' \) is a cut of the coteïloid cavity; the gathering of the peritoneum, \( P \), is seen at the moment of its engagement into the ring; \( V' \), the bladder; \( U' \), the uterius. The ovaries and tubes, which have been preserved on the figure, permit the relation of the parts to be well understood.

Figure 7 represents the sub-pubian hernia seen on the exterior. To exhibit it, it was only necessary to take away the pectineal; behind this muscle was an aponeurotic sheet, very tenuous, through whose transparency a red tumor could be perceived. This sheet removed, we came to the herniary tumor, which was very small; the sub-pubian nerve and vessels, \( N, V' \), were situated at its external and anterior side, the nerve before, the vessels behind; the external obturator muscle having been divided, I saw that the largest part of the tumor was situated between the muscle and the aponeurosis of the foramen ovale. A sort of thickness, very well depicted upon the figure, marks the point of union of the two portions of the tumor.

The bag, \( S, S' \), being cut, a certain quantity of sanguinolent serosity escaped; the intestine, \( J \), was

* Cruveilhier, Plate VI, No. 15.
red and injected. The intestine (Fig. 2) was withdrawn without much effort from the sub-pubian ring; it was elongated, in form of the finger of a glove; it was neither thickened nor altered in its organization.

When the symptoms of intestinal obstruction exist, a differential diagnosis may sometimes be impossible. Localized pain, especially over the distribution of the obturator nerve, has already been referred to. Movements of the hip-joint may be painful, especially rotation outward, since this compresses the canal. Comparison and pressure over the obturator foramen of each side is important, also a careful inspection of Scarpas's triangle on each side. The pelvic opening of the obturator canal can be felt by the finger in the vagina or rectum, and the additional evidence which such examination will give must never be omitted. Having detected a hernial tumor, the effort at its reduction should be carefully made. The pressure is to be directed in a manner to free the hernia from the ramus of the pubes, and carry it upward from beneath.

The neck of the sac lies behind the horizontal ramus of the pubes, occupies the obturator canal, then makes its way sometimes between the superficial fibers of the external obturator muscle, sometimes above them, and the sac is covered with the fascia of this muscle. The obturator vessels and nerves, as might be supposed, vary in their relation to the tumor. Vinson* found the artery upon the outer side of the sac six times, upon the inner side an equal number of times, and behind it three times.

Both sexes are liable to obturator hernia, but a large majority of cases on record have occurred in the female. The anatomical differences of structure are a sufficient reason. This form of hernia may be found as a complication in connection with other varieties of hernia, and on this account it is more liable to be overlooked. Mr. Birkett reports one case where there was a reducible femoral hernia on either side; in three cases, a femoral hernia on the same side with an obturator; in one case, on the opposite side; and in another case, an inguinal and obturator on the same side.

The symptoms of strangulated intestine being clearly marked, it is the duty of the surgeon to examine carefully under ether, and if uncertain as to the reduction of an intestinal loop, he should operate promptly, as in the other varieties of hernia. This is usually best effected by an incision directly over the site of the tumor.

* Günther's Lehre v. d. blutigen Operationen, Abschnitt xv, p. 146.
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The incision through the tissues should be parallel to the trunk of the femoral artery, but sufficiently inside to avoid the femoral vein. The fascia covering the pectineus muscle being exposed, the hernial tumor is more readily felt. The fascia and the pectineus muscle having been divided in the line of the original incision, usually a layer of fat is met with before the obturator muscle is brought into view. This muscle must next be divided, since its fibers may completely screen the hernial tumor; and it is not until the finger can be placed within the outlet of the obturator canal that the operator is able to distinguish the pathological conditions with which he has to deal. The section must be made with care, so as not to injure the vessels and nerves.

When it becomes necessary to divide the neck of the sac, because of its relation to the obturator vessels, it is better to cut directly inward. Here, as elsewhere, it is important carefully to differentiate the sac, open it, and thus be assured that its contents, which are usually only intestinal, have been freed and restored. This done, the neck of the sac is ligated or sutured, and the sac excised. The wound should be immediately closed by lines of continuous buried sutures and sealed with iodoform collodion. The importance of opening the sac and the certitude of having freed the intestine from constriction is emphasized by two cases which are reported where operation was attempted, the hernial sac made "visible and tangible," without finding the inclosed intestine. Post-mortem examination, however, showed an obturator hernia seated immediately beneath the site of the operation, which was proved to be the cause of death.

In this variety of hernia the local symptoms may be so obscure as to be entirely overlooked, and yet the evidences of intestinal obstruction demand prompt surgical relief. Under these conditions, it is plainly the duty of the surgeon to make an exploratory laparotomy, and to find and relieve the cause of the obstruction; and this method of procedure, now so safe under modern surgical precautions, is often to be advised, since it enables the surgeon to determine accurately the condition of the intestine, and make available suitable measures for its repair in perforation or gangrene.

Sir Astley Cooper reported a case, operated upon by M. Arnaud, where a portion of omentum was removed with the sac, followed by cure, but he criticised the operation as needless, and stated that, in a case of strangulation where other measures have failed, "the operation of cutting the ligament which embraces the sac is the only hope of preserving life. This operation must be extremely difficult, and, so far as I am informed, it
has never been performed.” The honor of having first demonstrated this variety of hernia is apparently due to the elder Arnaud. In Arnaud’s Treatise, so frequently referred to in this work, the following is found: “Ruptures of the oval foramina of the pelvis, which my father originally discovered, were at first rejected as impossible by M. Duverney, a celebrated anatomist, but ten years after he found two of that nature in the same person. He was, however, then paid in his own coin by those who seem to think the rejection of novelties a point of honor. There were some who maintained this same error till 1742,* when I performed the operation for a rupture of that kind in a young lady of quality, which Messrs. Mataval and Grammont, surgeons, declared to be necessary. Who could have given me courage to have performed the first operation of this nature, had I not been minutely acquainted with every step which ruptures take in their progress?”

Duverney met it post-mortem, and communicated his observations to the Royal Academy of Sciences, but they were not printed in their Memoirs. In a female, upon both sides of the pelvis, the peritoneaum had protruded through the openings of the obturator canal, and formed tumors the size of an egg. They contained intestine, were placed between the anterior heads of the triceps, and formed an external tumor. The first publication in which the existence of an obturator hernia was clearly demonstrated was by Garengeot.

A case is minutely described by M. Cloquet, in which a thyroideal entero-epiplocele caused death. It produced no visible external swelling. The tumor was about the size of a small hen’s egg, and contained sphacelated intestine and omentum. It was covered by the pectineus and adductor longus, and rested on the vessels and nerve. In the very large number of dissections which Cloquet made for the purpose of studying hernia, he naturally examined the thyroideal canal, and gave it as his opinion that this variety of hernia was much more common than is generally supposed. In post-mortem examinations, as usually conducted, I am sure the peritoneaum in this locality is rarely made the subject of investigation.

PLATE XLIV†

Contains two views of a thyroideal hernia (or hernia foraminis ovalis). A view of a perineal hernia in the possession of Mr. Cutcliffe, of Barnstaple. Also a hernia congenita in the female, and a crural hernia sent me by Mr. Allan Burns, surgeon, of Glasgow.

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† Cooper, Plate XI, Part II.
Figure 1.
Thyroideal hernia.
a. Symphysis pubis.
b. Spine of the ilium.
c. Abdominal muscles.
d. Acetabulum.
e. Tuberosity of the ischium.
f. Ligament of the obturator, or thyroid foramen.
g. Crural artery.
h. Arteria circumflexa ili.
i. Spermatic vein.
j. Obturator artery.
k. Inguinal hernia drawn aside.
m. Thyroideal hernia situated just behind the pubes.

Figure 2.
Posterior view of the same preparation.
a. Symphysis pubis.
b. Tuberosity of the ischium.
c. Sacr-sciatic ligaments.
d. Ligament of the thyroid foramen.
e. Abdominal muscles.
f. External iliac artery.
g. Epigastric.
h. Circumflexa ili.
i. Spermatic vein.
j. Internal iliac artery.
k. L. Obturator, or thyroidal artery.
m, m. Internal pudendal artery.
n. Mouth of the inguinal hernia.
o. Mouth of the thyroideal hernia.

Figure 3.
Perineal hernia.
a. The lumbar vertebrae.
b. Spine of the ilium.
c. Sacrum.
d. Spinal marrow.
e. Symphysis pubis.
f. Erector penis.
g. Accelerator urinæ.
h. Bulb of the penis.
i. Corpus cavernosum.
j. Corpus spongiosum.
k. The rectum.
l. The bladder cut open, which it is not in the preparation.
m. The urethra.

n. Prostate gland.
p. Vesicula seminalis.
q. Anus.
r. Mouth of the hernia.
s. Body of the sac.
t. Its fundus, terminating nearly opposite the anus.

Figure 4.
From Mr. Allan Burns:
a. The spine of the ilium.
b. The tubercle of the pubes.
c. The crural arch.
d. The abdominal muscles.

5. The inferior or external orifice of the inguinal canal. The canal itself in this subject is very large and short, and contains—
6. An incipient hernia congenita. The pillars of the canal are here seen to separate from each other fully an inch above the tubercle of the pubis, by which the herniary tumor appears much nearer to the spine of the ilium than it ought to do, and on the opposite side, where it protruded farther, it took the direction more of the crural than of inguinal hernia.

7. The lower pillar of the canal inserted into the tubercle of the pubes.

8. The upper pillar, in part, inserted into the tubercle, but a production arising from it, which encircles the head of the gracilis and triceps muscles, reaching to the posterior part of the thigh, where it is lost. The healthy and morbid action of this fillet has been already explained.

9. Gimbernat’s duplicature protruded so as to form an envelope of the herniary sac, which has been removed to show the parts more distinctly.*

10. The opening which had been originally placed in the center of the septum, stretched across the crural foramen.

11. The falciform process of the septum receiving a part of the protruded duplicature, and concealing from view the femoral vein.

12. The psoas aponeurosis covering the pectineus muscle, and rising up between the vena saphena and deep-seated vein to join the falciform process.

13. The vena saphena.

14. The (seat of the) femoral artery.

* I have called this the fascia propria of the hernial sac.
Hilton* reported a case simulating intestinal obstruction within the abdomen, to relieve which gastrotomy was performed.

According to Mr. Birkett, the first surgeon to operate, followed by cure, was Mr. Obrè, of London, in 1851. Patient, a tall, stout female, aged fifty-one. He incised the sac and its orifice, and returned a congested loop of intestine. The next report which I find was in 1853, by B. Cooper.† Division was made and contents returned; recovery was slow, but satisfactory. The same year M. Case‡ operated, followed by cure. A most interesting case is reported by Welsch,* where a portion of the end of the processus vermiformis and a very small part of the urinary bladder were carried into the sac. An abscess supervened, followed by death.

Since the above dates I have found reported twelve operations undertaken for obturator hernia, with seven recoveries.

The following case of right obturator hernia is reported by Mr. Charles Frith,| of London. "A thin, feeble, elderly woman had suffered for a number of years from a swelling at the upper and inner part of the right thigh. By careful manipulation the contents of the bunch could be pressed upward, with a sudden gurgle. She had worn a truss for years. Marked symptoms of intestinal obstruction had existed for some days, and she was very ill when first seen. A tense, fluctuating, fist-size tumor presented at the upper and inner part of the thigh. It was painful upon pressure. The femoral vessels could be distinctly felt at the outer side, seeming to be pushed aside by the tumor. Poupart's ligament could be plainly made out, and no hernia could be felt in either the femoral or inguinal ring. A vertical incision, four inches long, was made over the tumor midway between the line of the femoral artery and the spine of the pubes; the adductor longus was pulled down and inward and the sac brought into view. This was thick and tough, and upon division more than a pint of blood-stained, offensive fluid escaped. The bowel was found deep down in the upper and outer part of the wound. The thyroid membrane was nicked in a downward and inward direction and the intestine returned into the abdomen. The sac was dissected out and removed. Death occurred some hours later, from collapse. The

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| British Medical Journal, April 19, 1850.
OBTURATOR, OR HERNIA OF THE FORAMEN OVALE.

post-mortem examination showed that eight or ten inches of the intestine had been strangulated—the portion of the ileum near to the ileo-cæcal valve."

Dr. Josef Englisch, of Vienna,* reports a second case of obturator hernia which came under his observation, and figures a truss which he has constructed especially for its retention. The article is of considerable length; the author reviews the literature of the subject, and concludes that not more than two hundred cases have been reported, but this teaches that obturator hernia has been recognized much oftener than is generally supposed.

I have met with this variety of hernia only once. A girl of twelve years was considered well until three days before death. She received a severe strain from sliding down the banister-rail of a stairway. Continued at school the following day; was seized with symptoms of intestinal obstruction, stercoraceous vomiting, and was in extremis, when I was summoned by the late Dr. Moses F. Church, of Cambridge. There was an illy defined, tender tumor upon the inner side of the thigh below the pubes, the size of a small egg. The abdomen was tense and tympanitic. The fact that strangulation had existed for so long caused taxis under ether to be undertaken with more than the usual care. Failing in this, and fearing the intestine was necrosed, and possibly further intra-abdominal complication existed, I determined to perform laparotomy, and in this I was aided by Drs. Church and G. W. Nash. By careful manipulation of the intestine, gentle pressure being made upon the tumor, a loop of darkly congested, small intestine was withdrawn and the wound closed. The recovery from ether was unfortunately complicated by the vomiting of an enormous quantity of dark fluid, a quart or more. The prostration was extraordinary, and death supervened in a few hours. This and one or two other instances, where intestinal obstruction had existed for a considerable period, have taught me to feel that, in such severe cases, a careful washing-out of the stomach before operating is of the first importance.

Although rare, this variety of hernia has been treated here at the greater length since in most works it is scarcely more than alluded to. I have no doubt it often escapes observation, and death from obscure abdominal inflammation is the verdict generally rendered. Since the great majority of hernial cases must come under the observation of the general practitioner, it is well to emphasize the possibility of this very dangerous variety.

* Wiener klinische Wochenschrift, December, 1891.
The only pathological specimen of this variety of hernia which I have ever seen I examined last year in the Museum of the College of Physicians of London. The following is the description given:

2689. Part of a pelvis, with a strangulated hernia of a small portion of ileum through the obturator foramen on the left side. The sac is opened anteriorly; it protrudes straight through the foramen at its upper and inner part.—From the Museum of John Howship, Esq.
CHAPTER XIV.

ISCHIATIC HERNIA.

A few cases of this rare variety of hernia are on record. The tumor can not be discovered until of a considerable size, since it is covered by the gluteus maximus. Lawrence wrote that "it has never been diagnosticated upon the living subject." Sir Astley Cooper reported at length a case dying of intestinal obstruction where the autopsy showed a strangulated ischiatic hernia, and he illustrated it with two plates, which I give.

A brief abstract of the case of ischiatic hernia from the dissection of which Mr. Cooper made his plates, is of interest.

On the 18th of April, 1800, Dr. Jones first saw a young man, a clerk in a mercantile house, aged twenty-seven. A few hours previous he was seized with nausea, retching, and violent pain in the epigastric region. Earnest effort was made without avail to relieve the marked intestinal obstruction, until the 25th, when death supervened. Upon dissection it was found that the ileum had descended on the right side of the rectum into the pelvis, and that a fold of it was protruded into a small sac. Dr. Jones reported the case to Mr. Cooper, who thought it worthy of further investigation. Mr. Cooper, in his work, refers obscurely to the then common practice of obtaining interesting specimens through the illegal service of the "body-snatchers," and says, "After considerable difficulty the doctor and myself opened the body a second time, and I removed the portion of the pelvis in which the hernia was situated, and which will be seen in Plates XII and XIII of this work."

"... In order to get at the parts more conveniently, a ligature was made on the ileum just at the place where it enters the pelvis, and around all the intestines above the pelvis; this gave a fair and ample opportunity of perfectly satisfying ourselves with regard to the nature of the case; after which the intestine was gradually withdrawn from the sac, in which it was rather firmly confined. On examining the surface of that part which had been contained in the sac, it was found to have adhered at two points by coagulated lymph. The strictured part of the intestine, and about three
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

Inches of it on each side, were very black; the intestines from the hernia toward the stomach were very much distended with air, and had here and there a livid spot on them. There was also a dark-colored spot on the stomach just above the pylorus. The colon, as far as its sigmoid flexure, was so rigidly contracted as not even to admit the passage of air through it, but was of its natural color, and the inflammation had scarcely extended to the cecum.

"Upon careful dissection of the parts after they had been brought to my house, we found a small orifice in the side of the pelvis, anterior to, but a little above, the sciatic nerve, and on the fore part of the pyriformis muscle. When the finger was passed into this opening it entered a bag situated under the gluteus maximus muscle, and this was the hernial sac in which the portion of intestine had been strangulated. The cellular membrane, which connects the sciatic nerve to the surrounding parts of the ischiatic notch, had yielded to the pressure of the peritoneum and viscera. The orifice of the hernial sac was placed anterior to the internal iliac artery and vein below the obturator artery, and above the obturator vein; its neck was situated anteriorly to the sciatic nerve, and its fundus, which was on the outer part of the pelvis, was covered by the gluteus maximus. Anterior to, but a little below, the fundus of the sac was situated the sciatic nerve; behind it, the gluteal artery. Above, it was placed near to the bone; and below, appeared the muscles and ligaments of the pelvis."

PLATE XLV *

Gives an internal view of the ischiatic hernia from Dr. Jones's patient. The preparation is in the anatomical collection at St. Thomas's Hospital.

\[\begin{align*}
a. & & \text{Section of the pubes.} \\
b. & & \text{Spinous process of the ilium.} \\
c. & & \text{Sacrosciatic notch.} \\
d. & & \text{Obturator foramen.} \\
e. & & \text{Psoas muscle.} \\
f. & & \text{Pyriform muscle.} \\
g. & & \text{Coccygeus muscle.} \\
h. & & \text{Termination of the common iliac artery in the crural.} \\
i. & & \text{Beginning of the crural vein.} \\
j. & & \text{Trunk of the common iliac artery.} \\
k. & & \text{Internal iliac artery.} \\
\end{align*}\]

\[\begin{align*}
l. & & \text{Obturator artery, which may be traced before the sac as far as the obturator foramen.} \\
m. & & \text{Obturator vein, which may be traced before the sac as far as the obturator foramen.} \\
n. & & \text{Internal iliac vein.} \\
o. & & \text{Obturator vein passing behind the hernia to the obturator foramen, from which another vein (\(\rho\)) is seen passing into the iliac vein.} \\
p. & & \text{Hernial sac.} \\
q. & & \text{Its orifice.} \\
r. & & \text{The artery was injected with red wax, the vein with yellow, which is the reason the artery is so much darker than the vein in the plate.} \\
\end{align*}\]

* Cooper, Plate XII, Part II.
ISCHIATIC HERNIA.

Camper also recorded a case where the ovary was in the sac. Should ever the question of operative interference be deemed advisable, Sir Astley Cooper recommended that the safest direction in which the orifice can be dilated will be directly forward.

The following case is reported by Lawrence: * "An exception must be made to this remark if we admit, according to the general opinion, that the case described in Papen's Epistola de stupenda Hernia dorsalis was an ischiatic rupture. A woman, at the age of forty, perceived near the right side of the anus a small tumor, which gradually increased into an immense pendulous bag, hanging down to the knee. She was obliged to lie on the left side, to suspend the tumor from the back when at work, and to elevate and compress it in order to promote the evacuation of the feces. Frequent borborygmi were heard in the part. It seems that this great infirmity did not materially affect the patient's health, nor prevent her from following laborious occupations, as she died suddenly while employed in harvest-work, and her body was very fat. The swelling resembled an oblong flask, narrowest toward the anus and increasing below. Its length was an ell, and the circumference of the lower part half an ell. It formed a cavity lined by peritonæum, containing all the small intestine, with part of the large and of the omentum. The course of the stomach described a perpendicular line, and the pylorus was at the entrance of the sac in the pelvis. The opening at which the parts protruded is by no means clearly described. The circumstance of the swelling having been perceptible when small, of its situation near the anus, and of its increase to so great a bulk, make me doubt whether the parts had passed out at the sacro-sciatic foramen" (Halleri Disput. Chirurg., tome iii). The following case is mentioned so shortly that it also must be classed among the doubtful instances: "My father had occasion to visit a child with a large tumor under the glutæi muscles, which became tense when the child cried, owing to the tumor containing a large portion of the intestine." (Monro. Morbid Anatomy of the Human Gullet, etc., p. 380.)

M. Alex. Wassilieff † describes a case of this rare form of rupture. The patient, a man aged fifty-four, was seized with pain in the left buttock when straining during defecation. Symptoms of acute strangulation set in. After careful exploration ischiatic hernia was diagnosed. The rupture was very tender. Taxis was undertaken, after preparations for an operation, and the mass went back. Relief was almost immediate. In the night, after a free escape of flatus, the symptoms recurred during

* Treatise on Hernia, p. 473.
† Revue de chirurgie, March, 1891.
an attempt to defecate. Taxis again effected reduction, and a stout pad was fixed, by means of a bandage, over the region of the great sciatic notch. M. Wassilieff divides ischiatic hernia into a suprapyramidalis variety, where the intestine escapes between the border of the great sciatic notch and the upper margin of the pyramidalis. This is the commonest form, and if an operation be attempted the stricture should be divided toward the notch. The subpyramidalis variety includes a form where the intestine escapes between the lower border of the pyramidalis and the lesser sacro-sciatic ligament (supraspinous), and a form where it passes out between the lesser and the greater ligament (subspinous), but it is doubtful whether subspinous ischiatic hernia has ever occurred. Diagnosis is always difficult. The seat of the tumor and the pain, which appears to be severe owing to the hardness of surrounding structures, as well as the general symptoms of hernia, are the chief guides to diagnosis. The hernia may contain omentum, large intestine, small intestine, bladder, or ovary. In operation, the skin incision must be parallel to the line of ligature of the gluteal artery.

PLATE XLVI.*

A Posterior View of the Ischiatic Hernia.

a. Anterior superior spinous process of the ilium.  
b. Crista of the ilium.  
c. Sacrum.  
d. Os coccygis.  
e. One of the sacro-sciatic ligaments.  
f. Acetabulum.  
g, g. Sciatic nerve.  
h. Gluteal artery.  
i. Ischiatic hernial sac situated between the artery and the nerve.

The weakening of the pelvic floor in woman from child-bearing is a common cause of a downward displacement of the pelvic contents. By the earlier writers quite a number of these lesions are described under different varieties of hernia, as pudendal, vaginal, and perineal hernia; also hernia of the urinary bladder, through the vaginal outlet, cystocele, etc. All these displacements are important and interesting, but come more properly under discussion in the consideration of the injuries and diseases of the female organs rather than in a general treatise upon hernia.

* Cooper, Plate XIII, Part II.
CHAPTER XV.

CÆCAL HERNIA.

A very considerable variety of pathological conditions are met with in hernia which have been indirectly referred to already. An attempt has been made to classify some of these conditions, designating them from the character of their contents. Most of these varieties are rare, and yet it is well to know that such herniae may be met with. Perhaps as interesting as any of the rarer forms is that called cæcal hernia, because usually the cæcum is so fixed that it is not easy of displacement.

"Left inguinal hernia containing the cæcum and appendix, the latter having developed into a tumor.* A man, aged sixty-four, had suffered from hernia for fifteen years, continuing, however, at his occupation as porter. For a long time the tumor had not been entirely reducible, but was retained in position by a truss. After an injury from a fall, it became larger, and for three days it had resisted every attempt at reduction. On entrance into the hospital the tumor was soft, not tender, or painful on pressure. Inguinal ring readily admitted the extremity of the finger. It was easy to determine the existence of a hard body, the size of a nut, as a part of the contents of the hernial tumor. Taxis under ether having failed to reduce the contents of the sac, kelotomy was performed by Prof. Pomcet. The contents of the tumor were made up of the ascending colon with fifteen or twenty centimetres of the small intestine. Slight adhesions fixed the intestine to the sac. The hard body proved to be the extremity of the appendix vermiformis, the size of an almond, with the pedicle about five centimetres long, the size of the little finger. This was ligatured and resected. After some days insanity developed without any explanation of the cause, and he was removed from the hospital in this condition, repair of the wound having gone on without suppuration. Examination of the appendix showed the walls to be greatly thickened and the pouch filled with fecal material."

The case is interesting, since we have already noted that hernia of the cæcum is

rare, and especially occurring upon the left side, and the pathological conditions which had supervened in the appendix makes the case one of extreme interest.

R. S. Black * reported an interesting case of left caecal hernia which was accidentally discovered.

*Post-mortem.*—"On lifting aside the coils of the small intestine, the large gut was seen crossing obliquely from the right lumbar region at the lower level of the kidney and applied to the posterior wall of the abdomen till it disappeared through the left internal inguinal ring. On making firm traction, the bowel gradually slipped from the ring, and the contents of the hernial sac were then seen to be the caecum with the appendix vermiformis and a small portion of the small intestine at its junction with the caecum. Eight or nine inches of the large intestine were thus included in the sac, and there were no remains of a meso-caecum." Although the caecum is oftentimes rather loosely attached, which permits of considerable motion, it is exceedingly rare to find it as a part of the hernial contents, and obviously much more extraordinary when transposed to the left side of the body. A case of left inguinal hernia in a male containing the caecum is described in Billroth's Handbuch, 1878. Mr. Treves met with a case occurring in a female where a left inguinal hernia contained the caecum and its appendix.

Mr. William H. Bennett † reported a case of caecal hernia entirely wanting in a peritoneal sac, in which strangulation at the internal abdominal ring existed with intussusception through the ilco-caecal valve. "A laborer, aged fifty-two, was admitted into St. George's Hospital, October 26, 1889, with a large irreducible strangulated scrotal hernia. An oval fluctuating tumor was exposed, which had not the appearance of peritoneum and which was suspected to be intestine, although no peritoneal sac had been seen. The constricting soft parts were freely divided, and yet the hernia remained absolutely irreducible; and as the tumor contained a hard mass of doubtful character, it was opened, when a large quantity of perfectly clear fluid escaped. The opening had been made into the caecum, and projecting into it through the ilco-caecal valve was an invaginated piece of intestine three inches long. The caecum was entirely free from peritoneal covering, but behind it, adherent to the testicle, was a piece of omentum lying in a peritoneal sac, presumably a reducible hernia, which the patient had described. All attempt at reduction of the hernia and the intussusception failed.

* British Medical Journal, November 22, 1890. † Ibid., February 1, 1890.
and a temporary artificial anus was made. Patient died three days later." The conditions described were considered as unique by Mr. Bennett.

Mr. Treves, in discussing the case, stated "that, so far as he was able to learn, this case was without parallel. He had collected fifteen cases of hernia of the cæcum, in thirteen of which there was a complete sac, and in two so little as almost to justify the statement that none existed. He mentioned a specimen in St. Bartholomew's Museum, which was described at length in the catalogue as hernia of the cæcum without a sac; but a careful examination showed that the hernia was of the sigmoid flexure, and that there was a complete sac. He thought this specimen was responsible for a good deal of erroneous teaching upon the subject." Mr. Treves believed that the presence of the clear, watery fluid was due to early œdema of the convex side of the intussusception.

The following case of cæcal hernia, and the complications involved in the operation for its cure, are of interest sufficient to give in detail.

"H. H.,* aged fifty-three, had been a soldier, is healthy-looking, spare man. Right inguinal hernia for eleven years. Had worn a truss. Two years ago hernia was strangulated and reduced with difficulty, a hard lump since remaining in the inguinal canal. April 15, 1891, hernia came down and could not be reduced. Constipation, nausea, severe pain, and tumor excessively tender. Sent to hospital, 18th. There is a sausage-shaped swelling at the site of the right inguinal canal, which is hard, tense, nodular, dull on percussion, and excessively tender. No impulse on coughing. Below and continuous with this swelling, and filling up the scrotum, is a much softer tumor which is neither tense nor tender. Ether was given, taxis employed without avail, and operation at once undertaken.

"Operation.—The parts having been properly cleaned and shaved, an incision was made over the sausage-shaped swelling, and after cutting through the skin a dense, hard mass was met with which appeared to be composed of fibrous tissue. On extending the incision below this mass the thin, bluish wall of the sac was discovered. This was incised, and immediately about two ounces of a straw-colored fluid escaped. No intestine was found in the sac, and it was supposed the gut slipped back when the fluid was evacuated. The sac was now slit up to the upper

* Case of Cæcal Hernia; Herniotomy; Wound of Bowel; Suture; Recovery. By Francis J. Shephard, M. D. Montreal. Annals of Surgery, February, 1892.
end, through the thickened fibrous mass, and then an attempt was made to dissect it out. This was found to be a difficult task, as it was very adherent. The floor of the sac was composed of an irregular cystic mass, with elevated ridges containing large blood-vessels. This mass on close examination proved to be omentum, which had become incorporated with the posterior wall of the sac. Posteriorly the sac was so intimately blended with the spermatic cord that separation could not be effected without destroying the vas deferens. So the cord was cut through and the testicle afterward excised. The veins of the cord were enormously distended, and the whole cord was in a state of cystic degeneration which formed a mass below the hernial sac, causing the second swelling already alluded to. After a time I managed to separate the sac and the structures incorporated with it. The neck, which seemed to be thicker than usual, was fixed beyond the internal ring, pulled down, and then tied with strong silk. It was now turned up and the scissors were used to cut it off. The first cut made from below, much to my surprise, opened the bowel. The ligature was immediately loosened, and it was now found that the cut had been made into a collapsed portion of the cæcum which was closely attached to the upper part of the posterior wall of the sac. In pulling this down farther, the appendix was seen. The cut in the bowel was about one and a half inch long, and the part of the cæcum opened was quite free from fæces. It, however, was well washed and then the cut was closed with a continuous suture of fine silk, and a Lembert suture over this again. The omentum was separated from the sac, tied off, and returned. The sac itself was ligatured below its attachment to the cæcum, and the part in front cut away and then returned within the abdomen with the sutured cæcum. A radical cure was performed by suturing the conjoined tendon to Poupart's ligament. The wound was sutured with silk-worm gut and a drain placed in the lower end.

"The patient's condition was excellent at the end of this prolonged operation, and he had no vomiting afterward. Next day his temperature and pulse were normal; there was some pain about the wound, but his condition was still excellent.

"On the 25th, six days after the operation, the wound was dressed, the tube removed, and the stitches taken out. There was union by first intention. He went on well, without a bad symptom, and was discharged from the hospital on May 16th, with a small sinus persisting where the drainage-tube had been. He returned to the hospital May 22d, saying he felt well and was attending to his work as usual. Had some pain and tenderness about the center of the scar."
"June 5th returned again with a small suppurating point at center of scar, through which protruded a silk ligature. This proved to be one of the ligatures which united the conjoined tendon to Poupart's ligament. The sinus now quickly healed, and the patient has felt well ever since, attending to his duties and suffering no pain. He has never worn a truss. In this case there was no doubt a double hernia—viz., one of the cæcum and one of the small intestines in front of the cæcum. The hernial sac which contained the small intestines and omentum, had for its posterior wall a layer of peritonaæum covering the cæcum, and as it descended it pulled the cæcum down with it. From prolonged use of a truss, and from inflammatory attacks which had occasionally occurred, the sac was thickened, and the omentum so fused with it that it really had become a part of the sac. Closely incorporated with the posterior wall of the sac was the lower end of the cæcum, which was only covered in front with peritonaæum, and as it was empty and of the same color as the sac, from having been herniated probably for some years, it was not recognized or even suspected, until, when cutting off the sac, it was opened. As soon as this occurred, the bowel was pulled down, and then it was recognized as the cæcum, and the character of the hernia was at once apparent. The cut in the bowel was immediately sutured, and no harm resulted.

"The removal of the right testicle was a necessary proceeding; for the cord and sac were so blended that a separation without injury was not possible. In one way the sacrifice of the testicle was a great gain, in that it helped to make the radical cure more certain."

The only case of cæcal hernia which it has been my fortune to meet occurred recently. A child of Mr. G., of Chelsea, Mass., aged two months, was sent me by Dr. Samuel N. Nelson. It was otherwise a strong, well-developed infant. Since birth the mother had noticed a soft swelling of the right scrotum, at times nearly the size of a small fist. The tumor was tender on pressure, and could be only imperfectly returned into the abdomen. Operation the 9th of January, 1892. The ring was large, admitting the tips of two fingers; the sac was an extremely thin layer of peritonaæum, containing a testicle. The cæcum, with three or four inches of the head of the colon and several inches of the small intestine, made up the contents of the hernial tumor. The appendix was unusually large, and was the first portion of the tumor to protrude upon opening the sac. It was with extreme difficulty that the intestine could be restored to the abdominal cavity, even after holding the little
fellow in the reverse position. Operation was performed in the usual manner, and an easy and uneventful recovery followed. Dr. Nelson has recently reported that the result is perfect.

The following case, which might be designated anal rupture, reported by Sir Benjamin C. Brodie,* is of exceptional interest, in that this distinguished surgeon was equal in his resources to the emergency of the extremely rare conditions, and promptly performed laparotomy.

"A middle-aged woman was seized in the evening with pain in the abdomen, and sickness. After straining violently in the act of vomiting, she discovered an unusual appearance, which led her to believe that she had suffered a miscarriage. The following evening she was admitted into St. George's Hospital. At this time not less than two yards of small intestine, with a corresponding portion of the mesentery, were seen protruding through the anus. The whole mass bore marks of a high degree of inflammation, and the intestine was much distended with air and liquid feces. On examining the rectum with the finger, it was found that there was a transverse slit on the anterior part of it about two inches above the anus, through which the protrusion of the small intestine had taken place. On attempting to reduce the protruded intestine, at first it readily re-entered the anus, but when about one half part of it had disappeared, the reduction became difficult, and about one fourth part of it

* London Medical and Physical Journal, June, 1827.—Singular Variety of Hernia treated by Sir Benjamin C. Brodie, Esq.
could not be reduced at all. In fact, no method could be devised by which even a part of it could be made to pass through the slit in the rectum, so as to resume its natural position in the peritoneal cavity. The pressure of the hand caused the small intestine to ascend into the rectum, where it lay only as long as this pressure was continued, and nothing further in the way of reduction could be accomplished. Under these circumstances, Mr. Brodie made a longitudinal incision of the linea alba, about two inches in length, below the umbilicus. The incision was continued through the peritoneum into the cavity of the abdomen, and the finger being introduced at this opening, by gently pulling the small intestine, that portion of it which had protruded through the slit of the rectum was readily drawn back into the abdomen. It having been ascertained, by examining the rectum with the finger, that the reduction was completed, the edges of the wound in the linea alba were brought together by sutures.* After the operation the pulse was scarcely perceptible, the extremities were cold, and the patient was sick, throwing up again immediately whatever she swallowed. In about two hours the pulse was somewhat stronger and the extremities were warmer; but the restoration of the vital powers was imperfect, and after some hours they again began to fail, and the poor woman died about six o'clock the next evening.

"On examining the body, the peritoneum generally was found much inflamed, and in many parts covered with a layer of coagulated lymph. That portion of the intestine and mesentery which had formed the protrusion, was, however, less inflamed than it had appeared to be previously to the operation. There was a transverse opening in the anterior part of the rectum, without any marks of ulceration in the neighborhood, whence it was concluded that the opening was the result of accidental laceration."

* During the operation a part of the small intestine protruded through the wound of the linea alba, but it was readily replaced after the reduction of that which had protruded through the opening in the rectum was completed.
CHAPTER XVI.

HERNIA OF THE OVARY.

The ovary forms a part of the hernial contents only very rarely, and yet sufficiently often to be held in remembrance by the surgeon; and it presents pathological conditions of such an interesting type, that I abstract freely from the valuable monograph by Dr. Robert Barnes,* of London, who states that he has exercised especial care to cite only those cases which present definite facts, and which can therefore safely be trusted as a basis for physiological and pathological study. One of the earliest authentic cases is recorded by M. Gouey, of Rouen, in 1716: “It was a case of gestation in a hernial sac of the right groin. Gouey opened the sac, and extracted an embryo of between two and three months' development. The placenta came easily on slight traction. It had grown to the circumference of the external oblique muscle.”

Puech cites this case as evidence in proof of his contention that gestation in this situation is proof of the pre-existence there of the ovary. This theory had been explicitly enunciated by Cruveilhier. Pott's classical case is almost the first well-authenticated case (1756). A girl, aged twenty-three, went to St. Bartholomew's Hospital, having a tumor in each groin, which had for several months caused her much pain. She was healthy, and menstruated regularly. The tumors were soft, uneven, easily movable, and lay externally to the tendinous apertures of the inferior abdominal wall. Pott removed them. From this time she never menstruated; her breasts fell away, and the muscular system became developed as in man.

Deault found in the dissecting-room the left ovary, tube, and the uterus in a hernial sac (1779).

Lallement (1816) relates a case described and figured by Cloquet (1831), of right crural hernia containing the uterus, tubes, ovaries, a part of the vagina, and a piece of...
epiplon. The hernia had existed for forty years. The right ovary had changed to a
cyst, and another cyst adhered to it.

"Deneux relates a case: A pluripara, four and a half months pregnant, sustained a
fall on her knees and belly; she felt a dragging in the pelvis and right iliac fossa aug-
mented by the movements of the fetus. During labor the suffering was especially
severe. A tumor was found at the inner edge of the left crural arch, irreducible, very
tender. On the seventh day after delivery the pain had become intolerable, therefore
operation for hernia was performed. A hydatid was found, and behind it an ovary.
Three fourths of the cyst and nearly all the ovary were cut off. The suffering was re-
lieved, and the patient recovered.

"Mr. Cesar Hawkins reports two cases: He operated for femoral hernia of the
right side on a lady about sixty-five years of age. She had worn a truss for many
years; it had not been reduced for a long time. Symptoms of strangulation set in.
Bowel had been incarcerated. The hernia was divided into two parts, one of which
felt like omentum. On opening the sac further, it was found to contain the whole
Fallopian tube and broad ligament, with a shriveled ovarium, and five or six inches
of intestine. On dividing the stricture the bowel readily went up, and so did also the
uterine appendages, but with some little adhesion to the sac. Recovery.

"Of Case II he says: I have a very distinct recollection of having seen it in the
post-mortem room of St. George's Hospital. The chief feature noted was the elonga-
tion of the uterus, and which, with the Fallopian tube, formed a canal fourteen inches
long. The subject was an elderly woman, who died of peritonitis. The Fallopian tube
and ovary had been lodged for many years in the hernial sac.

"Two cases reported by Dr. Oldham to the Royal Society are especially interesting:

"CASE I. A girl, aged nineteen, had never menstruated. Eighteen months ago a
swelling suddenly appeared in the right labium; it gave pain, and then it disappeared.
Four or five months later a similar swelling again appeared, with great pain. It re-
turned several times. Dr. Oldham found a tumor the size of a goose-egg between the
external abdominal ring and labium, tense, firm; the surrounding tissues inflamed,
painful. On the left side was an oval body the size of a walnut, just emerging from
the outer ring, but readily slipped back into the canal. This was the left ovary; it was
quiescent. No trace of uterus or vagina could be found. The mammary glands were
fully formed. She married. For three years the right ovary was exclusively enlarged
then for two years the left ovary was more frequently affected. This accession of a
menstrual nisus was sometimes suddenly felt. It became doubled in size, and it was plain that the whole, not merely a part, of the organ was involved. There was no vicarious flux.

"Case II. A girl, aged twenty, never menstruated; tall, stramous-looking, in weak health. Mamæ developed; no marked efforts at menstruation; pelvis fairly formed. The ovary on either side just appearing at the external abdominal ring, readily returned by pressure. Each was about the size of a small chestnut, not tender upon touch. No trace of a vaginal canal or uterus discovered.

"The late Mr. Holmes Coote published the following case: A young woman was admitted to the hospital with symptoms of strangulated hernia. The ovary and part of the Fallopian tube were found in the sac. A similar formation was found on the right side. The left ovary was removed; thickened omentum was cut away; the sickness and constipation continued. The patient died on the fourth day. The cause of the sickness was assumed to be displacement of the stomach and arch of colon. Both ovaries were developed. She had menstruated regularly. The uterus was quite absent; the vagina was a short canal an inch and a half long.

"Mr. Lawson reports a case: October 11, 1877.—The patient was a young woman. There was a small tumor of the right inguinal canal, presenting very much the appearance of an undescended testicle in a man. Selecting a time after the menstrual period, assisted by Dr. Meadows, I cut down upon the ovary, and came upon it and a rather dilated Fallopian tube. I removed the ovary and left the Fallopian tube, passing a hare-lip pin through the edges of the wound, and transfixed the tube so as to close its orifice and fasten it in the wound. The patient recovered without a bad symptom. The ovary presented numerous irregular spaces, varying in size from a pin's head to one fourth or one half an inch in length, all filled with the same kind of serous fluid as flowed from the pedicle.

"A very instructive case has been reported by Dr. Leopold.* The subject was twenty-eight years old. Menstrual molimina set in at fourteen, marked by pain, but no menstrual discharge. The pain was centered in the left groin, and from the first day of the molimen a mass there, the size of a plum, swelled and became very painful; on the decline of the molimen it shrank to its ordinary size. She married at twenty. A year later she came under treatment. The vagina was dilated by incisions and lami-

* Archiv. für Gynäkologie, 1879.
naria tents, but it does not appear that the uterus was reached. A menstrual molimen was now observed. The face became congested, and epistaxis set in. Then followed a rigor, convulsions of the extremities, and lastly, for some minutes, a tetanoid spasm. Then sweating came on, affecting the left arm and hand, the right side remaining perfectly dry. The mucous membranes vividly injected. No fever. The slightest touch on the tumor caused great pain. The woman's sufferings had become so intense that she had several times attempted suicide. The tumor was removed. On dividing the peritoneum, what had been assumed to be the ovary was found to be the fundus of the small uterus. From its outer pole arose the Fallopian tube, and from the inner pole the cord which had been felt before the operation proved to be the round ligament. The ovary and tube were first cut away, a ligature having been applied between them and the uterus. It then being found that the uterus was two-horned, the left horn was also cut off beyond a ligature. Recovery seemed complete. Examination proved that normal development of ova and their extrusion may take place with a rudimentary and closed uterus and defective vagina, and without the smallest blood-effusion in the uterine cavity.

"Boinet reported in 1858 the following case: The subject a child aged three. She had a tumor in each groin, detected six months previous. The right tumor was as large as a pigeon's egg. Both were solid. The left was reducible. At the autopsy it was ascertained that both iliac fosse were filled by enormous tumors which touched at the median line. These tumors were the hypertrophied and degenerated ovaries. A portion projected into the inguinal canal. There was no uterus. The vagina was a small cul-de-sac.

"Scanzoni relates a remarkable case of uterine inguinal hernia, gestation supervening. The subject first menstruated at twenty-one. She was delivered of a child when twenty-eight. Four weeks later, lifting a heavy wine-butt, she fell, and a hernia the size of a walnut appeared in the left groin, which could not be reduced. It swelled perceptibly at the menstrual period, but did not trouble her much at other times. Four years later she had typhoid fever, during which profuse hemorrhage ensued, and it was surmised that the uterus had entered the hernial sac. She conceived a second time, and aborted. Eight and a half months after, she conceived again. She was now thirty-nine years old, of strong, healthy frame. The tumor got as big as a man's head, and covered the pubes. The foetal heart was not heard in it, but the uterine souffle was. Pains set in, and retention of the urine. A catheter was passed into the
utus and three ounces of tepid water injected. A dead foetus and the placenta were expelled. Next day, after-pains were felt in the tumor. The tumor shrank, became less painful, and she made a good recovery.

"Englisch relates two cases of his own, and tabulates thirty-eight cases:

"E. S., single, a school-teacher, aged forty-one, admitted to St. George's Hospital, under Dr. Barnes, March 31, 1877. She had always enjoyed good health. Catamenia punctual, not subject to leucorrhœa. She sustained a rupture in the left groin at twenty-four, and has since been obliged to wear a truss. About three years ago she first observed a second swelling a little below the old rupture. She had sustained no blow or strain. This mass, she asserts, becomes almost twice its usual size at menstruation, and is tender and painful. The mass, examined a week after the cessation of menstruation, is rather larger than a pigeon's egg. It occupies the upper half of the left labium majorus, and lies obliquely from right to left. It is compressible and movable to a slight extent. Manipulation causes very little pain. Its surface is smooth. Its length is an inch and a half; breadth, one inch and an eighth. It is evidently quite distinct from the inguinal hernia when the latter protrudes. The external abdominal ring is unusually large.

"As the periodical distress seriously interfered with the patient's occupation, and her condition was not free from danger, it was determined, on consultation, to remove the tumor. This was done by Mr. Pollock, on the 7th of June. The tumor was adherent to the surrounding tissues, and had to be dissected out. There was no evidence of any peritoneal connection, nor was any trace of a Fallopian tube seen. The patient left the hospital at the end of June, quite well."

Subsequent histological examination clearly demonstrated that the tumor was ovarian. Dr. Barnes quotes the following case reported by Dr. Chambers to the London Obstetrical Society in 1880, showing that a double hernia of the ovaries may be present in the so-called hermaphrodite, thus simulating testicles:

"A woman, so reputed, aged twenty-four, had observed swellings in the groins as long as she could remember. She had never menstruated or experienced menstrual molimina. There was a short conical vagina, at the top of which was the opening of the urethra. No uterus could be found. The herniated bodies were removed, and were pronounced by Drs. Golobin and J. Williams to be imperfectly developed testicles. Sections showed the small tubules characteristic of these structures."

It will be noted that there are several varieties of hernia where the ovary makes up
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a part of the contents of the sac. It may escape from the abdominal cavity by the umbilicus, by the inguinal ring, by the femoral canal, or through the ischiatic foramen. Inguinal are obviously the most frequent, since the ovary would be more likely to follow the opening which might exist for the passage of the round ligament.

Of Dr. Englisch's thirty-eight cases, twenty-seven were inguinal, nine femoral, one right obturator foramen, and one ischiatic.

Dr. Byford, of Chicago, reported a case of complete hernia of the left ovary. He removed it, and cure resulted. A very few cases are on record where the Fallopian tube and uterus together with the ovary were found in the hernial sac.

Schmidt* wrote that inguinal ovarian herniae are mostly congenital, and that when congenital consist of both ovary and tube, but the acquired hernia contains the ovary only. The broad ligament is generally dragged outward and the uterus is drawn near the hernial ring, and therefore the hernia is irreducible. In acquired hernia the broad ligament is greatly elongated. In one of Mr. Hawkins's cases the Fallopian tube and uterus were drawn out to form a canal fourteen inches long.

A case of strangulated, right ovary having passed through the femoral canal was recorded by Mr. Owen in the British Medical Journal in 1873. Mr. A. E. Maglard,+ of Glasgow, reported a case of strangulated hernia of the left ovary in the femoral canal. Patient, aged seventy-five, first felt a small lump in the left groin three years ago. The chief discomfort was the constant desire to micturate, which disappeared upon lying down, and in this position she was enabled to return the tumor. Evidence of strangulation occurred; the swelling was tender, and the tumor solid, about half the size of an egg. Skin red; temperature 100°; pain pronounced. Adherent sac was peeled off, the tumor isolated, the ligature placed about its neck and removed. Recovery satisfactory. Microscopic examination showed it to be an ovary; in one part there was a cyst large enough to hold a hazel-nut. Within it was a mass of soft, fat-like material, mixed with blood. The most prominent symptom of the case was the difficulty of micturition, always associated with descent of the ovary.

As an illustration of the conditions which may sometimes be found, I append the following case reported by Prof. Rizzoli,++ where not alone the ovary but a greatly distended and deformed Fallopian tube made up the contents of the hernial sac: "I

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* Billroth, Handbuch der Allgem. u. Spec. Chirurgie, 1865.  † British Medical Journal, April 9, 1892.
‡ Mémoires de Chirurgie et d'Obstetrique. Prof. F. Rizzoli, Paris, 1872. Translated by R. Andreini, M.D.
have already stated that to the varieties of congenital inguinal hernia that we meet with in the male we must add a peculiar variety in the female, congenital hernia inclosing the ovary and corresponding Fallopian tube. The 12th of May, 1844, we received into the hospital of Ricovero, a female, forty-six years of age, who had symptoms of a strangulated inguinal hernia. She said that her mother had told her that at her birth she had noticed in the left inguinal region a small tumor of the form and size of an infant’s testicle. Because of this she was doubtful of her sex, until a physician, having found the external genital parts perfectly formed, assured her that she was a female. At the age of puberty the swelling increased and the menses presented nothing remarkable. After marriage she was delivered of two girls. She was twenty-two years old at the birth of her first child, and twenty-four when the second was born. At the time of her last delivery she felt a violent pain in the left groin, and shortly after the tumor increased in size, presenting all the symptoms of a strangulated hernia. An attempt was made to reduce the hernia, but failed. Then various bandages were tried, but the intestine came down again, and there was developed a labial inguinal hernia. At her entrance to the hospital the symptoms were such that we thought the intestine had become gangrenous. Herniotomy was immediately performed. When the sac was opened, I found a large loop of strangulated ileum. Upon the reduction of the intestine, a second viscera presented having the form and dimensions of a new intestinal loop, b (Fig. 15).

"I at once recognized the tube. It was enormously dilated, and adherent to the ovary (a) and to the internal wall of the inguinal canal. The serious lesion of the intestine caused me little hope of success in the operation, although I had had already cases of strangulated intestine which, although threatened with gangrene, had returned to their normal condition after operation. I did not desire to cut away the ovary, as a few surgeons
advise, so I decided to cut the adhesions which united the peritoneum and the horn of the ovary to the neighboring parts and return all into the abdomen. Notwithstanding all our care, success did not crown our efforts. She died six days later.

"The autopsy showed that the cause of death was the sloughing of the strangulated intestinal loop which had been reduced. It showed also that the ovary (a) contained in the hernia was greater than that of the opposite side (d), and that the tube, enormously large, resembling a loop of intestine, had thickened walls and contained a body that Prof. Alessandra believed to be a pathological ovum. The large ligament which we had cut in order to reduce the ovary and tube, and the peritoneum itself, had no trace of inflammation."

Dr. G. Pacinotti reported the following interesting case of acquired femoral hernia of the ovary, its removal followed by cure:

L. S., a housewife, forty years of age, and married, had always been well, except an intestinal crural hernia, which some five years before became incarcerated and was successfully operated on. She returned home, wearing as a precaution a truss. A year after the operation she noticed that another hernia had formed in the opposite groin. Although this was quite troublesome, she did not consult a physician. One day, after a violent sneeze, the tumor suddenly increased in size, became more consistent and painful on pressure, while she found that she could not reduce it, as she did before. Still, she had no symptoms of incarceration, as she had had with the hernia of the other side. The tumor increased in size and became more painful during the menstrual periods. Finally, the hernia becoming more troublesome, she only obtaining relief during menstruation by lying on her back with her thigh flexed upon the pelvis, she entered the hospital. On examination, a swelling of the size of a pigeon's egg was discovered in the middle of the base of Scarpa's triangle. It was covered with normal integument, gave on pressure a feeling of unequal consistency; above, it seemed pediculated, was resistent and painful on pressure. The pain did not radiate to the abdomen, but rather to the uterine region. The uterus was found in anteversion, and drawn toward the side on which the hernia was situated. There were no enlarged glands to be discovered. A longitudinal incision was made through the hernial sac, and the ovary was discovered as a hard and fibrously degenerated body, occluding the opening of the sac. Several small cysts of the fimbriae of the Fallopian tube were removed, the adhesions of the Fallopian tube broken up, and the ovary returned entire into the pelvic cavity. The hernial sac was then removed entire, and the neck of the sac stitched
as high up as possible. Four sutures were placed through the crural ring, and the skin sutured over the whole with silk. Union took place by first intention.*

The herniated ovary presents a small ovoid tumor, circumscribed, resisting, without change of color of skin, and always more or less painful; its size rarely exceeds that of a walnut. The pain is increased by pressure, and extends in the direction of the broad ligament toward the uterus. The uterus itself is often deflected, so that its fundus is included toward the opening from which the ovary escapes. If the patient stands up, or lies on the opposite side, the pain is increased, and is attended by a sense of dragging. This variety of hernia is attended neither by vomiting, colic, nor constipation, and does not by itself return into the abdomen.

The ovary, when within the sac, may become inflamed, contract adhesions, and be shut off from the abdominal cavity. It may also undergo a considerable variety of pathological changes. Cases of cystic degeneration have been reported, sarcoma, etc.

The surgical treatment of hernia of the ovary is generally indicated. Dr. Barnes advises this: "Even if it should appear that the hernia is reducible, it will generally be preferable to remove it than to return it within the abdomen." When the ovary has escaped through the ring it is always painful. A truss can not be borne, and if returned within the abdomen it is retained with great difficulty. When not strangulated, the pain is often so severe as to make its removal necessary. No special direction is indicated as to the surgical procedures to be undertaken for the cure of hernia of the ovary.

* La Sperimentale, No. 11, 1890. Dr. G. Pacinotti, Camerino, Italy.
CHAPTER XVII.

HERNIA OF THE BLADDER.

The older writers described under this name the varieties of cystocele in woman dependent upon the loss of, or relaxation of the perineal floor, usually incident to, or following the injuries attendant upon delivery. As defined at present, these seriously disabling conditions do not properly come under the term hernia, and their discussion is foreign to the purposes of this work.

Portions of the bladder may become displaced through the openings of the abdominal wall forming part of a ventral hernia, resulting from injury or an imperfectly closed wound after a laparotomy; or they may escape through the femoral ring, or an opening in the pelvic floor; but much more frequently it occurs as a part of the contents of an old, direct, inguinal hernia. Hernia of the bladder must necessarily be rare, since the anatomical disposition of the parts is such that, in the normal condition, the fundus of this organ rises above the brim of the pelvis only when the cavity is distended; and it is generally true that, when the very rare condition of hernia of the bladder is met with, it is owing to adhesions to other organs which have become displaced, and thus this viscus is dragged down into an abnormal situation. Under conditions of this character the bladder has been found to form a part of a large scrotal tumor, the emptying of which could only be effected by lifting the mass above the level of the brim of the pelvis. In large, old hernia: the elongation of the peritoneal sac gradually draws into the ring that portion of the peritoneum which is attached to the bladder, and the bladder itself becomes little by little involved in the protruding mass. When only the anterior part of the bladder is involved, it will have developed without a true peritoneal covering, since that portion alone is included beneath the reflection of the peritoneum. An illustration of this condition is found in the appended case reported by Mr. Percival Pott, which is of sufficient interest and value to be quoted entire: “A poor fellow who worked with a farmer at Islington came to St. Bartholomew’s, with a troublesome swelling in his scrotum. The tumor was large, tense, of a pyramidal figure, palpable, contained a fluid, gave no pain but from its weight when full,
and had every mark of a hydrocele, except that the testicle was perfectly distinguishable at its bottom. While I was hesitating concerning this circumstance, the man said, 'Sir, I can get rid of it all by urinating, but it fills again in a few hours, especially if I drink.' Upon my seeming to disbelieve what he said, he took up his scrotum, and, squeezing it together with some violence, discharged the whole by the urethra."

"A boy, about six years old, was seized with an acute pain about the region of the pubes; it lasted nearly an hour and a half, and suddenly ceasing he became perfectly easy. During the time the pain lasted he could not discharge a drop of water, although he endeavored to do so, but as it ceased he urinated freely. A few days later, a tumor about the size of a pea was discovered in the spermatic process, just below the groin. By slow degrees it descended lower and lower, and increased in size; when it had got to the upper part of the scrotum the boy found himself more frequently urged to make water, but without pain. Within the space of five years it got down to the bottom of the scrotum, and then it increased much faster than before. At the age of thirteen he was sent to London, as the swelling was now troublesome upon motion. Some, who first saw him, deemed it a scirrhoustesticle and advised castration, to which the friends of the boy would not submit. From the most careful examination I could make, I could not think it was formed of the testicle; but, on the other hand, I could not find any testicle on that side. The swelling was perfectly equal in its surface, was indolent, had a stony, incompressible kind of hardness, was troublesome from its weight, but never occasioned pain in the back or loins; it had all the appearance of being dependent from the spermatic process, which process had neither the feel nor the appearance of being diseased. The trouble it now gave the boy, and its disposition to increase, seemed to authorize its removal. I therefore proposed and undertook it. I made an incision through the skin and cellular membrane the whole length of the process and scrotum, by means of which I discovered a firm, white, membranous cyst, connected loosely with the cellular membrane in the same manner as a hernial sac. I dissected all the anterior part of this bag, quite clean, and found that, as I traced it upward, it became narrower and seemed to proceed from the upper part of the groin. In clearing it from its posterior connection I discovered a testicle, which lay immediately behind the body forming the tumor, and was small, flat, and compressed. The dissection of this and of the spermatic cord from the bag and from its neck gave me some trouble, but when I had finished it I found that the cyst was dependent from and continuous with a membranous duct about the breadth of the largest wheat-straw, or, what it was more
like to, a human ureter, which passed out from the abdomen through the opening in the muscle. When I had cleared this duct from all connection with the spermatic cord, I cut it off immediately above the tumor, and upon the division there issued forth about four ounces of a clear liquor, and the mouth of the cyst, expanding itself, disclosed a stone exactly resembling what is found in the human bladder.

"As there was not the least evidence of fluid, either in the bag or in its neck, before the division, its immediate effusion, and the appearance of the stone, induced me to believe that the case was a hernia cystica. In order to be certain, I stayed some time, and when I thought a quantity of urine might have passed from the kidneys, I desired the boy to try and make water; he did so, and a large stream of urine flowing through the wound instead of through the urethra, put the matter out of all doubt. He was dressed superficially, had no bad symptoms, though this portion of the bladder was totally removed; his urine came through the wound in his groin for about a fortnight, but as that wound healed it resumed its natural course, and the patient has remained free from complaint ever since, except that, the natural size of the bladder being lessened by the extirpation of a part, he is obliged to discharge his urine rather more frequently."

Mr. Cooper* had met this rare condition only twice. In the case reported in detail he was summoned because of a strangulated ventral hernia; he discovered that the patient, a man in advanced life, was the sufferer from vesical hernia.

Some years later he was enabled to make the autopsy. A large inguinal hernia of the right side had descended into the scrotum so as to occupy its lower part.

The hernial sac was formed of peritoneum, as in the common inguinal variety. It contained both omentum and intestine. Upon inflation, the bladder became nearly as large as an ostrich's egg. The bladder was situated behind the peritoneal sac, to the posterior part of which the anterior surface of the viscus closely adhered; posteriorly it was connected by cellular membrane to the scrotum and to the tunica vaginalis of the cord. On tracing it upward it was found to ascend through the external abdominal ring into the inguinal canal, where it maintained the same relative situation to the cremaster and spermatic vessels as in the scrotum; it thence descended through the internal abdominal ring into the pelvis.

Scarpa† reported an interesting case in a female infant born with the external orifice of the urethra closed by a membrane. An umbilical hernia formed, and afterward a

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† Wishart's edition, p. 385.
urinary fistula at the same place. The girl having reached the age of eighteen the umbilicus protruded about four inches. An incision was made in the above-mentioned membrane, which was of considerable thickness, and a canula introduced into the bladder by the urethra, by means of which the urine took its natural course. The fistula closed, and the tumor at the umbilicus disappeared.

A number of cases are on record where a large portion of the bladder had descended to the bottom of the scrotum. Mr. Lawrence * notes a number of such instances, with references to their publication. He also quotes, from Clement, † a case where the history and the dissection are given of a patient whose entire bladder had passed through the inguinal canal into the scrotum, where it had become enlarged by distention so as to form a tumor of enormous magnitude. The patient, a very corpulent man, about sixty years of age, had been troubled with a swelling for about twenty-five years. It was small at first, and slowly increased to its immense size, having varied but little during the greater part of the time above mentioned. The patient could not pass urine without first raising the rupture toward the belly and then rolling it about for a short time, when the urine would pass in a full stream, though he was unable to make much at one time. He had been able to take considerable exercise, and was in fairly good health, until within two weeks of death, which was the result of apoplexy. The true nature of the hernial tumor does not seem to have been suspected during life. The circumference of the swelling was twenty-nine inches; its length, fourteen inches and three quarters. The whole penis was retracted within the integuments, and the urine had been discharged through an opening resembling the navel. One of the testicles could be distinctly felt at the middle of the tumor, but the other was not discoverable before the parts were dissected. Although the rupture was so large as to extend generally over the pubes and occupy both inguinal regions, the protruded parts came through the left abdominal ring. When the inguinal canal had been exposed and opened, a portion of the colon was seen traversing it, distended with feces, but not inflamed or compressed, as the entire hand could be passed through the opening.

The tumor was found to consist of a sac resembling an enormous hydrocele, from which two quarts of fetid urine escaped by the rupture of a part which had become red.

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* Lawrence. On Ruptures, p. 455.
† Observations in Surgery and Pathology, pp. 144, 145.
and pointed before death. It was now ascertained that this sac was the urinary bladder, which had passed through the abdominal ring.

The following interesting case has been furnished me recently by Dr. Horace E. Marion, of Boston:

J. E. D aged seventy, came under my care suffering from what he called "rheumatism in the hip." A careful examination convinced me that he was suffering from malignant disease of the liver. For nearly a year he had had much trouble in urinating. He had an enormous scrotal hernia. Of late, when he desired to micturate, he was obliged, using his own words, "to pump it out." This he did by grasping the scrotal tumor and compressing it. He could then eject a stream from an almost hidden penis. This he would do as one would press the bulb of a syringe, until the bladder was evacuated. On passing the catheter I could detect its course down into the scrotal tumor, and on withdrawing the urine the tumor almost disappeared.

An autopsy by Dr. W. F. Whitney showed not only malignant disease of the liver but also of the prostate gland, with secondary deposit extending out toward the iliac fossa. It was also easy to demonstrate the bladder in the scrotum, adhesions first having been established. The prolonged and violent straining on account of diseased prostate had evidently given rise to this very unusual condition of hernia of the urinary bladder.

Mr. Arthur T. Norton, of St. Mary's Hospital, furnishes an interesting article upon the radical cure of irreducible hernia, in which he reports a case of irreducible inguinal hernia which contained large and small intestine and bladder. The scrotal tumor measured ten inches in length and nine in breadth. The patient could not pass his urine without a catheter, and stated that he had had considerable difficulty for some years in emptying the bladder, and in order to do so, he had been obliged to lift the scrotal tumor. The sac was greatly thickened, and contained a considerable quantity of omentum, the caecum with the vermiform appendix, ascending colon, small intestine, and the bladder. The intestines were everywhere adherent to the sac, and the adhesions were separated with difficulty. After these were freed it was discovered that the bladder was likewise fixed in the sac, and this, having been separated, was returned first into the abdomen. The intestine was replaced, the omentum ligatured and cut away, the sac dissected, ligatured at the internal ring, and removed, the operation lasting nearly two hours. The patient recovered with a
suppurating wound, although the operation was performed under antiseptic precautions. He was discharged in about six weeks, cured.*

When vesical hernia is uncomplicated, its diagnosis is not especially difficult, but this rarely occurs unless from congenital defect, and, as in the last case reported, it is more commonly met with as a complication in an old, large, irreducible hernia.

Further complications may supervene, decomposition of urine taking place, the formation of calculi, endangering life and demanding surgical interference. This latter procedure would not be difficult if undertaken under more favorable conditions, when this viscus could be easily returned into the abdominal cavity; pathological changes in the organ being so little marked that its restoration to normal conditions would be probable. Even when the pathological changes are pronounced, operative measures are advised for the cure of this distressing condition. The bladder must be carefully freed from its attachments and restored to its normal position. The existing complications are to be dealt with as their conditions demand; the peritoneal pouch, if existing, must be removed, and the abdominal opening closed. A catheter should be retained for a considerable period, with frequent irrigation of the bladder, until the walls of the organ have had sufficient time to become, at least in a measure, restored to their normal anatomical and physiological condition.

The recent literature upon the subject of vesical hernia is comparatively meager; and since, when met with, it is usually a complication dependent upon long pre-existing hernial displacement of other organs, the radical treatment for the cure of hernia which is now so very generally practiced will render this distressing malady less frequently met with in the future than in the past.

A few cases of perineal hernia are on record. This variety is certainly very rare, and yet more rarely recognized before death. Scarpa reported at length a case occurring under his own observation where, some years later, he made a post-mortem examination. The man attributed the cause of his hernia to a violent exertion with the legs apart and the body bent forward, when a tumor suddenly formed at the right side of the anus as large as a small nut, which receded on pressure. In one instance the intestinal contents became strangulated, but were reduced. The ileum passed into a hernial sac, of which the orifice, nearly an inch in diameter and round, was situated at the right side of the rectum and bladder, and it was protruded in

* The Medical Press and Circular, November 18, 1891.
the interval between the right side of the anus, the tuberosity of the ischium, and the point of the coccyx.

Scarpa devised a truss which this patient wore, and by which he kept the hernia reduced. It consisted of an oval pad attached to a circular steel spring surrounding the pelvis. Several cases of perineal hernia are on record as the result of injury.

**PLATE XLVII**

*Figure 1.*

 Represents a peculiar variety of internal hernia, formed by a fold of peritoneum that includes the remains of the umbilical artery. The case occurred in the practice of Mr. Ring.

  a. Pouch formed by the peritoneum.
  b, b. Remains of the umbilical artery inclosed in the fold of peritoneum.

*Figure 2.*

 Represents a steatomatous tumor in the situation of inguinal hernia in the female.

  a. Site of the external abdominal ring.
  b. Fatty tumor proceeding from the inguinal canal and forming a tumor over the pubes somewhat resembling inguinal hernia.
  c. Femoral vessels.

*Figure 3.*

 Is a drawing of a steatomatous tumor upon the spermatic cord.

  a. The tumor, consisting of lobes, which give it the character of omentum.
  b. Spermatic cord.
  c. Testis.

*Figure 4.*

 Shows a stricture at the inner ring, formed by a band given off by the fascia transversalis.

*Figure 5.*

 Is a drawing of a vesical hernia.

  a. Shows the situation of the external abdominal ring.

  b, b, b. Oblique inguinal hernial sac cut open to show the bladder.
  c. Tumor, formed by the bladder, covered only on the fore part by peritoneum.
  d, d. Represents an outline of the bladder within the abdominal cavity.
  e. Testis.

*Figure 6.*

 Shows *Fig. 5* more completely dissected.

  a. Neck of the hernial or peritoneal sac.
  b, h. Hernial sac cut open, as in *Fig. 5*.
  c. Aperture of communication between the protruded portion of the bladder and that within the abdomen; the bladder being in this view cut open.
  d. Interior of the bladder exposed.
  e. Epigastric artery, taking the same course as in oblique inguinal hernia of the common kind.
  f. Abdominal muscles.

*Figure 7.*

 An outline, explaining the descent of the bladder into the scrotum, and the manner in which a vesical hernia receives only a partial covering of peritoneum. The outer reflected line represents the peritoneum descending through the abdominal ring, and giving a partial covering to the fore part of the bladder. The inner line represents the bladder protruding through the abdominal ring; showing that the lower and back part of the viscus has no peritoneal covering.

* Cooper, Plate XIII, Part I.
CHAPTER XVIII.
UMBILICAL HERNIA.

This variety of hernia might have been placed in order after inguinal, since it is of such frequent occurrence. I have, however, thought best to discuss the herniae of the pelvic region as a group.

The connective tissue which closes the umbilical opening is much thinner than the surrounding parts, and the peritoneum is very much more closely adherent than at any other portion of the linea alba.

The umbilical opening through the tendon is not larger than a quill, and is formed, like the apertures we have already considered, for the escape of the vessels. It will be remembered, however, that these vessels are extra-peritoneal in their development and course. The umbilical arteries arise from the internal iliac arteries by the side of the bladder, and are continued to the navel, between the peritoneum and muscles. The umbilical vein after entering the ring is continued between the peritoneum and muscles; this forms the round ligament of the liver. Thus we observe the peritoneum, in normal development, is never absent beneath the umbilical site.

Umbilical hernia is often seen in infancy and childhood, but is usually small and easily controlled; it frequently protrudes in a pointed, dependent tumor, generally contains intestine, is easily returned, but usually sensitive upon pressure. Derangement of the digestion is frequently caused by it. In adults the tumor is in considerable variety of shape and appearance. This is dependent less upon the size of the opening than upon the resistance offered to its extension. In thin persons it becomes pendulous, circumscribed, and often pyriform in shape. In fat people it often extends upward as much as in other directions, is sometimes flattened, and quite concealed by the thick abdominal wall.

While, in children, the contents of an umbilical hernia escape through the umbilical ring, in adults it is rare. M. Petit met it only twice in a large number of cases, and he believed that the viscera almost always pass through an opening sit-
Umbilical Hernia.

Umbilical hernia is a congenital or acquired defect in the abdominal wall, typically occurring at the umbilicus (navel) region. The aperture is formed by the separation of the fibers of the linea alba. M. Boyer* gave the following reasons for this: "The umbilical ring is obliterated after birth, and forms a cicatrix as much more firm as the subject is advanced in age. The surrounding parts are much weaker, and consequently resist less well the viscera if any pressure is brought to bear upon them. Thus, when a distending force acts upon the umbilical region, the aponeurotic fibers separate, and form a rent through which the viscera escape. In adults the resistance of the ring is so great, as compared with that of the linea alba, that if the contents escape through the ring it is probably due to some congenital weakness. Umbilical hernia in adults is usually made up of the epiploen, rarely of intestine only, frequently of both. Congenital umbilical hernia is so called because it is formed while the foetus is yet within the uterus, and may commence at any time during pregnancy."

He classified umbilical hernia as congenital and acquired, the latter showing itself soon after the sloughing off of the umbilical cord. The parts which form this hernia escape from the abdomen through the umbilical ring by pushing before them the peritoneum which forms the sac. Some have doubted the existence of a sac, but if one dissects carefully an umbilical hernia he will find a sac, whatever the size or age of the tumor. It is true that this sac is thin, and so closely united to the skin, especially in the place corresponding to the top of the tumor, that it must be sought for with great care. The neck of the sac is always very short, round, and forms a sort of ring. The envelopes of the hernia consist of skin, a layer of cellular tissue, and the sac. Boyer reported the following case: "A woman, aged sixty, had been afflicted with an umbilical hernia twenty years. The skin which covered the tumor had become so thinned that the intestinal folds were perceptible whenever distended with gas. In lifting a basket, the skin was torn to the extent of six or eight lines, and the intestine escaped. Five hours after the accident I was called, and I found that an intestinal loop, ten inches in length, distended with gas and almost violet-red in color, had escaped through the rent. The pulse was weak, and the countenance visibly changed. It was impossible to return the intestine without enlarging the opening. I had made only a very small incision, when so large a quantity of intestine escaped that it was with great difficulty returned, and I was obliged to suture the

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* Treatise upon Surgical Diseases. M. Le Baron Boyer, 1834.
skin in order to retain it. The patient grew worse, and died at the expiration of twenty hours."

The coverings of the sac are usually intimately blended, and often distended so as to be extremely thin. Then nothing of anatomical factorage can be determined, and even the peritoneum which always lines the sac can scarcely be differentiated. The sac in rare instances may be double. The contents of the sac may be intestinal, omental, or both—in large herniae usually intestine and omentum. The contents can be generally distinguished without difficulty.

Women are much more often the subjects of umbilical hernia than men. This is dependent in large measure upon child-bearing, the distention of the abdomen by the gravid uterus, pains of parturition, ovarian tumors, etc. Women who are especially corpulent are more liable to large umbilical hernia than any other class. In these instances the omentum has generally become thick and heavy from a deposition of fat.

PLATE XLVIII.*

Shows three umbilical herniae, one of which is curious on account of two small omental herniae being formed through orifaces in the hernial sac. Figs. 2 and 3 were drawn by Mr. Cliff.

Figure 1.
The common appearance of umbilical hernia.

_\(a, a, a\). Integuments._

_\(b, b\). Abdominal muscles._

_\(c, c, c\). Peritoneum lining the abdominal muscles._

_\(d\). Mouth of the hernial sac._

_\(e, e\). Hernial sac._

_\(f, f\). Termination of the linea alba around the mouth of the sac; also seen below at _\(b\)._

_\(g\). Fascia lining the integuments and covering the sac._

In this preparation some omentum adhered within the sac, which was not included in the drawing.

Figure 2.
Umbilical hernia in a very fat person.

_\(a, a\). The common integuments._

_\(b\). The umbilicus._

_\(c, c\). Adeps between the integuments and abdominal muscles._

_\(e\). Fascia over the sac._

_\(f\). Hernial sac. The fascia, sac, and integuments adhering together at the umbilicus._

_\(g\). Opening of the sac._

_\(h\). Omentum descending to the sac._

_\(i\). Omentum adhering within the sac._

Figure 3.

Umbilical hernia.

_\(a, a\). Integuments of the abdomen._

_\(b, b\). Integuments on the sac._

_\(c, c, c\). Cicatrices from ulcers on the integuments._

_\(d, d\). Hernial sac._

_\(e, e\). Omentum within the sac, but a part of the sac absorbed so that it adheres to the skin from _\(l\) almost to _\(k\)._*

_\(f, f\). Intestine ruptured by a fall. (See case._

_\(g\). An omental hernia._

_\(h\). A smaller omental hernia._

* Cooper, Plate IX, Part II.
UMBILICAL HERNIA.

1. The hole in the sac through which the larger passed.
2. The hole in the sac through which passed the smaller.
3. Two other holes in the hernial sac.

_Figure 7._
Anterior view of the ventral hernia.
_a, a, a._ Integuments.
_b, b._ Tendon of the external oblique, and rectus muscle behind it.

_c._ Hernia.
_d._ Fascia turned from the sac.
_e._ Hernial sac.

_Figure 8._
Posterior view of Fig. 7.
_a, a._ Peritoneum lining the abdominal muscles.
_b._ The mouth of the hernial sac.
_c._ The umbilical vein within the sac.

Umbilical hernia is without question more commonly met with in the earlier months of infantile life, owing to an arrest of the processes of closure about the cord, which usually takes place prior to birth. I have myself seen one or two cases where I felt the hernia was clearly attributable to an accidental pulling upon the cord at the time of delivery before its division.

This considerable class of little sufferers are invariably troublesome patients for treatment, since it is with the greatest difficulty that mechanical means can be applied to prevent the escape of the abdominal contents, and the colicky pains to which they are subject are greatly increased by crying. This is, however, not usually a dangerous form of suffering, and a spontaneous cure is generally effected in early life. It is the better plan carefully to adjust a compress of some sort over the opening, and teach the mother the means of its retention. This is the method that naturally occurs even to the most superficial observer. It is advocated in the works of Celsus and Scultetus, and the plate of lead now in common use, covered with linen or leather, was recommended by Heister.

Children are sometimes born with a deficiency of the structures about the umbilicus. At one side of the cord there may be seen a considerable protrusion, with only the peritoneal covering, through which the intestines may be observed. Rarely, even this may be wanting. An illustrative case has been furnished me by Dr. William Hogue, of Charleston, W. Va. The boy was born with non-closure of the abdominal wall. The intestines passed through the opening and extended as far as the pubes. The opening was about two inches in diameter. The child was otherwise well developed. The bowels were replaced, leaving the funis out, and the abdominal walls were drawn together with adhesive plaster. The opening was permanently closed in about six weeks.

I quote the following case because of its peculiar conditions: "A male child,
weight ten pounds, was delivered on January 9, 1892.* There was an entire arrest of development in the skin and muscles of the umbilical region of the abdomen, the edges of the skin forming a perfect circumference of a circle whose radii were two inches, and adherent by a rounded edge to the peritoneum and reflected covering of the cord, which was spread over the whole mass adherent to the mural peritoneum. The umbilical cord passed out from the lower edge of the hernia, and one and a half inch from the pubis. The color of the mass at birth was a dark bluish-black, and the coverings so thin that the movements of the viscera within could be seen. Realizing that I had a desperate condition of affairs to deal with, and being undecided just then what to do, I covered the whole mass with dry bichloride gauze, bandaged firmly with a flannel roller an inch and a half wide, and had the child dressed, giving directions to handle carefully and prevent crying as much as possible. The same day I began to hunt up authorities upon umbilical hernia, and failed absolutely to find in any work on surgery at my command any report upon, or instructions for, dealing with such a case. Wyeth, Ashhurst, Erichsen, Reference Hand-book, etc., were searched, but in vain. In Gross's Surgery, vol. ii, p. 712, issue of 1859, is a very accurate description of the condition, and the only thing of the kind I could find. He says: 'When umbilical hernia is large, death usually takes place in a few days after birth from the effects, apparently, of peritoneal irritation. If the child survive, an attempt may be made,' etc. Seeing no possible chance for this child to survive, with the large area of peritoneum to be exposed when the cord covering should slough off, I decided that there was nothing to do but to attempt an operation. Accordingly, on Monday, January 11, 1892, and fifty-three hours after birth, the operation was made. With the assistance of Dr. James C. Bloomfield and Dr. John Ger-

* Medical Record, March 5, 1892. An Enormous Congenital Umbilical Hernia without Cutaneous Covering—Operation—Recovery. Samuel C. Benedict, M.D.
dine, the latter giving the anaesthetic, I began by attempting to dissect up the now dead and yellowish-white membrane covering the peritoneum. This was the most difficult part of the whole work, as it was firmly adherent to the external surface of the mural peritoneum, and the dissection had to be carefully done in order to avoid tearing or cutting the peritoneum, which was as thin as a cobweb and tore upon the slightest tension, exposing more than once the cavity. After dissecting off, as best I could, to the skin circumference, I divided, close down to the lower portion of the wound, the umbilical cord and vessels, now a dried and shrunken mass and giving no blood upon section. It had been hoped that I could pare the rounded edges of the skin, and, by tension upon it, invaginate the peritoneum and so approximate the edges in a perpendicular line. This was found impossible, as, besides the firm union of the skin, to the peritoneum, the liver and spleen occupied a large portion of the hernia, the intestines being at the lower portion only. I then penetrated the skin circumference with a pair of fine-pointed conjunctival scissors, curved on the flat, and cut the skin closely to the peritoneum all the way round, leaving a ring of skin an eighth of an inch wide, approximately, still adherent to the peritoneum. The skin was then dissected up for two or three inches to the sides before sufficient was obtained to approximate, and even then with difficulty, by reason of the great intra-abdominal pressure.

"The approximation was made upon the subcutaneous surface rather than upon edge of skin, in order to get a broader contact. This was held together by three silver pins, an inch long, wound with silk in the figure-of-8 way, and intermediate apposition obtained by black silk interrupted sutures. The line of approximation was about four inches long, and perpendicular, and this was first dusted with iodoform, strengthened by adhesive plaster, covered by narrow strips of rubber tissue, bichloride gauze, cotton, and a firm flannel bandage. Bichloride solution was used for personal cleanliness, carbolic acid for instruments, and boiled sodium-chloride solution for wound surfaces.

"The operation lasted fifty minutes, the child, two days' old, taking only half an ounce of chloroform and rallying promptly and in good condition. Directions were given for one drop of paregoric every hour or two, if necessary to quiet the child, and we left, satisfied that peritonitis would develop within forty-eight hours. We were agreeably disappointed. There was never any elevation of temperature or abnormal rapidity of heart's action, the child resting nicely with not over an average of a drop of paregoric every four hours.
"The wound was not examined until the third day, when it was found that the skin had become adherent over the peritoneal surface and along the line of approximation, although there was considerable redness a half-inch or more outside of this line, this gradually subsiding. Upon the fifth day it was found that the tension had loosened the silver pins, so that they, with the sutures, were removed and their place supplied by adhesive strips. On the tenth day I found a separation of the edges about an inch in length, and exposing a granular space of peritoneum one quarter of an inch wide at the widest part. This was drawn together by strapping, and a rubber plaster band, three inches wide, passed around the body, and laced over the gauze covering the wound, answering the purpose of resisting the great intra-abdominal pressure so well that to-day (January 30th) there is a complete union everywhere. The child has never acted other than any child of its age, has nursed regularly and with avidity, bowels and bladder acting normally. Paregoric has been used occasionally, chiefly at night, but never over six drops during the entire night, and the child was always easily aroused from sleep. There is now nothing to show for the hernia but the line of cicatrization, four inches long, which is a finer truss than anything else could be.

"When the little fellow cries or strains there is a slight round bulging at the umbilical opening, but not enough to give cause for further uneasiness, and this is kept down by a silk elastic bandage. The case as it now stands is an unanswerable argument in favor of a strictly aseptic mode of procedure, by which a cure has been made of a condition from arrest of development which I do not believe has ever before been attempted with success following."

In attempting the reduction of an umbilical hernia the recti muscles must be relaxed. A knowledge of the character, contents, shape, and tension of the tumor is requisite for the proper manipulation in taxis. Often, grasping with the hand and directly lifting it from the ring will materially aid in its reduction, at the same time gently kneading the neck of the tumor with the other hand. Once reduced, it is important to retain it with a truss. Instruments in some variety are to be found, but the essential is compression over the opening. This is often made easily and effectually by a firm bandage around the body, with a conical-shaped pad to fit the depression.

Umbilical hernia may become irreducible from the same causes which produce irreducible hernia elsewhere. The most frequent is the adhesion of the omentum. When irreducible, the tumor sometimes grows to an enormous size, disabling the
sufferer, if not endangering life. Ulceration of the integuments rarely occurs, but when it takes place it greatly complicates the danger. Some years since I had under observation a large hernia where the ulceration was so extensive as to lay bare to a considerable distance both recti muscles. The abdomen was of very exceptional weight, and cure was effected only by support and prolonged rest in the horizontal position.

A large cup or basin-shaped pad may often be of value in supporting the tumor produced by an irreducible umbilical hernia. A band carried over the shoulder can be arranged to relieve in part the weight when a circular belt is insufficient.

Strangulated umbilical hernia is not infrequent. It may not be as urgent as in inguinal or crural hernia, yet Sir Astley Cooper reported a case which proved fatal within eighteen hours. The danger lies, of course, in the close constriction of the neck of the sac. Here the opening through the linea alba is a circumscribed ring, entirely inelastic and firm, resisting the knife like cartilage. The intestine is often in a measure protected by a thick pad of omentum. In a case of a strangulated umbilical hernia, where stercoraceous vomiting had continued for three days—a patient of Dr. H. L. Chase, of Cambridge, March, 1881—I freed a loop of very dark-colored intestine, slightly ulcerated at its mesenteric attachment, and returned it. It was surrounded by a mass of necrosed omentum, double-fist size. This I sewed through beyond its constriction, and excised. The entire sac was resected, and the wound closed with animal sutures, followed by a rapid and permanent cure. The intestine undoubtedly escaped necrosis because of its omental surrounding.

Even at so early a day as when Celsus wrote, efforts at cure of this form of hernia were recognized as legitimate. After describing various other methods, he recommended the following: "The patient is first to be laid upon his back, that the intestine, or omentum, may be returned into the abdomen, and the umbilical perforation being then empty, the slit is to be tied together from the bottom with a needle armed with two threads, each of which are to be fastened with two knots on opposite sides of the wound, by which means the parts above the ligature will be compressed with it and fall off, and a firm cicatrix formed beneath." Celsus also advised that it was often wiser to open the sac before applying the ligature, in order to secure the safety of the intestine and omentum, having returned the contents of the sac with the finger before the introduction of the ligature. When this had been done, he recommended the use of caustics, or the actual cautery, in order, as he thought, to secure
a stronger cicatrix—a method which we recognize to-day as of chief importance because of its antiseptic value.

Paulus Æginatus adopted the method as described by Celsus, and it was long practiced by the Arabian surgeons. Avicenna, Albucasis, and Guy-de-Chauliac give descriptions of this method in their respective works. Ambrose Paré advocated the ligature without the opening of the sac, and stated that, when properly applied, it never fails of a cure. Dessault was in the habit of operating by ligature without the opening of the sac, and stated that, when properly applied, it never fails of a cure. Dessault was in the habit of operating by ligature without the opening of the sac, and stated that, when properly applied, it never fails of a cure. Dessault has performed the operation in a vast number of instances and with uniform success. Children were brought to him every week at the public theatre where he lectured, and had the ligature applied in the presence of the students; but they were then taken home and brought back daily to be dressed, until the cure was complete.

Mr. Lawrence admits that, in the great majority of cases, this method was followed by cure in the hands of Dessault, but he thinks this great surgeon ascribed to the ligature, “a safety and certainty of cure which the experience of others has not confirmed, and that he has not fairly represented the advantages of compression.”

Saviard is reported as having adopted this operation, cases of which he recorded in the early part of the eighteenth century. Heister also recommended this method, of which he gives a detailed account, using in strangulated cases what he called the latent scalpel, invented by Le Dran. After the division had been made and the contents of the sac returned, he closed the ring by a knotted suture, and dressed the wound with lint smeared with a balsamic preparation well wet with spirits of wine. This first dressing was not removed for three or four days, after which he advised its renewal daily until the cure was effected. If the patient was an infant or child, he did not recommend any support to be worn after the operation, but he advised the adult ever after to wear a girdle, to strengthen the parts and prevent a relapse of the hernia. Garengeot transcribed the method recommended by M. Petit, in which he used his scalpel armed with a button at the point. Petit dressed his wound in a manner singularly like that which has found favor recently with some of the New York surgeons, under the name of the McBurney method. He filled the opening with a pledget of lint, or a ball of linen fastened by a thread, dipped in the white of an egg. The external

* Lawrence. Treatise on Hernia, p. 472.
parts were anointed with the oil of roses. Petit reported a case which was well in five days after the operation.

Although operations for the relief of strangulated umbilical hernia were frequently undertaken for a permanent cure upon the Continent, such surgical procedures did not find favor at this early period in England. The distinguished London surgeon, Percival Pott, gave to hernia such special consideration that he published a separate work upon the subject. After referring briefly to the operations above described, as advocated by the ancients for the cure of umbilical hernia, he commented as follows: *

"The objections to either of them are so obvious that it is hardly necessary to say anything concerning them, though in this age of quackery and credulity I should not wonder to see them revived and practiced. . . . In young subjects and small herniae, a bandage worn a proper time generally proves a perfect cure; and in old persons and large tumors, it is hardly to be supposed that anybody can think of any but a palliative cure, the hazard of producing a mortification being so great.

"But suppose the subject to be young, and the tumor of such size and in such state as to make it unlikely that a bandage would do more than palliate; that the skin covering the tumor is so lax as to make it improbable that it should ever recover its former state and lie smooth, and that when it has been removed the cicatrix shall bind so tight as to prevent the future protrusion of any of the contained parts; yet who can tell what may be the consequence of this destruction of parts, and this indilatability of the skin in a state of pregnancy? I mention this because I have seen very terrible mischief from the bursting of a cicatrix on the navel during gestation; though the scar was from an abscess opened by incision, and consequently could not be supposed to be equal, either in size or resistance, to one produced by the before-mentioned operation.

"The umbilical, like the inguinal hernia, becomes the subject of chirurgical operation when the parts are irreducible, by the hand only, and are so bound as to produce bad symptoms. But though I have, in the inguinal and scrotal hernia, advised the early use of the knife, I can not press it so much in this; the success of it is very rare, and I should make it the last remedy. Indeed, I am much inclined to believe that the bad symptoms which attend these cases are most frequently owing to disorders in the intestinal canal, and not so often to a stricture made on it at the navel as is supposed.

I do not say that the latter does not sometimes happen—it certainly does; but it is often believed to be the case when it is not.

"When the operation becomes necessary, it consists in dividing the skin and hernial sac in such manner as shall set the intestine free from stricture, and enable the surgeon to return it into the abdomen, if sound, and not adherent; but if it is gangrenous or mortified, the altered part must be removed, and the fecal discharge be derived through the wound; by which means some few have preserved their lives, if such state can be called living."

Sir Astley Cooper considered operations for the relief of strangulated umbilical hernia, although in a more hopeful light than Mr. Pott, as attended with the gravest of dangers, and only to be recommended as a last resort. In common with his predecessors, he detailed at length many measures to be brought into requisition in the hoped-for reduction prior to operation. He reported a considerable number of cases where he operated, some of which were followed with the happiest results; but where the intestine was adherent to the sac it was allowed to remain, only freeing the constriction. In the illustrative case cited, the operation was performed May 18, 1804. The divided parts were sutured, and all the stitches were removed except one, on the 26th. The wound was treated with a poultice, and the patient was discharged June 15th, perfectly cured. He gave the following directions: "After the parts are returned, great care should be taken to close the wound by sutures; this is required in all operations for hernia, but especially in the umbilical, where the passage into the abdomen is nearly direct, and in which, after the strictured bowel has been relieved, peritoneal inflammation often proceeds to the destruction of the patient's life."

Scarpa, who published somewhat later, recognized that the great danger in the operation for strangulated umbilical hernia is owing to the injury of the incarcerated intestine, and says most cases are unsuccessful because the operation is almost always performed too late.

Until within a very recent period few complications in surgery have been held in greater fear, since the infective peritonitis which very generally followed operative measures usually ended fatally. I am constrained to believe, from my own experience, that by far the larger number of cases of strangulated umbilical hernia are still improperly treated, owing to this dominating fear. As in the other varieties of hernia, prolonged and repeated attempts at reduction, with the application of far too great and oftentimes ill-adapted force, are made; and even after failure by these measures, inexcusable
delay frequently follows before the physician, the friends, and the patient are educated up to the undertaking of what they consider the *dernier ressort*—surgical interference—and which, indeed, if relied upon at this period of the disease, is associated with extreme danger—a danger to be emphasized as dependent not upon the surgical measures undertaken for the relief, but upon the condition of the incarcerated abdominal organs, which have been subjected to the criminal manipulation and neglect of an incompetent adviser. The number of lives lost annually for want of proper treatment is far greater than is generally supposed, and it is hardly possible to emphasize too strongly the condemnation of the Micawber-like policy which is the too common practice in dealing with this serious lesion.

There is but one surgical rule to be adopted in the treatment of strangulated umbilical hernia; an immediate and careful attempt at reduction should be made under ether, and, this failing, the constriction must be at once divided. This generally necessitates the opening of the sac, which is important even in recent cases, in order that the surgeon may determine the condition of the constricted contents. When it is found that these admit of a safe return into the abdominal cavity, the problem confronting the surgeon is, Shall an effort be made to effect a permanent cure of the disability? I think the consensus of surgical opinion is in favor of an affirmative reply, and that the large, old, deformed sac should be resected and removed as a pathological factor. Having done this, the more common method advocated is to join the pillars of the ring with deep interrupted sutures, preferably wire, the application of an antiseptic dressing, and a supporting abdominal bandage.

The question at issue is, to determine if cure is possible, and if the measures proposed for this purpose are of a character to warrant their adoption? To Dr. H. R. Storer, of Newport, R. I., formerly of Boston, is due the credit of having first in America deliberately undertaken the cure of umbilical hernia. This was in 1866, and the operation was followed by primary union.

That cure is effected by removal of the sac and closure of the opening in the abdominal wall, few can question; and that the cure generally remains permanent, there is abundant proof. The danger of the operation has been considered sufficiently great to regard the risk unwarrantable, and this is the factor of the problem that needs most careful elucidation.

The operation undertaken for the cure of umbilical hernia, when the contents of the tumor are non-adherent and can be restored, may justly be considered as an explora-
tory laparotomy, to be done with all the care of the modern aseptic operator. He who is skilled in making and maintaining an aseptic wound has little to fear, since the danger is almost altogether summed up in the one word—infected.

In large, old, irreducible hernia the operation is less simple; adhesions of the omentum are unimportant, although there may be bleeding points in the separated parts. The omentum itself is not seldom so altered at the point of constriction about the ring as to be separated with difficulty, and so deformed as to make its return within the abdominal cavity ill-advised. It is not, however, a serious complication to remove considerable masses of omentum and to control the resultant haemorrhage. Sew through the base of the unstricted part of the omentum with one or even two lines of continuous sutures. It must be remembered that necrosis, by a too firm compression such as very commonly follows from ligation, is to be avoided. Compression evenly applied, although quite moderate, is sufficient to control any ordinary haemorrhage. Resect and return the healthy base of the omentum within the abdominal cavity. When loops of intestine are adherent, much care is demanded in separation, and oftentimes it is wiser to resect a portion of the sac at the point of adhesion. A few light-running stitches are sufficient to intrafold this—a precaution to be recommended before returning the intestinal loop into the abdomen.

In umbilical hernia the sac differs essentially from the condition in which it is found in the other forms of hernia, in that the whole peritoneal pouch is generally closely united to a thinned-out cutaneous investment. This skin, covering the sac, is of no value in the restoration of the parts; its vascularization is greatly diminished, and when, under favorable circumstances, a portion of it is retained for a special re-enforcement to the parts, its vitalization is so defective as to break down easily and complicate the repair processes. It is therefore better, as a rule, to resect the peritoneal sac and its external envelope quite to the margin of the ring. The re-enforced bands of connective tissue which surround and fortify the ring are subject to considerable modifications of treatment, dependent upon their disposition. When the opening is small, two or three deep stitches may be sufficient to unite the edges of the ring and hold them in firm apposition. If the opening of the ring is considerably larger and the edge of the ring sharp and firm, I recommend, as a general rule, the dissection of the peritoneum quite within the edge of the ring, and joining it with a line of continuous tendon sutures before resecting, as advised in the treatment of the sac in other varieties of hernia. This has its advantage, in that the abdominal cavity is thus shut off from
extraneous contact, and the subsequent steps of the operation can be conducted, if desired, under the protection of irrigation. Moreover, it refreshes the edge of the ring, which favors a better reunion of the parts. The edges of the ring are often advantageously split laterally, which permits the coaptation of the parts by a double row of buried continuous sutures.

Again, it is sometimes wiser to resect the ring altogether and close the walls of the abdomen, as in an ordinary laparotomy. I do not hesitate to advise the use of the deep, double, continuous tendon suture, applied in the same manner as recommended in femoral hernia, only the needle and tendon should be of a larger size, and the sutures taken at a considerable distance away from each side of the margins of the opening, in order to coapt and evert the inclosed portions. By the introduction of the sutures in this manner, as also in the splitting of the edges of the ring laterally, the object gained is the thickening and re-enforcement of the parts.
The superficial tissues are to be joined by a line of light-running sutures, as also the skin itself, the needle penetrating from side to side the deeper layer only, and the dressing is completed by the application of iodoform collodion, re-enforced by a few fibers of cotton. Since the patient generally has heavy abdominal walls, it is well to apply a rather firm, wide bandage. Almost the only subsequent care necessary is to maintain the patient at rest, in a position where the recti muscles are not called into use. I have had occasion to operate on a very considerable variety of umbilical herniae according to the above method, and in a number of instances have resected large portions of omentum; I have never seen any ill results therefrom, and in no case where the integrity of the intestine was not involved has the patient even approached the danger-line. So far as I have been enabled to follow my cases, cure has not alone been speedily obtained, but it has remained permanent.

Dr. Championnière,* of Paris, writes: "I believe the urgency for the cure of umbilical hernia very great, and I do not hesitate to advise every young woman, whether the hernia be large or small, to be operated upon, since she is doomed to a life-long painful and dangerous infirmity. Now, the operation is excellent, and the danger is not materially greater than in other varieties."

Sänger† contributes an interesting article upon the radical operation for the cure of umbilical hernia. He has collected, since 1879, twenty-seven cases, with only one death; of these the hernia returned in seven cases. He thinks the indications for operation for cure are, all cases of strangulated hernia, and those large and painful tumors which are retained imperfectly by a truss. He divides the tissue about the ring in two layers and unites with silk sutures. He reports three cases which he has operated upon by this method, followed by cure. He operates with antiseptic precautions, resects the sac, and dresses with a strong, firm bandage.

Before the days of the proper understanding of the active ferments as factors in the surgical problem of wound treatment, emphasized by the most serious results, whenever their incubation occurred within the abdominal cavity, we may well understand the fear and trembling associated with the name of peritonitis. The experience of the centuries had taught that the peritoneum was the "noli me tangere" of surgery. Upon this, in large measure, is yet based the general belief of the medical profession to defer

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* Études sur la Cure radicale de la Hernie, non-étranglée. Jour. de Méd. et Chir., 1888.
† Centralblatt Gynäkologie, July, 1890.
operative procedures as a last resort. This has been emphasized in a much greater degree in the consideration of operative measures undertaken for the cure of umbilical than of inguinal and femoral hernia.

The time is not far distant when the cure of this oftentimes disabling and dangerous condition will be considered as safe and simple as an exploratory laparotomy, and under proper precautions almost devoid of danger.

The description of the following catalogued specimens, which have been carefully dissected and preserved in the Museum of the College of Physicians in London, can not fail to be of especial interest, since they give us a detailed account of the surgical measures attempted by some of the most distinguished surgeons of the time:

2630. Portion of the intestine of a child, from a strangulated umbilical hernia. It is said to have been wounded in an operation to reduce it; but the form of the aperture in its coats—which is small, oval, with evenly circumscribed and abrupt thin edges, without protrusion of the mucous membrane—makes it more probable that it was perforated by ulceration or sloughing. Its peritoneal surface is thinly covered with lymph.—From the Museum of Sir A. P. Cooper.

2687. A portion of the anterior wall of an abdomen, with part of the sac of an umbilical hernia and its contents, from a woman who died twenty-four hours after the operation for hernia was performed and the contents of the sac were returned. The sac was very large; the part which remains has thick walls strongly fasciculated on their internal surface. The returned omentum is closely adherent to every part of the mouth of the sac, and the returned intestine is adherent at the back of the omentum.

Mr. Hunter used to say of it: "This is a preparation where Nature had done everything in her power; it is of the umbilicus of one on whom I performed the operation, and who died in a little time after; and here you may see that the epiploën has, after the operation, adhered all round to the inner edge of the wound."—Hunterian Reminiscences, by Mr. James Parkinson. London, 4th, 1833, p. 88.

2688. A large umbilical hernia containing small intestine, and, at the upper part, some hardened omentum. The greater part of the sac and its coverings has been removed. An incision an inch and a half long was made into the front of the intestine during life, for it was found, in the operation performed for the relief of hernia, that the intestine had sloughed beneath and near the stricture. A quill is passed into the sac and through its neck into the aperture produced by the sloughing in the intestine. Except at this aperture the intestine is everywhere adherent to the mouth of the sac, and shreds of lymph and false membrane are attached to its outer surface.

The patient, a woman thirty-seven years old, had the hernia many years. The operation was performed on the eleventh day after strangulation commenced. The cuticle had begun to separate, the skin was purple, and a part of the sac over the aperture in the intestine had sloughed. The intestine was freely opened, the omentum was cut off, and the stricture was not divided. The patient died six hours afterward.
After death, it was found that feces had escaped into the abdomen through the aperture produced by the sloughing of the intestine. This aperture, as the preparation shows, extended into that part of the intestine which was within the abdomen as well as into that in the sac immediately beyond the stricture.

The case is recorded in the Edinburgh Medical and Surgical Journal, vol. xxi, p. 293, April, 1824.—Presented by Joseph Swan, Esq.

Dr. W. W. Potter,* of Buffalo, reported an interesting case of large umbilical hernia operated on in 1877, which contained a lobe of the liver and constituted a portion of the contents of the sac.

He introduced deep sutures. Recovery followed, and, when heard from five or six years after (as by recent report), the cure remained permanent.

* Umbilical Hernia in the Adult. Buffalo Medical and Surgical Journal, January, 1879.
CHAPTER XIX.

VENTRAL HERNIA.

This form of hernia assumes an importance for present consideration entirely disproportionate to that of an earlier period, since within the last few years laparotomy has become so very frequent as to be of daily occurrence in a great variety of abdominal diseases. It is variously estimated by different authors that ventral hernia follows the closure of the abdominal wound after laparotomy in from five to ten per cent of the sum total of cases.* Although not very common from other causes, it may occur alike to both sexes and in all conditions of life. It may be situated in any portion of the abdominal parietes, but for obvious reasons it is more likely to occur at or near the median line, between the umbilicus and the pubes. As a result of the surgical division of the abdominal wall, it may happen from defective union in consequence of improper closure of the parts, the common cause of which was first pointed out by Sir Spencer Wells a number of years ago, from the fact that operators often failed to include the peritoneum in the line of their sutures. This leaves a more or less gaping wound, from within outward, of the parietal wall, and when hernia occurs from this cause it will be generally found without a peritoneal investing sac.

PLATE XLIX.

Contains an anterior and posterior view of a double umbilical hernia; also anterior and posterior views of the umbilical hernia, showing the danger of cutting the intestine within the abdomen; and two views of a ventral hernia, situated in the linea alba, about two inches above the umbilicus.

* "I have been surprised to find that thirty women out of over three hundred, or nearly ten per cent, have ventral hernia."—Dr. John Homans on Three Hundred and Eighty-four Laparotomies for Various Diseases. Boston, 1887.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

Figure 2.
Posterior view of the same preparation.
a, a, a, a. Abdominal muscles.
b. Linea alba.
c. Orifice of the larger umbilical hernia.
d. Orifice of the smaller hernia.
e. A band of tendon situated between the two herniae.

Figure 3.
Umbilical hernia, anterior view.
a, a. Linea alba.
b, b, b, b. Recti abdominis.
c, c. Lineae transversales.
d. Hernial sac within which the omentum is seen adhering.
e. Omentum.

Figure 4.
Posterior view of Fig. 3.
a, a. Recti abdominis.
b, b. Peritoneum.
c. Remains of the umbilical vein.
d, d. Remains of the umbilical arteries.
e, e. Epigastric arteries.
f. Linea alba.

g. Intestine adhering to the orifice of the hernial sac.
h, h. The omentum glued to the mesentery and to the hernial sac, forming a pouch toward the abdomen.

Figure 5.
Anterior view of a ventral hernia.
a, a. Abdominal muscles.
b, b. Linea alba.
c. Umbilicus.
d. Fascia over this hernia.
e. Hernial sac.
f. Portions of fat between the fascia and the sac.

Figure 6.
Posterior view of Fig. 5.
a, a. Abdominal muscles.
b, b. Peritoneum.
c, c. Portion of adeps at the umbilicus.
d, d. Umbilical arteries.
e, e. Umbilical vein.
f. Mouth of the ventral hernia.
g. Fat adhering to the mouth of the hernial sac, into which the umbilical vein is seen to pass.

Another and not infrequent cause of ventral hernia following abdominal operations is found in imperfect or non-union of a portion of the abdominal wound from the use of the drainage-tube, and from localized abscesses, more commonly called "stitch abscesses." These are usually the result of a localized infection, dependent upon careless or at least imperfect and unsatisfactory treatment of the abdominal wound, too oftentimes considered an unimportant factor in abdominal surgery. As Sir Spencer Wells pointed out, when the interrupted suture is used for closing an abdominal wound, it should be introduced carefully through the various layers of the abdominal wall, including the rectus muscle or the firm connective-tissue aponeurosis which unites the recti on the median line and the peritoneum. The relationship of these parts must be carefully restored in tying the sutures. I can not myself doubt that the much better method is to close the different layers of the abdominal wall in lines of buried tendon sutures. Since the adoption of this method, in quite more than one hundred cases of laparotomy, I have had but one case of ventral hernia. This occurred in a woman, after the removal of a large uterine myoma, where the abdominal wall had been for a long time extremely attenuated.

Ventral herniae may assume proportions of such exceptional character as to pro-
duce a tumor of extraordinary size. I operated in one case, assisted by Dr. Samuel N. Nelson, followed by complete cure, where the exit of the tumor was a little to the left of the median line, below the umbilicus; it was irregularly lobulated in shape; the dependent portion, when the patient was in the erect position, was some inches below the crest of the pubis, making a tumor in size nearly that of an adult head. The patient was photographed, but unfortunately the negative proved defective.

In 1887, Dr. James R. Chadwick,* of Boston, published an article upon the surgical treatment of hernia following laparotomy, based upon an operative case shown in photographic illustration. "The operation lasted over two hours. An incision was made through the wall of the sac at the lower angle of the cicatrix, and the whole sac subsequently laid open with the scissors in the median line nearly up to the navel. The transverse colon, its mesentery, and numerous coils of the small intestines were quite firmly adherent to the lining membrane of the sac at its upper angle, requiring long and careful dissection to detach them. About ten fine interrupted silk sutures were passed by means of Peaslee's needle through the integument, three inches of fat, and finally through the middle of the rectus muscle on each side, fully an inch back from the edge of the cleft." Recovery was satisfactory, and the union firm at the expiration of five months. Dr. Chadwick, after a thorough search, found only twelve published cases, of which seven were tabulated by Dr. W. Gill Wylie, of New York. Six of Dr. Wylie's cases followed the use of the drainage-tube, the seventh a second operation where the first had failed.

Two cases of ventral hernia, with cure, are reported by E. F. Neve:†

"Case I. A boy of eighteen suffered from a firm, flattened tumor, measuring five inches by four, situated in the median line between the umbilicus and ensiform cartilage. The tumor consisted almost entirely of an organized blood-clot, together with a small portion of omentum, which was ligatured and removed. The abdominal opening did not exceed three fourths of an inch. The peritoneal sac was about the size of a filbert, which was removed and the wound drained. Recovery excellent.

"Case II. Hernia, size of a child's head, containing omentum and intestine. Corpulent woman, aged forty-five. Neck of sac two inches above the umbilicus, diameter of ring two and a quarter inches. The sac was dissected and removed, the wound closed

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* Reprint from Gynecological Transactions, vol. xii, 1887.
† British Medical Journal, June 8, 1889.
with sutures. Suppuration supervened, but in four weeks the patient was discharged cured."

Dr. A. P. Dudley reported a case of strangulated ventral hernia in a woman ninety years of age, upon which he operated.*

More than a year ago I operated upon a ventral hernia which followed the third laparotomy, performed in one of the public hospitals of Boston, for the cure of diseased ovaries and tubes. The cicatrix was about four inches in length, and three distinct herniae had formed on the line of the imperfect union, associated with adhesions of loops of the small intestines—a condition which for months had rendered life miserable. The intestine was freed, and the entire cicatrix was resected, followed by primary union and a firm, strong restoration of the parts. It is not rare to find examples of ventral hernia in the median line above the umbilicus. These, so far as I have had the means of observation, are small in size, oftentimes giving little or no discomfort. Occasionally they interfere with the process of digestion, causing nausea, flatulency, and pain.

Scarpa explained the reason why he considered the greater frequency of ventral hernia occurring above rather than below the umbilicus, as due to the less compact structure of the linea alba above the umbilicus and the more close approximation of the recti muscles in the lower portion of their course.

Several cases have come to my notice of ventral hernia occurring in the lateral portions of the abdominal wall from various causes. When a ventral hernia is small and reducible, it is generally not difficult to retain it by the application of a properly fitting truss. If irreducible and troublesome, as it is likely to be, although its contents consist of only omentum, it is better to attempt its cure by surgical interference rather than by the application of the hollow-pad truss.

Strangulation of this class of hernial tumors is comparatively rare, since, from the anatomical construction of the parts, a well-defined, circumscribed, inelastic ring is much less likely to be found than in the other varieties of hernia. If, under ether, the hernial contents are not easily reduced by taxis, operative measures must be undertaken immediately, and the rule here, as elsewhere, closely followed of an attempted cure by surgical procedures. The technique is exceedingly simple, consisting of reduc-

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tion of the hernial contents, resection of the sac, and a firm closure of the abdominal walls as recommended in umbilical hernia.

It is well to remember, especially in very fat subjects, that a small hernia of the linea alba near the ensiform cartilage may be easily overlooked, and the true cause of occasional uneasiness of the stomach and vomiting escape undetected. It should not be passed without mention, that under rare conditions tumors other than hernial may be met with which sometimes render the diagnosis extremely difficult.

My late friend Dr. H. A. Martin, of Roxbury, sent me a tumor for examination, fist size, which he removed from the median line, about midway between the umbilicus and the pubis, which proved to be a calcified uterine myoma, with the hernial opening through which it had escaped completely closed. A photographic reproduction of a microscopical section of this tumor will be found in a work which I published some years ago upon uterine myoma. As an illustration of the error in diagnosis which may lead a surgeon to operative interference, I quote the following case, which occurred in the experience of Scarpa: “A few years ago a woman about fifty-five years of age was brought into this school of practical surgery, rather fat, but of a weak habit, and habitually hysterical, who in the preceding night had been attacked by very violent intestinal colic, in consequence, as was said, of an incarcerated hernia. Her abdomen was very tense, and painful to the touch, the lower extremities were cold, the pulse small, nausea, inclination to vomit, and suppression of stools. A little below the umbilicus, toward the left side of the linea alba, there was a small tumor about the size of a large nut, of the natural color of the skin. Persuaded that this tumor was a true incarcerated hernia of the linea alba, and conscious that these herniae, like the umbilical, are most prone to pass into gangrene, I proceeded immediately to the operation. Having laid open the integuments, I did not find the least vestige of a hernial sac. The contents of the tumor were small masses of hard fat continued into a pedicle, which evidently passed through the linea alba, and was removed by a stroke of the knife. I then ascertained the true nature of the disease. The general tepid bath, repeated emollient glysters, fomentations, and the use of castor-oil by the mouth in small doses, procured alvine evacuations, and the colic disappeared in a short time. The small wound was not long in healing.”
CHAPTER XX.

DIAPHRAGMATIC HERNIA.

Fortunately, diaphragmatic hernia is very rare. However, when lesions of this great muscular curtain which partitions off the organs of the body occur and dislocations of the organs supervene, it follows of necessity that the suffering is most severe, often resulting in fatal consequences. On this account the bibliography of the subject is very considerable, and a detailed study of the different phases of the disease is of exceptional interest. The limitations of the present work, however, make it necessary that this chapter be less complete than most of those preceding, since the conditions pertaining to diaphragmatic hernia are those which permit only very rarely of surgical consideration. Sir Astley Cooper gave a comprehensive review of the conditions usually present in this form of hernia; but perhaps the most detailed and exhaustive study of the subject, made by any author, is that of my late master, Dr. Bowditch,* who published an exhaustive résumé with all the data at that time available, and with his rare acumen made a careful analysis and classification of the varieties, both in kind and degree, symptomatology, etc.

As we have already observed, in treating of the other varieties of hernia, the weakest portions of the great elastic envelopes which surround and inclose the abdominal organs are found in the course of the vessels which necessarily emerge therefrom. This inherent weakness is the more common cause of diaphragmatic hernia. When, for any reason, it develops gradually, it is classified, as in the inguinal and femoral varieties, as a form of acquired hernia. A considerable proportion of the cases, however, are due to a defective development of the structures, and on this account have been denominated congenital. A third class result from injuries, and therefore are called traumatic.

In Dr. Bowditch's table, which includes all the cases of which he was able to

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*A Treatise on Diaphragmatic Hernia. Dr. Henry I. Bowditch, Boston, 1853.—Reprint from Buffalo Medical Journal.
find a record—eighty-eight in number—twenty-six were congenital, and this class comes naturally first under our consideration. Of these, the first division comprises those who die at, or immediately after birth, since, when the diaphragm is so defective as to be wanting in its physiological action, respiration is impossible. The infant may be otherwise well developed, the placental nutrition not having been impaired.

It may aid in the diagnosis to determine the location of the heart, since in this condition this organ is often found more or less displaced.

In the second subdivision, the sufferer may survive a number of years, but must be necessarily an invalid, dyspncea being rather constant, or supervening upon slight exertion. Constitutional disturbances exist, the digestion is so imperfect as to cause extreme emaciation, but the objective symptoms, in large measure, are grouped about an imperfect and difficult respiration.

Notwithstanding pronounced conditions of defective development, a number of cases are on record where the general nutrition has gone on without any marked degree of impairment, allowing the individual to pursue some light occupation without serious suffering. Although a considerable opening exists, the abdominal organs are not displaced, or, at the most, are subject to dislocation in a temporary way. When this variety of hernia is congenital, the displaced organs are not contained in a peritoneal sac, for obvious reasons. In the acquired form of this hernia a sac usually exists.

Anatomical Characteristics.—Because of structural relationships the hernial opening is more frequently upon the left side of the diaphragm. The great mass of the liver, to which it is posteriorly united, serves as a protection to the right side. The right crus of the diaphragm is longer and stronger than the left. The left side of the diaphragm contains two distinct depressions opposite the spleen and the stomach. In the analysis of the eighty-eight cases tabulated by Dr. Bowditch, hernia of the diaphragm occurred upon the left side forty-one times, on the right side eighteen times, and in only three of this large number of cases (the left side) was the sac demonstrated; while of the eighteen herniae upon the right side, in eleven the sac had formed, and in two of these it was double. In seven of the eleven cases the opening existed just to the right of, and posterior to, the ensiform cartilage. From this cartilage is given off a thin fasciculus, which leaves a small triangular space on both sides of it, which is completed only by the serous membranes of the abdomen and chest, and it is very probable that the sac usually commences to form at this
weak point. In some cases the sac has been found passing up into the mediastinum and thence into the right pleura.

Dr. Bowditch gives a diagram of a transverse section of the body, which shows that the right pleural cavity is normally much nearer the median line than the left.

The opening through the diaphragm is rounded, oval, or semicircular. This has been observed in most of the reported cases, and it is doubtless dependent upon the anatomical structure of the diaphragm, the muscular fibers of which are disposed in a somewhat circular direction. The contraction of these fibers tends to produce a rounded opening, a disposition of the parts which prevents the closure of the defect in case of injury. Of Dr. Bowditch's cases, eleven were the result of recent severe injuries, in two of which death was instantaneous.

The relative frequency of hernia of the different organs, as analyzed by Dr. Bowditch, is as follows: "Stomach, 44; large intestine, 39; omentum, 30; small intestine, 29; liver, 17; spleen, 13; pancreas, 6; mesentery, 2; kidney, 2."

In the complications resulting from the displacement of the abdominal organs, there must be more or less impairment of their functions; and intestinal obstruction caused by a loop of the bowel being caught in the hernial opening gives resulting symptoms quite similar to those from the escape of the viscera through any of the openings in the abdominal cavity. As a rule, in this variety of hernia, the thoracic disturbance and the interference of the respiration are commonly the most marked symptoms, dependent upon the impairment of the functions of the diaphragm and the mechanical displacement of the organs of the chest, the lungs being almost invariably compressed.

It is not easy to diagnosticate diaphragmatic hernia. Dr. Bowditch stated "that in the whole number of recorded cases this has never been made but twice, and in these cases it was too late to be of service. We must do better than our predecessors; better, likewise, than we ourselves have done, and recognize the affection before the commencement of the fatal attack." Of the entire number, symptoms of actual strangulation occurred in thirteen cases, all of which proved fatal. Dr. Bowditch suggested: "Finally, as a last resource, might not an operation for cutting the strangulated ring be effected? It never has been done, though Laennec suggested it. Yet I see no good reason why it may not be possible to recognize, by the physical signs, the side at which the disease exists, and the probable amount of the affection."
Having learned these two points, and having tried other means for its relief without success, ought we not to undertake the more serious operation with the scalpel?

"Where should the incision be made? Sac commence about the lower and front part of the mediastinum; therefore, near this is a proper place to commence the incision. Passing along the edge of the ribs for the space of three or four inches, we should divide the muscles, and come upon the peritoneum covering the lower part of the diaphragm, and reflected thence upon the inside of the abdominal muscles. It would be possible (I think) to push aside this membrane and not enter the cavity of the peritoneal sac until we might be able to make out the exact place of stricture, and there a very slight incision only would be necessary. But, in this operation, there is at present so much of difficulty, owing to the proximity of important organs, and to the distention and alteration of position of the abdominal organs, that it will probably have few to perform it, especially as the disease is so rare that no person would be likely to have more than one or two opportunities for operating during his whole lifetime."

The following case from Sir Astley Cooper is illustrative:

"W. R., aged thirty, was admitted to Guy's Hospital February 5, 1804. Fracture of the six lower ribs of the right side from a fall. Death occurred the following morning. Autopsy showed a small wound of the right lung.

"On pushing down the vault of the diaphragm, a fold of intestine of livid color was discovered; and, upon extending the examination into the cavity of the abdomen, a portion of the intestine, which proved to be the ileum, was found proceeding upward behind the liver into the cavity of the chest, through a large opening in the diaphragm. This opening, which appeared lacerated, was situated about two inches from the cordiform tendon, in the muscular portion of the diaphragm, and on its right side. The aperture was filled by the intestine, around which a very firm stricture existed. It had been strangulated by the muscle itself; and from the livid state of the intestine only nineteen hours after the accident, the strangulation seemed to have been unusually complete. The hole in the diaphragm had been occasioned by the broken point of the tenth rib, which had penetrated the muscle when it was in a state of expiration, and the muscle had withdrawn itself from the point in inspiration, so as to leave the opening through which the intestine had protruded.

"The viscera in the cavity of the abdomen appeared little altered in any other respect, but about a quart of bloody serum had been extravasated into both cavities."
PLATE I.*

DIFFERENT VIEWS OF DIAPHRAGMATIC HERNIA.

Figure 1.
Phrenic hernia, produced by fracture of the ribs.
a. a. The liver.
b. b. The ribs.
c, c. The fractures of the ribs.
d. The diaphragm.
e. The intestines within the abdomen.
f, f. The intestine strangulated through a laceration of the diaphragm.

Figure 2.
Phrenic hernia in the foetus.
a. a. The liver.
b. The stomach.
c, c. The colon.
d. The bladder.
e, e, e. The small intestines within the left cavity of the chest.
f, f. The diaphragm.
g, g. A bougie thrust through the aperture in the diaphragm, by which the intestines had passed into the chest.
h. The heart.
i. The right lung.

The late Dr. George A. Otis† reported in detail a case of diaphragmatic hernia, with an illustration of the specimen, to show that "the accepted doctrine that wounds of the diaphragm, whether in the fleshy or tendinous part, never unite, but remain with their edges separated ready for the transmission between them of any of the loose viscera (Guthrie), is confirmed."

"Case DXCII.—Private C. C., aged twenty-two, was wounded at Gettysburg, July 2, 1863, by a musket-ball, which penetrated the left wrist and the lower part of the left chest. Death occurred the following November. A careful autopsy was made. Right lung diminished in size; only a small portion of the left lung visible, extending from the first to the second ribs, and lying directly in the median line. The left chest was filled with the stomach, greatly distended with air. Consolidation of the left lung was complete, a portion of it sinking in water. The diagnosis of the condition had evidently not been made prior to death."

Two very interesting preparations of gunshot-wounds of the diaphragm exist in the museum at Netley. "In both instances, the stomach, colon, and omentum formed the hernial protrusions. In one, death occurred a year after the wound, from strangulation induced suddenly after a full meal; in the other, the soldier continued at duty twenty-two years after the wound, and then died from other causes.‡ All the cases

* Cooper, Plate XIV, Part II.
† Medical and Surgical History of the War of the Rebellion, Part II. Surgical Volume, p. 185.
‡ In the Museum of the British Army Medical Department, preparations 1,152 and 1,153 represent diaphragmatic
which occurred in the Crimea, in which an opening had thus been established between
the cavities of the chest and abdomen, proved fatal. . . . In case of recovery, the risk
of hernial protrusion and strangulation should be explained to the patient."

Modern surgery has rendered the exploration of the abdominal cavity comparatively
a safe process. Guthrie advocated the advisability of opening the abdomen and the
withdrawal from the thorax of the displaced organs in diaphragmatic hernia. Quite
forty years ago, Dr. Henry I. Bowditch, as we have shown by quotation, clearly sug-
gested its possibility.

The difficulty appears to be, even in the chronic cases, the determination of diag-
nosis, although in marked cases it would not seem to be difficult. This having been
established, and the suffering such as to endanger life, I do not question that it is
the duty of the surgeon to make an exploratory incision; withdraw, if possible, the
abdominal organs from the thoracic cavity, and if, as we have seen from the analysis
of the recorded cases, it commonly happens that the opening in the diaphragm is
near the ensiform cartilage, an effort should be made to effect its closure. I have
failed to find record of an instance in which this has been attempted. But a number
of the reported cases teach that this could have been effected had the attempt been
made by a skillful surgeon. There is abundant proof that diaphragmatic hernia occurs
more frequently than has been generally supposed; I have found record of seventy-one
cases published since the date of Dr. Bowditch's tabulated statistics.

Hernia not seldom exists within the abdominal cavity, caused by a displacement
of some portion of the intestinal canal through an opening in the omentum, mesen-
tery, or by some adventitious product of inflammatory character—the retroperito-
oreal hernia (mesenteric hernia of Cooper), for example. These intestinal obstruc-
tions are of a most dangerous character, and may be very difficult of diagnosis. The
consideration of them, however, comes more properly under abdominal surgery, which
at present offers to the general surgeon a chapter of greater interest than ever before.

There is but a single rule. When the obstruction to the intestine endangers life,
an exploratory operation must be undertaken in order to determine the conditions
accurately, and, if possible, restore the parts to their normal state and function.

hernia (Wilkinson's cat., p. 153). In St. Bartholomew's, specimen 74 of series xvii is an example (cat., p. 334). At
the New York Hospital Museum, specimens 406, 407 are both examples of traumatic phrenic hernia (cat., p. 189). In
the Boston Medical Improvement Society's Museum, 493, a dry specimen, is a hernia through an old stab-wound of the
diaphragm (cat., p. 141.)—(Medical and Surgical History of the Rebellion, p. 185.)
CHAPTER XXI.

COMPLICATIONS INCIDENT TO THE SURGICAL MEASURES FOR THE RELIEF OR CURE OF HERNIA.

It has long been the verdict of surgical opinion that operative measures for the relief of strangulated hernia should be undertaken with promptitude, and yet it is astounding in how large a proportion of cases a useless and dangerous delay occurs before such service is called into requisition.

There can be but one rule, and it is impossible to emphasize too greatly its enforcement, regardless of the variety of hernia or the causes which have led up to the strangulation of a portion of the abdominal contents. Each hour of delay in its reduction adds to the difficulty of its accomplishment, and almost in geometric ratio increases the danger to life. There can be no question that the duty of the practitioner, as soon as the condition of strangulation is made apparent and slight efforts at reduction have failed, is at once to etherize his patient and apply taxis with all the skill and caution at his command. In case of failure at reduction, he should either proceed at once himself to operate, or secure such surgical assistance as he may be able to procure. I can not question but that it should be held as an imperative duty that every practitioner of medicine, located where he can not command competent surgical aid, should so fit and qualify himself as to be competent to perform the operation for the relief and attempted cure of a strangulated hernia. The life-trust is a sacred one, and the delay of even a few hours makes the conditions worse, with the chance of greatly endangering the results. I have sometimes thought that operative measures for the relief of strangulated hernia should be taught as a part of the emergency courses in surgery, since the strangulation of an intestine unrelieved leads as surely to death as any of the accidental conditions to which mankind is liable. The one and only sad feature of my experience in the operation for hernia, extending over more than twenty years, is the condemnation which has so frequently followed from operating too late. Even now, I often see cases occurring in the hands of practitioners, who, although well informed in a general way and competent to discharge the duties
intrusted to them, after an effort at reduction of a strangulated hernia, narcotize their patients to relieve pain, apply hot fomentations locally, poultices, etc., waiting in an expectant way for the relief which Nature is unable to give. If I write for no other purpose than to ring out anew the alarm and summons to a prompt rescue of impending danger, my effort will not be in vain.

Although in a considerable measure this has been the teaching of the surgical profession for the centuries, since the introduction of ether into general use, we have in this one agent alone that which is more valuable than all others combined to aid us in the reduction of hernia. When we contrast its use with that of the various measures which it replaced, we are indeed grateful for the greatest boon ever furnished the surgical profession. The remedies most relied upon, prior to ether, were bleeding to faintness, and the use of the injection of a decoction of tobacco in amount sufficient to produce almost a deathly sickness. Even these remedies are not yet entirely without their advocates. The greatest possible harm that results from any attempted medicated relief is in the fact that it consumes time, and is a dangerous process of educating the physician, as well as his patient, up to the point of surgical measures which it is so all-important promptly to determine.

Regardless of earnest warning to the profession and the community alike, the surgeon will from time to time be obliged to determine what is best to do after constriction of the abdominal contents has endangered the vitality of the organs involved. The subject may be properly divided, and I shall take into consideration first its least important factors.

_The Integuments._—The skin and the tissues which cover the sac in hernia vary greatly in appearance. Ordinarily they are themselves not involved in a way to impair their vitality, although the greatest of danger may exist directly beneath them. In large scrotal herniae there may be a general edema, infiltration beneath the skin, with redness and greatly increased sensitiveness of the cutaneous surfaces. This may go on, little by little, to mortification. The same may be true in the coverings of a femoral hernia. It is perhaps more commonly met with in old, large umbilical herniae. The cause of this change and its significance are important in teaching the conditions of the contents of the sac. Although the changes in circulation and nutrition in the investing envelope are in a measure interfered with from pressure, the necrosis which supervenes may oftentimes be traced directly to the infective changes which have commenced in, and extended without, from the imprisoned loop of intestine. Septic
poisoning, thus set up, spreads rapidly, and the partially devitalized tissues become an easy prey to further bacterial infection.

The important practical lesson to be deduced from these changes is to understand that, when these pathological conditions exist, it is very probable that they are the precursors of dissolution, and that surgical aid, although rendered, gives only a forlorn hope of cure. This is all the more important to note, since in this extreme state of the disease the pain has frequently disappeared, the swelling lessened, the patient is bright and hopeful, and the attending physician greatly encouraged in the expectation of recovery. This seeming improvement is generally of short duration, and death not seldom suddenly supervenes from a general toxemia.

The Sac.—The parts inclosing the misplaced abdominal organs not seldom are so changed as to involve their integrity. This, however, is of less importance, as I have elsewhere shown that the general verdict of authority is in favor of the removal of the sac, and I have given at length my own reasons for the enforcement of this as a general rule for surgical guidance, although subject to certain exceptions. Certainly, whenever there may arise any question as to the devitalization of the sac, there can be no doubt but that there is only a single rule to be enforced: it must be removed. Occasionally the surgeon will meet with complications, caused by injury to the surrounding tissues by misdirected efforts toward reduction. I have more than once seen this condition, and felt obliged to dissect away a certain amount of tissue the vitality of which had been endangered by the bruising of the parts.

As an illustration of the pathological conditions occurring in the sac and the tissues enveloping the hernia, I insert the following plate from Scarpa. Fig. 4 shows exceedingly well the changes incident to the peritoneal envelope in a marked case of hernial constriction.

PLATE II.*

* Scarpa, Plate V.
† Mesial.
‡ Lateral aspect.
* Dorsal aspect.

Note the omentum surrounding the protruded intestine. The omentum forming a sort of ring b, d, e, strangulated the loop of intestine, and is firmly attached to the posterior part of the hernial sac. The place where the omentum produced the strangulation of the intestine in the greatest degree.
COMPLICATIONS INCIDENT TO THE SURGICAL MEASURES.

g. The bottom of the hernial sac.

h. The external covering of the hernia formed by the membrano-aponeurotic sheath of the cremaster muscle.

i, l. The vaginal coat of the testicle laid open.

k. The testicle.

l. The epididymis.

m, n. The integuments of the groin and scrotum.

o. The right testicle inclosed in the scrotum.

p, q, r. The aponeurosis of the external oblique muscle of the abdomen.

r, r. The left inguinal ring.

s. The ventral aorta.

t. The inferior vena cava.

u. The lumbar vertebrae.

x. A portion of the left psoas muscle.

y. Part of the great sac of the peritoneum.

Figure 2.

a. A portion of the aponeurosis of the external oblique muscle of the abdomen constituting the superior \( \dagger \) or internal \( \ddagger \) pillar of the left inguinal ring.

b, k, d. The hernial sac formed by the peritoneum.

c, e. The ilium in the cavity of the abdomen.

d. A loop of it protruded in the hernia.

e. Part of the omentum in the cavity of the abdomen.

f, j. Fissure formed in the omentum by the loop of intestine protruded in the hernia.

g, g. Adhesion of the omentum posteriorly * and to the sides of the hernial sac.

h. A complete ring formed around the loop of intestine by the omentum lacerated about its middle, and adhering posteriorly || and to the sides of the hernial sac.

i, l. Hard and callous edges of the preternatural fissure of the omentum.

k. The spermatic cord pushed toward the \( \wedge \) outer side of the hernia.

l, l. The vaginal coat of the testicle.

m. The epididymis.

n. The testicle.

o, o. The integuments of the groin and scrotum.

p. Part of the left rectus muscle.

q. Part of the great sac of the peritoneum.

Figure 3.

a, a. The aponeurosis of the external oblique of the right side.

b, c, c. The integuments of the groin and of the scrotum.

d, d. The hernial sac.

e, e, e. The omentum protruded in the hernia and adhering to the bottom and sides of the hernial sac.

f. A strip of omentum like a ribbon, adhering to the neck, to the sides and bottom of the hernial sac which compressed the loop of intestine at its middle so as to form two small loops, one on each side of the omental band.

g, g. The two small loops of intestine distended with air, and projecting on each side of the omental band.

h, i. Continuation of the sheath formed by the membrano-aponeurotic expansion of the cremaster.

b. The spermatic cord.

l. The testicle.

m. The epididymis.

Figure 4.

a, a. The aponeurosis of the external oblique muscle.

b, b, c, e. The hernial sac laid completely open.

d, d. Constriction of the sac a little below its middle.

c. The \( \dagger \) superior cavity of the hernial sac.

f. The \( \ddagger \) inferior cavity of the hernial sac.

g, g, g. The deep fossa of the \( \ddagger \) superior cavity of the hernial sac.

h, h. A dotted line, marking the bottom of the \( \ddagger \) inferior cavity of the hernial sac behind the testicle.

i, i. Membrano-aponeurotic expansion of the cremaster, lying over the tunica vaginalis testis.

l, l. The vaginal coat of the testicle laid open.

m. The testicle.

n. Part of the epididymis.

o, o. The integuments of the groin and scrotum.

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* Peripheral.
† Atlantal.
‡ Mesial, as to insertion.

* Dorsal.
† Dorsal.
‡ Lateral aspect.

‡ Atlantal.
‡ Sacral.
Omentum.—As would naturally be inferred from its shape, position, and function, the omentum will very commonly form a portion of the extruded part of the abdominal contents in all varieties of hernia. Although manifestly far less important than the intestine, omental hernia, called by the earlier writers epiplocele, is a cause of great discomfort and suffering, and of frequent danger. In nearly all the varieties of irreducible or adherent hernia the omentum forms a part. Very commonly, when the intestine is involved, the omentum is also an accompanying portion—entero-epiplocele.

Not seldom, in delayed cases of operation for strangulated hernia, the omentum has been so long and closely constricted as to cause its necrosis, although its vitality, as a rule, is much less liable to be endangered than that of the intestine. When necrosed, withdraw the parts sufficiently from the wound to make the line of demarkation clearly apparent; disinfect carefully, and apply, with all possible aseptic precaution, constriction (sutures to be preferred to the ligature) through the vitalized portion, and excise above the part of which the vitality is in danger. It is well to emphasize, that a common surgical fault in the deligation of tissues is, that the part inclosed in the ligature is so tightly constricted, as to cause necrosis by the ligature itself. One of the lessons of modern surgery is, that the ligature must never be applied with a force sufficient to effect this, even in the occlusion of the larger arteries. It frequently is advisable to remove very considerable portions of omentum when operating upon large irreducible herniae for the purpose of complete cure. In these conditions, not seldom the omentum makes up the great bulk of the tumor, and it has been so long retained in the sac that it has become greatly deformed. Although in a measure constricted, it is not devitalized, and the nutrition has gone on in such a way that the fatty deposit in its meshes has produced a tumor of very considerable size. This is so blended together that it can be unraveled with difficulty, leaving many minute bleeding points, which renders it unsafe for its return into the abdominal cavity. It may, again, be so changed as to make it impossible to separate it from its inherent adhesions, and therefore its removal becomes necessary. Some of the modifications to which the omentum is liable in large, old, retained herniae are extremely complex and confusing. Whenever these changes have gone on to a degree which renders it unwise to attempt the restoration of the omental mass, it should be removed. The portion through which the division is to be made, is oftentimes far too large to admit of safety by including it in a single or double ligature. It should frequently be subdivided into a number of parts; and the method which I commend as easy, simple, and effective, is the use of the double contin-
uous animal suture, frequently referred to in this work. It encloses effectually every portion of the tissue involved, which may be subdivided by the stitches to any degree considered desirable. These should never be drawn too tightly; and if the operator is in doubt that the occlusion is not sufficient to control haemorrhage, it is better to introduce a second line of sutures a little away from the first. It is surprising to note how effectually a moderate uniform compression controls a bleeding, which otherwise would be serious. Another advantage arising from this method of suturing is, that a broad fan-like edge of omentum can be thus divided, and returned very little puckered, or deformed, thereby serving far better its physiological function. I have oftentimes removed large masses of omentum in the manner here recommended without any serious consequences; and I have never seen a single patient where the hernial operation was undertaken for any purpose, in which I have considered the changes which have occurred in the omentum, and the measures devised for its remedy, to have endangered the life of the individual.

**Intestines.**—When a constriction about a loop of intestine has been maintained for a considerable period, it is interesting and important to note the changes which have taken place in the parts involved. The danger is, of course, dependent in direct ratio with the force applied at the point of constriction, and its duration. This may be so great as to cut off entirely the venous return-current, or the blood-supply furnished to the parts. Necrosis rapidly ensues, and death has supervened within fifteen to twenty hours. It is more likely to occur in the varieties of femoral hernia. Oftentimes the danger from constriction is greatly delayed from the loop of the intestine being surrounded by a large cushion of fatty omentum. This is more commonly found in the umbilical variety, where strangulation supervenes in the case of an old irreducible hernia.

After operation for the relief of a strangulated hernia, the first and most important question to determine is the condition of the inclosed intestinal loop. Upon the judgment of the operator depends frequently the life of the patient. The intestinal loop is changed in color to a dark, livid tint; it is frequently surrounded by a small quantity of purulent serum, and covered with patches of recently effused lymph. This material is almost certain to be infective, probably from bacteria that have been conveyed from the contents of the intestinal loop under the pressure exercised upon its walls. The first duty of the surgeon is to recognize this factor, and disinfection should be immediate and most thorough, otherwise the implantation of ferments within
the abdominal cavity may induce peritonitis, and death result. This is best effected
by irrigation. Gently separate any adhesions which may have formed at the neck
of the sac, after which withdraw the loop of intestine without the wound, and mark
the changes that supervene in the circulation of the inclosed part under the stimulus
of the warm irrigating fluid. If the line of demarkation is not clearly defined, and
the dusky hue slowly fades as the circulation is re-established while the inclosed loop is
unloaded of its contents, by the peristaltic contractions, we may safely return it within
the abdominal cavity. It not seldom happens—at least I have observed it in a num-
ber of instances—that the peritoneal coat about the point of constriction has become
so weakened that it separates easily upon slight tension. If lesion of the peritoneal
coat of the intestine exists, it is better to intrafold the separated edges with a fine run-
ning continuous suture. This I have done several times, followed by recovery. It is
well to remember that the strength of the intestine lies mainly in its connective-tissue
sheath, and injuries to its peritoneal coat, although considerable, are chiefly dangerous
from infection which may there find lodgment and develop. The extent to which the
intestine, in strangulated hernia, may be affected with necrosis varies from a small spot
to a more or less considerable portion of the entire canal. This is dependent upon the
constricting force which often bears very unequally upon the part involved. As may
be supposed, the tissues primarily and to the greatest extent affected by this change lie
directly beneath the surrounding ring, and not seldom in small herniae a very limited
portion of the intestine is subjected to close constriction. I recall a case of femoral
hernia, operated upon some years ago, followed by relief, death supervening from gen-
eral peritonitis, where the autopsy disclosed a minute opening into the small intest-
ine, and the whole portion of the bowel involved in the stricture was apparently not
much larger than the thumb-nail. If the surgeon finds a very limited necrosis, as in the
case described, with or without an opening, it is better that he intrafold the part in-
volved and unite over it the healthy peritonæum by lines of fine continuous sutures
with the running Lembert stitch, care being taken not to penetrate through the mucous
coat of the intestine. Under such conditions, should Nature be able to repair the dam-
age after the surgical relief of the stricture, without an opening in the intestinal wall, the
suturing, if made carefully as directed, would probably not add to the danger of the
outcome, by the stenosis of the canal. In the event of a slough forming, the general
peritoneal cavity would be protected by the rapid lymph effusion which takes place,
re-enforcing and burying the lines of suturing.
When marked conditions of gangrene have ensued in the constricted portions of the intestine, the mortified part is usually of a dull, yellowish-gray, or slate color. When it is relieved from constriction, it no longer retains its form, but collapses like wet paper, owing to having entirely lost its power of contraction. The contrast between this portion and the vitalized surrounding part is very marked. This is generally of a bright, or dusky red color, and is easily excited to contraction.

It is possible for even the experienced surgeon to be in doubt as to the vitality of the constricted loop of intestine. If so, it is advised that he delay further steps in the operation for a little while, and watch the changes which ensue under the stimulus of a hot irrigating fluid, after having removed the constriction from the intestine, emptied it of its contents, and placed it in a position favorable for the unloading of the vessels through which the circulation has, for so long a time, been impeded.

PLATE LII.*

Various Cases of Intestinal Strangulation.

Figure 1.

(Borrowed from Scarpa.) Strangulation of an intestinal loop by the neck (a) of a hernial sac, with constriction caused by two appendices (b and c) of a portion of the large epiploon (d), which passes in front of the intestinal loops, while another portion (e) passes behind.

Figure 2.

(Taken from Dupuytren's collection.) Strangulation of two intestinal circumvolutions, upon an adult male, by a loop of the large epiploon adhering to their peritoneal tunic.

Figure 3.

Strangulation, in a young woman, of the caecal extremity of the ileum by a fatty appendage of the cæcum.

Figure 4.

Crural hernia in a male. Internal strangulation from a tear in the peritoneum. A crural hernia with strangulation has been reduced; but the effects of the strangulation have remained.

a. The primitive site of the hernia in the acci-
dental crural canal. The femoral vessels are seen on the posterior wall.

b. Shows the strangulation of the intestinal loop through the peritoneum, which has been torn under the pressure and allowed the intestine to pass without forming a hernial sac.

Figure 5.

Case shown in three views A, B, C. The large intestine is narrowed in the angle of union of the transverse and descending colons. The stools were suppressed for thirty-nine days before death.

a. A small portion of bone, which seems the first cause of irritation, was found imbedded in the thickened intestine.

b. An annular narrowing of the opening to less than a centimetre.

c. Adhesions of the fatty appendices strengthen the strangulation.

d. An adhesion of the intestine with a commencing erosion (e).

f. The transverse colon, with thickened walls, dilated below the strangulation into a large cavity (f).

* Bourgery, Plate XXXII.
g. The descending colon, on the contrary, is thinned out in its walls and greatly contracted.  

Figure 6.  
A singular case of abnormal development of valvular folds very numerous in the cecal extremity of the ileum, which has caused the narrowing, then the swelling, and, at last, the symptoms and effects of an intestinal strangulation.

Having found that necrosis has supervened, the all-important question of subsequent operative measures must now be determined. Here, unfortunately, precise rules for direction can not be formulated. One of the most noteworthy triumphs of modern aseptic surgery is in the treatment of wounds of the intestine. Even several wounds, or the resection of the entire intestine, does not necessarily involve a fatal result. Such patients sometimes make seemingly easy and rapid recoveries. Owing to the encouragement given by this brilliant chapter of surgical experience, it has seemed possible to many that it should modify our rules for guidance in injuries of the intestine resulting from the comparatively slow constriction in hernial incarceration. I must myself admit having been among the first gladly to accept, and, as I had hoped, to profit by the lesson; but in each case of resection of the intestine which I have made in preference to an artificial anus, death has supervened—five cases in all. I do not think that it by any means follows that life would have been preserved had I adopted the opposite course, but this experience has taught me to enter carefully into the consideration of the differences in the factors presented in the problem before us. We must remember that in cases of necrosis in strangulated hernia usually some days of constitutional disturbance have preceded, that a general condition of septic poisoning is present, and that the great vital forces are extremely depreciated.

Mechanical changes have supervened especially in that portion of the intestine above the constriction, and active and extreme conditions of fermentation have taken place in the watery contents with which the intestine and stomach are too commonly distended. Scarpa called attention to this condition, which it is so important to know, and wrote: * "The extreme distention of the upper part of the intestinal canal, and the increased action excited in it to free itself from the distending and irritating cause, are the principal source of the acute pains which the patient feels in the whole circumference of the abdomen, and especially in the umbilical region, which are much greater than those occasioned by the strangulated intestine. This state of violent irritation and increased action, always accompanied by great inflammation, and afterward gangrene, is

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* Treatise on Hernia, p. 266.
what, properly speaking, kills the patient, rather than the incarceration of the intestine included in the hernia. I am of opinion that if the rupture of the strangulated intestine occurred much more speedily than it commonly happens, and before that portion of the intestinal tube continued from the stomach were subjected to the enormous distention and excitement, such as are observed in the bodies of those who have died of strangulated hernia, the event of this severe disease would not be, at least, either so quickly or so frequently fatal."

It is impossible to formulate rules for guidance in the treatment of the intestine which has become gangrenous from hernial constriction.

Very naturally the first factor, already emphasized, is the general condition of the patient, which too often peremptorily forbids the necessarily difficult and somewhat prolonged operation for the resection of the gangrenous portion and the coaptation of the vitalized parts.

When this is the condition, the only alternative is an artificial anus, with the possibility of a radical operation at a later period. It is well to remember, even here, that the portion of the intestine involved must govern in a considerable measure the decision of the operator, since, if high up in the intestinal tract, the processes of digestion are necessarily so limited that starvation may ensue.

Fortunately, the extreme conditions which supervene in a strangulated gangrenous hernia allowed to go to a natural terminus, are now rarely met with. When they do occur, adhesive processes usually precede, and the sound portion of the intestine is rather firmly agglutinated to the neck of the hernial sac, which serves as a protection to the abdominal cavity. After the separation of the gangrenous parts retraction ensues, drawing inward the divided extremities of the intestine, as also the modified neck of the hernial sac, which in a measure forms a substitute for the loss of tissue, and the feculent material descending from the superior orifice of the intestine, by making a semicircle, passes into the lower part of the bowel. When operations are undertaken in these extreme conditions, temporary relief only is possible; the adhesive processes which have supervened should be left undisturbed, and only a safe exit established for the feculent material which so greatly distends the obstructed, overloaded intestine; and this, in any form of hernia, involving any portion of the intestinal canal, is called an artificial anus.

The accompanying illustration, from Scarpa's work, shows the pathological conditions exceptionally well.
**ANATOMY AND SURGICAL TREATMENT OF HERNIA.**

**PLATE LIII.*

*A, a, a. Part of the great sac of the peritoneum.

b, b, b, b. The part of the great sac of the peritoneum, which formed the neck of the hernial sac, and which is converted into a membranous funnel, or passage of communication between the two apertures of the intestine divided by gangrene.

c. The superior orifice of the divided intestine.

d. The inferior orifice of the intestine.

e. The place where the hernial sac strangulated the intestine.

f. The promontory or projection formed by the approximation, in a parallel line, of the two portions of the intestine divided by the gangrene.

g. The intestinal canal uninterrupted on the side next to the attachment of the mesentery.

h, i. The furrow along which the feculent matter descended, passing from the superior orifice of the intestine into the membranous funnel, whence it was directed into the inferior aperture of the intestine.

k, l. Fistulous canal of the groin, formed partly by the remains of the neck of the hernial sac, partly by the aponeuroses of the abdominal muscles, and by the common integuments of the groin.

m. The superior part of the ileum.

n. The inferior part of the ileum.

a. The mesentery.

The aponeurosis of the abdominal muscles, turned back upon the femoral arch.

q, q. The crest of the os ilium.

r, r. The articular cavity for the head of the femur.

s. The fat.

t, t. Tuberosity of the ischiun.

**Figure 2.

a. The superior portion of the ileum.

b. The inferior portion of the ileum.

c. Segment of the ileum included in the strangulation caused by the neck of the hernial sac.

d. Remains of the circumference of the intestinal canal where the mesentery is attached, which was not strangulated by the neck of the sac.

e. The mesentery.

f, f. Part of the great sac of the peritoneum.

g, g. The hernial sac stripped of the external covering formed by the aponeurosis of the cremaster, and degenerated into a pulpy substance of a brown color.

h, k. The precise place where the ileum was strangulated by the neck of the hernial sac.

i. The spermatic cord stripped of the sheath of the cremaster.

**Figure 3.

a. The superior portion of the ileum.

b. The inferior portion of the ileum.

c, c, e. The ileum laid open, including that portion of it which had been strangulated by the neck of the hernial sac.

d. The promontory formed by the approximation of the two portions of the intestines a, b, in a line parallel to each other.

e. Deep depression of the superior portion of the ileum above the promontory.

f, g. The furrow by which the feculent matter prepared to descend from the superior orifice of the intestine into the membranous funnel, after the separation of the gangrened portion of the strangulated intestine.

h. The continuation of the internal membrane of the intestine.

i, i. The seat of the strangulation caused by the neck of the hernial sac.

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* Scarpa, Plate IX.
† The orifice leading to the stomach.
¶ The part leading to the rectum.
* The orifice leading to the rectum.
\* The part leading to the stomach.
\* Scarpa, Plate X.
\& Peripheral.
\& Orifice leading to the stomach.
COMPLICATIONS INCIDENT TO THE SURGICAL MEASURES.

k, k. The hernial sac, after the removal of the aponeurotic sheath of the cremaster, changed in texture, in consequence of the preceding inflammation.

l. The spermatic cord.

m, m. The vaginal coat stripped of the aponeurotic sheath of the cremaster.

n. The epididymis.

o. The testicle.

Figure 4.

da. The extremity of the ileum.
b. The colon.
c, c. The cicatrix of the integuments of the groin.
d. The colon adhering to the cicatrix of the integuments of the groin.

The measures adopted for the cure of this most unfortunate condition furnish an exceedingly interesting and instructive chapter in surgery, but it is foreign to the purpose of this work to enter in extenso upon its discussion, and therefore I am obliged to refer the reader interested in this subject to the larger treatises upon general surgery.

If it is determined to operate by the resection of the gangrenous portion of the intestine, it is essential that the preparations be made previously so complete that no time shall be wasted, as the prolongation of operative procedures adds greatly to the danger. If possible, the surgeon should have had previous experience in operating upon animals, since the technique of intestinal surgery is entirely different from that of ordinary operative measures. Careful coaptation of wound-edges and the accurate apposition of serous surfaces must be effected. Very much time is spent in the tying of fine wet sutures, with fingers sticky with blood, in the soft, slippery intestine. The interrupted sutures, as usually applied, are from twenty to thirty in number, and the numerous knots produce much more extensive inflammation and adhesions than result from the use of the continuous suture. The so-called Lembert suture, in which the needle enters and emerges through the peritoneal surfaces of the intestine, the latter point being several lines away from the cut surface of the bowel, marked an important advance in intestinal surgery, since by it the divided edges are inverted into the bowel, and that portion of the peritoneal covering of the intestine included by the suture is coapted, and speedily becomes firmly agglutinated by effused lymph.

For a number of years I have felt that the continuous Lembert suture, as ordinarily applied, was faulty; since this incloses necessarily the peritoneum in a series of constricted loops, which cause a wavy or puckered line of union.

A very simple modification, coapting evenly the peritoneum yet more rapidly, is effected by introducing the needle through the peritoneum and the tough connective-tissue layer of the bowel, avoiding the mucous membrane, parallel to the cut surface of the intestine, a little less than a quarter of an inch from its edge. This stitch should in-
clude about one eighth of an inch of the surface, and enter exactly opposite the point of emergence in the corresponding section of the bowel. Thus one stitch follows another until the complete circuit of the intestine is made, each stitch as taken being drawn sufficiently tight to appose accurately the peritoneal surfaces. It will be found, when thus united, that the cut edges are inverted to the extent of the distance of the line of sutures from the divided edge; that the suture itself not alone firmly coapts the peritoneal surfaces with accuracy, but that it is itself completely buried within the tissues, and, if carefully done, without any appreciable constriction of the caliber of the bowel. In several instances I have applied a second line of sutures parallel to the first, and three or four lines distant from it, as a still further guarantee against failure.

The operation is briefly described as follows: Having withdrawn sufficient of the intestinal loop from the abdominal cavity to make it easy for manipulation, press back the intestinal contents with the thumb and finger several inches in either direction, naturally the one from above being the more important in hernia. At the selected points compress gently the bowel with spring forceps, properly constructed, the broad blades of which are covered with rubber. Resect the necrosed portion and irrigate the parts carefully. Wash the intestinal canal with the bichloride-of-mercury solution, having first properly protected the abdominal cavity. Unite the mesenteric attachments of the sundered loops with care, and then join the cut ends of the bowel equidistantly with four interrupted sutures, the especial object of which is to hold the intestine for guidance to accurate coaptation. A fine straight needle, threaded with a carefully selected tendon, is introduced at one side of the mesenteric attachment by an inverted Lembert stitch, fastened in a loop-knot or tied in the ordinary way. Then introduce rapidly but accurately what, for want of a better definition, I have called the parallel, buried continuous Lembert suture, since it is taken always parallel to the line of division, in the manner described for the skin suture, introduced through the deeper layer only, for the coaptation of the cutaneous surfaces. A portion of intestine can be thus united post-mortem, which will hold a considerable column of water.

The advantages of uniting the intestine in this manner are emphasized as follows:

1. It gives the most perfect coaptation.
2. It is less difficult than any other method.
3. Its application is more rapid; the operation, under favorable circumstances, can be completed in fifteen minutes, even if re-enforced by a second line of sutures. It is, of course, important that the stitches should be so taken as not to involve the mucous
membrane. Intestinal obstruction and its complications, with the attempts at relief and cure, have an interest and value rarely exceeded in any of the modern contributions to surgery. We are largely indebted to the experiments and extended observations of Dr. Nicolas Senn, of Chicago, who has worked out the task which he assigned to himself with a patience, skill, and fidelity, rarely excelled in any department of original research. His methods of union by the use of bone-plates and sutures, peculiarly his own, offer many advantages, but reproduce the same fundamental idea referred to in another chapter by devices which were successfully carried into effect in a former century; and were it necessary to apply special means to prevent the undue narrowing of the lumen of the canal, the trachea of a calf, as then recommended, would serve an admirable purpose. Dr. Waldo Briggs, of St. Louis, has recently carried on a series of experiments upon the resection of the intestine, closure of wounds, etc., which I judge of sufficient importance to abstract freely from, by his special permission, and he is to be congratulated for having demonstrated the advantages of his method by two successful operations upon the human subject. Dr. Briggs's object is to be assured of the safe closure of the intestine before its return into the abdominal cavity. He writes:

"Believing that some of these dangers, at least, could be avoided if a method could be devised by which the intestine could safely be maintained outside the abdominal cavity, where it could be examined at will by the surgeon, until the process of reparation was sufficiently advanced to justify him in returning it to the cavity, I undertook a series of experiments upon dogs, which proved that not only was this feasible, but that, under the precautions and circumstances about to be detailed, Nature assists the reparative process, and that in a marvelously short space of time union between the wounded parts (the severed ends of an intestine from which a portion has been excised, for example) is so complete as to obviate all danger of relaxing sutures, fecal extravasation, etc. Not only is this the case, but inflammation is reduced to a minimum and peristaltic action in the intestine apparently completely suppressed.

"The features of my method by which these effects are produced, and which differ from all others hitherto suggested, are:

1. The maintenance of the wounded intestine outside the abdominal cavity during the preliminary stages of reparation.

2. The use of an animal membrane as a covering of the wounded portion of intestine and the sutures.

The precautions usually observed in similar laparotomies are followed in preparing
the animal for the operation. The hair is shaved off the abdomen, the surrounding surface is washed first with carbolic or campho-phenique soap, and, after drying, with pure campho-phenique. Of course, the instruments and all material used in and around the operation are carefully asepticized, etc. The subject is placed in a trough, bound as usual in such cases, and thoroughly anaesthetized. The incision is made in the *linea alba*, or at a point on the surface nearest to the part upon which it is desired to operate.

"After entering the cavity, a loop of the intestine embracing the portion to be operated upon is drawn up through the opening. If enterectomy is to be performed, compression is made on each side of, and at least one inch and a half from, the proposed line of incision, by rubber bands or by clamps or forceps whose blades are covered with soft rubber tubing. The section is then made either diagonally or straight through to the mesentery. The abdominal wound, intestine, and surrounding parts are carefully and thoroughly cleansed with warm water, and the severed ends of the intestine are brought together preferably by the loop or button-hole suture, as in Lembert's method (Fig. 20), though, owing to the protective and cohesive action of the membrane, any suture that will coapt the edges may be used.

"The membrane, which may be taken from any of the serous surfaces of a recently slaughtered animal (bullock, sheep, and hog membranes having been used by me, and each giving good results), is now taken from the four-per-cent solution of carbolic acid in which it has been resting and applied to the intestine so as to cover the sutured ends and stitched to the mesentery by a few light sutures, either continuous or interrupted, of the finest cat-gut.

"In my earlier operations and experiments, in searching for the best manner to maintain the loop of gut in the wound, I used rubber bands, stretched across the latter from lip to lip and held in place by pins. This arrangement enabled the wound in the abdominal parietes to adapt itself to the breathing of the animal, and kept the intestine gently but firmly held within the same. At that stage of my work I also used thin India-rubber gauze to protect the intestine until I was ready to return the latter to the abdominal cavity. When, however, as the result of a happy suggestion, an asepticized animal membrane was substituted for the India-rubber, I found that the
tendency of the substitute to adhere quickly and closely to any freshly wounded, abraded, or serous surface with which it came in contact, produced adhesions with the edges of the incision which were difficult to break up without causing considerable haemorrhage. I therefore devised the apparatus or ring shown at Fig. 21, the object of which is to protect the lips of the incision through the abdominal parietes, and to give support to the pins which separate the loop of intestine and keep the same in place. This ring, shown in perspective plan and section in Fig. 24, is oval in shape, 3" in its longer and 1.5" in its shorter diameter. The one I am now using is made of block-tin, but I think a lighter one of hard rubber would be better.

"The membrane having been applied and lightly stitched to the mesentery, the abdominal ring is now applied, being slipped over the loop of intestine and fitted into the wound in the parietes. Two long steel pins, A and B, are now passed through the skin, slit in ring, membrane, and mesentery, on one side and out in reverse order on the other, as shown in Fig. 22. Pins C and D are then passed, in a similar manner, through the side of abdominal wound, ring, serous coat of lower ends of loop of intestine, above and below, and out in reverse order, as in A and B.
"A batting of absorbent cotton, the smooth surface of which is well covered with pure glycerin, is now placed (glycerinated side downward) over the exposed gut, and the whole covered with a dry layer of absorbent cotton sufficiently large to completely protect the wounded surfaces. Bandages are unnecessary.

"When, in the course of three or four hours, the cotton covering is removed, a remarkable transformation will be found to have occurred. The membrane, which when applied to the intestine fitted loosely and irregularly, will be found lying smoothly and tautly stretched over the surface with which it has been placed in contact, and so closely and firmly united thereto at every point as to form practically a part of the intestinal walls. Its physical appearance seems also to have undergone a change; from the flabby, "dead" look which it had when first applied, it has assumed a "living" appearance, and its edges, above and below (at line m, Fig. 22), have smoothly beveled themselves, so that, except for the difference in color, it would be almost impossible to discover the line of juncture. Even now, only four hours after the operation, the gut may be dropped back into the abdominal cavity with full assurance that there will be no giving way of stitches, and no separation of the joint or splice made at the line of juncture of the severed ends of the gut.

"It is better, however, to wait two or even four hours longer before withdrawing the pins, removing the ring, and letting the intestine fall back into the cavity and closing the incision in the abdominal parietes.

"In none of the experimental operations that I have made since adopting the use of the animal membrane has the temperature of the subject at any time gone beyond 101° Fahr.

"From the moment that the loop of gut is fixed in the external wound peristaltic action seems to cease, and is not resumed until the gut is dropped back to its place. In no instance has a subject had an action from the bowels while the gut was in the position named; and in every instance, as soon as the gut was dropped back and the external wound closed, the animal had a copious evacuation.

"The extra-abdominal method, as I call this for lack of a better term, seems to me to
be applicable in all laparotomies for wounds, injuries, or diseases of the intestinal tract, except, of course, in those cases of multiple perforations caused by gun-shot or other agencies, where the wounds are found at widely separated points. In these, after application of the membrane, the intestine should be dropped back into the cavity at once.

"It also seems to me that the use of the animal membrane, as described, has a wide range of application in surgery. Among the more prominent operations wherein I believe it will be found extremely valuable, I may mention its application to the pedicle after ovariectomy, whereby the danger of adhesions will be very much lessened or entirely obviated. It may also be used as an application to the stump after amputations of the uterus, and to surfaces denuded of skin by burns or other injuries.

"Dr. F. L. James, a number of years ago, called my attention to the uses made of animal membranes by hunters and trappers in their rude surgery in cases of emergency, and also as coverings for surface wounds of all descriptions. Recently, in investigating the matter afresh, I found that butchers and men employed about slaughter-houses are nearly all aware of the great value of animal membranes in the direction mentioned, and are in the habit of applying them to cuts and fresh wounds of every description.

"To sum up, in conclusion, the remarkable features of the operation as developed in the course of my experiments, I will note:

"1. The great rapidity and firmness with which the membrane adheres to the intestinal surface.

"2. The absence of any notable degree of shock produced by keeping the intestine outside the abdominal cavity during the healing process.

"3. The very short time required for repair to the intestine to progress sufficiently to warrant the restoration of the latter to the abdominal cavity, viz., five or six hours, as a mean. This is just about the time, too, when the inflammatory process for healing the abdominal incision is commencing to set up.

"4. The absence of peristalsis during the period that the loop of intestine is kept outside the abdominal cavity."

The exudation into the intestinal canal, when constricted, is truly enormous, and frequently the patient is constantly vomiting large quantities of fermented fluid with stercoraceous odor. It has happened in two cases, after I had finished the operation for the relief of intestinal obstruction, that death followed from impeded respiration, caused by the pouring out, rather than vomiting, of a large quantity of
fluid from the stomach. Profiting from the sad lesson taught by these experiences when operating in extreme cases, I have since emptied and carefully washed out the stomach with a stomach-pump before undertaking operative measures.

Dr. J. Mason Warren* reported a case of strangulated hernia where death supervened from the introduction of fecal matter into the oesophagus.

"The operation was performed with great rapidity, only occupying a few minutes. Some serum was found in the sac, and the intestine much congested. The stricture was divided and the intestine replaced. The ether was discontinued at about the middle of the operation. The edges of the wound were brought into apposition, the patient breathing tranquilly, and the usual preparations made to return her to bed in the ward. Suddenly the patient (who had made the usual groans and sighs of a person recovering from ether) made an effort to vomit, and was placed on her side to facilitate the escape of the fluids from the mouth. These efforts were once or twice repeated, when the face became livid, the pulse began to fail, and a loud subcrepitant râle could be heard all over the chest, the symptoms resembling those of a person asphyxiated from drowning. All the usual remedies were employed to restore her vital powers, but the pulse and respiration gradually failed, and she died in the course of ten or fifteen minutes. Autopsy following day. Stomach and intestines entirely filled with a large quantity of yellow fluid of a very fetid odor. The mouth and fauces were also filled with a similar fluid. On opening the air-passages this same fluid was found to have penetrated the most remote ramifications of the bronchiae. . . . At first sight I thought I had met with a case of death from the use of ether; but the autopsy revealed the nature of the case."

Prof. Küster † calls attention to an accident which happened to one of his patients during operation for the radical cure of hernia, which had a fatal termination. The patient, a man of fifty-six years, was brought to him suffering with symptoms of an incarcerated hernia on the right side. Operation for the radical cure thereof was performed. Upon opening the hernial sac, a quantity of cloudy fluid escaped, and the omentum and mesentery made their appearance. The contents of the sac consisted of ascending colon, transverse colon, cecum, appendix vermiformis, about three feet of small intestine, with considerable fatty mesentery. Reposition of this intestinal

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† Centralblatt für Chirurgie, 36, 1890, Pittsburgh Medical Review.
mass was exceedingly difficult, in spite of enlargement of the ring; it appeared as if the abdominal cavity was too small for the reposed mass. However, after persistent endeavors it was accomplished. Some time before this it was observed that respiration had become shallow and rapid and the face cyanotic, while there was no attempt at vomiting, nor even nausea. After closure of the abdominal cavity, the patient ceased breathing completely, though the pulse remained full and strong. Inasmuch as artificial respiration proved unsuccessful, the pulse began to weaken, and the pupils to dilate, Küster rapidly opened the trachea, whence immediately enormous quantities of gastric contents emerged. By means of a catheter the trachea was cleansed and artificial respiration was continued; all efforts proved fruitless, however, and the patient died.

Post-mortem examination revealed enlargement of the heart, due to excentric hypertrophy of the left ventricle, with a great deal of atheromatous degeneration of the aortic walls and valves; the coronary arteries were abnormal, the papillary muscles degenerated; the lungs œdematous and almost airless. None of the bronchial tubes contained any of the gastric contents; the bronchial mucous membrane was highly hyperæmic, the mucus of mild acid reaction. The stomach was empty and collapsed, the intestines inflated, with many portions of blue-black color, but glossy all over. The explanation of the accident is evident. The forcing-in of the great hernial mass into the abdominal cavity, diminished in size in adaptation to the lesser bulk of abdominal organs, increased the intra-abdominal pressure to such an extent that the contents of the stomach were forced out through the cesophagus into the pharynx, whence it was carried into the bronchi during inspiration.

The practical part of this experience is that, before operating upon hernia of long standing and large contents, the stomach should be washed out carefully, in order to facilitate reduction of the hernial mass and to anticipate the accident just described.

Although the line of demarkation between the dead and living portion of the intestine may be somewhat clearly defined, it is not by any means so clear that the latter is uninfected and its vitality sufficient to warrant the surgical measure of resection. However, resection may be more favorably considered, dependent upon that portion of the intestine which is involved in the stricture. This is illustrated by the case of vaginal hernia already reported resulting spontaneously in an artificial anus into the cul-de-sac of the vagina behind the uterus. Here we had a most favorable position for an artificial opening, but the portion of the bowel involved was so high up in the small
intestine as to interfere very seriously with the processes of digestion, and death from starvation was imminent.

When the constriction occurs so high up in the intestinal tube as to endanger life from defective nutrition, it should cause resection of the intestine to be considered at the primary operation. Oftentimes it happens that about the necrosed portion of the intestine, presenting at the ring, rather firm adhesions have already taken place. Nature herself was making ready to relieve the system by a spontaneous opening. In this instance the surgeon should limit his endeavor by making the opening free, great care being taken not to break up the adhesions already formed (Hunter).

Suppose this to have been effected and the wound properly cleansed, an effort should be made to unload the upper bowel and restore peristalsis, not forgetting that the rectum and lower portion of the large intestine may also suffer from retained feces.

A considerable number of cases are on record where adhesions have united portions of the bowel within the ring; an opening in front of this has taken place, which after a time closed, and the normal function of the intestine was restored. It is under conditions of this character that it may be accepted that only a portion of the intestine was involved.

In the great majority of cases where necrosis of the intestine has occurred, the surgeon will be at no loss in determining it. Adhesions about the ring will have already ensued, and an opening into the intestine completes the operation. Under these conditions the outlet of the bowel is usually small, and it may be difficult to free the intestine from its contents through the opening. This risk, however, had better be incurred than the attempt to enlarge it, since in so doing it is easy to break up the adhesions, which is Nature's only method for protection from a general infection. Subsequent treatment is simple. Having emptied the intestinal canal, small doses of saline laxatives are to be given sufficiently often to produce loose dejections, and fluid food should be taken in small quantities, often repeated.

In the event of protective adhesions not having been formed, or if broken down at the time of operation, the division of the constricting ring should be made sufficiently free, the upper part of the loop pulled down, so that the vivified portion may extend quite a little beyond the lips of the wound. The intestine is now carefully stitched to the edge of the divided ring by two rows of continuous suturing, care being taken that the stitches do not entirely penetrate through the wall of the intestine.
The wound is then properly cleansed and its upper edge packed with a slight layer of iodoform gauze; the necrosed part is divided, and the intestine emptied. It is often-times wise to introduce within the intestine a large drainage-tube, which admits of a better protection of the wound from the outflowing fecal material. It is surprising to note the rapidity with which a patient will rally from conditions which a few hours before seemed to render dissolution imminent.

It is interesting to study the subsequent processes of repair in such a wound. The upper end of the intestine slowly retracts; the lower part of the intestine adherent to the wound is generally kept open without difficulty, and, little by little, the feces pass from above downward under the restraint afforded by the protective dressing.

Scarpa was the first to demonstrate the reparative processes which go on under such conditions, and showed that the ends of the intestine can never reunite to restore properly the anatomical relationship of the bowel, and that the repair processes, when sufficient to close entirely the external wound and to restore the continuity of the canal, are completed by appropriating a portion of the peritoneal sac which contained the hernia. This he called a membranous funnel. His demonstrations were based upon many observations made upon the lower animals, and the careful study of post-mortem conditions of patients in whom restoration of the intestinal tube had thus been effected and who had died from other diseases. His conclusions are as follows: "Afterward, the two orifices of the intestine, retracting gradually more beyond the ring into the cavity of the abdomen, and the neck of the hernial sac along with them, the latter begins to form the membranous funnel, and then some marks of incipient communication are observed between the two portions of divided intestine. But as this funnel or membranous passage between the two orifices of the intestine is still very narrow, in comparison with the size of the external wound, so the quantity of feculent matter passing out by the wound is much greater than that which takes the way of the rectum. Finally, the intestine, daily rising more up into the cavity of the abdomen along with the neck of the hernial sac, and the base of the membranous funnel necessarily enlarging while its apex contracts, together with the external or peripheral wound, the passage of communication between the two orifices of the divided intestine at last becomes so large as to permit the feces to abandon the fistula entirely, and, making a half circle from the superior orifice—the orifice leading toward the stomach—they enter the inferior aperture—the orifice leading toward the rectum—and pass solely by the natural way."
It is clearly evident that the angle in which the portions of the injured intestine join will be dependent upon the amount of necrosed tissue, varying from a small portion of its walls to that of the whole diameter of the canal. When this latter has taken place, the two portions of the intestine may lie almost parallel, as Sir Astley Cooper described it, joined like the barrels of a double-barreled gun. This necessitates the sharp angle to which the flow of the intestinal fluids is subjected, which the membranous funnel of Scarpa, formed from the hernial sac, can never entirely compensate, and must mark subsequently the site of a more or less pronounced intestinal obstruction. In direct ratio to the stenosis occurs an important change in the intestine above the constricted part, sometimes dilated and deformed in the most surprising degree. These conditions explain the oft-recurring attacks of colic and abdominal pains to which such patients are liable, and end not rarely in a fatal result from rupture of the thinned intestine, as abundant examples of autopsy have demonstrated.

Pathological conditions of this character are important to have in mind when operations for cure by resection of the intestine are taken into consideration. Very likely laparotomy, either at the site of the constriction or in the median line with resection of the intestine, may be wisely discussed. However, the limitations of our subject prevent extended inquiry into one of the most interesting problems of modern surgery. Rather reluctantly I am constrained to believe that, under the favorable conditions above outlined, it is better that we content ourselves with an artificial anus, and defer the attempt at curative measures until a later period. It is only just to note that in the present state of experience the question is an open one, admitting of great differences of opinion. But when we take into account the extreme condition and too often imperfect surroundings of the patient operated upon, we can easily understand his frequent inability to endure the severe strain of so serious surgical measures. The whole subject is hedged about with difficulties, which I can not doubt the surgeon will be less often called upon to encounter as the need for prompt surgical relief is better understood and more earnestly advised.

The cure of an artificial anus and fecal fistula by other and less radical measures than laparotomy and resection are also interesting questions of surgical inquiry which would furnish material for an entire chapter, but we must refrain from the discussion of these as foreign to the subject under consideration.

Resection of the Intestine at the Primary Operation.—If the surgeon has determined that the conditions make it advisable to resect the intestine at the time of the
operation for strangulated hernia, the procedures are as follows: First, having freed the parts about the constriction sufficiently to bring the ends of the intestine well into the operative field, protection of the abdomen and its contents must be made as far as possible. A pair of spring forceps, the blades of which are covered with rubber, are applied to compress the intestines at a considerable distance above the division. The parts are cleanly washed with a sublimate solution, the ends of the intestine resected, and joined by one of the several measures to be commended for favorable consideration with which the surgeon is most familiar. The use of decalcified bone plates, as devised and recommended by Dr. Senn, of Chicago, or a ring of catgut, of the proper size, may be used for the purpose of a rapid joining of the divided ends so that the lumen of the intestine may not be diminished. If these are not at hand, or it is judged undesirable to use them, the intestine may be quickly and firmly united by interrupted silk sutures, including the entire thickness of the bowel, the stitches taken at a distance of about one third of an inch apart. There is no objection to the use of silk in the making of these sutures, since they will be ultimately eliminated into the bowel. These interrupted stitches are to be supplemented by a row of fine continuous tendon Lembert sutures. I have, in several instances, applied two rows of these running sutures with ease and great advantage. They must not penetrate the intestine, and are best applied by means of a fine round-pointed, common sewing, or a fine Hagerdorn needle. Care is requisite in the use of the continuous running suture not to bunch the parts by overtension; and, if this is kept in mind, there is really little need of foreign material within the canal to prevent the diminution of its lumen. The edges of the divided mesentery must be carefully joined and the bleeding points properly secured before returning it within the abdomen. The continuous suture has a great advantage over the interrupted in a better adaptation or adjustment of the parts, and, even when applied in two lines, occupies much less time than the adjustment of a single row of interrupted sutures.

This operation is always attended with difficulty, since the intestine is never easy to handle, and the divided ends have a tendency to contract and evert the mucous membrane. It is on this account that interrupted stay sutures are first advantageously placed directly through the divided edges of the opposing intestinal surfaces which are to be introflected and coapted as mentioned above.

I operated upon a patient of Dr. H. C. White, of Somerville, where the abdominal tumor, an umbilical hernia, was the size of an infant’s head, and already necrosed. We resected seven inches of small intestine and joined with a double row of fine continuous
animal sutures. We also removed large masses of gangrenous omentum. Death supervened, sixty hours after, from exhaustion. At the autopsy it was demonstrated that there had been no haemorrhage or general peritonitis. There was a free effusion of lymph about the line of union, and the intestine, at the line of juncture, held water after removal from the body.

When the intestine has been successfully joined, carefully cleansed, and the compression forceps removed, it is replaced in the abdominal cavity. There is a considerable gain in doing this operation under constant irrigation, not alone because of keeping the operative field clean and under immediate supervision, but more especially is it advantageous on account of the too great abstraction of heat which ensues from a long atmospheric exposure of large peritoneal surfaces. For this reason it is better to maintain the irrigating fluid at, or a little above, 100° Fahr. Subsequent surgical procedures are not unlike those already described in detail in uncomplicated cases of hernia.

It is interesting to note that many of the modern surgical procedures were long ago anticipated. In order to support the ends of the bowel and prevent subsequent contraction of the point of union, many ingenious devices were recommended. Fabricius Aquapendente condemned the practice, which had been instituted in his time, of introducing into the intestine, before suturing, a hollow piece of elder, or a portion of intestine, or the trachea of an animal. Duberger * advised a portion of animal trachea; Ritsch, a cylinder of varnished paper. The former removed a piece of intestine of two fingers' length and united the ends with sutures over a piece of a calf's trachea, followed by a speedy recovery.

Heister preserved in his collection a portion of intestine two feet in length, with its mesentery, which was removed in a gangrenous state by Ramdohr,† who was the first to introduce the superior into the lower end of the gut, and retained it by sutures. The case was one of crural hernia; the intestine was resected, and recovery followed.

M. Jobert modified the method of Ramdohr by first turning in upon itself the lower end of the divided intestine. M. J. Cloquet reported to the Royal Academy of Medicine a case of strangulated hernia in which the whole diameter of the bowel had mortified. He sutured the intestine after the manner of Jobert. The parts were returned as soon as it had been ascertained that nothing escaped from the bowel on

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* Mém. de l'Académie de Chirurgie, tome iii, p. 188.
† Morbillus Observat., Méd. Miscell., præside Heister, 1730, Obs. 18.
pressure. At the time of the report fifteen days had elapsed, and everything promised an early cure.

Lawrence mentioned the methods of M. Denons and Ammusat, as quoted from Velpau and Fleury. These consisted in introducing three hollow metallic cylinders into the intestine, and fastened by sutures, the bowel thus charged being returned into the abdomen. Mr. Lawrence comments thus: "A patient who could survive the infliction of such surgery must be endowed with great tenacity of life."

These surgical procedures, some of them undertaken more than a century ago, are extremely interesting prototypes of new devices under present discussion; and it may be indeed questioned if any artificial means recently recommended can serve a better purpose than the properly prepared trachea of a calf.

Dr. Waldo Briggs,* of St. Louis, applied his method of extra-abdominal intestinal surgery to herniotomy, with a report of two cases, which is novel and interesting. He was led up to it by a series of comparative studies, already quoted, in which he covered the line of excision and closure of the intestine with membrane taken from beef kidney, which in a brief period becomes firmly attached to the intestine while yet the latter is extraneous to the abdominal cavity. After fourteen hours the parts were normal in appearance, and union seemed complete. The intestine was returned to the abdominal cavity, and the external wound closed in the usual manner. Recovery was rapid, and at no time was there any indication of shock, and the temperature never exceeded 99.5°. In the first case the necrosis did not exceed in size a silver quarter of a dollar; this was dissected out, and the edges closed with Lembert sutures. The second case is of sufficient interest to quote entire. "Mrs. N., female, sixty years old, suffering for many years with a femoral hernia of left side. Strangulation had occurred two days previously to my being called into the case. On my first visit I found the patient suffering intensely. There was an almost continuous vomiting of stercoraceous matter. On examination I found that immediate operation was necessary, and an incision of the sac laid bare an omental mass about the size of the adult human hand, very much decomposed. This was ligatured and removed, and the ring enlarged. The intestine, on being withdrawn, was found necrosed for about two inches, completely gangrened. The gangrened portion was at once excised, and the ends united with fine silk by Jobert's method. Beef membrane was applied, as heretofore described,

* St. Louis Medical and Surgical Journal, January, 1891, p. 41.
and the pins which were placed in position to hold the intestine outside were passed through the side of the sac and omental plug. On the next day an ulceration was discovered about a quarter of an inch from the line of juncture, through which fecal matter was oozing. I at once incised, leaving open, with expectation of uniting when a perfect line of demarkation had formed. The urgent symptoms of strangulation were relieved by the operation. In the course of a few hours the intestinal wound was firmly closed and the gut returned to the cavity. The patient made a complete and rapid recovery; and while, during the first few days, the pulse was rapid, varying from 112 to 120, at no time did the temperature go above 99.5° Fahr. Two weeks after the operation the patient was sitting up, and she is now attending to her household duties as usual."

Dr. Briggs very properly emphasizes the importance of a free division of the constriction in order that the circulation in the intestine may be impeded as little as possible while external to the abdomen.

Although I have purposely refrained from a discussion of intestinal obstruction, produced by constrictions occurring within the abdominal cavity, as a subject foreign to this work, which necessarily causes the omission of mesenteric hernia, I deem it important to note that constriction of the intestine producing death may happen, caused by bands of the omentum. The following plate taken from Scarpa is a beautiful illustration of this condition, where death supervened, from a loop of the ileum having been firmly held by a bridle of omentum, although the hernia was reduced. Under these conditions it would have been extremely improbable that the life of the patient could have been preserved by adhesions to the abdominal wall and the formation of an artificial anus. It will also be noted that, when constriction of the intestine occurs, as high up in the canal as here figured, resection of the intestine is the only alternative, since the nutritive processes would be so impaired as to endanger life, even if an artificial outlet was safely established.

**PLATE LIV.**

*a, a, a.* The omentum in the cavity of the abdomen.

*b.* The anterior portion of the omentum, or that which was spread over the intestines.

*c.* The posterior portion of the omentum which insinuated itself posteriorly behind some turns of the intestinal canal.

*d.* A bridle or noose formed by the two above-mentioned portions of the omentum *b, c.*

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* Scarpa, Plate VII.
† Sternal.
‡ Dorsal.
* Dorsad.
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\[ e, e. \] The place where the omentum which had protruded into the hernia was cut away.

\[ f. \] The remains of the omentum contained in the hernia.

\[ g, g. \] The loop of ileum strangulated by the bridle or noose formed by the two portions of the omentum \( b, c, d, e, e. \)

\[ h, h. \] The bottom of the ileum which reappeared without the abdomen after it had been reduced.

\[ i, i. \] Constriction formed by the neck of the hernial sac.

\[ l, l. \] Part of the great sac of the peritoneum.

\[ m, m. \] The hernial sac.

\[ n, n, p, p. \] A very considerable portion of the ileum included in the noose formed by the \( * \) anterior and posterior \( \dagger \) portions of the omentum \( b, c, d, d. \)

\[ r, s. \] Continuation of the intestinal canal under the noose formed by the omentum.

\[ t. \] The beginning of the colon.

\[ u, u. \] The appendix vermiformis.

\[ v. \] Glutinous adhesion of the omentum to the ileum beyond the strangulation.

\[ x. \] The testicle.

Dr. Maurice H. Richardson,* of Boston, contributed in 1889 a valuable paper on the surgical treatment of gangrenous hernia, with a report of four cases. The intestine was resected in one case, followed by death from shock the evening after the operation. In a second case the resection was made through the small intestine, which was gangrenous, and joined by a single row of Lembert sutures, occupying only twenty minutes in their application. The vomiting ceased immediately after the operation; the fecal dejection occurred the third day, and recovery was rapid. In commenting upon the operation, attention is called to the time consumed, which should be minimized as much as possible and secure accuracy. The amount of intestine to be resected should be limited to an inch on the sound side of the constriction. Preference is given to Lembert's interrupted sutures applied in a single row. The author believes the danger of artificial anus and subsequent resection fully as great as that of an immediate excision. "So far as I have been able to find, the first case of successful termination of gangrenous hernia at the Massachusetts General Hospital, from its foundation to the present day, is the case reported in this paper. With the exception of the first case all were treated by incision or artificial anus. At the Massachusetts General Hospital, in ninety-four cases of all kinds of strangulated hernia upon which an operation has been done, there have been fifty-two recoveries and forty-two deaths a mortality of forty-four and three fifths per cent; excluding the cases which were practically moribund on entering, the mortality would be considerably diminished."

Dr. W. W. Keen,+ of Philadelphia, favored lateral anastomosis by the method of Dr. Abbe, and reported a recent case where he had seen Dr. Abbe operate. As the

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* Sternal.

† Dorsal.

1 Transactions of the American Surgical Association, 1889.

2 Transactions of the American Surgical Society, 1889.
result of a fistula which had existed for six months, the patient was emaciated to the last degree. "The intestines were exposed, and two cravats of iodoform gauze passed through a hole in the mesentery above and below the fistula. The fistulous portion of the bowel was then removed, and the two ends were turned in and closed with a continuous suture. A slit was then made in the two portions, and into these openings were slipped two rings made by winding catgut into loops and then securing the strands by transverse winding. Each of these rings had four sutures attached, one at each end and one at each side. After the rings were inserted the two portions of bowel were brought together and secured. Around the outside a continuous Lembert suture was passed, bringing the opposed peritoneal surfaces in contact. Not more than thirty minutes were required for the operation after the intestines were released." The patient made a rapid and uninterrupted recovery.

Dr. H. H. Mudd, of St. Louis, reported seven cases of gangrenous hernia. In one case he excised and sutured the bowel with perfect recovery. The method of operation is, in a measure, peculiar to himself. He compresses the intestine at right angles with catch-forceps near to the line of demarkation. He then carries six interrupted Lembert sutures into position before excising the gut, leaving outside of the forceps a line of the intestine in which there are no sutures. Then the intestine is emptied of contents by backward pressure with the aid of an assistant, and held while the bowel is excised and the sutures tightened. Then a line of fine continuous catgut sutures encircles the bowel. This expedites the operation, which Dr. Mudd thinks can be done in fifteen to twenty minutes.

Statistics of Excision and Suture.—Schmidt gives a mortality of 71.1 per cent; Makins collected fifty-five cases, with a mortality of 52.7 per cent; Reischel in 1884 collected fifty-six cases, mortality 52 per cent; McCosh collected one hundred and fifteen cases, mortality 50 per cent.

Artificial Anus, Primary Operation.—Kütte records one hundred and eleven cases of gangrenous hernia treated by formation of an artificial anus, with one hundred recoveries, eleven deaths. Coffens reports twenty-eight cases: twelve recoveries, sixteen deaths. Schmidt reports a mortality of 85.5 per cent. Hermann reports eighty-three cases: seventy-six recoveries, seven deaths; twenty-six had fistula left. Weil records fifteen cases: two recoveries, thirteen deaths.

Resection of Artificial Anus.—Matins records forty cases: 38 per cent mortality.
Haemel records forty-three cases: twenty-seven recoveries, eighteen deaths; 37 per cent mortality.

Dr. T. A. McGraw, of Detroit, analyzed the cases as to location and inflammation, upon which should depend, in large measure, the advisability of operation. He has found that the continuous Lembert suture can be applied in one fourth of the time of the interrupted suture.

Dr. George W. Gay* of Boston, contributed an interesting paper upon the treatment of gangrenous hernia, in which he gave it as his opinion that “it is extremely difficult to lay down any definite rules for guidance. In extreme conditions it may be doubtful to operate, and if undertaken it is better to save time by making an artificial anus, trusting to the future for closure of the same by Nature or art.” He reported an interesting case of a large umbilical hernia, where strangulation existed for twenty hours. Five and a half inches of gangrenous intestine were cut away with its accompanying mesentery. The bowel was closed by two rows of continuous silk sutures, one including the muscular coat, the other a Lembert, involving only the serous layer. Death occurred on the fifth day. The autopsy showed fecal extravasation at the junction of the intestine and mesentery. A similar case, operated upon in the same manner, made a good recovery.

Dr. H. L. Burrell, of Boston, reported in the same journal four cases of gangrenous hernia operated upon at the Boston City Hospital. The first case was interesting in that the hernial tumor was large, consisting of omentum, fist-size, surrounded by a coil of small intestine seven or eight inches long, of a dark plum-color. The primary wound was diminished in size by sutures and packed with iodoform gauze. On the fifth day a segment of the ileum came away two and a half inches in length, including the lumen of the intestine. On the fifty-sixth day the patient was removed from the hospital by his friends, and the subsequent history is unknown. At this time there was a fecal fistula, but feces were also passed per rectum. Sharp attacks of pain were occasionally referred to the abdominal wound, and, when severe, a coil of intestine was distended near the site of the ring, giving evidence of intestinal obstruction. The second and third cases proved fatal on the second and eighth days after operation; in both an artificial anus was made. The fourth case is chiefly interesting from the fact that the recovery after the formation of the artificial anus was so satisfactory. "Forty-second day.

* Boston Medical and Surgical Journal, March 3, 1892.
The wound had closed completely; the patient was having normal movements. The patient was seen two years later, at which time he had suffered no inconvenience from the operation, and considered himself cured. Wore a truss constantly, and has a distinct impulse under the scar tissue. . . . I have never attempted to do an intestinal resection for gangrenous hernia, and have always felt that it was a hazardous undertaking, and that it would be better to establish an artificial anus, and, if the patient recovered, to do a secondary operation and resect the intestine at one's leisure." Dr. M. H. Richardson, in the same journal, reported an interesting case of intestinal resection for the cure of old fecal fistulae resulting from a gangrenous hernia of the right side. Dissection was made, freeing adhesions, and about four inches of the intestine was removed. The bowel was closed with a single layer of interrupted Lembert sutures, the tissues being everywhere protected by iodoform gauze, which was not entirely removed for some days. The wound was closed after about six weeks, and the patient now remains well.

Hab† has recently written at considerable length upon gangrenous hernia. In sixteen collected cases the intestine was resected and sutured immediately when operating for hernia; nine cases died and seven recovered.

Poulsen‡ collected twenty-three cases of primary resection of the intestine with immediate suture, with only five deaths. These operations were performed between 1883 and 1889, and very likely include some of Hab's cases.

Having reviewed the surgical measures now advocated and given some of the results, it has seemed to me wise to append the following most interesting cases, as illustrative of the operative measures in use among the celebrated surgeons of the early part of the present century.

STRANGULATED GANGRENOUS HERNIA—REMOVAL OF SIX FEET OF INTESTINE—ARTIFICIAL ANUS—CURE.§

"In 1732 I was called to Ibonville, a town about forty miles from Paris, to see M. Doudeuill, a man of sixty years of age, who had a complete hernia twenty-six inches in circumference. It descended to the middle part of the thigh. The tumor was very soft, and seemed as if it would re-enter easily. The patient told me that

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‡ Treatise on Ruptures. Arnaud, Observation 17, p. 341.
it was nearly six years since it had arrived at the same bulk; that it was almost twenty in assuming that largeness; that for four or five years past he was afflicted with colics and faintings, which often obliged him to sit down for relief, and support the tumor with his hand; but that for eight or nine days past he felt a great deal more pain than usual. For five days he had vomited his feces, and went but very little to stool, though the wind was freely discharged through the anus. The tumor was soft and very sensible. From these signs I concluded that adhesions were the cause of these symptoms, and therefore thought the only method to be taken was to perform the operation. Nothing could be added to the general remedies, which had been used with all possible care. I took the advice of M. Coste, surgeon of Miru, who agreed with me on the pressing necessity for the operation. I apprised the patient's friends and himself of the danger there was in undertaking an operation of this kind; but stated, at the same time, that there was no other method of preserving his life. The courage of the patient, who was a man of robust constitution, was animated by the hope of a cure, though uncertain, so that he prevailed on his friends to consent that I should perform the operation, which I did in this manner: I laid bare the whole tumor by dissecting all the intestines, which made only one body, with the herniary sac, which was of a considerable thickness. I used all the necessary precautions not to open the intestine, in which attempt I succeeded. However, it was gangrened in a great many places, which were of different bulks and figures. Some of them were round, others long, others triangular, and others of irregular figures. Some of them were half an inch broad and long, some were two, and others three inches. But there were distances between them, consisting of five or six inches of the sound parts. I at last laid all the parts bare, after an hour and a quarter's hard labor. Then, being fatigued to such a degree as almost to have lost the use of my limbs, I was obliged to rest myself, and in the mean time covered the tumor with a fine linen cloth soaked in tepid water. I deliberated with M. Coste on the method to be taken in order to finish the operation. The confusion of the parts, by means of the thick and fleshy adherences which kept them together, and the mortification which had seized most of them, made me propose cutting off all that was without the abdomen. I told the patient this ungrateful piece of news, which, instead of terrifying him, augmented his courage. The large portion of the mesentery, which sustained the ileum, which was less altered than the colon, was the principal object of my attention. I could not remove this intestine without dreading
a haemorrhage from the mesenteric vessels. In proportion as I made the ligatures I cut the intestines where the tied vessels terminated. I then tied the vessels of the caecum with a single thread and cut that intestine. I made three or four ligatures on the mesocolon, and cut the intestine which it sustained and which was very gangrenous in all its length, which consisted of about eight or ten inches. All this parcel of the intestine thus cut successively, according to its length, being totally removed, there no longer remained anything in the scrotum except the testicle, which was found, and included in its membranes, and the mesentery with the ends of the colon and the ileum, each of which came about two inches without the ring. There was no portion of the epiplon in the tumor. My design at first was to stitch the two ends of the intestine together, but the determination they had taken to come out of the abdomen was such an obstacle that I could not have succeeded in this attempt. They came out in such a manner that the colon passed above the ileum, and was situated toward the penis, while the ileum lay toward the thigh. Besides this circumstance, they were intimately adherent not only to each other but also to the ring itself. In order to have joined their extremities it would have been necessary to detach these adherences, which was not possible; it was therefore necessary to leave them in this situation. As the ring greatly compressed the two ends of the intestine, and as the feces had not a sufficiently free discharge, I made a dilatation in the ileum and ring by introducing my buttoned bistoury into the remaining part of the ileum, which I boldly divided. But I acted otherwise with respect to the ring, which I was obliged to disengage on the side of its inferior pillar. I only made a small dilatation in it, on account of the epigastric artery, which in such cases is very near this pillar. The feces were forthwith discharged in a very large quantity, and the excrements were involuntarily voided for ten or twelve hours without intermission. Notwithstanding the many ligatures I had made, a great number of small vessels which had escaped discharged a good deal of blood during the operation. I permitted this discharge so long as it did not incommode me, both to facilitate the evacuation of the vessels and because I had nobody to assist me except a woman, who secured the parts while the patient himself held the candle; for M. Coste was obliged to leave me on account of some pressing business. I dressed the wound with dry lint, with which I covered the mass of the mesentery. I left the extremities of the intestines free, only covering them with a simple pledget dipped in the yolk of an egg. I compressed the mesentery as regularly as I could by means of
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compressures and a bandage. The hæmorrhage ceased, but it was only for twelve or fifteen hours; for I was obliged to dress the patient twice in the night, and to use the strongest styptics, in order to brace up the extremities of the small vessels, which either could not be comprehended in the ligatures or which had escaped from them, and whose orifices were become much larger, and permitted so great a quantity of blood to be extravasated that the patient must have died if I had not continued with him; for M. Coste was obliged to go to his own home, which was about three miles distant. Next day there supervened a hiccough so violent that I thought the patient could not surmount it, for he was several times likely to die for want of intervals sufficient for respiration. The great quantity of blood he had lost by the hæmorrhage, and by two copious venesections, did not permit me to seek for relief in the aperture of a vein; I was therefore obliged to use laudanum in substance, the dose of which I augmented by half-grains every half-hour, so that in two hours he took four and a half grains of it, which at last alleviated the hiccough. He remained about five or six hours, as it were, intoxicated and without sleep, but during that time he enjoyed an agreeable tranquillity, and the hiccough was so diminished that nothing dangerous was to be dreaded from it. It continued, however, three or four days, but always became less and less. By the examination we made of the quantity of the intestines I had taken away we found that there was more than seven feet of them. The patient, by the care of M. Coste, was cured in six weeks. Three months after the cure I advised him to come to Paris, that I might try to reunite the extremities of the intestines. Messieurs Petit, Le Dran, Morand, and Verdier, whom I called to consult on the means which might be employed to remedy this inconvenience, found that the reunion was so much the less impracticable because the direction which the ends of the intestine had taken could not have permitted it during the operation; besides, the portion of the ileum was so retracted that it was hardly possible to perceive it. It formed a kind of body like a hen's arse, whose margins re-entered internally. The colon had totally disappeared. All the part of the mesentery which had remained out of the abdomen after the operation was so dissolved that no mark of it was to be felt either in the scrotum or about the ring. It afterward created no trouble in the dressings. This remark is of great importance, because it lays a foundation for some reflections on the cause of that perplexity which a part of the mesentery remaining without the abdomen created to M. Le Dran in the operation described in the sixtieth observation. Our patient
was therefore obliged, during the remainder of his life, to use an artificial anus. But his industry rendered this inconvenience more supportable to him than it would have been to any other person. He was very careful not to offend others by the bad smell, which they must necessarily feel if he had not subjected himself to some little pieces of art and contrivance which freed him from that disagreeableness which his misfortune must have otherwise produced. He had made several pessaries of cork covered with wax, in the form of a bottle cork, proportioned to the bulk and largeness of the intestine, and about an inch and a half long. This pessary was tied with a small cord to the principal compress. He introduced it into the intestine and laid three or four other compresses on the former. He secured the whole by a bandage composed of a single circular and a slip, which passed under the thigh from behind forward, in order to be fixed to the circular by a pin. He undid this apparatus every morning and evening, in order to empty it as occasion required. He was sometimes obliged to facilitate the discharge of the excrements, though always of a very liquid consistence, by means of a clyster. At other times the smallest portion of the feces was not discharged into his apparatus. By this means he enjoyed six years of perfect health, and at last died of an indigestion.

Operations for the Cure of Artificial Anus.*

2727 a.* A portion of skin removed, some time before the death of the patient, from the margin of the artificial anus last described.

The history of the case was thus recorded by Mr. Hunter:

"Hernia.

"An Italian was taken into St. George's Hospital with a bubonocele. It was an old rupture, which had been reduced at different times, but at last came down so large as not to allow of being returned.

"When he came in it had been down nine days, which gave rise to the appearances I observed in the operation. He had all the symptoms of a strangulated hernia, now reduced to the last extremity; therefore no time was to be lost.

"Upon exposing the contents of the sac and cutting through the stricture, it was found to contain epiploon inclosing the gut. The epiploon on its external surface everywhere adhered to the sac, but these adhesions were recent; however, I was obliged to use force with my finger to separate them. When this was done I unraveled the epiploon and exposed the gut, which adhered by its external surface everywhere to the epiploon. This I separated with ease, except at the lower part, where the adhesion was pretty firm; however, it gave way, but I found the

* Catalogue of Pathological Specimens.
substance of the gut was gone there, and that it only adhered round the hole in the gut. I cut off the whole of the epiploon; the whole of the intestines were reduced except where the hole was, and that part was fixed in the rings by two stitches.

"Quare: Would it not have been better practice not to have separated this union, but have reduced it in the united state, so that the epiploon might have become part of the gut; or have reduced it all to (except?) this part, leaving it in the sac, and healing the parts over it?

"The wound healed up to the openings of the gut, which were very large, making a slit about three inches in length and about one inch wide; with the inside of the gut a little protuberant or inverted, with the faces coming this way. When the parts were perfectly healed and the cicatrix all round became pliable and soft, I tried to bring the skin on each side together over the opening, which I found I could easily do. I next endeavored to prevent the faces coming this way, by applying a large piece of sticking-plaster over the whole [hole?], over that a thick compress, and over the whole a steel spring-truss, to make a compression. I found by this means that the faces found the lower orifice of the gut, and came away by the anus.

"Finding that, if the faces were prevented coming through the wound, they then could pass the right way, I thought it was worth trying how far it was in my power to close up this opening entirely.

"I conceived that if I was to remove the edges of the skin all round the opening and make it a fresh sore, I might then be able to unite them across the opening by the first intention; to which experiment he readily consented. It was now made a fresh wound all round for half an inch in breadth; the two surfaces were brought together, and kept there with the bare-lip pins, as also with compresses on each side to support the pins; but part of the faces worked through between the two surfaces and prevented the union, although the larger part of them went the right way.

"When the sore began to granulate, I next tried to unite them as before; but, as before, the same cause of prevention took place, and it again proved unsuccessful. Upon the healing of this sore all round, the opening into the gut was much lessened by the contraction of the granulations.

"Finding that I could not succeed in the union by the first intention, nor by means of granulations, and finding that the opening was much lessened by the method above taken, I conceived, if the same operation were repeated, that I might be able to bring the opening into a very small compass, and probably might be able afterward to close it entirely up.

"The man submitted to the operations the second time, and when this was healed the opening in the skin was not above an inch long. He now left the hospital till the parts became fit for some other trial; but he made his complaint a means of support, which was probably an easier mode than that arising from industry; and on the benevolence of the nobility and gentry of this country he lived comfortably himself and supported his sisters till his death, which was in consequence of a pulmonary consumption. Upon opening the body we found the gut which had protruded was the ileum, about two feet from the cecum. Upon the inside of the belly it appeared as if the gut only adhered to the peritoneum as it passed across, for it almost went straight across without making an angle; for the gut was nearly as broad or thick at this part as at the two adjacent loose parts; so the canal of the intestine was continued freely across the opening, and almost without any diminution. By introducing the finger into the ex-
ternal opening it came directly into the gut at this adhesion, and could thence be pushed into either part of the gut.

"As a certain portion of the gut was lost by mortification at this part; and as also a certain portion more was retained down in the ring to admit of adhesions there, both of which we must conceive was nearly, if not wholly, the diameter of the gut—but most probably making the gut make an angle there, so as to make the opening appear double, one going into each part of the gut, and the angle forming the septum—then it becomes a question, How came the gut to be so complete at this part? only seeming to pass across, making no angle, only having an opening on the adhering side, which communicated externally without the least appearance of there having been any loss of substance. The only way to reconcile these two contradictory facts is to suppose that Nature had been employed in perfecting the gut within the abdomen, and which, probably, was assisted by the stopping of the mouth of the external opening, with a view to force the feces the right way, which, obliging that side next to the abdomen to stretch, did dilate, and which would dilate inward toward the cavity of the abdomen; and this would also be assisted by every motion of the intestines within the abdomen; for every motion would be a pulling or dragging of the intestines inward, so as to take off the angle. It had not pulled inward that part of the intestine which lay in the wound, for there it still lay."—

Hunterian M.S.: Cases and Dissections, No. 54.

On a drawing of the parts, preserved as No. 138, it was written, "The preparation is in the possession of Mr. Ford." It was presented to the museum by Mr. Copeland, Mr. Ford's nephew, but no record could be found of the exact time or circumstances of the patient's death.

In his lectures Mr. Hunter used to say of this case: "A man in St. George's Hospital had a hernia, for which I laid the integuments open, and then the sac, when I found that the intestine had a tendency to mortify, and had formed adhesions to the sac. These adhesions, which were newly formed, I separated, when that part of the intestine which had adhered to the sac gave way, and the excrement came out. I therefore returned the intestine, and retained the torn part to the external wound, which became the anus; but there was still an open communication between the upper and lower parts of the gut, so that, could the opening in the groin have been stopped, the feces would have passed the natural way. To produce this, I dissected off the skin round the opening, and then brought it into contact with ligature, compress, etc.; but this would not do, although the granulations, by their contractions, lessened the size of the opening. I therefore repeated this operation, hoping that at last I might quite close it; but all my efforts were in vain.

"Now, in the above case, I acted like a blockhead, being ignorant of what Nature was here doing; for (admire her work) she was forming adhesions of the intestines all round that mortified, whereby she would not only have preserved the continuity of the canal, but by this same process would have prevented any escape of the feces: all which I prevented by separating those adhesions. If the case was to happen again, I should not separate the adhesions after taking off the stricture."—Hunterian Reminiscences, by Mr. James Parkinson, p. 41 (London, 1833, 4to).

2627. A portion of small intestine, of which the mucous membrane is of a dark-brown tint, from congestion; its mucous membrane is thickened and finely granular or velvety, as if from effusion of lymph. It had been strangulated in an inguinal hernia for eighteen hours.

From a man, aged twenty-seven, who had hernia for six or seven years. The truss which he
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2628. Portion of small intestine, about eighteen inches long, which was strangulated for twenty-four hours. It is dark-colored and distended; there are numerous shreds of lymph upon its peritoneal surface, but no marks of constriction.—Hunterian.

2629. A piece of omentum, completely gangrenous from strangulation.

A female infant aged three months, with right inguinal hernia. The sac was opened, the neck or pedicle of its contents ligatured with carbolized catgut, and the mass which is preserved was removed. On the twelfth day all parts were healed.—Presented by Richard Rendle, Esq., 1872.

2634. A large, oblique inguinal hernia of the right side. The sac contains the lower end of the ileum, the cæcum, with its appendix, a portion of the ascending colon, and a large piece of omentum. All the coverings of the hernia appear thickened, indurated, and consolidated.—From the Museum of John Howship, Esq.

2635. An inguinal hernia, containing a cæcum and its appendix, with the end of the ileum. The termination of the appendix is fixed to the lower part of the sac; the rest of it is free. Of that part of the cæcum which has not passed into the hernia, one half only is covered with peritoneum.—Presented by Sir William Blizzard.

2636. Part of a cæcum, with a portion of the abdominal walls, showing hernia of the vermiform appendix, which, passing through the internal ring (held open by a green glass rod), lies in the inguinal canal. This has been laid open so that the appendix may be seen attached to its walls by a fibrous band at the extremity. A bristle is passed through the vas deferens, and a glass rod into the vaginal process of the peritoneum behind.

A clergyman, aged fifty-six, who had long worn a truss for incipient right inguinal hernia. Increased swelling and pain were at length noticed in the right groin, followed by an abscess and fecal fistula, through which a small piece of bone came away. He then completely recovered, but died two months later from other causes. (See MS. Notes, vol. i, p. 294, and Trans. Path. Soc., vol. i, p. 269, 1848.—Presented by Dr. Thurman, 1871.

2637. A diverticulum of the ileum protruding into and adherent to the anterior surface of the sac of a direct inguinal hernia. The diverticulum is funnel-shaped, and connected with the bowel exactly opposite the attachment of the mesentery. It measures one inch and a half in length and is pervious throughout; its coats are similar to those composing the intestine. Its distal end is adherent to the outer end of the hernial sac, which is an inch long, and passes obliquely downward and forward in the substance of the abdominal wall. Its orifice is situated immediately to the inner side of the obliterated hypogastric artery. A sinus opening at one end through the skin passes obliquely inward, and communicates at the other end with the ileum near the apex of the diverticulum. The diverticulum may, judging from the history, have been formed by an adhesion, drawing out a portion of the intestinal wall into a tubular form.

A woman, aged seventy-seven, admitted into the hospital one month after she had been taken ill with vomiting and obstinate constipation. On admission she was much exhausted; her tongue was brown and dry; the bowels acted naturally, though still much constipated; the diffuse cellulitis of the right groin was present. In a few days a large bleb over the middle of Poupart’s ligament, in the midst of the inflamed area, burst and discharged watery fluid and
fical matter. Three months later the patient died of severe diarrhoea. The case is recorded in the Trans. Path. Soc., vol. xxvi, p. 109.—Presented by Dr. T. Stretch Douse, 1875.

2642. Portion of small intestine, which was strangulated in a hernia, and was burst, probably in an unsuccessful attempt to reduce it. A rent extends round half the circumference of the intestine; its edges are not ulcerated, nor do they appear much altered in texture. The marks of constriction are evident.—Presented by Sir William Blizard.

2645. Portion of small intestine, with the inguinal hernia in which it was strangulated. The part strangulated includes the whole circumference of the intestine; it was so completely filled with the portions of the skin of an apple or potato, which now lie below it, that it was impossible to return it. In the efforts at reduction, part of the neck of the sac and of the peritoneum round it were separated from their connection and pushed into the abdomen.—Presented by Sir William Blizard.

PLATE IV.*

* Scarpa, Plate VI.

† Peripherad.

Figure 1.

a, a. The cæcum.
b, b, b. The natural adhesion of the beginning of the colon and of the cæcum to the great sac of the peritoneum, as is observed in the natural state in the right iléo-lumbar region.
c, d, e, f, g. The hernial sac formed by that portion of the peritoneum which in the natural state occupied the right iléo-lumbar region.
h. The extremity of the ileum close to its insertion into the colon.
i. The beginning of the colon.
k. Fatty appendix of the colon.
l. The appendix vermiformis.
m, n. The membrano-aponeurotic sheath of the cremaster muscle laid open at the place where it surrounds the vaginal coat of the testicle.
o, o. The integuments of the scrotum.
p, q. Dotted lines pointing out the termination of the ileum and the beginning of the colon within the cavity of the abdomen.
r. The epigastric artery.
s. The epigastric vein.

Figure 2.

a, a. A part of the cæcum protruded in the hernia.
b, c. The natural adhesion which connects the cæcum and the beginning of the colon with the peritoneum in situ in the right iléo-lumbar region.
d, e, f. The appendix vermiformis.

g, h, i. Natural adhesions of the appendix vermiformis, with the part of the peritoneum which has protruded and forms the hernial sac.
k. The extremity of the ileum.
l. The insertion of the extremity of the ileum into the colon.
m, n. Dotted lines pointing out the position of the extremity of the ileum, and of the beginning of the colon within the abdomen in the right iléo-lumbar region.
n, o. The aponeurosis of the external oblique muscle of the abdomen.
o, o, o. The hernial sac.
p, q. The vaginal coat of the testicle laid open.
r. The testicle.
s. The epididymis.
t. The spermatic cord.

Figure 3.

a, b. That portion of the left colon which, previous to its descent into the scrotum, was naturally connected with the great sac of the peritoneum in the left iléo-lumbar region, in the vicinity of the great iliac vessels of the same side. This loop of the left colon is seen raised on purpose from the bottom of the hernial sac, and drawn outward,† in order to show clearly the natural union of this intestine with the portion of the peritoneum which has descended and forms the hernial sac.
COMPLICATIONS INCIDENT TO THE SURGICAL MEASURES.

The natural bridles or ligaments of the left colon connecting it to that portion of the great sac of the peritoneum protruded and forming the hernial sac.

(a) The lateral ligament of the colon.
(b) The hernial sac.
(c) The cellular substance interposed between the hernial sac and the membrano-aponeurotic sheath of the cremaster muscle.
(d) The membrano-aponeurotic sheath of the cremaster muscle.
(e) The sheath of this muscle divided at the place where it tightly surrounds the vaginal coat of the testicle.
(f) The vaginal coat of the testicle.
(g) The testicle.
(h) The epididymis.
(i) The spermatic vessels surrounded by the cellular substance of the cord.

* Atlantad.
CHAPTER XXII.

HISTORY OF OPERATIVE MEASURES ADVOCATED FOR THE CURE OF HERNIA.

An exhaustive review of the various measures undertaken for the relief or cure of hernia, during the centuries since the art of surgery has been preserved in a written record, would be altogether out of place, even in a work which has for its purpose a complete discussion of the subject. However interesting such a research might be—and to the lover of antiquity it certainly is so—it would necessitate a review, in large measure, of the various phases of surgical thought and the repetition of certain fundamental factors, subject to individual modifications. The distinguished Parisian surgeon, George Arnaud, who published, in 1748, his Memoir upon Hernia, stated, in the preface of his interesting work, that, prompted by a zeal to exhaust every resource of knowledge then available upon this subject, he caused a thorough search to be made in the great libraries of Paris, and a copy of all that had been written upon this subject to be transcribed for the purpose of publication. So great, however, was the magnitude of the work undertaken, he found that the manuscript copy thus furnished would make over three thousand pages in quarto, and therefore he wisely desisted from his ambitious design. If we add to this the contributions of a century and a half, he who should undertake the subject would indeed labor under the embarrassment of riches.

Rupture was certainly recognized at a very early date.* Dr. J. D. Bryant,† of New York, writes as follows: “The subject of hernia is an ancient one, and has associated with it the dust and traditions of the earliest times of medical and surgical matters. It can be safely assumed, I think, that the consideration of means of relief from this affliction was but a step behind the first occurrence of the affliction itself, and the age of the affliction is best measured by the length of the time of the establishment of the present relations of the abdominal contents and their walls

* Leviticus xxi, 17-20. In the old editions was rendered “herniosus.”
† Transactions of the New York State Medical Society, vol. vi, p. 116.
with each other. The person who had the first hernia was the first person to contemplate means of relief from it, and no doubt soon learned to seek the same relief in the recumbent posture and from manual pressure that these measures afford to-day."

Hippocrates pointed out different varieties of hernia, and described some of the causes. Celsus, the great Roman author, who lived in the time of the Emperors Augustus and Tiberius, wrote with a care and exactitude that would reflect honor upon any age. He advised the opening of the hernial sac with the knife, the division of the constriction, and the return of the intestine into the abdominal cavity. He separated the sac and ligatured it. He tied the spermatic cord and removed the testicle. He cut away a part of the scrotum and united the lips of the wound in such a way as to form a solid cicatrix. He observed that it is the habit of some to cauterize the parts with caustics, or the actual cautery. This method he thought advisable where the rupture was very large or the patient subject to humors, but remarked, "The patient should be of good habit, and neither an infant nor an old person."

Paulus Ægineta modified the operation of Celsus by separating the sac and cutting it below the ligature, in this way saving the testicle and cord. He amplified in many ways the teachings of Celsus, giving in detail descriptions of the varieties of ruptures, emphasizing those in which the intestine is involved. He pointed out the different causes and symptoms, describing the changes which take place from the distention of the peritoneum, and taught the conditions under which it may be necessary to cut the constriction in order to restore the abdominal contents. Albus casis practiced after the method of Celsus, emphasizing more strongly the application of the actual cautery, searing the tissues to their very base. Lanfranc devised a pair of forceps or pincers, in which there was a longitudinal slit, for the purpose of introducing a red-hot instrument. The parts including the neck of the sac were thus seized and pierced. The object of this method was to protect the surrounding parts from the effect of the cautery and preserve the cord. Guy de Chauliac recommended the cautery as very successful in repeated applications, until he had destroyed the sac, and reported many cases without injury to the testicle. Rosset reported, in 1559, a number of operations by different surgeons which he distinctly stated were performed after the method of Celsus, first making, with the utmost care and caution, a division of the parts, cutting away the sac, and stitching up the wound. These cases were followed by complete cure. In one case he described the removal of a portion of necrosed omentum "the bulk of two hen's eggs."
Severinus advocated the cautery, but commented as follows: "He who useth the actual cautery ought to have a solid judgment, with a certain foresight which is not so easily to be described. These gifts of the mind are from Nature, and improved and preserved by long practice and use."

Claudinus used the actual cautery in a way to produce several crusts, in order to make the skin shrink and grow callous and firm. Albuscasis preferred a cautery shaped like a half moon. All insisted upon a low course of diet, a loose condition of the bowel, and absolute quiet in bed, even forbidding the use of the arms.

Heurnius, commenting upon the value of the cautery when properly applied, as the cure by the use of iron and the demand of large fees, said, "It is the unhappiness of this iron age that it can be sweetened with nothing but gold."

Houstoun, who published in 1726, after reviewing the advantages of the cautery as early used, lamented the neglect of its use in too many instances in his day, and asked, "What may be expected from the actual cautery were we as well skilled and dexterous in its application as the bold and wise ancients were?" When the best results were obtained from the methods above mentioned, an instrumental support was applied for the retention of the hernia, to be worn permanently.

The caustic treatment succeeded the cautery, and was advocated for similar reasons. An eschar about an inch in diameter was to be made over the external ring, and by repeated applications the tissues were thus destroyed, including as much of the sac as could be safely done without injury to the cord. This was advocated by a physician named Little as a secret remedy, and so important was it made to appear, that King George the First bestowed upon him the sum of five thousand pounds for making known the remedy.

The object to be attained was a cicatrix firmly closing the ring. This procedure was in use for a considerable period, and was advocated by Guido, Lanfranc, Parey, Scultetus, and others. Many dangerous complications and unsatisfactory results were recorded by these writers. The danger, the suffering, the frequent return of the hernia behind the cicatrix, compelling the use of bandages, caused these measures gradually to fall into disuse.

As improvements upon the above methods, followed the punctum aureum and the royal stitch. Since these two methods were attempts in the direction toward which the pendulum of modern opinion has again swung, I quote from the ever-interesting work of Percival Pott, a surgeon famous for all time: "The punctum aureum
was performed as follows: The bowel being emptied by purging and the hernia reduced, an incision was made through the skin and membrana adiposa down to the spermatic process. This incision was to be of such length as to permit the operator, either with his finger or a hook, to take up the said process and to pass a golden wire under it; the wire was to be twisted in such a manner as to prevent the intestine from slipping down again into the hernial sac, but not so tight as to intercept or obstruct the circulation of the blood to the testicle. Some operators preferred a leaden wire to a golden one, and others a silk ligature. . . . The royal stitch was performed in this manner: The intestines being emptied, and the portion which had descended being replaced, an incision was made, so as to lay bare the spermatic cord, about two inches in length, from the abdominal opening downward. When the process was freed from the cellular membrane it was to be held up by an assistant, while the surgeon, with a needle and ligature, made a continuous suture from the lower part of the incision to the upper in such a manner as to unite the divided lips of the wound again, comprehending the cellular membrane, and thereby endeavoring to straighten the passage, as they called it, from the belly into the scrotum, without injuring the spermatic vessels. The operation is described by many of the old writers, with some small variation from each other, both in the manner and in the instruments, but all tending to the same end, and all proving that their idea of the disease and of the parts affected by it were erroneous and imperfect."

Ambrose Paré gave a careful description of the operation by twisting about the neck of the sac a small gold wire four times backward and forward, so that the two ends of the wire could come together and the ends be filed off, without compressing the spermatic vessels. This Heister objected to upon theoretic grounds, because he could not understand how the wound could heal from the constant irritation produced by the wire, and on this account there must be a continual ulcer at the site of the wound. Arnaud ascribed this device for the cure of hernia to Berault. He stated that French surgeons adopted its use, substituting often iron and lead wire to save expense. It became the common practice of the surgeons of the time; and even Arnaud, who condemned the method, apparently having never practiced it, admitted that it was ingenious, and that great advantage followed from reducing the size of the hernia by destroying the sac and rendering possible retention by instrumental supports. Sermeccrus described a method he learned among the Russians, and recommended it as of the greatest advantage in adults where the intestine could not be
retained in the abdomen by a bandage. Heister illustrated this method by a drawing, but it consisted only of the separation of the sac, which was tied with a strong thread as nearly as possible to its neck, and the ligature left hanging in the wound, which was dressed in the usual manner until it spontaneously separated. This method Heister recommended in the main for adoption. He emphasized that the "intestine should be treated so tenderly as rather to divide the part to which it adheres, even if it be the testicle itself, than injure its own proper coats. In the next place, the sacculus of the peritoneum is to be freed from all its parts and secured by a ligature, tied round near the ring of the abdominal muscles, made of a flaxen thread, waxed, and three or four times doubled; after which that part of the sacculus below the ligature is to be extirpated, and the wound dressed as before; after the ligature is digested off it forms a sort of tubercle, or hard cicatrix, which, being joined by scarification to the lips of the wound, firmly resists the pressure of the intestine and prevents it from subsiding into the scrotum."

Heister did not think it of special importance if the epigastric artery was divided, since it could be at once tied. If the intestine was wounded, it was sutured and fastened by a thread to the wound. He advised, as a rule, the opening of the sac before ligaturing, in order to ascertain the condition of, and return the abdominal contents, which he pointed out were often in a state that demanded special care, when the parts were found to contain humors by which it seems to have been understood that pathological changes had supervened.

Drainage was in general use, at least in Paris, although it is supposed to be of modern origin. Dionis (Pieric), of Paris, published in 1708 upon this subject. He recommended the opening of the sac with caution, taught the principles of dilatation of the ring when necessary, and removed portions of compressed omentum. After the operation he filled the wound to its very base with lint soaked in the yolk of egg and oil which was held in place by a bandage. These procedures were practiced in France for many years. According to Heister, Videnmanus and Dionis directed the tent to be made about the thickness and length of the finger, and wrote that "it ought not to be extracted until it falls off of itself by suppuration of the parts; but Petit condemned the use of these as pernicious, by irritating the parts and admitting the external air; yet I can not but acquiesce in their use, when there is a repeated discharge of putrid humors to be made from the abdomen, otherwise it may be sufficient, according to Petit, to apply a thick pellet only for the more speedy agglutination of the wound." Here is
clearly foreshadowed the idea of modern drainage in wounds; and, since parallel fibers of lint in considerable abundance were used, the method is not unlike that recently recommended by Dr. Morris, of New York, for the purpose of abdominal drainage.

When the removal of these unhealthy fluids was not deemed necessary, it was generally advised to dress the wound after Petit’s method. This consisted in filling it to the base of the ligatured sac with pellets of compact lint dipped in a fluid made of the white of an egg shaken in the spirit of wine. This was covered by several compresses moistened with the spirit of wine and firmly secured by a spica bandage. The dressing was removed in two or three days, the wound washed with warm spirits of wine, and new dressings applied. When the wound was firmly healed, a light truss was fitted, which, if the individual was young, was to be worn for a year or more; if an adult, to be worn for life. We see in this method almost the exact counterpart of that which has been recommended by Dr. W. McBurney, of New York; and although the albumen may have been useless, we find a very good antiseptic dressing in the spirit of wine. I quote from Arnaud a quaint description of a then common method among the Turks, which gives an interesting picture of the cure of rupture in the East at this period.

“Demetrius de Cantimir, Prince of Moldavia, related, in the History of the Ottoman Empire, translated by M. de Joncquières, vol. ii, p. 397, that the inhabitants of Albania and Epirus, otherwise called by the Turks Arnaut, excelled in the cure of ruptures; and after he had spoken of their skill in many respects, he related a process which he observed himself.

“‘As to the cure of ruptures (says he) they undertake it upon all sorts of people and at all ages; their method is coarse, but yet successful. When I was at Constantinople I had the operation performed upon my secretary, who was an elderly man, in my own palace. Having agreed as to the expense, they tied the patient down upon a broad plank, and secured him from his breast to his feet with proper bandages; then the operator made an incision in the inferior part of the abdomen with a kind of razor or bistoury. The peritoneum being opened, he pulled out about the bulk of a hand of the internal substance, under the skin, and drew up the intestine, which was fallen into the scrotum, into its proper place. Afterward he sew’d up the peritoneum with strong thread, and a knot at the end to hinder it from slipping; and the lips which hung over were cut off with the same razor. Then the wound was rubb’d with hog’s-lard, and cauteriz’d with a red-hot iron. Before the dressing was applied they lifted up a little the legs of the patient, who was almost dead, and pour’d the whites of nine new-laid
eggs into the wound; and if that liquor fermented and bubbled within the space of an hour or two, it was a certain sign of a cure; on the contrary, if there was no appearance of that kind in three hours, they made no favourable prognostic. They attribute ill success to the age or weakness of the patient, which obstructs the cure, for they never doubt of the efficacy of their method; and indeed there seldom die two out of an hundred of those whom they undertake. After two or three days they repeat the use of the whites of eggs, and all this time the patient is kept extended upon his back, without giving any signs of life or having any great sensibility. The operators did not suffer him to take anything, but thought it sufficient to moisten the tongue from time to time with a little water. The fourth day they took him out of bed, as yet secured upon a plank; he then soon came to himself, and with a feeble voice complained of his pains. They then gave him two or three spoonfuls of warm water to comfort him; and the three following days he drank broths, recommending to him, above all, not to overcharge his stomach, and not to touch anything solid. The seventh day they untied him and put him into a bed; but, for fear he should stir his legs or turn upon his side, two of his physicians continually kept their eyes upon him to prevent it. Every day the application of the whites of eggs was renewed; but from the ninth to the twelfth day they were reduced to six eggs; and as soon as they were poured upon the wound they fermented more than before. On the fifteenth day the white of a single egg could scarcely be admitted, yet they did not desist while any would enter, and there was the least appearance of a fermentation. That sign being over, they covered the wound with a plaister made of pitch, oil, etc.; then the patient had liberty to stir his feet, and to lie on his side. Every morning, before the patient took any nourishment, they gently pulled the end of the thread, to see if they might leave off the ligature, which depends upon the strength of the patient. To some, forty days are necessary, to others thirty, and in some the thread may be taken away in twenty, when, by the help of a second plaister, the cure is completed. Here we see a surprising operation, of which I was eye-witness, and which is nevertheless practiced with success by a savage people ignorant of science. This operation is so surprising, that we could scarcely believe it had it not been related by so respectable an author; but it gives men of judgment a notion of the talents of those people very different from that of the author."

The operation for the cure of hernia involving the sacrifice of the testicle was in common practice for a considerable period, with excellent result, until it was forbidden by an edict of the Emperor Constantine. He punished with banishment all those who
PERFORMED CASTRATION, to be followed by death if they ever returned to the empire. He likewise decreed the confiscation of the house in which the operation was done. This law, however, was intended to inflict punishment upon the common practice of castration of children in order to supply the demand for eunuchs, although the surgeons who thereby attempted the cure of hernia were included in its jurisdiction.

Under the leadership of the master-minds of Sir Astley Cooper, Scarpa, and Cloquet, the attention of surgeons was directed to the anatomical factors of the problem which were presented in strangulated hernia. It was, indeed, rare that any other complication caused even these master-surgeons to consider favorably operative measures. Viewed from the light of our present knowledge, it must be admitted that the treatment of wounds during the early part of the present century was far less satisfactory than in the generation which preceded. An illustration of this is shown by a quotation from the last edition of Mr. Cooper's valuable work: "When the operator has returned the protruded contents of the hernial sac, he should clear it of any blood which it may contain, and, having nicely adjusted the sac and its coverings, bring the edges of the wound together, confining them by sutures. The needle and ligatures should be passed through the integuments only, and great care should be taken to avoid penetrating the sac, which might occasion a dangerous extension of the inflammation. A piece of lint should then be laid on the wound, with a compress of linen over it, and these pressed pretty firmly down upon the groin by the T-bandage, so as to close the orifice of the hernial sac. The patient is then to be carried to bed in a horizontal posture, and, while this is doing, the surgeon should support the wounded part with the palm of his hand, to prevent the intestine from being forced down by the motion of the patient."

In Lawrence's last edition on Hernia, published in 1843, he repeated the directions given by Mr. Cooper, and commented upon the management of the wound "as a very simple affair, that which was known until the present generation as the cold-water treatment of wounds." He advised that the sutures should be cut out in thirty-four to forty-eight hours, and stated that he had "often seen primary union after operation for strangulated hernia, without requiring any attention that could be called dressing." He also pointed out the dangers which are likely to ensue if the sac is interfered with; and Schmucker and Langenbeck seem to have been almost the only men during the first half of the present century who attempted its removal. A careful suturing of the canal in order to produce firm closure does not seem to have been advo-
icated by any of the surgeons until within a comparatively recent period. Wounds which suppurated were usually treated with poultices.

Ligature of the sac has been in vogue from an early day. The distinguished Prussian surgeon Schmucker dissected the sac, and opened it to be sure that it was empty, and then, ligaturing as closely as possible to the ring, cut it away. This he did, however, in only two cases. The elder Langenbeck made careful anatomical dissections, and published at length the results of his clinical and surgical experiences* (see plates, pp. 104, 123). I quote the description of his operation as given by Lawrence:

"I divide the integuments over the swelling, without pinching them up into a fold, clear the hernial sac, push back the prolapsed parts, and place a ligature on the neck of the sac close to the ring. The tightening of this ligature gives no pain. If the sac has been completely detached from all its connections below the ligature, it perishes; if, on the contrary, it has been separated only sufficiently for passing the ligature, and still remains connected with the scrotum below, it becomes inflamed, and the scrotum itself is affected with inflammatory enlargement, as after the radical operation for hydrocele. The detachment of the ligature occurs from the ninth to the fourteenth day. If the case is an external inguinal hernia, the sac must be separated from the spermatic cord. I detach it just below the ring, to a sufficient extent to allow the application of the ligature, and leave the rest undisturbed in its situation. To separate the entire sac from the scrotum and from the tunica vaginalis propria testis would cause much irritation. The operation is much easier with small ruptures which have not descended into the scrotum, and in internal inguinal hernia where the spermatic cord, with its tunica vaginalis communis, lying on the other side of the swelling, is not so closely connected with the sac. It is most easy in femoral hernia, where the entire sac can be readily cleared. I have already performed this operation twelve times with the most successful results, and all the patients are capable of the hardest labor without wearing a truss. Two years have elapsed since I first put my method in practice on a youth sixteen years old with a large scrotal hernia, in whom there is at present no appearance of a new protrusion. A year ago I operated on a crural hernia in a female domestic, who does the hardest work without having experienced any return of her complaint. The ligature causes adhesive

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* Bibliothek für Chirurgie, B. II, 1808.
inflammation of the serous surfaces, and the neck of the sac becomes closed up to the abdomen like the portion of an artery which has been tied."

Lawrence,* in commenting upon the operation, although he placed great emphasis upon the importance of the sac as a factorage of hernia, stated: "But, in truth, something more is required: we want a remedy that should contract the tendinous opening; for, while that remains preternaturally large, a new protrusion is a highly probable occurrence."

The operation for the cure of hernia was advocated at a much earlier period by Arnaud, Sharp, Petit, Abernethy, and others, who reported their experiences; but, while a considerable number of cures followed, a considerable number of those operated upon were dangerously ill, and some cases resulted fatally. It is painful to note the bleedings, purgings, etc., undertaken to combat the inflammation, as it was then understood. Surgical operations by what might be called the open method for the cure of hernia slowly fell into disregard, to be revived only in our own time. At least they fell into disrepute with the profession, and were relegated to the hands of the peripatetic pretender, who for a long time reaped a rich reward by cultivating this abandoned field of surgery, so strong was the desire of the suffering to obtain relief by any means promising cure.

At this period, and for a long time afterward, we may trace a legitimate effort of the surgical profession to profit by the monumental labors of Camper, Cooper, Cloquet, and Scarpa, and effect a cure of this distressing complaint. Their teachings, however, fell upon a barren soil in the subsequent generation, save in the hands of a few of the leading surgeons in general hospitals, where late operations were performed for the relief of strangulation, but these were for the most part fruitless because of the delay, thus bringing even these measures into disrepute.

The teachings of the great master, Sir Astley Cooper, found a worthy American exponent in Dr. John Collins Warren, of Boston. When only twenty-two years old, writing home to his father, July 9, 1800, from London, he stated: "Mr. William Cooper, my old master, is succeeded by his nephew, Mr. Astley Cooper, as lecturer; a young man of the greatest natural abilities, and almost adored at the hospitals. His practice is directly the reverse of his uncle's. Old Mr. Cooper would say: 'Let Nature alone; she will open that abscess infinitely better than you can.' The other

* Treatise on Hernia, p. 103.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

says: 'Had you dilated that abscess from top to bottom at first, it would have been well long ago.' The obligations that I am under to Mr. Cooper are infinite. He has always treated me with the most particular attention, and suffered no opportunity of instructing me to pass by. I wish it were possible to return in the smallest degree the favors with which he has loaded me.'*

In the Warren Anatomical Museum, No. 2364, there is still preserved a portion of omentum four and three quarter inches in length, removed from a crural hernia, where the strangulation had already existed seven days. Dr. Warren was then twenty-seven years of age. Of his experience he wrote: "When I began to operate in Boston, many of the great and difficult operations had never been performed. My father had done a great number of amputations, and had successfully removed many cataracts. He had also repeatedly done the operation of lithotomy—that is, he did it four or five times altogether. I have done it since then, including operations of lithotomy, thirty to forty times. But the operation for strangulated hernia, that of aneurism, and many others, had not been done in Boston. The first cases of hernia upon which I proposed to operate excited great opposition on the part of friends of the patient and surrounding physicians. In consequence of this difficulty I lost two or three patients in the outset, from delay: one, an only son of the Rev. D. Baldwin; the other, an only son of B. B., Esq. In consequence of these occurrences I determined to operate soon, or not at all. This became known to physicians, and they fell into the plan of operating early. Since this arrangement I have lost scarcely any patients in operations for strangulated hernia. In the winter of 1805 I was summoned to the wife of Dr. C., of Amherst, N. H., and, accompanied by Dr. Gorham, rode in an open vehicle on the snow, the best part of a cold night in February, to Amherst. The disease had lasted seven days. The hernia was crural and large. The intestines adhered to the peritoneum, and I dissected the peritoneum from the intestine through a large space, cut off a considerable portion of swelled omentum which could not be reduced, and which is still to be seen at the Medical College, and reduced the adherent intestine. The patient recovered, and lived many years afterward. The operation of strangulated hernia became at last so familiar, that it cost me no more anxiety than the extirpation of a tumor, especially since the introduction of ether."†

For many years I find no record of any attempt at revival of methods of cure. In 1818, Dr. Jamieson,* of Baltimore, reported a case of permanent cure following the dissection and implantation of a tongue of tissue into the crural canal. After plugging the canal, skin-flaps were united over it, thus making a plastic operation covering the parts.

P. N. Gerdy published his method in 1835. This consisted in inflaming, by the application of ammonia, a portion of the skin of the serotum and invaginating it within the ring, and retaining it by suturing through the ring. This operation was variously modified, the most interesting of which was the device of M. Belmas,† invaginating the ring with an inflated bag of gold-beater's skin. The hernia was first returned, the sac exposed, and the empty bag carried as far as possible toward the neck or ring. A cannula fixed in the bag was then used to inflate it, where it was retained in the sac. Afterward pieces of gold-beater's skin were used, instead of the inflated bag. A number of cures resulted. The chief interest pertaining to this operation lies in the experiments which led to its adoption, since M. Belmas demonstrated that these tissues when placed in the serous cavities of animals became adherent and were incorporated as a part of the living structures. These experiments were the legitimate antecedents of animal sutures, and might easily have led up to the use of tendon or catgut thus applied for the closure of the ring.

M. A. Bonnet,‡ of Lyons, published his method of the introduction of three or four pins through the integuments of the sac and the twisting of the points so as to compress the included parts—a sort of hare-lip pin.

The wood pad was employed accidentally by a laborer, with the result of cure. The pad was variously modified, and called the "Stagner" truss. From the report of a committee appointed by the Philadelphia Medical Society, in 1835, I quote: "An irritation of the skin and subcutaneous cellular tissue is produced by the pressure of the hard, unyielding, and rugose block, and is gradually extended to the tendons beneath, as well as to the serous membranes of the sac which is closed and obliterated at its neck, the whole mass of integument, tendon, cellular tissue, and the sac being agglutinated by the process of adhesion, in such a manner as to oppose an insuperable barrier against the exit of the intestine."

‡ Bulletin général de Thérapeutique, May, 1836.
Later the pads were made smooth. I have seen excellent results from their use; and in one case followed by cure, in a young student, the pad was worn for a time under so firm a spring that it was nearly imbedded in the swollen parts. Only within a few days a man presented himself, wearing a truss with a thick wood pad of his own construction, which, he said, "held him when all others had failed."

Wutzer,* of Bonn, improved upon Gerdy's method of invagination, by the invention of an instrument through which was carried a needle. Both were allowed to remain in situ for eight or ten days. A truss was recommended for some months subsequent. Permanent cure, however, proved the exception.

The use of the seton may be traced far back in the history of surgery; and when the inflammatory processes which supervene are taken into consideration, it is easy to conceive its supposed adaptability for the cure of hernia. The seton was introduced into the hernial sac, for this purpose, early in the present century. No definite results are reported, and the practice has for a long time been generally abandoned. Dr. Holthouse,† however, has given such an exceptionally interesting statement of its use that I quote the following: "Cases are sometimes met with in which, owing to the smallness of the inguinal canal, the finger can not satisfactorily make out the structures involved in the operations which I shall have presently to speak of, and under such circumstances their performance can not be altogether free from risk. For these, the seton operation may be instituted, and from my experience of it, derived, however, from a limited number of cases, I am disposed to regard it with more favor than is usually accorded to it. True, I have not done it of late years, but that is because I have met with scarcely any cases that were not amenable to the superior operation by the rectangular pins, which act both on the sac and on the canal. The following, however, is an example of the seton operation:

"G. E., aged seventeen, was admitted into the Westminster Hospital for an oblique inguinal hernia, which had descended into the upper part of the scrotum, and existed three months. It was easily reduced, and no truss had been worn for it. On the 31st of July, 1860, the bowels having been previously cleared by castor-oil, a seton composed of eight threads of silk was drawn through the inguinal canal, the patient was put on low diet, and a grain of opium given at bedtime.

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"August 8th.—Seton removed, very little pain or suppurition having been caused by it. Has not had any unfavorable symptoms, and looks and feels perfectly well. Middle diet, with half a pint of porter, was ordered, and a truss with a weak spring was applied.

"August 10th.—Continues well; some tenderness is felt on pressure over the inguinal canal, and the truss causes pain in the parts; it was therefore removed, with an injunction to the patient to place his hand over the site of the internal ring during defecation or straining.

"August 21st.—Discharged cured, but wearing a weak truss. Wounds very nearly but not quite healed.

"September 1st.—Presented himself at the hospital, the wounds being now quite healed. The truss was taken away.

"October 13th.—Continues very well, and has gained flesh. He is working as a bricklayer's laborer, without a truss.

"August 31, 1861.—A month ago, or exactly one year after the performance of the operation, the rupture suddenly came down again while he was making a violent muscular effort. He has been nearly constantly at work without a truss ever since his discharge from the hospital. Notwithstanding the hernia eventually returned in this case, the operation can scarcely be called an unsuccessful one. Indeed, it appears extremely probable that, had the patient delayed going to work a little longer, or had he been in a station of life which called for less bodily exertion, there would have been a pronounced success. This view is supported not only by the cures resulting from the use of a truss only, and to which allusion has already been made, but by the following dissection of a case in which this principle of operating was adopted:

"A German, forty-seven years of age, affected with a scrotal hernia of the right side, was operated on by Prof. Carnochan, after Rigg's method, on the 2d of May, 1857; the operation was completely successful. Toward the latter part of July pulmonic symptoms made their appearance, and on the 9th of September he died of tuberculosis of the lungs. Post-mortem 10th of September.—Upon opening the cavity of the peritoneum the orifice to the hernial sac could not be traced, the internal ring being firmly closed around the cord. On the outer side of the peritoneum, and just below the situation of the internal ring, was found a small rounded body of a yellowish color, supposed to have been the remains of the hernial sac. The upper portion of the inguinal canal,
for nearly an inch, was closed by plastic exudation, which had become organized and somewhat fibrinous in its appearance, while the canal at its lower part and the external ring were to appearance in their normal condition, though the cord throughout the entire length of the canal seemed to be imbedded in plastic formation. The skein of silk used in this case being too large for the puncture made by the instrument, it was not introduced more than one inch, which will explain the facts mentioned of the lower portion of the canal and external ring being in their normal condition; while at its upper portion both the canal and internal ring were firmly closed."

In explanation, it should be mentioned that Rigg's operation is identical in principle with the seton operation. The method of performing the seton operation is as follows: "A fold of scrotum is carried up on the finger as high into the inguinal canal as possible; a strong curved needle, set in a handle and having a large eye near its extremity, is next passed along the palmar aspect of the finger, thrust through the anterior wall of the canal, and brought out on the surface, about half an inch or more above the center of Poupart's ligament; it is then threaded with the number of threads previously determined upon, and medicated or not, as the case may be, and withdrawn through the same opening at which it was entered. The upper and lower ends of the thread are tied together, and pressure made over the outside of the canal with a compress and bandage. The threads are allowed to remain in the canal till a sufficient amount of inflammation appears to have been excited, and are then withdrawn at periods varying from three to nine days."

M. Velpeau operated a number of times by opening the neck of the hernial sac and introducing the tincture of iodine. The success which so often followed the operation for hydrocele by injection led him to adopt its use for the cure of hernia. An assistant compressed the inguinal canal so as to prevent the fluid entering the abdominal cavity; a mixture of six drachms of tincture of iodine in three ounces of water was introduced, and, after pressing it into all the parts of the sac, it was allowed to escape. No serious symptoms followed, but the imperfect results led him after a time to abandon its use.

Dr. Pancoast, of Philadelphia, in his work on Operative Surgery, published in 1844, reported the injection of tincture of iodine, or tincture of cantharides, half a drachm, introduced into the sac by means of a small syringe, fitted with a fine canula which is first carried free into the sac. The canula was withdrawn, and a compress, placed
under a truss, directed to be worn. His cases numbered thirteen, operated on in 1836, and were all benefited. Some worked at farm-labor a year after the operation without wearing a truss, and there was no return of the hernia.

Dr. E. M. Moore* gave a brief account of cases operated on by Dr. Pancoast when he was intern under the latter, as follows: "The operation for the radical cure of hernia had not at that time been performed on this side of the Atlantic. Four cases were treated by injection. Dr. Pancoast was so fearful of peritoneal inflammation that he had a fine trocar made and a small gold canula. The point of the trocar was round, so as to avoid cutting the tissues and thereby causing haemorrhage. This instrument was plunged into the tissues at the neck of the sac, and forced down to the bone so as to insure a sufficiently deep injection. The trocar having been removed, twenty-five drops of the officinal tincture of cantharides were injected. The cut produced by the needle healed immediately, but the irritation caused by the injection was very considerable. The swelling was marked, and very hard along the line of the cord. At first some alarm was felt lest the peritoneum should become inflamed; but this did not happen, and the patients progressed favorably as far as the hernia was concerned. Unfortunately, one of the patients died of typhoid fever. The ultimate results, in two of the other cases, were not known, as the histories of the patients after the operation could not be traced. One of the cases presented an enormous scrotal hernia. After the injection the swelling of the parts was very great, and the cure apparently satisfactory, but the patient refused to wear a truss, and the hernia returned. Some time afterward, Dr. Moore took care of a case operated on by another physician for the radical cure of an ordinary inguinal hernia. The operation consisted in cutting and tearing through the tissues until the neck was reached, and then introducing six drops of oil of cloves by means of an ordinary glass syringe. The patient was placed in bed, and advised to wear a truss even while recumbent. This, it was subsequently learned, he neglected to do, even rising from bed without adjusting the truss. Nevertheless, he made a perfectly successful recovery, and, although he returned to his work—that of waiter at a hotel—without using a truss, there was no return of the trouble."

Dr. John Watson,+ of New York, published upon the subject in 1851. The process

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* Transactions of the New York State Medical Association, vol. vi, pp. 139, 140.—Discussion by E. M. Moore, M. D.
+ The Radical Cure of Reducible Hernia by the Injection of Tincture of Iodine.—New York Medical Times, 1851.
of injection with iodine was revived in Paris in 1854-57, with favorable results, as reported by Boinet, Demeaux, Jobert, Maisonneuve, Nélaton, and Ricord.

The injection method, of by far the widest repute and general adoption, is accredited to Dr. George Heaton, of Boston. He first published his results in 1843.* He used the fluid extract of oak-bark.

The late Dr. Joseph H. Warren,† of Boston, the most famous of Dr. Heaton’s followers, wrote: “But the honors of the true hypodermic injection, without any preliminary incision, I think, after much careful research in the literature of surgery, belongs to the late Dr. George Heaton, of Boston, who, after eight years of discouraging experiment, discovered a process which I call the method of tendinous irritation, by the injection of a solution of quercus alba. Since he performed successful cures by his new method as early as 1840, and experimented, as he tells us, eight years previous to this, we are carried back to the year 1832, when he first conceived his method. His first operations were performed with Dr. Jaynes, of St. Louis.” The operation as performed by Dr. Heaton created much discussion in Boston. It was generally adversely criticised, and his methods were claimed by some to be unprofessional. There can be little doubt but that he pursued the investigation of the subject with enthusiastic devotion and with good results, if not always followed by entire cure. Dr. J. H. Davenport edited Dr. Heaton’s book,‡ which contains much that is novel and interesting. There is appended a list of one hundred and forty cases “from the many hundreds,” with brief notes of each.

Dr. Warren began operating upon hernia by the Heaton method soon after the author’s death. He stated,* in a note to his second edition, that he “is convinced the credit of the origination of the method belongs to Dr. Pancoast; that to Dr. Heaton is due the discovery of the exceptional value of the thick extract of the oak-bark.” Dr. Warren thought that this peculiar effect was due to non-absorbability of the particulate elements of the bark, and, by their remaining in the tissues, a much greater exudation of the cell elements occurs. He greatly modified and improved the instruments to be used, both needles and syringe, and changed somewhat the medicamenta employed.

* Boston Medical and Surgical Journal, 1843, pp. 217, 219.
‡ Cure of Rupture. By George Heaton. Boston, 1877.
Among the recipes commended the following is preferred:

B. Fl. ext. querci alboe (reduced by distillation one half) .................. 5 ij
Alcohol, 90 per cent............................................................... 5 ss.
Ether sulph ................................................................. 3 ij
Morphia sulphatis .......................................................... grs. iv
Tr. veratri viridis ........................................................... 3 ij. M.

Inject from 5 to 20 drops in small and recent hernia, but 25 to 50 drops in old and larger hernia.

Dr. Warren also modified the operation by not injecting into the sac, but "into the rings and around the sac." This he considered very important.

For a considerable time following the publications of Dr. Warren the operation was performed in various parts of America and in Europe. The exudations which supervene, as I have myself seen, are very considerable, the pain and suffering not severe, the danger in competent hands is slight, but the results are certainly not as satisfactory as the profession was led to expect.

In the volume of the Transactions of the American Medical Association, 1861, page 251, is a most interesting paper by Dr. Thomas Wood, of Cincinnati, upon the radical cure of hernia by a subcutaneous closure of the external ring by suture.

"This is effected by a needle constructed for the purpose, curved so as to form about one third of the circumference of a circle of two inches radius. It has two spear-points, with an eye in the center of the shaft large enough to admit a silk braid one eighth of an inch wide." The sac is reduced, the finger carried into the ring through the invaginated scrotum, and upon it the needle. The cord having been protected, the needle, as may easily be inferred from its construction, carries the suture, inclosing the ring in a loop, and the ends of the suture are brought out from the opposite sides. These are tied over a compress and removed in from ten to fifteen days. Dr. Wood reported three operations, followed by cure. In submitting his paper to the profession he stated that "he does it feeling confident that it will be appreciated according to its merits."

Dr. John Wood, of London, first published his method of subcutaneous operation by suture in 1857. His experience is now probably greater than that of any other living operator, and his method has been and is so extensively in use, that I copy from his most recent publication * his operation for the radical cure: "The patient being

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placed on the table, the parts shaved clean and purified, and an anæsthetic administered
so as to get the muscles relaxed, an oblique incision is made with a small, sharp-pointed
tenotomy-knife, well washed in a one-to-twenty carbolic lotion, in the front of the scro-
tum over the fundus of the rupture, three quarters of an inch long, and through the skin
and superficial fascia. The handle of the knife is then used to separate the integument-
ary tissues from the deeper fascial coverings of the hernia, or cord, so as to form a
circle of detached integuments large enough to be invaginated into the hernial canal
without drawing up the skin into the superficial ring. A stout-handled needle curved
in the segment of a circle, with a sharp point, blunt shoulders, and a large eye near the
point, is used for carrying the wire. This should be well-annealed and flexible copper
wire, silvered over, thick enough not to cut the tissues when drawn tight, but not
so thick as to be at all inflexible. A piece about twenty inches long, briskly rubbed
so as to render it flexible and clean, dipped in a one-to-twenty solution of carbolic lotion,
and then in carbolized oil (one to five), should have each end bent into a hook three
quarters of an inch long, and evenly curved so as to pass easily through the eye of the
needle. The forefinger, oiled, should then be passed into the scrotal puncture and
made to invaginate the fascia and sac into the hernial canal, as far as it will go into the
deep ring behind the lower fibers of the internal oblique muscle, which should be raised
well upon the finger. To the inner side of the finger will then be felt the raised edge
of the conjoined tendon, lying on the outer side of the rectus abdominis muscle. The
needle must now be carefully and slowly passed along the finger until its point can be
felt plainly by the bulb of the digit placed behind the conjoined tendon. The point
should next be directed inward, so as to take up the tendon and to transfix it and the
aponeurosis of the external oblique which covers it. Its point will then be seen to
raise the skin. The skin must next be drawn toward the median line, and the needle
directed by its stout handle so as to bring its point out through the skin one and a half
inch external to the puncture, and through the deeper tissues. One end of the wire is
then hooked on to the eye of the needle, and is drawn with it by a slight jerk through
the tissues, emerging at the scrotal puncture. The needle is next detached from the
wire and the finger again passed into the canal. Now the spermatic cord is to be felt
for, lying in a groove formed by the union of Poupart's ligament with the fascia trans-
versalis. The cord is to be pushed gently inward, and the point of the finger placed
in the groove which it occupied, and lifted forward, so as to elevate Poupart's ligament
at its center, and with it the outer pillar of the superficial ring.
"The iliac artery may be sometimes behind the finger, which lifts up the tendinous structure from its immediate contiguity, and protects the vessels from injury. The needle, passed again along the front of the finger a little to its outer side, is then pushed through Poupart's ligament till its point raises the skin. The latter is now pulled inward until the point of the needle can be made to pass through the same puncture in the skin of the groin which the wire already traverses. The opposite end of the wire is next hooked on to the needle, drawn down as before through the scrotal puncture, and then detached. There is now a wire loop at the groin, and two hook-ends at the scrotal puncture, opposite the latter; the sac is then pinched up by the finger and the thumb, in the same way that a varicocele is separated from the spermatic duct when submitted to operation. An assistant seizes it with the finger and thumb, also in the same way, at about two inches distance, both assistant and operator recognizing the situation of the spermatic duct. The needle is then passed at one corner of the scrotal puncture across the sac, in front of the duct, and out at the other end of the scrotal puncture. The skin here is so elastic that the puncture stretches sufficiently to allow this to be easily done. The inner end of the wire—viz., that which traverses the conjoined tendon—is next hooked on to the eye of the needle and drawn across behind the sac. Care must here be taken, by dealing with the wire roundly, not to make an acute bend or kink, which would put a needless difficulty in the way of its subsequent withdrawal. The wire should be drawn down so as to get straight parts in the tissues, and to bring the loop an inch or so from the skin surface. The two scrotal ends are then twisted two or three times around each other, the operator observing the direction of the twist, so as to be able readily to untwist the wire when it is to be withdrawn. The loop of the wire above is now seized and drawn firmly upward, so as to invaginate the scrotal fascia into the hernial canal as high up as the deep hernial opening, and then it is twisted firmly down, in the same way and with the same precautions as the lower ends. The ends and loops are then bent over toward one another, the former cut off to a convenient length, passed through, and bent on to the latter. In large cases, where the superficial ring is very patulous, the wires may be crossed in the canal, and the needle passed through the pillars near the pubis, after the sac is invaginated. Thus the lower opening of the hernial canal may be more effectively closed. In these cases a cylindrical pad of glass or boxwood may be used with advantage to secure the loop, and for the ends of the wire to be twisted over. A pad of lint, large enough to exercise compression, is fixed under the bight of the double wire
loop which has been formed, a little carbolized tow is put over the scrotal puncture to catch any discharge, and a flannel spica bandage is applied, the ends of which, on being tied, should be made into a sling or suspender to support the whole of the scrotum and penis. The patient should be placed in bed, with the shoulders well raised and the knees tied together and bent over a long bolster, with a prop for the feet to keep the body firm. The bowels should be opened on the morning of the operation, and then left until some discomfort is experienced. Opium should be given for the first twelve hours—one grain every four hours—until pain ceases or sleep comes on. The diet should be of milk and beef-tea, with ice to relieve any nausea left by the anæsthetic. The discharge is trilling and of a serous character. The bandage rarely requires to be touched till three days have elapsed, when it may be removed entirely, with the pad of lint. A lump of well-teased antiseptic tow placed under the wire will be sufficient dressing. The scrotum should be well supported. The wire should be kept in from eight to twelve days according to the amount of reaction set up, the lower ends of the wire acting as an efficient drainage conductor. At the end of this time the wire may be untwisted, and it will then be found that the two parallel, straight portions of the wire, which originally passed through different tracks, have by slow ulceration joined each other in the same track, and that they will come out together by cutting off their lower ends with pliers and pulling upon the upper loop. If by reason of slight kinks there is any difficulty in this, the wire may be straightened by pulling at each end with pliers, and the ends may then be drawn together or singly. The upper opening usually closes soon after their withdrawal, and a truss may then be applied with cotton-wool beneath it, and the patient may be allowed to get up and lie on a couch until the lower sinus heals. . . . The effect of this operation is to unite in one cicatrix the sides of the inguinal canal as far up as the deep ring, together with the pillars of the superficial ring, the union of which supports the invaginated, twisted, obliterated sac, with its intimate coverings of external and internal spermatic and cremasteric fascie. The conjoined tendon of the internal oblique and transversalis muscles is connected firmly with the deep part of Poupart's ligament, and upon this union depends, for the chief part, the success and permanence of the radical cure. Thus the valvular arrangement of the front and hinder walls of the canal is restored and strengthened by adhesion, and the rounded knuckle of bowel can no longer enter the deep ring; and thus the most effectual preventive of the formation of a hernia.
in the healthy inguinal canal is restored, and even strengthened, by the operation. Unless this is accomplished the cure is not satisfactory, and one of the chief causes of failure in the hands of the inexperienced is the want of dexterity and experience in obtaining a hold upon the conjoined tendon with the needle-point, at the first stage of the procedure. . . . By the method just described I have operated upward of two hundred times consecutively, with not a single seriously bad symptom occurring. The average period of convalescence has been about a month from the operation to the healing of the lower opening; the average time in bed about eighteen days. Before adopting the use of the wire, thread and compresses were employed; and while the steps of the operation were imperfectly understood and carried out, and when, perhaps still more important, cases were operated on somewhat indiscriminately, three deaths occurred in the first one hundred cases: one from pyemia, one from erysipelas, and the third from peritonitis, all having been published at the time in the medical journals. Two of these were decidedly from hospital or other infection, while the third case was a peculiar one; the necropsy clearly showed that fatal peritonitis had been set up by a knuckle of intestine which had been involved in the sac before the operation, with the truss pressing upon it. In no case has any trouble arisen from hæmorrhage, nor have there been any signs of injury to the epigastric, femoral, iliac, or other vessels."

In the evolvement of thought in the same direction should be mentioned the operation by Dr. Agnew, of Philadelphia,* which consists in the use of an instrument for invagination, and then the subcutaneous sewing of the ring with wire. Three other sutures, also of wire, were used to inclose the canal.

The late Dr. Greensville Dowell,† of Texas, devised a most interesting modification of subcutaneous suturing with interrupted silver wire sutures, using a needle like that of Dr. Thomas Wood, of Cincinnati, but with an eye at each end instead of in the middle. The sutures were introduced in a manner not unlike that of Dr. Wood. He first published in 1866. He advised from one to seven sutures as required for firm closure. A little before his death he wrote me as follows: "The result of my operations, so far as I can learn is: One hundred and three cases, treated by myself; twenty-five cases partially relieved, two cases made worse. One child

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† Medical Record, New York, vol. i, p. 266.
died in seven days after the operation, with congestion of the brain. Cured, seventy-six. So far as I know, all these remain well; some have had partial return of the hernia and worn trusses. Several were operated on twice, and failed both times. I know no particular reason for the failure except that the ligatures were put in too tight. . . . I simply put a piece of lint over the ligatures and saturate it with collodion."

I knew Dr. Dowell, and greatly admired his inventive genius and fertility of resource. His operation has been performed by many of his associates with good results.

It will be observed that, in the operations for subcutaneous suturing, the fundamental idea is not unlike the old, abandoned operations by the "punctum aureum" and suturing of the ring, in various ways, by the early fathers of surgery. To this, however, Dr. Wood brought correct anatomical knowledge, and by his method of suturing sought to bring together the pillars of the ring. By the rare tact and experience of the master, he secured better results than any operator preceding him—much better, indeed, than his followers.

Dr. David W. Cheever, of Boston, surgeon of the City Hospital, in 1870, reported twenty-four cases operated on for cure, with two deaths. In commenting upon the operation, he writes: "Hernia has long been one of the opprobria of surgery. To cure it no operation is certain. The operation of Mr. Wood seems the most reasonable one proposed. It will cure a certain number of children and young adults. It will fail to cure others. Mr. Wood, it must be remembered, claims some seventy per cent of success. We can show barely twenty-five per cent." From Dr. G. W. Gay's* report I quote the following: "During the past five years herniotomy has been performed twenty-six times for strangulated or irreducible hernia. Thirteen ruptures were inguinal, six died; twelve femoral, five died; one umbilical, died. Of eleven patients over fifty years of age only two recovered; while of fifteen under that age twelve resulted favorably. The average duration of convalescence was about a month; in the fatal cases death resulted at periods varying from five hours to eighteen days; about five days being the mean duration of life. The cause of death, so far as could be determined, was as follows: Exhaustion, six; peritonitis, four; tetanus, one; erysipelas, one; total, twelve out of twenty-six operations. . . .

"Twelve patients suffering from inguinal rupture were operated upon for a radi-

* Medical and Surgical Reports of City Hospital. Boston, 1882, pp. 267-271. G. W. Gay, M. D.
cal cure. Wood's method was resorted to in four instances, with temporary relief. The so-called Heaton operation was performed eight times; six cases were partially successful, and two were complete failures. All these patients left the hospital wearing a truss or bandage, and their subsequent condition is unknown. No radical operation has been performed upon any of the other varieties of hernia during the past five years. We have ventured to give a brief account of our personal experience with the Heaton operation, and have recorded all the cases operated on by us, both in hospital and private practice; the results are stated as fully as possible. All were cases of inguinal hernia, and, with the exception of those specified, were supposed to contain intestine. Only those patients are called cured who have remained well for at least one year after discarding all support to the rupture. . . .

"Number of patients, fifteen. Cured, four. Relieved, eight. Not relieved, three.
"Number of ruptures, eighteen. Cured, five. Relieved, eight. Not relieved, five.
"Number of operations, twenty-three."

The criticisms which I think we are now warranted to make, owing to the safety of properly treated operative wounds, is that subcutaneous surgery is blind surgery, and blind surgery is, as a rule, bad surgery. A subcutaneous wound is better by being such, only that it is less liable to be, or to become, an infected wound. The problem of hernia, as we have endeavored to show, by the careful study of the anatomical relations of the parts, and the formation of the peritoneal sac, re-enforced by the experience of the centuries, is one containing factors which necessitate treatment by a careful dissection of the parts, in order to furnish the best measures for resultant cure. The peritoneal sac is a redundancy of extraneous tissue, and should be treated as a factor to be eliminated. This has been the stumbling-block in the surgical treatment of hernia during the centuries, often recognized as such, but because of the too generally occurring septic infection of open wounds, and high mortality when in this locality, considered of unwarranted danger. This is one of the fundamental faults in the treatment of hernia by the injection method, and by the subcutaneous sutureing of the ring. In both the above methods, also, there is an attempt to fill the ring by material foreign to its primary construction. In the first, by a large exudate, often incorporating the sac; in the second, by drawing together blindly the parts incorporated which at best imperfectly restores the tissues to their normal state, and may include tissues which it is important to exclude.

Experience had long ago taught that the complete closure of the canal and rings
gave much the better result. It was in recognition of this that castration became for a long time the adopted method, and continued so until prohibited by law, not because the hernia failed of cure, so much as that a considerable class suffered loss of virility—a choice of evils which many voluntarily made when all surgery, as compared with the present, was necessarily almost brutal.

Mr. Wood, by his subcutaneous wire suture, can make at the most only two stitches in his effort to occlude the canal, yet he recognized the necessity of close approximation and wrote, "To insure success, complete union must be established along the length of the canal." Drs. Agnew and Dowell increased the number of stitches in order the better to secure this result. In part, also, to remedy this fault, the very interesting modification of Mr. Wood's operation was devised, namely, the extremely ingenious and original instrument by Mr. Spanton, whose good work as an operator is well known in England. The cork-screw instrument is at once needle and suture, and is to be commended for its advantages over the so-called Wood suture.

The methods of subcutaneous suturing are, for obvious reasons, marked improvements upon preceding operations for the cure of hernia. These improvements, however, are but modifications of the general idea which, we have seen, dominated the profession for centuries: to close the canal by some subcutaneous method, through the fear, born of experience, of the dangers incident to septic infections of the locality. Such fatality was quite sufficient to justify the general opinion, and it required a large amount of the heroism of conviction to put into execution, in operations undertaken for the cure of hernia, the methods of antiseptic wound-treatment.

I introduce here the following beautiful plate from Bourgery, which is especially instructive because of the demonstration of the deformity of the internal ring which is the necessary accompaniment of old, large hernia. *Figures* 1 and 2 teach the difficulty, or well-nigh impossibility, of cure by the processes of injection which have been under discussion in the present chapter, even if the hernia is non-adherent and easily reducible. *Figures* 3, 4, and 5 are exceptionally well-selected illustrations of the changes which the internal ring undergoes in inguinal hernia, and show at once the hopelessness of its permanent occlusion by the measures under discussion.

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Figure 1.

External Inguinal Hernia in a Female. The hernia is dissected, to show plainly the hernial sac. This bilocular sac, with a moderate constriction which formerly corresponded to the ring when the sac was simple, presents to us upon the cadaver the same case that we sketched, a few months since, from the living (see Plate XXXV, Figure 1).

Figure 2.

Bilocular External Inguinal Hernia, in a man aged fifty years. In this case, analogous to the preceding, the hernia is an intero-epiplonch, with two continuous hernial sacs, separated by a stran- gulation at c.

d. The inferior sac incloses only the epiploon.
b. The superior sac shows in addition an intestinal loop.

Figure 3.

Two Herniae, containing omentum and intestine, upon the same subject. The point of view is taken at the interior of the abdominal cavity, going into the peritoneal apertures of two hernial sacs. The nature of each of these herniae is indicated at sight by their respective distance from the linea alba.

A. External Inguinal Hernia. Here the cord of the spermatic vessels, situated below and outward, is masked by the viscera.

a. The epigastric artery, which passes below, and is seen again in the thickness of the pillar at the internal edge of the orifice.

B. Internal Inguinal Hernia. The dilatation of the orifice has crowded back its external pillar very near to the internal inguinal ring, in which we see the cord of the spermatic vessels insinuating itself.

c. This pillar, at the external edge of the orifice, incloses the epigastric artery, situated consequently without, and which we see extends beyond upon the line of section.

* Bourgery, Plate XXXIX, Bis.

Figure 4.

Peritoneal Orifice of the External Inguinal Hernia.

a. Internal infundibulum orifice of the dilated inguinal canal.
b. Border or internal pillar of the peritoneal orifice.
c. Epigastric artery, which arises under the peritoneum of the external iliac.
d. Cord of the spermatic vessels.
f. External iliac artery and vein.

Figure 5.

Accidental Crural Canal, which has given passage to a hernia, the viscera of which have been removed.

a. Contour of the abdominal orifice forming the first layer.
b. Contour of pubian orifice, closer pressed, formed by the aponeuroses. The pubian layer, with the covering of the external crural ring, is visible through this elliptical orifice.
c. Upon the other side the edge is formed by the femoral aponeurosis; between the two is seen an elliptical orifice, which is only the accidental crural ring forming under the integuments of the thigh the entrance to the hernial sac.

Accessory Parts.

d. External iliac artery and vein.
e. Epigastric artery, situated without and above the crural orifice.
f. Spermatic vessels, a little deviated from their course, the orifice of the peritoneal being carried somewhat higher than normally.
g. Foetal cicatrix of the testicular prolongation of the peritoneum.
h. Deferent canal.
i. Obliterated umbilical artery.
j. Bladder.
CHAPTER XXIII.

THE ANIMAL SUTURE: ITS HISTORY, AND ITS PLACE IN SURGERY, ESPECIALLY WHEN BURIED IN THE TISSUES.

In the previous considerations upon the cure of hernia I have endeavored to show that the ligature or suture carried through the neck of the sac was a very important factor; that the sac should be resected and cut away, and its sutured base returned within the ring. I have also emphasized that, in the large and difficult class of inguinal hernia in the male, the most important factor in surgical procedure consists in the restoration of the obliquity of the canal, and that this can be effected only by the use of sutures applied through the deeper structures, in order to strengthen the weakened tissues and close the internal ring from below upward upon the cord. This necessitates a line of sutures which must remain buried deeply in the wound without the causation of subsequent trouble. Although the closure of the remaining tissues might be effected by interrupted sutures, subsequently to be removed, I think I have clearly shown, by the abundant experience of others as well as my own, why these structures should also be closed by sutures to be left undisturbed, or buried in the tissues. Inasmuch as the curative measures for hernia are so largely dependent upon the suture and its method of application, and that the use of the buried animal suture in an important degree revolutionizes the treatment of all aseptic wounds, I have determined that the subject of animal sutures is of sufficient interest and importance to devote to it a distinct chapter.

Investigations upon the origin of means adapted to a given end clearly teach that active minds have already subjected its chief factors to careful analytical study, although certain phases of the problem are ever presenting themselves under new aspects. Dominated by such thought, Solomon taught that "there is no new thing under the sun," and it is quite probable that the animal ligature was known and used by the Egyptian surgeons at a period antedating this wise Jewish philosopher.

The connective tissue of animals was early utilized for a great variety of purposes when it was necessary to secure great strength and high tension. The Homeric poems
THE ANIMAL SUTURE.

afford familiar illustrations. In the Odyssey, the strings of the old Greek harp are described as made from the twisted intestine of the sheep. The ancient Egyptian harp is said to have been strung in a similar manner. The celebrated Arabian writer Rhazes, who practiced in Bagdad A.D. 900, described the stitching of wounds of the abdomen with the strings of the harp; and Albucasis also mentioned the stitching together of wounds of the bowel with a fine thread from the twisted intestine of an animal.

The careful student of the early history of surgery finds abundant evidence that the ligature was used as a hemostatic agent at a very early date. Celsus, at the end of the first century, described the ligature as of ancient origin, and stated that it was used by the Alexandrian school of medicine, with the teachings of which he seems to have been familiar. He advised placing two ligatures upon the vessel and dividing it between the points of tying. Galen recommended its use; and Vesalius, in the sixteenth century, mentioned the ligature as a relic of the past, greatly underestimated in value because of the lack of anatomical knowledge. Its first application in amputations, on account of gunshot-wounds, was doubtless by Ambrose Paré. At this time such wounds were cauterized with boiling oil, in the belief that gunpowder in some way poisoned the wound.

Special studies, however, for demonstrating the value of the material used for ligatures do not appear to have been made in the early history of surgery. Indeed, there is little doubt that, whatever the material used, it was always considered as a foreign body to be ultimately eliminated from the wound; and the material, selected for its strength without special reference to the irritation which might be induced thereby, was naturally the thread, silk, or hemp which was in ordinary domestic use.

To our distinguished countryman, Professor Physick, of the University of Pennsylvania, is undoubtedly due the honor of having first introduced into surgical practice in modern times what is known as the animal ligature. His ligatures were made of chamois-leather, and he and Dr. Dorsey usually rolled their ligatures on a marble slab to make them round and hard. The advantages claimed for the ligature by Dr. Physick were that, being composed of animal tissues, they would serve long enough to obliterate the artery and be speedily removed by the absorbents, thus avoiding the difficulty arising from a foreign body, however minute. These ligatures were used in this country to a great extent, and Sir Astley Cooper demonstrated their superiority in his own operations.
“Dr. Hartshorn used strips of parchment for his ligatures. My friend* Dr. H. G. Jamieson, Professor of Surgery in Washington Medical College, Baltimore, has for a series of years been employing the animal ligature in an extensive surgical practice. He has used it in many amputations of the limbs and of the mammae; he has tied the carotid, the iliac, the femoral, the radial, the posterior tibial, the spermatic, and other arteries, with the buckskin ligature, and in no instance had secondary haemorrhage; and he states that he has never seen anything of his ligatures, and, of course, his wounds have generally healed by first intention. Dr. Jamieson gives to Dr. Physick the honor of having first introduced the animal ligature, but he contends that the practice of rubbing or drawing, to harden the leather, is highly reprehensible. He advises to tie the artery with a buckskin ligature very soft and little broader than the thickness of the skin, taking care not to tie it too tightly. He states, as the result of his observations and experiments upon sheep, dogs, and other animals, that a capsule will surround the ligature, if the capillary vessels be not much disturbed, or the vessel will be surrounded by an abundance of lymph and the ligature dissolved.”

The method of Aetius and Celsus, revived by Abernethy, of applying two ligatures and dividing the artery between them, Dr. Jamieson condemned as unnecessary, since by a single flat buckskin ligature the artery may be obliterated without destroying its continuity. Hence, he opposed all indissoluble ligatures of whatever material; he declared it not only to be unnecessary, but highly hazardous, to cut the inner coats of the vessel, as recommended by Jones, and others, and agrees with Scarpa as regards flat ligatures; but, by the use of the buckskin, he has no need, like him, to remove his ligatures on the fourth day. For a very able and interesting account of his views, which are of the highest practical importance, I would refer to the thirty-seventh number of the Medical Recorder, published at Philadelphia in 1827, and from which I quote the following extracts:

“We believe that the animal ligature will secure the patient from all these dangers except one—to wit, the awkwardness of the surgeon; and even in this respect the animal ligature is preferable, not requiring the precision of management essential to the cutting ligature. If the ligature is cut from the leather with care, it will always admit of being tied sufficiently tight, but can never be made to cut the coats, provided it is made of soft buckskin and not hardened by drawing it. It is less likely

* Cooper’s Medical Dictionary, sixth American edition, vol. ii, p. 130, edited by Dr. M. Reese, M. D.
to slip when somewhat insecurely applied, because, being elastic and soft, it is spread over a small space of the vessel, and almost immediately adheres by its glutinous properties. It lies more securely, while the cutting ligature, resting on a mere line, and having neither adhesive properties nor the advantage of a small vacuum between the vessel and the ligature, as is the case with the flattish adhesive ligature, is more likely to slip off. Besides, as we cut off the ends close, there is no risk of pulling them away by an accidental jerk of the hand. In support of these assertions, we have to offer the experience of several years' practice, during which we have used no other than the buckskin ligature, and no such thing as a secondary haemorrhage has ever occurred in our practice, extending alike to cases of aneurism, tumors, and amputations. . . .

"We are, moreover, decidedly of the opinion that in no case whatever have we had reason to suppose that the healing of a wound, accidental or surgical, was delayed by our ligatures; we never see anything of them after their application. . . . Mr. Cooper tied the femoral artery in a female, aged eighty, with a ligature of catgut steeped in water, which was cut close, and the wound was healed on the fourth day, and must therefore have healed by first intention. In many cases we believe the catgut would answer as well as the buckskin, but we are confident that a flattish ligature holds best and is most convenient. It may be proper to mention that this case occurred in 1817, three years after Dr. Physick's use of the leather ligature. . . . If we are right in the opinion which we have just expressed, Dr. Physick is entitled to the credit of bringing into use the best ligature as to the material, but here his claim is at an end. Dr. Physick and Sir Astley Cooper have shown the advantage of using a substance which will serve as a ligature till the artery is obliterated, and be speedily afterward in the power of the absorbents, so that they will remove it. . . . We will now proceed to point out our own views, and endeavor to support them by experiment:

"First, we believe that with an artery sufficiently healthy to admit of its obliteration by the adhesion of its sides, it is best done by a ligature which will neither cut its coats nor strangulate, except in parts, the true *vasa vasorum*, so that the continuity of the vessel shall not be destroyed, although we obliterate its caliber.

"Second, we believe that if an animal ligature of suitable material be properly applied, the vessel will be obliterated, the wound may be healed by first intention, and the ligature will not cause suppurating inflammation; but in due time, being dissoluble, the whole will be removed by the absorbents. There will be no break of continuity in the artery, the *materia arteriarum* will be removed, and the vessel which, during
the state of inflammation and the effusion of lymph, was converted into a cord, will pretty soon afterward be resolved to a flat string of white cellular substance.

"Experiment I.—Twenty-two days after tying the carotid artery of a sheep with buckskin ligature, the wound was found entirely healed, the artery obliterated, upon one side of which was a little yellowish matter which proved to be a portion of the ligature.

"Experiment II.—Twenty-five days after tying the left carotid of a dog there were seen on either side of the vessel two little yellowish knobs, which proved to be the two ends of the ligature in the state of yellow pulp. The knobs were completely enveloped in a strong membranous capsule, the same capsule inclosing both knobs, and its fibers plainly seen crossing over the artery. . . . On the lower side, where the coats were not cut, in splitting open the vessel to examine its interior, there was an actual adhesion of the leather to the inner coat. The string was softened into a pulpy consistence, and near the inside of the vessel was evidently covered with organized lymph, and extended along its edge on one side some distance. When the string was gently pulled, one plainly saw a delicate membrane, passing off from the artery and ending on the string in fringed extremities. This attachment of the vessel by a new formation existed on both sides of the artery. The capsule covering the knobs or ends of the string was fully equal in strength to the outer coat of the artery, and therefore there was no tendency to hemorrhage."

It will be observed that in all the essentials the experiments of Dr. Jamieson, undertaken for a similar purpose, were not unlike those of Sir Joseph Lister, repeated half a century later; and the former, at a period when so little was expected of the American people in the way of literary productions, to say nothing of scientific research, that one of England's famous critics asked, "Who reads an American book?"

In the history of ovariotomy in the United States, by the late Dr. Peaslee, it is stated that Dr. Nathan Smith, Professor of Surgery in Yale College in 1821, tied the arteries with leather ligatures (narrow strips cut from a kid-glove), which were returned into the peritoneal cavity, and the incision was closed, followed by recovery.

Dr. John Bellinger,* of Charleston, S. C., in 1835, successfully performed ovariotomy, tying two arteries in the pedicle with animal ligatures.

Professor Paul Eve,* of Nashville, Tenn., wrote in 1876: "I have been in the habit of using the sinews of the deer for ligating vessels, for forty years. The tendons of the deer, dried and torn in shreds and rolled into ligatures, are what I employ. They are absorbed. I have occasionally used them as sutures."

These fragmentary experiences, drifting down to us through the years, teach that there was more or less blind groping after a something that should serve a better purpose than that which the routine of daily practice, in the use of hemp or silken ligature, afforded. It was reserved for the present generation to make possible a scientific basis for the better consideration of ligatures and sutures in their application to the living structures. In the light of our present knowledge of surgical pathology, the opposition to the ligature in the days of Ambrose Paré, which we have been wont to attribute to the conservatism of ignorance and stupidity, is invested with a new and vital interest. The amputated limb, seared with the hot iron as a hemostatic, a measure most barbarous and revolting, gave as a result an aseptic wound. Repair was necessarily slow and tedious, but abundant granulation supervened to protect from septic absorption before decomposition ensued.

The constricting ligature, the septic pocketed wound, with little care as to cleanliness, gave such secondary fatal results, that we are led to wonder that the innovation of the ligature in the closing of the great vessels became the established practice. Had it not been for the frightful dangers from secondary haemorrhage after the use of the cautery, slow healing giving imperfect results, it may well be questioned if even the indomitable spirit of Ambrose Paré could have made the innovation survive his own time.

A deeper philosophy sought solution of the problem as to the causation of suppuration in wounds, and if its prevention were not within the possibility of the rule rather than the exception. The studies of Pasteur, Tyndall, our own Jeffries Wyman, and others, undertaken for the solution of the problem of spontaneous generation, brought fruitage to the human race little dreamed of by these wise philosophers. The genius of Mr. Lister seized upon the application of the thought, and with a patient, investigating spirit and painstaking toil he worked out the fundamental factors of the rôle of ferments in wounds. It was not until rules could be formulated, based

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upon the scientific deduction that operative wounds should be free from suppurative processes, hitherto considered almost necessary concomitants, that the proper conditions for the study of ligatures and sutures were rendered possible. Of necessity in intimate association with the question of the treatment of operative wounds, arose de novo a most interesting chapter devoted to the best means of controlling arterial haemorrhage.

It was clear that the hitherto prevailing method of ligation, having the ends of the ligature long, extending from the wound, by so much at least prevented primary union; while cutting the ligature short, and closure of the wound, were fraught ever with disastrous consequences, when the septic ferments were thereby deeply buried. When aseptically applied, the constricting silken ligature too often proved an irritating foreign body, to be ultimately slowly eliminated.

In retrospect, with present knowledge, what seems simple factorage of the problem proved extremely difficult of solution. The conservatism of opinion, the prejudices of the large number of the surgical authorities of the time, wedded to present measures, misled by other phases of dominating thought—the so-called vital processes of inflammation, irritation, cell-proliferation, etc.—engrossed the subject with many difficulties. The demonstration that fermentation and suppuration in a wound resulted from the introduction of a something from without, was the first real step of progress. To eliminate that something was the next problem for solution. It was clearly shown that the torsion of an artery to procure rupture and intrafolding of its interior coat causes permanent closure of the vessel, and that the living structures, unpoisoned by germ infection, possess the power of easy disposition of the aseptic necrotic portion devitalized by violence.

Histological study demonstrated that the necrosed part does not undergo the changes which had formerly been supposed necessary for the elimination of dead material, known as suppuration, gangrene, etc., but that the part becomes invaded by living cells, which little by little produce a local change marked by early disappearance of the necrosed tissue. This naturally led up to the thought, could not extraneous animal tissue be prepared in a way that, introduced into the vitalized structures, a similar result would follow.

Repeated experimentation taught that small pieces of dead tissue preserved in carbolic-acid solutions, incorporated into the living structures, were disposed of in a manner not unlike the necrosed portion of a twisted artery, and led to the inference that animal
tissues properly preserved could be used for the constriction of vessels. In looking about for suitable material of animal type to be used as ligature, the catgut prepared for musical instruments was naturally suggested. It proved comparatively easy to render the material non-infective, by immersion for a considerable period in an aqueous carbolic solution, but being a soft, slippery strand, it lacked the necessary qualities for making a secure knot, and by its early softening in the tissues, it loosened and thereby failed to secure the end sought. A long immersion in an oily solution of carbolic acid, to which a very little water had been added, produced a marked change of structure—a kind of tanning process thereby resulted which gave to the material the quality of less easily softening in the tissues, as well as the better retaining a firm knot, which was ultimately disposed of by the surrounding structures.

I know of no series of original studies better worthy of admiration or emulation than Mr. Lister’s experiments, undertaken for this purpose upon the lower animals, and the laws of England necessitated his resorting to the Continent in order to make possible his investigations. The resulting changes shown to have taken place histologically in catgut ligatures applied to the vessels of the lower animals, examined at different periods, taught that the cell-proliferation at first inclosed, and later on penetrated, the carbolized ligature, until, little by little, it became replaced by living connective-tissue cells—a discovery the importance of which is scarcely fully appreciated even at the present time. Mr. Lister’s experiments were limited to the ligation of vessels, and there has resulted from his teachings the surgical treatment of the great arterial system with a safety hitherto deemed impossible. The larger vessels are now tied in continuity in close relation to their bifurcations, even the greater trunks, with a seeming impunity little less than startling.

Returning from my studies in Edinburgh under Mr. Lister in 1870, liberally supplied with a variety of the antiseptic materials which he then advised to be used in operative treatment, I not only made use of catgut for the ligation of vessels, but accident early furnished me the opportunity for a new application of the ligature in the form of buried sutures. On February 19, 1871,* I closed the ring, necessarily greatly enlarged for the reduction of a strangulated hernia, with deep sutures of catgut. This I did in order to retain the abdominal contents, because of a severe asthmatic bronchitis

from which the patient was also a sufferer. The resultant permanent cure of the hernia, with a marked proliferation of tissue along the line of the buried sutures led me to inquire if the sutures buried in the part had not been disposed of in a manner similar to that demonstrated by Mr. Lister, resulting about the catgut ligatures surrounding the arteries.

I instituted a series of experimental histological studies upon the lower animals, and demonstrated that, along the track of an aseptically buried suture, cell-proliferation rapidly supervenes, and that new cells invade the softened structure, and, pari passu with its absorption, a living band of connective-tissue cells replaces the whole line of the suture. If rapidly absorbed, the proliferated cells are minimized; as the process goes on more slowly, the change becomes more distinctive, until, in young animals, in ten to fifteen days all trace of the suture as a foreign material is lost. The value of such re-enforcement of the tissues along the line of the sutures became at once apparent in their application to the cure of hernia, and, little by little, I early extended their use to the closure of wounds of every description, publishing* from time to time my results.

In the pursuance of my studies I early had occasion to examine a great variety of the specimens of catgut offered in the market, although from the first I adopted what seemed to me the wise precaution of preparing my own sutures. In catgut there are of necessity certain inherent defects. Its method of preparation is not generally known to the profession, who have rarely questioned the product beyond the condition in which it is offered for sale, as prepared for the musician. The best of these varieties usually comes from Italy, prepared from the intestine of the sheep of the mountainous districts. The small intestine necessarily undergoes maceration, until the strong connective-tissue layer, which, as a fibrous sheath unites the mucous and muscular coats of the intestine, is loosened and can easily be separated, in a manner not unlike that practiced in the preparation of the intestine of the pig for the making of sausages. This is split by a cork armed with sharp blades drawn through the circular sheath, dividing it into sections to produce the desired size. These ribbons are twisted, dried, and often-

times sand-papered to give evenness of surface, and usually put up in skeins from twelve to fifteen feet in length—the catgut of commerce.

The connective-tissue cells of the fibrous coat of the intestine are irregularly disposed, the fine fibrils more commonly crossing diagonally to the longitudinal axis of the intestine, a wise distribution of this strengthening portion of the intestine to allow considerable change in its shape. When carefully examined under a low-power lens, the fibers are seen to be irregularly interlaced, not unlike a strip of cloth cut diagonally. The gut, even in the dry state, has a perceptible yield on tension, and every musician knows the care requisite to protect his strings against moisture. Frequent allusion is made in the classics to the care demanded of the bowman in this respect, when it was customary to string the weapon with animal products.

The above condition is readily apparent if a piece of catgut is macerated until it can be easily unfolded. Moreover, its division is rarely uniform, and when sandpapered the removal of the irregular projections causes oftentimes large abrasions or rents. No matter how prepared for surgical use, ultimately the result obtained will depend in considerable measure upon the integrity of its structure, since the component cells are, little by little, separated by the penetration of the new proliferating tissue. In the first stage of preparation, the long maceration of the material, remaining for a considerable time a putrefying mass, necessarily damages it, not only by softening the adhesion of the cells, but infecting them with bacteria; and in the use of the catgut for all surgical purposes it is important, as the first step in preparation, to destroy any germ infection that may remain. After this has been effected, no method which I have tried gives a result equal to that formulated by Sir Joseph Lister:

"Dissolve one part of chromic acid in 4,000 parts of distilled water, and add to the solution 200 parts of pure carbolic acid or absolute phenol. In other words, I use a 1-to-20 watery solution of carbolic acid, only that the carbolic acid is dissolved not in pure water but in an exceedingly dilute solution of chromic acid. But, minute as is the quantity of the chromic acid, it exerts, when in conjunction with carbolic acid, a most powerful effect upon the gut. The first effect of the addition of the carbolic acid to the chromic solution is to change its pale-yellow color to a rich golden tint; but if the liquid is allowed to stand without the introduction of the catgut, it changes in the course of a few hours to a dingy reddish brown, and a considerable amount of gray precipitate is formed. If, however, catgut about equal to the carbolic acid is added as soon as the ingredients are mixed, the liquid retains its
brightness, and the only change observed is a gradual diminution in the depth of the yellow color; the precipitate, which I presume still occurs, taking place in the substance of the catgut. As soon, therefore, as the preparing liquid has been made, catgut equal in weight to the phenol is introduced into it. If you have too large a proportion of catgut, it will not be sufficiently prepared; if you have too small a quantity, it may run the risk of being over-prepared. At the end of forty-eight hours catgut steeped in such a solution is sufficiently prepared. It is then taken out of the solution and dried, and when dry is placed in one-to-five carbolic oil. It is then fit for use.*

It improves by age, and is better not to be used until after it has been several months in carbolic oil. The preliminary disinfection of the gut is of the first importance, since preservation of the hardened structure in the carbolized oil may not penetrate to the destruction of bacteria within the strands.

I have elsewhere published † in detail the micrococal infection, developing only along the line of the buried sutures, of four consecutive surgical cases, giving evidence upon which I deduce the conclusions that it could have been owing only to this inherent defect of the catgut, which had been selected from freshly opened preparations, preserved in carbolic oil, and sent me from London.

From an interesting communication by Drs. Burrell and Tucker,‡ of Boston, I quote the following extracts bearing upon this point: "A great deal of difficulty had been experienced from time to time in the use of catgut in the formation of stitch abscesses, and the following methods of preparing silk and gut were put to trial. . . .

"The original catgut, as taken from the carbolic oil, was cultured, and found to show organisms in every case. Eleven specimens of silk and gut were taken from their ligature bottles. The silk was found to be perfectly sterile, while the catgut was found to have growths on all except the smaller sizes.

"It is difficult to understand how germs can live that have been immersed in an alcoholic solution of 1-to-1,000 corrosive sublimate, but it is suspected that the hardening of the catgut prior to complete sterilization shuts up within the substance of the gut

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* In several instances I have known sutures to be ruined by a misunderstanding of the above directions of Mr. Lister, much too large a quantity of chromic acid having been used. It may simplify to remember that the quantity is about four grains of chromic acid to a quart of a saturated solution of carbolic acid.

† The Surgical Advantages of the Buried Animal Suture.—Journal of the American Medical Association, July 21, 1888.

‡ Ligature and Suture Materials.—Medical Communications, Massachusetts Medical Society, article xxv, by H. L. Burrell, M. D., and G. R. Tucker, S. B.
a certain number of organisms, which remain latent until they are placed in living tissues, when the catgut swells, the germs are set free, and stitch abscesses result. Reverdin reports a series of experiments in reference to the sterilization of catgut. He found that crude catgut, which had not been kept in fat to preserve it, which was exposed four hours to a constantly increasing temperature, maximum 140° C., and then placed for a day in oil of juniper and kept in alcohol, was aseptic. This he had used clinically for eighteen months, with perfect results.

“V. Boret has cultured the catgut preserved by Reverdin in bouillon, glycerine, and sugar at different temperatures and found that there was no reaction at the end of six weeks. Boret has tried the other methods of sterilizing catgut, and found that bacteriologically and clinically they failed.

“Conclusion.—Small catgut was found, as ordinarily prepared, to be always sterile; large catgut, never; silk, always sterile. As catgut is too valuable a material to be discarded, the writers would advise the method of Reverdin by heat, which is bacteriologically a good one.”

Dr. Macewen* published a very interesting article, giving his method of preparing catgut so as to render it more reliable, by immersing it in a watery solution of chromic acid (one to five) and adding one part of this to twenty of glycerine. Remove in two months, and preserve ready for use in carbolic acid and glycerine (one to five). By varying the strength, gut is prepared possessing different degrees of resistance to absorption in the tissues. My own experience of animal sutures prepared in this way has not been satisfactory. I have also used catgut prepared in oil of juniper and kept in alcohol, but think it inferior to chromicized gut. Owing to these inherent defects in catgut, in common with other surgeons I was led to inquire if there were not animal tissues better suited for surgical use.

The tendinous structures of the body present the connective-tissue cells parallel and firmly united to each other. Although generally thus disposed, there is considerable variety in the arrangement of the cells, making a parallel separation much more uniform in some tendons than in others. As far as possible I entered into a detailed investigation of all animal tendons of sufficient size for surgical purposes with varying results. The tendons of the hind-leg of the moose and caribou, soaked in a sublimate solution

until soft, were the first tested. A considerable portion of the tendon can be subdivided sufficiently fine for sutures, in length from fifteen to eighteen inches.

The late Dr. John H. Gilman,* of Lowell, called my attention to tendons from the whale, stating that he had "used them with great satisfaction in the ligation of vessels." Specimens were sent me from Provincetown four feet in length and of sufficient strength to draw a cart, but the ultimate fibrils were interlacing, while the whole tendon was interspersed with adipose cells. I obtained ligatures also from the whale tendon which were made under the direction of Dr. T. Ishiguro,† of Tokio, surgeon-in-chief of the imperial Japanese army. The mode of preparation is given as follows: "First, a whale's tendon is dissected by the points of the needles, and teased out until the fibers look very like those of hemp; secondly, the longest and finest fibers among them are selected, and they are then spun together as ordinary silk thread." There can be no question but that ligatures thus prepared are very serviceable, but the specimens furnished me were not suitable for sutures.

The Sioux Indian women in the Northwest taught me, in 1882, their manner of sewing buffalo-skins with the tendinous structures derived from the fascia lata of the buffalo, which they preserve for this purpose by drying and smoking. During the summer of 1889 I obtained from Mr. Harry Adams, of the Hudson Bay Company, in Winnipeg, Manitoba, specimens from the fascia lata of the moose, prepared by the Indians as a substitute for that from the buffalo, now extinct, called by them astis. They use it in the dry state, stripping it as they sew, occasionally wetting it in the mouth. Good tendon sutures in any quantity can be obtained from this source. My specimens, however, are not more than fifteen inches long, and are quite inferior to the tendons from the tail of the kangaroo. Some years since, a distinguished Russian surgeon sent me specimens from the reindeer, finely divided and slightly twisted. These I prepared, and used with good result.

In 1880 Dr. S. G. Simmons, of Charleston, S. C., sent me admirable specimens of tendons from the tail of the fox-squirrel, with the statement that he had often used them for delicate surgical purposes with great satisfaction. This tendon is composed of exquisitely beautiful parallel fibrils, which can be subdivided without fraying to the size of fine threads. Their extreme length, however, scarcely exceeds nine inches. Reason-

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* Boston Medical and Surgical Journal, October, 1880, p. 433.
ing from comparative studies, it seemed to me highly probable that the kangaroo should have a tendon similar in quality, traversing the entire length of the tail. Through the kindness of the late Mr. Alonzo H. Newell, of Boston, for many years a prominent merchant in Australia, I secured some most excellent specimens from the wallabee, one of the smaller species of the kangaroo.

At the International Medical Congress held in London in 1881,* in a paper upon the cure of hernia I mentioned the use of the tendon suture from the kangaroo and other animals as especially to be commended. Reference to my recommendation of the kangaroo tendon and its value in surgery was some time later made in an Australian publication. This came to the notice of Dr. Girdlestone, who wrote me that he had used kangaroo tendons for some years with great satisfaction, and that he had published the results;† The tendons should be taken from recently-killed animals, quickly sun-dried, and kept dry until ready for further preparation. This prevents primary decomposition, which we have pointed out as unavoidable in the preparation of catgut. When soaked until soft they are easily separated into as fine strands as desired with remarkably little waste, and give threads from the size of hairs upward, and from eighteen inches to two feet in length, exceptional specimens being even considerably longer. Kangaroos are very numerous in Australia; their skins have a very considerable commercial value, and hundreds of thousands are exported annually; yet it has been with the greatest difficulty that I have succeeded, until quite recently, in securing tendons more than sufficient for my own use, although I sent carte blanche orders to various parties in Australia.

Quite recently I have made arrangements with commercial firms in Australia for furnishing kangaroo tendons for surgical purposes in an abundant supply. These have been prepared under my personal supervision, and can now be obtained from the various dealers in surgical materials at a cost somewhat in excess of that of catgut, to which they are in every way greatly to be preferred.

In an interesting article published in 1882 by Dr. Girdlestone,‡ he emphasizes the use of the tendon entire as a ligature rather than as a suture. “In their preparation they should not be removed from the tail en masse, but one at a time, without force, as, if

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ANATOMY AND SURGICAL TREATMENT OF HERNIA.

split longitudinally, they could not be relied on. Every diameter that was required was attainable, so that there was no occasion for splitting; neither should two or more tendons be twisted together, as it destroys their flattened form." The advantage claimed is that they may be used as flat rather than round ligatures, constricting the artery with less liability of cutting the vessel. The construction of the tendon is very similar in all varieties of the kangaroo, no matter of what size the animal may be. It is composed of independent strands which run without subdivision to the very extremity of the tail. Each tendon is attached to a separate fasciculus of muscle. These vary, as may naturally be supposed, in size, corresponding to that of the different species. The strands from the larger animals, in their natural state, are altogether too large for surgical purposes. They admit, however, of subdivision very much more readily than the tendons from any other animal, but when thus divided are less strong than whole tendons of the same size, yet they are of nearly equal value when used as a continuous suture. When able to select the material best suited for surgical purposes, the tendons from the medium-sized animals are quite to be preferred. In 1890 Dr. C. H. Mastin, of Mobile, favored me with specimens of tendon from the tail of the opossum. As might be inferred, the construction of the tendon is the same as in the Australian marsupial species. They are exquisitely fine, strong, and delicate, but are scarcely more than ten or twelve inches in length. The larger varieties of the common rat have the tendons of the tail similarly disposed, but are hardly long enough to be of any practical value.

In the Medical News for December 5, 1891, Dr. E. Oliver Belt, of Washington, states that he has made extensive use in ophthalmic operations of a fine fiber derived from the rat's tail. The tail is skinned and soaked in water for several days, when, on slight manipulation, it splits into perhaps a hundred fibers, each about eight inches long. They are placed in alcohol, and about once a month, for two or three days at a time, they are soaked in a 1-to-5,000 solution of corrosive sublimate. Dr. Belt recommends these fibers in cases where a strong and fine animal suture is required. He says they are much finer than those prepared from the opossum's tail, which he had seen used by Dr. Chisolm, of Baltimore.

Dr. Dudley,* of Texas, has written an interesting article upon the use of the tendon of the lepus, or mule-eared rabbit, as a material for ligatures and sutures. Dr.

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* Animal Ligatures and Sutures. H. W. Dudley, M. D., Hillsboro, Texas.—Transactions of the Texas State Medical Association, 1884, p. 133.
Dudley does not state the portion of the animal from which he obtained the tendon, but described them as "an aponeurosis of muscles rolled upon each other, susceptible of being torn into minute threads, if so desired." He first had occasion to use the tendon of the lepus as a suture, in the fresh state, in 1881, finding he had no silk in his pocket-case. He has continued the use of these tendons with the greatest satisfaction to the time of his report.

Dr. Bernes* published an interesting study upon animal ligatures in 1874. Although his experiments were not conducted with the care demanded to-day, yet they are of interest and importance as original studies. They include a large number of experiments upon the lower animals with catgut, both carbolized and uncarbolized, peritoneum cut into strips and rolled as recommended by Dr. Agnew, and beef tendon dried, split into fine shreds and twisted, as well as silk, which was taken as a standard of comparison. "The extreme non-irritating properties of the tendon, coupled with its capacity for fine division, render its slow absorption of decided advantage, since a vessel can be secured with a strand of it so fine as to produce no irritation, and yet sufficient time elapse before its disappearance to render any danger from secondary haemorrhage as remote as in the employment of silk, by which the vessel is usually severed in the course of a very few days. . . . It will be seen that the tendon ligature fulfills all the requirements set down at the beginning of this paper as a substitute for the material now in use. . . . It is, beyond all doubt, ultimately absorbable, so that a ligature of it can be cut off close to the knot and left in the wound. The tendon is by no means so absorbable as catgut."

The use of the animal suture requires the same and the only precautions that are requisite for the successful application of the ligature. It must be in itself aseptic; it must be aseptically applied in an aseptic wound. When thus applied, the range of its uses should be extended to all operative wounds. It is difficult to conceive if any possible advantage is to be derived in the treatment of any aseptic wound by leaving it open—the so-called open-wound method. Before the rôle of bacterial development in wounds was understood, when it befell from chance rather than from scientific care that primary union supervened, it is easy to understand how many, who dreaded the daily experiences of fermentative material retained in pocketed wounds, not only refused to rely upon drainage with occasional irrigation, but insisted, as far as possible,

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upon allowing no recess in which purulent material could gather. In order to effect this, the lips of the wound were separated and kept apart by dressings, so that the wound might heal by granulation from its very base. This was manifestly safer for the patient, and the result attained was not unlike that from the repair processes which supervene in the secondary healing of infected wounds; but those who still advocate this method thereby confessedly acknowledge their lack of confidence in the modern methods of wound treatment, and their inability to protect wounds from infection. In rare instances it has been claimed that the resulting cicatrical union gives an increased strength to the parts involved—an opinion which it seems easy to demonstrate is unscientific and contrary to the general consensus of surgical opinion. If it is correct to assume that the theoretic perfection in wound treatment, which it is the ambition of the surgeon to attain, means a reunion of the divided parts, the anatomical relationship to be restored and maintained, then the buried animal suture holds a higher place in surgery than ever hitherto considered.

If the suture itself is replaced by vitalized structures, then its proper application becomes of the highest importance, the value of which the profession even to the present time with few exceptions fails to appreciate. Given, as illustration, the joining of a divided retracted nerve or muscle, and its restoration to subsequent perfect usefulness; the sundered cervical tissues after a hysterectomy where the delicate joining of the peritoneum allows no open wound for haemorrhage or absorption; the reunion of the abdominal wound after laparotomy, where the peritoneum is independently united by a layer of buried sutures, and where the linea alba or the muscular aponeurosis of the sheath of the recti is carefully rejoined, since the adoption of which method I have not had a single case of ventral hernia; or, again, in the amputation of large tumors of the breast, where the remaining tissues are carefully coapted, so that retention and pocketing of fluid are impossible, rendering drainage not only superfluous but harmful.

I would not underestimate the importance of drainage in wounds that are necessarily septic, and in this class of wounds the interrupted silk-worm gut or silver-wire suture is to be preferred. The recent discussions upon the uses and advantages of the buried animal suture are both interesting and profitable. A valuable article, based upon original observations, was published in Germany by Dr. Werth,* in which he advocated

* Ueber die Anwendung versenkten Catgutsuturen bei Operationen in der Scheide und am Damm. Dr. Werth, Kiel.—Centralblatt für Gynäkologie, November 8, 1879, p. 561.
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the use of catgut as an interrupted buried stitch in the repair of the perineum. These were taken between one and two centimetres apart, the gut tied and cut short upon the knot. In cases where the surfaces to be coapted were large, a second row of stitches was similarly placed. Great care was exercised in making the application under aseptic precautions, and most satisfactory results were obtained.

Schroeder* repeatedly used catgut as a buried continuous suture and commended it highly. Dr. A. Martin,† of Berlin, is less enthusiastic, and writes: “I myself have tried catgut sutures according to Werth’s method five times; the results were not favorable, but I must admit that in two of these cases the catgut may have been too old.”

Doléris‡ recommended knotting the thread, from time to time, of the continuous suture, and believed the buried catgut is absorbed in seven or eight days. He reported to me when in America, in 1887, a still further satisfactory use of the buried animal sutures. Bröse* wrote approvingly of buried catgut sutures rendered aseptic by a corrosive-sublimate solution and preserved in absolute alcohol.

Dr. C. B. Keetley‖ published a valuable article upon the uses of the buried suture. He ascribed to Professor Esmarch’s assistant, Neuber, and Professor Küster, much valuable original work with the use of the buried suture, especially in amputations, thereby doing away with drainage. He wrote: “Küster read his paper at the last meeting of the Society of German Surgeons. In the discussion that followed, Esmarch having stated that, with these sunk sutures, drainage-tubes could be altogether dispensed with, he was asked, “What! after excision of the hip?” He thereupon answered, shortly and decisively, “Yes.” In conclusion he said: “I have to say that it is only in strictly antiseptic surgery I would venture to recommend the use of these sutures; but that in the case of all surgeons who have faith in the antiseptic theory and practice they will find in buried sutures an effective and beautiful addition to their methods.”

Mr. John Wood‡ wrote in regard to femoral hernia: “Latterly I have found

* Centralblatt für Gynäkologie, July, 1885.
‡ Archives de Tocologie, February, 1885*
§ Centralblatt für Gynäkologie, 1883.
‡ Lectures upon Hernia and its Radical Cure, 1885.
the use of tendon ligature so satisfactory that for this operation I prefer it to wire. The wound usually closes over it and heals by adhesion at once, and there are not the pain and inconvenience of the withdrawal of the wire. So far the endurance of the tendon, when buried in the tissues, has been long and satisfactory enough to maintain the cure, which has been watched, noted in some cases about two years."

My own experience with the buried animal suture commenced with its use in the case of hernia above referred to in 1871; and this, with other cases where the cure was believed to be referable to the buried suture, was first published in the Boston Medical and Surgical Journal, November, 1871. In 1878 I contributed a paper upon the cure of hernia, based upon the resection of the sac and closure of the parts with buried sutures, at the meeting of the American Medical Association. A further contribution upon the same subject, emphasizing the value of the tendon suture, was published, in 1881, in the Transactions of the International Medical Congress. These, and several other articles giving the results and surgical advantages of the use of the buried animal suture and its adaptability to special purposes, were reprinted and widely distributed to the profession, in Europe and America.*

If the premises which I have assumed in the early discussion of this article are correct, that a properly prepared *aseptic* animal suture, *aseptically applied*, retains its strength sufficiently long to hold at rest the coapted parts until primary union is effected, and then itself slowly disappears after having fulfilled its function, to be in a measure replaced by vitalized connective tissue, there can be little wanting to attain the theoretic perfection in the suturing of wounds. The first observations which I published, perhaps naturally, provoked only criticism and incredulity, and the results were considered rather as accidental. But the evidence, already accumulated and presented to the profession by a great variety of observers in different parts of the civilized world, is quite sufficient to substantiate this claim.

Silk has justly held a high place in the esteem of the profession, because of its exquisite perfection of preparation and it has been claimed, if rendered aseptic, that

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it was equally safe as a buried suture. Mr. Lawrence, the distinguished English surgeon,* already referred to, made many interesting and valuable studies upon the ligation of vessels with silk cut short and buried in the wound. His efforts to minimize what he considered the irritating foreign material are very instructive: "The method I have adopted consists in tying the vessels with fine silk ligatures and cutting off the ends as close to the knot as is consistent with its security. . . . Of the silk which I commonly employ a portion sufficient to tie a large artery, when the ends are cut off, weighs between one fiftieth and one sixtieth of a grain." He adds, "Although I have not yet ascertained what becomes of the pieces of ligature after the wound is united, I have never seen abscesses or any other bad symptom occasioned by them." Mr. Lister early experimented very carefully with silk steeped in various substances, immersed in melted wax and carbolic acid to render it aseptic. In further proof of its innocuousness, it has been claimed that it is also an animal product, and that the tissues should be capable of assimilating it into their own structures. My distinguished friend Dr. Pancoast, of Philadelphia, believes the fault lies in large measure in the introduction of lead during its preparation, and that hence the use of iron-dyed silk is greatly to be preferred. "It is innocuous, does not produce suppuration along the track of its thread, and the color adds much to the ease with which it may be distinguished for its removal." These are advantages, doubtless; but the necessity of removal emphasizes the fault in material, and not in the color, or skill of application, which renders it manifestly unfitted for use as a buried suture.

The general verdict of surgical opinion—and it has most certainly been often repeated in my own experience—is that aseptic silk, aseptically applied, may be incorporated into the tissues, but remains encysted, and often, after a considerable lapse of time, causes irritation, and is expelled as a foreign body.† Somewhat recently I removed a silk suture three years after its introduction; although buried in the tissues, it was still unchanged.

The following is a photographic illustration of exact size of silk ligatures which, after the most severe suffering for many weeks, ulcerated through the base of the bladder. This is, in brief, the history of the patient: Mrs. Dr. C— had for some years

* New Method of Tying the Arteries in Aneurism, etc. William Lawrence.—Medico-Chirurgical Transactions, vol. vi, p. 136.
† See Discussion upon Silk Ligatures and Sutures buried in Wounds.—New York Medical Journal, September 14, 1889, pp. 296-297.
suffered from pelvic trouble, and early in the winter of 1892 she entered the private hospital of, and was operated upon, by one of the most distinguished surgeons of New York city. The ovaries and tubes were removed, followed by a satisfactory recovery, and she was discharged at the expiration of four weeks. Somewhat later severe pelvic pain ensued with much infiltration and fixation of the pelvic structures. Vesicle irritation and tenesmus were extreme, and even partial relief was obtained only by the very free use of opiates. She came under my observation the latter part of May, when she had already passed by the urethra one single and one double ligature, the two smaller ones seen in the illustration. No relief followed, and upon examination a soft calculus of considerable size was detected. Assisted by my friend Dr. Daniel T. Nelson, of Chicago, I dilated the urethra, crushed and removed a calculus about the size of an almond, which had for its nucleus the larger double knot shown in the figure. It is a fair criticism that the ligature used was exceptionally large and consequently would be encysted with greater difficulty. That it was aseptically applied we can not doubt, not alone from the skill and wisdom of the operator, but from the subsequent history of the case. Even when large, the aseptic silk ligatures applied in tissues which are maintained at rest may be encysted and give no further trouble; but when applied in parts, as in the pelvic structures, which are constantly subject to movement, the encapsulating of the ligature often fails, and it is then thrown off with greater or less suffering as a foreign body.

At the meeting of the British Medical Association, in 1890, Mr. Timothy Holmes, of London, one of the most distinguished of living surgical authorities, delivered a valuable address upon the surgery of the large arterial trunks, in the discussion of which I had the honor of participating. In the consideration of ligatures he wrote:* "Silk admirably fulfills four of our five conditions. It is of trustworthy composition, easily tied, may be relied on not to untwist, and can be tied with any degree of force or gentleness; but it is questionable whether it is so far unirritating as to bury itself in the tissue of the artery and become absorbed or disintegrated without setting up suppuration and coming away—that is, dividing the artery. . . . Stout catgut liga-

* British Medical Journal, November 15, 1890, p. 1110.
tures are very handy, and I have used them on most of the great arteries and with uniform success; but they are certainly not of trustworthy composition. . . . Ox aorta appears to me an admirable ligature, and I used it with perfect ease and success in tying either the external or common iliac artery in 1879. But the kangaroo tendon ligature has seemed to us to unite all the advantages of the ox aorta, and to be also somewhat more manageable and more smooth, so that it has been employed at St. George’s in almost all such operations now for many years. . . . Tendon ligatures are of uniform and trustworthy composition, fashioned by the hand of Nature, instead of being prepared by a process involving an uncertain amount of decomposition. One of the most interesting papers bearing on the subject is Mr. Dent’s, in the Medico-Chirurgical Transactions, vol. lxiv, describing the microscopic examination of a tendon ligature, ten days after its application to the carotid artery, by Mr. Pollock. . . . In passing the ligature, it broke while the second knot was being tied, and therefore a stout piece of cat-gut was also tied around the artery, but no trace of the latter was found post-mortem. The ligature tendon was found still firm, its knot buried in a mass of lymph, the external coat of the artery uninjured, and not ulcerated, the internal coat ruptured in places by the ligature, and with its inner walls lying in contact, the tendon buried in and closely connected with the arterial wall, infiltrated with small, round, granular cells, or leucocytes, and permeated by blood-vessels which Mr. Dent believed to be of new formation. As far as a single case goes, nothing could be more satisfactory, as proving the unirritating character and firm grasp of the tendon ligature.” . . .

Mr. Holmes quotes* from a paper by Mr. Ballance and Mr. Edmunds: “Here it will suffice to say that the authors do not regard silk as a perfect ligature for aseptic wounds, but recommend the use of a small, round absorbable ligature, preferring tendon for this purpose, for the following very conclusive reasons: a. The structure is continuous throughout, and there are no spaces, as there are in catgut, due to twisting in its preparation. b. It does not split or crack during absorption, which takes place from the surface. c. It is easily made aseptic. d. It is only gradually, and after a long time, acted upon by the living materials which encompass it. They add that kangaroo tendon is very convenient for practical use, being strong, of ample length, and becomes as supple as silk by soaking for half an hour in tepid sublimate

solution; and they believe the tendon ligature to be trustworthy for at least two months."

Mr. Bennett May, in opening the discussion, gave decidedly his preference to the tendon ligature. "Judging from my experience of it, as a buried suture elsewhere, it appears to be very lasting, and tolerated well in the tissues. Then, it is a material which can be tied very tightly without cutting the coats. I should also carefully shut up the wound throughout its entire length, and securing, if possible, primary superficial union, leave Nature to deal with the deep parts in her own way."

The mode of application of the buried animal suture is of the greatest importance. Without exception, it should be a continuous suture, since thus more perfect coaptation of the parts is obtained, while knots are avoided as far as possible. It thereby equalizes the compression of the inclosed tissues, since if one stitch chances to be too tightly drawn compensation is secured by the yielding of the adjoining ones. It is also important to minimize the material consistent with careful coaptation. It should join like tissues, periosteum to periosteum, muscle to muscle, deep fascia to deep fascia, and skin to skin, after deep incisions of all kinds. It should support the parts always without any constriction of tissue. These important ends attained, it matters comparatively little by what manner of stitch the suture is applied. The opinions of operators will be modified in preference for those methods with which they are most familiar and to which they are accustomed.

For many reasons, in the uniting of the more important structures, I consider it a manifest gain to include the tissues by a double suture, taken by means of a needle with eye near the point, which allows the ends of the suture to be introduced through the same puncture from opposite directions. This of necessity incloses, and should coapt, but must not constrict, the tissues involved. The advantages of this stitch are most apparent in certain operations, and I have especially advocated its use in the closure of the canal in hernia, in suturing the pedicle of uterine and ovarian tumors, and in perineorrhaphy. For wounds in or resection of the intestine I have repeatedly used a double layer of tendon sutures—the Lembert stitch, taken as a continuous instead of an interrupted suture. The finer-curved Hagerdorn needles are the best. The needle pierces the peritoneum as in the Lembert stitch, entering and emerging about two lines from the sides of the wound. This intrafolds and evenly coapt the peritoneum. In resection of the intestine, or if an incised wound is long, I take a second layer about one fourth of an inch outside the first, coapting more peritoneum, and thereby burying
entirely the first line of sutures. *Post-mortem* intestine thus joined will hold water, and in a well-vitalized subject the effused lymph in a few hours entirely covers in the affected part.

The advantages of this method are simplicity, rapidity of operation, avoidance of knots, a minimum of manipulation and of injury to the tissues involved, even and sure closure of the parts—all of which are factors of the first importance to a good result, as well as to the security and non-irritability of the tendon suture.

As far as possible the suture should cross the wound at right or acute angles, and not lie parallel with it. For the coaptation of large wounds, as in the amputation of a breast, I find it a decided advantage to use a running stitch, taken from side to side, both ends left externally free, tension upon which evenly coapts the sides of the wound. Fine tendons are thus introduced in two, three, or more layers, commencing at the very base of the wound. The skin itself is evenly coapted by a blind running stitch, taken parallel to the incision, through the deeper layer only. This evenly unites the edges of the skin, while the suture itself is buried beneath it. The wound is dried, dusted with iodoform, covered with a layer of iodoform collodion, re-enforced by a few fibers of absorbent cotton. The ends of the deep lines of the running sutures, after sufficient tension has been exercised to produce coaptation, are fixed in the collodion and cut off.

The subsequent dressing matters little; a soft pad of cotton may give comfort by its support, but if the wound is *aseptic* at the close of the application of the iodoform collodion, it being presupposed that each step has been taken with modern aseptic precautions, *primary union will supervene, and drainage is not only needless, but is a positive disadvantage and danger.*

Aseptic wounds thus treated give a simplicity of detail which is really surprising when contrasted with the clumsy and bungling antiseptic dressings which this method—the aseptic application of buried animal sutures—is destined to supersede. In conclusion, the *rôle* of the buried animal suture may be accepted as a corollary to antiseptic surgery, upon the basic principles of which it is founded as a scientific deduction.
CHAPTER XXIV.

OPERATIVE MEASURES INSTITUTED FOR THE CURE OF HERNIA UNDER MODERN METHODS OF WOUND-TREATMENT (ANTISEPTIC AND ASEPTIC CONDITIONS) IN EUROPE.

The currents and counter-currents of surgical opinion have nowhere, in their entire history, a better illustration than that of the surgical measures advised for the cure of hernia. The student who will take the trouble to read the review given in a previous chapter of this work, all too briefly, of the various methods which have been put into practice in one generation, only to fall into disuse and be forgotten in a subsequent one, will note that, in the earlier part of the present century, the pendulum of opinion swung as far away from the attempt at surgical procedures for the cure of hernia as at any time perhaps since the days of Celsus. Even now, when the modern surgeon invades every cavity of the human body with a seeming impunity which borders almost upon recklessness, the cure of certain forms of hernia is generally acknowledged as the opprobrium of our art, and if ever to be undertaken, only in cases of the rarest exception. In contrast with this, I call attention to the following quotation from Arnaud,* who published in 1748: "It is only since the beginning of the present age that cures truly singular have been performed. The knowledge which has been acquired in anatomy, and the discovery of new kinds of ruptures, have enabled skilful surgeons to correct the methods prescribed by former authors, and to invent new ones, according to the exigency of the case. This superiority in the knowledge of anatomy has taught them methodically to treat ruptures accompanied with putrefaction, which used within these twenty years to be abandoned to the mere care of Nature. It has given them the boldness to cut away with success two, four, or even six feet of the mortified intestine, in order to secure the rest from gangrene. By this exact knowledge in anatomy they are cured of their prejudice concerning the epigastric artery in inguinal ruptures. They have learned to preserve the spermatic vessels in crural ruptures of men; nor is there any rupture, however complicated with adhesions, which they do not surmount. To

open the intestine in case of necessity, and to search out in the recesses of the abdomen the very remote strangulations, are achievements only to be found in the most modern surgery, which is not without expedients even in desperate cases. To repress any doubt of this truth, nothing is necessary but to look into the Memoirs of the Academy of Sciences at Paris, where the most surprising cures of this kind will be found; such as the people looked upon to be supernatural, until they were insensibly familiarized to the miracles of art. He who reads Mr. Garengeot's Treatise of Operations, will see the dexterity requisite in the different methods necessary for the cure of these diseases, and find all the means of success laid down according to the greatest masters which our nation has seen in the last or the present age."

The revolution in the surgical treatment of wounds had its inception, as we have pointed out, with Sir Joseph Lister, whose marvelous genius and indefatigable industry surmounted all obstacles. His inspiration came from the studies of Pasteur and others, including our own Professor Jeffries Wyman, upon fermentation and its dependence upon vital rather than chemical causes. The results of his labors for the benefit of his race have never been exceeded by any devotee to the healing art, and his name must be indissolubly associated with the treatment of wounds so long as surgery remains a branch of science. The demonstration seemed complete that, in an aseptic wound, aseptically maintained, the repair processes proceeded under the same favorable conditions as in subcutaneous wounds. The factors in the problem to be solved were the best method of preventing contamination in the wound when open, and retaining it uninfected during the process of repair.

No chapter in the history of surgery surpasses in interest that of wound-treatment in the last quarter of a century. The biological investigations of bacterial growth in its omnipresent energy and potent influence for good or ill over the human race is still so recent, that we are as yet unable fully to appreciate or fairly judge of its importance and value. Truth is ever more marvelous than fiction; and the new world to which we are introduced by means of the modern microscope, although infinitely small in its individual membership, possesses a power infinitely great over the higher organisms, from birth until death. So fundamental and far-reaching are these hitherto unknown factors of biological character that they underlie and in large measure modify our very existence. Without their potent energy, it seems, from our present knowledge, that the life processes themselves would, within a very short period, cease to develop, dependent as they are upon the never-ending round of transmutability of material upon which life
itself must exist. By the misdirected force of this invisible power the higher organic life is ever threatened, known to us under various names by which we call many of the more common and fatal diseases. Introduced into wounds, these organisms may become agents endowed with the highest potency of a death-dealing character. From a clearer knowledge of our invisible vital surroundings, many of the hitherto inscrutable mysteries, fraught with pain and suffering and the foreshortening of our very existence, are being made plain to us. The hidden rocks and reefs, so fatal during all the centuries to the barks of life launched upon the great ocean of existence, with painstaking care are being mapped and charted; and this work of the present generation is elevating medicine and surgery from an art into a really great science: God's own law of wonder-working from the infinitely small to the infinitely great—science, the knowledge which has its better definition as pure and simple truth.

The first application of antiseptic measures for the surgical relief of hernia of which I find record was, as seems natural to expect, by Mr. Lister during his early experimental studies. On this account I quote somewhat in extenso the following case of operation for strangulated inguinal hernia:* 

"H. R., aged twenty-one, admitted to the Royal Infirmary at Glasgow, July 30, 1869. After an unsuccessful effort at reduction under chloroform, Professor Lister proceeded at once to operate.

"The parts having been shaved, and well washed with a solution of carbolic acid, one to twenty of water, an incision two and a half inches long, extending into the scrotum, was made through the skin upon the neck of the tumor. The external ring, being found to form a constriction, was divided with a probe-pointed bistoury, and taxis again tried, but without success. Mr. Lister accordingly proceeded to open the sac. A considerable quantity of serous fluid escaped, and a piece of omentum six inches long by five or six wide, and very black in color, was exposed. It was folded in a cloth dipped in a one-to-forty watery solution of the acid and turned to one side. Beside this was found a fold of intestine of deep claret color. A testicle also slipped up into view from the lower part of the wound. Mr. Lister, introducing his finger, now discovered a second very tight and firm constriction, apparently the conjoined tendon, which he divided with a probe-pointed bistoury, the tissue crying under the knife. The neck of the sac, forming a third constriction, very tight but thin, yielded before the

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finger-tip. The intestine having been well washed with a one-to-forty solution was now returned, and the omentum was uncovered and examined. It had assumed a rosy, vascular appearance, circulation being evidently re-established. One part, however, about an inch wide, considerably ecchymosed, and somewhat detached from the rest, was ligatured with antiseptic catgut and removed. The remainder was returned. The wound was thoroughly sponged with a one-to-forty solution, and closed by points of interrupted catgut suture. All instruments, and the hands of those engaged in the operation, were dipped in a one-to-forty solution.

"The dressing consisted of a piece of antiseptic lac plaster, as recommended by Mr. Lister, coated with gum-copal to prevent irritation to the wound, overlapping about an inch, this in turn being overlapped for three or four inches by two layers of lac plaster without the copal coating. A pad was placed over the region of the wound, and the whole secured by bandaging.

"July 31st.—Pulse, 72; temperature, 100.7°; dressing not disturbed.

"August 1st.—Pulse, 62; temperature, 99°.

"August 2d.—Wound dressed for the first time under a constant stream of one-to-forty solution of carbolic acid. The wound not quite united, as between the stitches in nearly its whole length altered clot is visible. There is some fullness about the incision, as if from retention of discharge, but no irritation or tension.

"August 4th.—Wound redressed; on firm pressure two or three drops of orange-colored serous fluid escaped from the lower angle of the wound. Otherwise unchanged.

"August 7th.—Some of the stitches have been absorbed in their deeper parts, and have been lifted off. Some others have been divided. There is a layer of lymph over the wound, concealing the amount of cicatization. No pus can be squeezed from the incision, but the testicle has been dragged up from the scrotum and is lying beneath it, accounting for the fullness already mentioned and the sickening uneasiness produced by pressure.

"August 11th.—The wound is found to have stretched considerably; the edges are cicatizing, and there is no odor.

"April 16th.—The wound is perfectly sweet, and cicatizing beautifully.

"September 8th.—Patient dismissed, the wound being almost wholly cicatized."

This case is especially noteworthy, from having been done under antiseptic precautions, and, as may be seen in the report, the repair processes supervened somewhat slowly, but without suppuration.
No note is made of the disposition of the sac, and it is not probable that a permanent cure was anticipated. The anatomical disposition of the parts was peculiar, and the wound especially troublesome, from the tendency of the testicle to become withdrawn within the canal, and this certainly could not have happened if the external ring had been carefully sutured.

The case may surely be considered one of the early triumphs of the new method of wound-treatment, applied to one of the most difficult regions of the body.

The first case of which I find record, where the canal was closed by animal sutures, is that by Mr. Charles Steele, of Bristol, England. The operation was performed in May, 1873, on a boy eight years old, and the canal was closed by two catgut sutures. The recovery was rapid, and the hernia remained for six months cured, when strangulation occurred, and the operation was repeated, with the use of three sutures. Recovery was perfect, and a truss was applied. When reported, the cure remained, and the parts were firm. Mr. Steele wrote: * "While I thought out and performed this operation, as an original matter, I do not assert that I originated the operation; in fact, it seems to me the most likely measure to suggest itself to any surgeon's mind when considering the subject, and I dare say several have performed it."

Professor Thomas Annandale,† of Edinburgh, operated upon a case of strangulated femoral hernia in January, 1872, in which he tied the neck of the sac with catgut, and removed it with some adherent omentum. The result was so satisfactory, that he wrote: "I have adopted this method in all cases since operated upon; but during the last two years I have, in addition, stitched the margins of the abdominal opening together." He commended unhesitatingly "ligature of the neck of the sac, with excision of the same, and stitching together the margins of the abdominal opening." He used catgut and Listerian antiseptics.

To Professor Czerny,‡ of Heidelberg, is accredited in Germany the origin of the operation by a free dissection and closure of the parts, for the radical cure of hernia. His first case was a strangulated hernia of a child two and a half years old, operated on October 21, 1877. The pillars of the ring were closed by two silk sutures. The wound became septic with abscess, but the cure was complete two years later. He refreshed the pillars of the ring, after having resected the sac at its base, which he

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* British Medical Journal, November 7, 1874, p. 384.
† Edinburgh Medical Journal, December, 1880.
‡ Berlin. klinische Wochenschrift, No. 4, 1881.
tied with a double ligature of stout silk and cut away. Silver-wire sutures were introduced from within outward through the integuments. A rubber drainage-tube was used, and the skin carefully closed with a continuous catgut suture. Iodoform and antiseptic bandages completed the dressing. The wire sutures were generally removed on the twelfth day. Nineteen radical operations were reported upon sixteen patients. Complete ligation of the neck of the sac was made in nine cases. Suppuration supervened in thirteen.

Schede,* of Hamburg, reported his first case of operation for cure, upon a patient, suffering from a double reducible inguinal hernia, which in consequence of the large size of the rings could not be retained by a truss. The operation was performed by freeing the sac, drawing it down as far as possible, ligating it at the neck, and resecting. On one side, a piece of omentum was included in the ligature and removed. The cure was complete, although the rings were previously large enough to admit three fingers. He reported in connection a series of eight cases; the primary operation in all was the obliteration of the sac. The character of the suture was not mentioned. He stated that "the difficulty of applying a perfect antiseptic dressing in this region of the body is very great, on account of atmospheric contamination and the contact of urine, especially in children." Wolters† reported from Schede’s clinic, in the Hamburg Hospital, 165 cases, in which there was an adequate history of operations for the radical cure performed in cases of strangulated and non-strangulated hernia. In 95, a ligature was placed as high up as possible on the neck of the sac, and the sac extirpated (in congenital cases only partially), and the hernial apertures sutured. In 17 cases of femoral hernia the sac only was extirpated, and its neck tied without subsequently introducing sutures. In 15 cases, suture of the femoral ring was mentioned. In some cases there were slight modifications of procedure; and in 24 the method of operation was not given. In 53 instances, portions of omentum were ligatured and removed. In 51 cases of strangulated inguinal hernia, the total mortality was seven; but only four of these, or eight per cent, were in any way traceable to the operation itself. One patient, with an enormous scrotal hernia, died from shock—a rare accident. Three deaths were from peritonitis, and the others were complicated cases in old people. Of 64 cases of strangulated femoral hernia in which a radical

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* Centrblatt für Chirurgie, November, 1877. Max Schede.
† Remarks on the Radical Cure of Hernia. Sir William Mac Cormac. Vol. xix of the St. Thomas's Hospital Reports.
operation was performed, four died, two being feeble old women; one death was from pneumonia, the other from hæmorrhage dependent on a cancer of the stomach. There were 40 operations on 37 patients affected with reducible inguinal hernia (in three instances a double operation was performed). Two cases proved fatal, one that of a man of fifty; two died from fatty degeneration of the heart after the wound had healed; the other, a patient with fatty degeneration of the liver, succumbed to diffuse peritonitis, which it is believed had commenced previous to the operation, the symptoms being mistaken for those of incarceration of the bowel. Of the 10 operations on cases of femoral hernia all proved successful. In the 50 operations, then, there were but two deaths; and one of these not being assignable to the operation, the mortality is only two per cent.” His latest report is 387 radical operations, with 72 deaths.*

The interesting monograph of Victor Cuénod gives the work of Professor Socin in the hospital at Basle, from 1877 to 1881, in operations for the cure of hernia. The results are so interesting and instructive that I append a brief abstract:

“Professor Socin, having carefully disinfected the parts, and the bowel having been properly emptied by means of mild purgatives, if necessary, proceeded as follows:

1. Incision of the skin and subjacent tissues as far as the sac.

2. Dissection and isolation of the sac, effected by soft instruments or with the fingers. If this dissection is not possible, separation of the neck of the sac so as to be able to constrict it.

3. Incision of the sac, and reduction of its contents after freeing the constricted ring, if it is a strangulated hernia; if necessary, resection of the adherent omentum.

4. Simple ligature, double, triple, or quadruple, of the neck, carried as high up as possible, and excision of the sac.

5. Suture of the pillars when it is necessary.

Finally, the aponeurosis which covers the sac is often brought together with sutures, the cavity is drained, disinfected, and the edges of the skin are united by sutures. A Lister dressing, very carefully applied and well compressed, covers the wound.”

M. Socin considered it useless to refresh the edges of the ring, and had not practiced it upon the cases here reported. It is only rarely, in cases of inguinal hernia, that he sutured the ring. In one or two cases of crural hernia with a large opening

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* Boston Medical and Surgical Journal, May 26, 1892, p. 530.
he found it necessary to bring together the borders of the orifice in order to secure occlusion.

Finally, in inguinal hernia the presence of the spermatic cord is one of the most serious obstacles to the perfect success of the operation. It is evident that complete obliteration of the hernial canal is more difficult, since the surgeon is obliged to leave in this canal an organ subject to difference in size and frequent movements. In woman, the presence of the round ligament is of much less importance, and does not need to be considered from the surgical standpoint. It is owing to these anatomical conditions that we must attribute the difference in results obtained between inguinal and femoral hernia. In the first, the passage of the hernia is made through a canal already formed, which can be only narrowed and not completely obliterated after the operation; while in the second this passage is made through a simple orifice, the complete occlusion of which is much easier to secure.

Report of M. Socin's cases from 1877 to 1880, which were operated upon in the hospital at Baslé:

"Sur 17 hernies non-incarcérées, il y avait 15 hernies inguinales et 2 crurales; sur 17 hernies incarcérées, il y avait 10 hernies inguinales et 7 crurales."

Giving as a result:

"Sur 17 hernies non-incarcérées, 9 relapses, 8 cures. Sur 17 hernies incarcérées, 3 relapses, 14 cures."

Or, more exactly:


This gives as per centum in classes:

"For non-incarcerated hernia, 52.9 per cent relapses, 47.1 per cent cures; for incarcerated hernia, 17.6 per cent relapses, 82.3 per cent cures."

And in varieties:

"Inguinal non-incarcerated, 60 per cent relapses, 40 per cent cures; crural non-incarcerated, 60 per cent relapses, 100 per cent cures; inguinal incarcerated, 10 per cent relapses, 90 per cent cures; crural incarcerated, 18.5 per cent relapses, 71 per cent cures."

These cases had all been heard from as to their condition from nine to forty-three months after the healing of the wound.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

Of the twenty-two cures, eight were males, fourteen females. As to age, as follows:

<table>
<thead>
<tr>
<th>Age of patients</th>
<th>Patients cured</th>
<th>Patients operated upon</th>
</tr>
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<tbody>
<tr>
<td>One to ten years</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Ten to fifteen years</td>
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<td>Fifteen to twenty years</td>
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<td>Twenty to thirty years</td>
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<td>Thirty to forty years</td>
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<td>7</td>
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<td>Forty to fifty years</td>
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<td>Fifty to sixty years</td>
<td>5</td>
<td>11</td>
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<td>Sixty to seventy years</td>
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<td>2</td>
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<tr>
<td>Seventy to eighty years</td>
<td>1</td>
<td>1</td>
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</tbody>
</table>

22 34

Conclusions:

1. The result of the so-called radical cure can be considered definite only about two years after the operation.

2. The chances of success exceeding greatly non-success in children, the radical operation is indicated with this class always where the hernia can not be retained with a bandage.

3. The radical operation is indicated in adults and aged persons in all cases where a bandage can not be supported, or is not efficacious in its action.

4. The ablation of the sac and suture of the neck in no way complicates the operation of kelotomy, but increases, on the contrary, the chances of success of the operation, and should always be practiced in strangulated hernia.

In 1889 M. Socin reported seventy-five cases operated upon for radical cure, with two deaths. These were owing to the desperate condition of the patients, the enormous size of the tumors, and the complications incident to them.

M. Tilanus reported to the Congress held at Amsterdam, in 1879, a statistical paper upon the antiseptic operations performed for the cure of hernia. He collected reports of about one hundred cases by different surgeons, with only eleven per cent of cures. He advised excision of the sac and deep sutures.

One of the most interesting and valuable monographs upon the cure of hernia is that of J. Lucas Championnière,* of Paris. The author performed his first operation for

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* Étude sur la cure radicale de la hernie non-étranglée, avec une statistique de cent-vingt opérations. Par le Dr. J. Lucas Championnière.—Journal de Médecine et Chirurgie, 1888.
the radical cure of hernia uncomplicated by strangulation in 1881, under the protection of the antiseptic method, which at this time was absolutely unknown in France. In the statistical table of one hundred and twenty operations given, there is much that is interesting and instructive. Of the entire number, but one case proved fatal, although it will be seen that every variety of hernia was operated upon, including many of the most serious and complicated conditions. In some cases the herniae were of enormous size, the patient advanced in years and greatly reduced from long suffering. Twice the bladder was accidentally opened, and once laparotomy was necessitated because of an omental abscess, all of which the author adduces not alone to show the safety of the operation, but also to point out the irreproachable security which the antiseptic method furnishes in the treatment of wounds. While the author mentions a considerable variety of detail which is necessarily incident to hernial operations, the basic principle is always the same. Remove as thoroughly as possible the peritoneal sac; restore or remove the omentum, and produce a strong cicatrix. In umbilical hernia he uses buried sutures in layers, and oftentimes re-enforces by deep stay sutures. He urges the operation in a great majority of the sufferers from umbilical hernia, and does not hesitate to recommend it in all cases of young women, whether the hernia is large or small, since it constitutes a life-long infirmity, likely to increase with years. His table includes twenty-five cases of congenital hernia. He preserves the testicle unless it is diseased, restores the tunica vaginalis, and does not consider the operation much more difficult than the generality of other surgical cases. He emphasizes the advantages derived from the operation, and states that his results have been extremely satisfactory. His table includes a number of children, the youngest being only six months old. He prefers to operate, however, after six or seven years of age, because of the difficulty of retaining proper antiseptic dressings. He does not consider it advisable to operate, at the same time upon both sides, if the patient is suffering from a double hernia. The contraindications for operation are those common to operations in general. The only fatal case in his table is one where the operation was undertaken upon a man who had long been a sufferer from emphysema. The hernia was large, and the operation long and difficult. Death occurred in thirty-six hours, from pulmonary congestion, without any abdominal lesion.

"The subjects of diabetes, chronic nephritis, and cardiac complications should be carefully considered before advising operation. The author does not think the extirpation of omental masses a serious complication; on the contrary, he claims originality in
advocating the removal of large omental masses for the purpose of rendering greater security in the results, and believes his experience fully justifies his views. In one extreme instance he removed an enormous amount, weighing eight hundred grammes, nearly the size of an adult head, with a subsequent good result. The author considers the operation as one demanding careful dissection, with attention to details, experience having taught him that, while a few operations have consumed less than forty minutes, the larger number have taken an hour or more. Patients are usually retained in the hospital from six weeks to two months after the operation. Where cure has not been complete, the improvement is almost without exception very great."

The conclusions drawn from the discussion of the paper, and offered by L. S. Richelot, were to the effect that—

"1. In inguinal hernia, as in all others, the resection of the sac is the principal factor in the radical cure.

"2. The operation is not difficult unless there are adhesions with the intestine, or in cases of old herniae which have become strangulated.

"3. That the resection of the vagino-peritoneal canal is always possible in congenital hernia with atrophy of the testicle.

"4. That resection of the vagino-peritoneal canal in hydrocele of the cord, when existing without hernia, should always be performed to prevent the exit of a hernia.

"5. The simple operation, without removal of the testicle, should always be done in hydrocele and congenital herniae, just as it is done in acquired hernia."

Mr. W. Mitchel Banks,* of Liverpool, contributed an article, in 1882, upon the radical cure of hernia by the removal of the sac, and stitching together the pillars of the ring. His first reported operation was in January, 1880. In August, 1887, at the meeting of the British Medical Association, Mr. Banks reported a tabulated list of one hundred and six cases.† Sixty-eight cases were without strangulation; in thirty-eight, strangulation was present. His method of operation is as follows: "In inguinal hernia, the sac, after being cleanly dissected out, is opened, and all bowel is replaced and adherent omentum tied and cut away. The sac is then well pulled down, ligatured as high up in the canal as possible, and removed. Finally, the pillars of the ring are brought together by two or three silver ligatures, which are left in position. In femoral

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* British Medical Journal, 1882, pp. 985-988.
† Ibid., August 10, 1887, pp. 1259-1261.
hernia the dissection and removal of the sac constitute the whole operation, and no attempt is made to close the femoral aperture. In ventral and umbilical herniae use is frequently made of the whole or part of the sac, as a kind of plug to stop the aperture, which is generally large, and in which it is seldom possible to adapt any means of approximating the edges which seem likely to be permanent.

In the analysis of his tables Mr. Banks stated that "in the sixty-six cases which he has been able to follow up, forty-four were completely successful from a curative point of view." Mr. Banks does not consider the truss such a serious inconvenience, and would not operate where the rupture could be retained. He also "advises everybody to wear a light support after operation. . . . All parings, scrapings, and freshenings of the inguinal canal I hold to be utter nonsense, and quite theoretical. When an inguinal hernia is big enough to warrant operation, there is commonly little canal or ring left. I have generally found a big hole with a thin-edged margin, which has taken three or four fingers of an assistant to plug up while the sac was being removed. Then what is the use of pulling the pillars together by sutures? I do it simply to hold the parts together temporarily while the wound heals, so as to prevent all danger from coughing or straining, because in very big operations I leave the wounds quite open." Mr. Banks would rarely operate in children, having done it only four times in the entire series.

Mr. Kendal Franks,* of Dublin, first operated in 1882. Reported twenty-four cases done under strict antiseptic precautions. He wrote: "What I have most frequently done is to clear the sac from surrounding parts, then open it and pass my finger through it till I can feel the margins of the internal ring. I then pass the silver wire first through one pillar of the ring and through one side of the sac; then, passing the needle through the other pillar of the ring and through the other side of the sac, I thread it with the same wire and withdraw it. When this suture is fastened it not only closes the ring, but fixes the sac between its pillars in such a way as to obliterate its cavity. Two wires are generally used for this purpose. Below the sutures the sac is excised. . . . I always use buried sutures—that is, I endeavor to sew together with cat-gut the various layers of tissues which have been divided. The skin-wound I bring together with an oblique suture, so as to leave a slight pucker at the upper angle for drainage. By so doing a drainage-tube is seldom required, and the first dressing is

allowed to remain undisturbed for ten days. I generally find the wound perfectly healed and the dressings caked and dry. I first close the upper part of the internal ring, by passing the silver wire straight through the aponeurosis of the external oblique directly over the internal ring. The needle-point is, of course, protected by a finger passed through the canal and pressing the abdominal wall forward at this place. The needle armed with the wire then picks up part of Poupart's ligament, and, having reached the finger, is carefully made to appear through the canal, when the wire is caught and the needle withdrawn. The unarmed needle now passes through the external oblique aponeurosis, as before, and at a point corresponding to the other side of the ring, passes through this pillar, and, being brought out through the canal, it is threaded with the wire and withdrawn. Before this suture is twisted, a second one is passed at the lower end of the ring in the same manner. This second suture corresponds generally to about the middle point of the canal. It also passes through the aponeurosis of the external oblique, immediately in front of the lower part of the ring. The third suture, which is also generally silver, closes the external ring. This I believe an immense improvement."

All cases operated on by Mr. Franks easily recovered, and at the time of the report only four cases were known to have failed, and these were much improved. "In competent hands, where every precaution is taken against avoidable danger, the operation is believed to be eminently a safe one."

Mr. A. W. Robinson,* of Leeds, England, tabulated twenty-six cases. In all but two cases, where Wood's operation was performed, the sac was excised after its neck had been ligatured, the canal being sutured only when very open. Strict Listerism was followed in every case. He recommended ligature of the sac and suture of the pillars of the rings.

Mr. Chauncy Puzey,† of Liverpool, reported twenty-four cases of operation by the aseptic method; the first was performed in 1881. He emphasized the dissection of the sac and its ligation as far up as possible, and removal; suture of the pillars with stout chromicized catgut; he thought wire should not be employed. So far as known, there had been no failure, and all made rapid recovery.

Mr. Christopher Heath,‡ of London, reported six operative cases, two of extro-

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* British Medical Journal, December 17, 1887, p. 1324.
† Ibid., December 17, 1887, p. 1327.
‡ Ibid., May 23, 1885, p. 1041.
VERTED BLADDER; ONE DEATH. HE ADVISED RESSECTION OF THE SAC, WITH DEEP CATGUT SUTURES, ASEPTICALLY APPLIED.

MR. C. B. KEETLEY,* OF LONDON, CONTRIBUTED AN INTERESTING ARTICLE UPON THE RADICAL CURE OF HERNIA BY OPEN INJECTIONS, AND, IN SUMMING UP, WROTE: "I BELIEVE THAT A THOROUGH OPERATION OF COMBINED EXCISION, LIGATION, AND SUTURE WILL ALMOST CERTAINLY EFFECT A LASTING CURE. THE DANGERS ARE OFTEN CONSIDERABLE, BUT THEY BELONG TO THE OPERATOR RATHER THAN THE OPERATION, AND ARE AVOIDED BY CARE AND EXPERIENCE. THE INJECTION METHOD IS, AT PRESENT, UNCERTAIN AS TO RESULT, BUT IT IS PRE-EMINENTLY SIMPLE AND SAFE."

MR. F. TREVES,† OF LONDON, AND MR. G. A. WRIGHT,‡ OF MANCHESTER, HAVE PRESENTED MOST INTERESTING COMMUNICATIONS UPON HERNIA OF THE CECUM. MR. TREVES REPORTED TWO AND MR. WRIGHT FIVE CASES. THE OPERATIONS WERE GIVEN IN DETAIL, WITH A REVIEW OF THE SUBJECT. THE SAC WAS TIED AND RESECTED AND THE CANAL CLOSED UNDER ANSEPTIC CARE.


MR. ARTHUR E. BARKER,§ RECENTLY CONTRIBUTED AN INTERESTING PAPER ON RADICAL CURE OF NON-STRANGULATED HERNIA. IN THE ENTIRE SERIES OF FIFTY CASES THERE WAS NOT A SINGLE DEATH, ALTHOUGH SOME CASES WERE VERY TROUBLESOME. WITH THE EXCEPTION OF TWO THE WOUNDS HEALED BY FIRST INTENTION. HE WRITES: "HAVING GOT RID OF SUPURATION, ALMOST ALL OTHER SOURCES OF ANXIETY WERE READILY ELIMINATED AFTER OPERATION. SHOCK WAS NOT NOTICED; HEMORRHAGE WAS OF COURSE ABSENT; NOTHING WAS SEEN OF THE ACCIDENTAL WOUND INFECTIONS, SUCH AS Erysipelas, Pneumia, ETC. THE AGE OF THE PATIENTS RANGED FROM THREE MONTHS TO SEVENTY YEARS. THREE WERE UNDER SIX MONTHS; TWO

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* British Medical Journal, December 3, 1887, p. 1205.
† Ibid., February 19, 1887, p. 384.
‡ Ibid., March 5, 1887, p. 506.
§ Ibid., December 3, 1887, p. 1206.
between six months and one year; thirteen were between one and five years; six between five and ten; one between ten and twenty; eight between twenty and thirty; two between thirty and forty; six between forty and fifty; and one over seventy. Of the entire number, forty were inguinal, of which thirty-one were on the right side, and in four cases the hernia was double; there were three cases of umbilical and two of femoral hernia. Careful aseptic measures were observed." Mr. Barker has found drainage less and less necessary, until he now closes more often without drainage. Carbolized interrupted silk sutures are used. Occasionally small stitch abscesses occur, but these are not considered as cases of suppuration. In six cases one or more of the deep buried stitches worked their way to the surface at a period ranging from the thirteenth day to the ninth month, but without giving any further trouble. "Considering that at least two hundred deep stitches must have been left in the tissues in these fifty cases, the percentage which came away may be considered small. I think the fault has usually been attributable to using too much force in tying them on the included tissues, and for this reason I am now content if the edges of the opening are simply brought firmly together. If this is so, the percentage of stitches which come away in the next series will probably be smaller."

Of eleven cases nothing is known; of the remainder, in eight the hernia returned. Of the remaining thirty, when last seen or heard from, there had been no return. Trusses are not advised after operation. "In not one of all my own cases have I ever seen or heard of any ill effects upon the contents of the scrotum. The gauze dressing is applied, and usually remains undisturbed until the tenth day." Mr. Barker dissects the sac carefully to its very base, ties with catgut, and removes it. He sutures the ring deeply with silk or catgut. In children he finds the dressings must be frequently changed, on account of the soiling with urine and faeces. He closes the rings usually with from two to six interrupted silk sutures.

Mr. John Wood, in his later experiences, somewhat modified his method, under the conviction that antiseptic measures allow of better results. In the discussion that followed the delivery of Mr. MacCormac's address upon Antiseptic Surgery, December, 1879, Mr. Wood stated: * "In cases of large scrotal hernia, in which trusses are of no avail, and the sac is much thickened, of great size, and sometimes presenting constrictions in its substance which are a source of great danger from strangulation,

the spray and the gauze dressing, with the cleanliness and freedom from contamination, putrefaction, and suppuration which they afford, has enabled me to extend materially the scope of benefits to be derived from the operation for the cure of hernia. In such cases I have removed the whole sac, and sometimes coherent omentum, through an incision in the scrotum two and a half inches long; stitched up the peritoneal orifice with a continuous suture of strong carbolized catgut, and then I have drawn together the tendinous sides of the hernial opening with thick silver wire, to resist the tendency of the intestine to protrude and force through the catgut suture, which is too weak to support the strain when unaided by such support, and becomes speedily absorbed. A drainage-tube carried through the bottom of the wound, and along the wire, enabled me to keep the wound perfectly clean of accumulation and retention of discharges."

In Mr. Wood's lectures upon Hernia and its Radical Cure, delivered at the Royal College of Surgeons in 1885, and published in the British Medical Journal, the following June, he wrote: "In the case of tendon ligature being used, it is to be braced up tightly, tied in a well-secured surgeon's knot, cut off close, and buried in the wound. . . . In the case of tendon being used a drainage-tube should be placed, reaching from the superficial ring into the scrotal puncture, and the gauze dressing applied in the usual way, by a double spica bandage, with a piece of jaconet, through which the penis is passed, placed over all to keep off urine from the absorbent dressing." In twenty-eight cases operated on by free dissection and closure of the parts, the sac was tied at the neck with separate stout catgut and removed; the canal and rings were closed by sutures of kangaroo, or ox-tendon, or wire. Of the series there were three deaths, but all were the result of inflammation of the lung in bad subjects.

Mr. Wood's method of suturing is to transfix the sac with a stout tendon, carried through it by a needle with eye near the point, tie on each side, and cut the sac close. He closes the femoral ring with the same tendon, and leaves it as a buried suture; uses here drainage as in the inguinal variety. He reported sixteen operations for strangulated hernia—eight inguinal and eight femoral—with attempt at cure. "Seven were done by ligature of the neck with catgut and entire removal of the sac, with closure of the canal and rings by wire lacing, and nine by the use of tendon for all these purposes." Mr. Wood reported one case of radical cure of umbilical hernia. With respect to the supposed advantages of the open-dissection method, enabling the surgeon to see the parts on which he operates, he wrote: "I have myself found that, after the first cut and
the application of the sponge, the parts became so bleared with blood that I was obliged to rely mainly upon the aid of the sense of touch before I ventured to pass a needle through Poupart's ligament, the conjoined tendon, and the pillars of the ring."

In conclusion, Mr. Wood stated: "It appears indubitable, from the results of the last twenty years' experience of the radical cure of hernia, that the position of those surgical writers who have maintained that the radical cure should not be attempted except in the severest cases is untenable. The operation has given as great relief and exemption from the minor troubles and worry which make life miserable as any operation associated with prolapse, such as haemorrhoids, and is even more safe." Mr. Wood wrote me, under date of August 29, 1891, "My lectures are my last publications on hernia."

Mr. James Hardie,* of Manchester, England, in an article published in 1885, gave the results of an extended experience of operation by the method of dissection. He emphasized the liability of the hernia returning, induced by a depression in the peritoneal pouch, and recommended the taking of the sutures through the neck of the sac, so as to include quite a border of the transversalis fascia. This with him is all the more important, since he leaves the sac, having introduced into the lower end of it a drainage-tube. He used wire to close the canal.

Mr. Clement Lucas† emphasized the removal of the sac since it is always to be considered a source of danger. "To rid the patient of this abnormal, overstrained, ill-nourished, not only useless, but absolutely injurious piece of tissue, should be the aim of every surgeon when called to operate for strangulation after reducing the bowel. It is probably the only operation for radical cure that will stand the test of time. I regard no operation for femoral hernia complete until the sac has been excised, even although the bowel may have been reduced before the opening of the sac. The same may be said of acquired congenital hernia. The congenital inguinal presents especial difficulties, as the whole sac can not be excised without sacrificing the testicle; but I usually excise the funicular portion, and rigid antisepsis is here advisable." Mr. Lucas also reported two very interesting cases of cure of large umbilical hernia by the use of deep-buried catgut sutures; both patients made easy recoveries.

Mr. Thornley Stoker,‡ of Dublin, practices the dissection method of operation. He freely opens the sac, stitches up the neck, and draws together the canal and pillars of

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† British Medical Journal, October, 1885.
‡ British Medical Association meeting, August, 1884.
the ring with chromicized catgut, carbolized silk, or wire, but does not remove the sac. He considers it risky and unsurgical.

Mr. Alexander, of Liverpool, modifies the operation by tying the neck of the sac as deeply as possible, and divides below the suture, but does not disturb the sac or suture the rings. He reported thirty cases operated upon for the radical cure, without a death.

Prof. Buchanan, of Glasgow, in congenital hernia slits up the sac longitudinally on each side of the cord. The anterior part is divided transversely and sutured into the ring as a plug; the lower part is turned down to complete the tunica vaginalis.

Sir William MacCormac,* in an elaborate article upon the radical cure of hernia, held it as important to ligature the sac high up and remove it, and then close with sutures. He concluded as follows: "An operation for the radical cure is, I think, permissible in a large proportion of cases. It may be regarded as an accepted practice that in strangulated hernia, whenever the condition of the hernial contents warrants their return to the abdominal cavity, and the general state of the patient is otherwise satisfactory, the radical operation should be superadded to that of herniotomy. With reference to reducible hernia the question is more open. In children, during the first years of life, a hernia is usually cured by a properly adjusted truss, and this method of treatment should always be carefully tried, the more especially because the operation in infants is attended by considerable risk, owing to the difficulty in maintaining the wound aseptic. As the child grows older the chances of closure of the peritoneal process by means of a truss diminish. Probably after the first six or seven years of life the prospect of cure by any save operative measures is so small that the attempt need scarcely be made. The operation is most strongly indicated in cases of irreducible hernia with periodical symptoms of incarceration or impending strangulation—a condition so especially common in umbilical hernia. It is also desirable in the case of patients whose occupation is liable to provoke strangulation, or renders the condition extremely inconvenient, or where social conditions make palliative measures objectionable. It is also indicated where the hernia, although reducible, can not be so maintained by a truss, and in cases which are attended by distressing local symptoms. I would conclude by saying that in a large proportion of cases of inguinal hernia, especially those of congenital origin, a radical cure is possible; and that in femoral and

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* Vol. xix. St. Thomas's Hospital Reports. Reprint.
umbilical herniae of small or moderate size the prospects of cure are good. Even where an absolute cure is not accomplished a great gain is generally secured in the diminution of the size of the hernial aperture by which the retention of the hernia within the abdominal cavity becomes more practicable. Lastly, and most important, the operation when properly performed is scarcely dangerous to life."

Mr. John Poland,* of Guy's Hospital, London, in a paper upon the treatment of the sac in strangulated hernia, reviewed the different methods of treatment and commended the ligature of the neck and excision. "By it the peritoneum is effectively closed from haemorrhage and septic infection, and it holds out a great hope of permanent cure, not only in restoring the patient to a more normal condition by removing a more or less open tract along which a portion of the intestine might again descend, this tract being in fact composed of morbid and useless tissues, but also by producing a radiating puckering of the peritoneum around the hernial orifice and closing the orifice itself by dense cicatricial tissue, and thereby tending to prevent yielding again at this spot. We do away with an indurated thickened mass, which often exists where the sac has been allowed to remain untouched. . . . In cases where the opening is large the pillars of the ring may be brought together by sutures without adding to the risk of the operation. . . . Ligature without excision has no advantage over ligature with excision."

Mr. F. T. Heuston† contributed a most interesting paper to the Surgical Section of the British Medical Association, upon the radical cure of femoral hernia, and reported an illustrative case in a woman of seventy. The cure was easy and complete, although the sac, besides a loop of intestine, contained a gangrenous Fallopian tube and the ovary; both were removed. The sac was tightly twisted and transfixed with chromicized gut, and excised. The canal and fascia were closed by buried sutures. Mr. Heuston remarks: "It is sufficiently rare to find the Fallopian tube and ovary within the hernial sacs, to allow another case being recorded, as I find that in 1871 there were only thirty-eight cases recorded, namely, twenty-seven inguinal, nine femoral, one sciatic, and one obturator. Of these, however, seventeen were congenital, all of which were inguinal, and the ovary alone was usually in the acquired herniae, while only five of the cases contained intestine."

Besides the advantage derived from the removal of the sac and closing the perito-

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† Ibid., December 3, 1887.
næum by twisting the neck, Mr. Heuston emphasized the importance of closure of the tissues, "in proper and consecutive order, by hidden sutures, the most important being the first applied, namely, uniting the fascia transversalis forming the anterior wall of the femoral canal to the fascia iliaci and anti-psoas layer of the pubic portion of the fascia lata behind and within." He used chromicized catgut throughout the operation, which allows of immediate union, and does not require subsequent removal.

In the discussion of Mr. Hueston's paper, Mr. Walsham remarked that "he thoroughly advocated Mr. Banks's method. He used kangaroo-tendon, and believed that, when it was securely knotted, it was a most reliable ligature, and preferable to both wire and silk."

Dr. Ward Cousens observed that "the surgery of hernia had made recently most rapid advance, especially in the direction of the radical cure in young children. He had operated on more than fifty cases, and thirty of these were cures; the rest had been done too recently to express an opinion." He removed the sac after ligature of the neck, and closed the edges of the ring and wound with a continuous suture. He advocated silk or wire as more trustworthy than catgut.

Mr. C. B. Ball * reported a method for the cure of hernia by torsion of the sac. He emphasized the complete separation of the sac from the structures of the cord—a matter sometimes of no small difficulty. "The peritonneum loosened a little about the ring, the empty sac is firmly held at its neck by forceps and gradually twisted; generally four or five turns are sufficient, but the torsion should be continued until it is felt to be quite tight or rupture seems imminent. Thus held, the twisted neck is tied with catgut as high as possible and the ends cut off short. Two sutures of strong aseptic silk are now passed through the skin, at a distance of about an inch from the outer margin of the wound, through the outer pillar of the ring, through the twisted sac in front of the catgut suture, and then through the inner pillar of the ring and skin upon the inside. As these sutures effectually prevent the sac from untwisting, it may now be cut off in front of them, and a catgut drain is brought out through a separate opening at the back of the scrotum, and the two sutures closed over lead plates which lie at right angles to the wound. Superficial sutures are applied if required, and a dry dressing is held by a fixed silicate-of-potash bandage." Post-mortem testing shows the perito-

* British Medical Journal, December 10, 1887, p. 1272.
neum to be thrown into spiral folds radiating in all directions from the ring and extending about four inches.

Mr. Ball thinks the twisted sac thus transfixed makes a slight projection rather than depression within the abdominal cavity. He reported twenty-two cases of his own, besides a number, under his observation, done by other surgeons. All recovered. All had been performed within four years. Three were obliged to wear a truss, from a weakening of the ring. Mr. Ball deprecated the wearing of a truss, since the pressure of the pad tends to produce absorption of the plastic effusion in the canal, upon which the success of the operation so largely depends.

Mr. W. P. Stokes,* of Dublin, advocated the free dissection method; he adopted the plan of Mr. Ball of twisting the neck of the sac and suturing under aseptic precautions. He argues, as does Mr. Ball, that the lymph effusion is the factor sought; that sutures serve but a temporary purpose, and their chief end is to secure an abundant exudation.

No one of the recent contributions upon the cure of hernia has deservedly attracted a larger share of attention than the paper of Mr. William Macewen, of Glasgow, published in the Annals of Surgery, August, 1886. This was supplemented by a further contribution † upon the subject to the British Medical Association. Mr. Macewen stated that "he was led up to the adoption of his present method by his studies upon the various methods of the treatment of the sac; and, believing that there was generally left a depressed pouch or funnel-shaped puckering of the peritoneum at the internal ring, which receives the wave of impulse of the liquid movement of the intestine, he sought, in the device which characterizes his method, to re-enforce the weak spot by a new use of the sac." The steps of the operation are given as follows:

"1. Free and elevate the distal extremity of the sac, preserving along with it any adipose tissue that may be adherent to it; when this is done, pull down the sac, and, while maintaining tension upon it, introduce the index-finger into the inguinal canal, separating the sac from the cord and from the parietes of the canal.

"2. Insert the index-finger outside the sac till it reaches the internal ring; then separate with its tip the peritoneum for about half an inch round the whole abdominal aspects of the circumference of the ring.

* The Practitioner, November, 1887, p. 355.
† British Medical Journal, December 10, 1887, pp. 1263-1271.
"3. A stitch is secured firmly to the distal extremity of the sac. The end of the thread is then passed in a proximal direction several times through the sac, so that, when pulled upon, the sac becomes folded upon itself like a curtain. The free end of this stitch, threaded on a hernia-needle, is introduced through the canal to the abdominal aspect of the fascia transversalis, and there penetrates the anterior abdominal wall, about an inch above the upper border of the internal ring. The wound in the skin is pulled upward, so as to allow the point of the needle to project through the abdominal muscles without penetrating the skin. The thread is relieved from the extremity of the needle, when the latter is withdrawn. The thread is pulled through the abdominal wall, and, when traction is made upon it, the sac, wrinkling upon itself, is thrown into a series of folds, its distal extremity being drawn farthest backward and upward. An assistant maintains traction upon the stitch until the introduction of the sutures into the inguinal canal, and when this is completed the end of the stitch is secured by introducing its free extremity several times through the superficial layers of the external oblique muscles. A pad of peritoneum is thus placed upon the abdominal side of the internal opening, where, owing to the abdominal aspect of the circumference of the internal ring, having been refreshed, new adhesions may form.

The sac having been returned into the abdomen and secured to the abdominal circumference of the ring, this aperture is closed in front of it in the following manner: The finger is introduced into the canal and lies between the inner and lower borders of the internal ring, in front of and above the cord. It makes out the position of the epigastric artery, so as to avoid it. The threaded hernia-needle is introduced, and, guided by the index-finger, is made to penetrate the conjoined tendon in two places: first, from without inward, near the lower border of the conjoined tendon; then, from within outward, as high up as possible on the inner aspects of the canal. This double penetration of the conjoined tendon is accomplished by a single screw-like turn of the instrument. One single thread is then withdrawn from the point of the needle by the index-finger, and when that is accomplished the needle, along with the other extremity of the thread, is removed. The conjoined tendon is therefore penetrated twice by this thread, and a loop left on its abdominal aspect. Secondly, the other hernia-needle, threaded with the portion of the suture which comes from the lower border of the conjoined tendon, guided by the index-finger in the inguinal canal, is introduced from within outward through Poupart's ligament, which it penetrates at a point on a level with the lower stitch in the con-
joined tendon. The needle is then completely freed from the thread and withdrawn. Thirdly, the needle is now threaded with that portion of the catgut which protrudes from the upper border of the conjoined tendon, and is introduced from within outward through the transversalis and internal oblique muscles and the aponeurosis of the external oblique at a level corresponding with that of the upper stitch in the conjoined tendon. It is then quite freed from the thread and withdrawn. There are now two free ends of the suture on the outer surface of the external oblique, and these are continuous with the loop on the abdominal aspect of the conjoined tendon. To complete the suturing, the two free ends are drawn tightly together and tied in a reef-knot. This unites firmly the internal ring. The same stitch may be repeated lower down the canal if thought desirable. The pillars of the external ring may likewise be brought together. In order to avoid compression of the cord, which might lead to serious embarrassment and sloughing, or ultimate atrophy of the testicle, it ought to be examined before tightening the stitch. The cord ought to lie behind and below the sutures, and be freely movable in the canal. It is advisable to introduce all the necessary sutures before tightening any of them. When this is done they might all be experimentally drawn tight, and maintained so while the operator's finger is introduced into the canal to ascertain the result. If satisfactory, they are then tied, beginning with the one at the internal ring, and taking up in order any others which may have been introduced. In the great majority of cases the stitch in the internal ring is all that is required. During the operation the skin is retracted from side to side to bring the parts into view and to enable the stitches to be fixed subcutaneously. When the retraction is relieved, the skin falls into its normal position, the wound being opposite to the external ring. The operation is therefore partly subcutaneous. When the canal has been brought together, a calcified chicken-bone drainage-tube is placed with its one extremity next the external ring, the other projecting just beyond the lower border of the external wound. A few chromic gut sutures are then introduced along the line of the skin incision. The wound is dusted with iodoform, also the interstices of the scrotum and its junction with the thigh. A sublimated wool pad is applied, held in position by an aseptic bandage."

Mr. Macewen tabulated eighty-one cases, without a death, and with a firm occlusion obtained before leaving the ward. The material used for sutures, as by far the most serviceable, he thinks to be catgut, prepared so as to resist the action of the tissues
from two to three weeks. The use of decalcified chicken-bone drainage-tubes is considered by Mr. Macewen as admirably suited for the operation. He wrote me, under date of September 4, 1891: "I still operate by published method for radical-cure of hernia with permanent results, using no truss. Catgut as previously prepared (with exception of hastening method of preparation) is still used, and for the last two years nearly exclusively, in my practice, both as ligature and suture. It answers all my requirements admirably."

I introduce the following plate, which is of value not only on account of the pathological conditions illustrated, some of which are of exceptional interest, but also because it exhibits conditions of the peritoneal sac common to most old, large hernias which would prevent its utilization for any purpose of re-enforcement of the parts as suggested by Mr. Macewen. These conditions are also well shown in a number of the preceding illustrations.

PLATE LVII *

Figure 1.
Represents an internal view of an oblique hernial sac.
\[ a. \] Femoral artery.
\[ b. \] Epigastric artery, showing its course, first below and then to the inner side of the neck of the sac.
\[ c. \] Obturator artery.
\[ d. \] Mouth of the hernial sac.
\[ e. \] Sac within the scrotum.
\[ f. \] Testicle.

Figure 2.
Represents a direct hernia.
\[ a. \] Rectus muscle.
\[ b, b. \] Peritoneum divided to show the epigastric artery.

PLATE LVII A.

Figure 4.
Represents the division of the epigastric artery, in a case of strangulated oblique inguinal hernia.
\[ a. \] Spine of the ileum.
\[ b. \] Pubes.
\[ c. \] Rectus muscle.
\[ d. \] Mouth of the hernial sac.
\[ e. \] Extremities of the divided epigastric artery.
\[ f. \] Femoral vessels.

* Cooper, Plate XII, Part I.
At the meeting of the Congress of Italian Surgeons, held March, 1888, Prof. Bassini, of Padua, described a new method of cure in inguinal hernia which he had successfully practiced in one hundred and two cases. His method is quite similar to my own operation, and in both the chief object in view is the restoration of the obliquity of the canal. He lays open the canal to the internal ring. The sac is separated, drawn down, ligated, and resected. The closed peritoneum is returned, the spermatic cord is pushed aside, and the posterior margin of Poupart's ligament exposed. The deeper layer is dissected in such a manner that it can be brought in close apposition to the posterior margin of Poupart's ligament. From the ileo-pubic tubercle the canal is united posteriorly from five to seven centimetres to the entrance of the cord into the abdominal cavity. The cord is then replaced and the aponeurosis of the external oblique sutured, an opening being left sufficient only for the cord without compression. The wound is closed with drainage. The internal opening and the posterior wall are new-formed, the external ring narrowed. This restores the canal to its normal oblique position. The posterior wall, being composed of muscle and aponeurosis, is permanent, and will not disappear like the cicatricial plug in Wood's operation. In the author's 102 cases, 95 were reducible and 7 were strangulated; in 98 the hernia was complete oblique, and in 4 complete direct. Professor Bassini, in an article recently published in Langenbeck's Archiv, records 216 cases of operation upon reducible inguinal hernia. All recovered but one, in which death resulted from a pneumonia which commenced after the complete healing of the wound. The mortality, therefore, he considers nil. In 11 cases there was some constitutional disturbance, in the rest none. In 167 cases, or considerably more than two thirds, the wound had healed in a fortnight.

He was able to obtain the final result in 251 cases operated upon by himself or
his colleagues, and found in 108 no return after a period varying from one to four
and a half years. In 131 cases no reappearance had taken place up to periods vary-
ing from a month to two years. In 7 there was relapse, and in 4 the result was
not ascertained.

Anderegg* published a thoughtful article upon the radical cure of hernia by the
removal of the sac and closure of the canal. Of a list of 55 patients where the rad-
cial operation was performed, 38 were reported cured, free from any return. In 71
cases there were 11 deaths.

Leisrink† reported 188 cases of strangulated hernia operated on, and in the list there
were 33 deaths. He thinks the return of the hernia is less likely to follow the radical
operation when done after strangulation than when performed in reducible cases.

Riesel‡ advocates the division of the anterior wall of the canal as far as the in-
ternal ring. He narrows the canal by removing a portion of the anterior wall, and
unites by transverse sutures from above downward, so as to close the canal as much
as possible, in the belief that in this way he reforms and restores the obliquity of
the opening. Usually he ties the sac high up and leaves the empty sac below, be-
lieving that it gives further security and protection from return. The superficial
wound he unites over the deeper layer. He claims that by this method of splitting
the canal he can dissect and free the sac to its very base, and in this way obliterate
any pouching of the peritoneum.

Mr. Henry E. Robinson,* Assistant Surgeon at St. Thomas's Hospital, London,
has published recently a tabulated report, with an analysis of all the cases operated
upon for the radical cure of hernia by the surgeons in the hospital, from the begin-
ing of 1879 up to the end of March, 1890. In all the cases the operation was done
for non-strangulation, and not as one of expediency in cases of strangulation, when,
after relief of the strictured contents, the opportunity was taken to effect a perma-
nent cure. "Various methods of operation were adopted and cases of varying severity
treated, and we venture to think that the results obtained may be compared favor-
ably with the statistics of any one special operator.

* Die moderne Radicaloperation der Unterleibsrifice, 1885.
* Sixty-four Cases of Non-strangulated Hernia treated by Radical Cure. By Henry Betham Robinson, B. S. F.
R. C. S.
"There were 64 cases operated upon; 57 were in males and 7 in females. Of 57 cases, 56 were inguinal and 1 umbilical. Of 7 cases, 5 were femoral—2 on the right side, 3 on the left; 2 were umbilical. Of the inguinal herniae, (a) 24 were acquired, (b) 32 were due to defective closure of the processus vaginalis.

"(a) Of the acquired herniae, 15 were on the right side, 8 on the left, and 1 double.

"(b) Of those due to defective closure of the processus vaginalis, 18 were congenital herniae, 13 on right and 5 on left; 12 were funicular herniae, 7 on right and 5 on left; 2 were infantile herniae, 2 on right and none on left. With acquired inguinal herniae the favored operation was that advocated by Mr. Mitchell Banks, viz., tying the sac up as high as possible, removing it, and then suturing the pillars of the ring. Of 24 cases, (1) removing the sac and suturing the ring was done in 14 cases; and of these, the pillars were sutured with catgut in 4, wire in 1, and with kangaroo-tendon in 3 cases. In 5, the material used is not stated. (2) The sac was removed, but the pillars were not sutured in 5 cases. (3) The sac was ligatured at its neck and divided, but not removed, and the pillars sutured in 2 cases. In both, the herniae were very large, and as the amount of tearing through of the tissues which would have had to be encountered in the separation of the sac would have been great, it was not deemed advisable to attempt this. Silk was used to suture the pillars in one case, and catgut in the other.

"In femoral herniae the sac in all cases was dissected out and cut away, but in one case only were the soft parts about the ring sutured. In the cases of umbilical herniae the sac was separated and removed, and the ring sutured up."

Results of the operation: "The present condition was ascertained in 43 of the 60 cases inquired into as to the result. Of the 22 cases of acquired inguinal hernia, 14 answered. Of these, 9 were completely cured, but in 5 cases there was recurrence."

Among the cases due to defective closure of the processus vaginalis—

(a) Of the 18 cases of congenital hernia, 14 answered, and "all were cured."

(b) Of the 11 cases of funicular hernia, 8 answered, and "all were cured."

(c) Of the 2 cases of infantile hernia neither answered. Of the 5 cases of femoral hernia, all answered. In 3 there was cure, in 2 recurrence. Of the 64 cases, 4 have been fatal, or 6 per cent.

In Sweden, an "improved" operation for the radical cure of hernia has for some time past been practiced by Drs. Svenssen and Erdmann, Surgeons to the Sabbats-
berg Hospital,* at Stockholm. A ligature is applied to the neck of the hernial sac, and the sac is cut off below the ligature, the contents being previously examined by means of an incision into the sac, and returned; or, if only omental, excised together with the sac. In congenital hernia the upper part of the sac only is removed, and where the large bowel is included in the hernia and adherent to the sac wall, this, after being separated from the surrounding tissues, is returned together with the large intestine, and the divided portions of Poupart’s ligament united by sutures. The dressing employed is iodoform and boracic acid, the wounds being washed with sublimate solution. Since this has been substituted for carbolic gauze, abscesses which used to occur frequently have become rare. Of the 48 cases thus operated on, none of which were selected, 38 were permanently cured—at least, no return of the hernia occurred within six months; and in the cases where a return did take place, which amounted to 20 per cent, the condition was very much less painful and distressing than it had been previous to the operation.

Sabbatsberg Hospital has now been opened six and a half years, and during that time 300 cases of hernia have been admitted, about 200 of these being operated on with a knife; a milder procedure, consisting of alcoholic injections, being employed in the earlier cases. Not a single case proved fatal, though some of the herniae were very large, some reaching within three or four inches of the knee.

M. Thiriar reported, at the French Congress of Surgeons, held October, 1889, twelve cures of hernia without accident, following the method of M. L. Championnière. M. Leonté, of Bucharest, reported 7 operations followed by cure. M. Routier, 14 cases, all cured; M. Segend, 44 operations, without a single death; M. Richelot, 22 operations, one death, a man of seventy years.

Mr. E. S. Bishop,† of Manchester, England, published an interesting article upon the radical cure of hernia by a modification of the Macewen method of operation. He questions the probability of the interior fixation of the pad when the sac is drawn up like a curtain to form it, and thinks it often fails to protect the interior ring, stating that “it might either be drawn too high, or tilted slightly to one side, so that the original cause which slowly extruded the primary sac would produce gradually another at the unguarded point, slowly pushing aside the block which should protect the whole.”

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† British Medical Journal, April 19, 1890.
He is careful to separate the sac quite to, but not beyond, the internal ring. A long suture, armed at both ends with needles, is passed from below upward through each wall of the sac, in such a way that, when the ends are pulled upon, it is drawn up like a purse, the central fold being the largest. Having invaginated the sac thus sutured, the needles upon either side are made to pierce the abdominal wall from within outward. Tension upon both ends of the thread purses up the invaginated sac, which is thus firmly "fixed as a rounded boss, exactly over the internal ring; its peritoneal surface being turned toward the intestine, and its first fold on either side being firmly applied to the peritoneum immediately within the ring." The ends of the thread are then tied firmly but not tightly over the ring, which with the canal is then securely closed with buried catgut sutures, which are so placed as to draw the superior half of the anterior wall of the canal and internal pillar of the external ring well over in front of the inferior half and external pillar. A horse-hair drainage is left in the canal, which must not be so tightly closed as to prevent free movement of the cord lying in it. The superjacent tissues are then united by horse-hair sutures, and the whole dressed aseptically. The advantages claimed by the author are the accurate intrafolding of the peritoneal pouch and fixation over the internal ring. This, and the simplicity of surgical detail, appear to offer marked advantage in the disposition of the sac over the method introduced by Mr. Macewen.

Mr. Herbert W. Allen,* of London, has reported at length 23 cases operated upon during the last two years: 15 strangulated, with one death owing to complications, and 8 for radical cure, with one death, an umbilical hernia, size of an adult head, the contents of which had long been irreducible with adhesions, death occurring on the second day. He ligatures the neck of the sac and removes it, which he believes is the most important factor in effecting a cure.

Karewsker† advises operation in infants where the use of a truss is not satisfactory. Of 63 cases heretofore operated on, 3 died, 2 from sepsis and 1 from shock. He believes the cause of infection to be due not so much to the soiling of the wound as to the retention of the wound secretions due to the complicated attempts at closure. He advises, after replacing the contents of the hernia, to loosen the sac to above the internal ring, then twisting and ligating its neck. Skin sutures are inserted,

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* London Lancet, October 17, 1891.
† Report of Bardeleben's Surgical Clinic.—Centralblatt für Chirurgie, 1891, No. 7, p. 139.
and the wound tamponed for twenty-four hours, after which a button-hole drain is employed. Out of 25 cases of hernia under his care, he has performed this operation nine times. The wound healed, on an average, in ten days. The operations were done during the past three years, and in none has there been any return. The youngest case was nine months of age, and the oldest two and a half years.

A. Koehler suggests a new procedure to replace the purse-string suture heretofore employed, in which the hernial sac is used as a "stopper" for the hernial opening. "The sac is completely loosened from the spermatic cord, the peripheral end is removed, and the balance is slit into three or four strips. These are rolled up separately, with the surface which presented to the wound (the external surface of the sac) outward, and each roll is sutured, to prevent unrolling, by means of catgut; finally, all the rolls, together with the pillars, are sutured together, and the wound is closed by buried sutures. In subsequent cases the rolls were not stitched to the pillars, but were crowded into the abdominal cavity, and the latter sutured over the opening of the ring. The 'stopper' should press against the internal ring, but not press into the inguinal canal."

Ferrari * advocates a modification of Czerny's operation. After exposure, isolation, and removal of the hernial sac, in addition to suturing the pillars, he splits the external wall of the inguinal canal to the internal ring, and following this, the entire extent of the inguinal canal is closed, with the exception, of course, of an opening for the passage of the spermatic cord. He declares the valve-forming operation of Macewen and Bassini to be more or less theoretical.

R. W. Parker,† Surgeon to the East London Hospital for Children, recommends operation for the cure of all cases of congenital hernia over two years of age. He draws the spermatic cord well out of the way, pulls down the sac as far as possible, and introduces three or four stitches through its neck, care being taken not to compress it too tightly. He closes the pillars of the ring and wound with sutures. He prefers aseptic silk. "The longer it remains unabsorbed the better, for thus we have the mechanical help which its presence gives until complete adhesion of the sac walls has been effected."

In the same journal, Henry O'Neil, of Belfast, advises the operation for radical

* Centralblatt für Chirurgie, 1891, No. 3, p. 62.
† British Medical Journal, February 7, 1891, pp. 2-9.
cure in children as the rule. He drains with decalcified chicken-bone, uses chromized catgut sutures, and bandages the dressings on firmly with India-rubber web bandages. He changes the dressings only when the discharge has stained through them, or when the temperature rises suddenly above 101°. He advises an opiate for two or three nights, and gives an anaesthetic during the first and second dressings, to prevent the child's crying and straining the abdominal walls. "I have had no deaths from this operation. I consider this method only requires to be understood by surgeons to be generally adopted; and when the details of the operation are carefully carried out, in suitable cases the results are most satisfactory."

Mr. W. H. Bennett,* Surgeon to St. George's Hospital, London, published an illustrated description of his method of treatment of the sac for the radical cure of inguinal hernia. It is a modification of the Macewen method, in that the sac is divided just below the external ring, and the distal portion is allowed, after bleeding has ceased, to drop back into the scrotum. A long, straight needle with eye near the point is inserted about an inch above the margin of the external ring, a little to the outer side of its middle line, and it transfixes the abdominal wall, impinging upon the end of the finger in the canal. Thus guided, it is passed down upon the inside of the loosened sac and made to pierce its outer wall at a point about half an inch from the cut edge. The needle, having been threaded with a tendon or catgut ligature not less than twelve inches long, is withdrawn, taking one end of the suture with it. The needle unthreaded is passed in a similar way half an inch internally to the first puncture through the sac, threaded with the lower end of the suture, and withdrawn. The open end of the sac is ligated, and traction upon the deep suture invaginates the inverted sac within the abdomen. The canal is closed with silk sutures and a drainage-tube applied. In a somewhat similar way Mr. Bennett advises, under favorable circumstances, the utilization of a portion of the omentum to serve as a pad over the internal ring. In umbilical hernia, Mr. Bennett thinks that often the padding of the internal ring with omentum and suturing to it, are of much importance. The margins of the ring are then brought together by deep sutures of stout silk or tendon.

Mr. R. Morrison † showed a man, aged forty-seven, who had two undescended testicles, and a troublesome hernia on the left side which had been three times strangulated.

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* The Lancet, September 12 and 19, 1891.
† British Medical Journal, February 6, 1892, p. 277.
"On November 21, 1891, operation for radical cure was performed. A thin sac and cord were tied in one ligature. Two hours after, collapsed, wound and external ring opened up. Spermatic artery had retracted, a large haematoccele formed, and peritoneal cavity full of blood. The spermatic artery was caught and tied, and the abdomen washed out after median abdominal section. The man was now well, and his hernia radically cured."

Among the very recent contributions on the radical cure of hernia is a paper by Mr. Lawson Tait,* of Birmingham, The Treatment of Hernia by Median Abdominal Section. In a considerable number of cases of abdominal disease in women, complicated with hernia, Mr. Tait has closed the hernial opening by sutures taken in the following manner: "Two common glover's sewing-needles armed with one piece of salmon silk-worm gut are fastened in some convenient needle-holder at a very slight angle to one another, so that their points completely coincide, and can be made to enter through one hole in the skin. The left forefinger covers or occupies the inner aperture of the sac; the needles are made to enter from without, and are then separated. The outer needle is then made to dip deeply into the external column of the ring, and the inner needle similarly into the inner column. The needles are then pulled out through the central incision, and as many sutures as may be thought desirable are inserted in this way. When the insertion of the stitches is completed, they can be tied from within and cut short. The abdominal wound is then closed properly, and the operation is over."

Mr. Tait entered into a long argument to show the advisability of operating in this way in cases of incarcerated or strangulated hernia, even when the contents are only omentum, and stated: "My proposal, therefore, is now to apply this method of proceeding to all cases of hernia in which operation is required, either for the relief of strangulation, with an operation for the radical cure superadded, as I believe it always ought to be, or merely for the cure of a chronic hernia." In evidence of the originality of his method, he quotes from a paper published in the British Medical Journal in September, 1883: "I have an impression that the radical cure of hernia, other than umbilical, will by-and-by be undertaken by abdominal section. I am not sure but that it will be extended to operations for strangulated hernia." In the first

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part of Mr. Tait's paper he expresses his good fortune at having learned many important lessons in the surgical treatment of hernia from an eccentric practitioner of forty years' experience, practicing upon an unmentioned island, himself so obscure as to be nameless. This surgeon had had a remarkably large and successful experience in operating upon the fishermen subject to hernia, and openly expressed his contempt for the details in the anatomy of hernia, a subject with which Mr. Tait was in full accord. Had the latter, on the contrary, learned his lesson from one of the greatest of English surgeons, he would have found that Mr. Brodie* had anticipated and actually put into practice the method of reduction of a strangulated hernia by median abdominal section more than sixty years ago.

In the discussion which followed, Mr. C. R. B. Keetley, of London, stated that "in 1883 he reduced the contents of a strangulated umbilical hernia by pulling them back into the abdominal cavity, previously opened by a small incision in the linea alba. Soon afterward he attempted the same proceeding in a case of inguinal hernia. It failed in consequence of adhesions, which he was obliged to open the sac to separate. Annandale had done this operation ten years before. It could not be of general applicability because of the frequent existence of adhesions and other complications of the contents of the sac, and it created two potential apertures where there was originally but one. With regard to the sac itself, Mr. Tait had exaggerated the dangers and difficulties of dealing with it. After doing much to destroy the old superstitious fear of the peritoneum in general, did he want to awaken it again with regard to a small process of it?"

Mr. Keetley considered that the essential requirement in order to produce a radical cure was to bring into direct contact the edges of the hernial apertures in the fibrous and aponeurotic opening in the abdominal wall. To do this, the sac must either be removed, reduced, its neck divided, or in some manner got out of the way.

Mr. Jordan Lloyd, of Birmingham, expressed himself as quite content with the results of herniotomy as at present performed, especially when combined with a procedure for radical cure; but, good as these results were, they would be even better if patients were submitted to earlier operations. Mr. Keetley stated "that he had operated on a very large number of herniae, and had not met with a single one which could have been more easily dealt with by abdominal section. On the other hand, he had

* London Medical and Physical Journal, London, 1827.—See this work, p. 172, for report of case.
encountered many where an abdominal incision would have been both harmful and useless. He was surprised to hear that Mr. Tait expected to be able to draw the contents of strangulated hernia back into the abdomen without division of their constricting structures, particularly the tendinous pillars of the abdominal rings; and he knew of two cases where unsuccessful attempts had been made to operate in this way, and where ordinary herniotomy had subsequently to be performed. In a few cases the combination of abdominal incision and herniotomy might be advantageous, but he thought that even in these herniotomy should always be the primary procedure, and not abdominal section, because the former was undoubtedly the less dangerous, and had the great advantage of allowing the surgeon to learn with promptitude and exactness the nature and condition of the parts with which he had to deal. . . .

"In dealing with strangulated hernia, Mr. Tait's suggestion bristled with dangers, two of which only need be mentioned: first, that of tearing the softened bowel walls by traction of the gut; and, secondly, the admission into the general peritoneal cavity of the highly irritating and almost constantly present fluid contents of the sac."

Mr. J. Greig Smith, of Bristol, stated "that he would gladly welcome any method which would render unnecessary the division of the tendinous structures about the hernial opening. More than once he had known abdominal section performed for hernia from a mistaken diagnosis. Very recently he had operated for obturator hernia by abdominal section, and his experience in another case operated upon in this way two years previously had led him to decide that abdominal section was the best method of dealing with this rare form of hernia. But, so far as he could see, this was the only variety of external hernia in which it could be systematically adopted."

Mr. Bennett May, of Birmingham, stated that "he was present at an operation where median abdominal section revealed a strangulated hernia as the cause of an acute obstruction of two days' duration. The herniated structures could not be withdrawn even after division of the stricture from within, which was accomplished with difficulty. The ordinary operation had to be done, adhesions separated, and omentum removed. Any decisive attempt at withdrawal would have pulled away the inflamed gut. The fact was, the present operation was intrinsically almost free from danger, and left little to be desired."

Mr. H. W. Maunsell, of New Zealand, to whose experience Mr. Tait had made reference, reported "that he first performed suprapubic laparotomy for the relief and cure of a strangulated femoral hernia early in 1887. He believed that in many instances great
advantages accrued from this method of dealing with hernia. He thought his own operation had certain distinct advantages over that as described by Mr. Tait. It consists, in femoral hernia, in the introduction of a long and strong curved needle, on a handle with the eye near its point, from without inward through the skin, over the saphenous opening in the upper part of the thigh, piercing the fascia covering the pectineus muscle, and the lower or posterior border of Gimbernat's ligament at its attachment to the pectineal line and near its base or outer free margin, the bowels being protected by keeping the finger on the point of the needle. The needle should then be carried through the external abdominal wound, threaded with stout silver wire, and withdrawn. It is introduced in a similar manner upon the opposite side of the femoral ring, threaded with the other end of the same wire, and withdrawn. It only remains to twist it sufficiently tight to compress the parts, and the operation is completed. The moment the wire was cut the twisted ends retracted out of sight, deep in the tissues of the groin below Poupart's ligament, and completely occluded the entrance to the crural canal. In performing this operation one should not be satisfied unless the loop of wire lay directly across the center of the entrance to the femoral canal. In conclusion, Mr. Maunsell stated that “he advocated abdominal section in strangulated femoral, obturator, umbilical, and diaphragmatic hernia. All other cases (unless associated with abdominal tumors requiring removal) were best treated by direct incision on the sac and seat of strangulation in the usual way.”

Mr. Ernest Kingcote,* of Salisbury, advocates the utilization of the hernial sac as an internal pad in the radical cure of hernia. The especial feature of his operation is in the incision, which is transverse, and well above the internal ring. The advantage of this is the carrying of the wound quite above the groin, for the better protection in dressing. The subsequent steps of the operation are conducted quite in the usual way, the sac being freed about half an inch around the abdominal aspect of the internal ring, and two stout absorbable catgut sutures are inserted diagonally through the stump as far inward as the separation from the abdominal wall will allow, and carried loosely through the pillars of the ring. One or more fine absorbable catgut stitches obliterate the opening into the abdominal cavity. The stump is then pushed a little inward, and three or more very stout catgut sutures are introduced through the transversalis fascia, etc., and the ring closed. The stout diagonal sutures through the stump are now tied

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* British Medical Journal, June 28, 1890.
firmed over the tightly closed-up ring, and the operation is completed in the usual way.

Under date of January 4, 1892, Mr. Frank Marsh, of Birmingham, wrote me: “I always advise the operation for the radical cure of hernia, unless constitutional conditions contra-indicate surgical interference. I prefer not to operate on children until they are over twelve months old. Excluding cases of strangulated hernia, I have never had a death, nor do I know of one occurring in the experience of my surgical colleagues at the Queen’s Hospital. In the congenital hernia of children, I find it sufficient to expose and isolate the neck of the sac with the least possible disturbance of the scrotal tissues, ligating it as high up as possible, cutting through below the ligature, and suturing the pillars of the ring in the ordinary way. In adults, and especially if the hernia is an acquired one, Macewen’s method has so far given me the best and surest results, proving effectual in cases of recurrence after the above method. If the sac is very large, I excise a part, so as not to have too large a pad. During the healing process I consider this pad becomes slowly adherent to the abdominal surface round the internal ring, and that it materially strengthens the parts.

“In femoral hernia I suture the upper margin of the crural arch to the fascia over the pectineus muscle, and then carefully approximate the margins of the saphenous opening with sutures. If omentum is adherent to the sac, I am careful to free it from all attachments, and return or excise it. In a post-mortem after operation for a strangulated hernia, where the omentum was used to block up the opening, the transverse colon was dragged down and held within an inch of the pubes. I have used catgut prepared after Sir Joseph Lister’s method, and also kangaroo-tendon; I think I have had the best results with the tendon. I never advise the wearing of a truss after operation. Very recently I employed your method with the buried tendon sutures in an operation for hernia in a youth of sixteen, sealing the wound with iodoform collodion; a pad of wool and spica bandage were applied over this, but on the third day were omitted as unnecessary. The simplicity of your method, and the excellent result obtained, have so favorably impressed me that I intend to employ it in this and other suitable operations. When better known I believe it will be often used. It is certainly an important advance over the older methods.”
CHAPTER XXV.

OPERATIVE MEASURES INSTITUTED FOR THE CURE OF HERNIA UNDER MODERN METHODS OF WOUND-TREATMENT (ANTISEPTIC AND ASEPTIC CONDITIONS) IN AMERICA.

It is generally conceded that surgery was both taught and practiced in America, prior to the late war between the States, with a success quite equal to that in Europe. The art of surgery, however, was practiced in the great centers of civilization with comparatively few—and these unimportant—changes as it had been taught by the great masters of the previous generations. The active discussions upon wound irritation, inflammation, suppuration, and dressings, had settled into a very general consensus of opinion, resulting in large measure in routine methods of treatment.

To the many young American surgeons, engaged for four years in the constant care of an immense number of gunshot-wounds, the question of wound-treatment assumed an entirely new aspect, and military surgery was advanced to a degree of perfection hitherto unknown. The reports from the Surgeon-General's office made by one of my early teachers, Dr. George A. Otis, Surgeon U. S. A., will remain an enduring monument of the genius, skill, and learning of the medical profession of this generation. The influence of these lessons and experiences, necessarily diffused through the entire country, crystallized into convictions more or less uniform, until it was generally believed that little more of vital importance was to be garnered by the profession which could be of value in the treatment of wounds.

It was probably owing to this wide-spread conviction that the so-called Listerian doctrine, in the early days of its promulgation, found so few advocates in America. A large number of our more ambitious young men became post-graduate students in Germany as the Mecca of scientific medical teaching, and, with comparatively few exceptions it was not until after the leading surgeons of Germany had adopted the principles of antiseptic surgery that they received serious consideration in America. For this reason slow progress was made in the complete revolution demanded by this system of treatment of wounds, and, as a consequent, the favorable consideration of antiseptic operative measures for the cure of hernia found few advocates in our country.
In a former chapter I have called attention to a number of original devices for the cure of hernia advanced by American surgeons, notably the injection method, originated by Dr. Pancoast, of Philadelphia, Dr. Heaton, and later elaborated by Dr. Joseph H. Warren, of Boston. Dr. Gross, of Philadelphia, as early as 1858 operated for the cure of hernia in two cases, by dissection of the parts and closure with silver-wire sutures. Both cases resulted in permanent cure.

In 1870 it was my good fortune to become the pupil of Prof. Lister, in Edinburgh, and I returned to America thoroughly convinced that the great principles enunciated by him were truly scientific, and that the extraordinary results which he obtained in surgery were based upon their accurate and painstaking application. Upon the resumption of my surgical practice I inaugurated his methods with scrupulous fidelity of detail, which I taught in a wide range of clinical demonstrations. The opportunity soon came of making a definite application of these principles to the cure of hernia.

On the 19th of February, 1871, in consultation with Dr. A. P. Clarke, of Cambridge, I operated upon a patient, Mrs. M——, aged fifty, who had suffered for years from hernia. Five days previous she was seized with severe pain in the inguinal region, accompanied by vomiting. Long-continued and careful taxis had failed to reduce the hernia, and for twenty-four hours the vomiting had been stercoraceous, and the patient seemed in extremis. The hernial tumor was the size of an egg, protruding from the external inguinal ring. A careful dissection exposed the sac, which was closely adherent to the surrounding parts. The constriction was at the internal ring, and was divided with some difficulty. The hernial contents were reduced, and the sac, unopened, was returned within the ring. Two stitches of medium-sized catgut were taken directly through the deeper structures about the ring. The wound was dressed antiseptically, and from Dr. Clarke's notes, taken at the time, I find that the patient steadily progressed without pain or accident, and was convalescent in three weeks. The result was a radical cure of the hernia, although the canal was not closed for this purpose. The opening into the abdomen was so large that we feared the escape of the contents, especially as the patient was afflicted with a severe chronic bronchitis. I only expected the sutures to hold the parts in situ temporarily. Mrs. M—— died six years after the operation, and was troubled with the cough during the entire period, but the canal remained firmly closed at death. She did not wear a truss after the operation.

On March 10, 1871, assisted by Dr. W. W. Wellington, of Cambridge, I operated upon Mrs. L——, aged forty-five, suffering with strangulated hernia. The hernia was
of some years' standing, usually retained by a truss. It was on the left side, and direct inguinal in variety. The sac was returned unopened; the canal was closed by three large-sized catgut sutures, taken deeply through the pillars of the ring, and the wound carefully dressed antiseptically with Lister's carbolized lac-plaster. When examined the following June, the cicatrix was linear, and a firm deposit of new tissue could be felt, marking the site of the buried sutures.

I reported these cases at the meeting of the County Medical Society, October 11, 1871, and published* a paper discussing the subject, November 16, 1871, under the title, A New Use of Carbolized Catgut Sutures. In closing, I remarked: "As far as my observation has extended, this is a new use of the carbolized catgut ligature, and suggests a still wider field of application. No method of operation for the radical cure of hernia appears more feasible, is probably attended with less danger, and at the same time affords a means of closing and strengthening the weakened ring, which is so desirable, and yet, with all the ingenious devices of surgery, is so difficult to obtain."

Although I continued to operate from time to time, as occasion demanded, upon cases of strangulated hernia, and in every case closed the ring with buried animal sutures, it was not until February 4, 1878, that I deliberately attempted the radical cure of a reducible hernia. This patient I had some time previously (December 2, 1877) cured of a large, old, irreducible omental hernia of the right side, which had become complicated by the descent of a strangulated loop of intestine. In this instance I dissected the sac and resected the omentum. I closed the neck of the sac with catgut sutures, excised the sac, and carefully closed the ring and structures of the abdominal wall. A truss retained imperfectly a large direct inguinal hernia of the left side, for which Mrs. W—— besought cure, although seventy years of age. In the operation I was assisted by Dr. A. L. Norris, of Cambridge, who cheerfully gave his approval. In this I was the more fortunate, since until that time my advocacy of operative measures for the cure of hernia in non-strangulated cases had been considered unjustifiable.

The operation was not difficult, and the result was most satisfactory. On the 17th of April following, Mrs. W—— died of an aneurismal tumor of the brain. The autopsy furnished me two excellent specimens of different dates, showing not only the histologi-

* Boston Medical and Surgical Journal, vol. viii, p. 316.
cal changes which ensued about the suturing, but also the condition of the underlying peritoneum. In the first operation, where the sac had been sutured and resected before closure of the ring, the peritoneum was perfectly smooth, and without depression at the former site of the ring. Upon the opposite side, where the sac had been returned unopened, there remained a little pouch depression of peritoneum, which taught the ease of reformation of the hernia. These specimens I presented at the annual meeting of the American Medical Association in June, and communicated * at considerable length my views of the operation for the cure of hernia by the buried animal suture. I gave, in this paper, the history of the animal suture and its preparation for surgical uses, since few surgeons at that date, even in England, used catgut for the ligation of vessels, and the use of the buried animal suture was advocated by none. In a further communication upon the cure of hernia, read at the International Medical Congress held in London in 1881, I emphasized the freeing of the sac and its resection, after sewing it across at its base with a continuous animal suture, and then refreshing the pillars of the ring, and closing by deep buried double continuous sutures of kangaroo tendon, which are much to be preferred to catgut. I summarized the advantages of this method of operation as follows: †

"I. We are enabled to see clearly each and every step of the operation; blind surgery is bad surgery, as a rule.

"II. It is the only method with which I am acquainted by which the hypertrophied elongated peritoneal pouch, which has been a primal factor of failure hitherto, can be removed.

"III. Hereby we actually re-enforce as well as occlude the ring. In the weakened, attenuated condition of the parts, in all old cases, there is no small gain in securing this effect.

"IV. Experience has, I think, now demonstrated that this operation may be catalogued among those safely advised, and that femoral and umbilical hernia are no exceptions. I would not exclude children from the class to be benefited, for in them the vital processes are at the best, and when thus cured they are saved from a life-long disability."


† Transactions of the International Medical Congress, vol. ii, p. 446.
In May, 1886, at the annual meeting of the American Medical Association, I contributed a paper* entitled The Radical Cure of Hernia, based upon a series of over thirty consecutive operations, in which I showed that surgical procedures, in my experience, had been devoid of danger. In conclusion, I recommended the dissection of the sac to its base, its suture, and excision, the restoration of the obliquity of the canal, and closure of the parts with the buried tendon suture—

1. In all cases of operation for strangulation.

2. In all cases where the abdominal contents are imperfectly retained by a truss, unless the age and condition of the patient prevent.

3. In the large class of children, when the conditions do not promise a spontaneous cure.

Soon after the publication of my early experience in the use of catgut as a buried suture for the cure of hernia, it was attempted by a number of operators. Dr. David W. Cheever, of Boston, wrote me in May, 1878, as follows: "I have tried catgut for the radical cure of hernia, but it was speedily absorbed, and failed." Dr. J. C. Warren wrote me about the same date: "I should fear catgut would not hold long enough to keep the parts in apposition, until union became firm. We have given up its use in the Massachusetts General Hospital for this reason. The sutures do not hold longer than four days." The method of preparation of the catgut was not given. Somewhat later, Dr. Charles B. Porter, of Boston, reported two cases of hernia operated on, catgut being used for the closure of the parts, which were followed by cure.

In August, 1886, Dr. John B. Hamilton,† Surgeon-General United States Marine Hospital Service, read before the Chicago Medical Society a very valuable lecture upon the cure of hernia. In the discussion of the advantages of the modern operation of dissecting out the sac and its removal, and closure of the parts under antiseptic precautions, with a resultant permanent cure, to which he gave his unqualified approval, he stated: "Dr. Henry O. Marcy, of Boston, reported, October 11, 1871, cases treated by this method. Prof. Annandale and Sir William MacCormac give the priority to Dr. Charles Steele, of Bristol, but Mr. Steele's first case was reported in the British Medical Journal, November 7, 1874, nearly two years after those of the Boston surgeon. Marcy and Isidore Israelsohn are undoubtedly the pioneers in this application of antiseptic

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* Journal of the American Medical Association, May 28, 1887.
† Ibid., September 4, 1886.
surgery." After a careful review of the dissection method as performed with antiseptic precautions, he closed as follows: "As no logical reason can be given for a failure to accept the view that there has been an advance, I perhaps need not say that 'I favor, in all cases affording even a reasonable prospect of cure, an operation therefor, and that all cases whatsoever of bubonocele should be operated upon.'"

Dr. T. J. McGillicuddy * reported, in 1887, a case of radical cure of a strangulated oblique inguinal hernia, with ligature, removal of the sac, and recovery. He closed his paper with a plea for the removal of the sac and closing with deep, firm sutures.

In an interesting paper by Dr. Thomas H. Burchard,† of New York, upon the modern treatment of strangulated hernia, the subject of operative measures was carefully reviewed. As is well known, he is an advocate for early operation; he prefers dissection of the sac, suture of the base, and return of the stump, then a careful coaptation of the rings and canal by deep sutures of catgut. He reported one case operated upon by Macewen's method: "This is the only case in which suppuration of any material consequence occurred. Had I ever seen the operation performed, or had I previous experience with it, I might have secured a better result. As it is, the cicatrix is very painful, and a hardened mass at the site of the internal ring will scarcely tolerate the slightest pressure. I have operated in nine cases of strangulated hernia in which I have been enabled to carry out the operation in all its details. Eight recovered; one developed delirium tremens, and died the fourth day."

Dr. Dudley P. Allen,‡ of Cleveland, contributed an interesting article upon the radical cure of hernia, in which he advocated the dissection method under strict antiseptics. He advises extirpation of the sac after suturing at the base with catgut, and uniting the pillars of the ring with interrupted silk sutures, one end left long; a drainage-tube is inserted to just outside the united pillars, and superficial interrupted stitches close the wound. An aseptic state is maintained for a week, when suppuration is allowed, and the silk sutures through the ring are removed as they become loose. In this way he thinks the plastic repair is more firm and resisting than in primary union. Reported one case operated upon at two years of age. His first operation was done in 1885.

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† Ibid., January 21, 1888, pp. 6-15.
‡ Medical Record, New York, August 11, 1888, pp. 141-143.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

At a meeting of the Suffolk District Medical Society, held November 7, 1888, Dr. R. Whitman,* of Boston, reported a case of cure of inguinal hernia by Macewen's method. A long discussion followed, in which a considerable number of surgeons who had operated for the cure of hernia took part, and the general consensus of opinion was in favor of the radical disposition of the sac and closure of the canal with animal sutures.

Dr. H. L. Burrell,+ of Boston, reported eight cases of radical operation for the cure of hernia. In the manipulation of the sac he had found it advantageous to distend it with a ball of iodoform gauze. He closed the canal with two or three interrupted stitches, silk or catgut, and did not use drainage. Closure of the wound was effected by a continuous catgut suture. Dr. Burrell made emphasis upon aseptic conditions, and especially in the case of the superimposed dressings; "six gauze pads, six by eight inches, held in place by careful bandaging, then a piece of mackintosh, with hole to admit the penis, and over this sterilized sheet wadding; a cravat gauze bandage six inches wide, long enough to form a double spica bandage, holds this in place; over this is another piece of mackintosh, through which the penis protrudes, held in place by safety-pins." In the same journal, Dr. Hayward W. Cushing reported a case of femoral hernia in a boy of twelve years, where he operated by adapting the Macewen method to the conditions found. After freeing the sac, which in this instance was attended with difficulty, he replaced and retained it within the ring, as advised by Mr. Macewen. Dr. Cushing then closed the femoral ring by suturing Poupart's ligament with a "quilted suture" to the pubic portion of the fascia lata and the fascia covering the pectineus muscle, the femoral vein protected by a retractor. The margins of the saphenous opening were then closed by overlapping, after Macewen's method in inguinal hernia. The result was excellent. Under date of September 7, 1891, Dr. Cushing wrote me: "The patient was last seen in 1889, almost fifteen months after the operation, and at that time was well. I have operated on only one other irreducible femoral hernia since, and the result was equally satisfactory. The incision above Poupart's ligament I have found of great value while freeing the sac."

Dr. Arthur Cabot, of Boston, referred to three cases of femoral hernia, in two of

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* Boston Medical and Surgical Journal, December 6, 1888.
+ Ibid., December 6, 1888, pp. 551-556.
which he had operated very much as Dr. Cushing. The first of these was a large hernia, double-fist size. "The sac was a thick one, and formed quite a large mass. Having threaded it in in the way described as ‘through and through,’ and stitched it well up inside of the ring, I pulled on the thread and pushed the sac up. I then brought the ring together firmly outside. The patient had a good recovery, and a large, hard mass filled the whole of that portion of the pelvis where the hernia formerly existed." Dr. David W. Cheever gave at some length his own experience, in which he stated that "the modern method of open dissection gave much better and safer results than were obtained earlier." Referring to the difficulties of cure of inguinal hernia in the male, where a passage for the cord from the abdomen must be kept open, he quoted a statement of the late Dr. John B. S. Jackson, Boston’s most distinguished pathologist: "Doctor, you will never get a cure until you can obliterate the serous canal." "The wonderful safety of present processes of antisepticism in operating on these structures I can not speak too highly of, because I saw so much trouble in the old methods by the throwing out of sutures, suppuration, etc."

Dr. A. P. Clarke, of Cambridge, referred to Dr. Marcy's experience, and favored his method of operation. He stated: "I was present and assisted Dr. Marcy in his first operation, which was in 1871. The patient was one of mine, a female, subject to asthma, and everything was unpromising. A spray of carbolic acid was used, and the canal was completely obliterated by the use of the catgut suture. The patient lived six years, with no return of the rupture, dying of pneumonia."

Dr. Samuel N. Nelson, of Boston, reported: "I was operated upon by Dr. Marcy for double inguinal, the right a large scrotal hernia, and after my operation, two years ago, I tried faithfully to wear a truss, and found it impossible to bear it; and I fail to see the necessity of it, or any other support. After the buried suture has closed the ring and united the other layers firmly, the effectiveness of the very simple dressing, which Dr. Marcy has mentioned, I think ought to be emphasized. When the edges of the wound have been coapted by the blind stitch, the collodion dressing in itself is sufficient."

Dr. Robert Weir,* of New York, treated at some length the subject of the disposition of the sac after operation. He emphasized the great advance made in modern surgery in the treatment of strangulated hernia, contrasted the various methods of dis-

posal of the sac, and thought, in some cases, the Macewen method advisable. This he had performed eight times. The preference will be between this method and ligation with excision of the sac. He uses heavy catgut for sutures. Dr. Weir accepts the radical operation as a marked improvement in the treatment of hernia, whether free or strangulated, although he does not consider the operation perfected.

Dr. Charles McBurney,* of New York, in a contribution upon the radical cure of hernia by the open-wound method, reported in 1888 twenty-seven cases of non-strangulated hernia operated upon by various methods since 1882. One patient died from shock a few hours after operation, but he was a hard drinker. All the other cases made easy recoveries. He considered haemorrhage and sepsis the chief dangers, both preventable. Under the most careful antisepsis, he opens the entire canal up to the internal ring, loosens up and ligates the sac as high on its neck as possible; this being done, he closes the upper and lower angles of the integumental wound, and then packs the entire canal with gauze and iodoform, allowing it to heal by granulation. He gave his reasons as follows: "The method of closing the sac by ligature is clearly better than the other plan of cutting it off and closing the communication with the peritoneal cavity by sutures. It is more rapid, it is more even, and the great danger is absolutely avoided of having the intestines suddenly forced out through the wound by an unexpected effort at coughing or vomiting. Two methods of shutting off the sac remain to be referred to, that of torsion and of Macewen... That this method obliterates the sac, is evident from the brilliant results obtained by Mr. Macewen in a large number of cases; but I question its superiority in ordinary cases over the carefully applied ligature, and in larger hernia it makes no provision at all against the great laxity of peritoneum which exists in all such cases around the internal orifice of the canal." Dr. McBurney entered into an argument of some length to show why he considered suturing of the canal a useless undertaking, based upon the conditions and relations of the tendinous structures which make up the canal. Because of this he has abandoned closure, and treats the wound by the open method in a manner peculiar to himself. "Six or eight interrupted stitches, on the upper side of the wound, bind into one thick edge the skin, the external abdominal aponeurosis, including the inner pillars of the ring, the transversalis and internal oblique muscles, and conjoined tendon. As many more stitches, on the lower side of the wound, bind together the skin and Poupart's ligament, including

below the outer pillar of the ring. This insures an open canal, which must slowly fill by granulation. Iodoform gauze is packed into the wound, and completes the dressing."

Dr. McBurney thinks he obtains double advantage—an antiseptic wound without drainage, and a firm closure of the walls of the canal by strong cicatricial tissue. On March 2, 1889, he reported thirty-six cases operated upon, with only one death, and that attributable to alcoholism. In three cases there was suppuration of the wound, and in one there was a return, which he attributed to insufficient ligation of the sac. He had been able to follow up the history of thirty-one of the cases, and the result was perfect.

The late Dr. John H. Mackie, of New Bedford, wrote me in 1889: “I have operated nearly two hundred times in strangulated hernia, with a mortality of only ten or twelve. One case, I think, is a little remarkable. I operated on a man aged eighty-three, right inguinal hernia, strangulated—recovery perfect; but one year later I operated on the same man for left strangulated hernia, and he made a good recovery, living several years. In one case of strangulated femoral hernia, in an elderly woman, the right ovary was found in the hernial sac.” Dr. Mackie opened the sac, closed the wound with deep catgut sutures, and used antiseptic dressings.

Dr. A. Vanderveer,* of Albany, reported two cases of strangulated femoral hernia operated on under antiseptic precautions, where he dissected the sac, ligated at the neck, and excised it. Wound closed with catgut sutures, horse-hair drain, careful dressing with bichloride gauze. Second dressing fourth day, drainage removed, and primary union.

Dr. D. G. Wilcox,† of Buffalo, reported a case of irreducible femoral hernia operated upon under aseptic precautions. "Epigastric artery was cut and tied. Sac dissected, pulled down, transfixed, and wound closed. Union primary, and recovery rapid. At three months seems cured. Wears a truss as a precautionary measure."

Dr. Lewis S. Pilcher, of Brooklyn, in 1889 reported to me two cases of strangulated hernia where he operated with complete cure on patients eighty-three years of age. The first, a male, in whom inguinal hernia had existed many years; the double sac was dissected, tied high up, and cut off. The wound was filled with iodoform gauze

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* Albany Medical Annals, October, 1888.
† North American Journal of Homoeopathy, October, 1888.
and allowed to granulate; recovery slow. The second, a female; old femoral hernia; the adherent omentum was ligatured and resected; also the sac, the stump of which was pushed within the internal ring, and "the tissues of the canal closely sewed over and over with catgut superficial sutures. Healing by first intention throughout whole extent of wound, with quite an appreciable plastic exudate in site of canal."

Dr. C. H. Mastin, of Mobile, read a most interesting and valuable paper upon the comparison of the various methods adopted for the cure of hernia, before the American Surgical Association, May, 1889. He closed the article as follows: "From a comparison of all the methods, it is apparent that no fixed rule of proceeding is established; and although the radical operation is a marked improvement in the treatment of hernia, whether free or strangulated, we can not consider it perfected, because the methods hitherto resorted to have not proved radical in results. The operation is ideally correct, but the question arises whether, with the uncertainty of success, the risk justifies the operation; especially is this so if the circumstances of the individual are such that he can content himself with the use of a properly adjusted truss. I have operated on thirty-four cases of hernia, with three deaths—all strangulated cases. I should exclude two of those deaths, because the patients were in extremis when the operations were done."

In the discussion which followed, Dr. D. H. Agnew, of Philadelphia, expressed a preference for Mr. Barker's method of operating, by which the sac is sutured into the internal ring, and gave his experience of plugging the internal ring with omentum, retained by suturing, recognizing the importance of narrowing this portion of the canal before closing the pillars of the ring. "I think, first, that in all cases of strangulated hernia we are justified in attempting the radical cure; and, second, in those rebellious hernia which can not be controlled by a truss, and which place the lives of the patients in great risk."

Dr. W. W. Dawson, of Cincinnati, concurred with Dr. Agnew, holding conservative views, however, upon the question of operation. "When it is merely a question of aesthetics, or of abridging usefulness, the operation should be approached cautiously." Dr. Dawson would not advise the radical operation for children, since a spontaneous cure may be expected.

Dr. L. M. Tiffany, of Baltimore, stated that "his results were far more satisfactory than formerly; that he believed no operation for strangulated hernia was complete without the attempt at radical cure." In non-strangulated cases the question at once
arises, in determining operation, on the amount of hernia, the inconvenience produced, and the circumstances of the individual. Where the life-work is interfered with, or the mode of life necessarily changed because of the rupture, he advised operation in the belief that, in the large majority of cases, it was not followed with much suffering or danger. He considered it often the duty of the surgeon to operate also in hernia of children.

Dr. D. W. Yandell, of Louisville, thought we were just on the threshold of experience in regard to the methods of operation, and that ten years hence we might arrive at some definite conclusions. He saw Mr. Macewen operate, and so fell into his way of doing the operation. "I think that all here will agree that they would not operate when they can help it, and operate when they are obliged to do so."

Dr. W. W. Keen, of Philadelphia, thought that the profession were surely tending toward enlarging the bounds of the operation for the cure of hernia, greatly increasing the number of cases operated upon. "If the hernia is very large, I should not be disposed to use Macewen's method. Some two years ago I reported a case in which I used that method in a large labial hernia, operated upon at the Woman's Hospital at Philadelphia. The sac was very large, and I think I was indiscreet in using this method. The life of the sac is imperiled by separating it, and if it is large it is almost certain that a portion of it will slough. Macewen's operation should be limited to hernia of moderate dimensions."

Dr. J. R. Weist, of Richmond, Ind., reported forty-one cases operated upon for strangulation, in about thirty of which he had attempted the radical cure under various methods, but in many of the cases there had been a recurrence.

Dr. Mastin, in closing the discussion, stated that "at this date the operation that is best calculated to offer general satisfaction remains a mooted question, and, until more accurate experience decides it, the selection of the special operation must remain sub judice."

At the annual meeting of the New York State Medical Association, held in 1889, the discussion upon the cure of hernia was given prominence, and elicited much interest. Dr. Joseph D. Bryant, of New York, introduced the subject by a long and carefully written paper of great value. He treated with judicial fairness the various operative measures that have been advanced for the radical cure of hernia. He accepted the

method advised by Mr. Macewen as a representative one, demanding dissection and suturing. He discussed at some length the disposition of the sac, which is the chief factorage in the Macewen method, and questioned its advisability. "I am not aware that the occurrence of "bossing" has been actually demonstrated, but I am reliably informed that the reverse of the proposition has been noticed under circumstances calculated to demonstrate it." He recommended a disposition of the sac peculiarly his own, which is at least ingenious, and which I am persuaded to believe may in certain conditions be made available. He draws down the sac after its separation from its surrounding parts, and ligatures it at the base; then, making two parallel slits on either side of the ring, he interweaves it back and forth through the tendinous divisions, and confines the sac thus disposed of as a vivified, re-enforced retention band of living tissue, by quilting all the parts together with deep stitches of catgut, leaving room in the lower angle of the wound for the passage of the cord. He cautions against the use of the sac in this way if by any reason its vitality has been endangered, and, in a foot-note, reports a case where a sac thus disposed of sloughed, because of too tightly ligaturing at its base. In order to avoid this, he advises to pass the ligature double and tie in halves on either side. The utilizing of the sac that it may become, so to speak, a vitalized suture, holding together and re-enforcing the pillars of the ring, seems to be an ideal disposition of it. It is, however, open to grave objections, the first of which is that which had already happened in Dr. Bryant's case—its devitalization. By reference to the chapter devoted to the formation of the hernial sac, it will be seen that in an old, large hernia this structure is dependent for its nutrition upon the sources of blood-supply formed by abundant and oftentimes very vascular adhesions, extending quite into the scrotum. Not seldom does it happen that the constriction at the neck of the sac, at the internal ring, has so changed the structures that it is reduced to an imperfectly vascularized, non-elastic band of connective-tissue fibers, compressed together in adherent, plicated folds, as is a bag by the constriction of tying. This disposition of the parts alone reduces its nutrition to such a degree that the hernial sac is dependent upon its acquired blood-supply for its vitalization.

The following plate, from Sir Astley Cooper, is selected as a beautiful illustration of the changes which supervene in the peritoneal sac in femoral hernia. These pertain in a greater degree to inguinal hernia, where the sac and contents often assume very much larger proportions.

In Figure 1 the hernial sac is small, non-adherent, and well vitalized. It could
be returned, doubtless, without damage to its vitality, and, when aseptically sutured at the mouth of the ring, would speedily agglutinate and retain its nutrition.

In Figure 2, on the contrary, the peritoneal sac is externally firmly adherent to the superficial fascia; while within, the omental contents are closely fixed to its inner layer. The constriction at the base had almost altogether cut off its blood-supply through the plicated folds at the ring. To attempt to utilize the material in a case like this, which the deformed sac furnishes, folded upon itself and pushed within the ring, would very likely be followed by the most disastrous consequences.

Figure 4 is worthy of especial study, but not in connection with the present subject, since it illustrates the anatomical deviation of the obturator artery passing before and on the inner side of the neck of the sac. This not very rare anatomical disposition should be kept in mind by the surgeon, since when in this position its division would not infrequently happen in operation.

PLATE LVIII *

Contains some varieties of crural hernia, viz.: A hernial sac, situated within the sheath of the crural vessels, which it had not protruded; a large hernia, having the remains of the umbilical artery placed on the outer part of the mouth of the sac; a hernial sac, which had been contained in part in the sheath and in part in the common situation; and, lastly, the preparation, with which I was kindly favored, for the purpose of having an engraving made of it, by the late Dr. Barclay, teacher of anatomy in Edinburgh, showing the obturator artery passing before the mouth of the hernial sac.

Figure 1.

Hernia within the crural sheath.

a. Symphysis pubis.
b. Spine of the ileum.
c. External oblique muscle raised.
d. Internal oblique muscle.
e. Transversalis.
f. Crural arch.
g. Fascia transversalis passing from the crural arch under the transversalis muscle.
h. Upper abdominal opening.
i. Lower abdominal opening.
j. Spermatic cord passing through both of these openings.
k. Femoral artery.
m. Femoral vein.
n. Saphena major vein.
o, o. Epigastric artery.
p. Crural sheath opened and turned back.
g. Hernial sac within the sheath.

Figure 2.

Large hernia, descending more inward than usual, so as to have the umbilical artery on its outer side.
a. Pubes.
b. Spine of the ileum.
c. Internal oblique muscle raised.
d. Transversalis muscle raised.
e, e. Linea semilunaris.
f. Rectus muscle.
g. Abdominal ring.
h. Fascia transversalis.
i. Inner part of the same fascia, with the tendon of the transversalis upon it.
k, k. Fascia lata.

* Cooper, Plate VIII, Part II.
Round ligament passing from the abdomen on the fore part of the mouth of the hernial sac.

Epigastric artery.

Remains of umbilical artery.

Mouth of the hernial sac, which had the bladder, much dilated, resting upon it.

Superficial fascia and that of the hernia consolidated into one.

Hernial sac.

Omentum adhering within the sac.

A hernial sac—part within the sheath, and part in the usual situation.

Peritoneum.

Hernial sac within the crural sheath.

Hernial sac which had protruded the sheath in the usual manner.

Portion of the hernial sac which crossed the crural artery and vein within the sheath.

Dr. Barclay's preparation.

One of the lumbar vertebrae.

Spinous processes of the ilia.

Abdominal muscles raised.

Aorta.

Bifurcation of the aorta.

External iliac artery.

Iliac artery of the left side.

Femoral arteries.

Arteria profunda.

Epigastric artery on the left side, the rectus muscle being drawn down to show it.

Inferior cava.

External iliac vein.

Femoral veins.

Peritoneum descending to form the hernial sac.

The hernia.

Common trunk of the epigastric and obturator arteries.

Obturator artery passing before and on the inner side of the neck of the sac, in its course to the obturator foramen, and situated a little above the posterior edge of the external oblique muscle.

Epigastric artery.

An engraving of this preparation has been published in an ingenious Thesis on Crural Hernia, by Dr. James Sanders, of Edinburgh, 1805.

When the favorable condition of a hernial sac well nourished at its base exists, it may be wise to consider the value of its utilization by the novel way proposed. Should this be determined upon, it is better loosely to sew across it at its base, in order to minimize its devitalization; or, rather, I am in the belief that it would be advantageous to split the sac longitudinally into two or more parts, since by thus doing we at least double the amount of suture material, and, introduced in opposite directions, we can make a more advantageous disposition of the material used, and secure it safely without suturing it at its base, which in a measure must devitalize it. That it may retain its vitality, and thereby serve as a re-enforcement of the parts as a deeply implanted graft, I have no question; and it is certainly a step in the right direction to use every possible measure at our disposal, oftentimes for the re-enforcement of the weakened tissues. It must, however, be very exceptional that the occasion will warrant its utilization. In my experience of about two years, since I first knew of Dr. Bryant's method, I have not met with a single case in which I considered it applicable. At the best, it re-enforces only the external pillars of the ring, and can affect little the elongation of the canal, or strengthen its deeper structures.
Dr. Bryant emphasized the dangers resulting from the improper use of taxis, advised the rigid enforcement of antiseptic principles, and, all things being equal, believed that the radical cure should be practiced as an addendum to herniotomy. He discussed very clearly the question of operative treatment if the incarcerated intestine is necrosed, and advised: “When the condition of the patient permits, intestinal repair should be attempted at once, and the gut returned within the abdominal cavity.” When the constriction has occurred in the upper two thirds of the intestine, this rule is to be emphasized, even if the immediate result of the operation be somewhat doubtful. When the conditions do not warrant this, or when the surgeon is not familiar with the details of intestinal surgery, a temporary artificial anus must be made.

Dr. William T. Bull, of New York,* reviewed the present status of hernial operations, and added thereto the details of his own very considerable experience, including the report of 72 operative cases of hernia, with 69 recoveries; the 3 deaths were accidental, and in no way chargeable to the operation. From the 40 cases whose subsequent history he was enabled to trace, 20 were operated upon by ligature of the sac, its excision, and suturing the pillars of the ring. Of these, 12 were cured and 8 were failures. Exactly the same number of cases were operated upon by the simpler method, ligature, and excision without suturing, and, curiously, with the same result in all, forty per cent of failure. The remaining sixty per cent may, as a class, be considered improved. Primary union occurred in 32 cases, and suppuration in 37 cases. He thinks the suture is not applicable in femoral hernia. He concluded by advising further trial of the Macewen method. He objected to the so-called open method, as advocated by Dr. McBurney, as possessing a radical defect, and one that, notwithstanding its able advocacy, should not be attempted until operations based on sounder principles of surgery have been thoroughly tried. “It certainly is a perversion of our knowledge of the phenomena of reparative processes to assume that the granulative cicatrix is stronger than that of primary union. There is no other region of the body, or any other operative wound, where surgeons of experience would act in accordance with this idea. Who would think seriously of trying to make the umbilicus stronger by cutting out a disk of all the tissues exterior to the peritonæum, and then trying to get a ‘strong’ cicatrix, by the methods proposed? It would surely invite the occurrence of hernia.”

Dr. Roswell Park, of Buffalo, stated that “he had been surprised to read, in a

* Transactions of the New York Medical Association, 1889.
recent monograph, that the radical cure of hernia was regarded as a rare achievement. He believed firmly in making the attempt to cure every case of hernia radically, because the cure is radical in a large percentage of the cases, and because, even if success be not complete, the patient is always benefited. If the hernia returns, it is not so severe as at first; men who could not even take exercise because of their hernia are rendered good working members of society." Dr. Park wrote me, under date of October 18, 1891, giving a report of 115 cases where he resorted to reduction of the hernial contents (unless it were adherent omentum, when he tied it off), ligation of the neck of the sac high up, with extirpation of the sac (or preservation of its lower part and closure of canal in congenital cases, to make a new tunica vaginalis), and closure of the inguinal canal and ring. "For this latter purpose I now use buried silkworm-gut sutures. In cases operated on at convenience, 85 in all, I not only have had no death, but never even a condition which has caused me apprehension. I believe in thoroughly opening up the inguinal canal, and occasionally I transplant the spermatic cord, though by no means always. I now resort also to buried catgut sutures in closing the wound, and seldom put any through the skin.

"Deliberate Cases.—Males, 68; females, 17. Of these, 6 were operated upon both sides simultaneously, 8 were umbilical, 3 femoral, 74 inguinal or scrotal. No deaths; slight suppuration in 5.

"Strangulated Cases.—Males, 19; females, 11. Of these, 4 died. Each of these cases was most unfavorable, from too late operation or some other unavoidable reason."

Dr. Park considers the advantage of the closed method over the open method to be, that it makes it possible to bring together the edges of the cut fasciae, thus achieving on a small scale the same good results as are obtained by the proper closure of large abdominal wounds.

Dr. William Detmold, of New York, reported an interesting case of femoral hernia, published in 1842, upon which he operated in 1837. The operation was then considered unjustifiable, and surgical assistance was declined him. After division and reduction, he scarified the upper portion of the canal and packed with lint for several weeks. The hernia was cured, and remained so for five years, when the patient passed from under observation.

Dr. Detmold reported this case at some length, the circumstances of which were peculiar. He had just commenced the practice of his profession. A young woman, recently married, was abandoned by her husband because of a considerable large fem-
oral hernia which made a permanent tumor of the groin, he believing it evidence of syphilitic infection. Dr. Detmold promised the operation, relying upon his old master, Dr. Willard Parker, for performing the same. This Dr. Parker not only refused to do himself, but declared the operation absolutely unjustifiable. Without relief, suicide was determined upon, and therefore, unaided, Dr. Detmold performed the operation. The young husband, convinced of his error, served faithfully as nurse, and the matrimonial union thereafter remained one of great happiness. It is believed that this is the first radical cure of hernia deliberately determined upon by any American surgeon.

Dr. H. D. Didama, of Syracuse, advised: "If natural tissue can be secured to retain the intestine instead of a cicatrix, it were better to have the natural tissue. If a variety of suture can be used which is not followed by suppuration and does not require removal, let us use this variety." He referred approvingly to the elaborate report which Dr. Marcy had just given of his large experience in the use of the buried tendon suture for the restoration of the obliquity of the canal and closure with the same, and stated, "I have seen Dr. Marcy operate in a number of cases, with the most satisfactory results."

Under date of February 24, 1892, Dr. George W. Jones, of Cambridge, wrote me as follows: "In thirty-seven consecutive operations for cure of hernia performed during the past six years by your method exclusively, thirty-six have been cured, so far as I can judge at this time of writing. In no case has the patient's life been jeopardized for a moment by the operation, the primary dressing remaining intact until healing was complete; in only one case was this otherwise, when a septic suture was the cause of suppuration, and the wound healed by granulation."

At a meeting of the Johns Hopkins Medical Society, November 4, 1889, Dr. William S. Halsted presented five patients upon whom he had performed his operation for the cure of inguinal hernia. He described the operation as follows:

"1. The incision begins at the external abdominal ring, and ends one inch or less (less than one inch in children) to the inner side of the anterior superior spine of the ileum, on an imaginary line connecting the anterior superior spine of the ilea. Throughout the entire length of the incision everything superficial to the peritoneum is cut through.

"2. The vas deferens with its vessels is carefully isolated up to the outer termination of the incision, and held aside."
"3. The sac is opened and dissected from the tissues which envelop it.

"4. The abdominal cavity is closed by quilted sutures passed through the peritoneum at a level higher by one and a half to two inches than that of the so-called neck of the sac.

"5. The vas deferens and its vessels are transplanted to the upper outer angle of the wound.

"6. Interrupted strong silk sutures passed so as to include everything between the skin and the peritoneum are used to close the deeper portion of the wound, which is sewed from the crest of the pubes to the upper outer angle of the incision. The cord now lies superficial to these sutures and emerges through the abdominal muscles about one inch to the inner side of the anterior superior spine of the ileum.

"7. The skin is united over the cord by interrupted stitches of very fine silk. These stitches do not perforate the skin, and when tied they become buried. They are taken from the under side of the skin and made to include only its deeper layers—the layers which are not occupied by sebaceous follicles.

"8. One or two small, short gauze plugs are used as wound-drains."

Dr. Halsted remarked in this connection that whether or not it were possible or easy to disinfect absolutely the human skin, he had been much impressed with the fact that skin sutures not infrequently suppurate, even in wounds sewed by the most careful surgeons in this country and abroad. He thought it advisable, therefore, to test for a time the subcutaneous buried-skin suture.

The After-treatment.—The gauze plugs are removed at the first subsequent dressing—usually at about the seventh day. The patients are allowed to walk about on the twenty-first day.

The following is a brief summary of his cases:

Case I.—William H. Richardson, colored, aged eight years. Operation, June 13, 1889, for the cure of large, congenital inguinal hernia on the right side. The sac, when opened, contained caecum and vermiform appendix; a very short meso-caecum bound the sac to its contents.

June 2d.—The wound has healed by first intention, except where the gauze plug was introduced. Linear cicatrix.

July 4th.—Patient is allowed to get up and walk about.

Case II.—George Holdorf, German; blacksmith; aged twenty. Operation, June 17, 1889, for the cure of a moderately large, reducible right inguinal hernia.
June 18th.—Gauze plug removed.

June 25th.—Patient is discharged for misdemeanor. Wound has healed by first intention. Linear cicatrix.

Case III.—John Bleecher, German; blacksmith; aged forty-eight. Operation, August 16, 1889, for the cure of a large, reducible right inguinal hernia. The neck of the sac was large enough to admit the tip of the fingers.

August 26th.—Passes urine through wound. Infer that one of the deep sutures was passed through the wall of the bladder.

September 4th.—Patient passes all his urine through the penis.

September 17th.—Patient is out of bed. The wound is healed, except at its lower angle.

Case IV.—Joseph Davis, aged eight years. Operation, October 9, 1889, for the cure of a small, reducible left inguinal hernia.

October 19th.—Wound has healed by first intention. Linear cicatrix.

November 3d.—Boy is allowed to get up and walk about.

Case V.—Frank Fisher, aged seven years. Operation, October 12th, for the cure of a small right inguinal hernia.

October 20th.—Wound has healed by first intention. Linear cicatrix.

November 4th.—Boy is allowed to get up and walk about.

Dr. F. C. Larimore, of Mount Vernon, Ohio, in a recent publication stated “that he had operated three times for the radical cure of hernia by the use of the buried aseptic animal suture, after the method of Dr. Marcy, with most excellent results. In the third case I was completely astonished to note how neatly and accurately the skin was approximated by the blind continuous suture. No gauze, no cotton, no bandage, and no truss, will strike every one as laying aside many restraints, and showing sublime faith in the result of the operation.”

Dr. Nathan Jacobson,* of Syracuse, published an interesting article upon the recent advance in the radical treatment of hernia. He advocated the splitting of the inguinal canal in order to expose the internal ring, as first proposed by Riesel. He wrote as follows: “This plan McBurney and Marcy have both adopted. Schade objects to it, believing that it is exceptionally bad, and increases the danger of peritonitis. But the operators mentioned have found no reason for this fear. . . . It certainly gives greater

* The Times and Register, August 2, 1890. Reprint.
exposure of the internal ring, better opportunity for freeing adhesions and separating the neck, and, as I believe, after operating in this manner, is of great advantage to the operator. . . . Küster recommends the continuous suture for closing, but Schede prefers an interrupted suture of No. 1 catgut. As to the comparative value of these two methods, perhaps time enough has not elapsed to decide.

"Yet it is most remarkable how wonderfully well Schede and Marcy agree in the statement of the results of their methods; for, while the latter says in his paper, read before the American Medical Association last year, that fully ninety per cent are permanently cured, as far as he can judge from the histories of those cases of which he has absolute knowledge, and in no instance does he advise the subsequent wearing of a truss, Schede's statistics show that, of the one hundred and sixty-five operated upon, recurrence occurred in but fifteen. It certainly is the best possible indorsement of an operation to have two operators as widely separated as these, differing in some details, but striving for the same end, working independently of each other, as I know to be the case here, reach conclusions so thoroughly alike."

We have elsewhere quoted favorably and freely from contributions of Dr. William T. Bull, of New York, giving the results of his special studies upon the operative measures advised for the cure of hernia. Unfortunately, he has been quoted by those who hold conservative views upon the question, with the attempt to show that modern surgical methods for the cure of hernia do not warrant the assumption that very much progress has been made in methods or results. A careful perusal of his papers does not lead to such a sweeping conclusion, for he distinctly states that the great majority of the cases operated upon are vastly improved, if not cured; while he frankly admits that in the larger number of cases suppuration supervened even in the patients under his own supervision, and this alone must greatly modify the result. Suppuration should not ensue, and does not if the wound is maintained aseptic. In none of the cases operated upon was the effort made to restore the obliquity of the canal, and in only four of the series, Macewen's method, was it attempted to reinforce and strengthen the weakened tissues posterior to the spermatic cord. In a contribution published in the New York Medical Journal, May 30, 1891, Dr. Bull has availed himself of the material at hand to compile tables in which are arranged, as far as possible, the imperfect histories which he has obtained of 119 cases where hernia has returned after an operation of some sort for its relief or cure. Of the whole number, the method of operation was definitely ascertained in 73 cases, as seen in the following table:
A careful study of the table teaches less of value than we could wish. The Heaton injection method is now so generally abandoned that these cases may be eliminated from the discussion. Five were by methods now seldom in use, which reduces the number to 59. Of these, 5 were femoral, leaving 54 cases of inguinal hernia for consideration. Of these, 10 were reducible hernia, and the operation was undertaken for cure by Czerny's method, and, singularly, an equal number by the open method, and 4 after Macewen's method—in all, 24 cases. It is presumable that in these, the operators used every precaution of which they were masters to induce a permanent cure, and yet Dr. Bull remarks: “The duration of treatment, practically wound-healing in Czerny's method, where the pillars of the external ring and the integuments are carefully sutured, is almost as great—average seven weeks—as in the open method. This confirms my own experience in operating, that the wound is a difficult one in which to obtain absolute primary union, and is an argument in favor of allowing the wound to granulate.” Although the table does not show the percentage of primary union, it is an admitted fact that the supervention of suppuration is one of the most common causes of failure. One case is noted where relapse occurred in three years and four months.

### Table: Summary of Cases of Hernia relapsing after Operation for Radical Cure, in which the Nature of the Operation has been ascertained from Hospital or Private Records

<table>
<thead>
<tr>
<th>Method of Operation</th>
<th>No. of Cases</th>
<th>Nature</th>
<th>Age 1</th>
<th>Hospital Treatment</th>
<th>Relapse 1</th>
<th>Total after Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heaton's</td>
<td>9</td>
<td>Inguinal, 6</td>
<td>53</td>
<td>yrs., wks., wks.</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Double ing., 2</td>
<td>28</td>
<td>wks.</td>
<td>21 1/2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Double fem., 1</td>
<td>6</td>
<td>d.</td>
<td>12 1/2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. red., 10</td>
<td>5</td>
<td>mos.</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. irred., 3</td>
<td>10</td>
<td>wks.</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. str., 6</td>
<td>6</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fem. irred., 1</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fem. str., 1</td>
<td>7</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Excision of sac.</td>
<td>22</td>
<td>Sacrum.</td>
<td>70 6</td>
<td>38 1/2</td>
<td>3</td>
<td>5 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. irred., 1</td>
<td>7</td>
<td>wks.</td>
<td>12 1/2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. str., 1</td>
<td>7</td>
<td>wks.</td>
<td>12 1/2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fem. irred., 2</td>
<td>7</td>
<td>wks.</td>
<td>12 1/2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fem. str., 2</td>
<td>7</td>
<td>wks.</td>
<td>12 1/2</td>
<td>3</td>
</tr>
<tr>
<td>&quot;Open method.&quot;</td>
<td>24</td>
<td>&quot;Open method.&quot;</td>
<td>72 21</td>
<td>42 3 1/2</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. irred., 2</td>
<td>2</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. str., 3</td>
<td>3</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. double, 7</td>
<td>3</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fem. irred., 2</td>
<td>7</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fem. str., 2</td>
<td>7</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Double ing., 2</td>
<td>7</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. red., 1</td>
<td>7</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ing. str., 1</td>
<td>7</td>
<td>wks.</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>Macewen's</td>
<td>4</td>
<td>Inguinal, 1</td>
<td>49 32</td>
<td>39 1/2</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Bryant's</td>
<td>1</td>
<td>Ing. strang.</td>
<td>49 32</td>
<td>39 1/2</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Schwabé's</td>
<td>1</td>
<td>Double ing.</td>
<td>27 32</td>
<td>39 1/2</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Wood's</td>
<td>1</td>
<td>Ing. red.</td>
<td>26 32</td>
<td>39 1/2</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Open wound, suture of omentum in neck.</td>
<td>2</td>
<td>Ing. strang.</td>
<td>68 67</td>
<td>10</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
after operation without giving any details as to cause. Surely it is a far-fetched deduction, which the author expresses as follows: "This warrants the statement that future evidence as to the value of different methods must cover an experience of more than three years, and the patients who have been without recurrence for a year have no reason to expect to remain so permanently."

Of the 22 cases of recurrence operated upon after Czerny's method, 12—more than fifty per cent—wore trusses; a mistaken direction after operation, which undoubtedly, by the absorption produced under the pressure, often leads in itself to failure. Dr. Bull, however, thinks otherwise, and states: "I have never seen any evidence of damage to the repaired structures by the presence of a truss. In the cases operated upon by the open method (McBurney), where the hernia has returned, the opening in the abdominal wall is direct, like that of a ventral hernia, which makes the wearing of a truss much more difficult and painful. In several instances I have seen the peristaltic movements of the intestines through such a hernial covering, and in two cases an adhesion of the omentum to this cicatrix made all efforts at coughing or straining painful, while the truss pressure was almost intolerable. It must be stated that at different periods after operation, from three to six months, the cicatrix of the open method is to be recognized by its depressed situation and firm, contracted, and dense character. At a later period it begins to yield in places, or all along its line, and ultimately presents the features mentioned above." Dr. Bull declared that the majority of the above cases were certainly improved by operation, and stated that "these straggling notes do not afford any valuable evidence as to the comparative reliability of the different methods, but only emphasize lack of promise to effect a cure."

In the discussion of Dr. Bull's paper, Dr. Stimson stated that he was "glad to hear Dr. Bull say that the statistics given were not to be taken as evidences of the proportion of recurrences after any given operation, but that they were only tabulated statements of those cases which had come under observation. These recurrences might, however, be taken as an indication that no case could be pronounced permanently cured until after a number of years; but if a case remained cured, say, for four years, it would hardly be fair to argue that, because it had not gone five years, it was not a radical cure."

Dr. Stimson stated that he had had "recurrences in a number of cases after operation, that in a general way he had followed the method advised by Dr. McBurney, and that possibly his modifications were by no means improvements. Cicatrices left after
the open operation for hernia were not materially longer or wider than after primary union, and were a very strong barrier to oppose to a hernia. He believed that a uniform cicatrix continuous with all the layers of the abdominal wall on each side formed an ideal support. He had found the only weak spot to be in the upper angle of the cicatrix. No operation could make the aponeurosis of the external oblique and the external ring a better barrier against a hernia than Nature made them, and yet they were unable to prevent a bubonocele from becoming a complete hernia; consequently, operations that were limited to create a barrier at this point must fail, if a new hernia began. The hernia must be arrested at the beginning, if at all; and in the absence of any means of closing the internal ring, and thus preventing the beginning of a hernia, he believed that the open method, which rested upon a basis that was radically different from the others, was the best now at our command. In one case of bubonocele, he had narrowed the internal ring by drawing down and suturing the edge of the internal oblique and transversalis muscles, but sufficient time had not yet elapsed to determine the result."

Dr. J. E. Kelley, in discussing the paper, stated that "Dr. McBurney's operation was to be mainly recommended because of the consolidation it produced between the deeper fibrous coverings of the abdominal cavity and the superficial cicatricial tissue. Unfortunately, union was limited superiorly by the conjoined margin of the muscles, intact, or divided as they might be in the operation. Here they separated the fibrous and superficial layers, and, owing to their interposition, these were no longer mutually supporting. The secondary protrusion forced through or before it the deeper structure, then made its way under or between the inferior muscular fasciculi, and eventually overcame the resistance of the superficial tissues, whether they consisted of the normal structures or the cicatrix." The ultimate result of the speaker's observations indicated this as "an insurmountable defect in McBurney's operation, as, notwithstanding to what extent the incision might be carried upward, this weakness still existed. In fact, the higher the incision the greater was the thickness of the muscles between the superficial cicatricial tissue and the fascia transversalis, which latter, in addition, became weaker as it ascended on the abdominal wall.

"In consideration of this objection, he had attempted another method in his recent cases, which he termed the "laminated operation," the principle being to utilize each layer of the abdominal wall as a vital splint for the lines of incision in the structures lying superficial to and deeper than it. The axial line of the hernial tumor being re-
garded as the line of election for the incision in the ordinary operations, he made his cutaneous incision parallel to it, but about half an inch higher, and separated the lower margin for a corresponding distance below the line of election, where he divided the next layer of tissue (in well-developed patients, Camper’s, or the superficial fascia), the upper margin of which incision he treated in a manner similar to the lower one of the preceding plane, until he reached the level corresponding with the incision in the skin, where he divided the next fascial covering (Scarpa’s, or the deep fascia), thus coming down to the aponeurosis of the external oblique, which in turn was divided in a line corresponding to the second incision. It was obvious that, when the structures were restored, each line of incision was overlapped to the extent of an inch, and if union was obtained a much firmer wall would result.” Dr. Kelley emphasized the importance of the closure of the neck of the sac in such a way that a depressed point of the peritoneum should not be left to invite, through intra-abdominal pressure, a return of the hernia. He thought Mr. Ball, of Dublin, who twisted the neck of the sac until the peritoneum became tense, had given the best means yet furnished to obviate this defect.

Dr. Robert Abbe reported his experience, comprising operative procedures for radical cure in all classes of cases to the number of about one hundred and fifty. He was constrained to favor Macewen’s method, as yielding the best results, and it had the merit of applicability to femoral hernia.

In closing the discussion, Dr. Bull said that he had not attempted to bring into prominence the merits of any method of operating. He himself was undecided as to the best form of operative procedure, but was inclined to think that simple excision of the hernial sac after ligating high up, without any attempt to suture the hernial orifice, was as good as any, and this method could be used with equal advantage in both inguinal and femoral herniae. He must join issue with Dr. Stimson if he placed confidence in a method that was supposed to cure by the substitution of a plug of cicatricial tissue for the normal structures. The cicatrix would eventually yield before the pressure of the viscera from within.

Statistical tables, as such, I can not help thinking, are quite as often misleading as instructive, since necessarily nothing can be known of the conditions present; and in the table upon which Dr. Bull has based his conclusions it will be seen that a classification has been made by so-called methods undertaken by a considerable number of unknown operators, and I am myself surprised that when thus classified the surgical
procedures, as generally undertaken for the cure of hernia, do not show even a larger number of failures.

I am reminded of the comment made by a very distinguished medical authority, who stated, "he considered that the chief value, after all, of statistics lay in the ability to utilize them in confounding our opponent rather than in the elucidation of truth."

I have been in doubt if I might not justly be criticized for quoting in extenso too freely, in this and the preceding chapter, from the recent contributions upon the subject of hernia and its surgical treatment both in Europe and America. During the last few months the medical journals in every part of the civilized world contain more frequent reports of cases operated upon for the purpose of effecting a radical cure than at any previous period in the history of surgery, although no especial contribution adds materially to the knowledge or instruction of which we were heretofore possessed. The general consensus of opinion, however, is that hernia is no longer considered an opprobrium to the art of surgery; that the operation for its cure in a very wide range of cases is justifiable; that when done under the precautions generally accepted as advisory, pertaining to all wounds made in aseptic tissues, the operation is eminently a safe one, the risks being, as we have shown from the experiences collated, when the abdominal contents are not involved, those pertaining to that which is justly considered minor surgery.

All the operations previously in vogue—of injection, subcutaneous suturing, etc.—have been practically abandoned; recognizing a fact which might be rendered in an axiomatic way, that blind surgery as a rule is bad surgery.

We are almost too near the present field of many of our surgical victories to realize fully the importance of that which has already been accomplished. In the discussion of the subject in the preceding pages, which I trust has been approached in a purely judicial spirit, it will be seen that it is not too much to accept as demonstrated that all the usual varieties of hernia in the female are, as a rule, safely and permanently curable; to which may be added hernia in the male as usually met with, except in the inguinal variety. That this is true, should be predicated as expected, since the abdominal opening for the escape of the viscera is entirely abnormal, and its complete closure is within the easy limit of surgical procedure. As has been elsewhere stated, inguinal hernia in the male follows the line of an important organ, through a canal which must remain patent, and the problem assumes an entirely new factorage, since the spermatic cord must be allowed a free escape without the protrusion of, or pressure by, any of the ab-
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

dominal organs. Although for centuries well understood from the standpoint of its anatomical construction, all the surgical measures of the centuries have necessarily failed of its reconstruction, since it has not been supposed possible, until within a recent period, to deal surgically with any of the tissues which make up the posterior wall of the canal without sacrificing the testicle and the cord. We have seen, in the history of the operation, that it was well understood that the cure of this variety of hernia could easily be made permanent by the removal of the spermatic cord; and in the sixteenth and seventeenth centuries this was a recognized practice, of which large numbers availed themselves, until forbidden by law. It is now generally accepted that the dissection should be freely made, exposing the spermatic cord to the internal ring, freeing the peritoneal sac to its very base, treating it as a pathological factor by suture or ligature, and excision, or utilizing it in order to produce a bulwark to protect the weakened abdominal wall.

The considerable variety of operations, and the greater number of operators, treat with the factorage of the problem after the disposition of the sac by the consideration only of the structures of the abdominal wall external to the inguinal canal. These consist in suturing with a considerable variety of material, and with various methods of procedure, the parts, for the purpose of re-enforcing and strengthening the tissues. It was not possible to do more, without the use of sutures that could be left buried in the tissues. As an indirect hinting of the recognition of the need of this in the preceding generations, we note the experiences of the punctum aureum and golden stitch of the seventeenth century, gold, silver, and lead wire having been frequently left buried in the tissues; and Ambrose Paré distinctly states his purpose to have been the closure of the internal ring by four times bending the golden wire upon itself to support, but not compress, the cord. It was, however, reserved as one of the legitimate deductions of antiseptic surgery, as has been pointed out in detail in the chapter upon sutures, that animal sutures could be permanently left to retain and support weakened tissues in any part of the body.

The methods for the cure of hernia which have been discussed as those of the author of this book during the last two decades are based upon this fundamental factorage. The closure of the internal ring from below upward behind the cord, lifted from its bed; the coaptation and re-enforcement of the transversalis fascia and structures which go to make up the posterior wall of the inguinal canal, are effected by the use of the buried animal suture. In this way the exit of the spermatic cord is elevated, the obliquity of
the canal restored, and the intra-abdominal pressure brought to bear at right angles to it.

I introduce the following plate from Sir Astley Cooper, beautifully illustrating by a special dissection the transversalis fascia. It will be remembered that Mr. Cooper was the first to demonstrate the especial strength of this fascia, producing a remarkable re-enforcement of the parts, especially for the maintenance of the obliquity of the canal. The peritoneum having been removed, the internal ring appears longer than otherwise; the cord has been lifted one side, and the vas deferens drawn down, which deepens also the ring. It is well to remember that the canal is rarely round. The structures posterior to the cord making up the deeper portion of the canal, assume an importance, from the surgical standpoint in operations attempted for the restoration of the obliquity of the canal, not hitherto recognized.

PLATE LIX*

Exhibits an internal view of Poupart's ligament, the origin and course of the fascia, which it sends upward to unite the transversalis muscle to Poupart's ligament, and the origin and course of a second fascia which passes over the iliacus internus muscle; also the course of the spermatic cord through the first of these fasciae, and the situation and course of the epigastric artery and vein; with their origin from the iliac artery and vein.

a. Symphysis pubis.
b. Anterior spinous process of the ilium.
c. Articulation of the ilium with the sacrum.
d. Spinous process of the ischium.
e. Foramen ovale.
f. The muscles of the abdomen.
g. The rectus muscle.
h. United tendons of the internal oblique and transverse muscles passing behind the rectus.
i. Semicircular insertion of Poupart's ligament into the pubis.
j. Tendon of the transversalis which is inserted into the pubis behind the abdominal ring, and which prevents the abdominal ring from being seen.
k. A tendinous line from which the fasciae proceed, which shut up the lower part of the abdomen.
m. The anterior fascia, which is separated, to allow the passage of the spermatic cord. This fascia begins at l, and runs upward on the inner side of the transversalis muscle, and adheres to the linea semilunaris.

n. The other fascia which passes upon the iliacus internus muscle, and unites with the inner part of the crista of the ilium.
o. Iliac artery.
p. Iliac vein.
q. Internal iliac artery.
r. Internal iliac vein.
s. Spermatic artery and vein.
t. Vas deferens.
u. Epigastric artery.
w. Epigastric vein.

[These vessels, passing two inches upward before the peritoneum, are then continued between the rectus muscle and the tendon behind it.]

* Cooper, Plate II, Part I.
Modifications of the restoration of these parts have been made by Bassini in Italy, Schede in Germany, and quite recently by Halsted, of Baltimore. The latter advocates in certain conditions the yet more radical plan of making a new canal for the cord by uniting Poupart's ligament to the conjoined tendon beneath the cord, thus making an entirely new inguinal canal, covered only by the superficial fascia, adipose tissue and skin.

As will be seen in the preceding pages, each of these operators report percentages of cure effected equaled by no other methods. It is very probable that the early future will teach a safe outcome from the comparative experimental or crucial experiences of the present, but sufficient has already been determined to outline clearly the surgical procedures usually to be undertaken for the cure of hernia. It is too much to expect that by any method cure can be made and maintained absolute. All admit that by the present more or less accepted measures undertaken for cure, the great majority of the sufferers are distinctly benefited even when failure of the desired object is demonstrated. If eight to ten per cent of the whole population of the world are subject to hernia, showing, however well Nature commenced her work, she made remarkable failures in the preservation intact of the abdominal supports, it would surely be too much to expect, however radically cured a hernia might be, that the subject of the same should never be in danger of its recurrence. And if the hernia should again return, there is no reason why the individual may not a second time profit by the means of surgical relief, rather than be relegated to the great army of instrument-bearing sufferers, incapacitated in a measure from active employment, and at a possible risk of strangulation and fatal consequences.
CHAPTER XXVI.

CONDITIONS RENDERING SURGICAL PROCEDURES FOR THE CURE OF HERNIA JUSTIFIABLE.

The advisability of operation in any given case must always be considered as an independent problem, the factorage of which consists of many individual details. Judged from my own experience, the operation is permissible and generally to be advised in a very large proportion of all the sufferers from hernia.

Children.—There is much to be said in favor of operation upon children. It is admitted that, in a considerable percentage of the very young, hernia results from an imperfect development of the structures, the inguinal canal being abnormally open. In this class, if suitable care is exercised, and pressure brought to bear continuously upon the canal, especially at the internal ring, cure without surgical intervention may be often rapid and permanent. It should be the aim of the surgeon to effect this by a carefully adapted support, supplemented by proper attention and care.

The last illustration (Plate LIX) shows the exceptional manner in which Nature fortifies the internal structures by the tendinous expansion of the transversalis fascia in its lower portion, by which the internal ring is strengthened and the intra-abdominal pressure brought to bear at an angle to compress its opening. In children, all the parts which go to make up the abdominal wall are comparatively delicate, and at the best the fascia is thin and yielding. We have previously shown* that the foetal structures during the formative processes of the canal are quite unlike those at the period of maturity after birth. The peritoneum, which has been carried before the testis, is unclosed, and is, in its normal development, first shut off only a little above the testicle, and is slowly narrowed through the upper portion of the canal, leaving the infundibulum process, which in adult life marks a slight depression where the cord enters the abdomen.

This is subject to considerable variation in healthy adults, and the defective closure

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* Congenital Hernia, p. 38.
of the peritoneal process is the common cause of inguinal hernia in male infants. This is exceedingly well shown in the accompanying plate, taken from Cloquet, where Figure 2 exhibits the infundibulum process as an unclosed pocket, extending into the scrotum, at the base of which lies the testicle. In Figure 1 the infundibulum is abnormally open, although the dissection was upon a healthy adult who was not the subject of a hernia. The obliquity of the canal, as shown in Figure 3, is such that the intra-abdominal pressure closes the abnormally large internal ring. A careful study of the plate teaches the very common cause of incipient hernia, as also the importance of the even, smooth closure of the neck of the peritoneal sac, which is now generally emphasized by operators as of great value, although at the time of Cloquet it was considered beyond the domain of surgical procedure. Figure 3 also illustrates beautifully the re-enforcement of the parts by the greatly thickened transversalis fascia, which has yielded much more than usual obliquely downward and inward on account of the imperfect closure of the internal ring. This shortens in a measure the canal, and causes the intra-abdominal pressure to become deflected toward the line of its opening.

PLATE LX.*

_Anterior View of the Superior Opening of the Inguinal Canal on the Right Side._

_Figure 1._

A. Rectus abdominis.
B. Pyramidalis.
C. Aponeurosis of the obliquus externus turned downward upon the thigh.
D. Internal column of the inguinal ring divided and reflected.
E. Remaining fibers of the internal column.
F. Tendon of the rectus continuous with the fascia transversalis.
G. G. Fascia transversalis.
H. Aponeurosis of the obliquus externus continuous with the fascia transversalis.
I. Funnel-shaped canal formed by the fascia transversalis, opened anteriorly, in order to bring into view the spermatic vessels which it incloses.
K. Proper sheath of the spermatic vessels derived from the fascia transversalis.
L. Peritoneum covering the posterior surface of the fascia transversalis.

M. Prolongation of the peritoneum, which sometimes extends in front of the spermatic cord.
N. Epigastric artery, passing between the peritoneum and the fascia transversalis.
O. Dotted outline indicating the course of the epigastric artery, behind the fascia transversalis.
P. Spermatic veins.
Q. Spermatic artery.
R. Vas deferens.
S. Fasciculus of fibers belonging to the obliquus externus.

_Figure 2._

Disposition of the obliquus internus and cremaster, in the foetus of seven or eight months.
A. Rectus abdominis.
B. Aponeurosis of the obliquus externus turned downward.
C. Obliquus internus.
D. Lower border of the internal oblique becoming curved, to form the cremaster.

* M. Jules Cloquet, Plate I.
E. Inverted arches formed by the fibers of the obliquus internus, which constitute the cremaster.

F. Part of the gubernaculum testis.

G. External fasciculus of the cremaster.

H. Internal fasciculus.

**Figure 3.**

Posterior view of the superior openings of the inguinal and femoral canals, on the right side.

A. Part of the rectus abdominis.

B. Posterior surface of the pubes.

C. Fascia transversalis.

D. Fascia iliaca continuous with the fascia transversalis.

E. Fascia transversalis continuous below with the tendon of the rectus and with the crural arch.

F. Superior opening of the inguinal canal, formed by the fascia transversalis.

G. Fasciculus of fibers, forming the inner margin of the superior opening of the inguinal canal.

H. Spermatic vessels.

I. Vas deferens joining the other vessels of the cord at an acute angle.

K. Triangular space, bounded externally by the epigastric artery; internally by the rectus muscle; and inferiorly by the crural arch. In this situation internal inguinal hernia takes place.

L. Posterior surface of the crural arch.

M. External iliac artery.

N. External iliac vein.

O. Epigastric artery. The epigastric vein has been divided.

P. Branches of the epigastric artery to rectus muscle.

Q. Superior opening of the crural canal.

R. Gimbernat's ligament.

S. Concave fibrous fold, forming the external angle of the superior opening of the crural canal and situated opposite to Gimbernat's ligament.

T. Upper part of the obturator foramen.

V. Dotted outline indicating the course which the obturator artery most frequently takes when it arises from the epigastric. Here the obturator artery would be situated to the outer side of the sac of a femoral hernia.

X. Dotted outline indicating the course of the obturator artery, when the common trunk which furnishes this artery and the epigastric is of considerable length. In such a case, the obturator artery descends behind Gimbernat's ligament, and passes first above and then on the inner side of the neck of the sac in femoral hernia.

Accepting the above conditions as the most common cause of inguinal hernia in male children, it is of comparatively little importance to the surgeon whether the peritoneal process is open (that is to say, the hernia of the congenital variety) or not. If closed, the infundibulum process has become dilated into a pouch, which is protruded with its contents through the canal, often into the scrotum. Recognizing the rapidity with which the repair processes go on in early life, most surgeons have felt that a permanent cure was very probable by the maintenance of continuous pressure upon the canal, provided that the abdominal contents could be permanently retained—in other words, that pressure sufficient could be made in a constant way upon the internal ring so as to cause agglutination of the parts beneath. Nearly all observers of considerable experience have witnessed permanent cures by this means.

The great difficulty, however, is in the maintenance of constant pressure upon the restless little sufferers for a sufficient time for such changes to supervene. As a rule, when the hernia is slight it is well to attempt such measures, with the expectation that they may be curative. In order to effect this, the surgeon must be possessed of a thor-
ough knowledge of the anatomy of the structures involved, and must keep his little patient under close supervision for a considerable period. The truss must be carefully fitted, in order to bring the pressure over the exit of the cord from the abdomen—the internal ring. This is far more difficult in children than in adults, and the maintenance of such pressure for a length of time is by no means easy. Very commonly even the family physician relegates this duty to the instrument-maker, with only very general directions to the mother or attendant. The mechanician, understanding more or less imperfectly the task assigned to him, is generally governed by the thought only of retaining the abdominal contents, and to this end applies a pad, usually much too large, with its bearing upon the pubic bone. This inevitably produces pain, and the instrument in consequence is soon displaced.

The following plate from Cloquet is a beautiful illustration of the anatomy of the structures involved, and clearly teaches the importance of the direction in which the pressure should be applied in order to bring about permanent closure. It is also a fine demonstration of the transversalis fascia seen upon its anterior surface, which in large measure makes up the posterior wall of the inguinal canal. These tissues assume an importance from the surgical standpoint far greater than hitherto considered, since upon their restoration depends the reforming of the oblique direction of the canal, so frequently emphasized as necessitous for the permanent cure of hernia.

**PLATE LXI.*

Represents the Inguinal and Crural Canals of the Right Side.

_A_. Rectus abdominis.

_B_. Tendon of the rectus, continuous externally with the fascia transversalis.

_C_. Aponeurosis of the obliquus externus detached and turned down upon the thigh.

_D_. Fascia transversalis.

_E_. Funnel-shaped prolongation of the fascia transversalis around the spermatic vessels to form their sheath. It has been opened at its upper and anterior part.

_F_. Proper sheath of the spermatic vessels.

_G_, _G_. Fascia transversalis arising from the posterior border of the aponeurosis of the external oblique (crural arch), and with which it forms a deep channel.

_H_. Obliquus internus and transversalis muscles divided close to their attachment to the crural arch.

_I_. Radiating fibers which terminate upon the inside canal of the external oblique, and which, passing behind the internal column of the inguinal ring, are attached to the linea alba.

_J_. Internal pillar of the inguinal ring attached to the front part of the symphysis pubis.

_M_. Spermatic vessels, surrounded by their sheath, and covered by the fibers of the cremaster muscle.

_N_, _N_. Inverted loops or arches formed by the fibers of the cremaster muscle.

* Cloquet, Plate II.
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O. Internal fasciculus of the cremaster passing behind the inner column of the inguinal ring to be fixed at the pubes.

P. External fasciculus of the cremaster passing out of the corresponding part of the inguinal ring.

Q. Epigastric artery.

R. Dotted lines indicating the course of the epigastric artery behind the fascia transversalis, after having crossed the direction of the spermatic vessels.

S. Testis.

U. Superficial layer of the fascia lata, which is fixed to the crural arch and forms the anterior wall of the crural canal.

IV. Vena saphena.

X. Aperture in the fascia lata which gives passage to the vena saphena, and which forms the inferior opening of the crural canal.

Y. Strong semilunar edge of the inferior opening of the crural canal, which supports the angle formed by the union of the vena saphena and femoral vein.

Z. Point at which the deep and superficial layers of the fascia lata join each other.

1. Femoral artery. Ordinarily this artery is entirely covered by the superficial layer of the fascia lata, the femoral vein only being seen through the inferior opening of the crural canal.

2. Femoral vein.

3. Fibro-cellular prolongation from the opening of the vena saphena, which descends upon this vein and becomes intimately connected with the fascia superficialis.

4. Anterior wall of the crural canal. The small apertures in it are represented, which give passage to blood-vessels and lymphatics.

5, 5. Fascia lata covering the muscles of the thigh.


7. Dotted lines indicating the situation of the sartorius muscle beneath the fascia lata.

Dr. W. B. De Garmo,* of New York, gave in 1888 the results of the mechanical treatment of hernia in the analysis of one thousand cases in private practice; over one fourth of the entire number were dismissed as cured—i. e., all remaining so far at least six months without support; one third improved—i. e., able to wear a lighter truss than at first, and remaining comfortable. He believed that a large percentage of hernia occurring under middle age could be cured by early mechanical treatment. About twelve per cent of Dr. De Garmo's cases were under five years of age.

Constipation and tight bandaging of the abdomen are common causes of hernia in infants. Phymosis, with its attendant vesical irritation—frequent and difficult micturation—causes a straining of the abdominal wall, and thereby produces a yielding of the imperfectly developed structures about the canal. In the early period of childhood it is very difficult to fit and retain a truss in position. This is emphasized by the experience of each additional case, and not seldom is instrument after instrument thrown aside in despair. Does the medical profession discharge its duty to the public by allowing hernia in childhood to remain uncured? If the farmer has a colt thus affected—and this is not a rare condition in colts—does he allow the animal to grow up thus disabled? The veterinary surgeon does not hesitate to operate for cure under far less favorable

conditions, and with very few failures. If the sufferer is an orphan boy, dependent in the early future as a bread-winner upon his developing physical powers, is it the duty of the profession to allow the poor youth to enter the race for life, often for existence, handicapped at the start? He is unfitted for hard work, can not enter the public service, where a physical examination is required, and is debarred from many avenues where position and success might otherwise be attained. Shall the wealthy parent think less of the future well-being of his son, when he discusses his physical defects, and determines, because of his abundant means, that therefore, the necessity of physical labor not existing, he will permit the heir-apparent to go through life halting and maimed?

The English people have an able advocate for early operative measures in Mr. Spanton. In his address before the International Medical Congress* he stated: "The number of cures effected by trusses is infinitesimal, if we may judge from the report of the London Truss Society, where we find that, of a total of 96,886 persons relieved by trusses, only 4,387 are stated to have been cured—i.e., 4.53 per cent.

"If it is possible to effect the cure of rupture early in life (thereby eliminating at once one eighth of the whole number of cases), by an operation which is both safe and efficient, we are led to inquire, in the words of Sir Spencer Wells, 'whether it may not be better to operate even on young children, than to expose them for several years to the inconvenience of a truss, with the probability that, after all, a radical cure may not be obtained.' Parents have a certain duty to perform toward their offspring in the matter of physical defects; and in the performance of this duty it is generally the province of the medical adviser to recommend the course to be pursued. Hernia is surely a source of greater risk to life than club-foot, or hare-lip, or nævus, a crooked limb, or an anchylosed joint. Yet these are conditions for which an operation, and not infrequently a fatal one, is recommended; whereas it is thought usually sufficient to palliate hernia by the advice to wear a truss, and allow the dangers and other drawbacks incident to it to continue uncured. It is time this opinion changed, and I feel convinced that those who will not be unwilling to see for themselves the advantages of an operation for the cure of hernia over the uncertain and unsatisfactory treatment with trusses, will, in a large number of cases, advocate its adoption. Operative measures, in modern days,

have not had a fair trial; they have not been carried out on a sufficiently extensive scale to demonstrate their real value."

The knowledge and adoption of antiseptic operative measures which have become general since the date of Mr. Spanton's writing, give yet more force to his earnest plea in behalf of a large class of helpless sufferers. If by mechanical means we can not effect a cure, it is our duty to operate. There is little to emphasize about the operation which does not pertain to adult life. All the tissues are more delicate, they are more vascular, but on this account admit of the more rapid repair. The sac is usually very thin, and it may be more troublesome to manipulate than in adults. On the other hand, its surgical treatment is of less importance. If easy to be separated, let it be treated by dissection, ligation, or suture at the neck, and removed, as we have already advocated. If congenital, rather than acquired, it is to be sutured across, in order to complete the tunica vaginalis testis, and closed upon the cord, continuing the buried suturing so as to close and increase the obliquity of the canal. Care must be exercised not to press too closely upon the cord; but when the cord is only pressed upon in an even, continuous approximation of the parts, it is surprising to note, if the wound is aseptic, how little the scrotum and its contents suffer in their nutrition. Sepsis, and the resulting infective changes, are the common causes of scrotal oedema, etc., which have usually been ascribed to pressure upon the vessels of the cord. If, after the operation, the aseptic state is maintained, oedema in any degree, or even tenderness of the scrotum, is the decided exception.

When the internal ring is closed from below upward and the inguinal canal reformed, continue the suturing of the tissues in evenly approximated layers until the lips of the wound are in close juxtaposition, and unite the skin by the use of fine buried continuous tendon sutures. In this way the tissues are held at complete rest, without hemorrhage or separation, and nothing remains to be eliminated as foreign material; therefore the drainage-tube, or its equivalent, is avoided.

This is of the first importance, especially in children, since it allows the complete closure of the wound, which the competent surgeon can make aseptic, and its hermetic sealing from subsequent infection. This is assured in a dried wound, dusted with iodoform and covered with iodoform collodion, into which a few fibers of cotton have been incorporated. To the surgeon who has labored for years to secure an antiseptic dressing with pads, gauze, bandages, macintosh, antiseptic cotton, or wool, until he made a little mummy of his patient, only to find, after all his care, that the doubly restless little
prisoner had generally succeeded in both urinary and fecal defilement of all his protection, such germ-proof dressing will be welcomed as the near approach to perfection.

The quiet rest in bed, with light diet, loose dejections, the interest and amusement with toys and games, and the little patient will hardly seem sick. I believe the statistics of to-day are sufficient to warrant the deduction that operative measures are almost absolutely devoid of danger, the mortality at the largest not exceeding one per cent, with not less than seventy-five per cent of permanent cures. I hazard little in predicting that a greater familiarity with and knowledge of the details of the operative measures, with careful attention to asepsis, will make the result of operative measures undertaken for the cure of hernia in children as favorable as any of the well-recognized operations advised for the cure of deformities.

Dr. A. P. Gerster,* of New York, advocates the operation in children, by closing the neck of the sac and packing the wound with iodoform gauze, treating it as an open wound, allowing it to heal by granulation. This he prefers, since in children there is so much difficulty in keeping the wound from being infected by the excretions, and because of the deep-seated septic inflammation which results.

The age at which operation is advisable must depend upon the individual condition, circumstances, surroundings, etc. There is nothing in age per se to debar operation. The youngest child upon which I have operated was a patient of Dr. S. N. Nelson, of Revere. The little fellow, otherwise healthy, had at birth a scrotal hernia of the right side. This was so large and troublesome that I unhesitatingly advised operation, although the child was only two months old.†

In another case I operated upon a large scrotal hernia in a child sixteen months old. The following illustration is from a photograph taken at the time of the operation.

He continued nursing during the few days he was under my care, and scarcely once cried as if in pain. When dismissed from observation, a few months later, the cure was complete. I have often operated upon umbilical hernia in children, and never have I seen any serious symptoms supervene. The youngest patient was a child about fifteen months old who had been under constant observation during the preceding summer, and all the various attempts at retention had proved entirely futile. The

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† See p. 172 for illustration, etc.
omentum was adherent to the sac, probably caused by the pressure of the pad. Convalescence was rapid, almost painless, and resulted in cure. Umbilical hernia in childhood, which is not cured after a few months by the use of properly adjusted supports, should unhesitatingly be subjected to operation.

The following is Dr. Nota's manner of treating umbilical hernia in children; his method is a modification of that recommended by Dessault. The hernia being reduced and the umbilical ring closed by the finger, the sac, emptied of its contents, is held firmly by an assistant. Around the base is thrown a ligature of rubber tubing an eighth of an inch in thickness. Three or four turns are made with the tubing, held very tense, and as close as possible to the abdominal wall. The two ends of the tube are tied together and the knot is secured with a ligature of silk. The whole is then covered with a little cotton, and the children are left entirely free in their movements. After ten or twelve days, according to the size of the hernia, the sac falls off at the level of the ligature, leaving a small round opening of perhaps an eighth of an inch in diameter. This wound is dressed with iodoform and carbolized cotton, and closes in four or five days, leaving a smooth, regular cicatrix, which prevents any return of the hernia. Dr. Nota used this method with eighteen children, and effected a perfect cure in them all.

The following abstract† of a laparotomy, performed upon a child ten hours old, for congenital umbilical hernia, is of interest, and is probably the youngest patient yet operated on.

A female child, otherwise healthy, was born with a tumor occupying the larger portion of the anterior abdominal wall. It was covered by the tissues of the cord and

* Gazzetta degli ospitali, November 23, 1890.
† New York Medical Journal, May 23, 1891, vol. iii, p. 586.—Dr. John R. Hinkson, Blissville, Long Island City, N. Y.
the peritoneum, and it contained a large part of the liver and small intestines. The tumor was elliptical in shape, and projected one inch and a half beyond the surface of the abdomen, measuring two inches and a half transversely by four inches in its vertical diameter. It was not pedunculated, and extended from the ensiform appendix to within one inch and a half of the pubes. The cord was in the median line at the inferior portion. No vessels were visible, but the liver could be plainly felt at the upper part of the tumor, which was most prominent. The covering of the tumor was quite tense and semi-opaque, with a few small cysts.

The abdomen having been washed with a bichloride solution, an incision was made in the upper part of the tumor. The adhesions over the right lobe of the liver were broken up with the finger. The membrane adjacent to the umbilical vein and the hypogastric arteries were dissected away and the vessels ligated. The membrane was finally removed in connection with the suspensory ligament of the liver; the edges of the abdominal wound were pared with scissors, and the abdomen was closed by interrupted and continuous catgut sutures. The difficulty of the operation was the want of sufficient material to allow the closure of the abdominal walls. On this account the operation occupied one hour and a half, anesthesia having been easily maintained under ether. Three days later, the catgut sutures having failed, under chloroform, wire was used to reclose the wound. Five days later it was found that these had cut through, leaving an elliptical opening an inch and a quarter in length near the middle of the wound. The hare-lip pins were inserted half an inch from the margin, not passing through the peritoneum, which had closed from the primary operation. Three days later these had cut through, and all effort at closure was abandoned, except a supporting bandage. The wound was completely healed on March 14th, four weeks after the first operation, leaving a scar three inches and a half in length. The writer reports two similar cases successfully treated—one by Dr. J. N. Barton, of Philadelphia, a child thirty-three hours old, and another at the clinic at Klassa, sixty hours after birth.

Inguinal Hernia in Women.—The operation for the radical cure of inguinal hernia in women should be favorably considered in all cases of hernia occurring in the female where difficulty of retention or serious inconvenience exists. Age, occupation, social position, etc., are, as ever in surgery, factors in the problem. Operative measures for the cure of inguinal hernia are greatly simplified in woman, since the absence of the cord
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allows a complete and firm closure of the canal. Although inguinal hernia is far less common in the female than in the male, the general condition and relation of the parts are not anatomically very unlike those of the male. The canal through which the round ligament passes appears to serve no special physiological purpose other than to allow the fixation of the distal end of the ligament, and thereby supplies to the uterus a support which, in different positions of that organ, must necessarily vary greatly in length. The peritonæum is attached to the cord by a loose-meshed connective-tissue sheath which admits of considerable mobility of the tendon within the canal. It is owing to this fact that the surgical procedure of shortening the round ligament has been advised by Mr. Alexander, in order to pull forward the retroverted uterus and hold it in its normal position.*

Inguinal Hernia in Man.—All cases of irreducible and strangulated inguinal hernia should be operated upon promptly and thoroughly; also all cases where the truss imperfectly retains the hernia. We have already noted the large percentage of adult males who are the subjects of inguinal hernia.† Few of this large army of truss-bearing individuals are without daily inconvenience and suffering. They are limited in their activities, debarred from many of the occupations of life, and are more or less constantly endangered by accidents incident to the escape of portions of the abdominal contents into or through the inguinal canal. These dangers are well recognized by the general public, are appreciated by every practitioner of medicine, and we have already shown, by reference to the statistics of the general hospitals, that the operations for the relief of strangulated hernia are followed by a mortality quite equal to that from the major amputations. If it can be shown that safe surgical measures can be instituted for the permanent cure of this large class of sufferers, it will be regarded as one of the most brilliant achievements of the surgical art. It is probable that no class of sufferers from any single disabling condition is by any means as large, since it is estimated that in the United States alone there are between three and four millions of individuals subject to hernia, and the mortality annually resulting therefrom is much greater than is generally supposed.

The adult sufferers from inguinal hernia who may wisely consider the advisability of permanent cure should not only include those who have difficulty in retaining the hernial contents by a truss, but also a large majority of individuals, otherwise in good

* See Plate XLIII, p. 165. † See Baxter’s tables, pp. 3-6.
health, who are thereby restrained from the more active vocations in life. It is also well to remember that the wearing of the truss even in comparatively light cases of hernia not alone very rarely produces cure, but also that the pressure of the truss upon the subjacent structures frequently so thins and weakens the abdominal wall, that the results when operative measures are undertaken are often far less satisfactory and permanent. The young adult, as a rule, has only to expect a more or less continued disability, gradually increasing with the years, the cure of which is more certain when undertaken in the earlier period of life, since the tissues are not only less deformed and weakened, but possess a greater vitality, giving thereby promise of easy and permanent reconstruction.

I would not be misleading in the views here presented, or be considered too radical in my teaching, in advancing the plea for the permanent cure of the large majority of the sufferers from hernia. I am sure the consensus of opinion, as expressed by the most careful of modern operators, is that the great majority of males otherwise healthy, suffering from inguinal hernia, yet within the safe period of life, are privileged to consider advisedly surgical measures for permanent cure.

Femoral Hernia.—When we remember that a femoral hernia is much more difficult to retain by a truss, that the canal through which the viscera escape is very firm and narrow, and consequently the contents are much more likely to become strangulated, there are abundant reasons why this variety of hernia should be especially held under surgical consideration. I have elsewhere given the opinion of the distinguished French surgeon M. Championnière,* that all cases of femoral hernia in the female should be operated upon, the general conditions being favorable. I have also shown that the cure in this variety is much more certain and permanent. There appears to be no valid reason why the great majority of all the sufferers from femoral hernia may not be safely and effectually cured.

Umbilical Hernia.—The writer of a single decade ago who had ventured to advocate the attempt of the cure of umbilical hernia, except in very rare instances, would have had very little if any support. In the chapter devoted to this variety of hernia, the conclusions have been reached that surgical measures adapted to the cure of this disabling and oftentimes very dangerous condition are advised in a very considerable percentage of this class of sufferers.

* Page 316.
The résumé of the subject seems to warrant the conclusion that safety and permanency of cure have been arrived at by a considerable variety of methods in the hands of a large number of modern operators in all the varieties of hernia. There is still a very considerable difference of opinion in the selection of the cases or class of cases where operation for cure is advised.

First, it is generally admitted that every case operated upon for strangulation should be given the advantages to be derived from the attempt at cure. This, we have seen, so far as the wound itself is concerned, independent of the condition of the hernial contents, when safety will permit of their return within the abdominal cavity, affords conditions not so very much less favorable for cure than when undertaken primarily for this purpose, and the resultant cure is generally permanent, with the exception of the cases of inguinal hernia in the male. These, we have seen, are generally improved when the cure is not complete, and there can be no question but that, in the hands of a very considerable number of operators, the great majority of even this class of cases remain cured.

Second, operation is advised in the large majority of the cases of irreducible hernia, and where great difficulty is experienced in retaining the parts in situ by a truss. Experience is now sufficiently ample to prove that irreducible or incarcerated hernia may be surgically treated with remarkable safety under the modern aseptic measures in common use. The great majority of these cases are rendered irreducible by adhesions formed between the omentum and portions of the sac, induced by pressure brought to bear upon them. These may be situated at the ring, or in any part of the peritoneal sac or contents. They are usually separated without danger, and, if need be, very considerable portions of compressed or deformed omentum may be removed with impunity.

In the rarer conditions, where a loop of intestine has become adherent, delicacy of manipulation is extremely important. If the adhesions are firm, it is far better to snip away the adhering part of the sac, or other structure, than to attempt separation at the line of union. This is rendered still more safe by intrafolding the edges of the remaining adherent portion by means of a fine suture. Arnaud pointed out, more than a century and a half ago, that even a small portion of the testicle when adherent might safely be cut away in the separation of the intestine without ultimate injury to either organ.

Third, besides the large numbers of sufferers from hernia that we have discussed
in this chapter, where operation is advised or may be considered permissible, there are often other reasons which might influence the surgeon to consider favorably operative procedures for effecting the cure of hernia; such as occupation, the desire to enter the public service, or a change of residence to localities where surgical aid could not be obtained in case of strangulation, as, for example, a residence in the remote districts of our own country, and in the colonies of India or South America.
CHAPTER XXVII.

OPERATIVE MEASURES ADVISED FOR THE CURE OF HERNIA.—THE ADVANTAGES OF THE BURIED TENDON SUTURE.

The treatment of operative wounds has from time immemorial been considered a subject of vital importance in the healing art. Upon the one hand, the philosophic observer holds ever prominent in consideration the so-to-speak factorage of individual type, the vital, resistant power. On the other hand, the discussion of the various changes which are observed to take place in wounds under different conditions has engaged a large class of investigators, and seemingly with little profit until within the present generation. The ever-present material for infection, and its non-development in a very considerable class of wounds, has been accepted by many as sufficient evidence for discarding the conclusions arrived at by the earlier advocates of antiseptic surgery. To many superficial observers it seemed to be clearly proved that the entire system was untrustworthy and impracticable. Scientific data were certainly wanting to answer satisfactorily the queries which arose, although in general the reply was made that the vital, resistant power of the individual was sufficient to prevent the growth and development of the bacterial infection. Why, when the seed was vitalized and implanted in a culture medium ample to serve as food, and retained at equable temperature, did it not develop?

Our laboratory experiments threw no light upon the question, for here, under the conditions given, reproduction was a constant factor. The observations of Metschnikoff upon the power of the leucocyte to surround and destroy, so to speak, to digest the bacterium under favorable circumstances, are now generally known. These observations are of interest as a possible explanation of this hitherto unknown quantity in the problem—the so-called vital resisting power of the tissues, which may vary greatly in different individuals. It is quite too early to draw general deductions from our present premises, and declare that in this the entire solution is found, but there is every reason to believe that this is an important discovery of a power which the organism brings to rescue it under favorable circumstances from impending danger.
The practical deduction is, that we seek to place the wound in such a condition that the phagocytes of Metschnikoff may be made the active allies of the surgeon. All this helps also to explain the success which surgeons have obtained by means which seemed directly opposite in their methods of wound-treatment.

If the so-called phagocytes of Metschnikoff, the familiar leucocytes above mentioned, not alone surround but actually eat up their enemies, we have the best of reasons for understanding why the comparatively few germs in the atmosphere of a healthy locality are far less dangerous to wounds than was earlier supposed. Again, too, we see that in the so-called surgically clean wound—that is, a wound where great care is taken to exclude foreign material, where blood-clots are removed, and the comparatively uninjured clean-cut surfaces are closely approximated—the reparative processes go on steadily, and rapid recovery supervenes, although in a strict scientific sense the wound is not aseptic. In wounds where the surrounding tissue is devitalized these favorable conditions are not maintained, and hence the germination of bacteria goes on much as seen in laboratory culture experiments.

The unbiased student must observe in the recent progress made in wound-treatment a fundamental truth based upon the repeated observations of abundant experiments and facts. This truth consists of three factors:

First, the condition of the patient—the so-called vital, resistant power.

Second, the character and amount of the bacterial infection—the tares introduced at the seeding of the field.

Third, the local condition of the tissues at the seat of the implantation—the pabulum from which may spring the direful harvest.

Upon this tripod at present rests the scientific basis of modern wound-treatment. The problem, then, confronting the surgeon is easily subdivided into two chief factors. The first factor, based upon the accepted premise that the vital organism with which surgery has to deal in itself in health is free from bacterial infection, protected from without by a coat of mail, when unbroken impermeable to invasion; and from within, through its mucous surfaces, by a similar disposition of protective cells; hence all operative wounds made in such tissues should be, as far as possible, made and maintained aseptic. The second, when septic, to determine the best measures to be instituted for the destruction of the infecting organisms.

The ideal of wound-treatment is surely to restore the condition of the parts as nearly as possible to their primal state.
If this can be assuredly aseptic, then there are no bacteria to remove; if the wound is surgically clean, with accurate coaptation of the sundered parts, then the vital forces are sufficient to utilize any resultant exudates, and drainage is not alone superfluous but harmful. If the leucocytes go promptly to work under such favorable conditions the first series of the repair processes take place, which ends in a prompt and speedy restoration. This should be effected under a dressing which will permit of the introduction of no foreign factorage.

Complete closure of an aseptic wound by buried aseptic animal sutures, retained at rest with a germ-proof dressing, comes nearer to the ideal than any method yet advised. There is no fear of haemorrhage in an aseptic wound thus closed. There is no further danger from infection, and clumsy and expensive antiseptic dressings are entirely avoided. Little subsequent care is requisite on the part of the surgeon or attendant, and the patient is relieved of the fear from subsequent suffering in the removal of sutures, is almost free from pain, and rapid recovery supervenes.

The experience of the centuries teaches that septic wounds, which were the rule after operation for strangulated hernia, occasionally resulted in a permanent cure. The cicatization was slow, the wound closed by granulation, with contraction of the parts and the long rest in bed that such a wound necessitated, did much to favor the result. This is noteworthy in a number of the methods formulated in the history of the operative measures already given. This was especially true of the charpie ball of M. Petit, which was first soaked in spirits of wine, with which the wound was packed, and then it was covered over with large compresses of the same material. Doubtless this kept the wound aseptic, resulting in healthy granulations, with the safest and most rapid cure possible to the open-wound treatment. I can not question that good results followed as a rule, and the contrast of this treatment with the ordinary suppuring wounds must have been very striking. Rather than wonder at Petit's enthusiasm, and the adoption of his method for a considerable period, it seems the more remarkable that it should have fallen into disuse, and to have had substituted for it far less scientific and satisfactory measures. We see in this a prototype of a modern method of cure for hernia which is called after its able and enthusiastic advocate, Dr. Charles McBurney, of New York, who wrote me, under a recent date, "my experience continues to prove in the highest degree satisfactory; but, owing to inability to trace the subsequent history of my patients, I am unable to give statistics as to the percentage of cures, but, so far as I can determine, every
case of femoral hernia thus treated has remained without relapse." The essential features of his operation are dissection of the sac to its base, ligation, and removal. The wound is sutured in a manner to prevent the divided edges from reuniting. The wound is then stuffed with a dressing of iodoform gauze and left to granulate. This method has sometimes been called the open-wound method of treatment, to distinguish it from that of suturing and closure in the attempt to secure primary union. The dissection in either instance remains much the same. The cure by the so-called open-wound method has also been used in distinction from the subcutaneous suturing, which is for the most part now abandoned. From this has arisen a confusion of meaning as to the term "open wound."

A very small class of surgeons think the excision of the sac the primal factor, and all-sufficient to effect a cure. However, it needs little argument to show that, if cure results, it is not from the closure of the peritoneum alone, but rather from the firm union of the parts which constitute the restored abdominal wall. There are several objections to this method. It does not allow of the reformation of the obliquity of the canal. Moreover, a granulating wound, even if aseptic, heals slowly, and the resultant cicatrix is inelastic, and often painful for a long period.

The subsequent operative procedures are, in my judgment, far more important than the disposition of the sac. In a former chapter, upon the anatomy of the inguinal canal, it was demonstrated that it is constructed to course through the abdominal parietes so obliquely that ordinary pressure from within outward serves to bring its walls into lateral apposition.

In the following plate from Cloquet, the deep dissection was made so as to demonstrate the vessels and their relations to the deeper portions of the inguinal canal. A considerable portion of the fascia transversalis has been cut away on this account, but Poupart's ligament has been retained, and, although the dissection was not intended for this purpose, it would be difficult to find a more beautiful demonstration of the oblique direction of the inguinal canal within which the spermatic cord finds easy lodgment. This disposition of the parts is the more noteworthy since, in the normal condition, muscular activity and violent exertion, regardless of the position of the body, has little or no effect in disturbing the relationship of the parts. Intra-abdominal pressure only serves to close the lateral walls of the canal, while the attachment of the cord to the surrounding parts is such that undue strain or tension is scarcely possible.
PLATE LXII.*

VIEW OF THE DEEPER STRUCTURES, ESPECIALLY SHOWING THE VESSELS AND SPERMATIC CORD
OF THE RIGHT SIDE.

A. Rectus abdominalis.
B. Pyramidalis.
C. Tendon of the rectus.
D. Portion of the fascia transversalis.
E. Aponeurosis of the external oblique muscle.
F. Another portion of the fascia transversalis
G. External iliac artery and vein.
H, H. Femoral artery.
I. Femoral vein.
K. Vena saphena uniting with the femoral vein.
L. Epigastric artery. The vein has been divided.
M, M. Spermatic vessels.
N. Vas deferens, forming an angle at its union with the blood-vessels of the testis.
O. Part of the proper sheath of the spermatic cord.

P. Spine of the pubes, giving insertion to the external or inferior column of the inguinal ring.
Q. Superior aperture of the crural canal.
R. Lower border of the aponeurosis of the external oblique forming the crural arch.
S. Superficial layer of the fascia lata detached from the crural arch, and reflected in order to exhibit the deeper layer of the same aponeurosis, the crural canal, and the femoral vessels.
T. Deep layer of the fascia lata forming the posterior wall of the crural canal.
U. The same layer fixed to the crista and superior border of the pubes.
V. Gimbernat’s ligament.
W. Sartorius muscle.
X. Semilunar edge, which forms the lower boundary of the inferior aperture of the crural canal.
Z. Fascia lata covering the Sartorius muscle.

The problem is to reconstruct and narrow the canal. Nature must be our guide in its solution. The ureter in its entrance into the bladder permits the flow of the urine in only one direction. The more distended the bladder, the more firmly are the orifices closed. In like manner intra-abdominal pressure closes the normal inguinal canal. In both instances the obliquity of the canal is the necessary condition for the accomplishment of the object desired. Therefore, the most important of all the measures to be sought in the cure of inguinal hernia is the restoration of the obliquity of the canal. This can only be effected by a free dissection of the parts, since the restoration must commence at the internal ring. I can not help thinking that to this fact, rather than the peculiar disposition of the sac, the good results of Mr. Macewen’s operation are due. His method of restoring the canal, so far as suturing the external pillars of the ring, is excellent.

Where the hernia is of long duration and large, the parts are deformed, and the criticism of Mr. Banks is correct, that the aponeurosis of the external oblique muscle, stretched and attenuated, leaves little material for the suturing of the external ring. In

* Cloquet, Plate III.
these cases the hernia approaches to the form called direct—i.e., the opening appears to be almost at right angles to the plane of the abdominal wall. It is in this form of hernia that the cure is especially difficult. The method which I advocate, and have practiced for many years, has been followed by most excellent results in the hands of a considerable number of operators. The cord is gently pushed aside, and the internal ring is narrowed from below and within, upward and outward, leaving only sufficient space for the cord at its upper and outer border.

This is best effected by the use of the buried double tendon suture, and it is not nearly as difficult as would at first appear. It will be remembered that the cord emerges from the internal ring normally by a small opening through the transversalis fascia, which is greatly strengthened and re-enforced by firm connective-tissue bands throughout the lower portion of its course. The following figure shows the re-enforcing bands of subperitoneal fascia which normally strengthens the internal rings, both inguinal and crural.

Although this fascia has become pathologically dilated and deformed in hernia, it is yet easy, by penetrating it with the needle at some distance upon either side, to find a firm fibrous margin for the support of the sutures. When these are drawn together the relaxed tissue is intrafolded, and a proliferation of connective-tissue cells along the line of suturing makes a firm support to the posterior border of the reformed canal. The following plate, taken from Mr. Cooper's work, should be studied in conjunction with Plate XXI; but it is introduced in this connection to show the dilatation and deformity of the internal ring when the hernia is at all pronounced. At x, although the hernia is regarded as incipient, the changes which have ensued are so marked that the inner mar-
gin of the internal ring has been depressed for several lines, while at \( w \) the mouth of the large inguinal hernia extends quite toward the symphysis pubis. The obliquity of the canal has been lost in the deformation. This plate shows clearly the importance of reconstructing the internal ring, and re-enforcing the weakened tissues which make up the inferior wall of the canal.

**PLATE LXIII**

Is an internal view of the preparation contained in Plate XXI. It exhibits the orifices of the two herniae in the abdomen, and shows the change of place which the mouth of the sac undergoes as it enlarges, by approaching nearer than at its first descent to the symphysis pubis. The origin and course of the vessels connected with the disease are shown.

- **a.** Situation of the symphysis pubis.
- **b.** Spinous process of the ileum.
- **c, c, c, c.** Abdominal muscles drawn downward.
- **d, d.** The thigh.
- **e, e.** The psoas muscle upon each side.
- **f.** The spine.
- **g, g.** The kidneys.
- **h, h.** Aorta.
- **i, i.** Iliac arteries.
- **k, k.** Epigastric arteries, arising from the iliac arteries, and passing between the mouths of the hernial sacs and the symphysis pubis, but still near to the inner side of the mouth of each sac.
- **l, l.** Spermatic arteries, arising from the aorta, and passing out of the abdomen behind the hernial sacs.
- **m, m.** Inferior cava.
- **n.** Iliac vein.
- **a. a.** Epigastric veins accompanying the epigastric arteries.
- **g, g.** Spermatic veins, arising upon the right side from the inferior cava; on the left, from the emulgent vein.
- **r, r.** Emulgent veins, which in part cover the emulgent arteries.
- **s, s.** Ureters.
- **t.** Urinary bladder.
- **v, w.** Vasa deferentia passing to the posterior part of the bladder.
- **x.** Incipient inguinal hernia; its mouth seen midway between the spine of the ileum and symphysis pubis.
- **y, y, y.** The peritoneum.

As I pointed out when discussing the etiology of hernia, the large proportion of all the cases of hernia are of the inguinal variety, and surgical procedures, to effect a radical cure, must be especially adapted to this form. I have followed out in detail, in a previous chapter, the history of operative measures instituted and attempted for this purpose, through the literature of surgery, since the problem has been for more than two centuries clearly defined in its varying factorage, and the best minds of the generations have given unwearyed, devoted study to its solution.

The necessary patency of the canal is the one condition more than any other which has been the reason of failure to effect a radical cure. To *constrict* and not *occlude*
the canal, to allow the free escape of the cord with unimpaired circulation and function, and to retain within the abdomen all besides, are problems the happy solution of which, by the delicate adjustment of means to ends, is scarcely exceeded in interest in all surgery.

For a considerable period in the earlier history of operative measures the resultant cure was effected by the sacrifice of the testicle and cord and the end attained by this means was so satisfactory, and such numbers sought relief even at this cost, that it was after a time forbidden by legal enactment. Open dissections fell into disuse, only to be revived with the introduction of the principles of antiseptic surgery.

Subcutaneous closure with the wire suture led up in a measure to, and made the way for, again resorting to the free-dissection method, and closure of the canal and rings, by suturing in a considerable variety of manner. Success by this method, however, could not be assured until antiseptic surgery taught the measures necessary to secure the closure and retention of the wound free from infection.

In the review of the recent literature of surgical procedures which I have given at length in the previous chapters, there is abundant demonstration that the operation for the radical cure of hernia can be undertaken with the assurance of success almost if not quite equal to that of any of the well-established surgical operations.

I have incorporated the experiences of the most distinguished surgeons of Europe and America, as far as I have been able to collate them, and although they are very far from being complete, and, like all statistical tables, imperfect and unsatisfactory, still they give a pretty clear idea of the work being done in this field of surgery, and show the great advance made, not only in the surgical procedures adopted, but also in the results attained. These experiences include about three thousand operative cases; and while the mortality may seem somewhat large, most of the deaths are explained as having been the result of either too long delay after strangulation before operation, or as due to accidental causes rather than to the operation, as pneumonia or feebleness on account of age. Even when permanent cure has not been effected, it is the decided exception that the condition of the patient has not been improved; in other words, a large scrotal hernia has been exchanged for one easily retained by a light truss, an irreducible and incarcerated hernia for one under easy control. The remote results are not sufficiently defined to tabulate, for the reason that many operators agree that it is necessary that a hernia should remain for a considerable length of time—one to five
years—without evidence of return before it should be classified as permanently or radically cured.

The general consensus of surgical opinion at present emphasizes the factorage of operative measures in the treatment of inguinal hernia, as: First, the free dissection, under rigid antiseptic or aseptic precautions, of the structures, making the incision sufficiently large to demonstrate the condition of the parts. Second, the treatment of the sac. The earlier methods were numerous, and consisted in invagination of the hernial sac; cauterization of the orifice and the neck of the sac; ligaturing the same; incision of the sac and subsequent healing of the wound by granulation; detaching the sac from its connections and returning it into the abdomen; excision, suture, and scarification of the sac; immediate and forcible compression of the sac by bandaging and applying a truss, and the use of stimulating injections. But, with the revolution in the surgical treatment of wounds, there were instituted new principles and methods of operative procedures.

All surgeons now agree as to the importance of the peritoneal pouch as a factor, but differ widely as to the manner of its disposition. It may be returned to the abdomen unopened, and the canal closed with sutures. When this is done, especially if the hernia is small and the internal ring remains firm, it is probable that it slowly contracts and becomes greatly diminished in size; very likely it is often consolidated into a puckered mass which remains for a considerable time as an indurated swelling. This may serve as a wedge to reopen the pillars of the ring, rather than as a buttress of defense. When a depression remains over the internal ring we have not only a peritoneal pouch, but also a weakened, slightly open ring. In this condition the wave-like motions of the intestinal fluid contents impinge into the recess, weakening and dilating the parts, until, upon some severe strain, there comes to the knowledge of the sufferer a giving way of the structures—a rupture occurring suddenly.

If the sac is of considerable size, the general opinion, although not accepted by all surgeons, is that it should first be opened to ascertain its contents, if any, and its relation to the canal and the rings. The objection urged against it being opened is that it is continuous into the abdominal cavity, and a peritonitis might be engendered. This is not, however, considered valid by antiseptic operators.

It is also generally advised to dissect the peritoneal sac quite freely, after opening, to within the internal ring, and this for the purpose of securely closing its abdominal orifice. The profession are divided as to the best means of effecting this closure.
The majority of surgeons advocate ligaturing or suturing: some adopt Mr. Ball's method of twisting the sac and a retaining suture as more likely to obliterate the peritoneal pouch; others, more recently, have followed Mr. Macewen, adopting his ingenious method of puckering the sac into folds and drawing it quite within the ring, to become attached, and thereby serve as a buttress to deflect the intestinal impulse.

It may rarely happen to the operator, who has opened the abdomen for some other purpose, to find the complication of hernia. When the section has been made considerably large, as in the removal of a large tumor, the internal abdominal ring is within reach of the surgeon. Upon reflection, it would naturally occur to any operator that under these conditions it is better to close the internal ring, and reform the smooth internal parietal surface from within by means of suturing. My friend Dr. N. Bozeman, of New York, easily did this at my suggestion in a case of ovariotomy more than ten years ago.

In Chapter IV, in which the formation of the sac was discussed, it was shown that the normal peritoneum, within a considerable limit, is elastic; and there can be little doubt but that, when the sac is freed quite within the ring, it can be safely drawn down and ligatured or sutured, so that very little, if any, depression upon its inner surface will exist. I have verified this fact in a number of instances. In one case already mentioned, a female upon whom I had operated for the cure of inguinal hernia upon both sides, death occurred later from rupture of a cerebral vessel. Upon the one side I had returned the sac, which was about the size of an egg; upon the other side the sac was much larger, and I had dissected it, and when drawn tense sutured it quite within the ring, and excised. The autopsy showed, upon the side where the sac had been returned, a slight puckered peritoneal depression, although the closure of the abdominal wall was firm and unyielding. Upon the other side the peritoneum was firm and smooth, without depression, and exhibited as the only mark of resection and suturing a slight adhesion at the site of the obliterated internal ring.

The advantages of Mr. Macewen's buttress are probably more theoretic than real. The use of the sac sutured and retained as a plug to close the ring has been very generally abandoned as unsatisfactory. Nearly all operators at present consider the sac, when large, an abnormal, deleterious portion of useless material to be removed. Utilized as proposed by Mr. Macewen, if it forms a buttress, as supposed, for receiving the intes-

* See p. 346.
tinal impulse, may it not be equally inferred that it might act as a wedge to press unevenly against the newly formed tissues of the restored canal, and thereby cause harm, rather than serve as a deflector of the pressure? Although the peritoneum forms a pouch or pocket surrounding the hernial contents, Nature did not intend it to serve as a part of the supporting abdominal wall, but rather, by an even, elastic, smooth surface lining the firm muscular and tendinous structures, to allow the abdominal contents to glide easily and evenly in every direction. It is very probable that, when the peritoneum is thus disposed of, its vascularity and nutrition reduced to the minimum, absorption slowly ensues, and in the end leaves a smooth, even surface. If Mr. Mac-ewen's disposition of the sac has the advantage, as he believes, in serving as a re-enforcement to the parts, it might be inferred that this construction should have entered into the primal organization of mankind.

The effort of the surgeon should be to restore, as far as possible, the primal conditions. The peritoneum is normally slightly intrafolded at the ring, but loosely attached, and can be quite freely moved by slight traction in all directions, independent of the other structures which enter into the construction of the abdominal wall. Because the internal ring is ovate instead of circular, it is better to inclose the mouth of the sac in the direction of its longer diameter, as less likely to leave folds. This gives, as the resultant, a smooth rather than a puckered peritoneum, in the highest degree vitalized and resilient, as freely movable as possible upon its exterior, loosely attached fascia. In the attempt to effect this, no method is superior to that which closes the mouth of the sac with a continuous seam. However, there is no doubt but that good results follow any method which closes the mouth of the sac and effects its obliteration.

Having closed the peritoneum so that there shall be no depression at the mouth of the sac, it will be found, in all hernia of any considerable size, that the internal ring has
become greatly enlarged, almost exclusively at the expense of the tissues upon its lower and inner border. This foreshortens the inguinal canal to such a degree that its oblique direction is always diminished, and often it becomes the acquired form of direct inguinal hernia. The tissues which constitute the posterior wall of the canal are sometimes attenuated, but more generally they are found to have become considerably thickened on both sides of the opening—an apparently fruitless attempt of Nature to re-enforce and strengthen the structures.

![Fig. 29](image-url)

**Fig. 29.**—Inguinal hernia, showing the manner of closure of the internal ring, with the double continuous tendon suture. The needle is rethreaded for withdrawal.

**Fig. 30** represents the line of external sutures loosely taken, uniting Poupart’s ligament to the conjoined tendon. The spermatic cord is seen beneath the sutures, escaping externally below the knot.

It is manifestly of the first importance to reunite these tissues about the cord at its exit from the abdominal cavity. This is accomplished without difficulty by lifting the cord from the inguinal canal* and elevating it at its exit to the upper border of the internal ring. Having done this, the tissues comprising the posterior wall of the canal are carefully brought into juxtaposition by a continuous double-tendon suture.

The base or posterior portion of the canal having been re-enforced and elongated

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* See Plate LXIV, p. 399.
by the closing from below upward of the internal ring, the cord is replaced, and the
incision which necessarily extended as far as the internal ring is sutured. Usually the
tissues have become much thinned and weakened owing to the stretching of the parts from within by the pressure of the hernial tumor, and by the wearing of instrumental supports to retain it.

Fig. 30 shows the method of uniting Poupart's ligament to the conjoined tendon by a row of double sutures, which is an effective way of firmly closing and reforming the external portion of the inguinal canal.

PLATE LXIV.

Figure 1

Represents the free dissection of an inguinal hernia.

a. The spermatic cord elevated upon a hook.

b. The posterior fold of the relaxed transversalis fascia lifted between the thumb and finger a little below the opening of the large internal ring, ready for the introduction of the needle carrying the suture for the first stitch. It is only in excep-
tional cases that the tissues can be thus grasped. When less relaxed they are elevated upon a hook.

Figure 2

Represents the introduction of the needle threaded with the suture. The loop is left loose, to be pulled through and unthreaded. The needle when unthreaded is to be threaded with the longer opposite end of the suture and withdrawn, carrying the suture with it, thus completing the first stitch.

Fig. 31 serves an excellent purpose in demonstrating the structures external to the transversalis fascia which are to be united beneath the cord by a line of sutures. The lower border of the transversalis muscle is joined in an even approximation from above downward to the deep insertion of Poupart's ligament by a double continuous tendon suture.

A line of external sutures is taken to unite the lower aponeurotic border of the internal oblique and the external oblique muscles to the thick fascia extending over and blending into Poupart's ligament. These structures may be included in a single line of suturing, but the resulting union is often stronger, and larger surfaces are approximated by suturing in two layers. The tissues to be joined are fairly well shown in Fig. 32, also from Gray.

By reference to Plate XXX, from Blandin,* it will be seen that by the normal disposition of these structures very great strength is obtained, with power of resistance from direct intra-abdominal pressure. The dissection also shows that which in hernia

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* Page 121.
is usually much more marked than normally—the interblending and intrafolding of these aponeurotic structures. The restoration of these structures to a normal condition if often best effected by the folding in upon each other of the borders of the divided tissues by continuous suturing.

The soft parts external to the muscles and the skin are united, as has been previously advised, and the line of incision sealed with iodoform collodion.

In the dissection for the exposure of the parts, it is well to remember that there is a superficial artery of some size—the external epigastric—which courses across the parts in the neighborhood of the external ring. This is sometimes of such a considerable size that it misleads the inexperienced operator into the belief that the larger epigastric vessel has been severed. It is often unavoidably divided in the operation.

In the reconstruction of the parts, as above outlined, it will be observed that the spermatic cord is inclosed within a canal restored to its normal size, length, and obliquity. The superficial tissues and skin are closely and evenly approximated by the buried sutures. This is the more important, since we are enabled to do away with the drainage-tube,
never required in any wound where aseptic structures are to be approximated, although of the greatest value in septic wounds. The avoidance of the drainage-tube renders available the closure of the wound by a germ-proof dressing; the advantages of which can hardly be overestimated in the protection of the wound made for the cure of hernia.

The accompanying plate illustrates the author's method of the suturing of wounds, as well as of the coaptation of the skin by a running buried animal suture.

PLATE LXV.

Diagramatic illustrations teaching the author's method of coapting structures by means of the double continuous animal sutures.

Figure 1. The needle, having pierced the tissues, has been unthreaded, and is rethreaded with the opposite end of the suture, ready for withdrawal.

Figure 2. The needle has been withdrawn through the opening made when it pierced the tissues, carrying the suture with it, thus completing the first stitch, which is shown as a loose loop ready for tightening.

Figure 3. The needle, still threaded with the end of the suture, is ready for its second insertion which should be about a quarter of an inch from the first.

Figure 4. The needle, having pierced the tissues for the second stitch, is ready to be unthreaded, and then is to be threaded with the opposite end of the suture, as before, and withdrawn.

Figure 5. The end of the suture which has been carried through with the needle at its second insertion is unthreaded, and the needle, rethreaded with the opposite end of the suture, is ready for withdrawal, and this will complete the second stitch.

Figure 6 shows several stitches completed and loosely drawn, the better to exhibit the method of continuous suturing. It will be observed that, when the sutures are drawn more closely, the parts are evenly coapted and firmly held in position without undue pressure.

Figure 7. This imperfectly illustrates the coaptation of the posterior border of the inguinal canal, the cord having been held aside by an assistant.

Figure 8 shows the spermatic cord replaced beneath the line of suturing, and two stitches loosely drawn, taken through the superficial structures for the purpose of inclosing them and covering in the cord. It will be readily observed that this method of suturing is adapted to a great variety of uses, especially where it is desirable even to coapt and inclose divided structures. For a long period I have used it in a great variety of wounds, especially for uniting in layers the abdominal wall in laparotomy, and the rejoining of the widely retracted structures in the restoration of the pelvic floor—perineorrhaphy.

Figure 9 represents the running buried-tendon suture for the coaptation of the skin. The needle is introduced through the skin at a little distance from one angle of the wound, emerging in its deeper layer. At a point directly opposite the emergence of the suture the needle is introduced parallel to the cut surface, only two or three lines from its edge in the deeper layer of the skin, and is buried in it about a quarter of an inch or less, marking the length of the stitch. This is repeated upon the opposite side, the needle again entering exactly opposite its point of emergence, and thus the suturing is continued the entire length of the wound. When the last stitch is completed, the needle is carried from within outward through the skin, to emerge at a little distance beyond the limit of the incision. As each stitch is taken, the tendon may be drawn sufficiently tight to coapt the edges of the wound, and this is usually sufficient for an even approximation of the parts. There is, however, an advantage in leaving the distal ends to escape a little beyond the limit of the incision, since by drawing upon them the tension is made uniform, and the edges of the skin accurately brought into apposition. It is important that each stitch enters exactly opposite the point of emergence of the previous one, otherwise the line of approximation will be wavy or puckered. If this is at all
nounced, small portions of the skin will become everted, and the subsequent repair processes greatly retarded.

In wounds thus sutured, primary union ensues without cicatricial deposit, and some months later it is often difficult to trace the line of the incision.

_Inguinal Hernia in Woman._—Inguinal hernia never assumes in the female the importance that is attached to it in the male. The peritoneal entrance to the cord is usually surrounded by firm aponeurotic structures, which, when weakened, can rarely dilate into a pouch which compares in size or complexity with that of a scrotal hernia. The problem confronting the surgeon is therefore a simple one, even if the opening into the abdomen is large and nearly direct. The serious factorage, when such exists, is in the thin-walled condition of the abdomen, made abnormally so by the dilatation and weakening of the parts about the ring, often the result of child-bearing and the faulty pressure of a strong truss.

When the inguinal hernia is small the operation is usually very simple. The sac is generally thin-walled, and may be disposed of in a variety of ways, which have been already discussed in the consideration of the various methods advocated for the cure of hernia. If thin and small, as is generally the condition in children, it is oftentimes better to twist it carefully upon itself, as a means of freeing it from its attachments and of "taking up the slack" of the peritoneal pouch about the ring. This done, ligature or suture it, as seems most advisable. When uncomplicated by an irreducible condition of contents (adhesion, incarceration, or strangulation), it is admissible in some instances not to open the peritoneal sac, which simplifies somewhat the operation, and certainly renders it safer in the hands of many operators.

When the peritonæum has been disposed of in a manner to prevent pouching at the orifice, and the redundant portion cut away, the subsequent operative measures are not unlike those for any wound made in _aseptic_ tissues. The sides of the wound must be coapted by that method held in most favorable consideration by the operator. The wound is comparatively small, and I can not but believe that, by whatever method it may be rejoined, drainage is positively harmful. The edges of the wound must be carefully approximated, and the dressing applied so as to prevent subsequent infection. I have elsewhere emphasized my own method, and given the reasons why a far more satisfactory result is obtained by the use of the buried-tendon suture and the wound sealed with iodoform collodion.

When the sac is large and the abdominal wall thinned, the manner of closing the wound is even of far greater importance. The peritonæum is shut off by a line of su-
turing, the neck of the sac having been made tense by withdrawing it well from the wound. I think it is a manifest advantage to open the sac before suturing, not alone to be assured that a misplaced stitch does not penetrate an abdominal viscus, but when open the surgeon is much better able to determine the even suturing of the relaxed peritoneum. The double continuous suture is of great service in accomplishing this purpose. Having resected the redundant peritoneal pouch, the subsequent steps of the operation should be conducted under irrigation, guiding the point of the needle upon the finger so as not to penetrate the peritoneum; inclose upon either side a very considerable amount of the attenuated abdominal wall, since joining the pillars of the canal in this way permits the folding up from either side of quite a portion of the aponeurotic structures, which thus greatly re-enforces and strengthens the parts.

In some instances I have felt it was a manifest advantage to coapt the thinned abdominal wall by a so-to-speak flap-splitting method; in other words, to divide the muscular layers and coapt them so as to invert the deeper structures and exsert the superficial layers, thus greatly thickening the attenuated parts in the same way as already advised and figured in the discussion of the best method for the re-enforcement of the structures involved, where similar conditions exist, only in a more marked degree, in large umbilical hernia.* This is not difficult by the double continuous suture, and it serves also an admirable purpose in strengthening the abdominal wall in inguinal hernia in the male when it has been weakened under the long-continued pressure of a truss. It is important to remember that the sutures must not be drawn too tightly, since fixation and retention at rest, and not constriction, are the objects to be attained. I have several times coapted in this way for some inches in length and quite a finger's breadth upon either side, the attenuated, weakened abdominal wall. When thus united, it is noteworthy to observe the cell proliferation that occurs along the line of union, which may be traced for months afterward as a re-enforced, thickened band along the line of the former opening.

Femoral Hernia.—What has been said in relation to the operation for the permanent cure of inguinal hernia, may be emphasized when we take into consideration the operative measures to be advised in cases of femoral hernia. The relation of the sac and its contents to the surrounding parts has been fully discussed in the chapter on Femoral Hernia, in which also the greatly increased danger attending this

* See chapter upon Umbilical Hernia, p. 190.
variety was clearly pointed out and the importance of early operative measures emphasized. When the ring is sufficiently large to allow the occasional escape of a loop of intestine, the individual runs a risk of life never to be underestimated. The retention of the contents by a truss is more difficult than in inguinal hernia, and when strangulation occurs the danger is much greater, owing to the tense, firm, sharp border of the ring.

Until recently, the radical cure of femoral hernia was rarely if ever taken into consideration. The treatment advised, after the operation for a strangulated femoral hernia, was drainage, dressings to prevent the contamination of the wound by infection, packing with gauze, lint, etc. In this manner permanent cures often resulted from the cicatricial contraction which followed, but it is only within a short period that a systematic attempt for the purpose of radical cure has been taken into serious consideration. The ingenious application of Mr. Macewen's method for the closure of the ring and the narrowing of the canal, as illustrated in the case of Dr. H. W. Cushing, of Boston, has already been described. The disposition of the sac, however, after his method, is open to more serious objection than in inguinal hernia, leaving, as it must almost of necessity, a hard, painful swelling slow to disappear.

To one familiar with the anatomy of the parts involved in femoral hernia the dissection is not difficult, and the introduction of the sutures quite easy. Success is dependent upon doing away with the sac, and the narrowing of the ring and the canal to the minimum consistent with the safety of the vessels. When this is done aseptically, it is surprising to note how closely the vessels can be closed down upon, without the slightest disturbance of the circulation.

The operation having been determined upon the parts are carefully shaved and disinfected, and the incision is made through the skin and external tissues obliquely over the site of the hernial tumor. The dissection is continued until the femoral ring is reached. Often difficulty is experienced in seizing upon the hernial sac, since very commonly the contents of the hernial tumor have previously been restored to the abdominal cavity. When the sac is thin and small it is frequently difficult to isolate it, and this is of far less importance under these conditions than when large and thick. It is better, as a rule, to separate it from the surrounding parts quite to within the ring, and open it to be assured not only that it is empty, but also, by carrying the tip of the finger quite within its neck, the better to direct the needle while sewing it off at its base. When closed at its neck, excise the redundant portion and return the sutured
FUNDAMENTAL FACTORS IN THE CURE OF HERNIA.

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base within the ring. The next step in the operation is the introduction of the needle, with eye near the point, armed with the suture for the purpose of inclosing the dilated part of the ring. This is the more delicate procedure in the operation, since puncture of the femoral vein would be followed by most serious consequences. The vessel in its sheath is protected by the finger by pressing it gently outward. The needle is inserted from below through the falciform process of the fascia lata, care being taken to avoid the internal saphenous vein, upward through Poupard's ligament; the needle is unthreaded, rethreaded with the opposite end of the suture, and withdrawn. In this way the parts lying parallel to the vein are included in a loop-stitch, coapting the structures closely upon the sheath of the vessels.

A second stitch is taken through the same tissues parallel to the first, about a quarter of an inch nearer to the median line. A third is introduced through the pubic portion of the fascia lata exterior to the saphenous opening, and the needle is carried through Gimbernat's ligament in order to fold the strong fascia inward. In this manner the

---

Fig. 33.—Femoral hernia, showing the first stitch taken through the borders of the ring, for the purpose of occluding it. The needle is to be unthreaded, and threaded with the opposite end, in order to complete the loop or first stitch.

Fig. 34.—Femoral hernia, showing the second stitch taken for the closing of the ring, by the use of the double continuous tendon suture. The stitches are represented as loosely drawn, in order the better to show the method of suturing. The needle is passed through the firm pubic fascia and the outer border of the saphenous opening, and when drawn closely will fold the latter inward.
ring is closed, and the parts are drawn inward and upward, to become firmly fixed to Poupart's ligament.

In this way the peritoneal pouch is obliterated and the margins of the ring approximated. Folding over the fascia carries the saphenous opening quite a little to the inner side of its former site while the femoral vessels remain undisturbed in their sheath. The superficial tissues and skin are coapted by buried sutures, and the line of incision is held firmly at rest with iodoform collodion. This dressing remains undisturbed, and if the wound is aseptic it will loosen at the expiration of a week or ten days by the exfoliation of the epidermal cells to which it was attached.

It is generally wise to repeat the collodion dressing as a precautionary measure, although probably not necessary.

Fig. 35 in a diagrammatic way shows the femoral ring closed obliquely from above.

![Fig. 35](image1)

**Fig. 35.**—The suturing of the femoral ring completed. The stitches are left loose in order to show the direction of the sutures.

![Fig. 36](image2)

**Fig. 36.**—Exhibits the closure of the femoral ring, and the relation of the suture to the femoral canal.

The suture has been carried just internally to the sheath of the femoral vessels, which are seen slightly compressed in their sheath.

The patient is allowed to sit up at the expiration of a week, care being taken to protect the parts from undue strain. Permanent cure of femoral hernia does not seem to be especially difficult when treated in a variety of methods. Both Mr. Macewen and Dr. McBurney have written me quite recently that they do not know of a single recurrence among their own cases.

Until the structures become consolidated it is important to avoid active exercise,
the patient being permitted to undertake only light duties for some months. If the
parts are examined when the tissues are relaxed, a marked exudation will be felt along
the line of the suturing, which does not disappear for weeks. I can not but think the
advice given to wear a light truss for a considerable period is harmful. It interferes
with the processes of consolidation, and causes absorption of the newly formed tissue.

_Umbilical and Ventral Hernia._—Little is required to be added to the discussion
already given upon this variety of hernia. Laparotomy is considered in itself by many
surgeons to be attended with so little danger as to be counted almost a minor operation.
This is certainly true in exploratory incisions made under careful aseptic conditions.
The removal of a large umbilical hernial sac when emptied of its contents is scarcely
more than an exploratory laparotomy. In the reducible variety the abdominal contents
are not disturbed, often not even seen. The sac is resected and the parietal walls closed.
When we remember that the intra-abdominal tension is generally much greater than
normal, it is usually wise to pass deep stay sutures, to hold the wound firmly at rest as
in a splint until union is effected. Ventral hernia may be classed with umbilical in the
general direction for operative measures.

Regarding the value of statistics as applied to herniotomy, Mr. Birkett writes:* "It is, however, quite clear that we are unable to collect any facts upon which to
institute a safe comparison. Conclusions as to the success of the one practice or the
other, based upon the results of the cases under treatment, in the hospitals, are really
worthless, because the incidents in any two cases of hernia are never precisely alike,
and accuracy as to details, which is absolutely required to arrive at the truth, can not
be obtained."

The following table, as far as I have been able, has excluded from it all strangulated
cases operated upon, and it clearly teaches at least one fact—the eminent safety of the
operation as undertaken for the radical cure.

The appended table epitomizes briefly the published results of the more prominent
operators given in Chapters XXIV and XXV:

<table>
<thead>
<tr>
<th>Operator</th>
<th>Operations</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Czerny</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Schéde's clinic</td>
<td>165</td>
<td>2</td>
</tr>
<tr>
<td>Socin</td>
<td>75</td>
<td>2</td>
</tr>
<tr>
<td>Championnière</td>
<td>254</td>
<td>2</td>
</tr>
<tr>
<td>Banks</td>
<td>166</td>
<td>No</td>
</tr>
</tbody>
</table>

ANATOMY AND SURGICAL TREATMENT OF HERNIA.

Banks...................... 68 reported cures, 44 known to remain cured.
Franks...................... 24 operations, no deaths.
Robinson, A. W.............. 26 " " "
Puzey......................... 24 " " "
Macuwen..................... 81 " " "
Bassini's clinic............... 262 " 1 " (pneumonia).
" " .......................... 216 patients operated on.
" " .......................... 108, no return from one to four years.
" " .......................... 131, no return from one month to two years.
" " .......................... 7 relapses, 4 untraced.
Anderegg.................... 55 operations, no deaths.
" ............................ 38 reported cured.
Robinson, H. E.............. 64 operations, 43 traced, 7 of which relapsed, 4 deaths.
Sabbatsburg Hospital........ 200 " no deaths.
Thiriar..................... 12 " " "
Léonté....................... 7 " " "
Routier...................... 14 " " "
Segond...................... 44 " " "
Richelot.................... 22 " 1 " (aged seventy years).
Allen....................... 23 " 1 " (umbilical adhesions).
Karewsker................... 63 " 3 "
Treves, number of operations not given, no deaths.
Wright...................... " " " " "
Rabagliati.................. 10 operations, no deaths.
Barker...................... 50 " 38 traced and 8 relapses, no deaths.
Wood....................... 339 " 7 deaths.
Alexander................... 30 " " "
MacCormac, number of operations not given, no deaths.
Ball....................... 22 operations, no deaths.
Cousens.................... 50 " 30 known to remain cured, no deaths.
Weir....................... 8 " no deaths.
McBurney.................... 27 " " "
Burrell...................... 8 " " "
Cabot....................... 3 " " "
Vanderveer.................. 2 " " "
Burchard.................... 9 " " "
Bull....................... 72 " 3 " (all accidental).
" .......................... 40 cases traced, 24 cured, 16 relapsed, 40 per cent of failures.
Park....................... 115 operations, 85 reported cured, no deaths.
Jones....................... 36 " no deaths.
Halsted..................... 5 " " "
Marcy....................... 112 " " "
" .......................... 78 traced, 4 relapsed.
Rickets..................... 12 operations, 1 relapsed, no deaths.

This list gives over three thousand cases operated on with less than one per cent of deaths, and these are generally explained to have been from causes which the authors state were accidental, and not due to the operation.

Every surgeon appreciates the difficulty of following the history of operative cases
through considerable periods of time. No operation has been to me of greater interest during the last two decades than that for the permanent cure of hernia. A large proportion of my operations have been in the practice of physicians, not hospital cases, which renders it much more difficult to trace results. I have very recently gone over my list of hernia operations for the purpose of adducing such evidence as my experience teaches. The history of many cases is utterly wanting, but the following tabulated list gives the results of such cases as I have been able to trace:

**ADULTS.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inguinal</td>
<td>In</td>
<td>38</td>
<td>11</td>
<td>49</td>
</tr>
<tr>
<td>Femoral</td>
<td>In</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Umbilical</td>
<td>In</td>
<td>6</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Ventral</td>
<td>In</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

**CHILDREN.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inguinal</td>
<td>In</td>
<td>5</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Umbilical</td>
<td>In</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

Total................. 78

Of the four recurrent cases, three returned within six months of the time of operation. Of these, two have been operated on for the second time and remain cured.

Two cases have been reported to me where the abdominal wall weakened, a bulging of the parts rather than a return of the hernia, and for which a light truss has been advised.

By reference to the normal anatomical construction of the inguinal canal, it will be observed that its obliquity is the primal and important factor in the prevention of hernia. The usual methods recommended for radical cure depend upon the closure of the internal ring, by ligaturing the neck of the peritoneal sac and the uniting of the pillars of the ring. This, as will be seen by the accompanying diagram, leaves the posterior triangle, bounded by the inferior border of the canal, the inferior abdominal wall, and the peritoneum, unclosed. The internal ring remains large, and the canal is thereby foreshortened and funnel-shaped—a necessarily imperfect protection from the return of the hernial protrusion. Mr. Macewen apparently recognized this "funnel-shaped depression" more clearly than any other operator, and, in order the better to fill this, devised the chief factor peculiar to his operation, the "bossing" with the in-
trafolded sac. By the use of the buried sutures in layers this triangle is completely restored and the obliquity of the canal is reformed.

In résumé.—Emphasis is to be placed upon the following conditions in all the operations undertaken for the cure of hernia, applied to the different varieties:

Carefully disinfect the hands of the operator and assistants.

Have in readiness aseptic sponges, towels, instruments, and use nothing which may come in contact with the wound that has not been sterilized.

Have the parts shaved and disinfected, if possible, before etherization.

Place the patient upon a table in a good light.

Cover the abdomen and thighs, except about the region to be operated upon, with light rubber sheeting. Over all place towels wrung from a 1–1,000 mercuric bichloride solution.

Maintain strict asepsis during the operation with the same care as in laparotomy for any purpose.

Conduct the stages of the operation under irrigation with a mercuric solution, 1–2,000, until the last stitch has been taken.

Under exceptional conditions the bleeding may be stopped, and the wound maintained dry during the entire operation.

With the use of irrigation often not a single sponge is required, and every part of the wound is clearly within the field of vision during the entire operation.

The Sac.—The peritoneal sac of the hernia should usually be opened and dissected free quite within the internal ring—i.e., all the adhesions which the peritoneum has formed to the ring should be separated. Tension is then made upon the sac, which is sutured at its base and resected. The tension should be such that when the sac is resected the sutured base will retract quite within the ring.
In inguinal hernia the dissection must be sufficiently large to free the cord to its exit from the internal ring; the cord is to be raised from the canal and the internal ring closed upon it from below upward, so as to reconstruct and re-enforce the posterior wall of the canal. In this way the canal is very considerably elongated, and the transversalis fascia is intrafolded and very much thickened. The spermatic cord is restored within the reformed canal, and the superficial structures are sutured in layers closely upon, but not so as to impair the circulation and nutrition of, the parts inclosed. In this manner the length and obliquity of the inguinal canal are restored, and its walls re-enforced and strengthened even in the largest of old direct hernia.

The superficial tissues are brought into apposition by a line of continuous buried tendon sutures, and the skin is coapted by the running parallel buried suture. Joining of the structures in this way does away with the necessity of drainage, and permits the complete closure of the wound. The line of the incision is dried, dusted with iodoform, and sealed with iodoform collodion.

PLATE LXVI.

Diagrams showing in inguinal hernia, the author's method of closure of the parts, and restoration of the obliquity of the canal.

Figure 1

Shows a commencing hernia; the internal ring dilated, the inguinal canal only slightly fore-shortened, the external ring unchanged. A loop of the small intestine has found partial lodgment at the internal ring.

*a.* Spermatic artery.
*b.* Inguinal canal.
*c.* External ring.
*d.* Internal ring.
*e.* Intestine.

*M.* Muscular fasciculus re-enforced by the transversalis fascia.

$p, p.$ Peritoneum.

*s.* Spermatic cord.

*t.* Abdominal wall above the inguinal canal.

$v.$ Vas deferens.

The arrows in each drawing represent the direction of the internal abdominal pressure.

Figure 2

Represents the hernial tumor slightly protruding through the external inguinal ring. The lettering corresponds with Figure 1, with the addition of the letter $h$, which marks the site of the hernial protrusion.

Figure 3

Shows the peritoneal sac sutured evenly across at its base and resected. The deeper structures forming the posterior wall of the canal have been coapted by a deep double continuous tendon suture closing the internal ring quite upon the elevated cord.

*a.* Spermatic artery.
*b.* Inguinal canal.
*c.* Structures posterior to the inguinal canal.
*d.* Former site of the internal ring.
*e.* Former site of the external ring.

$p, p.$ Peritoneum.

*s.* Spermatic cord.

$v.$ Vas deferens.

*W.* Superior border of the abdominal wall.

$l, s, r.$ First layer of sutures, including only the peritoneum.

$l, s, 2.$ Second layer of sutures, coapting and intrafolding the transversalis fascia, closing and elevating the internal ring.
ANATOMY AND SURGICAL TREATMENT OF HERNIA.

Figure 4

Letters the same as in Figure 3.

Figure 5

The letters indicate the same structures as in the previous diagrams.

Figure 6

Represents the canal of an inguinal hernia foreshortened nearly to the thickness of the abdominal wall.

Indicates the former site of the inferior margin of the internal inguinal ring in its normal condition.

The advisability of operative measures in any given variety of hernia is always to be seriously considered as an independent problem, the solution of which must ever depend upon many individual factors.

There can be little doubt that the surgery of the future will include a large percentage of the sufferers from hernia, which the conservative surgeon of to-day relegates to the truss-bearing army of invalids. Sir William MacCormac emphasized the results of his large experience as follows: * "I would conclude by saying that in a large proportion of cases of inguinal hernia, especially those of congenital origin, a radical cure is possible; and that in femoral and umbilical hernia of small or moderate size the prospects of cure are good. Even where an absolute cure is not accomplished, a great gain is generally secured in the diminution of the size of the hernial aperture, by which the retention of the hernia within the abdominal cavity becomes more practicable. Lastly, and more important, the operation when properly performed is scarcely dangerous to life."

Mr. John Wood concluded his lectures as follows: "It appears to me indubitable, from the results of the last twenty years' experience of the radical cure of hernia, that

the position of those surgical writers who have maintained that the radical cure should not be attempted except in the severest cases, is untenable. The operation has given as great relief and exemption from the minor troubles and worry which make life miserable as any operation associated with prolapse, such as haemorrhoids, and is even more safe.”

In 1858 Sir Spencer Wells wrote: “The relief of a strangulated hernia is justly regarded as one of the noblest triumphs of operative surgery. The surgeon saves the life of the patient without removing or deforming any part of his body. But the surgeon who cures hernia radically, with certainty and safety, is a greater public benefactor, as he not only relieves large numbers of his fellow-creatures from suffering, but he averts the danger of a strangulation to which they are continually exposed, in a greater or less degree, through every period of life.”
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