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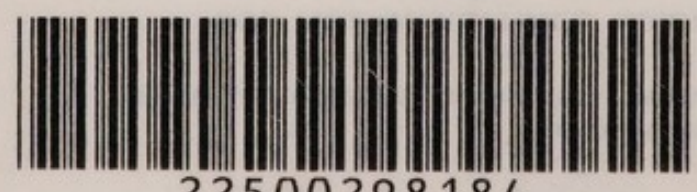

ATLAS AND EPITOME

OF

ABDOMINAL HERNIAS

BY

DR. GEORG SULTAN

First Assistant in the Surgical Clinic in Göttingen, Prussia

AUTHORIZED TRANSLATION FROM THE GERMAN

EDITED BY

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EDITORIAL NOTE.

THIS "Atlas of Abdominal Hernias" is certainly a most timely publication, and fills a long-felt want on the part of the general practitioner. The illustrations are not only very numerous, but they excel in character those of any other work upon hernia with which the writer is familiar. While the well-known work of Macready will always remain a classic, and will continue to be consulted as much as ever by all who desire to make a comprehensive study of hernia, this work has never made any claims to deal with the operative side of the subject, and this is a side that has been steadily growing in importance the last decade, until now it is absolutely essential to have a book to supplement such a treatise as Macready's. The present atlas of Sultan's seems to do this to an admirable degree, and I believe it will prove of very great value to the general surgeon as well as to the general practitioner.

WILLIAM B. COLEY.

NEW YORK, *June, 1902.*

PREFACE.

THE subject of abdominal hernia is one of the most important in the entire domain of medical teaching, since these hernias are not only exceedingly common, but the frequent occurrence of strangulation demands extraordinarily quick and energetic surgical intervention. In this respect the responsibility of the physician is unusually great, and he will have to decide between the life and death of the patient intrusted to his care more often, probably, than in any other affection. The treatment is productive of better results than in other affections, provided the condition is recognized early and that this recognition is followed by the proper therapeutic measures. In order to meet these responsibilities, however, a most thorough knowledge of the entire subject is necessary, and the details of this subject extend over a wide field.

If this book should succeed in awakening an interest in abdominal hernias among physicians and students, and in inciting them to a careful study of the subject, I shall consider that my labors have been rewarded.

Professors Braun, Orth, and Merkel, of Göttingen, have greatly assisted me by placing at my disposal the abundant material of the Surgical Clinic and that of the Institutes of Anatomy and Pathology. I am also indebted to Professor Nauwerck, of Chemnitz, for two valuable

specimens, and to Professor Reichel, of Chemnitz, who allowed me to use one of his clinical records. This volume has been rendered possible only by kind assistance from many quarters, and I take this opportunity to express my most sincere thanks to all the gentlemen who have aided me.

All the illustrations, except those prepared from photographs taken by myself, were drawn by Mr. Braune, of Königsberg, to whom I desire to express my special indebtedness for his clear understanding and untiring energy.

Thanks must also be given to Professor Wilhelm Schultze, of Göttingen, for etymologic information, and, last, but not least, to Mr. Lehmann, who has greatly added to the value of the work by his careful attention to the details of its publication.

Froriep's plates have been utilized in drawing Figs. 2, 4, 5, and 6, and Figs. 39 and 95 were taken from the plates of Nuhn.

Further details in reference to the cases illustrated in Plate 7, and in Figs. 90, 104, and 106, will be found in a work by Dr. Fertig, of Göttingen, which will shortly make its appearance.

GEORG SULTAN.

CONTENTS.

HERNIA IN GENERAL.

SPECIAL HERNIAS.

HERNIA IN GENERAL.

An abdominal hernia is a peritoneal protrusion which temporarily or permanently contains any abdominal viscus. The hernia is more definitely designated by the name of the anatomic region through which the peritoneal protrusion takes place (inguinal hernia, diaphragmatic hernia, umbilical hernia). The word "rupture," as applied to this condition, is to be explained by the old supposition that in those hernias which suddenly make their appearance, the protrusion of the abdominal viscus must be preceded by a laceration—*ruptura*—of the parietal peritoneum. At the present time it is known that this idea is erroneous. Another name in still more common use has been formed with the aid of the Greek word *kele* (*enterocele*, intestinal hernia; *epiplocele*, omental hernia), and these combinations at once reveal the nature of the hernial contents. It must, however, be remembered that this termination is used not only to designate hernias, but that it is also employed in reference to swellings resembling them (hydrocele, varicocele).

The etymologic derivation of the word hernia from the Greek τὸ ἔρνος, "sprout," "outgrowth," as given in some text-books, is just as incorrect as is the attempted deduction from *hira*, "jejunum." "Hernia" is an old Latin word which seems to have always had its present significance and the exact etymology of which is unknown. Some have assumed that there is a relation between the endings

χήλη and χοίλος, "hollow," but this is also wrong, since χήλη has also had the significance of "rupture" since time immemorial, as is shown by the etymologic agreement of the Greek word with the designation of the affection in old Bulgarian (*kyla*) and in old Scandinavian (*haull*). (From a personal communication from Professor Wilhelm Schultze, of Göttingen.)

An idea of the **frequency of hernia** may be obtained from a study of the statistics of Berger, which are based upon the observation of 10,000 cases of hernia, and which are of particular value, since the number of cases occurring among Parisians of a certain age are compared with the total number of the Parisian population at the same age. Considerable and interesting differences are found to exist in different periods of life.

In every 1000 individuals in the 1st year of life there are											19.6	cases	of	hernia.
From the 1st to the 4th year of life there are											4.2	"	"	"
In	" 5th	"	" 9th	years	"	"	"	"	.....		1.89	"	"	"
"	"10th	"	"14th	"	"	"	"	"	.....		1.35	"	"	"
"	"15th	"	"19th	"	"	"	"	"	.....		1.14	"	"	"
"	"20th	"	"24th	"	"	"	"	"	.....		0.88	"	"	"
"	"25th	"	"29th	"	"	"	"	"	.....		1.25	"	"	"
"	"30th	"	"34th	"	"	"	"	"	.....		2.02	"	"	"
"	"35th	"	"39th	"	"	"	"	"	.....		3.32	"	"	"
"	"40th	"	"44th	"	"	"	"	"	.....		4.67	"	"	"
"	"45th	"	"49th	"	"	"	"	"	.....		5.73	"	"	"
"	"50th	"	"54th	"	"	"	"	"	.....		7.97	"	"	"
"	"55th	"	"59th	"	"	"	"	"	.....		9.52	"	"	"
"	"60th	"	"64th	"	"	"	"	"	.....		14.03	"	"	"
"	"65th	"	"69th	"	"	"	"	"	.....		20.73	"	"	"
"	"70th	"	"74th	"	"	"	"	"	.....		24.20	"	"	"
"	"75th	"	"79th	"	"	"	"	"	.....		21.60	"	"	"
"	"80th	"	"84th	"	"	"	"	"	....		15.03	"	"	"
"	"85th	"	"89th	"	"	"	"	"	.....		5.09	"	"	"
"	"90th	"	"94th	"	"	"	"	"	.....		1.25	"	"	"

The relatively large number of hernias in the first year of life rapidly decrease with the beginning of the second

year, and then slowly and uniformly diminish until the minimum is reached in the twentieth to the twenty-fourth year. The number gradually increases until the sixtieth year is reached, when it suddenly rises, and the maximum is attained in the seventieth to the seventy-fourth year. From the eightieth to the ninetieth year the number of cases again drops suddenly. Men are more frequently affected with hernia than women in the proportion of three to one. The table just quoted shows that the number of cases of hernia in 1000 of the average population is about 4.4. This proportion is by no means absolute, since there are great variations in different countries, and even in different parts of the same country.

Every completely formed hernia possesses a mouth, a sac, certain coverings, and contents.

The **mouth of the hernia** is the opening in the abdominal wall through which the hernia leaves the abdomen. If this opening passes directly through the abdominal wall, as in an umbilical hernia, so that the canal is very short, it is designated the hernial ring. If the canal is longer, and particularly if it passes obliquely through the abdominal wall, as in the inguinal region, we may speak of an internal and of an external ring. The seats of predilection for the formation of a hernial mouth or orifice are to be found in those places in which the abdominal wall is more yielding, where its structure is weaker, and these situations are chiefly those in which the larger vessels and nerves normally pass through the abdominal wall. The spermatic cord, which traverses the abdominal parietes obliquely, serves as a guide for the external inguinal hernia, the mouth of which is consequently identical with

the inguinal canal; the femoral hernia passes out with the femoral vessels, finally making its appearance at the saphenous opening, and in the same manner the umbilical, obturator, and sciatic vessels determine the direction of a hernia occurring in these situations. A hernial orifice may also be formed in those situations where there is a gap in the musculature, as in some cases of diaphragmatic and lumbar hernia. The development of a hernia, however, is favored not only by pre-existing apertures, but it sometimes suffices that the abdominal wall is thinner in certain situations, whether it be because the normal structure is weaker, or whether it has become thinned by pathologic conditions, suppurations, or preceding operations. Such weak places are to be found in the internal inguinal fossa (internal inguinal hernia), in the linea alba (hernia of the linea alba, epigastric hernia), as well as in other portions of the anterior abdominal wall, particularly at the outer edge of the rectus (ventral hernia), and in certain places in the pelvic floor (perineal hernia). For the sake of completeness, mention should also be made of congenital malformations or fissures through which a completely developed hernia with all its parts may protrude at birth. Such fissures are observed chiefly at the umbilicus and in the diaphragm.

There is one group of hernias, the so-called internal hernias, which have no actual hernial orifice. In these cases the peritoneal diverticulum is situated between the abdominal wall and the parietal peritoneum, and is nothing more nor less than an expansion of a pre-existing peritoneal recess. In those internal hernias which protrude into the lesser peritoneal cavity, however, the foramen of Winslow may be regarded as the hernial orifice.

A brief anatomic survey will be of service in explaining the situation of the most important hernial orifices, and, at the same time, will show how the seats of predilection for the development of hernias are dependent upon the anatomic peculiarities of the abdominal walls.

An inspection of the anterior abdominal wall of a muscular and not too fat individual (Fig. 1) reveals a series of depressions and elevations the location of which must be known in order to avoid being led into error by their misinterpretation. Upon each side of the middle line there is a longitudinal elevation which gradually becomes flatter as it approaches the pelvis, and which corresponds to the position of the rectus muscle. The external border of the muscle is particularly well marked, and three, sometimes four, broad transverse furrows indicate the position of the tendinous intersections. These two longitudinal elevations are separated in the median line by a narrow groove which passes through the umbilicus and gradually disappears midway between this point and the symphysis. At the outer side of the rectus muscle another furrow is observed, which runs at first from above directly downward, then toward the median line, and which marks the situation in which the muscular portion of the external oblique joins with its aponeurosis. The external oblique muscle itself forms a flat elevation the serrated origin of which is distinctly marked, interdigitating with the serratus magnus and with the latissimus dorsi. The prominence below the flat elevation of the external oblique is the anterior superior spine of the ilium, and the anatomic base of the groove running from this prominence to the symphysis is formed by Poupart's ligament. For the sake of uniformity of

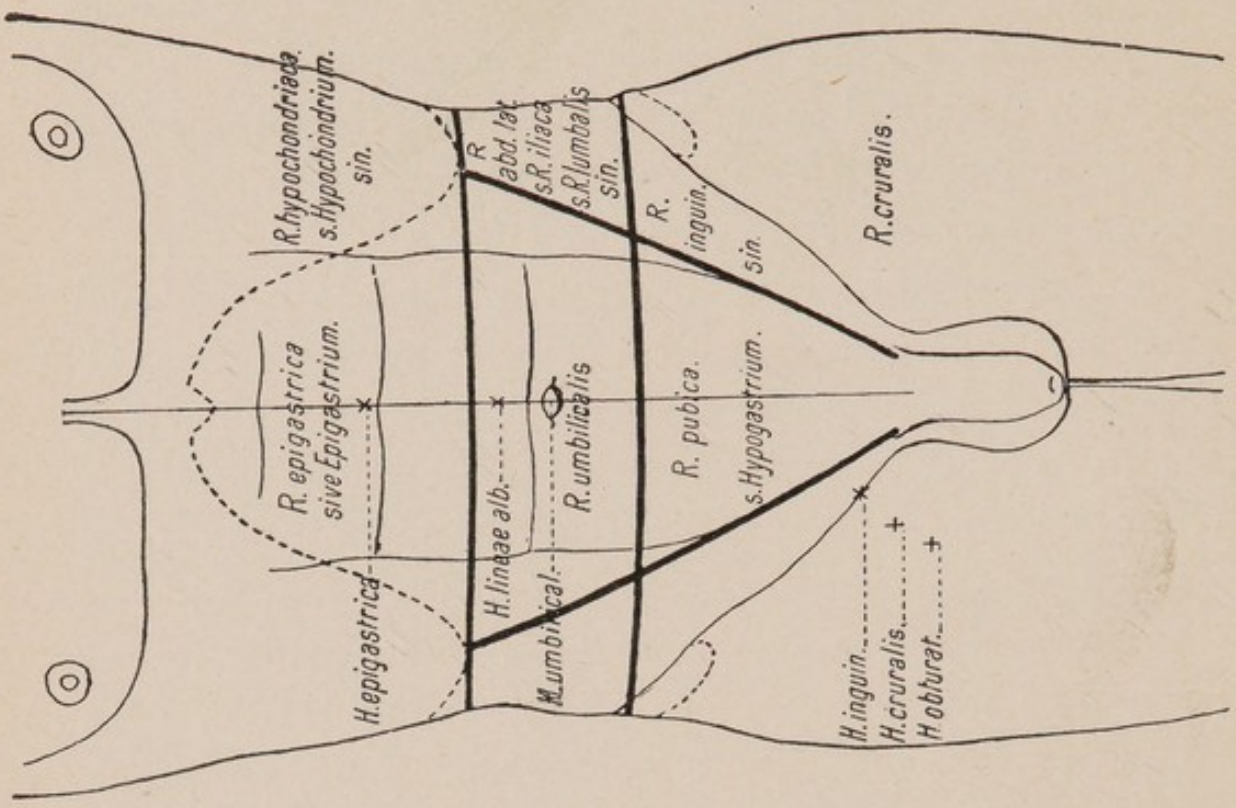
R. hypochondriaca s. Hypochondrium sin.
R. epigastrica sive Epigastrium.
H. epigastrica
H. lineae alb.
H. umbilical.
R. abd. lat. s. R. iliaca s. R. lumbalis sin.
R. umbilicalis
R. pubica.
R. inguin. sin.
s. Hypogastrium.
R. cruralis.
H. inguin.
H. cruralis
H. obturat.

Fig. 1.

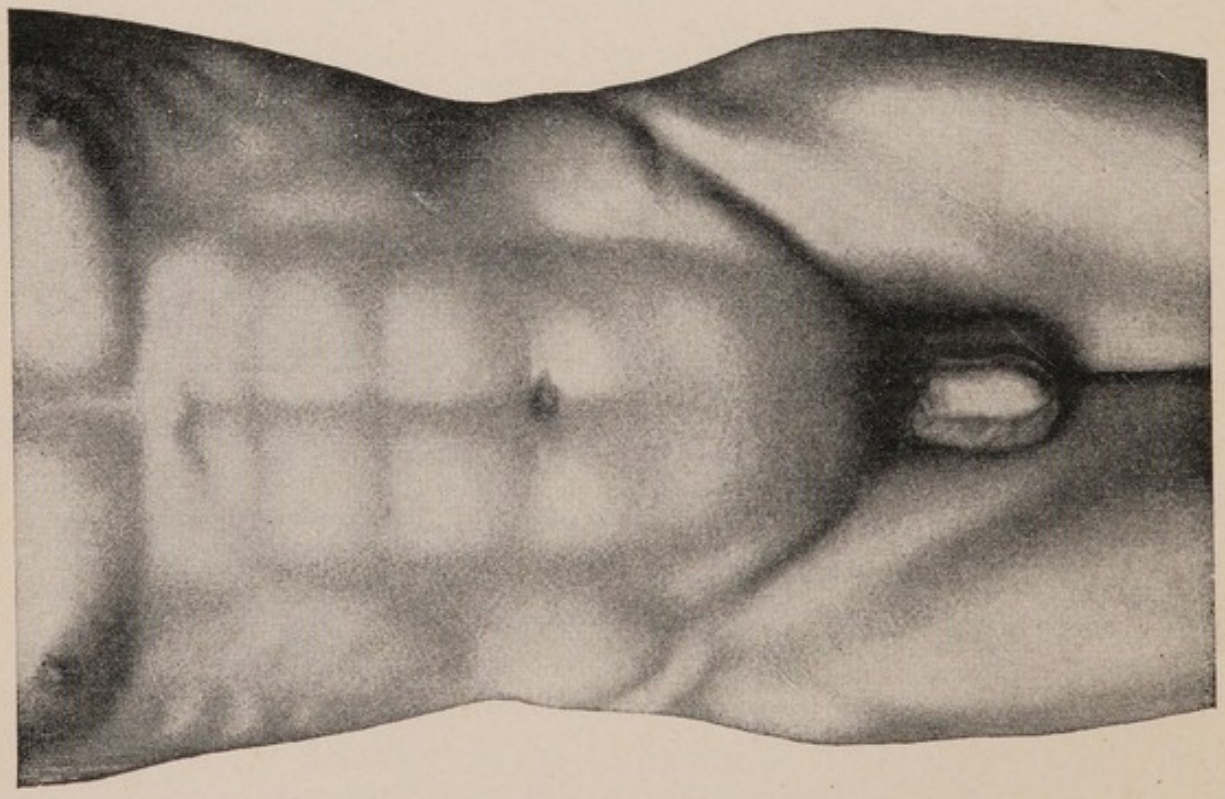

Fig. 1.—The outline at the right of the illustration gives the names of the different abdominal regions and also designates the positions at which the various hernias make their appearance.

The illustration itself reveals the elevations and depressions of the anterior abdominal wall of a very muscular subject containing little fat. The middle line of the abdomen—the linea alba—is indicated by a furrow which gradually becomes indistinct and disappears midway between the umbilicus and the symphysis. The longitudinal elevations on either side are caused by the recti muscles, the tendinous intersections of which are distinctly marked. The flat elevation just above the anterior superior spine of the ilium is formed by the external oblique muscle, and the groove running from this spine to the symphysis lies over Poupart's ligament.

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description of the different abdominal regions the following lines are drawn: (1) A line connecting the lowest point of the costal margin of one side with the corresponding point upon the opposite side. (2) A line connecting the highest point of the crest of the ilium of one side (viewed anteriorly) with the corresponding point upon the opposite side. (3) Two oblique lines from the end of the tenth ribs to the pubic spines of the same side.

Above the first line, in the middle, is the epigastric region, with the right and left hypochondriac regions on either side. Between the first and second lines is the mesogastric region, made up of the umbilical region in the center, with the right and left lateral abdominal, iliac, or lumbar regions at either side. Below the second line is the hypogastric region, composed of the pubic region or hypogastrium in the center with the right and left inguinal regions at the sides. The crural or femoral region commences at Poupart's ligament and extends downward.

The superficial fascia is exposed by the removal of the skin (see Fig. 2), and upon its surface are observed small

Fig. 2.—The anterior abdominal wall after removal of the skin: The superficial fascia is exposed and through its substance the underlying external oblique muscle may be seen. The continuation of the fascia upon the thigh is perforated by the great saphenous vein; in this situation it exhibits a number of sieve-like perforations and is known as the cribriform fascia.

Fig. 3.—The anterior abdominal wall after removal of the superficial fascia: The most external of the abdominal muscles—the external oblique—is exposed; the muscular fibers soon spread out into a broad aponeurosis the lower free margin of which is Poupart's ligament. The aponeurosis ends at the pubic spine with a sharp border, the convexity of which is directed outward and which bounds an opening—the external abdominal ring—through which the spermatic cord passes out of the abdomen.

In the femoral region the fascia lata is exposed. The curved free edge of this fascia—the falciform process—is situated below the inner third of Poupart's ligament and embraces the saphenous opening, through which the femoral vein and a narrow edge of the femoral artery are visible. The † designates the position in which femoral hernia makes its appearance.

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vascular ramifications which have no practical importance. The superficial fascia is continued upon the thigh, in one place exhibiting sieve-like perforations; this portion is known as the cribriform fascia, and one of its openings gives passage to the great saphenous vein. The superficial fascia of the abdomen is also continuous with the superficial fascia of the scrotum, in which situation it is known as the dartos.

Figure 3 represents the structures which are exposed upon the removal of the superficial fascia. The fibers of the external oblique muscle run from above downward and inward. They arise by a number of digitations from the seven lower ribs and spread out into a broad aponeurosis which ends in the median line in the linea alba and

Fig. 2.

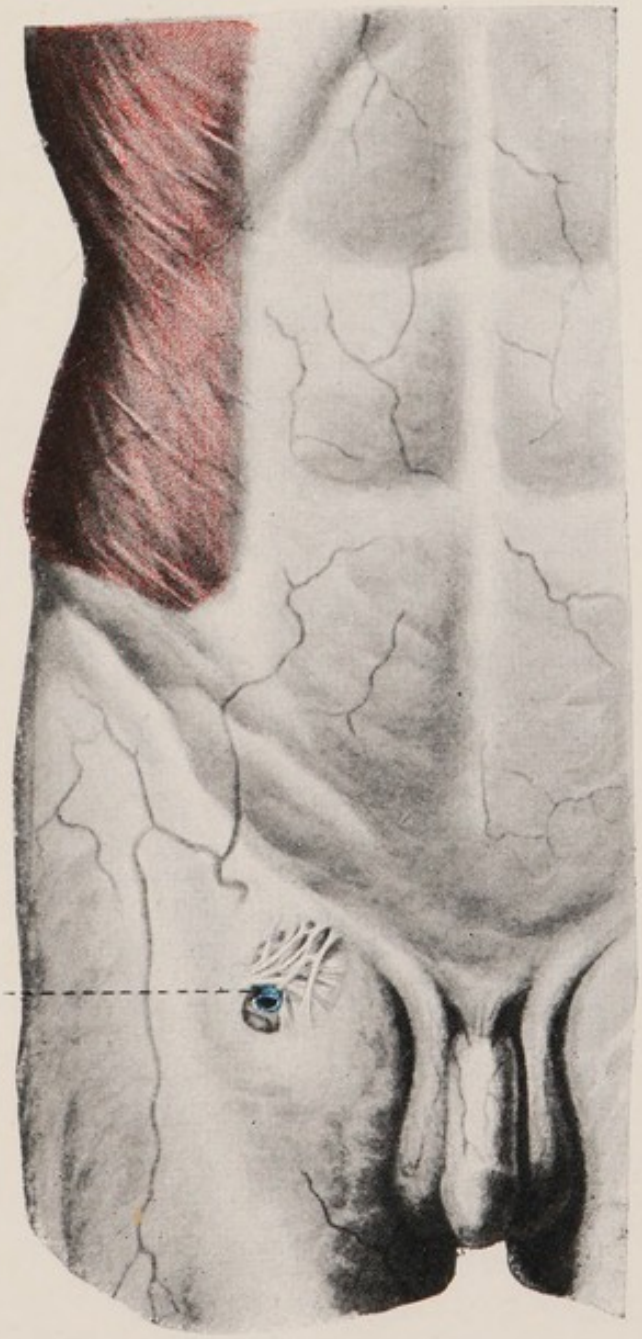
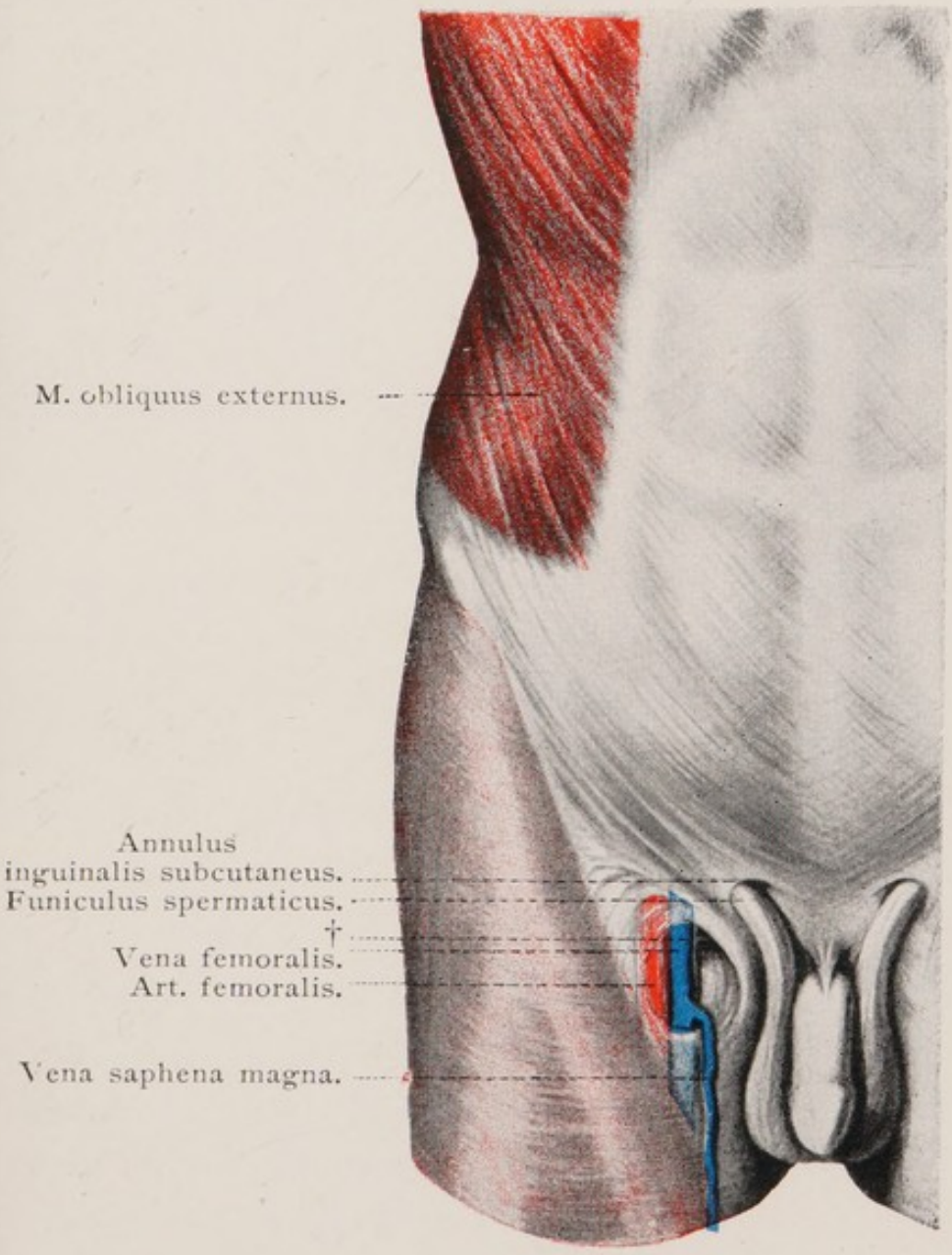


Fig. 3.


M. obliquus externus.
Annulus
inguinalis subcutaneus.
Funiculus spermaticus.
†
Vena femoralis.
Art. femoralis.
Vena saphena magna.

below in Poupart's ligament. At the inner end of this ligament there is a concave free border, the concavity of which is directed downward and inward and beneath which the spermatic cord passes out of the abdomen. This opening, which represents the outer end of the inguinal canal, is called the external abdominal ring. The prolongations of the aponeurosis which form the upper and lower boundaries of the ring are known respectively as the superior and the inferior pillars. It is in this situation that inguinal hernia makes its appearance. If the scrotum of such a patient is invaginated and the index-finger introduced into the canal, the sharp margin of the ring is almost always distinctly felt and an exact idea of the size of the hernial orifice may be obtained.

The femoral region is covered by the fascia lata, with the exception of the saphenous opening, which is situated immediately beneath the cribriform fascia. This opening is semilunar in shape with the convexity directed upward and outward. That portion of the fascia lata forming the upper and outer border of the saphenous opening is known as the falciform process. Through this opening a portion of the femoral vein is observed into which the great saphenous vein empties, and to the outer side of the vein a narrow margin of the femoral artery may be seen. Femoral hernia makes its appearance at the upper portion of the saphenous opening and internal to the femoral vein, as indicated by the † in the figure.

In figure 4 the external oblique muscle and a portion of the fascia lata have been removed so that the internal oblique muscle is exposed to view. This muscle arises from the lumbar fascia, from the crest of the ilium as far

Fig. 4.—The anterior abdominal wall after removal of the external oblique muscle: The internal oblique muscle is seen passing toward the middle line; it is inserted into a broad aponeurosis, and some isolated fibers of the lower portion of the muscle are continued upon the spermatic cord and testicle under the name of the cremaster muscle.

The fascia lata has been partly removed from the femoral region so that the femoral vessels are exposed. The vein lies to the inner, the artery to the outer side. The lymphatic gland situated at the inner side of the vein is known as the gland of Rosenmüller.

Fig. 5.—The anterior abdominal wall after removal of the internal oblique muscle of the aponeurotic layers covering the rectus muscle: The rectus muscle with its tendinous intersections is exposed, and to the outer side of the rectus the transversalis is observed. The latter muscle has a sharp inferior border which passes over the posterior portion of the spermatic cord. The spermatic cord itself is exposed up to the point where it makes its exit through the internal abdominal ring.

In the femoral region the muscles are exposed with the exception of the pectineus, which is still covered by the deep fascia.

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forward as the anterior superior spine, and from Poupart's ligament. The most posterior fibers pass vertically upward and are inserted into the three lower ribs; the adjoining fibers pass upward and inward and the more anterior ones directly inward, while those most anterior run parallel to the course of Poupart's ligament. By far the greater portion of the fibers are inserted into a broad aponeurosis which divides into two layers. The spermatic cord is seen passing upward and outward within the abdominal wall; some muscular fibers from the lower edge of the internal oblique are prolonged upon the spermatic cord and testicle (cremaster muscle). In the femoral region the vessels are more freely exposed, and to their outer side the edge of the sartorius is observed. A lymphatic gland is frequently found at the inner side of the vein in the position at which femoral hernia makes its appearance.

Fig. 4.

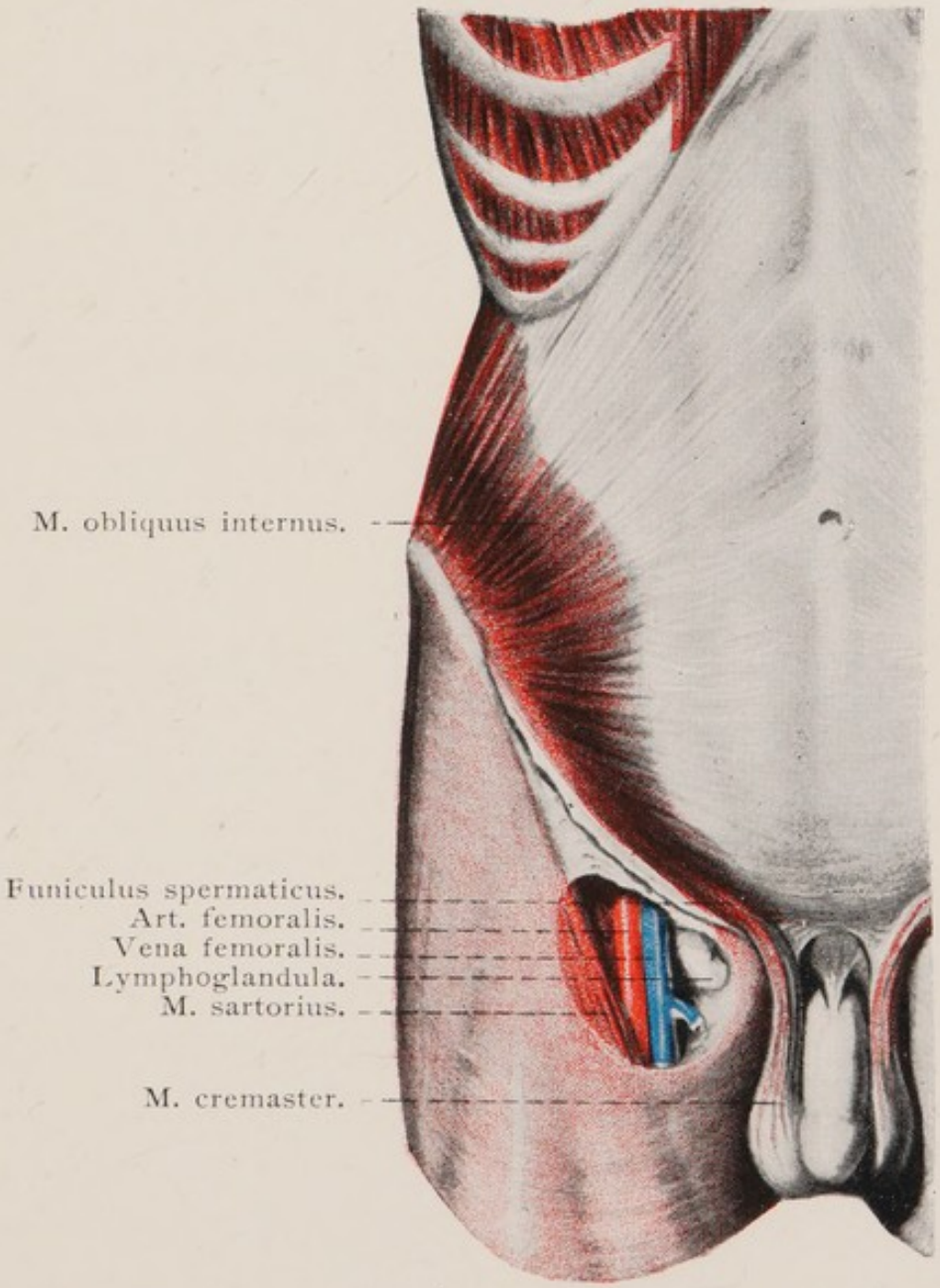
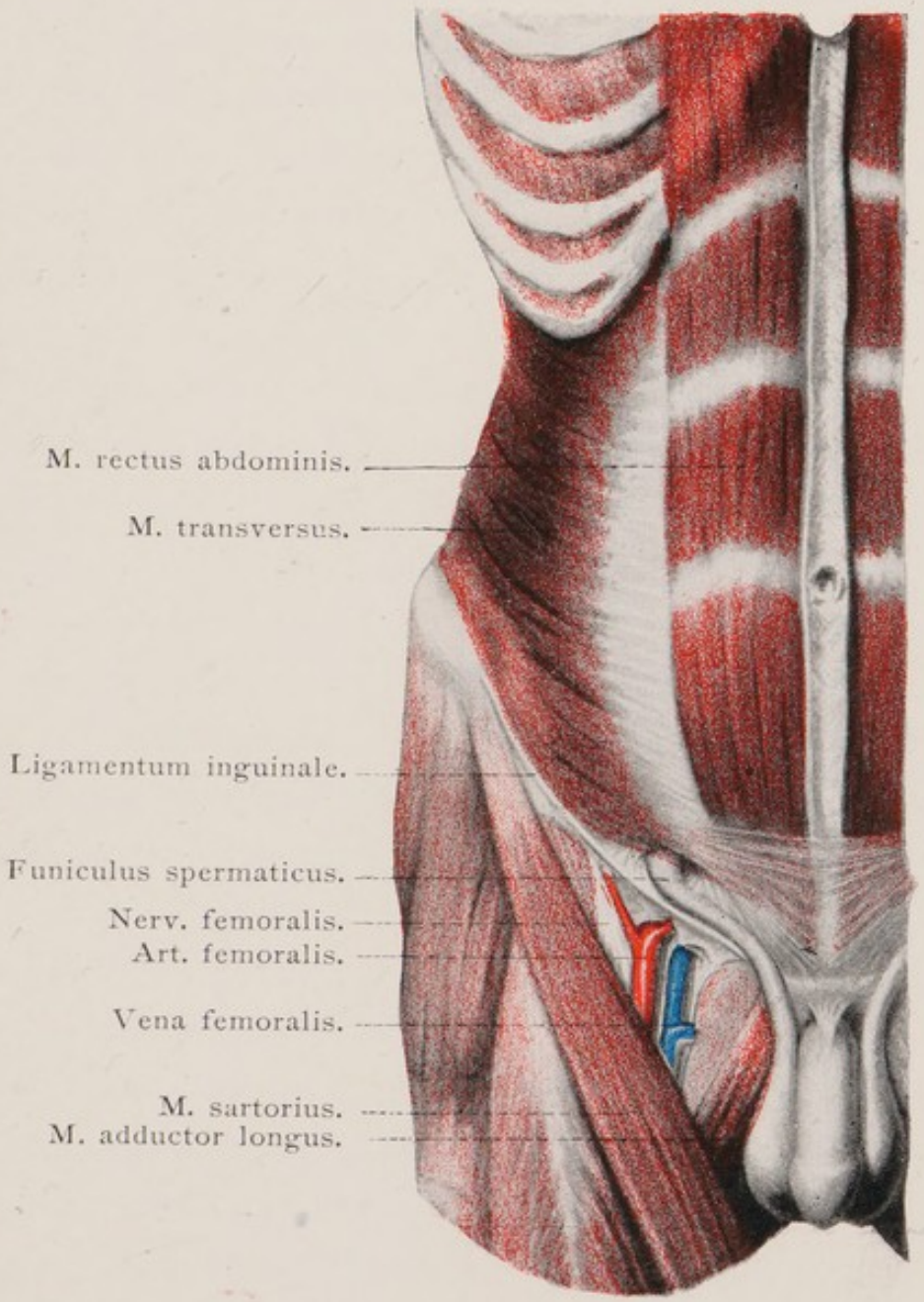

M. obliquus internus.
Funiculus spermaticus.
Art. femoralis.
Vena femoralis.
Lymphoglandula.
M. sartorius.
M. cremaster.

Fig. 5.


M. rectus abdominis.
M. transversus.
Ligamentum inguinale.
Funiculus spermaticus.
Nerv. femoralis.
Art. femoralis.
Vena femoralis.
M. sartorius.
M. adductor longus.

The next deeper layer is exposed by the removal of the internal oblique end of the anterior lamellæ of the aponeuroses (Fig. 5). At the outer side is the transversalis, while in the middle is seen the rectus muscle with its three tendinous intersections. The rectus has a broad origin from the fifth, sixth, and seventh ribs and from the xiphoid process. It becomes somewhat narrower as it passes downward, sends some fibers across the median line to its fellow of the opposite side, and is inserted into the upper border of the symphysis. The small muscle situated anterior to the lower end of the rectus and in the same sheath is known as the pyramidalis. Its fibers pass from below upward and inward, and are inserted into the linea alba. The transversalis muscle arises by six serrations from the inner surface of the six lower ribs, from the lumbar fascia, from the crest of the ilium, and from Poupart's ligament. These muscular fibers also terminate in a broad aponeurosis which is inserted into the linea alba, the upper three-fourths passing behind the rectus, while the lower fourth passes in front of this muscle (the portion of the aponeurosis forming the sheath of the rectus is not seen in Fig. 5). The spermatic cord is seen lying in the inguinal canal, which is exposed as far as its internal orifice—the internal abdominal ring. In the femoral region Scarpa's triangle (bounded by Poupart's ligament, the sartorius, and the adductor longus) has been dissected out, and in the space between the femoral vein and the adductor longus is seen a portion of the deep fascia covering the pectineus muscle.

In figure 6 the rectus muscle has been removed and the posterior portion of its sheath exposed. This sheath ceases

Fig. 6.—The anterior abdominal wall after removal of the rectus muscle: The posterior layer of the associated aponeurosis is exposed, and its sharp lower border, known as the semilunar fold of Douglas, is also seen. The background of the space below the semilunar fold is formed by the transversalis fascia, upon the surface of which a portion of the deep epigastric artery is observed. The greater portion of the spermatic cord has been removed and enough of the transversalis muscle cut away to expose the internal abdominal ring.

In the femoral region the fascia lata has also been removed from the pectineus muscle.

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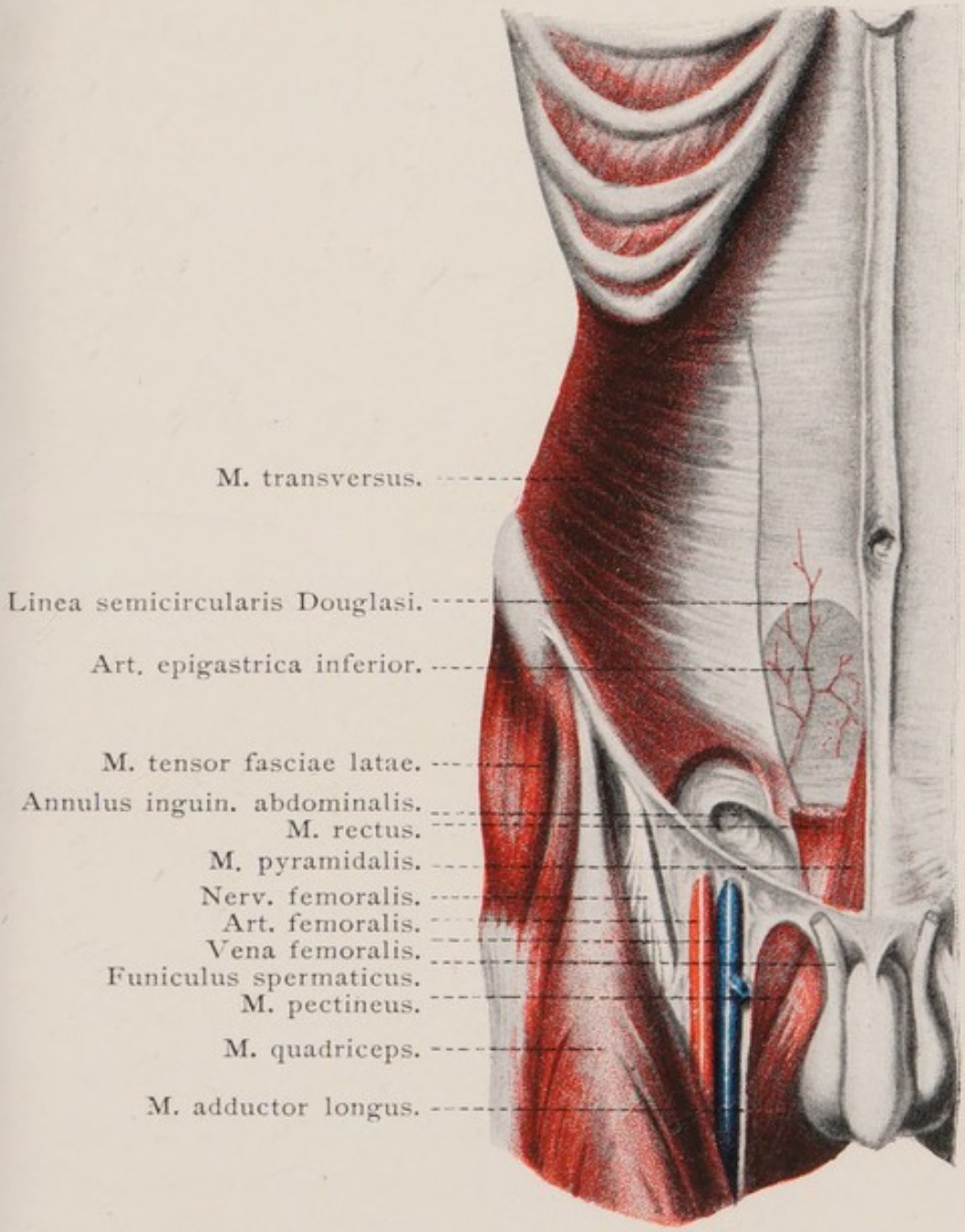
abruptly midway between the umbilicus and the symphysis, thus forming the semilunar fold of Douglas. The spermatic cord and the portion of fascia covering the pectineus have also been removed, so that the internal abdominal ring and the pectineus muscle are plainly visible. The remaining layers of the anterior abdominal wall, passing from without inward, are the transversalis fascia, the subperitoneal areolar tissue, and the parietal peritoneum.

Since the strength of the anterior abdominal wall is actually dependent upon the arrangement of the aponeuroses of the abdominal muscles, it will be of advantage to study particularly those portions of the aponeuroses which form the sheath of the rectus.

The aponeurosis of the external oblique is a single layer and covers the anterior surface of the rectus muscle.

The aponeurosis of the internal oblique divides into an anterior and a posterior layer: the anterior layer also covers the anterior surface of the rectus muscle and fuses with the aponeurosis of the external oblique; the posterior layer passes behind the rectus muscle and its inferior margin forms the semilunar fold of Douglas midway between the umbilicus and the symphysis.

Fig. 6.


M. transversus.
Linea semicircularis Douglasi.
Art. epigastrica inferior.
M. tensor fasciae latae.
Annulus inguin. abdominalis.
M. rectus.
M. pyramidalis.
Nerv. femoralis.
Art. femoralis.
Vena femoralis.
Funiculus spermaticus.
M. pectineus.
M. quadriceps.
M. adductor longus.

The aponeurosis of the transversalis muscle is a single layer which passes behind the rectus muscle as far down as the semilunar fold of Douglas, fusing with the posterior layer of the aponeurosis of the internal oblique. Below the semilunar fold of Douglas the aponeurosis of the transversalis passes in front of the rectus muscle.

From this description it will be seen that the posterior surface of the inferior portion of the rectus is covered by no aponeurosis whatever, and that this portion of the abdominal wall is particularly weak, since the rectus muscle lies directly upon the transversalis fascia and peritoneum. In addition to this, there is a space at the outer side of the rectus which has no muscular covering, so that with advancing years and relaxation of the abdominal wall, a hernia—the so-called internal inguinal hernia—can easily protrude through this portion of the abdominal parietes.

A glance at the interior of the pelvis (Fig. 7) will reveal the positions and relations of the most important hernial orifices. The figure represents a sagittal section through the median line of the lumbar vertebræ and the right horizontal ramus of the pubis at the level of the pubic spine. The peritoneum has been removed and the anterior abdominal wall is put upon the stretch by means of a tenaculum. The bladder is situated beyond the symphysis, and more posteriorly the stump of the rectum is observed. Poupart's ligament can be seen through the structures of the anterior abdominal wall, and the point at which the external inguinal hernia passes out from the abdomen is indicated by the junction of the spermatic artery and the vas deferens. For the sake of clearness the spermatic artery has been placed above the common iliac. Somewhat nearer

Fig. 7.—A sagittal section through the middle of the spinal column and the right horizontal ramus of the pubis, exposing the interior of the pelvis: a, Rectus abdominis muscle; b, deep epigastric artery; c, vas deferens; d, spermatic artery; e, external iliac artery; f, external iliac vein; g, obturator vessels and nerve; h, superior gluteal artery; i, urinary bladder; k, rectum.

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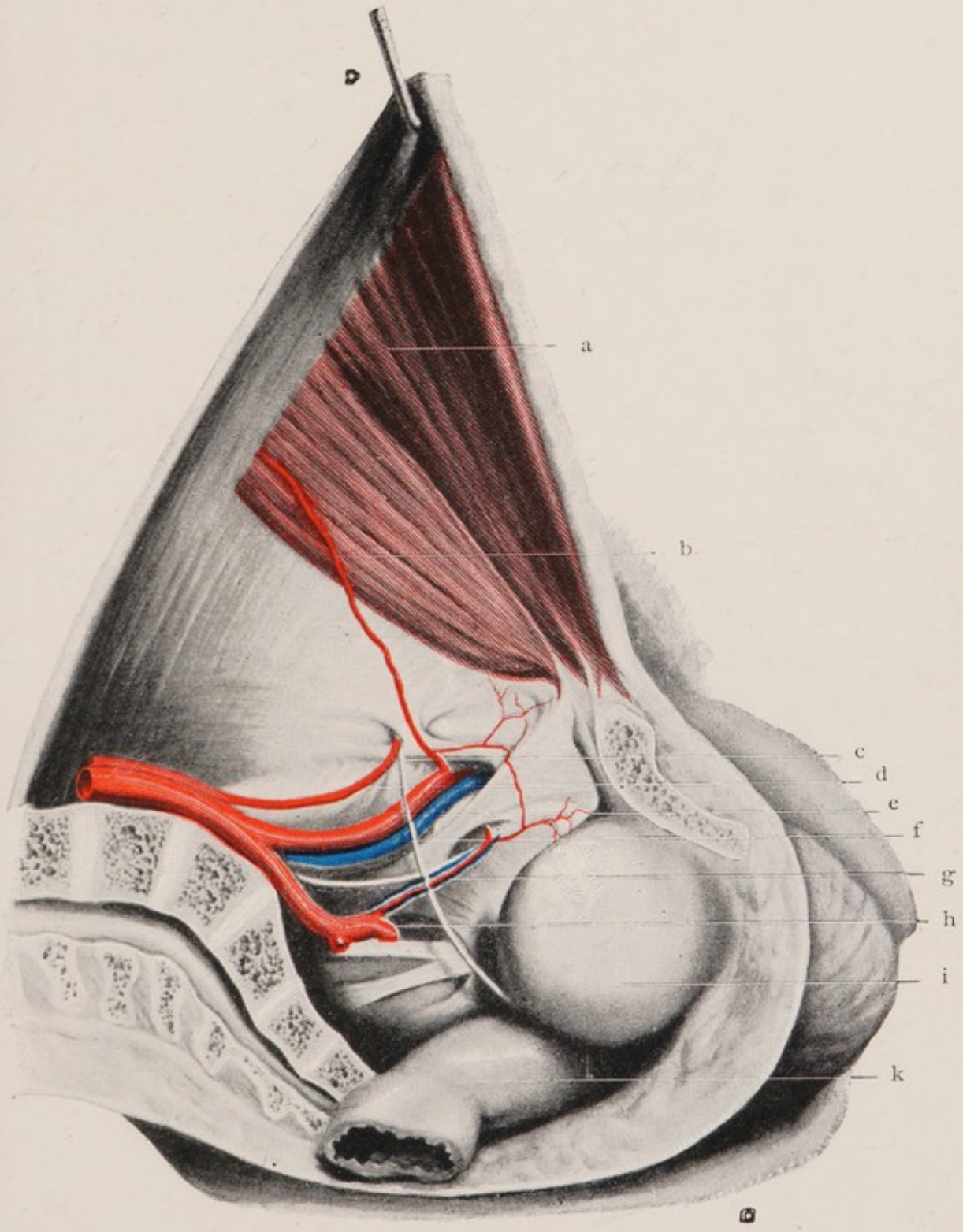
to the median line the deep epigastric artery is seen passing upward along the anterior abdominal wall, and it is between this artery and the border of the rectus muscle that the internal (or direct) inguinal hernia protrudes. The external iliac artery and vein pass anteriorly beneath Poupart's ligament, and just alongside of the vein the drawing shows a small lymphatic gland which marks the point of exit of the femoral hernia. Within the true pelvis the obturator artery is seen to arise from the superior gluteal, although this vessel is usually given off by one of the divisions of the internal iliac. The obturator artery, accompanied by two veins and a nerve of the same name, passes anteriorly and indicates the situation of the mouth of an obturator hernia. The superior gluteal artery passes posteriorly with a sharp turn and penetrates the deeper tissues just above the sacral plexus. The sciatic artery, which leaves the pelvis below the sacral plexus, has been cut off so that only its stump is visible. The sciatic hernia passes out of the abdominal cavity along the course of the superior gluteal or of the sciatic artery.

The other boundaries of the abdominal cavity—the diaphragm, the pelvic floor, and the musculature of the back—also have spaces between individual groups of muscles through which it is possible for a peritoneal diverticulum to protrude. These hernias are nevertheless very

Fig. 7.



rare, and we will defer the description of such hernial orifices until we consider special hernias.

The **sac of the hernia** is that portion of the peritoneum which protrudes through the hernial orifice, and in its unchanged condition consists of a very thin transparent lamella. A case in which the abdominal viscera protrude through the abdominal wall without any cutaneous or peritoneal covering (as after a punctured wound of the abdomen, for example) is not designated as a hernia but as a prolapse. In certain cases of congenital fissure of the diaphragm (see Fig. 102) the intestines may pass into the pleural cavity without a peritoneal covering, and custom has designated these cases as hernias, although, accurately speaking, this use of the word is incorrect. A yielding abdominal scar may allow the intestines to protrude, and it is also customary to refer to this condition as a ventral hernia, although the hernial sac is frequently wanting and its place taken by scar tissue. The hernias of the urinary bladder and of the ascending and descending colon make an apparent exception to the general rule that every hernia must have a sac. Since these structures have only a partial peritoneal covering, and consequently are only partly within the abdomen, it can happen that the portion which protrudes may have no peritoneal covering. In this case, however, the sac is somewhat higher up, so that the viscus constituting the contents of the hernia lies partly within and partly without the sac.

The hernial sac may be congenital, all of its parts being present at birth, although this is only possible in certain situations which are so predisposed for developmental reasons. It frequently happens that the hernial sac is first

formed during extra-uterine life by the influence of the so-called "abdominal tension"; *i. e.*, by a sudden increase of the intra-abdominal pressure, as in coughing, crying, sneezing, vomiting, straining at stool, or the lifting of heavy loads, or by traction from without from the growth of a subperitoneal lipoma.

At this place it may be emphasized that the complete protrusion of the peritoneum into a hernial sac never occurs from a single augmentation of the intra-abdominal tension, however great it may be; such a protrusion always occurs slowly as the result of the repeated effect of some of the influences just mentioned. It is partly due to a yielding of the peritoneum, but the most important factor is a loosening of that portion of the peritoneum about the internal ring and its protrusion through the hernial orifice. Evidence of this is frequently furnished by the radiating folds of the peritoneum. If a hernial tumor suddenly makes its appearance during a marked increase of the intra-abdominal tension, in an individual who has previously presented no sign of hernia,—and these are the cases which formerly led to the supposition of a rupture of the peritoneum,—we may be sure that the hernial sac was either congenital or gradually formed during some period of extra-uterine life.

The portion of the sac situated within the hernial orifice is known as the neck, the main portion of the protrusion is called the body, and the lowest part of the sac is designated the fundus.

In small and moderately large hernias the sac has certain characteristics which naturally become obliterated if the hernia increases in size. The sac of an umbilical her-

nia tends to assume a spherical shape, while that of a femoral hernia is more ovoid. According to Bayer, a congenital inguinal hernia usually has a pear-shaped sac with a narrow neck and a broad fundus, while the sac of an acquired inguinal hernia has a wide mouth from the very beginning.

The sac-wall, like the peritoneum, is a thin connective-tissue membrane which is rich in elastic fibers, but sparingly traversed by blood-vessels and nerves, which is lined with squamous epithelial cells, and which always presents a smooth, moist, glistening surface. If such peritoneal surfaces are exposed to any irritation, such as pressure, circulatory disturbances, or inflammation, they become adherent or form exudates and inflammatory deposits. It consequently happens that we occasionally see irregular thickenings in hernial sacs, particularly in those cases in which folds have been formed in intra-uterine or in extra-uterine life. If such a thickening runs around the sac in a circular direction, an hour-glass constriction may be produced (Fig. 8); if a number of these circular constrictions are present, the hernial sac may resemble a string of beads. Such configurations are more frequently caused by the loosening of the tissues about the thickened neck of the sac, which is produced by the traction of the herniated viscera with every increase of the intra-abdominal pressure; the adjacent peritoneum is drawn into the hernial orifice and the entire sac descends. If a number of thickenings of the sac-wall are present, the intermediate portions of the sac may yield from the intermittent augmentations of the intra-abdominal tension, and diverticula are easily produced (Fig. 9).

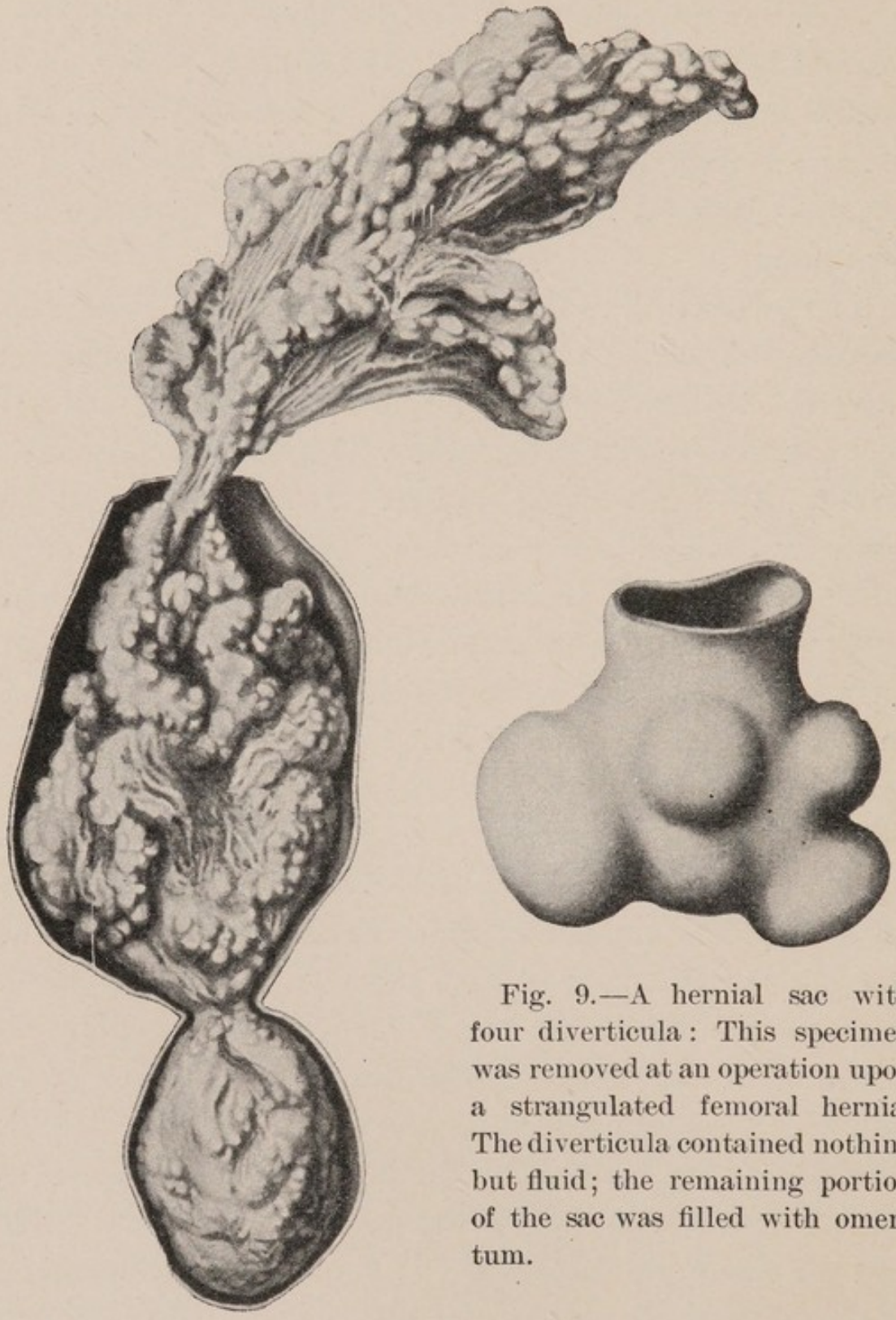


Fig. 9.—A hernial sac with four diverticula: This specimen was removed at an operation upon a strangulated femoral hernia. The diverticula contained nothing but fluid; the remaining portion of the sac was filled with omentum.

Fig. 8.—Hour-glass constriction of a hernial sac: This specimen was extirpated at a radical operation for inguinal hernia, and contained a large piece of omentum which had become adherent to the sac at the seat of constriction.

In the great majority of cases the **contents of the hernia** consist of portions of the small intestine, or portions of the omentum, or of both. This is because these structures are the most movable and the most susceptible to dislocation. Next in order come the colon and the cecum, either with or without the vermiform appendix, and the latter structure may be found alone. In a general way, it may be said that there is scarcely an abdominal organ that has not been found in a hernia, since the stomach, liver, pancreas, ovaries, tubes, uterus, bladder, kidney, and spleen have all been observed within a hernial sac. In addition to any of these structures, and particularly if circulatory disturbances or inflammation have occurred, there is present a collection of water which is known as the hernial fluid. There are certain organs which can pass into the sac of a hernia only when their fixation in the peritoneal cavity is looser than normal. Certain portions of the colon, for example, may possess such a long mesocolon that they may easily descend as low as the inguinal region and protrude into an inguinal hernia. Such a relaxation of attachments may also be acquired, since the abdominal organs may descend as the result of a general splanchnoptosis, or individual organs may be drawn down by the peritoneum and some adjacent viscus which is more movable.

The size of a hernia is principally dependent upon the amount of its contents, and is subject to the greatest possible variation. A small piece of omentum will produce a swelling that is scarcely visible externally, while an inguinal hernia may contain almost all of the abdominal organs and form a large sac extending as low down as the

Fig. 10.—Diagrammatic representation of a hernia of the intestinal wall.

Fig. 11.—Diagrammatic representation of a hernia of a diverticulum.

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knee. The latter condition is known as eventration, and if it exists for some time, it is frequently impossible to replace the viscera, since the abdominal cavity has become correspondingly contracted.

If the contents of a hernial sac consist of an intestinal loop, that portion of the intestine situated on the proximal side of the hernia is known as the afferent intestine, while that portion on the distal side is known as the efferent intestine. An entire intestinal coil does not always protrude, however, and it not infrequently happens that only the intestinal wall opposite the insertion of the mesentery is found within the sac, so that a pouching of the intestinal wall is produced (Fig. 10). Such cases are known as hernia of the intestinal wall. A similar condition is observed when a Meckel's diverticulum enters a hernial sac. This diverticulum is the remains of the omphaloenteric duct of fetal life, and is usually found from one-half to one meter above the ileocecal valve (see "Umbilical Hernia," page 208). This hernia of a congenital diverticulum (Fig. 11) was first described by Littré, and is consequently called Littré's hernia by many, although the same name is usually also employed in reference to the ordinary hernia of the intestinal wall.

There are also acquired intestinal diverticula (Fig. 12) which may occupy a hernial sac. They may develop in any portion of the intestinal canal, are usually multiple, and are formed by a protrusion of the mucous membrane

Fig. 10.

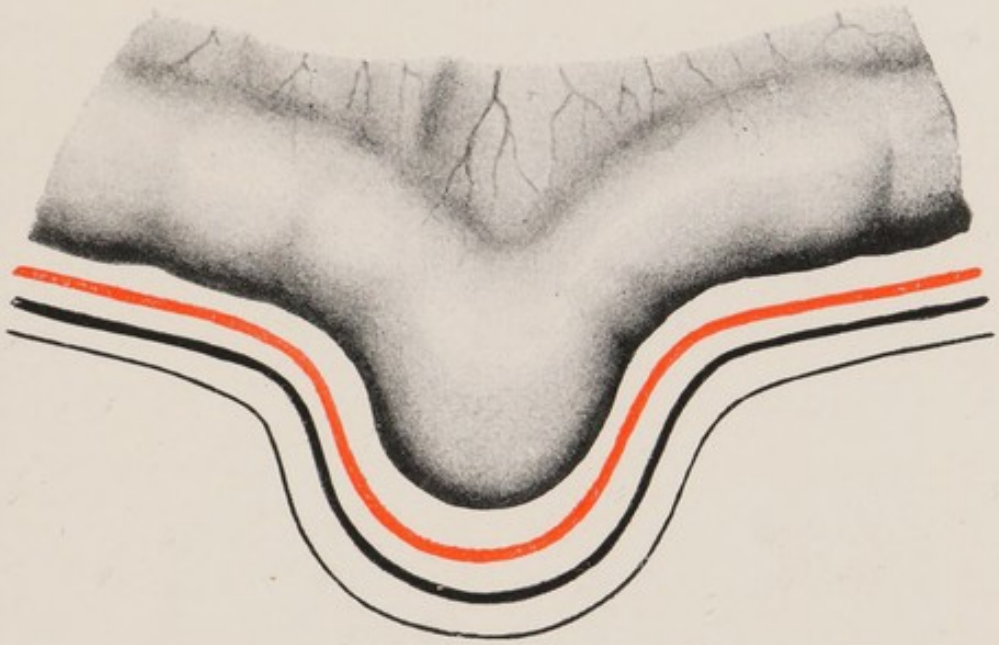
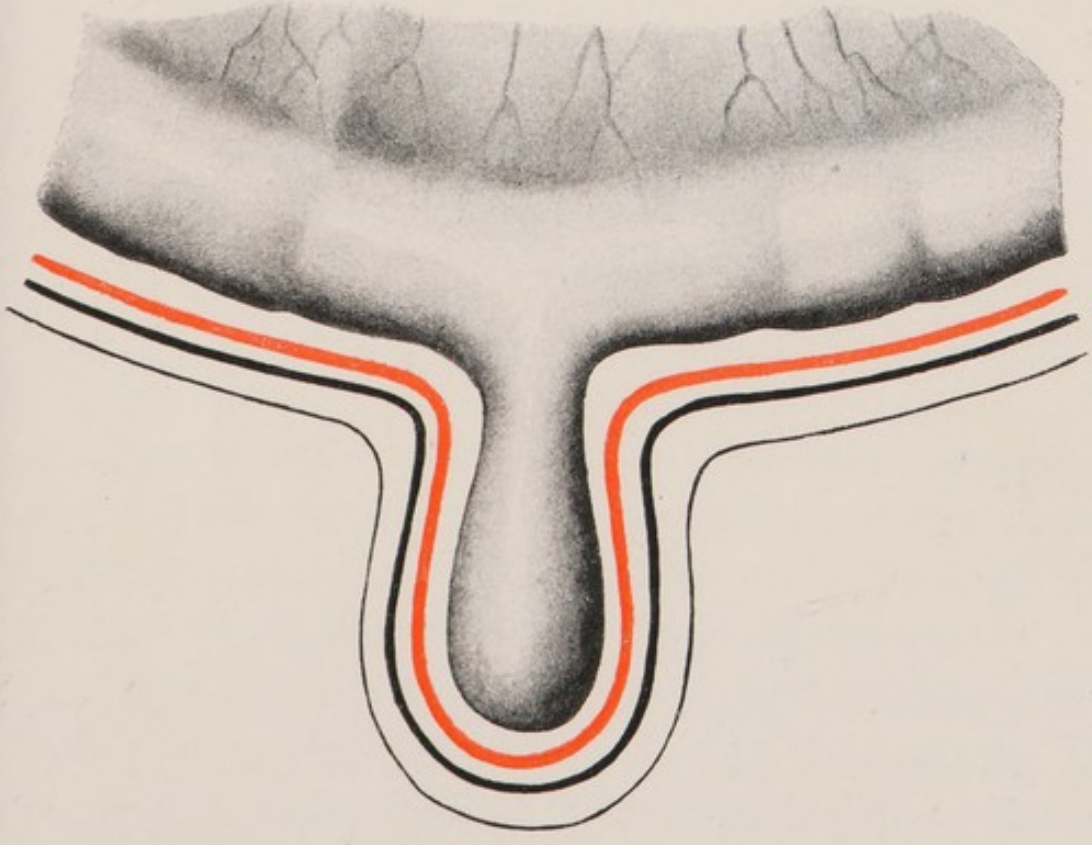


Fig. 11.



through an opening in the muscular coat of the bowel. It consequently follows that while the congenital diverticulum of Meckel (Fig. 13) contains all the layers of the normal intestinal wall, the acquired diverticulum consists of the serosa and mucosa and of but a few fibers from the longitudinal muscular coat of the bowel.

In order to appreciate the special characteristics of the

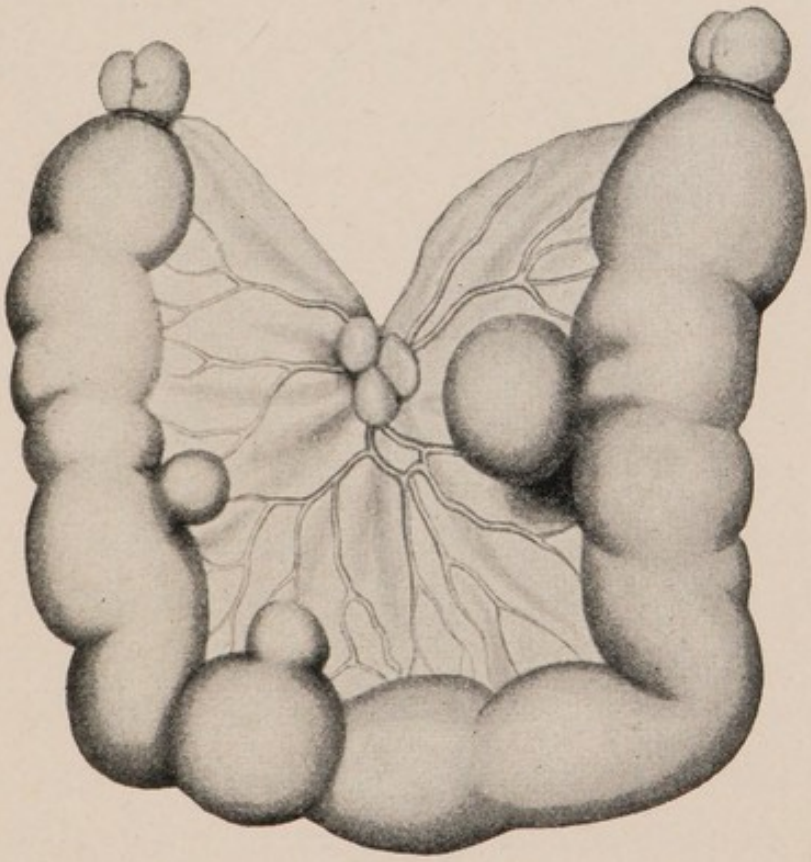


Fig. 12.—Acquired intestinal diverticula (from Schmidt).

contents of any hernia, it will be appropriate to separately consider the individual organs which have been observed in hernias, and they will be taken up in the order which corresponds to the frequency of their occurrence.

The **small intestine** has the longest mesentery of any abdominal organ, and is consequently the one most likely to descend into a hernial sac. Approximately speaking,

the upper three-fifths of the small intestine are known as the jejunum, while the lower two-fifths are called the ileum. The distance from the line of insertion of the mesentery at the posterior abdominal wall to the intestine is greatest at about 25 centimeters above the appendix, and in this situation is about 23 centimeters. This distance becomes

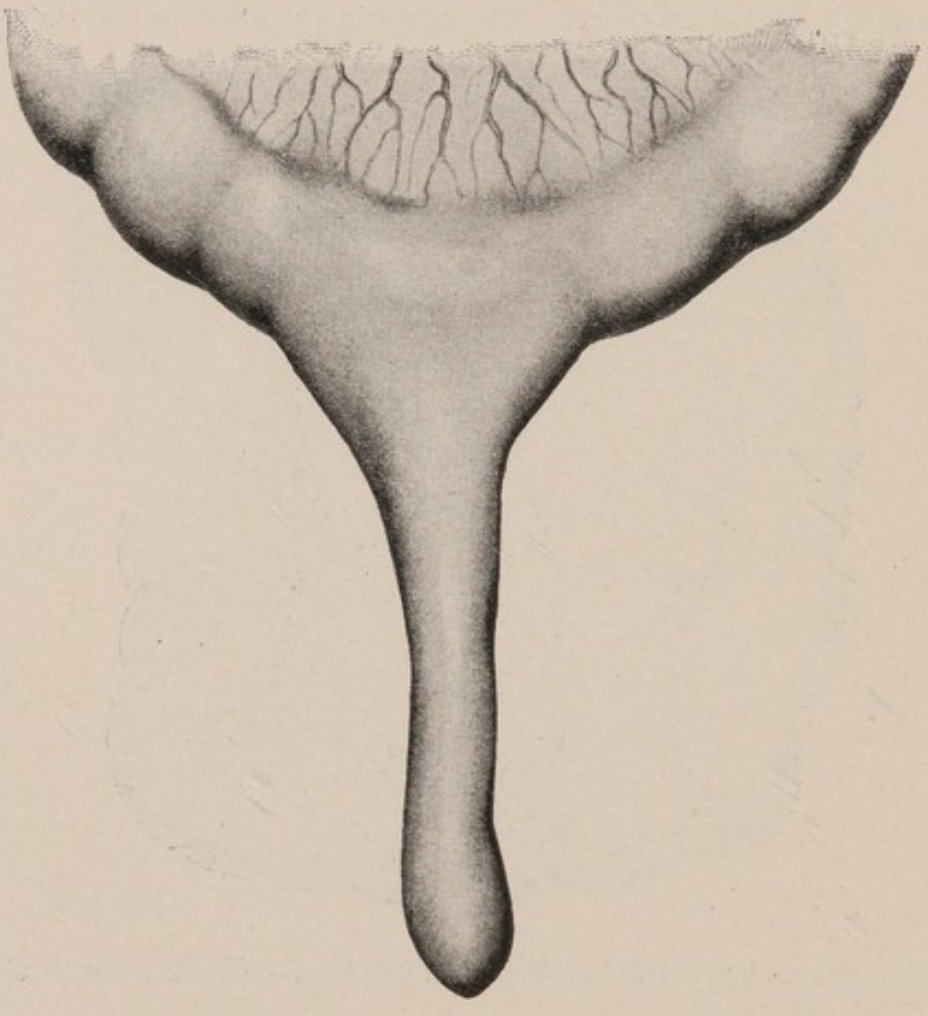


Fig. 13.—A long Meckel's diverticulum of the small intestine.

much shorter both toward the duodenum and toward the cecum—11 to 13 centimeters. From this may be seen which portion of the intestinal canal is particularly predisposed to form the contents of a hernia, and also that the passage of an intestine into a hernial sac is so dependent upon the condition of its mesentery that with every descent

of the hernia it is highly probable that one and the same intestinal coil protrudes through the hernial orifice.

The Omentum.—In 283 inguinal hernias, Maydl has found the omentum as the sole contents 77 times, and omentum together with the intestines 34 times; in 123 femoral hernias he found omentum alone 19 times, and in combination with the intestine 14 times. If both omentum and intestine are contained in the same hernia, the omentum usually retains its relative position and is situated in front of the intestinal coil. If the omentum remains in the sac for some time, it frequently undergoes certain changes. The opposed omental surfaces may grow together, forming irregular masses, or the fatty tissue of the omentum may take on a lipomatous thickening. Adhesions are very easily formed between the omentum and the wall of the sac, and it is usually the lowest tip of the omentum that grows fast to the sac. This is not always so, however, since in some rare cases a certain portion of the surface of the omentum may adhere to the fundus of the sac and the free end turn upon itself and pass back into the abdominal cavity (Fig. 14). If such a condition is not recognized at the time of operation, the customary ligation of the omentum in sections may be followed by bad results, since such an omental process, being cut off from all of its connections, falls into the peritoneal cavity, becomes necrotic, and thus favors the development of a purulent peritonitis.

The Large Intestine.—The sigmoid and the transverse colon possess rather long mesenteries, which are, however, subject to great variations in this respect. The ascending and the descending colon have no free mesentery;

their posterior surfaces are adherent to the posterior

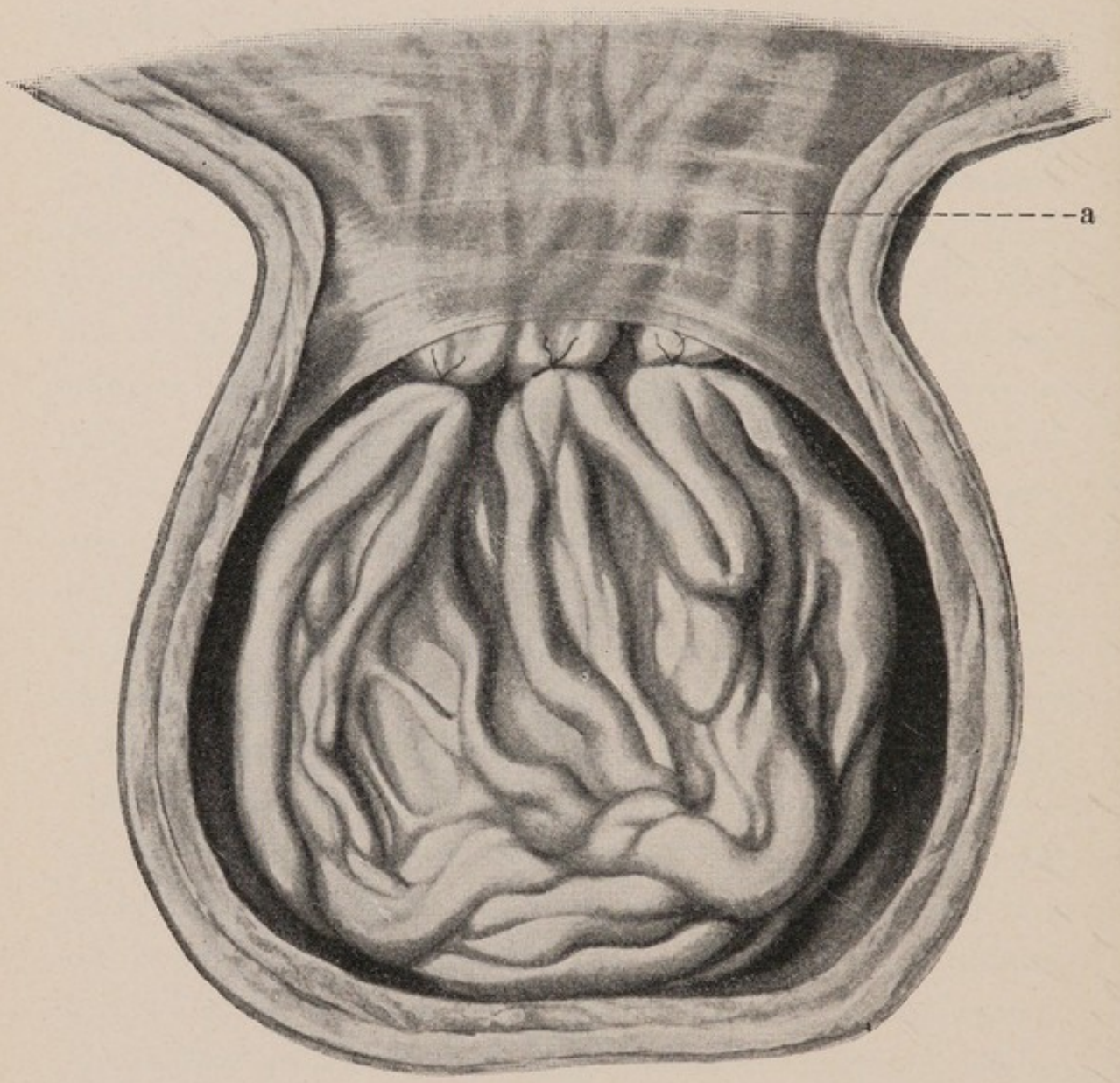


Fig. 14.—A hernial sac containing adherent omentum, the tip of which has turned upon itself and passed back into the abdomen. The omentum has been tied off by three ligatures, and, at the point of ligation furthest to the right, the recurrent tip of omentum (a) may be seen projecting into the peritoneal cavity. (Diagrammatic drawing based upon a case operated upon at the Surgical Clinic of Göttingen.)

abdominal wall and are consequently uncovered by peritoneum. Under certain circumstances, however, these

viscera are not so firmly adherent, and then even these portions of the intestinal tract have a certain range of motion. The peritoneal covering of the cecum at its point of reflection upon the ascending colon shows a similar arrangement; *i. e.*, the posterior surface of the cecum is extraperitoneal, while the cecum itself and the vermiform process are surrounded by peritoneum. [The cecum is frequently so movable that the appendix may be found in a left inguinal hernia. I have observed one such case and a number have been reported.—Ed.]

From this description may be seen the relative ability of the different portions of the large intestine to descend into a hernial sac. It is also to be remembered that the mobility of the transverse colon is limited by its connection with the more firmly fixed ascending and descending colons, and that the cecum can be more easily dislocated by the adjacent and more freely movable ileum. It consequently happens that the cecum, the transverse colon, and the sigmoid flexure can pass into a hernial sac much more easily than the ascending and descending colons. In no small number of cases the vermiform appendix, either alone or with the cecum, is found as the contents of a hernia, and sometimes becomes inflamed within the hernial sac.

[In 32 cases of cecal hernia operated upon by the writer the appendix was also found in the hernial sac eight times. In two of these cases the hernia was strangulated.—Ed.]

When those portions of the large intestine which have only a partial peritoneal covering pass into a hernia, they maintain the same relations to the peritoneum; *i. e.*, they lie partly within and partly without the hernial sac, as has previously been mentioned.

With the exception of umbilical hernia, and in accordance with the usual location of the abdominal viscera, hernia of the cecum and of the ascending colon are more frequent upon the right side, whereas those of the sigmoid and descending colon are more commonly observed upon the left. The opposite condition may, however, obtain, and it is then fair to assume the existence of a congenital displacement of the viscera. At an early stage of development both the ascending and descending mesocolons are as freely movable as is the mesentery of the small intestine, and at a later period they become closely attached to the parietal peritoneum of the posterior abdominal wall. If the mesocolon remains long and movable instead of passing through the usual developmental changes, the appearance of the cecum in a left-sided inguinal or femoral hernia may be easily understood. In a similar manner if the sigmoid flexure is found in a right-sided hernia, we are forced to assume that it has a congenitally long mesentery. It goes without saying that, in addition to the large intestine, both omentum and coils of the small intestine may be found in the hernial sac.

No other organs except those just mentioned are commonly found as the contents of a hernia. It is true that in 1898 Brunner was able to collect 180 cases of vesical hernia from the literature, but these cases were those occurring within a period of about a hundred years, and their number is not so great when compared with the enormous number of operations for hernia which have been performed in the last decennium as a result of the modern methods of asepsis and of the development of the technic of the operation for radical cure. [Of 950 cases of inguinal and

femoral hernia operated upon I have not observed a single hernia of the bladder.—Ed.]

From the fact that only the upper and a part of the posterior surface of the bladder is covered by peritoneum, it will be seen that either the intraperitoneal or the extraperitoneal portion of this organ may pass into a hernia. According to Brunner, it most frequently happens that the uncovered portion of the bladder is the first to protrude through a hernial orifice, and that this is followed by a sac of peritoneum. It must also be remembered that a vesical hernia may be simulated during an operation upon an inguinal hernia if strong traction is made upon the isolated sac. Under such circumstances the bladder is sometimes drawn down with the hernia, but it sinks back into its normal position when the traction is discontinued. It not infrequently happens that the presence of a vesical hernia is not suspected until the bladder is cut into at the time of operation. To avoid the occurrence of such an accident, the anamnesis should be carefully studied for the pre-existence of vesical symptoms and a catheter should be introduced to determine the relation of the bladder to the hernial contents. During the operation the presence of the bladder is frequently indicated by a marked increase in the amount of the prevesical areolar tissue.

The publications in reference to hernia of the ovaries were last collected in 1878 by Puech. He was able to find 86 cases, of which the greater portion (54) must be regarded as congenital. Both ovaries have been repeatedly found in bilateral hernias. English collected 9 such cases of bilateral inguinal hernia, Otte found a similar condition in a bilateral femoral hernia, and in one of the cases col-

lected by Puech one ovary was in a sciatic hernia while the other was situated in an umbilical hernia. The characteristic symptoms of a hernia of the ovary are a typical pain upon pressure, analogous to that produced by pressing upon the testicle, and a periodic swelling of the hernia appearing simultaneously with menstruation. The latter and more important symptom is, of course, absent in children and in women who have passed the menopause.

The Fallopian tubes, rarely alone but more frequently with the ovaries, have been found in both inguinal and femoral hernia.

Maydl states that, up to the present time, the uterus has been found seventeen times as the contents of a hernia. In nine cases the uterus, the ovaries, and the tubes were present, and in two of these intestinal coils were also observed within the hernial sac; in five cases the uterus showed evidence of developmental anomalies, and in several instances it was in a pregnant condition. According to Gurlt, the latter state of affairs gave the surgeon, Trautmann, an opportunity to successfully perform a Cæsarian section in 1610, both mother and child being saved.

The stomach has been observed not only in diaphragmatic and umbilical, but even in inguinal and femoral hernia. On account of the frequent occurrence of gastric pain in cases of epigastric hernia, it was formerly supposed that these hernias were particularly likely to contain a part of the stomach. Since we now know that traction upon the omentum may cause such gastric pains, or that they may even result reflexly from traction upon the parietal peritoneum, we should designate only those cases as gastric

hernia in which the presence of the stomach within the hernial sac has been incontrovertibly proved.

The microscopic examination of small fistulas, cysts, and tumors of the umbilicus which sometimes remain as rests of the omphalo-enteric duct has repeatedly demonstrated the existence of a mucous membrane, the structure of which resembled that of the stomach. In one instance the mucous membrane even furnished a secretion which possessed certain digestive properties. Tillmanns, who described the first case of this kind, thought that originally a small gastric diverticulum had been present in a congenital umbilical hernia, that this diverticulum had become walled off from the stomach, and that it had protruded externally after the separation of the cord had taken place. This case, which the newer works still classify with gastric hernias, has nevertheless nothing to do with them, and should be considered as a developmental anomaly of the omphalo-enteric duct (Ophüls).

The liver has been found in diaphragmatic and in congenital umbilical hernias. In the latter position it has sometimes formed the sole contents of the hernial sac.

The dilated gall-bladder was found alone in a hernia of the linea alba by Lanz and in an inguinal hernia by Skey.

As instances of rare contents of an inguinal hernia may be mentioned a floating kidney (Deipser), a dilated ureter (Reichel), and the spleen (Ruysch). The pancreas has been found in an umbilical hernia (Rose), and a testicle which failed to descend into the scrotum has been observed in a femoral hernia (Guincourt).

The **coverings of a hernia** (Fig. 15) are those layers of tissue which inclose the hernial sac. The hernial orifices are not naturally patulous, but are closed by loose

Fig. 15.—A diagrammatic representation of the coverings of a hernia: a, The skin; b, the superficial fascia; c, the muscular layer—*e. g.*, the cremaster muscle in an inguinal hernia; d, the transversalis fascia; c, d, have also been called the fascia propria herniæ; e, the peritoneum —*i. e.*, the sac of the hernia.

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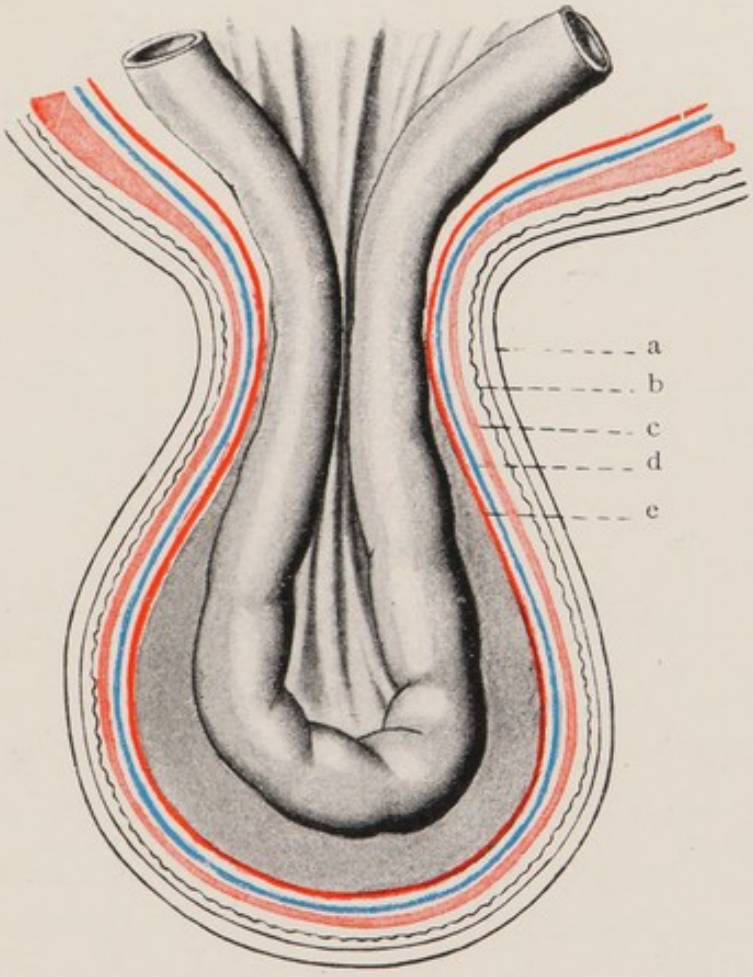
connective tissue, fascias, tendons, or muscles, and filled up by vessels making their exit from the abdomen. When a hernial sac commences to descend, the tissues in front of it are either pushed to one side or forced in advance of the hernia. The protruded structures form the coverings of the hernial sac, and their number, character, and thickness vary with the anatomic peculiarities of the location involved. If the parietal peritoneum is separated from the inner surface of the abdominal wall, it will be seen that the entire abdomen is lined by a fascia which is known as the intra-abdominal fascia. The vessels are always situated between this fascia and the parietal peritoneum, and in those situations in which the vessels pass out of the abdomen there is always an opening in the fascia. This opening is not an orifice with a free border, but is formed by the fascia passing out with the vessel for a certain distance and then becoming adherent to its wall. The various portions of this intra-abdominal fascia are known by different names in the different regions of the abdomen. Upon the posterior abdominal wall, where it partly covers the iliac muscle, it is known as the iliac fascia ; upon the anterior and lateral abdominal walls, where it lines the transversalis muscle and aponeurosis, it is called the transversalis fascia, and within the pelvis it is spoken of as the pelvic fascia. The particular relation of this fascia to any individual hernia will be fully considered in the section

Fig. 15.



upon special hernias, and at this place it will be sufficient to emphasize the fact that this fascia always exists as one of the coverings in any variety of hernia. In accordance with the teaching of Cooper, who first described it in femoral hernia, this fascia, alone or together with a layer of muscular fibers, is called the fascia propria, or the fascia Cooperi. However interesting the relations of the various hernial coverings may be from an anatomic standpoint, they are of little practical value, and any one who operates upon a hernia, and who attempts to use his anatomic knowledge to recognize all these layers as he cuts through them, will soon find that such a course is almost impossible. In certain situations these coverings are unusually thin and difficult of recognition; in others they may be fused together, and if the hernia is old, they are greatly thickened.

SUBPERITONEAL LIPOMAS.

The space between the intra-abdominal fascia and the parietal peritoneum contains all the vessels which leave the abdominal cavity, and a loose connective tissue, more or less rich in fat, which in certain places in the abdominal wall may proliferate and form lipomas of considerable size. These are called subperitoneal, preperitoneal, or subserous lipomas, and have also been referred to as "fat hernias" and as "apparent hernias." They have been mistaken for true abdominal hernias, and must be discussed in connection with them, since the two conditions frequently coexist, and in certain cases it is fair to assume that the lipoma holds a causal relation to the hernia.

In the vicinity of certain hernial orifices—for example,

to the inner side of the femoral vein and in the linea alba —this subperitoneal areolar tissue is markedly developed, and in these situations favors not only an increased mobility of the parietal peritoneum, but also the formation of lipomas (Fig. 16). The points of similarity between subperitoneal lipomas and abdominal hernia may be stated as follows: (1) They are found in the common hernial orifices, the femoral, the inguinal, and the umbilical regions, and particularly in the linea alba; (2) they frequently become more protuberant with any increase of the intra-abdominal pressure, such as that produced by coughing, and may be partly or wholly replaced; (3) they frequently produce symptoms which are similar to those of abdominal hernia. These symptoms are actually due to the traction of the lipoma upon the adherent parietal peritoneum, since this in itself is sufficient to produce pain. We have an opportunity of observing this in laparotomies done under Schleich's anesthesia, in which the parietal peritoneum usually remains exquisitely sensitive to the slightest traction in spite of the most successful anesthesia. This irritation of the peritoneum produces a reflex pain which is usually localized in the gastric region.

The traction upon the peritoneum may occasionally be so marked that the growing lipoma draws the peritoneum after it, and thus forms a hernial sac. If a tip of omentum is adherent to this sac,—a not infrequent occurrence, —we have, in addition to the lipoma, a completely developed hernia with all of its phenomena. Subperitoneal lipomas are most frequently encountered in the following situations, which are named in the order of their frequency: first, the linea alba or its immediate vicinity, and almost

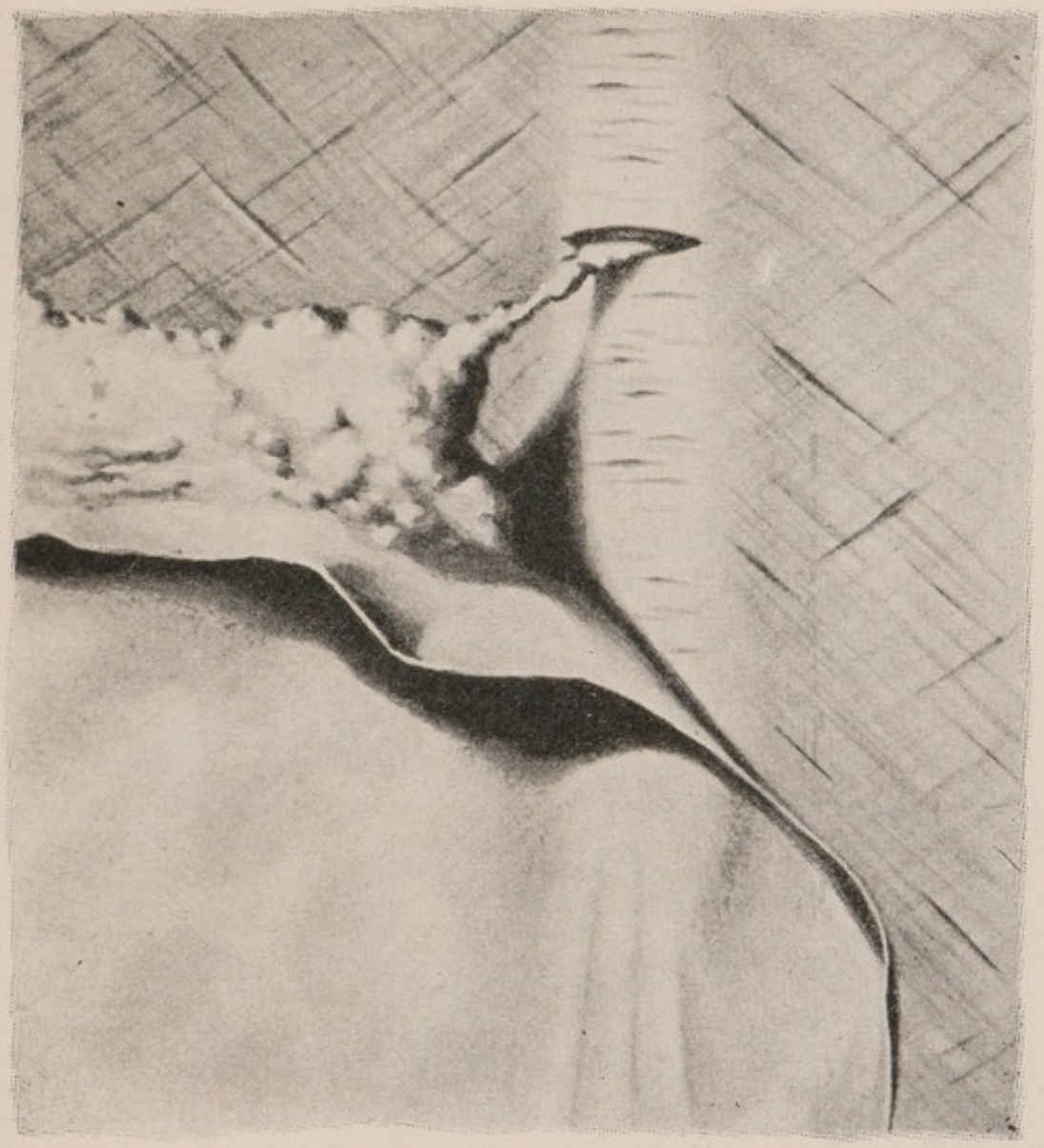


Fig. 16.—Subperitoneal lipoma of the linea alba above the umbilicus, viewed from within: This figure shows the inner surface of the anterior abdominal wall. Above the umbilicus, which may be recognized by the point of union of the three folds passing up from the bladder, the peritoneum has been partly dissected up and thrown back. A small subserous lipoma is exposed, the small pedicle of which is seen as it passes forward through a narrow transverse slit in the linea alba. From the picture it will be readily understood how larger lipomatous masses may be forced outward by any augmentation of the intra-abdominal tension, and how it might be possible to partially replace them, as may sometimes be done with true hernias.

always above the umbilicus; next, in the femoral region; and, finally, in the inguinal and umbilical regions.

When these fatty tumors coexist with a hernial sac, they have an additional interest, since their growth may exert such marked compression upon the sac that its opposed inner surfaces finally become completely adherent and thus obliterate its cavity. In this manner it is possible that a hernia might undergo a spontaneous cure. If the growing lipoma, instead of exerting a uniform pressure upon the entire sac, simply compresses a portion of it, the adhesion of the serous surfaces takes place in this situation only, and a part of the hernial sac may be cut off as a completely closed cyst. Such cysts upon hernial sacs may also be formed in other ways (see Figs. 51 and 52), and their presence makes the recognition of the hernial contents much more difficult.

THE ORIGIN OF ABDOMINAL HERNIAS.

The mechanism of the formation of hernia is of considerable and by no means purely theoretic interest. If the causes of an ailment are known, its permanent cure may be more readily accomplished, and with the present rapid growth of the accident insurance laws, the physician is called upon so frequently to express an opinion upon the etiologic connection between an accident and an abdominal hernia that he has a pressing and undeniable need of an exact knowledge of the mechanism involved.

The previously mentioned supposition that a hernia was preceded by a rupture of the peritoneum was particularly held in reference to strangulated hernia, while non-strangu-

lated hernias were supposed to result from a relaxation and displacement of this membrane. These were the fundamental views which were generally accepted from the most ancient times until the beginning of the eighteenth century, and it was not until this time, most important for the development of surgery in general, that Mery (1701) published some observations intended to prove that the peritoneum was not torn, but simply stretched, in the formation of a hernia. Corvillard (1672) had previously discovered that there were certain congenital hernias which were completely formed before birth. Reneaulme de Lagaranne and Garengeot (about 1730) gave the first complete description, in a more scientific manner, of the mechanism of the formation of a hernia. They supposed that the intestines were subjected to pressure upon all sides by the abdominal muscles and diaphragm, from which they attempted to escape through the weak portions of the abdominal wall, particularly in those places which give exit to the vessels. In these situations they believed that the peritoneum was pushed outward, either gradually or suddenly, by the abdominal pressure and the weight of the intestine, which they supposed to be filled with solid feces. No further mention of a rupture of the peritoneum is made by Garengeot. A marked advance in the understanding of the development of hernia is seen in the theory of Benevoli (1797), that the causes previously given for the formation of a hernia were not sufficient, but that an additional factor was necessary—namely, a relaxation of the mesentery. Whether this relaxation is primary or whether the mesentery elongates secondarily from the descent of the intestine into the hernia, long remained a subject of controversy, and has not been definitely decided even at the present day. Cloquet (1819) treated the subject from another standpoint, and was the first to suggest that hernia could arise not only from pressure from within, but also from traction from without. The testicle, for example, in its descent could draw the intestine after it, or a subperitoneal lipoma could, by means of its pedicle, make traction upon the peritoneum and thus form a hernial sac. Roser (1843), followed by Linhart (1865), elaborated the

latter theory, and claimed that, in femoral hernia at least, the traction of such a subperitoneal lipoma was to be considered as the usual cause of the development of the hernia.

Recently Koch (Dorpat) and his followers have advanced the theory that neither traction from without nor pressure from within can produce a hernial sac during extra-uterine life, but that, with the rare exception of those formed by cicatricial tissue, all hernial sacs are congenital. They assume not only that the hernial sac is congenital, but also that the intestinal coil within the sac has attained this position from some congenital peculiarity of its situation or attachment within the abdomen. Koch recognizes the possibility of the enlargement of a congenital hernia in later life, and explains such an occurrence by the mobility of the peritoneum, and probably also by a specific theory of growth.

At the first glance Koch's theory is apparently favored by the influence of heredity upon the occurrence of hernia, which is shown in Berger's statistics, inasmuch as members of the same family are frequently affected. This, however, proves nothing, since the conditions which favor the development of hernia, such as the degree of resistance of the abdominal wall and the size of the hernial orifice, are also inherited and could influence the development of the hernia in the parent as well as in the child. The universally recognized rarity of femoral hernia in childhood speaks against Koch's theory. The statistics of Berger show but 9 femoral hernias in 1518 cases of hernia in children under fifteen years of age. [I have recently analyzed 9882 cases of hernia in children under fourteen years of age treated at the Hospital for Ruptured and Crippled in New York, and found 60 cases of femoral, or the proportion of 1:164 inguinal.—Ed.] Even if the hernial sac were congenital, and the femoral hernia became completely developed later in life by the descent of the hernial contents, autopsies upon the newborn should have revealed the presence of a peritoneal diverticulum much oftener than has been the case. As long as such a congenital predisposition is not supported by anatomic evidence, it will be well to regard Koch's theory with a great deal of skepticism.

The prevalent views in reference to the origin of abdominal hernia may be expressed as follows:

1. Congenital hernias are observed which are complete at birth, even the hernial contents being present. They are to be regarded as disturbances of development, and such disturbances of development occur almost exclusively in umbilical, inguinal, and diaphragmatic hernia. There are other cases in which only the hernial sac is congenital, and this is observed particularly in external inguinal hernia. In such individuals there is no sign of the presence of a hernial sac, and it probably is not until there is a sudden violent augmentation of the intra-abdominal tension by sneezing, crying, a fall, a blow upon the abdomen, or by lifting heavy weights, that the intestine is forced into the sac and the hernia is complete in all its parts. In these cases there is a congenital predisposition to hernia, since the sac exists at birth, but the hernia is not completed until one of the just mentioned exciting causes is brought into play. In a similar manner the intestine may be forced into a congenital sac by a frequently repeated moderate increase of the intra-abdominal tension, and thus complete the formation of a hernia.

2. In addition to congenital, we have acquired hernias. They are characterized by the fact that they never arise from a single increase in the intra-abdominal pressure, be it ever so violent, but make their appearance gradually. As Graser very correctly emphasizes, the development of the majority of acquired hernias is not due to any one cause, but to a series of different influences. As far as the development of the hernial sac is concerned, the yielding of the peritoneum is due to the fact that the abdom-

inal wall is less capable of resistance in certain situations, and that the peritoneum, which is easily movable upon its bed of loose areolar tissue, attempts to escape from the repeated augmentations of the intra-abdominal tension through the places of decreased resistance. The majority of hernialogists agree that the development of the hernial sac is favored both by rapid emaciation and by the rapid accumulation of fat. Paradoxical as this may sound, the explanation given is nevertheless a plausible one. With the occurrence of general emaciation, the fatty tissue filling up the hernial orifices usually disappears, and these places, which were already less resistant, become more yielding and relaxed; with the rapid appearance of obesity there is an increase in the amount of the subperitoneal areolar tissue, and this consequently results in a greater mobility of the peritoneum. The traction of a rapidly growing subperitoneal lipoma upon the peritoneum, to which it is tightly adherent, is also a factor in the development of a hernial sac, although it does not follow that this method of origin is frequent, or, as Roser claimed, the usual one.

3. The enlargement of a pre-existing hernial sac is due in a slight measure to elastic extension, but chiefly to a greater or less degree of mobility of the peritoneum upon the underlying structures. In my opinion, however, the ability of the sac to enlarge from an increased growth of its peritoneal surface is worthy of particular attention. If a cyst which is lined with epithelium becomes very tensely filled, the pressure of the secreted fluid acts as a stimulant, and the walls enlarge more by actual growth than by a flattening and stretching of the cellular elements. We

must also assume that a similar effect is produced upon the inner surface of a hernial sac which is constantly irritated by the repeated forcing of the intestine against its wall.

4. Only those portions of the intestines may enter into a hernial sac which are enabled to do so by their position, and particularly by the length of their mesenteries. We must consequently assume that a congenital predisposition enables the intestine to pass the hernial orifice, but that with the enlargement of the hernia it is possible for the mesentery to elongate by a process of growth similar to that described in reference to the hernial sac.

5. Both the origin and the enlargement of a hernia are favored by certain pathologic conditions, particularly those of the respiratory apparatus, by pregnancy, and by certain occupations.

The pathologic conditions of the respiratory organs which favor the development of hernia are acute and chronic bronchitis; whooping-cough; and probably also nasal obstruction—from adenoid proliferations, for example, on account of the associated exertion in breathing. Other factors to be considered are gastro-intestinal diseases, particularly chronic constipation, and anything which hinders the emptying of the bladder (phimosis). The stretching and subsequent relaxation of the abdominal wall in pregnancy is a sufficient explanation for the frequency of hernia in multipara. According to Berger, those occupations which require the output of considerable muscular effort combined with increased demands upon the thoracic organs are the ones which most strongly predispose to hernia.

In the critical examination of a causal relation between

hernia and accident we must remember, first of all, that a hernia, complete in all its parts, can never arise at the moment of an accident, or by a single augmentation of the intra-abdominal tension, be it ever so great. If the hernia first appears at the time of the accident, we may certainly suppose that the hernial sac was either congenital or gradually formed in the manner already described. [Bilfinger's [1] recent paper on "Traumatic Hernia" proves that traumatic hernia, though rare, does occur, and cites a case. I have recently observed an undoubted case myself. It was of the direct variety and there was no pre-existing sac. The hernia appeared immediately after the injury.—Ed.] After a severe subcutaneous wound of the abdominal wall in which the parietal peritoneum has also been torn, it is possible that the abdominal scar may stretch and lead to a hernial protrusion when the patient leaves his bed and resumes his ordinary occupation. These cases, which are to be classified with the hernia of scars (page 31), are, however, very rare. Such wounds may occasionally be recognized by the immediate consequences of the lesion—swelling, pain, tenderness, and the effusion of blood, but these symptoms may also be absent.

Although it must be unconditionally accepted that a hernia making its appearance at the time of the injury has never completely developed at that moment, a causal connection must nevertheless be recognized, since a pre-existing condition has been made worse by the accident [2] or injury.

[1] Archiv f. klin. Chir., Bd. LXIV, No. 1, 901.

[2] By an accident is meant that the affected individual suffers an impairment of his physical or mental condition, or even death, whether it be from external injury or from organic disease, and that this impair-

The investigation as to whether a hernia has previously existed is consequently very essential for a critical judgment upon this question. The following are some of the questions which must be asked: Has the injured individual ever been examined by a physician for any other disease? Has he been a soldier? Did he tell his fellow-workmen immediately of the hernial tumor which he claims suddenly appeared? How much time elapsed after the injury before he consulted a physician, and what did the physician observe? Are traces of the injury still present and can a conclusion be drawn from the size of the hernia and from the thickness of its coverings that it must have existed for a considerable time?

The further questions as to whether the injury is to be regarded as an accident, and whether it can be proved by witnesses that a hernia did not previously exist, are subjects for judicial decision, and frequently have nothing to do with the medical opinion.

It has recently been stated by Russian physicians that inguinal hernia may also be artificially produced, and that such attempts have been made in order to escape military service. More exact information upon this point will be found in the section upon expert opinions in reference to hernia.

ment can be traced to a certain event which has suddenly occurred—*i. e.*, within a definite and relatively short period of time. It is also possible that the results of this injury may gradually make their appearance. Another idea involved in the conception of an accident is that the amount of exertion ordinarily associated with the particular occupation of the individual must be exceeded, or that the exertion must be out of the ordinary as a result of something unusual in connection with the occupation.

THE GENERAL DIAGNOSIS OF HERNIA.

The diagnosis of hernia is greatly aided by a careful study of the anamnesis, which will show whether the swelling in question developed suddenly or gradually, whether it seemed to originate from within the abdomen, whether it has always been of the same size, or whether the protrusion is smaller or absent when the patient rises in the morning. It is also of interest to ascertain whether the patient has become rapidly emaciated or, on the contrary, rapidly obese; what occupation he follows; and, in the case of women, whether they have borne children, and, if so, how many. The patients ordinarily state that they have pain which is either localized at the hernial orifice or reflected from there to the abdomen; that they suffer from digestive disturbances, such as nausea and occasional vomiting; and that they are troubled with constipation. These latter symptoms demand considerable attention in the very beginning of the affection, when there is as yet no distinct external protrusion. [My own experience is that the symptoms are seldom of sufficient importance to attract the attention of the patient prior to the appearance of the swelling.—Ed.]

The examination commences with inspection, which reveals whether the position of the swelling corresponds to one of the hernial orifices; whether it is sharply outlined or seems to have a pedicle connecting it with the interior of the abdomen; whether the size of the tumor changes when the patient alternately assumes the erect and the horizontal positions; and particularly whether there is an enlargement and increased tension of the protruded parts,

with augmentations of the intra-abdominal pressure, such as that produced by coughing, for example. In sparely built individuals it is sometimes possible to recognize through the skin the contours of the intestinal coils situated within the sac.

Additional conclusions may be drawn from palpation. If an external swelling is visible, it is to be grasped between the thumb and index-finger and an attempt made to differentiate its base from the abdomen. If the case is one of hernia, such a differentiation is impossible, and a more or less thick cord is felt between the fingers. One of the surest signs of hernia is obtained when it is possible to replace the protruded parts into the abdominal cavity by external pressure. In large hernias this is not easy, and in such cases it is well to leave the reposition to the patient himself, who usually has acquired a certain skill in this procedure. As soon as the tumor has been forced back, the skin of the scrotum should be invaginated and the index-finger carried into the hernial orifice in order to obtain an idea of its size (Fig. 17). A rough measure may be made by observing how many fingers may be comfortably passed through the hernial orifice. If the skin is not invaginated and an attempt is made to force the finger directly into the mouth of the hernia, the skin becomes so tense that it hinders the advance of the finger.

If this method is followed in the examination of the hernial orifice of a patient who has as yet developed no distinct external protrusion, a distinct impulse upon coughing is felt, the intestines striking upon the palpating finger. Such an impulse alone is, nevertheless, no proof of the presence of a commencing hernia, and it is only

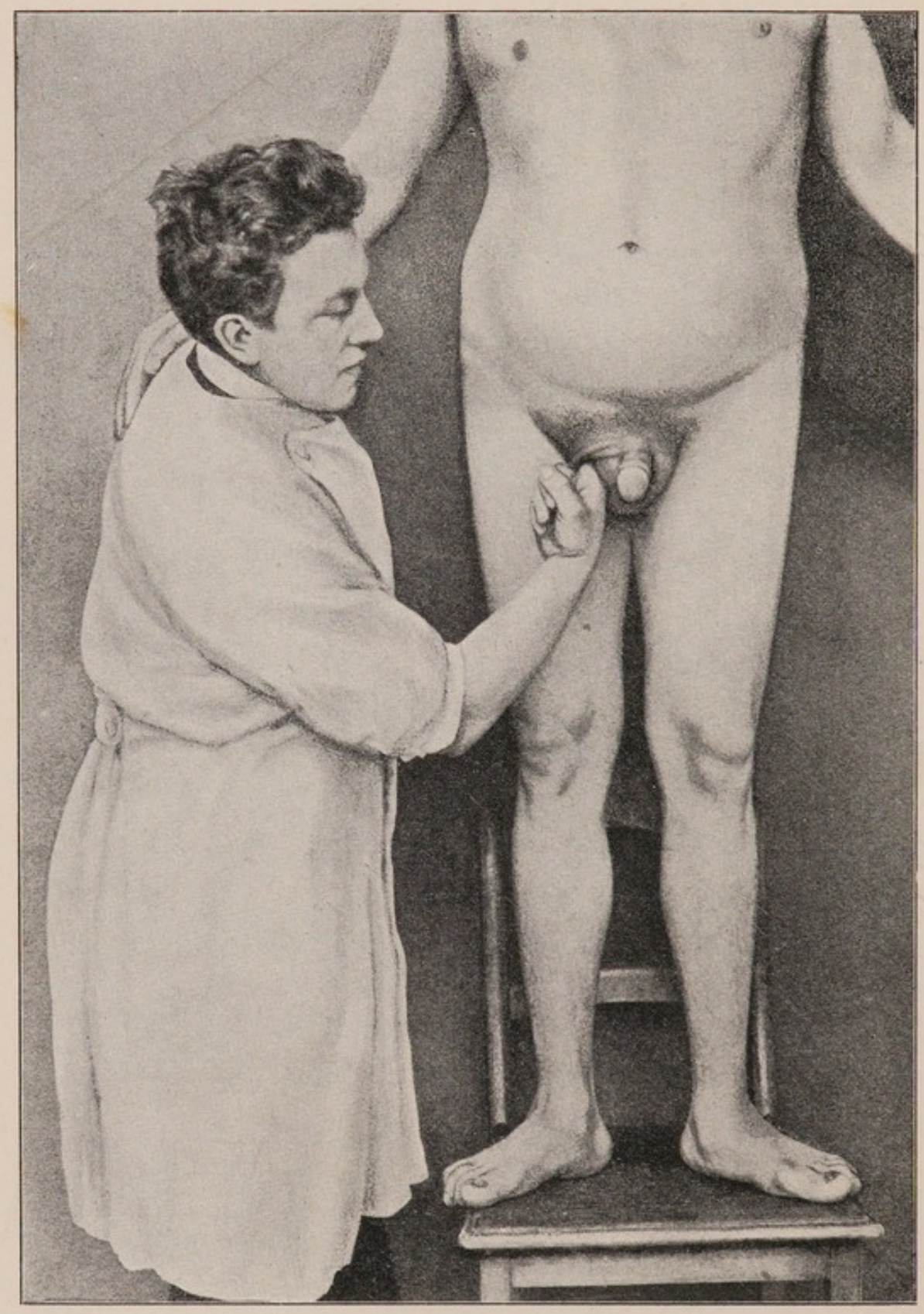


Fig. 17.—The position of the hand and the invagination of the skin in the examination of the mouth of an inguinal hernia.

after repeated examinations which show an increase of the impulse or the development of a hernia at the corresponding point upon the opposite side that there is any justification for such a diagnosis.

If the hernia contains intestine, reduction is accompanied by a very characteristic gurgle, and it not rarely happens that pressure will cause the entire contents to suddenly slip back into the abdominal cavity. If loops of intestine are present, the percussion note over the swelling is frequently tympanitic, although this sign may easily be wanting if the intestinal loop is small, if it is covered by omentum, or if much hernial fluid is present. While an intestinal hernia is uniformly smooth and elastic to the touch, an omental hernia is usually harder, feels rather lumpy, and its reduction is never so rapidly accomplished.

If the hernia is irreducible, the diagnosis is more difficult. The causes of the irreducibility are mostly to be found in adhesions in the contents themselves or between the contents and the hernial sac. In omental hernia, such adhesions to the sac are quite common, and it frequently happens that the contiguous omental surfaces become adherent, or sometimes even calcified, into a thick lump, and thus are unable to pass back through the narrow hernial orifice. [Calcification is of extreme rarity.—Ed.] In other cases, intestinal loops which have been in a hernial sac for a considerable time may become mutually adherent from some inflammatory or mechanical irritation,—such as the pressure of a badly fitting truss, for example,—and form such a thickened mass of convolutions that their reposition is impossible. A hernia must also be irreducible if its contents are formed by some viscus which is only

partially covered by peritoneum (ascending colon, descending colon, cecum, urinary bladder), since these organs are naturally tightly adherent to the peritoneum and can only change their positions in association with this membrane. The reposition of the sac of the hernia is, however, almost always impossible. After a consideration of all the symptoms, which in reference to pain and digestive disturbances are apt to be much more pronounced in irreducible hernia, it will usually be possible to make the diagnosis.

Since hernias are most likely to be confused with cysts, swollen lymphatic glands, and lipomata, more rarely with other new-growths, these affections consequently require particular attention from a differential diagnostic standpoint. The differentiation of a hernia, and particularly of an omental hernia, from a subperitoneal lipoma is by no means easy, and sometimes absolutely impossible. As we have already seen, the position of a lipoma, the form and consistence, the impulse on coughing, and the possibility of partial reduction may be similar to that of an omental hernia, and since the symptoms of the patient with a lipoma may be like those of a patient with a rupture, the reason for the difficulty of differentiation in such cases is understood. The cases which present such diagnostic difficulties are nevertheless in the minority, and the subperitoneal lipoma will usually be recognized as such by its situation in certain predisposed locations, such as the linea alba, femoral, or umbilical region, and since it maintains the same degree of tension, although often more markedly protruded by augmentations of the intra-abdominal pressure. Subperitoneal lipomata of the inguinal region are very rare.

Cysts and solid tumors may be differentiated from a hernia by the fact that they may be lifted up from the abdominal wall and sharply isolated from it, since they have no pedicle. In addition to this, cysts with clear contents are transparent. Variations in the intra-abdominal tension have no effect upon either the volume or the tension of solid or cystic tumors.

The differential diagnostic factors which are of importance in reference to individual hernias will be particularly pointed out in the section upon "Special Hernias."

GENERAL TREATMENT.

Before we consider the remedies which we possess for the improvement and cure of abdominal hernia it should be stated that a hernia may undergo a spontaneous cure. We have already learned how the growth of a subperitoneal lipoma may cause the obliteration of a hernial sac. It more frequently happens, particularly in young children, that the walls of the narrow neck of the sac become directly apposed, and finally adhere to each other; the remaining portion of the hernial sac may become obliterated in the same manner or it may remain as a closed serous sac which at any time may give rise to the formation of a cyst by the secretion of fluid. In no small number of cases a spontaneous cure is only simulated. This is chiefly observed in those cases in which a hernia present in youth has disappeared with advancing years. There has been no obliteration of the hernial sac or of its neck, but although the sac remains unchanged, the mouth of the hernia has become so markedly narrowed by the

growth of the body that it hinders the passage of a viscus. In later life the hernia may reappear in such individuals if the abdominal walls are relaxed and the intra-abdominal tension greatly increased.

The treatment of an ordinary reducible hernia may be either palliative or radical. The palliative treatment is the treatment by means of a truss, and has in view the reposition of the hernial tumor and the maintenance of this reposition by an appropriate support. If properly applied, it may cause a disappearance of the symptoms, prevent the further enlargement of the protrusion, and aid in the spontaneous cure of hernias in the early years of life.

The radical treatment aims at the complete and permanent cure of the hernia, and is an operative one.

The Palliative Treatment.—The fundamental requisite for the application of a truss is that the hernia is reducible. If the truss is applied while portions of the viscera are still within the sac, the attempt to close the hernial orifice will not only be fruitless, but the continuous pressure injures the protruded viscera and produces pain, since the irritation causes the formation of adhesions; the affection is made worse and a freely movable hernia is converted into an irreducible one. Before the application of a truss our first duty is consequently to reduce the hernia, and this procedure is known as taxis. The performance of taxis is usually quite simple in small hernias, the tumor being grasped by the hand and squeezed like a sponge. In larger hernias, taxis may be quite difficult and require the aid of several adjuvants. In the first place, the muscles of the abdominal wall should be relaxed

This may be accomplished by having the patient hold his mouth wide open and breathe deeply, and by placing a cushion beneath the pelvis, the lower extremities being flexed at the hips and knees. If the patient is kept in this position through the night, the hernia will frequently become spontaneously reduced without the aid of any manipulation whatever. Taxis is also more readily performed if the intestinal coils within the hernial sac are not filled with feces, and the cautious administration of purgatives by the mouth and of large enemata are consequently of service. Very large hernias which are difficult of reduction may sometimes be replaced if an elastic bandage is evenly applied about the entire hernial protrusion and allowed to exert a uniform pressure for several hours. After a successful taxis the application of a truss is indicated. If taxis is impossible and if operation is contraindicated or refused by the patient, we must content ourselves with the application of a truss with a cup-shaped pad or of some form of suspensory.

The knowledge of the application of the truss (*bracherium*) dates back to the time of Celsus, who employed a soft strap provided with a plate, and in this manner frequently succeeded in curing hernia in boys. For a long time plates were employed, which were fastened over the hernial orifice by a strongly adherent plaster (Lanfranchi, about 1300). Gordon (1305) seems to have been the first to mention a spring truss, but this suggestion was very soon forgotten, and it was not until 1785 that the truss, practically as it is still in use at the present day, was rediscovered and introduced by the Dutch physician, Peter Camper.

The truss consists of a steel spring the anterior extremity of which is provided with a pear-shaped pad. Conical

pads which project into the hernial orifice and are supposed to block it up simply dilate the mouth of the hernia, and should therefore be unreservedly condemned. Figure 18 shows the rough spring which at its anterior extremity is continuous with a metal plate provided with two pins or buttons. This plate is loosely covered with a case of stout drilling which is firmly stuffed, on the side next the body, with horsehair, cotton, wood-fiber, sea-grass, or, best of all, with the so-called "pig's-wool" (the soft hair which is shed by the pig). A thin leather covering is stitched over the pad and spring and continued beyond the end of the spring as a strap which embraces the opposite half of the body and is fastened to one of the buttons upon the pad (Fig. 19).

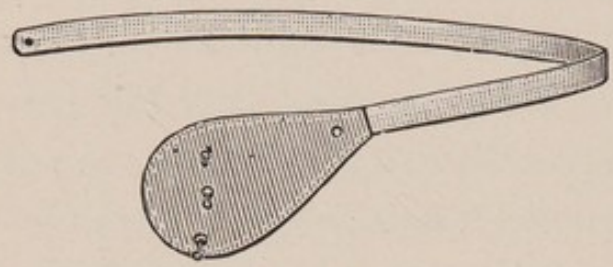


Fig. 18.

In certain cases the position and size of the hernia make it necessary to add a perineal strap, which gives the pad additional fixation (see Figs. 54 and 79). In this truss the spring encircles the affected side, while the complementary strap, which represents the continuation of the spring, embraces the other half of the body. The strength of the spring to be employed is dependent upon the size of the hernial orifice, upon the age of the patient, and also upon the amount

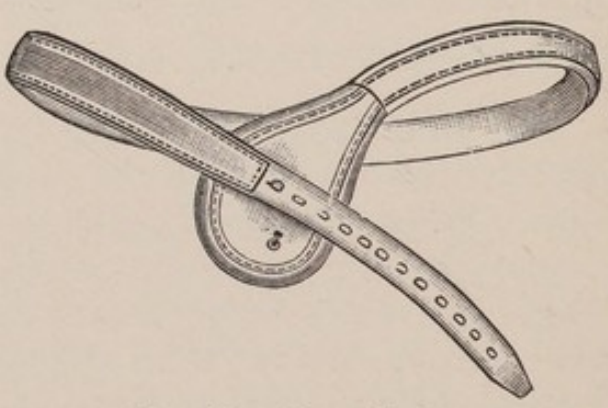


Fig. 19.—French truss.

of force with which the hernia is protruded. The truss should not change its position in walking, lying, or sitting, and is ordinarily worn only during the day. If the patient coughs frequently, or if there is a possibility of cure by means of the truss, it should be worn both day and night. If the hernia is bilateral, a double truss is to be applied, and this is best made by placing the free ends of two springs together and holding them in this position by means of a buckle attached to their leather coverings. In such a truss the distance between the two pads may be regulated at pleasure. The most important part is the spring, upon the curve and strength of which the worth and applicability of the truss are almost entirely dependent. The many modifications of the truss almost exclusively affect the nature of the pad, and of these modifications I will mention only the spring-pad, the hard-rubber pad, and the pad made by filling a small rubber bag with fluid (glycerin).

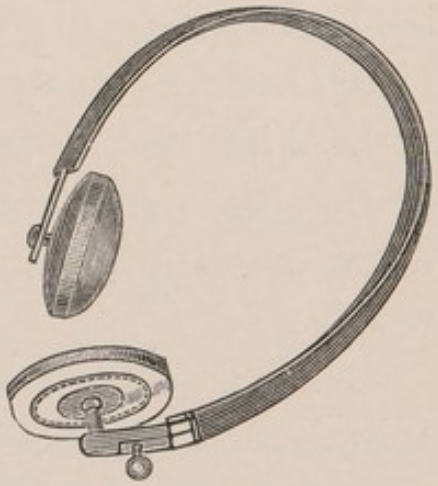


Fig. 20.—Cross-body truss.

The so-called English or Salmon's truss (Fig. 20) is somewhat differently constructed from that of Camper. Freely movable pads are attached to both ends of the spring by ball-and-socket joints; the anterior pad closes the hernial orifice, the posterior pad rests upon the sacral region, and the spring encircles the normal half of the body without touching the skin. In this truss the complementary and perineal straps are unnecessary. Al-

though very popular in England and America, this truss has nevertheless been but little employed in Germany.

The general rules for the treatment by means of a truss are as follows:

1. The hernia must be reduced before the application of the truss.

2. The pad must always be placed in direct contact with the skin or upon a small piece of linen.

3. The pressure of the pad must never be so great as to injure the skin; cutaneous excoriation may frequently be prevented by scrupulous cleanliness of the hernial region and by repeated bathing with alcohol.

4. When the truss has been applied, be sure that it retains the hernia when the patient walks, sits, lies down, goes upstairs, bends backward and forward, and coughs.

5. In children the chances of recovery are more favorable the earlier the treatment with the truss is commenced. A truss may ordinarily be applied when the child is three or four months old. In these cases a washable pad of hard rubber is to be recommended.

Certain details which are of importance in the different varieties of the truss will receive particular attention in the section upon "Special Hernias." [After the age of puberty cure by truss treatment is very rare in inguinal hernia, and femoral hernia at any age is practically incurable by mechanical treatment.—Ed.]

The Radical Operation.—Since the earliest times efforts have been made to cure hernia by operation, and these efforts have constantly been renewed on account of the unreliability of the older methods of retention. Good

results were not obtained until the beginning of the antiseptic era, and, at the present day, the procedures formerly adopted have only a historic interest. For centuries the radical operation was practised only by strolling laymen, who were known as "hernia cutters" (*Bruchschneider*). The results were poor, and in the most frequent variety, the inguinal hernia, the ligation of the sac was always accompanied by castration. On account of these reasons the operation fell into disrepute, the craft was considered dishonorable, and in the eighteenth century, when reputable surgeons commenced to operate for hernia, the "hernia cutters" completely disappeared.

The following table is a brief review of the methods employed for the radical cure before the beginning of the antiseptic era:

1. The obliteration of the hernial orifice by the actual cautery, according to the method of Abulkasim, who replaced the hernia and burned the hernial region to the bone.
2. Attempts to obliterate the hernial orifice or the sac itself by the production of scar tissue.

Velpeau: Injection of tincture of iodin into the sac.
Bonnet: Acupuncture in and about the sac.
Luton: The injection of concentrated saline solution around about the hernial orifice.
Guerin: Subcutaneous scarifications.

3. The ligation of the sac of the hernia (Celsus.—Paul of Ægina, who was the first to recommend castration in the operation for inguinal hernia).

The "golden ligature," because the ligation was made with a golden thread (Geraldus von Metz).

The "royal ligature," since it saved the soldiers for the king.

4. The ligation of the sac and the union of the edges of the hernial ring by means of sutures (Wood).

5. The plugging of the hernial orifice.
   Petit: by the invagination of the sac.
   Mösner: by foreign bodies which were introduced into the hernial orifice.
   Gerdy: by invagination of the skin into the hernial orifice and its fixation in this position by sutures.
   Wutzer and Rothmund: by invagination of the skin by means of special instruments.

Without going into the details of the methods used in special hernias, which will be fully considered later, the curative procedures employed under the protection of antisepsis may be divided into two groups: first, those in which an attempt is made to obliterate the sac by the injection of irritating fluids in its immediate neighborhood; second, those in which an open operation is performed.

The first of these methods was recommended in 1877 by Schwalbe, who employed 70% alcohol. Although the procedure has not been generally adopted, it may occasionally effect a radical cure in young children, in whom there is always a great tendency to spontaneous cure. Since the careful execution of the method is followed by no danger, it may be tried in appropriate cases, particularly if an operation is not indicated upon general grounds. [I believe that all injection methods are attended with some risk, and should never be employed. They rarely, if ever, effect a permanent cure, and often make the radical operation more difficult when it has to be performed. I have seen one fatal case from intestinal obstruction caused by escape of fluid into the abdominal cavity, and formation of adhesions. Now that the open methods are so safe and so effective, and require but two weeks in bed, it is difficult to see under what conditions it would be preferable to give daily

injections for two weeks, one week of which the patient must be kept in bed, and finally only the most uncertain and indifferent results can be promised.—Ed.]

After the skin over and about the hernia has been carefully disinfected, the hernia is reduced and the left index-finger is carried into the hernial orifice and allowed to remain there, in order to surely prevent the descent of the viscera during the injection. The needle of a hypodermic syringe is now introduced at a distance of 1 or 2 centimeters from the edge of the hernial orifice, and when no blood trickles out of the needle,—a sign that a vessel has not been punctured,—a syringeful of 70% alcohol is injected, and this procedure is repeated in several places about the neck of the hernia. The injections should be made daily or every other day for at least two weeks, later at longer intervals, and the patient should remain in bed during the first week.

Instead of alcohol, Lannelongue recommends the employment of a 10% zinc chlorid solution, of which five or ten drops are to be injected in several situations about the hernial orifice.

The first radical operations under the protection of antisepsis consisted simply in the closure of the hernial orifice by suture (Steele). Subsequently great stress was laid upon the closure of the neck of the sac, and after Czerny, in 1877, had pointed out the rational manner of performing the radical operation,—since he taught that both the neck of the sac and the hernial orifice should be closed,—the way was clear for the further development of operative procedures. The principle of the majority of these operations is as follows: The sac of the hernia is exposed by an incision and isolated, this isolation being most readily accomplished by starting at the neck of the sac; the

contents of the hernia are either replaced before opening the sac or, if irreducible, they are subsequently freed from adhesions; omentum which has been in the sac for some time is usually tied off in sections and extirpated. After the reduction of the contents, traction is made upon the isolated sac and a needle armed with two catgut ligatures is passed through the middle of the neck as high up as possible. This step is to be carried out under direct control of the eye in order to avoid puncturing any of the viscera which may be forced down again at the last moment. Ligatures Nos. 1 and 2 are now tied upon their respective sides, and then the ends of ligature No. 2 are carried about the entire neck and tied just below ligature No. 1. Such a knot will never slip, and the stump, about one centimeter in length, usually retracts into the abdominal cavity when the sac is cut off. In those cases in which the hernial orifice is very large or the pressure of the protruded viscera is so great that a ligation is impossible, the suture of the neck of the sac is to be recommended. In all cases the closure of the neck of the sac must be so high up and the isolation of the neck so complete that no trace of a funnel-like diverticulum of peritoneum can be observed. The second part of the operation is the closure of the hernial orifice by suture. The patients usually remain in bed for three weeks, and are then discharged without a truss, since experience has shown that pressure weakens rather than supports the scar.

In the special consideration of the various hernias, we will see that certain hernial orifices, such as those in the inguinal region, require rather complicated methods in order to effect their permanent closure. That such a

closure can be effected is proved by the results of the modern radical operation, which may now be regarded as a procedure free from danger, and as one which, with few exceptions, results in a permanent cure. These statements may be proved by extensive series of statistics, which include all the cases operated upon by the respective authors during a certain period of time. Smaller series of statistics and reports of selected cases are of no value in the solution of this question, and consequently will not be considered.

Before we recommend the radical operation to a patient with a non-strangulated abdominal hernia, and tell him that the procedure is safe and sure in its results, we must know both the mortality of the operation and the percentage of recurrences. We consider a patient free from recurrence who has carried on his usual occupation for at least a year after the operation and who still remains free from any return of the hernia.

In order to obtain a proper conception of the present status of this question it is fitting to consider the publications of recent years only, since during this time there has been considerable progress in the development both of asepsis and of the radical operation. The following tables consequently contain only the statistics which have been published since 1895. The names in parentheses designate the method employed by the different operators.

It will thus be seen that in 5419 radical operations upon non-strangulated hernia there were 28 deaths; *i. e.*, a mortality of 0.5%.

The number of cases at our command for the purpose of determining the frequency of recurrences is a much smaller

TABLE SHOWING THE MORTALITY AFTER OPERATION FOR NON-STRANGULATED ABDOMINAL HERNIA.

Year.	Author.	Operations.	Deaths.	Cause of Death.
1895	Nordische Sammelforschung (Bassini)	748	10	Two hemorrhages, 1 hemorrhage and sepsis, 1 bichlorid poisoning, 1 chloroform poisoning, 3 degeneration of heart, 1 emphysema and bronchitis, 1 pneumonia.
1895	Beresowski (Kocher)	220	0	
1896	af Schultén (Bassini)	235	2	One phlegmon, 1 collapse, pericardial adhesions.
1896	Simon (mostly Czerny)	105	2	One aspiration pneumonia, 1 gangrene of the lung.
1897	Ludwig (Bassini) .	143	1	Pyemia.
1898	Slajmer (Wölfler) .	250	0	
1898	Lebensohn (Kocher)	126	0	
1898	Borelius (Bassini)	147	1	Cardiac paralysis 8 days after the operation.
1898	Iwensen	102	0	
1898	Maydl	190	2	One pulmonary tuberculosis 17 days after the operation, 1 bronchopneumonia.
1899	Rotter (Bassini) .	250	1	Erysipelas.
1899	Franz (Bassini) .	100	0	
1899	Bull and Coley (Bassini) . . .	917	5	One double pneumonia, 1 peritonitis, 1 pericarditis and pneumonia, 1 omental hemorrhage, 1 shock.
1899	Bloodgood (Halsted)	395	2	One diphtheritic colitis, 1 pulmonary embolism.
1899	Galeazzi (Bassini, Kocher)	1400	2	Accidental diseases having no connection with the operation.
1900	Kirschkopf (Kocher)	191	0	
	Total . . .	5419	28	

[1901, Coley (Bassini), 954 cases, 2 deaths.—Ed.]

one, since considerable difficulty is encountered in keeping these cases under observation, and also since there are always cases published in which too short a time has elapsed to allow us to form an opinion of the definitive result. In addition to this, the material is not homogeneous, since the individual varieties of hernia behave quite differently in reference to the radical cure; some authors have reported all forms of hernia together, while others record the results in but one definitive variety. At all events, the table on page 76 will furnish a general idea of the frequency of recurrence.

[My personal results in operations for the radical cure of hernia, up to the present time,—May, 1902,—are as follows:

Of a total of 954 operations, 931 were for inguinal and femoral hernia, 24 for umbilical, epigastric, and ventral. There were 62 operations for femoral hernia; and of these, 16 cases were operated upon by Bassini's method for femoral hernia, the remaining 46 by the purse-string method, consisting of very high ligation and removal of the sac, with a purse-string suture surrounding the crural opening and bringing the floor of the crural canal, pectineal fascia, and muscle into contact with the roof of the lower border of Poupart's ligament. This method I consider the simplest and most satisfactory of any thus far devised, and in 46 unselected cases in which I have used it in the past ten years, not a single relapse has thus far been observed, and nearly all of the cases have been traced. In the series of 62 cases of femoral hernia only one relapse has been observed, and this occurred in a case operated upon according to Bassini's method, and is the only one of the series in which suppuration occurred. The relapse is

so slight that it is scarcely more than an exaggerated impulse, and although five years have elapsed, it has not increased in size nor been sufficiently large to need a truss.

TABULATED REVIEW OF THE NUMBER OF RECURRENCES APPEARING AFTER RADICAL OPERATIONS.

Year.	Author.	Number of Cases Subsequently Observed in Which at Least One Year Had Passed Since the Operation.	Percentage of Recurrences.	Variety of Hernia.
1895	Beresowsky (Kocher)	152	10.8 %	All varieties together.[1]
1895	Nicoladoni (Bassini)	49	6.1 %	Not stated.
1896	af Schultén . . .	112	1.5 %	All varieties together.
1896	Simon (mostly Czerny)	109	11.9 %	Inguinal and femoral hernia.
1898	Slajmer (Wölfler) .	76	9.2 %	Inguinal hernia.
1898	Lebensohn (Kocher)	83	4.8 %	Inguinal hernia.
1898	Brenner (modification of Bassini) .	169	5.9 %	Inguinal hernia.
1898	Bull and Coley (Bassini) . . .	618	1.9 %	Not stated.
1899	Franz (Bassini) .	31	6.4 %	Inguinal hernia.
1899	Galeazzi (Bassini, Kocher)	840	5.71 %	Inguinal hernia.
1900	Hirschkopf (Kocher)	83	1.2 %	Inguinal and femoral hernia.
1901	Coley (Bassini) . .	531 (500 inguinal and 31 femoral)	1.3 % (7 relapses)	Inguinal and femoral.

[1] This number was obtained from the following statement of Beresowsky:

External inguinal hernia,	I	method of operation:	64 cases with	6 recurrences.
" " "	II	" " "	32 " "	2 "
" " "	III	" " "	22 " "	0 "
Femoral hernia			13 " "	1 recurrence.
Internal inguinal hernia			12 " "	2 recurrences.
Umbilical, epigastric, and ventral hernia			10 " "	3 "

153 cases with 14 recurrences =10.8%.

Of the 869 cases of inguinal hernia, 851 were operated upon by Bassini's method with the substitution of kangaroo tendon for silk in all the buried sutures. But seven relapses have been observed, although upward of 500 cases have been traced for periods of one to nine years. —Ed.]

This table shows the great improvement in the number of permanent results obtained within the last three years. The largest number of recurrences after operations for inguinal and femoral hernia was 9.2%, while other authors reported still smaller percentages, some being as low as 1.2%. We can conscientiously claim that in the overwhelming majority of cases of abdominal hernia the radical operation is able to effect a permanent cure. According to the computations of Bull and Coley, the majority of recurrences appear within the first year: 64.5% occur during the first six months, 80% during the first year, 20% after the first year, and of the total almost 9% made their appearance between the first and second year after the operation.

Since the operation is not a dangerous one, the indications for the procedure may be given a considerable latitude. We are justified in performing the operation not only in patients who suffer considerable annoyance from their hernias (irreducible hernia, strangulated hernia), or in whom a truss cannot be properly applied, but also regarding as a sufficient indication the wish of the patient to be emancipated from his truss and the danger of eventual strangulation. The only questions are whether the operation is contraindicated in the very young, in the very old, or by an enormous size of the hernia.

The fear of operating in very young children has disappeared since we have learned that the mortality is no greater than among adults. However, since experience teaches that no small number of the hernias of childhood are spontaneously cured with advancing age, we regard the operation as indicated in those cases only in which the treatment by means of a truss cannot be carried out. In very young children great care must be exercised to prevent the infection of the wound with feces and urine. Thick absorbent dressings which come in close relationship with the anal and urethral orifices should not be employed, but the wound is to be accurately sealed up with as limited a dressing as possible. This is to be accomplished by painting the sutured wound with airol paste [1] or zinc paste,[2] applying some sterile gauze, and strapping on the small dressing with an abundance of rubber adhesive strips. [The dressing that I have uniformly employed the past ten years has been 10% iodoform gauze, with moist 1 : 5000 bichlorid gauze, held in place by rubber adhesive plaster. Over this is placed absorbent cotton and three firmly applied bandages of gauze and muslin. In all of the children, more than five hundred in number, I have also applied a plaster-of-Paris spica extending from chest to below the knee. I do not believe in the small dressing or in sealing the wounds. The moist dressing absorbs the slight exudate, and I have had one series of 200 cases with but a single suppuration.—Ed.]

[1] Airol, 5.0 (gr. lxxv); Mucil. acaciæ, Glycerinæ, āā 10.0 (℥iiss). Bol. alb. qu. sat. ut fiat pasta mollis.

[2] Zinci oxidi, Mucil. acaciæ, Glycerinæ, āā 20.0 (℥v). Bol. depur. 40.0 (℥x). M. Ft. pasta.

In aged patients the conditions are different; the narcosis itself is not a harmless procedure, and the forced rest in bed after the operation favors the appearance of stasis in the lungs, from which a hypostatic pneumonia frequently develops. Those patients who already have a chronic bronchitis are particularly endangered. In an individual case we could say, in a general way, that in persons over sixty years of age the radical operation of a reducible hernia should be performed only when the symptoms produced by the hernia are quite annoying, and that it is contraindicated if marked arteriosclerosis or bronchitis are demonstrable, or where there is general debility from deficient cardiac activity.

Is the enormous size of a hernia a contraindication to the radical operation? Kramer has undertaken the meritorious task of reviewing the publications upon this point, and comes to the conclusion that even with the perfected asepsis of to-day, the radical operation of unusually large hernias is associated with no small danger to life, the danger being proportionate to the size of the hernia. The explanation of this is to be found in the extent of the wound and in the different manipulations and attempts at reduction which must be undertaken upon a large mass of viscera. The statistics collected by Kramer also show that patients affected with complications have borne the operation badly, particularly decrepit individuals suffering from chronic alcoholism or obesity, or those with diseases of the respiratory, circulatory, or urinary organs. It consequently follows that a patient with a very voluminous hernia should be subjected to a most thorough examination before the operation is attempted.

In every case of radical operation the patient must be carefully prepared for the procedure. In order to obtain the most favorable results the individual must be bathed, and on the day preceding the operation the hernial region is to be shaved, thoroughly scrubbed, and then covered by gauze saturated with a 1 : 2000 solution of bichlorid. The intestines must be sufficiently emptied, since the necessary cleanliness of the dressings makes it desirable that there should be no movement of the bowels during the first few days after the operation. This evacuation of the bowels is of special importance if the hernia is large and irreducible, since it aids materially in the reposition of the hernial contents. While a patient with a small reducible hernia, who does not suffer from constipation, is sufficiently prepared in a day by a single dose of castor oil, the preparation in other cases must extend ever several days, during which the patient receives only a liquid diet, purgatives by the mouth, and large enemata by the rectum.

THE ACCIDENTS OF HERNIA.

A hernia renders a patient liable to certain dangers which may at any time make their appearance, either suddenly or gradually, and which are designated as the accidents of hernia. Under this heading are usually included: (1) The accumulation of feces and obstruction of the intestine situated within the hernial sac; (2) inflammation; and (3) strangulation.

It was formerly believed that the **accumulation of feces** played a much more important rôle than we now know to be the case. In a large irreducible hernia where peristal-

sis is hindered by the changed relations, and probably also by adhesions, it may seem plausible that the passage of feces is disturbed and that the intestinal contents must consequently become obstructed, but such cases, in which symptoms are produced resembling those of strangulation, and which are to be unequivocally explained in this manner, are extremely rare. Since fecal stasis in a non-strangulated hernia could only be caused by solid fecal masses, only hernias of the large intestine would come under discussion, and this in itself would place a marked limitation upon the frequency of the occurrence. In a markedly constipated patient with a hernia of the large intestine, it is easily understood that an engorgement of the intestinal loop within the hernial sac may occur, making the constipation more obstinate, and causing the patient no small amount of annoyance, but it is extremely rare that a strangulation would develop from such a pure fecal stasis —an occurrence which was formerly almost universally accepted.

Fecal stasis in the herniated loop is to be combated by purgatives, by intestinal irrigation, and particularly by direct manipulation of the hernia. If the hernia is reducible, evacuation will be more easily accomplished, after the reposition, if the intestines are permanently held within the abdomen by the immediate application of a truss or a substitute in the shape of a large pad of cotton. The treatment of fecal stasis in a large irreducible hernia is more difficult, and in these cases the desired end is best attained by attempting to empty the intestinal coils by manual compression of the entire hernia. A single attempt is not always successful, and sometimes the condition is not

overcome until systematic daily massage has been practised, and, the size of the tumor permitting, its envelopment in elastic bandages in the interval.

Inflammation of a hernia is a never-failing concomitant of strangulation, occurs not infrequently as an independent affection, and can produce a grave clinical picture. The symptoms sometimes have a striking similarity to those of strangulation, but there are nevertheless clearly pronounced cases in which the diagnosis can be easily made. The tendency of the peritoneal surfaces to become adherent or form exudates when subjected to slight irritation is retained both by the sac of the hernia and also by the peritoneal covering of the abdominal viscera. The peritoneum is so sensitive that even slight disturbances of the circulation may result in a reactive inflammation. A slight compression of the omental or mesenteric vessels, without the existence of constriction, or the weight of a heavy hernia is frequently sufficient to cause slight venous stasis and the formation of a minimum amount of exudate, which leads to agglutinations and adhesions in the hernial contents and between the contents and the sac. Such adhesions can also be caused by external pressure, such as that produced by a truss which has been applied while a tip of omentum was still within the hernial sac. Those hernias which have been incarcerated one or more times are particularly inclined to the formation of adhesions.

It has previously been mentioned that adhesions of the hernial sac may cause its obliteration, and the spontaneous cure of the hernia or the formation of cysts and diverticula. The mildest form of inflamed hernia may be recognized by the fact that the hernia which previously was freely mov-

able now becomes irreducible, partly from adhesions between the contents and the sac, and partly from the formation of large convolutions of adherent omentum and loops of intestine which can no longer be returned through the much narrower hernial orifice.

Exudates in the hernial sac may be due to a primary inflammation in this situation or to an inflammation originating within the peritoneal cavity or in the vicinity of the hernia. Like those of the peritoneum, the exudates produced by the inflammation of a hernia may be serous, fibrinous, or purulent. If from any cause a purulent inflammation of the peritoneum spreads to the hernial sac, the symptoms of inflamed hernia are forced into the background by the graver symptoms of the peritonitis. In the same manner, if a chronic inflammation, such as tuberculosis, extends to the sac, the symptomatology is dominated by the general inflammation of the peritoneum. The conditions are different if the inflammatory process is independent of the peritoneal cavity, developing in the sac primarily or extending to it from some inflammation, such as a phlegmon, of the hernial surroundings. Serous inflammation, as the name indicates, leads to the formation of a serous, clear, yellowish exudate, which is shut off from the peritoneal cavity by more or less firm adhesions. If the exudate arises in an empty hernial sac closed upon all sides, we have a cyst, a form of hydrocele, with the symptoms of dulness on percussion, transparency, no increased protrusion with augmentation of the intra-abdominal pressure, and usually some tenderness. Whether such a cyst may be lifted up from the abdominal wall, like a hydrocele of the testicle, depends upon the situation of the adhesion

in the neck of the sac. If there are contents within the hernial sac, the exudate becomes apparent as an increased amount of hernial fluid.

Fibrinous inflammation, characterized by fibrinous deposits upon the surface of the herniated viscera and of the sac, is the chief form which rapidly produces agglutinations and firm adhesions. It more frequently appears in combination with a fluid exudate as a serofibrinous inflammation.

Purulent inflammation is the most severe form, and is produced by the presence of pathogenic micro-organisms. Disregarding their direct migration from neighboring foci of suppuration, the source of the bacteria is easily explained if portions of the intestine are in the hernial sac and have been subjected to circulatory disturbances or to inflammation, such as bruising by attempts at taxis, intestinal ulceration, or perityphlitis. Under such conditions the bacteria may pass directly through the damaged intestinal wall into the hernial sac and give rise to suppuration. What is the source of the pyogenic organisms, however, when the sac is empty or contains nothing but omentum? As the occasional suppurations occurring in subcutaneous extravasations of blood or in uncomplicated fractures are to be explained by the favorable conditions for growth offered to isolated bacteria circulating in the blood and coming from an angina or from a furuncle, we must suppose, in the present instance, that the power of resistance of the abdominal hernia to pyogenic organisms is diminished by some preceding injury, so that the bacteria find more favorable conditions for development.

These different varieties of inflammation may frequently

be combined, a hernial inflammation commencing as a serous type, becoming serofibrinous, and ending as a purulent form. Upon the other hand, the inflammation may be arrested at any part of the process or be a severely purulent one from the beginning without passing through the milder stages.

The symptoms of the mildest form of inflamed hernia are so slight that they are usually unnoticed. Adhesions are formed so slowly and painlessly that their presence is first manifested by the consequent irreducibility of the hernia. Some of the symptoms of serous inflammation have already been mentioned. In addition to the presence of a collection of fluid, and frequently of a moderate amount of tenderness, it often happens that there is an absence of all of the general irritative peritoneal symptoms which we will presently learn to recognize in the purulent inflammation.

It is usually stated that fibrinous inflammation may be recognized by the presence of crepitation, which is felt when the skin over the hernia is removed, and which is due to the rubbing of contiguous fibrin-covered surfaces of peritoneum and to the breaking-up of adhesions. I do not wish to place too much stress upon this symptom, since its absence does not preclude the existence of the condition.

The purulent inflammation of a hernia produces severe symptoms, and is the one which most resembles strangulation. There is usually a general febrile reaction, the local swelling, tension, and tenderness become more marked, the overlying skin may be reddened, and—most pronounced of all—there are symptoms of peritoneal irritation. This

irritation is manifested by pain radiating from the hernia over the entire abdomen, by the appearance of nausea, eructation, and vomiting, and by a more or less complete paralysis of the bowel, in consequence of which the passage of feces and flatus is markedly diminished. The condition differentiates itself from diffuse peritonitis in the following respects: the abdomen is soft, not tender or tympanitic, the signs of general sepsis are absent since the tongue remains moist, the pulse is neither small nor markedly accelerated, and the urinary secretion is practically undiminished.

The difference between the purulent inflammation of a hernia and intestinal strangulation is as follows: in the hernial inflammation the closure of the bowel produced by the intestinal paralysis is frequently incomplete, usually allowing the passage of gas at least, and painful visible peristaltic movements of the intestine on the proximal side of the hernia are absent. There are, nevertheless, some cases in which the differentiation is difficult, and if there is the slightest doubt, the case must be treated as though the graver condition—*i. e.*, a strangulation—were present.

The milder forms of inflamed hernia ordinarily pursue a favorable course, since the inflammation shows no tendency to spread to the general peritoneum. The symptoms slowly disappear, the exudate is absorbed, and adhesions are left behind. In some cases the inflammation may be followed by strangulation if the neck of the hernial sac has been thickened and narrowed.

If the purulent inflammation is not treated, it spreads to the surrounding tissues. In favorable cases the inflammation extends to the hernial coverings and perforates

externally, while in unfavorable cases the peritoneal cavity becomes infected and a peritonitis develops which threatens the life of the patient.

The treatment is governed by the severity of the inflammation. In the serous form an attempt may be made to arrest the inflammation and possibly to reduce the hernia by rest in bed and the application of an ice-bag. If there is a suspicion that the exudate is purulent, the great danger of infection makes any attempt at reduction inadmissible. Here, as in every case in which strangulation cannot be absolutely excluded, the only treatment to be considered is free incision of the hernial tumor, the most rigid asepsis being observed. If the process has not already extended to the general peritoneum, the escape of the pus and the maintenance of drainage will lead to a rapid recovery.

Strangulation.—By the strangulation of a hernia we mean such a firm constriction of a herniated viscus that the constricted portion cannot be reduced, that disturbances of circulation make their appearance and may end in gangrene, and that if the contents of the hernia consist of intestine the passage of feces and gas is prevented. In the majority of cases the constricting ring is formed by the hernial orifice, but it may be situated in the neck of the sac alone.

In spite of manifold investigations there is even at the present time a lack of general agreement as to the nature of the mechanism of strangulation. The difficulty in giving an explanation which is not open to some objection is due to the fact that it is impossible to artificially produce a strangulated hernia in an animal and have all the conditions correspond to those in the human subject.

According to their origin, two varieties are differentiated —elastic strangulation and fecal strangulation.

Elastic Strangulation.—The effects of elastic strangulation are easily understood. A loop of intestine is forced into the hernial sac by some marked augmentation of the intra-abdominal pressure, such as violent cough, and is subjected to the elastic constriction of the narrow hernial orifice, which has been momentarily dilated by the increase of the abdominal tension. If the constriction is moderate and the orifice not too small, at first only the venous return is impeded and the constricted portion becomes the seat of venous stasis. The intestinal loop takes on a dark bluish and later a bluish-black color, small subserous effusions of blood make their appearance, and there is also an edematous infiltration of the intestinal wall, so that the disproportion between its size and that of the hernial orifice constantly increases. At the same time there is a transudation of fluid into the sac, and this hernial fluid, which in the beginning is yellowish, clear, and serous in character, soon takes on a slightly bloody tinge. If the constriction continues, the intestine loses its moist, smooth, glistening appearance, becomes dry and lusterless, and small amounts of fibrin are deposited upon its surface. The nutrition of the intestinal coil suffers, and it may happen that the mucosa is already necrotic at a time when the serosa is still nourished (Fig. 22). The possibility of the existence of such a condition is of the utmost importance for the question of reduction. Under the further influence of the strangulation, the intestinal coil becomes grayish-black, then dirty gray in color, and loses a great deal of its tonus and elasticity. The walls

of the intestine feel relaxed and thinned—the coil has become gangrenous. In the mean time the hernial fluid has changed in character; it has become cloudy and taken on a distinct fecal odor, although this odor may be present even when the coil is not gangrenous.

Long since Garré supposed that bacteria did not pass out from the intestine until necrosis supervened, and recent investigations have shown that the hernial fluid is almost always sterile, in some instances even after a period of strangulation lasting five days (Schloffer). In fact, the hernial fluid does not contain living germs capable of development in every case of gangrene of the intestine (Tietze). We consequently have a right to suppose that the hernial fluid possesses bactericidal properties. These findings have nevertheless met with some contradiction. Boennecken, and subsequently Brentano, came to the conclusion that bacteria may be demonstrated in the hernial fluid much oftener than was supposed by the previous authors. In 31 strangulated hernias, Brentano found micro-organisms in 21 instances, and explained his result by the nature of his method of investigation. Several cubic centimeters of the fluid must be taken and bouillon employed as the culture-medium.

Perforation finally occurs through the necrotic intestinal wall, and there are two seats of predilection. The first of these is at the seat of constriction, and particularly opposite the mesentery of the afferent intestine, since this portion of the coil is exposed to the greatest amount of pressure. The location second in frequency is the convex side of the coil, because this portion is subjected to the greatest tension and is the furthest removed from the nutritive vessels (Fig. 21).

If the elastic compression is so marked that, in addition to the venous return, the arterial supply is also obstructed,

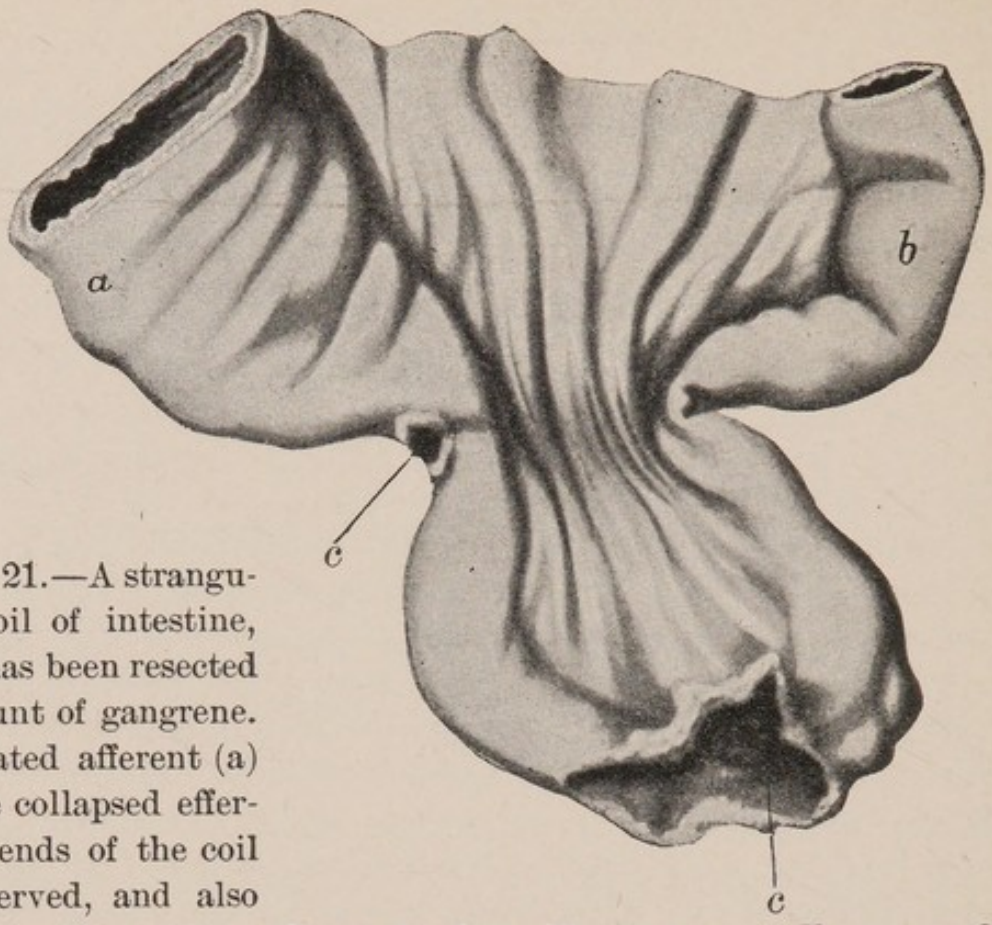


Fig. 21.—A strangulated coil of intestine, which has been resected on account of gangrene. The dilated afferent (a) and the collapsed efferent (b) ends of the coil are observed, and also two perforations (c) at the seats of predilection, a small one at the site of the constriction of the afferent intestine and a large one upon the convex side of the coil.

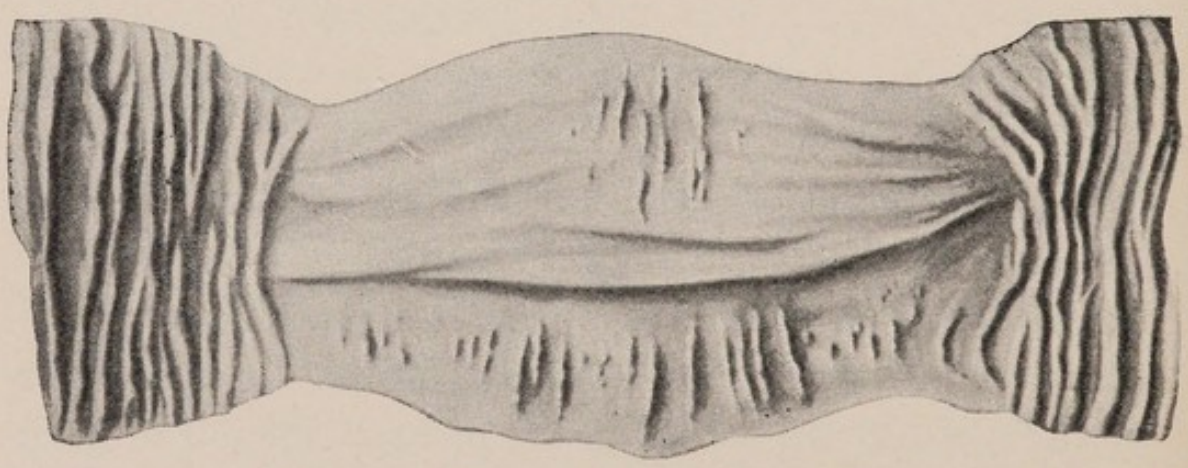


Fig. 22.—A longitudinally incised coil of intestine resected on account of gangrene after three days of strangulation. At the time of operation only a yellowish-gray necrotic area, about the size of a small bean, was observed upon the external surface of the coil, although when the resected coil was cut open, as shown in the illustration, it was found that the entire mucous membrane had sloughed away with the exception of small "rests."

the changes in the intestinal coil are quite different. Under these circumstances a few hours may suffice for the development of an anemic necrosis of the intestine which has been completely robbed of its blood-supply. Since neither venous stasis nor exudation is possible in the intestinal wall, the coil remains pale, thin, and relaxed, and finally assumes a uniform yellow color. For the reasons previously stated there is also an absence of hernial fluid, and the necrotic intestinal coil lies in close contact with the hernial sac. In contrast to the previously described case, in which the strangulation was less marked and in which the necrosis was limited to definite parts of the intestinal wall, the coil of intestine in this instance becomes gangrenous throughout. As in all varieties of intestinal obstruction, the intestinal contents are dammed up in the afferent intestine, which becomes more and more dilated, while the intestine below the seat of strangulation is empty, collapsed, and therefore apparently narrowed.

Fecal Strangulation.—In contrast to the preceding variety, there is a kind of strangulation in which the intestinal coil within the sac becomes blocked from the fact that intestinal contents are suddenly forced into it by a marked augmentation of the intra-abdominal pressure. It is not necessarily hardened feces which produces this result, but almost always fluid intestinal contents mixed with gas. This is the form of strangulation which is so difficult of a mechanical explanation and the correct interpretation of which has been prevented by our inability to exactly reproduce the condition in the lower animals. It is called fecal strangulation.

A number of meritorious investigators have tried to

solve the question experimentally, and their labors have rendered certain phenomena more intelligible, although it cannot be claimed that the process as a whole has been thoroughly and satisfactorily explained.

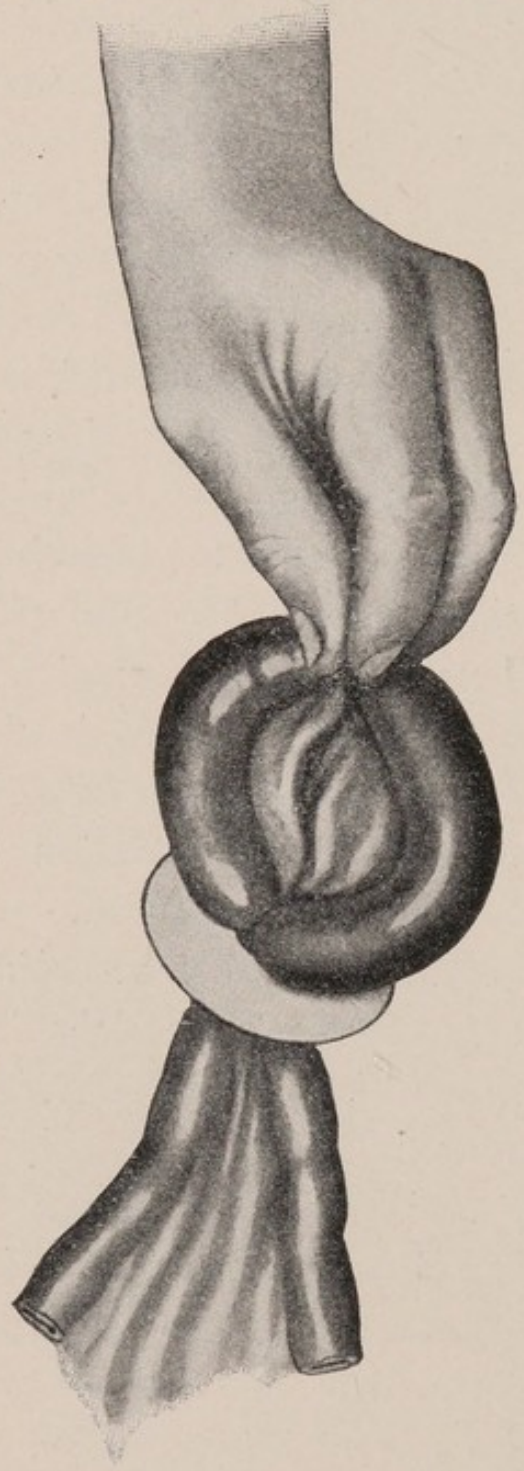


Fig. 23.—Roser's strangulation experiment.

Figure 23 illustrates the experiment performed by Roser (1856). A hole about one centimeter in diameter is made in a board and an intestinal coil filled with fluid and gas is drawn through the orifice. The edges of the orifice do not compress the intestinal coil and the opening in the board may be so large that a catheter can also be passed through it alongside of the intestinal coil. If pressure is suddenly exerted upon the convexity of the coil, the intestine becomes quite tense, but the intestinal contents cannot be forced through the orifice, although more fluid can be injected into the coil from the intestine on the other side of the constriction, and although a free space may be seen within the orifice when the intestinal coil is held to one side. Roser thought that this closure was brought about by the valve-like action of the folds of mucous membrane in the immediate

vicinity of the orifice, and that they acted like the semi-lunar valves in the aorta.

Busch (1875) in his first experiment drew an intestinal coil through an orifice and filled the coil, through the afferent intestine, with fluid under strong pressure. He

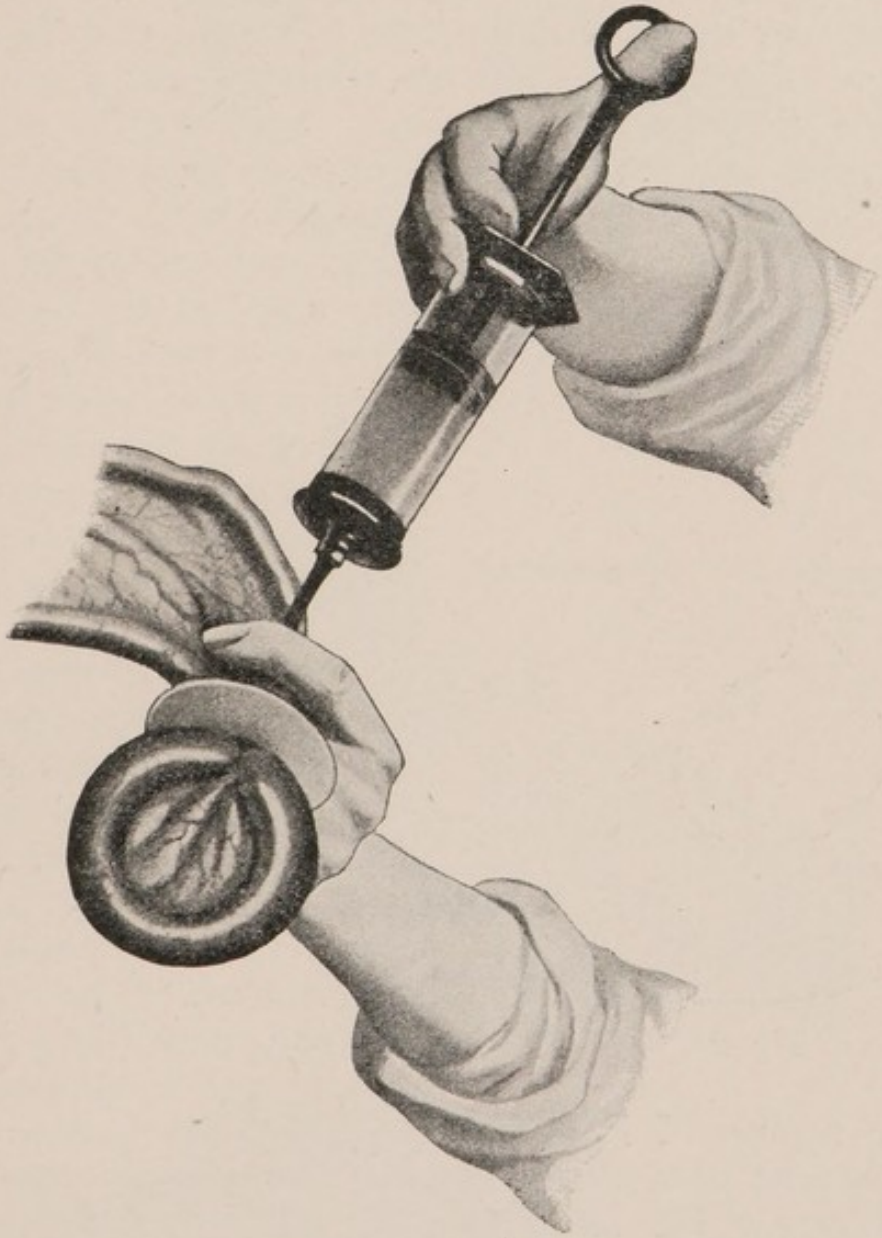


Fig. 24.—Busch's strangulation experiment No. 1.

found that there was an excess of pressure upon the greater or convex intestinal wall, in consequence of which the efferent intestine was drawn down as far as its mesentery would allow, and that it then suffered an angulation which

completely closed its lumen. When the injection of fluid was continued, the afferent end also became angulated. Figure 24 illustrates the manner of performing the experiment, the tensely injected intestinal coil, and the collapsed efferent intestine.

Lossen (1875) modified this experiment by using a hardening wax injection, and from the solid cast he came to the conclusion that it was not the supposed angulation of Busch which caused the closure, but that the afferent intestine, distended by a thick column of feces (Fig. 25, *a*), together with the mesentery, compressed the efferent end of the coil (*b*). This compression, moreover, would also be exerted upon the mesenteric veins, causing venous stasis, and the consequent edema would also encroach then upon the afferent end of the coil and finally effect its complete closure.

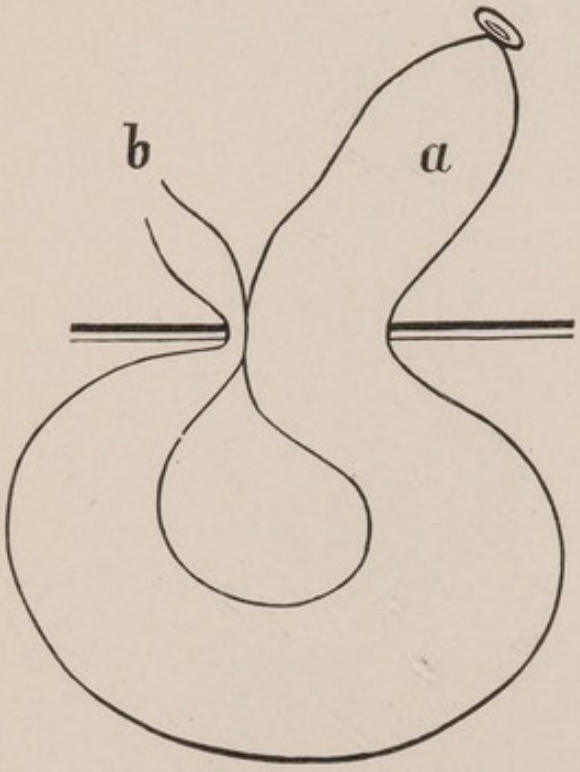


Fig. 25.

In order to entirely exclude the possibility of such a compression as that indicated by Lossen, Busch performed a second experiment. He introduced a metal tube of the diameter of a female catheter into a piece of intestine and secured it in this position by means of a thread passed through the mesentery and tied about the intestine (Fig. 26). "If the foreign body is now withdrawn, the intestinal canal is greatly narrowed by the thread, but its lumen still exists, since the catheter may be again carried through the narrow place from the peripheral side. If fluid or air is now rapidly forced into the intestine from a point some distance above the ligature, not a drop of liquid nor a bubble of air will pass the stenosis." The reason for this

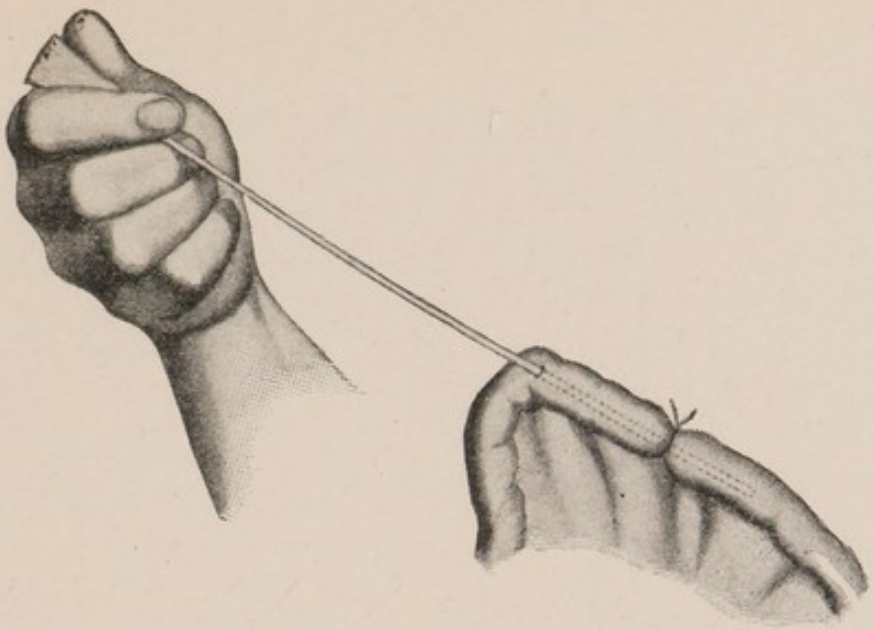


Fig. 26.

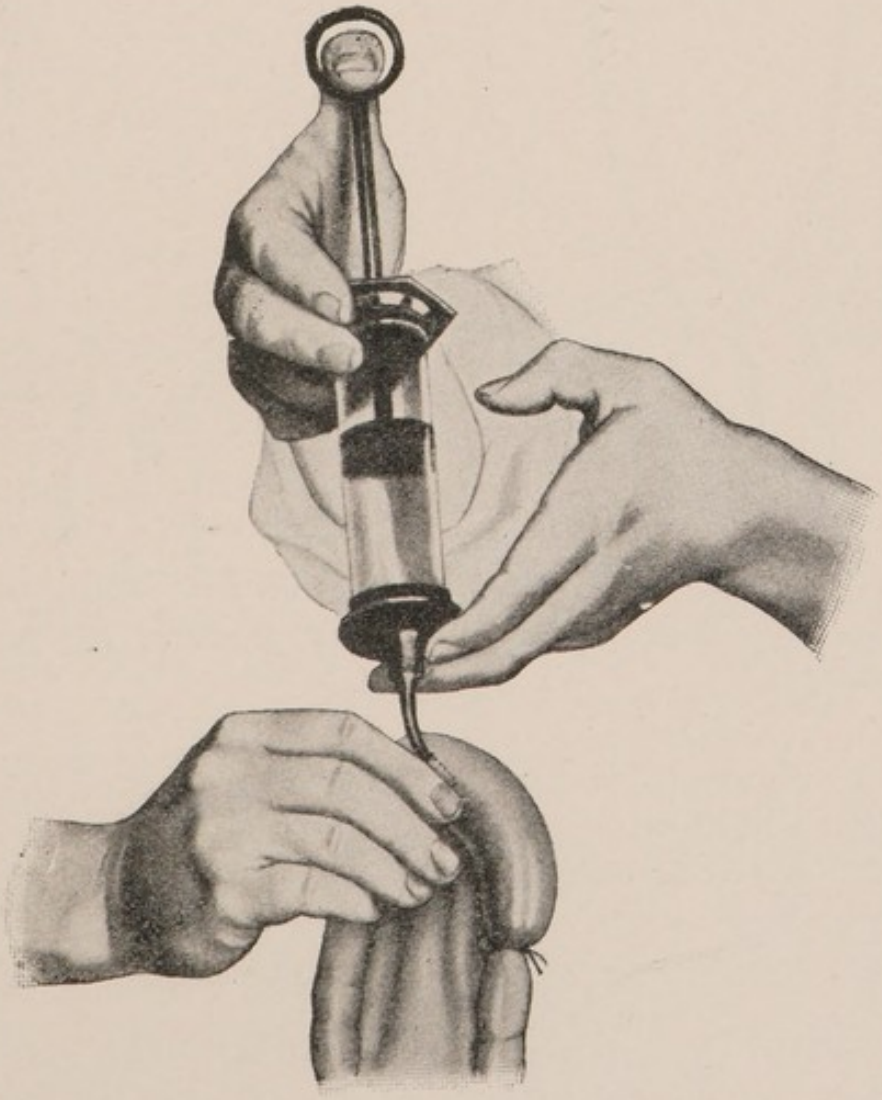


Fig. 27.—Busch's strangulation experiment No. 2.

is not to be found in any valve or fold upon the interior of the intestine, but the result, as in his first experiment, is due to the effect of the hydrostatic pressure. The convex side of the intestine is subjected to a greater pressure than is the concave or mesenteric surface, "the pressure causes the intestine to straighten upon its convex side, and the convexity, moving in this direction, pulls the lower portion of the intestine through the stenotic ring in such a manner that the intestinal walls are pressed to-

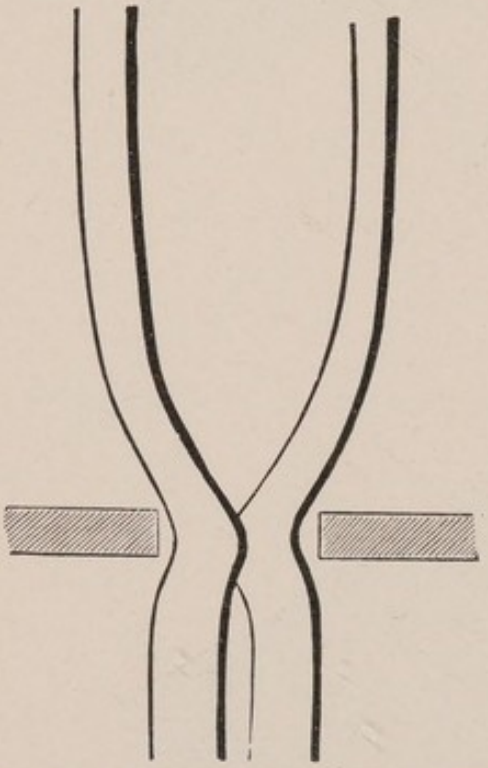


Fig. 28 (a).—Injection above the stenosis under slight pressure; no fluid escapes.

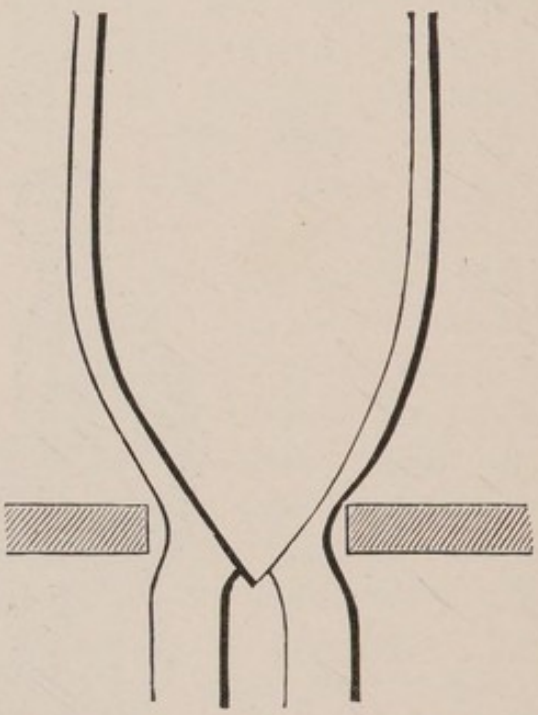


Fig. 28 (b).—Injection under greater pressure; the passage is free.

gether." Figure 27 shows the tense injection of the intestine above the ligature and the collapsed portion below it.

Bidder (1875) concluded from his experiments that the theories of Lossen and of Busch were wrong, and that the old view of Roser in reference to the origin of intestinal strangulation was entirely correct.

Kocher (1877) explained Busch's experiment, not by an angulation of the intestinal walls caused by different amounts of pressure, but by the dilatation of the intestine.

When he filled the portion of the intestine above the stenosis with water, he observed that the apex of the wedge of water was at the constriction, and that a certain amount of pressure would force the water through the stenosis. If a glass cylinder was now introduced from above and pushed down upon the stenosis, so that the intestine immediately above the constriction was dilated, the escape of fluid was suddenly checked. Kocher explained this by assuming that the column of water, together with the movable mucous membrane, formed a wedge, and that the escape of fluid was permitted only when the apex of the wedge extended below the stenosis. He illustrated this by the diagrams shown in figure 28, a-c.

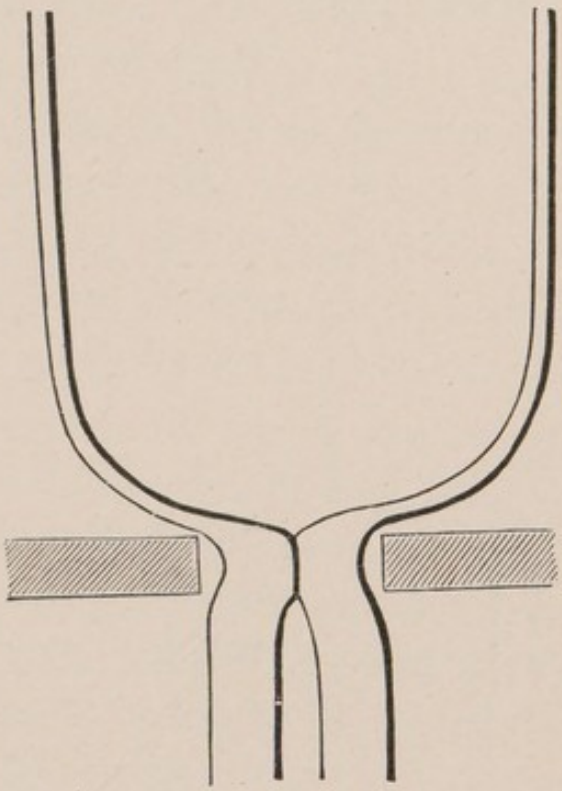


Fig. 28 (c).—Injection under very great pressure; as a result of the great distention the apex of the wedge is displaced upward and no fluid escapes.

Reichel (1886), from his own investigations, gives another explanation for the result of this experiment. He supposes that the stoppage is actually due to the fact that when the intestine above the constriction is tensely filled, the mucous membrane from below is drawn into the upper portion, and that an invagination is thus produced. The serosa is unable to take part in this displacement, since it is more tightly held by the constricting thread.

Korteweg (1878) came to a result quite similar to that of Reichel. He concluded that an intestinal fold was produced below the thread, and that this fold was drawn into the upper portion of the intestine, completely closing the stenotic orifice (Fig. 29).

There are two chief objections to the interpretations given to these experiments by their authors: first, the valvular formation which Roser claimed to exist in his experiment has not been recognized; and, second, Lossen's explanation of the compression of the efferent end by the afferent intestine is inapplicable, since it has been generally confirmed that there is always a complete closure of both the efferent and the afferent ends of the coil in every case of strangulation.

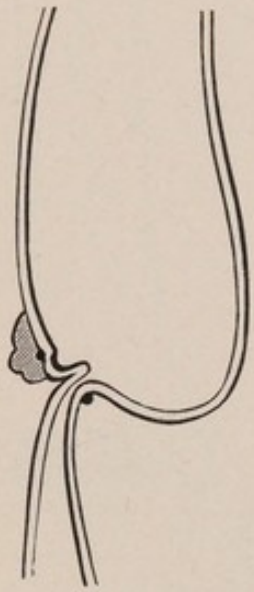


Fig. 29.

From what has been said, it may be stated that the following points are those which have made the mechanism of the so-called fecal strangulation more intelligible:

1. The relative narrowness of the hernial orifice is a predisposing factor for the development of strangulation. This narrowness may be due to the hernial orifice itself, to the neck of the sac as a result of adhesions, to omentum or mesentery which have been simultaneously wedged in, or to a turning of the intestine upon its longitudinal axis.

2. This stenosis within the hernial orifice is considerably increased by the entrance of intestinal contents into the herniated intestinal coil, which is subjected partly to a compression (Lossen) and partly to an angulation (Busch).

3. The complete closure of both the afferent and also the efferent ends of the intestinal coil is effected by the further dilatation of the intestine (Kocher), as a result of which we must assume the production of a variety of

invagination or valvular arrangement of the mucous membrane (Reichel, Korteweg).

The Symptoms and Course of Intestinal Strangulation.—A strangulation of the intestine almost always appears suddenly, so that the patient is able to state the exact moment of its occurrence and its immediate cause, which is usually a cough, the lifting of a weight, or something similar. The individual immediately experiences a stinging pain in the region of the hernial orifice, the hernia, which has either appeared for the first time or has been previously reducible, cannot be returned to the abdominal cavity, and to this is added the phenomena which we have learned to know as the "irritative peritoneal symptoms." These symptoms in particular are nausea, eructation, and vomiting, which is reflex at first, but also due to the intestinal occlusion. If the seat of strangulation is located high up in the intestinal tract, all food is vomited soon after its ingestion, and the patient retains nothing; the lower the obstruction, the later the appearance of the vomiting. As soon as the stomach has been emptied the dammed-up intestinal contents are ejected, the vomited matter takes on a foul odor and finally assumes a pronounced fecal type. From the moment of strangulation neither feces nor gas are passed by the rectum, although particles of feces located below the stenosis may be washed out by intestinal irrigation.

A further symptom, and one which is equally important in any case of intestinal occlusion, is the occurrence of attacks of colicky pain which are due to the intestine above the seat of strangulation attempting to overcome the obstacle by increased peristalsis. In lean patients the

contour of the distended afferent intestine may be seen through the abdominal wall, as may also the peristaltic movements during the attacks of pain. The abdominal wall which is still soft becomes tense and hard over the dilated intestine. This increased resistance during the attack may also be felt in patients with thick abdominal walls which obscure the individual contours of the intestine.

The hernial tumor, which in the beginning was soft and painful only upon considerable pressure, becomes more and more tense both from the formation of hernial fluid and also from the edematous swelling of the hernial contents and the accumulation of gas. It finally becomes very sensitive to the slightest touch. If the strangulation has existed for some time, the inflammation within the sac spreads to the overlying skin, which becomes edematous and thickened, so that it can no longer be lifted up in folds; inflammatory redness then appears, the symptoms grow worse, and external perforation finally occurs, the hernial contents having meanwhile become gangrenous. In this manner a preternatural anus or a fecal fistula is formed. Sometimes the previously described condition runs its course with very little abdominal involvement. In a large number of cases, however, the symptoms are more severe; the purulent inflammation produced by the intestinal gangrene also extends to the general peritoneum and causes a purulent peritonitis. This last and gravest stage is signalized by an immediate change in the symptomatology. The abdomen becomes tympanitic, tense to the touch, extremely painful, and particularly sensitive to pressure, vomiting occurs with renewed violence, and the general condition

becomes visibly worse. The patient, who in the beginning of the strangulation felt strong and experienced nothing but a sense of anxiety from the increasing pain and the obstruction to the passage of the feces, collapses at the moment in which the purulent inflammation extends to the peritoneum. Marked shock causes the pulse to become small, easily compressible, often scarcely perceptible, and increased in frequency to from 120 to 160 beats to the minute. The eyes sink back in the orbits, the nose becomes pointed, and the entire body is covered with a cold sweat. The breathing becomes superficial and accelerated, partly from the high position of the diaphragm caused by the meteorism and partly from cardiac weakness. The action of toxic substances upon the kidneys, the fall of blood pressure, and the deficient absorptive power of the paralyzed intestine cause a gradual diminution of the urinary secretion, and may produce complete anuria.[1] In this stage unconsciousness mercifully supervenes and spares the patient from the terrors of impending death. According to Graser, about 95% of the untreated cases of strangulated intestinal hernia end in death.

The symptomatology of the strangulation of a hernia of the intestinal wall (see page 36) is in marked contrast to that of the strangulation of an entire loop. There is a great probability, for various reasons, that the severity of the existing affection will not be appreciated. In the first

[1] The demonstration of indican in the urine is not an absolute sign of intestinal occlusion, and may not infrequently be accomplished in cases of pure peritonitis. According to Jaffe, the indican is formed by the absorption of the decomposition product of the intestinal contents, indol, and its elimination in the urine as indoxyl-potassium sulphate.

PLATE 1.

a, A Strangulated Hernia of the Intestinal Wall.—An early stage of a strangulation which involves a portion of the intestine opposite to the insertion of the mesentery. The strangulated portion, and particularly the constriction-rings, are intensely reddened, but there are no profound disturbances of the nutrition of the intestinal wall.

b, A Strangulated Coil of Intestine in Which More Marked Circulatory Disturbances are Observed.—The coil is dark blue, but its peritoneum still retains its moist glistening surface. The constriction-rings are distinctly marked without being gangrenous.

c, A Strangulated Coil of Intestine after the Strangulation Existed for a Considerable Period of Time.—The color has become almost black and the peritoneal surface is dull and covered with flakes of fibrin. The constriction-rings are deeply sunken, their walls markedly thinned, relaxed, and dirty gray in color. Both constriction-rings are gangrenous and hemorrhages are observed in the mesentery.

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place, the hernias are very small and consequently may easily be overlooked, and, secondly, the intestinal occlusion is incomplete, since only a portion of the intestinal wall, usually that opposite the mesentery, is involved, and although intestinal strangulation is present, flatus and liquid stools may still be passed. The sudden appearance of pain and the occurrence of nausea and vomiting, however, are observed in strangulated hernias of the intestinal wall, as are also the subsequent inflammatory phenomena, which may cause either external or internal perforation and the consequent formation of a fecal fistula or of a septic peritonitis.

In every intestinal strangulation, the tighter the constriction, the more rapid the entire course of the affection and the more severe the general symptoms from the beginning. The sudden occurrence of collapse or severe shock

Fig. a

Fig. b

Fig. c

Lith. Anst. F. Reichhold, München.

is sometimes a better indication of the severity of the strangulation, and consequently of the danger of a permanent disturbance of the nutrition of the gut, than the direct inspection of the exposed intestinal coil. Plate 1 shows the appearance of the intestine in different stages of strangulation.

Strangulation of Omentum.—The only form of strangulation of the omentum is necessarily the one known as elastic strangulation. The circulatory disturbances produced in this manner gradually cause a serous infiltration and hemorrhagic infarction of the constricted portion of omentum. In the further course of the affection, thrombosis occurs in the vessels and the entire mass of strangulated omentum finally becomes gangrenous. A large quantity of hernial fluid is usually produced, and if the strangulation lasts a sufficient length of time, migrating bacteria may infect this fluid and cause it to suppurate just as in an intestinal strangulation.

The clinical symptoms of a beginning omental strangulation are very similar to those of the early stage of strangulation of the intestine. The strangulation commences with a sudden stinging pain, and this is ordinarily soon followed by nausea and vomiting, which are purely reflex. The symptoms may now abate somewhat, vomiting ceases, flatus and sometimes feces are passed, but the patient always continues to experience a sensation of illness, since the hernial tumor cannot be made smaller by taxis and becomes more and more tender and tense from the inflammation and increased amount of hernial fluid. If surgical aid is not given in this stage, the inflammation spreads to the surrounding tissues, and one of two things may occur:

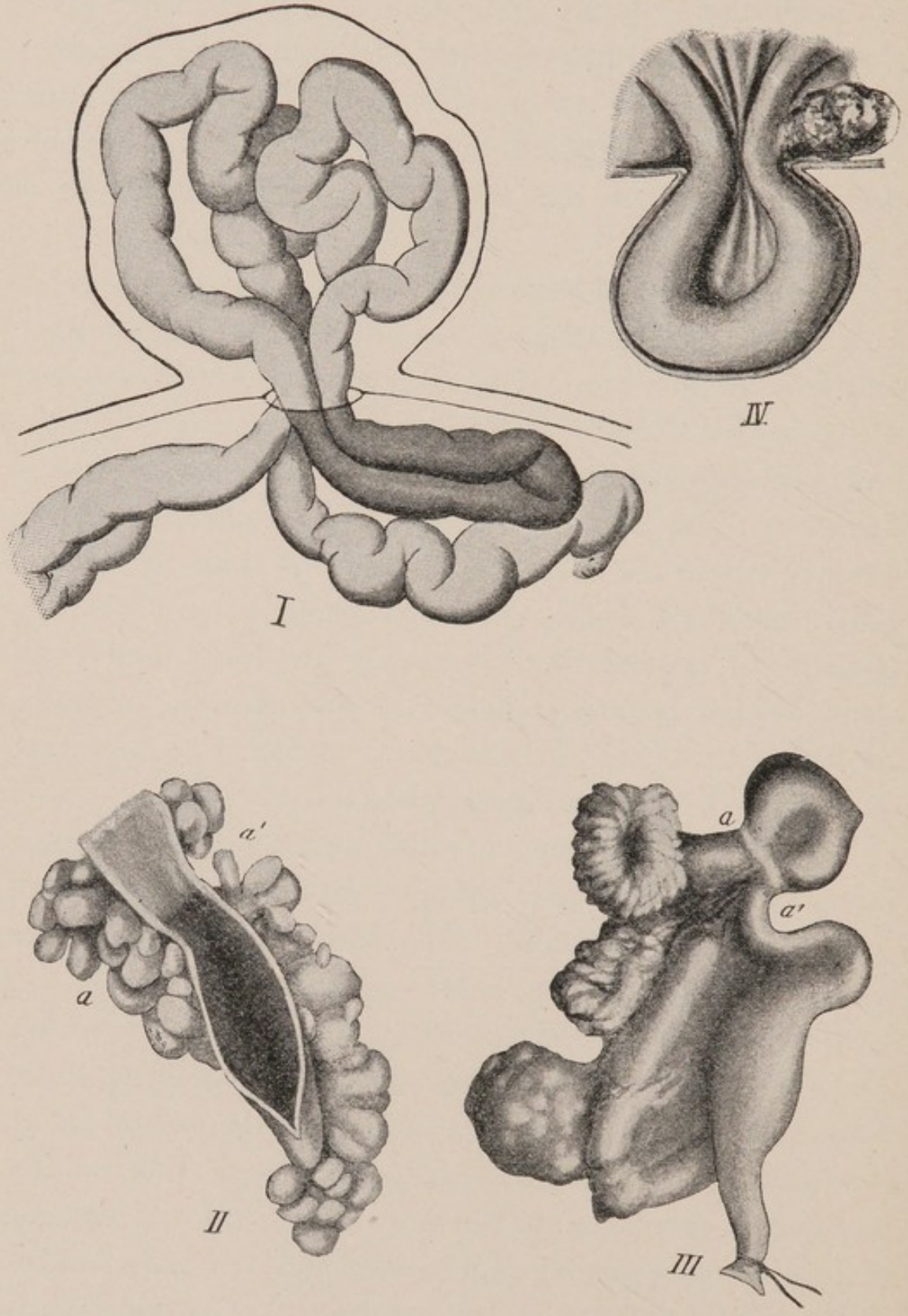

Fig. 30.

Fig. 30.—Retrograde strangulation: I, Retrograde strangulation of an intestinal coil (Schmidt). At the autopsy upon a woman who died from a strangulated umbilical hernia, the intestinal coils within the hernial sac were found to be unchanged and non-strangulated, but there was an intestinal loop, with all the signs of strangulation, which extended from the hernial sac into the abdominal cavity. The distended afferent and the collapsed efferent intestine may be seen within the hernial sac; the strangulated intestinal loop, which has been shaded darker in the illustration, protrudes from the sac into the abdominal cavity. II, Retrograde strangulation of a vermiform appendix (Maydl). The proximal portion of the appendix had remained in the hernial sac unchanged, but the peripheral portion, more darkly shaded in the figure, projected into the abdominal cavity and exhibited distinct signs of strangulation. At *a a'* is shown the seat of constriction. III, Retrograde strangulation of a Fallopian tube (Maydl). The larger portion of the tube was found unchanged in the hernial sac; the smaller portion, strangulated at *a a'*, extended into the abdominal cavity. IV, Retrograde strangulation of a subserous intestinal tumor (Maydl). The pedicle of the tumor has become compressed in consequence of the descent of the bowel.

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the pus may perforate externally, in which fortunate case the necrotic piece of omentum is cast off and spontaneous cure results, or the inflammation may extend to the abdominal cavity and produce a septic peritonitis. Although it may be said in a general way that omental strangulation has a less stormy inception and a slower course than intestinal strangulation, there are nevertheless cases of pure omental strangulation which begin with just as severe symptoms as does a strangulation of the gut, and which make the diagnosis very difficult and sometimes quite impossible. [I have operated upon cases with typical acute omental strangulation with severe symptoms simulating intestinal strangulation.—Ed.]

Mention should also be made of a variety of strangula-

tion, several examples of which have recently been furnished by Maydl, and to which he gives the name of retrograde strangulation (Fig. 30). In this form the strangulated portion of the viscus is not situated within the hernial sac, but within the abdominal cavity. If the omental hernia illustrated in figure 14 (page 40) had ever become strangulated, it would have been a strangulation of this type. In addition to omentum, this form of strangulation has been observed to involve an intestinal coil by B. Schmidt; and an appendix, a Fallopian tube, and a pedunculated intestinal tube by Maydl.

It is impossible to definitely state the period of time within which a strangulation usually runs its course. If the constriction is not very tight, there may be no marked disturbances of the nutrition of the intestine even after several days, while in other instances, in which the strangulation is more severe, gangrene may make its appearance within a few hours. The severity of the case is consequently better determined by a careful study of the general symptoms, and of the local signs exhibited by the hernial tumor, than by the time that has elapsed since the commencement of the strangulation.

The most frequent error in the diagnosis of strangulation is its confusion with an inflamed hernia. If the slightest doubt exists, the case should be treated as one of strangulation. If this course is pursued and every suspected case of strangulated hernia is operated upon, it may occasionally happen that the operation reveals an error of diagnosis, but scarcely any damage has been done the patient; while if the strangulation is unrecognized and the necessary procedures are neglected, the error may be most fatal in its consequences.

The Treatment of Strangulated Hernia.—If called to a case of strangulated hernia in the daytime, the sun should not be allowed to set, if called in the night, the sun should not be allowed to rise, before the strangulation has been relieved. This advice of Stromeyer, which even at the present day is not sufficiently heeded, is worthy to be taken to heart. It should be given all the more emphasis, since the means which we possess for the relief of the strangulation can be designated as harmless and safe in comparison with the great dangers which are coincident with an untreated case of strangulated hernia. There are two methods of reduction to be described, the non-operative, which is known as taxis, and the operative, which is known as herniotomy.

Taxis.—Taxis is indicated in all cases of strangulated hernia in which there is no impairment of the vitality of the strangulated viscera and in which there is an absence of any inflammation which might infect the peritoneal cavity. If there is any doubt whatever as to the presence of either of these contraindications, it will be well to disregard taxis altogether and to proceed to herniotomy.

Taxis is performed by firmly grasping and compressing the region of the neck of the hernial sac with the left hand and then exerting a uniform and constant pressure upon the entire hernial tumor with the right hand, taking care not to press the hernia toward, but rather to draw it away from, the abdomen (Fig. 31). In this manner the production of an angulation of the intestine at the hernial orifice is best avoided and some of the contents of the strangulated intestine may frequently be pushed through the constricting ring. If this can be accomplished, a great

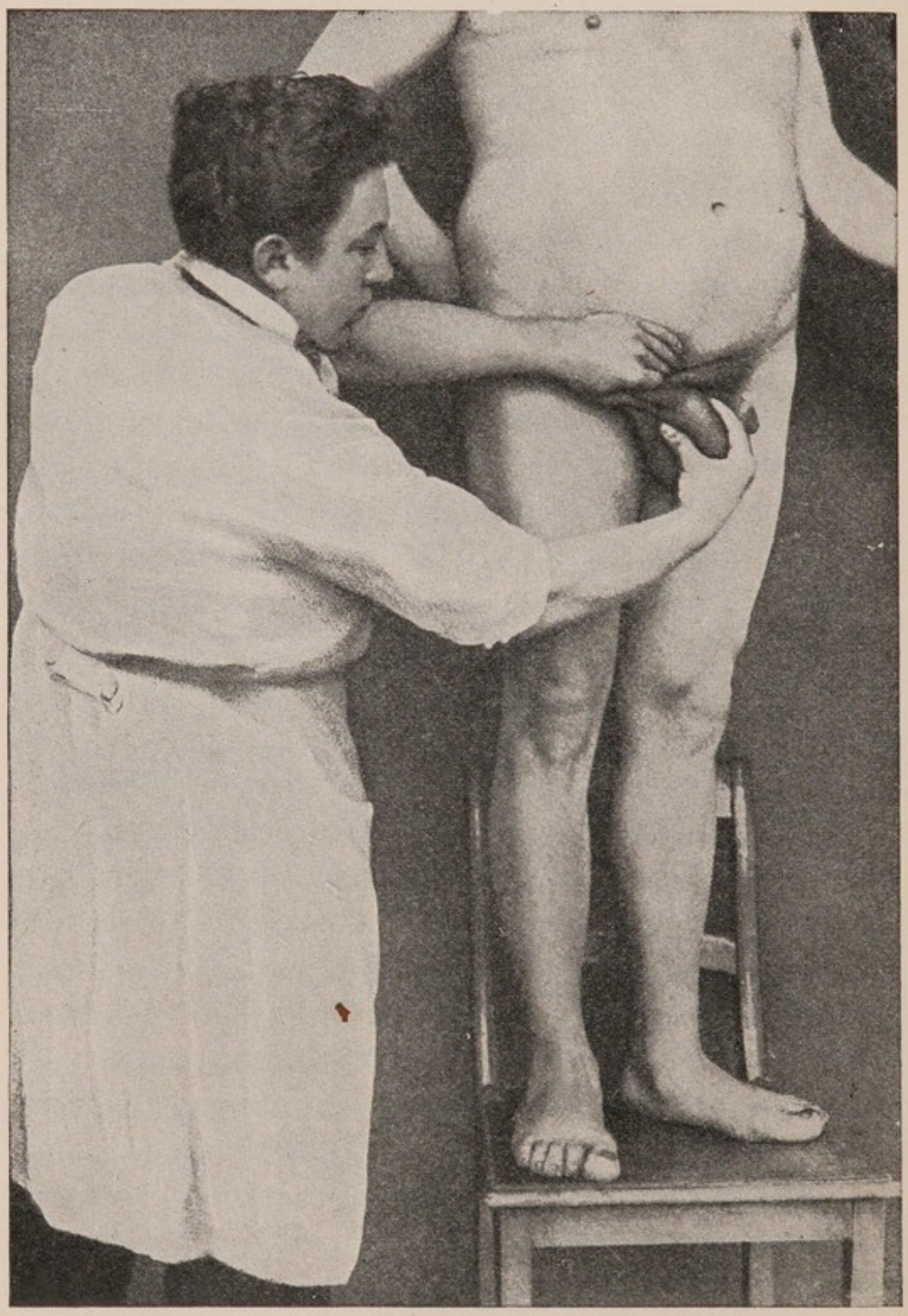

Fig. 31.—The method of performing taxis.

deal has already been gained, since the tension of the intestinal coil immediately decreases and reduction may frequently be effected by a single effort. Success may sometimes be attained by drawing the hernial tumor to one side or the other, in order to overcome any angulation of the strangulated intestine, such as that observed in Busch's experiment. If the attempt to reduce a portion of the intestinal contents is successful, a gurgling murmur is usually heard. The most important part of the procedure of taxis is the compression of the neck of the hernial sac, since if this is neglected and pressure is simply made upon the convexity of the hernia, the same conditions will exist which we have studied in Roser's experiment (Fig. 23), and even great force will fail to press a bubble of air or a drop of fluid out of the strangulated intestinal coil.

Care must be taken that too much force is not employed, since excessive kneading and pressing of the hernial tumor may easily produce hemorrhages in the walls of the strangulated viscus and increase the nutritional disturbances which are already present. Disregarding the danger of reduction *en masse* (see page 114), such forced taxis may cause a much more severe injury and produce a perforation of the strangulated intestinal coil. At first glance the taxis seems to have been successful, the hernial tumor suddenly becomes soft and may be easily and completely reduced. The true condition of affairs is revealed only too soon, however, by the sudden collapse of the patient and by the rapid appearance of the symptoms of a perforative peritonitis. In such a case, further surgical aid, which can be nothing but immediate laparotomy, will almost always be too late to save the patient.

A correctly performed taxis may be aided by the employment of certain auxiliary measures. The simplest of these is to obtain a relaxation of the abdominal wall and a diminution of the intra-abdominal pressure by having the patient open his mouth, breathe deeply, and flex the lower extremities at the hip and knee. Another measure, which is not without influence in certain forms of strangulation, is the effect of cold. This may be produced by the application of an ice-bag, or, better still, by dropping or spraying ether upon the hernial tumor. Whether the effect produced is due to the narrowing of the blood-vessels, to the contraction of the muscular coat of the intestine, or to other factors is still an open question. [Frequent application of very hot cloths is often of more avail than the ice-bag.—Ed.]

The most effective auxiliary measure, however, is the production of general anesthesia by either chloroform or ether. With the cessation of pain, the tension of the abdominal wall is decreased, the entire musculature is relaxed, and reduction is frequently easily accomplished. However, only that physician should employ anesthesia in his attempted taxis who, in the event of failure, is also in the position to immediately proceed to herniotomy under the same anesthesia, the consent of the patient having previously been obtained. If such a course is not pursued, a second anesthesia would be necessary soon after the first, and this alone is a great danger, particularly for individuals whose circulatory or respiratory organs are not perfectly healthy. If for any reason whatever the physician cannot perform herniotomy, his wisest course is to leave the taxis to be performed under an anesthetic by the surgeon of the nearest hospital.

The administration of purgatives by the mouth must be regarded as absolutely inadmissible. The employment of enemata, on the contrary, can meet with no objection, although the relief afforded by emptying the intestine below the stenosis is usually but temporary in its character. Lavage has a very agreeable subjective effect and gives considerable relief, since it removes the dammed-up gastro-intestinal contents and consequently diminishes the tendency to vomiting. This favorable influence is not only a subjective one, but the cessation of vomiting is of great importance to the patient, particularly in reference to the production of anesthesia, since the danger of an aspiration pneumonia is greatly lessened.

The administration of morphin or opium is sometimes indicated, since it relieves pain and therefore lessens the tension of the abdominal wall and the consequent resistance to the attempts at reduction.

Taxis should never be employed for too long a time, and the extreme limit should be placed at a half-hour. [Personally I would limit taxis to five minutes. I have seen a fatal result from taxis of but little more than five minutes' duration.—Ed.]

Batsch has recently claimed that cases of intestinal occlusion from the most varied causes can be favorably influenced by large subcutaneous doses of atropin, and this therapy has been extended, by himself and certain other physicians, to the treatment of strangulated hernia. All our previous experience contradicts the existence of such an influence so strongly that we must regard medicinal remedies as absolutely contraindicated by the presence of a strangulated hernia.

Too much emphasis cannot be placed upon the warning against such attempts at reduction, extending sometimes over several days, and the consequent neglect of the most favorable time for the operation for strangulated hernia.

A further series of auxiliary procedures will be briefly mentioned, which, although no longer employed, are of considerable historic interest.

The employment of cold water is thus described by Kirby: "I took the patient out of bed, laid him naked upon the wooden floor, and threw pail after pail of cold water upon the hernial tumor and abdomen. This procedure was continued until the respiration became labored and until the patient was very much exhausted."

A hot general bath at a temperature of 99.5° to 108.5° F. was very popular; "this is most effective when it brings about a weakness bordering upon unconsciousness. During the collapse which is thus produced the pressure upon the hernial tumor must be renewed and maintained as long as the condition of the patient will permit" (Kirby).

In the same category belongs the performance of venesection. "The sooner it is employed, the better and more helpful is the remedy. We bleed until the patient is weakened, since we wish to produce a marked impression and the approach of delirium shows us that this end has been attained" (Kirby).

Hoping to overcome the fecal stasis, powerful purgatives were employed, and they were supposed to be particularly indicated if the lumen of the intestine was not completely occluded. It was believed that the increased peristalsis would be sufficient to free the strangulated intestine.

For some time tobacco was supposed to exert quite a special influence, and it was employed as an infusion, which was thrown into the rectum, and also in the form of tobacco smoke, which was blown through the anus into the intestine.

Patients were frequently placed in most peculiar positions. For example, it was recommended that the physician should place the legs of the patient over his shoulders and attempt to reduce the hernia by repeated shakings of

the entire body. A similar procedure, the so-called "traveling method," was subjected to the most drastic censure by Dieffenbach. "This method consisted in placing the head and back of the patient upon a wheelbarrow, the thighs being elevated upon the front and higher portion, so that the knees were flexed and the legs hung down. While the unfortunate patient was trundled over a rough pavement, the operator ran backward in front of the wheelbarrow and manipulated the hernia, in the hope that the taxis, combined with the shaking of the patient, would be successful in effecting reduction."

In conclusion, mention should be made of puncture of the hernial tumor, which was recommended particularly by French authors. It was supposed that the intestinal contents could be aspirated with a fine needle and that the relaxed intestine could then be more easily returned into the abdominal cavity.

If the taxis is successful, and if the surgeon, by introducing his finger into the hernial orifice, has convinced himself that it is empty, a pad of gauze should be placed over the hernial orifice and held in this position by means of a bandage in order to prevent the descent of the gut and the consequent renewal of the strangulation. If the hernial region has not been contused by the taxis, a truss may be immediately applied. The condition of the patient rapidly improves. He feels well, nausea and vomiting immediately disappear, after several hours flatus is usually passed, and, with the exception of the pain produced by the taxis, the tenderness of the hernial region becomes markedly lessened. The bowels are not usually evacuated until twenty-four to thirty-six hours have elapsed, and it is well to save the intestine and avoid very active peristalsis by omitting purgatives during the first day after the taxis. At the expiration of this time, the rectal injec-

Fig. 32.—Apparent reduction of an intestinal coil (diagrammatic): a, The entire hernial sac with its contents has been pushed into the abdomen; b, the peripheral portion of the hernial sac lies externally, while the central portion and the contained intestine, together with the constricting ring, have been pushed into the abdomen. In both instances the seat of the constriction is in the neck of the sac and is represented by a dotted red line. In these cases the reduction *en masse* is in inguinal hernia, but it occurs in a similar manner, although not so frequently, in the other varieties.

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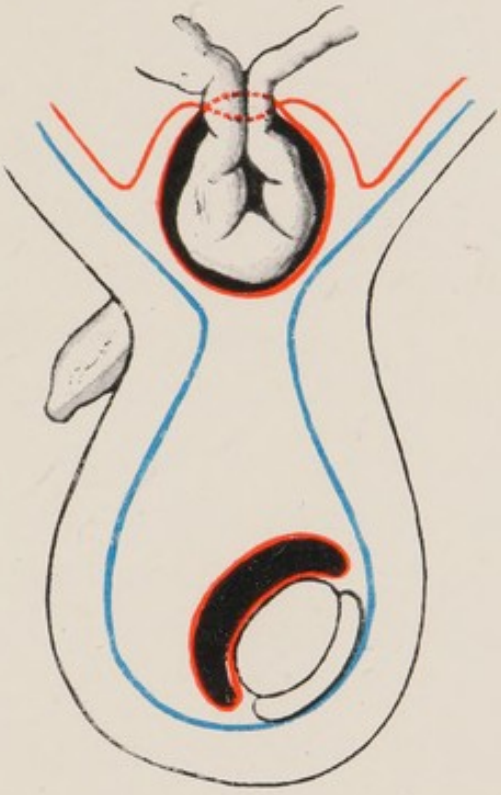
tion of 10 c.c. of glycerin will usually furnish good results.

Even after an apparently successful taxis the patient should be kept under medical observation for several days, since the signs of strangulation sometimes still persist. Such an occurrence may be due to the fact that the hernial viscus has been replaced but that a volvulus still remains, to an angulation of the intestine caused by adhesions, to inflammatory changes in the gut which end in gangrene with consequent peritonitis and intestinal paralysis, or, finally, to the fact that the hernial tumor together with the ring of constriction has simply been displaced by an apparently successful taxis. This latter occurrence is known as apparent reduction, reduction *en masse*, or reduction *en bloc* (Fig. 32). The amount of force which has been employed in such an apparent reduction need not necessarily be very great, and occasionally it has even been observed in cases where the patient has reduced the strangulated hernia himself. In such cases the entire hernial tumor is either only pushed to one side and forced between the individual layers of the abdominal wall, or the hernia, together with its sac, is pushed toward the abdomen, in which instance the adjacent parietal peritoneum is stripped up from the abdominal

Fig. 32.



a.

b.

wall. Sometimes only the proximal portion of the sac is displaced in the manner indicated, while the peripheral portion still remains outside. Isolated cases of this variety of apparent reduction have been described in which the sac has been lacerated, in one instance the sac having been completely torn off at the neck.

In addition to the persistence of the symptoms of strangulation, reduction *en masse* may sometimes be recognized by the presence of a palpable tumor within the abdomen in the neighborhood of the hernial orifice or of a round circumscribed swelling in the deeper portion of the hernial canal.

The only possible treatment of any of these disagreeable accidents which may occur after an apparently successful taxis is in the earliest possible operation, which must overcome the existing obstruction or remove from the peritoneal cavity those portions which may have become gangrenous. In a case of reduction *en masse* an attempt may be made to force the entire hernial tumor down again; although a second and more cautious attempt at taxis promises but little chance of success, the conditions for the performance of the operation are at least more favorable, since a large incision into the abdominal cavity may be avoided. If the abdominal cavity must be opened, the coil which has been reduced *en masse* will always be found in close apposition to the inner side of the hernial orifice; the incision should consequently be made in the hernial region and continued toward the abdomen if necessary.

Herniotomy.—The operation is indicated in all cases in which taxis has failed or in which some contraindication to taxis exists.

The sooner the herniotomy is performed, the more favorable is the prognosis, and it is easy to furnish statistic proof that the outlook becomes more gloomy with every day, or we might even say with every hour, during which the strangulation is allowed to persist.

According to the calculation of Henggeler, based upon 276 herniotomies, the mortality of the cases operated upon during the first day after the strangulation is 8.09%; during the second day, 22.2%; during the third day, 45.5%; during the fourth day, 60.0%.

Published statistics in reference to the total mortality after herniotomy, like those in reference to the radical operation, have an authoritative significance only when they are based upon the entire material of one and the same hospital for a lengthy period of time or upon the work of one and the same operator. In addition to this, it must be remembered that, owing to the perfection of the entire domain of abdominal surgery, in latter years, conditions have considerably improved, particularly in the treatment of gangrene and suspected gangrene of the intestine. Without a special consideration of the results obtained in the cases with intestinal gangrene and how these results vary with the treatment,—*i. e.*, whether an artificial anus or a resection is made,—the following table will furnish an idea of the mortality of herniotomy in general. It is based upon some statistics published recently which conform to the previously stated stipulations, upon the herniotomies performed in the Göttingen Clinic from 1884 to 1900 inclusive, and upon all the herniotomies performed in various clinics, from 1884 to

1900 inclusive, under the direction of Professor Braun (according to the works of Borchard and Wege):

Name of Author (Operator).	Herniotomies Performed in the Years:	Number of Cases with Non-gangrenous Contents.	Mortality in Per Cent.	Number of Cases with Gangrene or Suspected Gangrene of the Contents.	Mortality in Per Cent.	Total Number.	Mortality in Per Cent.
Habs (Hagedorn)	1883–1891	130	14.6 %	40	40.0 %	170	17.0 %
Henggeler* (Krönlein) .	1881–1894	206	9.7 %	48	85.4 %	254	24.0 %
Göttinger Klinik (König, Braun) . . .	1884–1900	152	13.1 %	49	71.4 %	201	27.3 %
Braun	1884–1900	129	8.5 %	38	57.8 %	167	19.0 %
Petersen (Czerny) . .	1877–1900	216	11.0 %	52	50.0 %	280	18.5 %
Maydl	1891–1896					293	17.7 %
Hofmeister (v. Bruns) .	1896–1900	39	10.2 %	25	40.0 %	64	21.9 %

If these cases are added together, we obtain a total of 1429 herniotomies with 296 deaths, which gives a total mortality of 20.7 %.

The preparation of the patient for a herinotomy does not differ from that for any other aseptic operation. The condition of the patient permitting, he is given a bath, and in all cases the hernial region and its surroundings are shaved and carefully disinfected in the usual way. The anesthetic must be given with great care, particularly to patients in a condition of shock and to those very stout elderly individuals who already suffer from impairments of the respiratory and circulatory systems. In such cases it is better to avoid general anesthesia and employ the infiltration anesthesia of Schleich, which is particularly

* Computed by omitting the non-operative cases from Henggeler's tables.

applicable in this operation on account of the insensibility of the surface of the intestine.

The first step in the operation of herniotomy is the exposure and opening of the hernial sac. The cutaneous incision is carried above the neck of the sac for 3 to 5 cm. so that the seat of the constriction may be freely inspected. The tissues at some distance peripheral to the constriction are then picked up with two pairs of rat-toothed forceps and the hernial coverings carefully divided between them until the sac has been opened. The greatest care is necessary in this step of the operation, because if the hernial fluid is small in amount or absent, an intestinal loop lying directly against the hernial sac could easily be incised. Hernial fluid is usually present, however, and its escape is the best indication that the sac has been opened in some part of the wound. From this opening the incision in the hernial sac is enlarged, either with scissors, or more safely upon a grooved director. The condition of the strangulated viscera can frequently be told from the character of the escaping hernial fluid. If it is clear, translucent, and odorless, the strangulated portions are almost always in a good state of nutrition, and even if the hernial fluid has a slightly bloody tinge and a rather stale odor, marked disturbances of nutrition are not always present. On the contrary, if the hernial fluid is cloudy or purulent and has a foul or fecal odor, most profound changes are almost always present in the hernial contents.

After the hernial fluid has escaped, the hernial contents are inspected, and the constricting ring is then to be immediately divided. As we have already seen, the constriction may be in the neck of the sac alone or in the sur-

rounding tissues, and this is why one case requires only the division of the sac, while in another success will not be attained until all the tissues of the hernial orifice have been divided. The constriction may be divided either from without inward or from within outward. The first

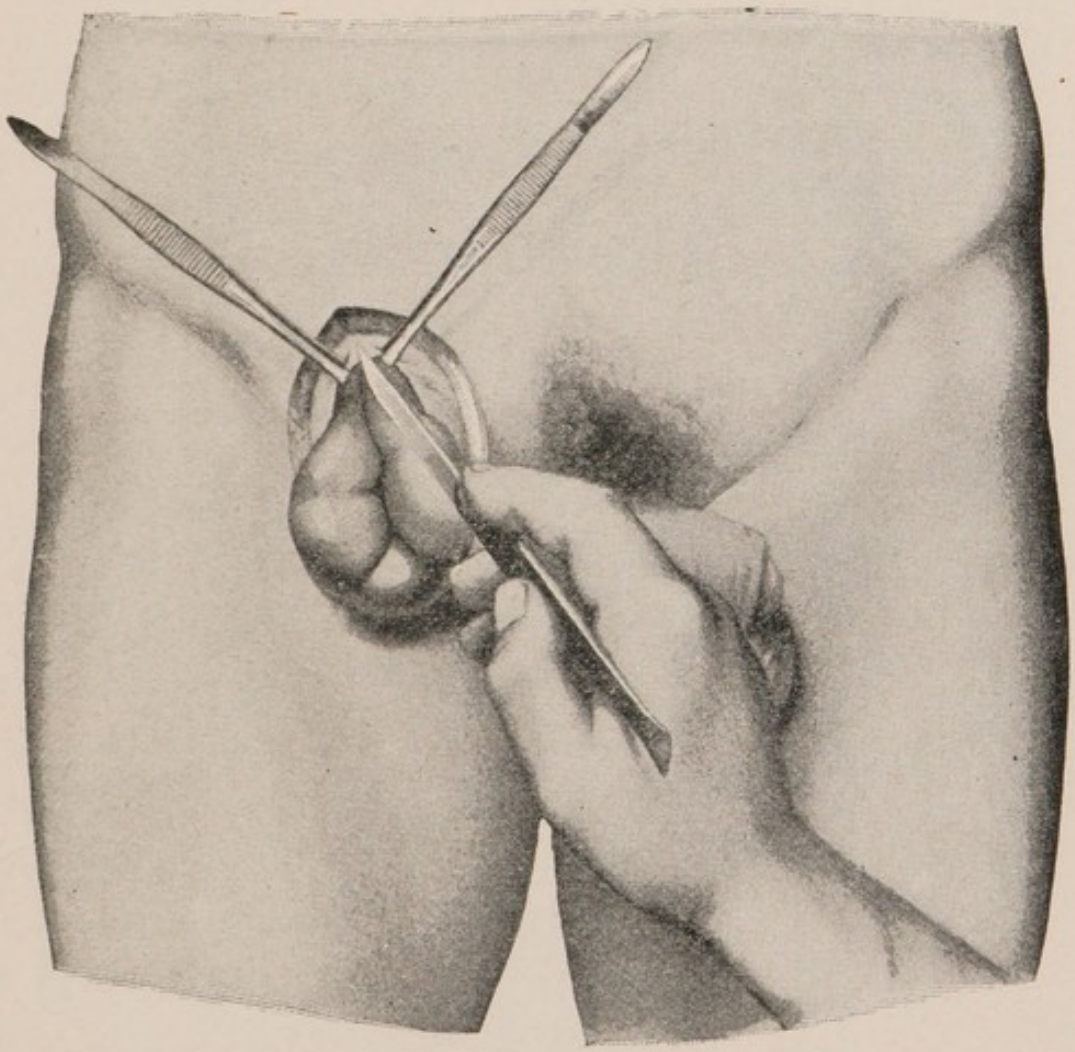


Fig. 33.—The division of the constriction from without inward.

of these methods is to be preferred, since the field of operation is freely exposed and any injured blood-vessel may be immediately caught and ligated. The ring of constriction is divided layer by layer between two pairs of rat-toothed forceps, as is shown in figure 33, until the stran-

gulated viscus can be easily drawn forward and it is certain that the constriction has been relieved.

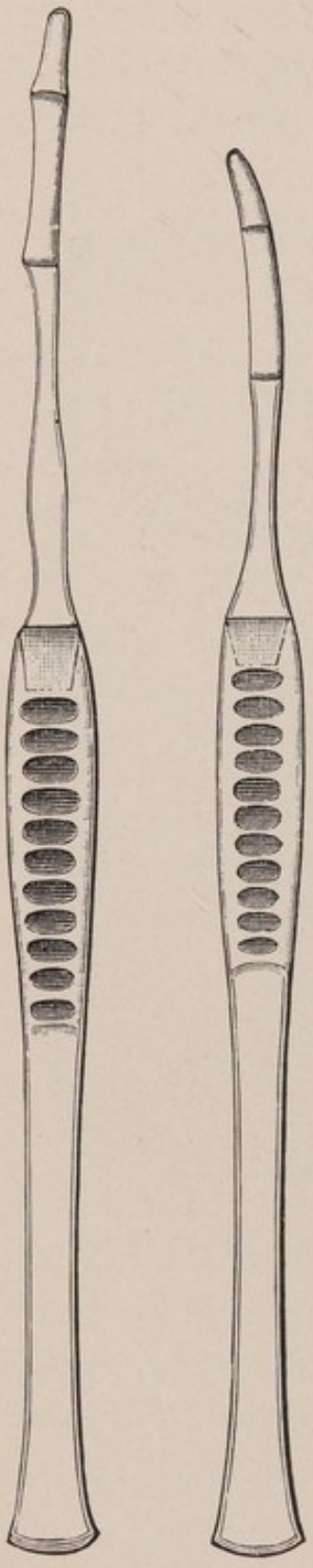


Fig. 34 a. Fig. 34 b.

If the constriction is divided from within outward,—and this is done particularly when the surgeon is forced to operate without sufficient assistance,—a special knife is employed, the so-called hernia knife or herniotome. The anterior and posterior portions of the blade are dull and the intermediate cutting-edge is about 1½ cm. in length. It is purely a matter of taste whether a straight (Fig. 34, a) or a curved herniotome (Cooper's, Fig. 34, b) is employed. As shown in figure 35, the index-finger of the left hand is introduced into the hernial sac and carried up to the seat of the constriction, and then the hernia knife is pushed in upon the finger which guards the herniated intestine from injury. When the cutting-edge of the hernia knife is within the constriction, the incision is made in an upward direction for from one to two millimeters. If the hernial contents cannot now be easily drawn forward, notches of a similar depth may be made in the sides of the constriction ring.

In former times, herniotomy was regarded as a highly dangerous operation, particularly in inguinal and femoral hernia, on account of the fatal intra-abdominal hemorrhages from a wounded epigastric or obturator artery. This was chiefly due to the fact that the constriction was

Fig. 35.—The division of the constriction from within outward.

always divided from within outward by means of incisions from one to two centimeters in length. If the previously stated directions are followed, such unfortunate cases will not occur, and even if a vessel is wounded its immediate ligation will be accomplished without difficulty.

If the constriction is situated outside of the neck of the sac, the strangulation may be relieved by the division of the tissues from without inward without opening the sac, and this operation, known as external herniotomy, was formerly frequently employed. It is scarcely necessary to state that such a course is admissible only in those cases in which the short duration of the strangulation and the general condition of the patient would exclude the possibility of the presence of marked changes in the nutrition of the intestine. Since errors of judgment are possible in such cases, it is safer to make it a rule to always open the sac and form an opinion of the condition of the strangulated viscus by direct inspection. After the division of the constriction, the strangulated intestinal coil should be drawn out far enough to allow of a thorough inspection of the constricted portions, but great care must be observed in making traction upon the intestine, since it may be torn where it has been thinned and weakened by the strangulation. It must now be decided whether or not the intestine may be safely returned into the abdomen. If omentum is in the sac, it should be ligated in not too large sections and extirpated. [If the omentum is in fair condition, I believe it bad judgment to prolong the operation by removing it.—Ed.] If intestine is in the sac, there are extreme cases in which it may be said, at first glance, this intestinal coil will surely live, or that one is gangrenous; but there are also intermediate cases in which correct judgment is very difficult, and only possible after a long experience. It is extremely difficult and often impossible to lay down definite rules in these cases. After the relief of the constriction, a cyanotic, bluish, discolored intestinal coil

should be enveloped in warm, moist, sterile gauze for several minutes, in order to see whether it recovers and takes on its normal appearance. As long as the intestinal surface seems smooth, moist, and glistening, as long as the walls are elastic and return to their original position when pinched up into a fold, and as long as extensive hemorrhages in the intestinal wall and marked changes in the constricted portions are wanting, it is scarcely to be supposed that severe disturbances of the nutrition of the intestine are present. In the remaining doubtful cases a correct decision is difficult and the most experienced operator is liable to err. The most deceptive cases are those in which there is a complete elastic strangulation of both the arteries and the veins, since a few hours may produce irreparable damage, which in the beginning is scarcely manifested in the intestinal coil. In such cases the appearance of the intestine should not be solely relied upon, but the general condition should be accurately observed. Marked shock with a small rapid pulse is one of the earliest and most important signs of a severe strangulation of the intestine (see page 101).

The reposition is best made by forcing the contents out of the herniated intestine by compression and pushing the portion situated nearest to the hernial orifice into the abdomen. During this step of the operation, a quiet and uniform anesthesia is of the utmost importance in order that the viscera may not be repeatedly forced downward by the augmentations of the intra-abdominal pressure produced by coughing or vomiting. For the same reason, when the operation is performed under local anesthesia, the patient must be constantly made to breathe quietly and

evenly with his mouth open. If adhesions exist between the intestine and the sac, they must be cautiously broken up, or if this is not possible, the portion of the sac which is tightly adherent to the intestinal coil may be left behind and replaced in the abdominal cavity together with the intestine.

In this operation, as in the one for radical cure, the surgeon must be prepared to meet with complications of a most varied character—a subperitoneal lipoma may simulate omentum, or there may be a cyst outside of and adherent to the hernial sac, which gives the impression that an empty hernial sac itself has been opened.

If there is the slightest suspicion that profound nutritive disturbances are present in the strangulated intestinal coil, it should never be reduced until it has been entirely surrounded by strips of iodoform gauze the ends of which are brought out of the external wound. In this manner the peritoneal cavity is protected from infection. In such a case the following course may also be adopted: The hernial orifice is freely incised, the intestinal coil is enveloped in sterile gauze, and allowed to remain outside of the abdomen, care being taken that the retaining dressing is not too firmly applied. If the intestine completely recovers, and if the wound remains aseptic, the intestine may be replaced in the abdominal cavity after a few days. It is self-evident, however, that this procedure is not altogether safe on account of the possible danger of infection of the peritoneal cavity.

The course of a case after herniotomy scarcely differentiates itself from that after a successful taxis. Ordinarily there is an immediate cessation of the pain, nausea, and

vomiting, and after a few hours flatus is passed. Neither opiates nor purgatives should be given; if the bowels are not moved spontaneously after twenty-four hours, a small rectal injection of glycerin will almost always produce an evacuation. The most frequent source of trouble after the operation is inflammation of the peritoneum, and in the great majority of cases we are powerless when confronted with this complication. If an intestine which has been considered capable of life and returned to the abdomen subsequently undergoes necrosis, the only chance of averting the threatened danger is by an immediate laparotomy. Later on, after a herniotomy, the phenomena of intestinal occlusion may reappear, and this may be due to angulations or adhesions of the reduced intestinal coil or to the production of a stenosis by the sloughing away of necrotic mucous membrane. The only treatment of such conditions must, of course, consist of a further operative procedure. Mention should also be made of an occurrence which is sometimes observed both after herniotomy and also after the radical operation—the inflammatory tumor of the omentum. These tumors may even occur in cases in which omentum has not been ligated at the time of the operation. Braun has quite recently directed attention to this form of epiploitis and collected the previous publications upon the subject. Either very soon after the operation or within a few weeks, a hard irregular intra-abdominal tumor is felt which usually disappears spontaneously in the course of a few months, but which may break down and suppurate.

The pneumonias which not infrequently develop after herniotomy may be partly referred to small pulmonary

embolisms, the emboli being derived from the thrombosed vessels of the hernial region.

If the intestinal coil is gangrenous, one of two procedures must be adopted—either the resection of the intestine or the making of an artificial anus. It is only in very rare and exceptional cases that it is allowable to invaginate a small gangrenous area (such as the decubitus resulting from the constriction) and sew the intestinal walls together over the invagination. Before such a course may be pursued the presence of marked disturbances of nutrition in the remaining portion of the intestinal coil must be absolutely excluded.

Without considering the fact that the general condition of the patient may forbid such a serious operation as resection of the intestine, and that a physician, from lack of knowledge of the technic of intestinal operations, or for other reasons, must satisfy himself with the making of an artificial anus, the choice of operation will depend upon which one offers the best chance of recovery. The statistics at our disposal for the purpose of forming a critical opinion, however, do not furnish evidence of the superiority of either method, since those who make an artificial anus only when the patient's general condition is so bad that the more severe procedure is contraindicated will naturally report but little good from the operation. The following statistics are the most recent upon the subject, and include those of the Göttingen clinic and Braun's cases from 1884 to 1900 inclusive:

Author (Operator).	Number of Cases in Which an Artificial Anus Was Made.	Mortality in Per Cent.	Number of Cases in Which a Primary Resection Was Made.	Mortality in Per Cent.
V. Bramann	66	45.4%		
Sachs (Kocher)	7	85.0%	25	60.0%
Maydl	30	46.0%	15	40.0%
Petersen (Czerny)	22	67.0%	28	33.0%
Göttinger Klinik (König, Braun)	17	88.2%	21	52.3%
Braun	13	76.9%	22	40.9%
Statistics collected by v. Mikulicz	94	76.6%	68	47.1%
Statistics collected by Hofmeister	167	60.5%	99	46.0%

These figures would speak still more forcibly for primary resection if the results obtained in recent years only were taken into consideration, since in this time there has been considerable progress in the operative technic. It might be mentioned that since the employment of the Murphy button and the performance of the operation under local anesthesia, Petersen has reported twelve primary resections of the intestine in the Heidelberg clinic, with but one fatal case, thus giving a mortality of 8%.

We speak of an artificial anus (*anus præternaturalis*) when the entire contents of the intestine are emptied through the new opening. Such a condition of affairs must obtain after the sloughing off of an entire intestinal coil. If only a portion of the intestinal wall has become gangrenous, as in a strangulated hernia of the intestinal wall, for example, a portion of the feces may be passed in

the usual manner, and we call this condition a fecal fistula (*fistula stercoralis*).

If it has been decided to make a fecal fistula or an artificial anus in a case of gangrene of the intestine, the constriction is divided as previously described in the operation of herniotomy and the strangulated coil is drawn out far enough to prevent its constricted portions from infecting the peritoneal cavity. The healthy intestine proximal to the constricted portions is now stitched to the peritoneal surface of the neck of the sac by several fine silk sutures which penetrate only the serous and muscular coats of the intestine. The intestinal coil is now completely surrounded by iodoform gauze, which is also stuffed into the hernial orifice in order to completely wall off the peritoneal cavity. When this has been thoroughly accomplished, the coil is freely incised, a rather thick rubber tube is passed into the afferent intestine, and the intestinal contents are drawn off into a vessel without infecting the wound any more than can be avoided. Whether the hernial sac should or should not be extirpated in such a case depends upon the degree in which the purulent inflammation has extended to the sac and upon the strength of the adhesions. In all cases, however, the entire wound should be packed with iodoform gauze and kept open in such a manner that a retention of the wound products is impossible.

If only a fecal fistula is made, a spontaneous cure may sometimes result, since the intestine may draw away from the abdominal wall, and the canal situated between the intestinal and cutaneous wounds gradually narrows, becomes filled with granulation tissue, and finally cicatrizes. These canal-like fecal fistulas must be differentiated from the lip-

like fistulas, in which the intestinal mucous membrane passes directly into the edges of the cutaneous wound. In such cases a cure can only be accomplished after the epithelial covering of the fistula has been destroyed by cauterization or by extirpation. Sometimes even this measure will fail, and then nothing is left but the separation of the intestinal coil from the abdominal wall and the closure of the intestinal and cutaneous orifices, an operation which is not absolutely free from danger on account of the reopening of the abdominal cavity.

The production of an artificial anus is only a makeshift, to be employed in extreme cases, since the nutrition of the patient suffers severely, particularly if the intestine has been strangulated high up and its contents are evacuated before the greater portion of the nutritive material can be absorbed. If the artificial anus cannot soon be closed and the intestinal contents allowed to pursue their usual course, the patient emaciates and very soon dies from inanition. The chief obstacle to the passage of feces from the afferent into the efferent intestine is due to the fact that the posterior wall of the opened intestinal coil, together with its mesentery, project anteriorly like a spur, and, as shown in figure 36, form a complete partition between the proximal and the distal ends of the intestine. If this spur can be removed so that the intestinal contents can pass into the efferent intestine, the case may be converted into a fecal fistula, and a complete cure may be much more readily obtained. Figure 36 illustrates the method followed by Dupuytren in the treatment of these cases. The branches of the enterotome are passed into the lumina of the intestine and the spur is slowly destroyed by pressure applied

by means of the external screw. The same principle has been employed in the newer and better clamps of v. Mikulicz and of Krause. These clamps do not protrude through the external wound, and effect an anastomosis further posteriorly. The main objection to any of these clamps is that the work is done in the dark, since it can never be known whether some viscus has not slipped in between the afferent and efferent intestine, to be subjected to crushing when the compression is made upon the spur. In the majority of cases the intestine must be secondarily sutured, or, if this is contraindicated by the possible formation of a stricture, resection of the intestine or enteroplasty as recommended by Braun.

Without considering the nutritive loss when the affected intestine is situated high up, the condition of a patient with an artificial anus is extremely annoying both to himself and to his associates. This is due, in no small measure, to the fact that the escaping intestinal contents—chiefly those of the small intestine—irritate the skin and sometimes produce an extremely painful and annoying eczema, which may extend over a large area about the artificial anus. This condition must be borne in mind and the skin protected by the application of thick layers of some ointment. The best combination for this purpose is one of zinc oxid and olive oil, which are mixed in such proportions that they form a thick paste. The cure of an eczema after it has developed is frequently very difficult to attain. The treatment with salves is often ineffectual, and the best results are obtained by the permanent water-bath, the employment of which will usually effect a cure within a few days.

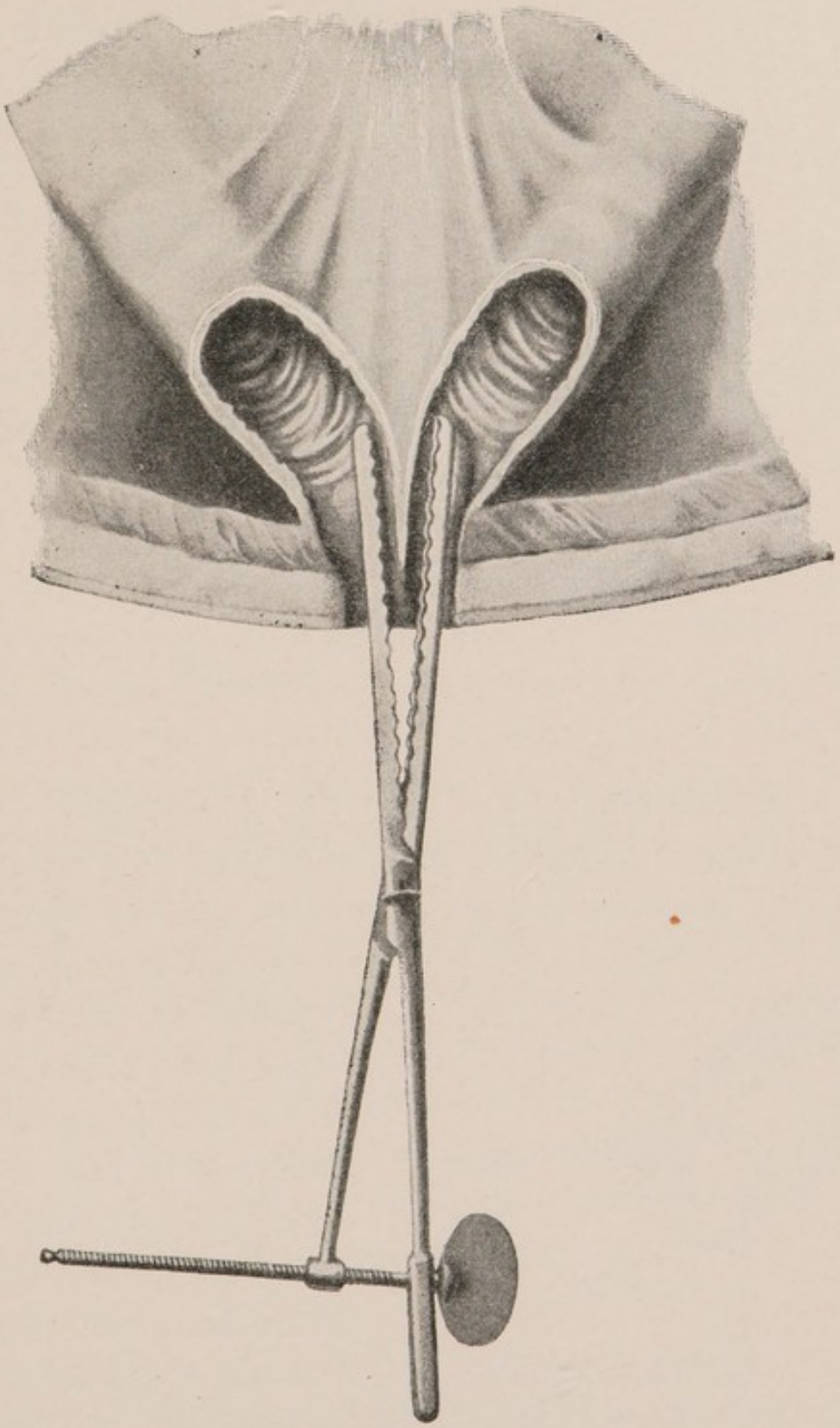


Fig. 36.—Artificial anus with Dupuytren's enterotome applied for the purpose of destroying the spur.

A good protective dressing for an artificial anus is shown in figure 37 a. It is made upon the same plan as a spring truss, the pad being replaced by a metallic capsule contain-

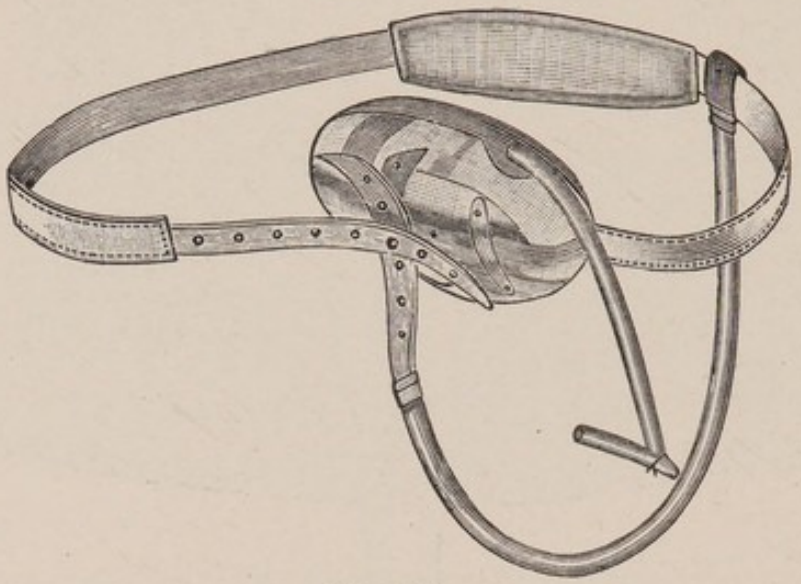


Fig. 37 a.

ing a changeable rubber ring (Fig. 37 b) which may be filled with air. This ring may be pressed so firmly against the skin that the closure is perfect and its cavity will accommodate a certain amount of feces without annoyance to the patient. Such an appliance will retain solid feces at least, and in favorable cases even allow the patient to fulfil his social duties.

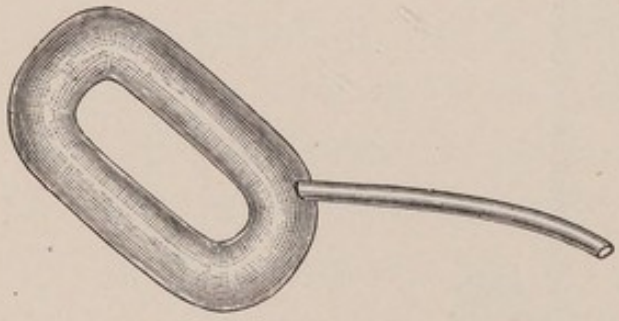


Fig. 37 b.

If it has been decided to resect the intestine, it must be particularly remembered that the nutritive disturbances extend upward a considerable distance above the constricted portion of the afferent intestine. This is chiefly due to the marked distention on the proximal side of the strangula-

tion. The walls of the intestine become very friable, and this is especially noticed by the tearing through of the sutures if much tension is placed upon them. In such a case the resection of the afferent end must be made high up in healthy tissue.

Individual operators lay great stress upon the thorough irrigation of the afferent intestine in order to draw off the stagnant intestinal contents before the ends of the resected intestine are united. The wound must be firmly packed with gauze to protect it from accidental contact with feces, a soft esophageal tube is introduced high up into the afferent end of the intestine, and the intestine is irrigated. The esophageal tube should project well beyond the wound so that the irrigation fluid can flow into a receptacle without infecting the site of the operation. [I do not believe this necessary, and in many cases it may do harm, as much of the fluid may remain in the intestine and cause distention.—Ed.]

In cases in which the intestine is suspected of being gangrenous, Helferich has suggested that the intestinal coil be drawn out far enough to make an entero-anastomosis between the afferent and efferent intestines a hand's-breadth above the site of the previous constriction, and that the intestine then be replaced so that only the suspected portion remains outside. If necrosis does not occur within twenty-four or forty-eight hours, this coil may also be returned to the abdomen ; if the intestine becomes gangrenous, only a portion of the intestinal contents will escape through the wound, the other portion being able to pass on through the anastomosis. This procedure is to be particularly recommended when the strangulation is situated high up

and the general condition of the patient will not permit of an operation requiring so much time as an intestinal resection.

A description of the technic of intestinal resection cannot be given, since it would carry us far beyond the limits of this atlas, and we must consequently refer the reader to the text-books upon operative surgery. The choice of the method by which the stumps are united after the resection of the gangrenous intestine, whether they should be united by suture or by the Murphy button, whether the efferent end should be closed and the afferent end implanted laterally in the former, or whether both ends should be closed and a lateral anastomosis made, depends so much upon the inclination and habit of the operator that general rules upon these points cannot be given.

Is it allowable to perform the radical operation immediately after a herniotomy? Such a course could only be pursued if the strangulated intestine were found quite intact and if all of the phenomena of inflammation were absent. We know that the result of the radical operation is in no small degree dependent upon the aseptic condition of the wound, and it is clear that the preparation of the patient by baths, by antiseptic fomentations over the hernial region, and by a sufficient evacuation of the bowels can be much more thoroughly carried out before the radical operation than is possible in any operation upon a strangulated hernia. It consequently follows that in all cases in which a resection of the intestine must be made it is well to omit the immediate performance of the operation for radical cure.

EXPERT OPINIONS IN REFERENCE TO ABDOMINAL HERNIAS.

The essential points in reference to a causal connection between accident and hernia have been sufficiently emphasized upon pages 53–57. If it is evident from the principles previously discussed that such a connection does exist, the determination of the amount of the loss in earning power will depend upon the condition, size, and reducibility of the hernia. As stated by the Government Insurance Bureau (Reichs-Versicherungsamt), even a small reducible hernia prevents the individual from utilizing certain opportunities of gaining a livelihood and debars him from using all his strength in his chosen occupation. He is forced to wear a good truss, to see that it permanently retains the hernia, and, finally, to always remember his physical weakness in his work and in his selection of an occupation. The earning power of an individual with a reducible hernia perfectly retained by a truss is assumed to be diminished about 10%. The loss in earning power becomes correspondingly greater if the hernia is retained by a truss with difficulty, and particularly if it is irreducible and of large dimensions.

It has already been briefly mentioned that inguinal hernias have been artificially produced. It is stated that in Russia these inguinal hernias are brought about by traumatisms in order to render the individual unfit for military duty, and a considerable literature upon the subject already exists. Very recently Galin has collected these observations and published them, together with his own experimental investigations. Galin states that a path for the

descent of an inguinal hernia can undoubtedly be produced by an intentional injury. It is probable that an instrument like a glove-stretcher is introduced into the inguinal canal, and that by its use the canal can be dilated and that extensive lacerations of the external abdominal ring and of the aponeurosis of the external oblique muscle can be produced. Galin demonstrated on the cadaver that with the aid of such an instrument the columns of the external ring can be torn; if the canal is so narrow that the instrument cannot be introduced, the aponeurosis of the external oblique may be torn at some distance from the external abdominal ring by the application of considerable force. Such a laceration can easily be enlarged by introducing the finger, and if the finger is pushed further inward, the path for the hernia may easily be made. The characteristics of such an artificially produced inguinal hernia are that it corresponds more nearly to the type of an internal inguinal hernia; that the external hernial orifice, which is either at the external abdominal ring or at an abnormal opening in the external oblique muscle, feels irregularly thickened from inflammatory exudate; and that intense pain is usually caused when the finger is introduced well into the hernial canal.

In conclusion, the existing regulations of the German army and navy in reference to the fitness for service of individuals with hernia will be given, as well as those which apply to the Austrian and Swiss troops.

GERMANY.

1. The simple dilatation of the external abdominal ring, designated as a predisposition to the development of a her-

nia, or the bulging of the thinned anterior abdominal wall in the region of the hernial canal produced by coughing, does not render the individual unfit for service with weapons.

2. One-year volunteers and volunteer color-bearers who have hernias that are easily and securely retained by trusses can be enrolled if they so desire, and if the commander of the troops, acting upon the suggestion of the army surgeon, is willing to accept their service.

3. A simple inguinal hernia capable of being retained by a truss does not render the individual unfit for service without weapons, but does disqualify him for service in the Commissary Department in the field.

4. Individuals with fully developed abdominal hernias which can be retained by a truss, and also those with hernias which are still within the inguinal canal, are disqualified for service in the standing army and in the reserve army; they are, on the contrary, usually fit for service in the last reserve corps.

5. Individuals with fully developed abdominal hernias which cannot be retained by a truss on account of their size and adhesions are disqualified for service in the standing army, in the reserve army, and usually also in the last reserve corps. Such hernias also render members of the Commissary Department unfit for service in the garrison and upon the field.

6. If individuals not in active service but serving as helpers develop a simple hernia which is easily retained by a truss, they shall not be disqualified on this account until their legal time of service has expired.

AUSTRIA.

1. Bulgings in the inguinal region and dilatations of the inguinal canal, provided that the viscera do not descend into the canal, and that the individual is otherwise well-built, do not disqualify the individual from service in time of war.

2. Visceral protrusions (hernias), regardless of their size and length of duration, absolutely disqualify the individual for service in time of war.

SWITZERLAND.

Any variety of abdominal hernia renders the individual so afflicted unfit for military service. (The presence of an inguinal hernia is to be assumed if the inguinal canal becomes filled under the influence of augmentations of the intra-abdominal pressure.)

An abdominal hernia developing during the time of service can disqualify the individual only when it cannot be completely and permanently retained by a truss.

SPECIAL HERNIAS.

INGUINAL HERNIA.

THE inguinal hernia is the most frequent of all varieties, and, according to Berger, 96 % of all male individuals who have single or multiple hernias are afflicted with this type, the corresponding percentage among females being 44.3 %.

ANATOMY.

By the inguinal region we understand that portion of the abdominal wall which is situated immediately above Poupart's ligament. This ligament extends from the anterior superior spine of the ilium to the spine of the pubis, and is nothing more nor less than the lower free border of the aponeurosis of the external oblique muscle, strengthened by bands of connective tissue which radiate to the ligament from the surrounding tissues. The external abdominal ring is shown in figure 3, and is formed by the semicircular edge of the external oblique muscle. This ring is the external orifice of the inguinal canal; it is the point at which inguinal hernia appears externally, and, as shown in figure 17, can be palpated in the male by invaginating the skin of the scrotum. In the female the inguinal canal gives passage to the round ligament; in the male it is filled up by the spermatic cord, surrounded by loose connective tissue, and indicates the path which has been

Fig. 38.—Oblique section passing through the anterior superior spine of the ilium and the spine of the pubis, so that the inguinal canal is laid open, exposing the spermatic cord in its entire course through the abdominal wall from the internal to the external abdominal ring: a, External abdominal ring; b, sciatic nerve; c, obturator vessels and nerve; d, gland of Rosenmüller; e, acetabulum; f, femoral vein; g, spermatic cord within the inguinal canal; h, femoral artery; i, anterior crural nerve; k, iliopsoas muscle; l, Poupart's ligament; m, transversalis muscle; n, internal oblique muscle; o, external oblique muscle.

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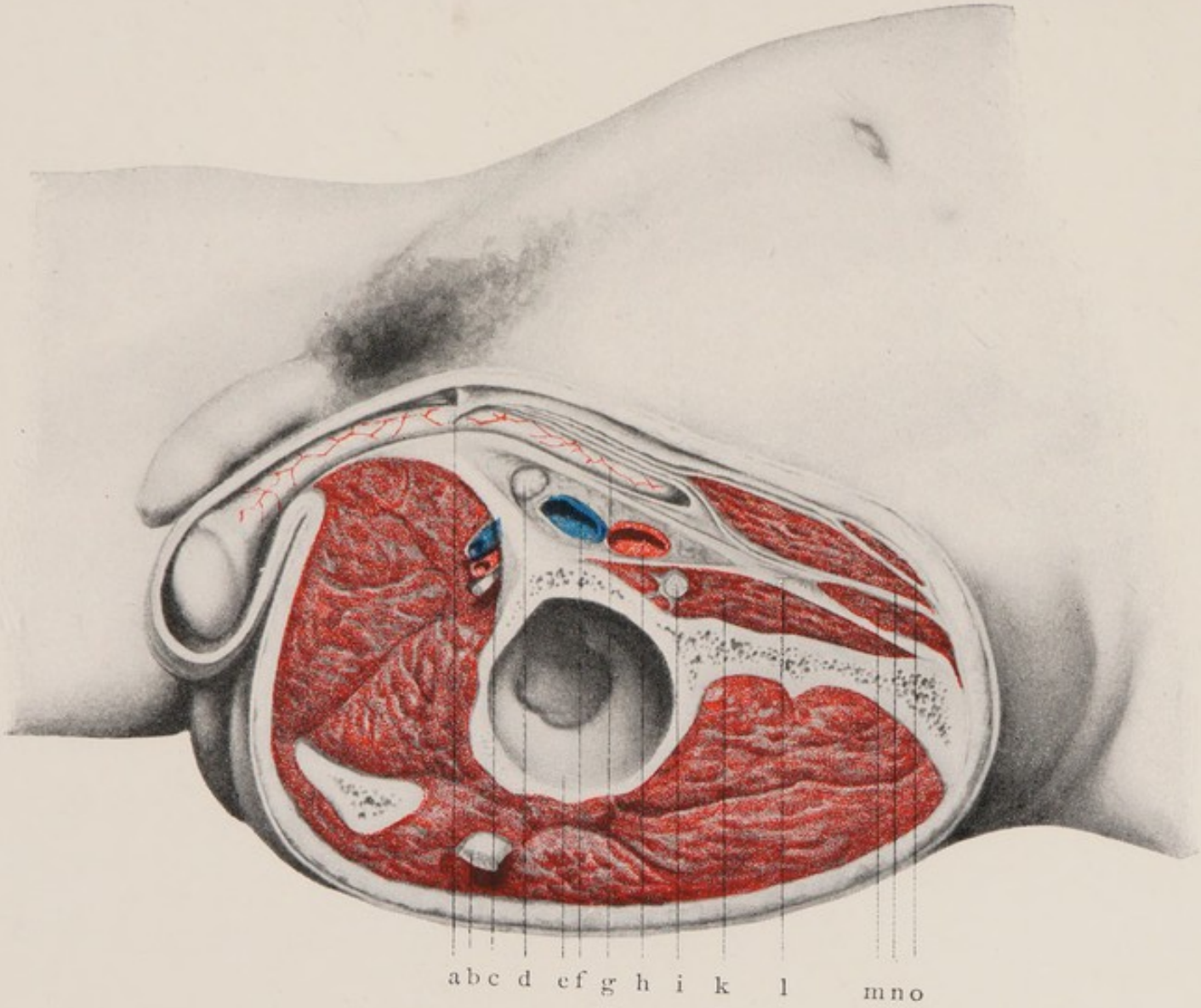
taken by the testicle in its descent from the abdominal cavity into the scrotum. The canal passes obliquely through the anterior abdominal wall parallel to Poupart's ligament and is from four to five centimeters in length. In children the canal is shorter and more direct, so that the internal abdominal ring lies almost directly behind the external abdominal ring. Throughout the entire inguinal canal, the spermatic cord is covered anteriorly by the external oblique muscle; the internal oblique muscle partly surrounds the cord and sends some of its fibers, which are known as the cremaster muscle, down to the testicle (Fig. 4). In figure 5 the spermatic cord is seen making its exit from beneath the free edge of the transversalis muscle, and figure 6 shows the internal abdominal ring, which has been exposed by the removal of this muscle. The oblique course of the spermatic cord is still more distinctly shown by figure 38.

As is seen in figure 38, the spermatic cord within the inguinal canal is bounded posteriorly by Poupart's ligament, anteriorly for a short distance by the internal oblique muscle, and for the remainder of its course by the aponeuroses of the abdominal muscles. The cord leaves the ab-

Fig. 38.



dominal cavity through the internal abdominal ring, passes through the abdominal wall, and leaves the same through the external abdominal ring.

A study of the inner surface of the anterior abdominal wall is of particular importance for the correct understanding of inguinal hernia (Plate 2).

The peritoneum of the anterior abdominal wall is lifted up into folds by several cords which are situated between it and the transversalis fascia, and these folds divide the surface into various fossæ. Of these folds, there are three which are well marked, particularly in the young, and which pass from the sides and apex of the bladder to the umbilicus. The middle fold—plica vesico-umbilicalis media—is caused by the remains of the urachus or the duct of communication between the bladder and the umbilicus; the lateral folds—plicæ vesico-umbilicales laterales—are caused by the obliterated hypogastric arteries. Still more laterally situated is a less prominent fold, which does not extend quite to the umbilicus. It is known as the plica epigastrica, and is caused by the epigastric artery (a branch of the external iliac) and its accompanying veins. To the outer side of the plica epigastrica there is a more or less markedly developed fossa, the external inguinal fossa, which is the place of exit of the external inguinal hernia; to the inner side of the plica epigastrica there is a similar fossa, the internal inguinal fossa, and this is the place of exit of the internal inguinal hernia. A fossa is sometimes encountered between the median and lateral vesico-umbilical folds, and this is known as the supravesical fossa. The external and internal inguinal fossæ are those in which we are chiefly interested.

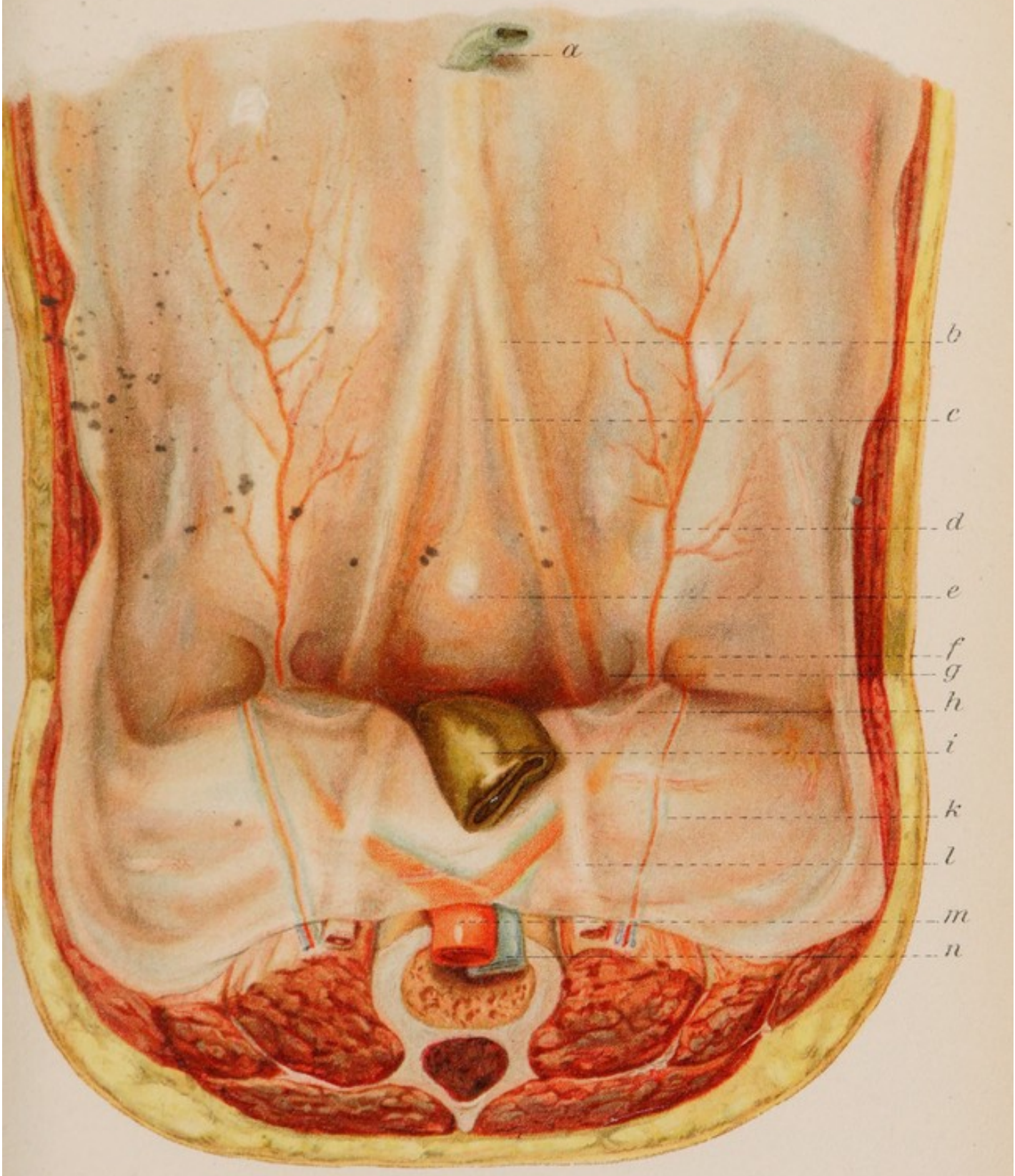
PLATE 2.

The Internal Aspect of the Anterior Abdominal Wall of a Newborn Male Child.—The anterior abdominal wall has been elevated and put upon the stretch, while the posterior abdominal wall has been divided by a transverse section at the level of the third lumbar vertebra. a, Hypogastric vein ; b, plica vesico-umbilicalis lateralis ; c, plica-vesico-umbilicalis media ; d, plica epigastrica (deep epigastric artery) ; e, urinary bladder ; f, external inguinal fossa ; g, internal inguinal fossa ; h, vas deferens ; i, rectum ; k, spermatic vessels ; l, ureter ; m, common iliac artery ; n, common iliac vein.

Figure 39 represents the conditions which obtain when an external and an internal inguinal hernia are present. The entire peritoneum has been removed with the exception of the two funnel-like diverticula which pass out to form the hernial sacs. In the external inguinal fossa, and consequently to the outer side of the deep epigastric artery, the structures which form the spermatic cord—*i. e.*, the spermatic vessels and the vas deferens—pass into the inguinal canal together with the external inguinal hernia. To avoid subsequent confusion, one point must be clearly noted, and that is that the *internal* abdominal ring is situated within the *external* inguinal fossa. The hernia which passes out with the spermatic cord is known as the external, the oblique, or the indirect hernia.

The hernia protruding through the internal inguinal fossa, and consequently to the inner side of the deep epigastric artery, does not pass through a previously formed canal ; it passes directly forward through the abdominal wall, and is known as an internal or direct inguinal hernia.

In very rare cases an inguinal hernia passes out through the supravesical fossa and appears at the external abdom-



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inal ring after passing obliquely through the abdominal wall. This form of hernia, together with a few poorly described cases in which the hernial sac descended partly parallel to the inguinal canal and partly by means of a diverticulum into the opposite half of the scrotum, are such great exceptions that it will be sufficient to simply mention the condition.

In the female inguinal hernia is considerably rarer than in the male, and this is due to the narrowness of the inguinal canal, which accommodates nothing but the round ligament, a structure which is much smaller than the spermatic cord.

EXTERNAL OBLIQUE INGUINAL HERNIA.

The external inguinal hernia may be either congenital or acquired. The congenital predisposition to such a hernia bears a most intimate relation to the conditions which obtain with reference to the descent of the testicle.

Congenital Inguinal Hernia.—Figure 40, a, represents the conditions as they are found at about the fourth month of fetal life. The testicle has developed within the abdomen and is located behind the peritoneum. The same picture shows that, independent of the subsequent descent of the testicle, a peritoneal diverticulum has formed in the inguinal region in the situation corresponding to what is later known as the vaginal process of the peritoneum. In the female there is also such a peritoneal diverticulum, designated as the diverticulum of Nuck, but such an open peritoneal process at the time of puberty is one of the greatest rarities (Merkel). During the sixth and seventh months of fetal life (Fig. 40, b) the testicle gradually descends, and at the ninth month has reached

Fig. 39.—External and internal inguinal hernias, seen from within : a, Psoas muscle ; b, rectum ; c, external iliac vein ; d, external iliac artery ; e, urinary bladder ; f, sac of an external inguinal hernia ; g, spermatic cord ; h, sac of an internal inguinal hernia ; i, epigastric artery ; k, rectus abdominis muscle.

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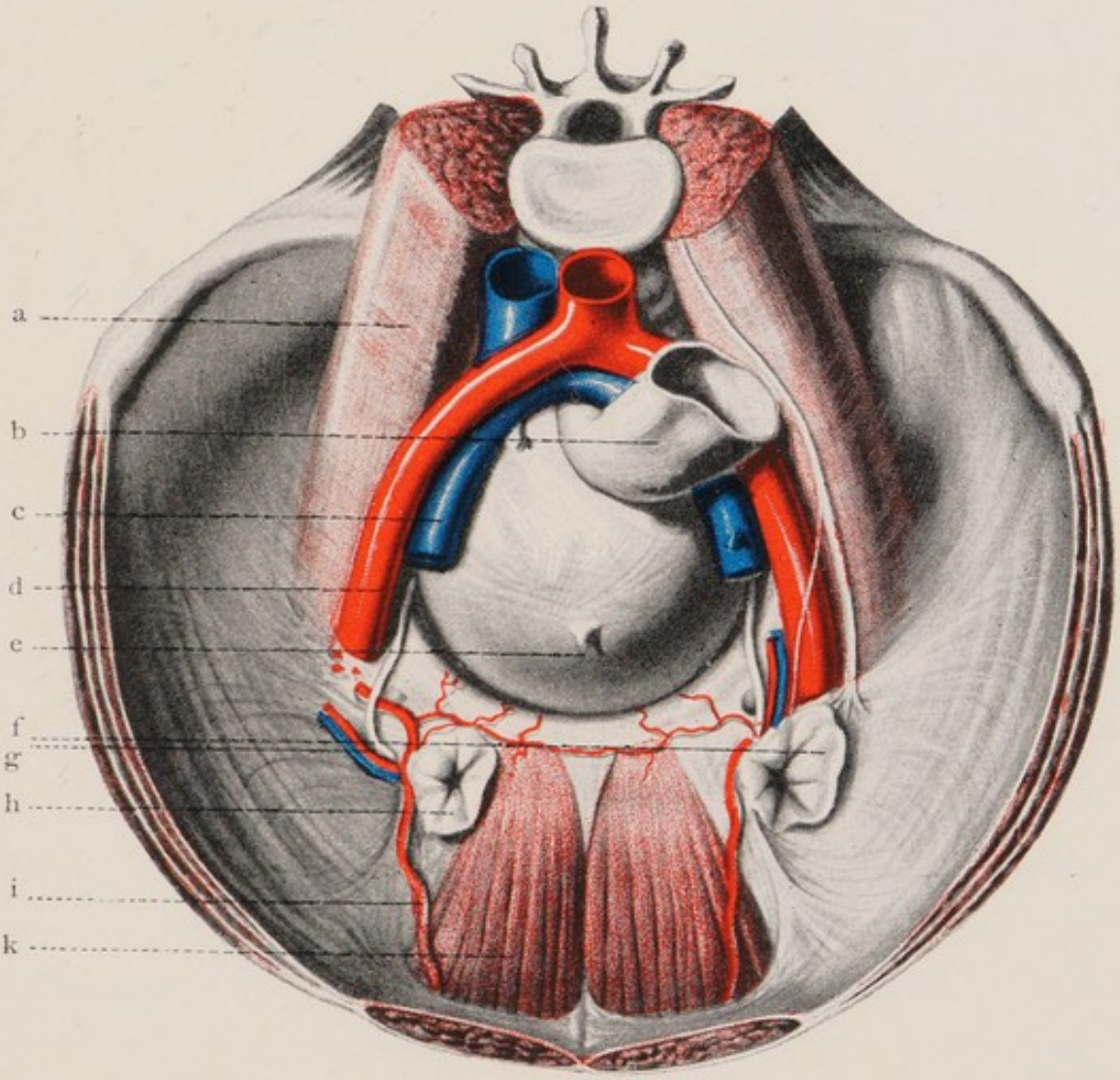
the bottom of the scrotum (Fig. 40, c). In this manner the testicle pushes the transversalis fascia down ahead of it, and this fascia consequently invests the testicle and spermatic cord as the *tunica vaginalis communis*. The cord and testicle are also surrounded by the fibers of the cremaster muscle, which are derived from the internal oblique and transversalis muscles. At this time the process of peritoneum which has been drawn down is still in communication with the peritoneal cavity, and this canal-like communication is known as the *processus vaginalis peritonei*. Before birth the walls of this vaginal process become adherent, so that on one side the parietal peritoneum passes smoothly over the internal abdominal ring, while on the other the closed serous sac is adherent to the anterior surface of the testicle and forms the *tunica vaginalis propria* (Fig, 40, d). If this obliteration of the processus vaginalis does not occur, there is a congenital hernial sac, as shown in figure 40, c, and this may become a hernia, either at birth or in later life, by the descent of some of the viscera (Plate 3).

The following figures, taken from Bayer, show the frequency of these disturbances of development as well as the differences which are observed between the right and left sides of the body.

In 70 newborn males, Camper found the vaginal process patulous upon both sides 34 times, upon the right side 14 times, and upon the left side 8 times.

Fig. 39.



In 100 newborn children, Engel found the process patulous upon both sides 60 times, upon the right side 30 times, and closed in all cases upon the left side.

Zuckerkandl examined the bodies of 100 children (first to the twelfth week) and found a patulous process upon both sides 20 times, upon the right side 12 times, and upon the left side 5 times.

In 102 inguinal hernias, Félizet found 63 cases upon the right, and 39 cases upon the left side. It is believed that the reason for the preponderance upon the right side is due to the fact that the left testicle descends into the scrotum at an earlier period than the right. Weil thinks that the earlier descent of the left testicle is probably due to the pressure of the full sigmoid colon.

The causes for the non-closure of the vaginal process are sometimes to be found in disturbances connected with the descent of the testicle, and such inguinal hernias are therefore not infrequently found in combination with cryptorchism. Another explanation for the condition is that some viscus becomes adherent to the peritoneal covering of the testicle within the abdomen, and that it is drawn down by the descent of this organ.

The possibilities of a congenital predisposition to hernias have not been exhausted by the varieties of congenital inguinal hernia which have just been described. Still other forms are possible, and they will receive particular attention in the description of the combinations of hernia with hydrocele (page 161).

Bayer has recently directed attention to a number of anatomic peculiarities of the congenital inguinal hernia, some of which were previously known. Of these peculiarities, the following might be mentioned :

1. The absence of the layer of subperitoneal fat, in

Fig. 40.—The descent of the testicle (Stieda-Pansch): a, Position of the testicle at about the fourth month of fetal life; b, position of the testicle at about the sixth, and until the seventh month of fetal life; c, position of the testicle in the ninth month of fetal life; origin of the vaginal process of the peritoneum; d, position of the testicle at birth; origin of the tunica vaginalis propria.

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consequence of which the sac is more firmly attached to the hernial coverings and seems to be adherent to them. For this reason the extirpation of the sac is more difficult than in acquired hernias.

2. The spermatic cord is not found as a connected bundle beside the hernial sac, but is rather frayed out; its blood-vessels frequently lie side by side, usually covering the entire external and posterior surface of the sac, while the vas deferens is almost always isolated and situated behind the hernial sac.

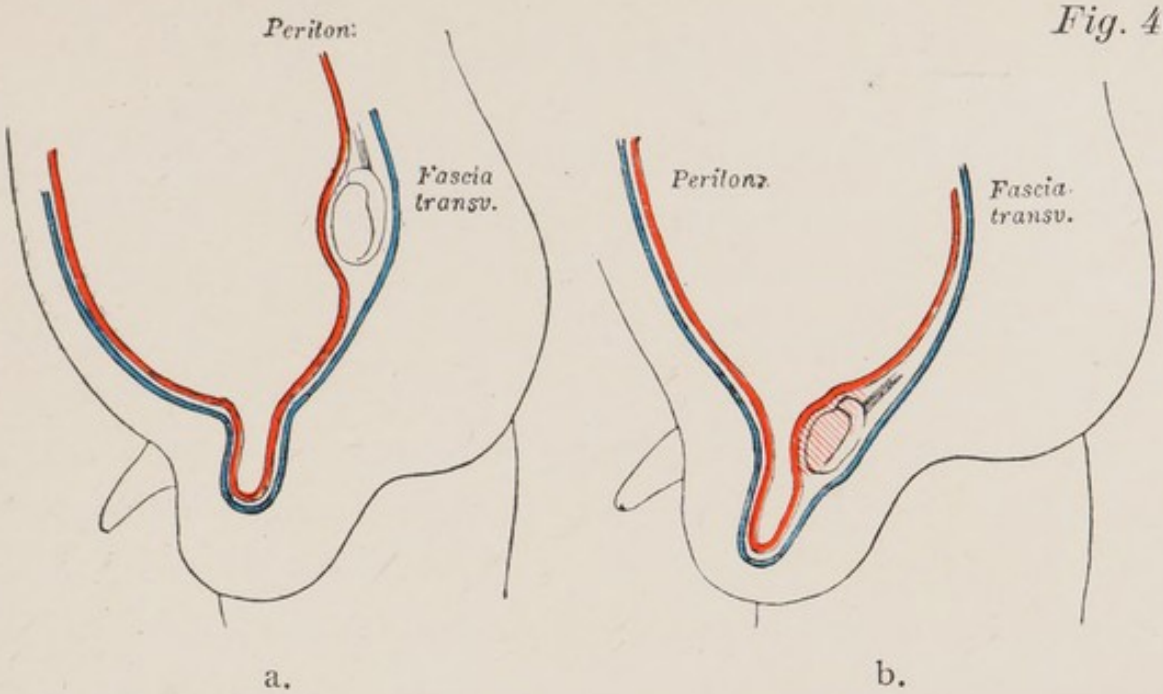
3. The cremaster muscle forms a connected muscular covering which is intimately associated with the tunica vaginalis communis about the hernial sac. In acquired hernias the muscular fibers are separated and very frequently interrupted in their course.

4. The aponeurosis of the external oblique muscle does not form an external abdominal ring with sharp tendinous borders, but is continued for a distance upon the layer of cremaster muscle as a veil-like membrane.

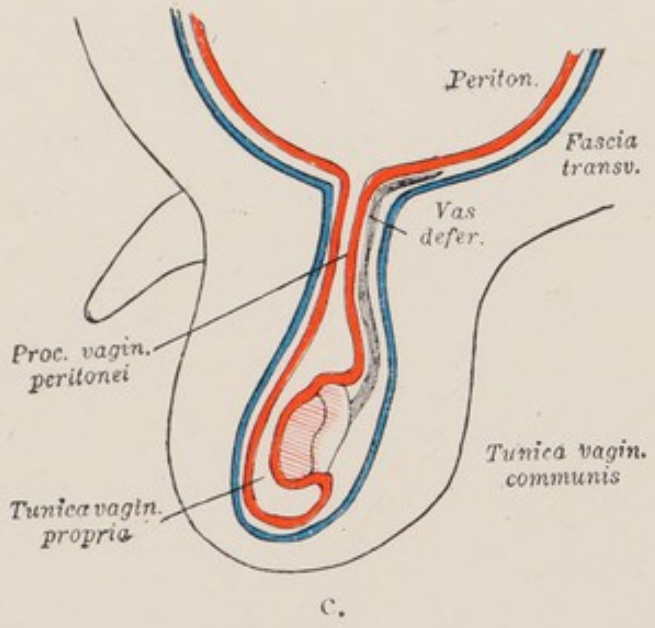
A clinical characteristic of the presence of a congenital sac is found in the fact that when a hernia first appears in such patients it descends very rapidly as far as the scrotum, while the descent of an acquired hernia is usually extremely slow.

Acquired External Inguinal Hernia.—As a matter

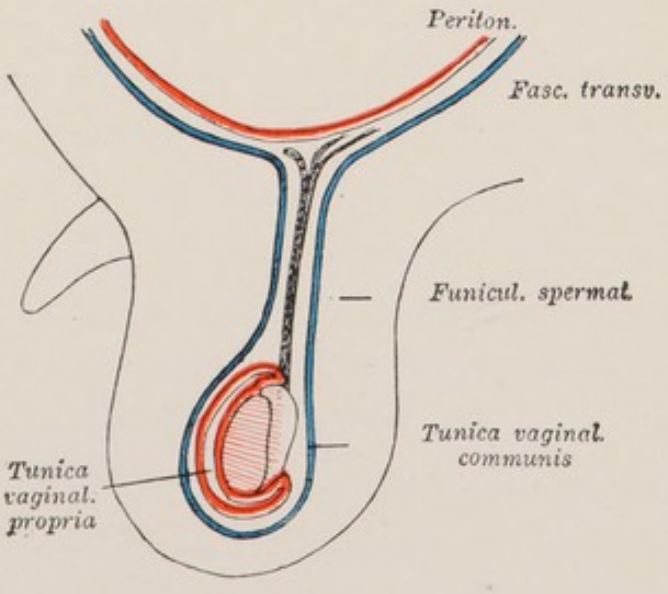
Fig. 40.


Periton.
Fascia transv.
Periton.
Fascia transv.

a. b.


Periton.
Fascia transv.
Vas defer.
Proc. vagin. peritonei
Tunica vagin. communis
Tunica vagin. propria

c.


Periton.
Fasc. transv.
Funicul. spermat.
Tunica vaginal. communis
Tunica vaginal. propria

d.

of fact, it is extremely probable that many of the hernias which we classify as acquired cannot be so designated. We have seen (page 18) that the number of hernias in the second and third years of life—and these hernias are almost without exception of the inguinal variety—is extraordinarily smaller than during the first year, and we have reason to suppose that in very many of these cases an adhesion and obliteration of the vaginal process has not taken place, but that this process has simply become much narrowed, and that the descent of the viscera into the sac is consequently prevented. If the abdominal walls become relaxed with advancing years, and if the occupation or a disease causes frequent and marked augmentations of the intra-abdominal pressure, the narrowed entrance to the sac can become dilated again and a hernia develops which is apparently acquired, but the predisposition to which was nevertheless congenital.

The acquired external inguinal hernia follows the course of the spermatic cord and may stop at any point in its descent. If the hernia remains within the inguinal canal, it forms a slight and obscurely defined protrusion of the hernial region, although there is no actual external projection of the hernial tumor, and this form is known as the *incomplete inguinal hernia.* Such a hernia is not felt until the finger is introduced within the inguinal canal. If the hernia descends somewhat lower, it forms a small tumor outside of the external abdominal ring, and this form is known as the *complete inguinal hernia.* If the hernia descends still further, it follows the spermatic cord, and finally reaches the bottom of the scrotum, when it is known as a scrotal hernia (Plate 4).

PLATE 3.

A Congenital Inguinal Hernia.—In this case the hernial contents, a coil of intestine, lie directly upon the testicle, the cavity of the tunica vaginalis propria being directly continuous with that of the hernial sac.

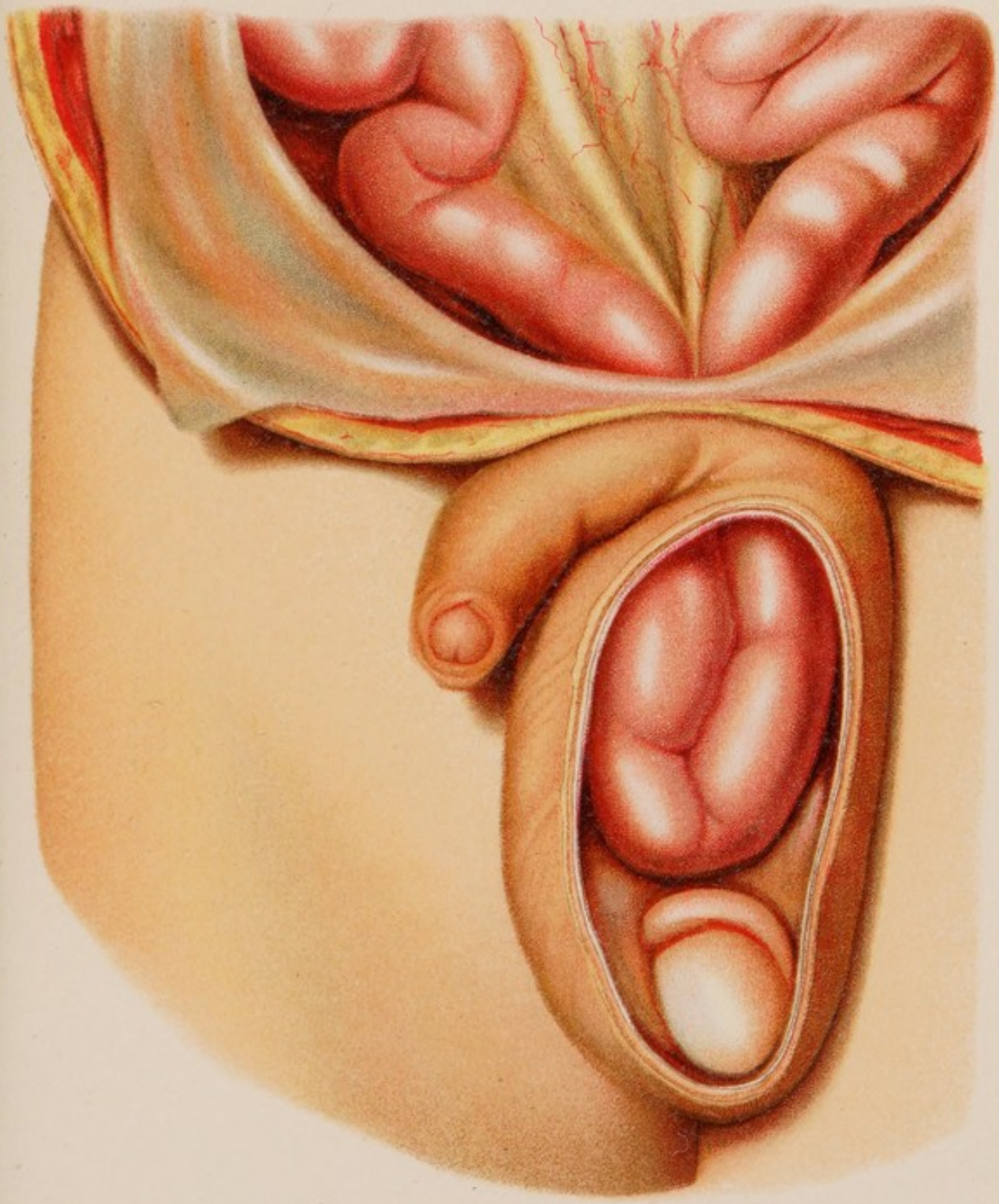
As the scrotal hernia increases in size, the overlying integument becomes more and more distended. The skin of the scrotum is first involved, and finally that of the penis also covers the hernial tumor. Figures 41 to 46 show the different stages of development of much scrotal hernias.

In the female, from what has been said, the external inguinal hernia must follow the course of the round ligament, and consequently descend into the labium majus. Such a hernia is known as a labial hernia (Fig. 47). The labium majus may become enormously distended by the hernia, although these large labial hernias are extremely rare as compared with the relative frequency of large scrotal hernias. The reasons for the more frequent occurrence of inguinal hernia in men than in women have been previously mentioned.

A hydrocele may develop from the diverticulum of Nuck in the female, as it does from the corresponding vaginal process in the male, and combinations of hernia with hydrocele have been observed which are similar to those seen in the male in figures 50 and 51.

INTERNAL INGUINAL HERNIA.

The internal inguinal hernia passes directly forward through the internal inguinal fossa (Plate 2 and Fig. 39) and makes its appearance externally at the external



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abdominal ring, as does the external inguinal hernia. Since the path taken by this hernia corresponds to no pre-existing canal, there are no congenital internal inguinal

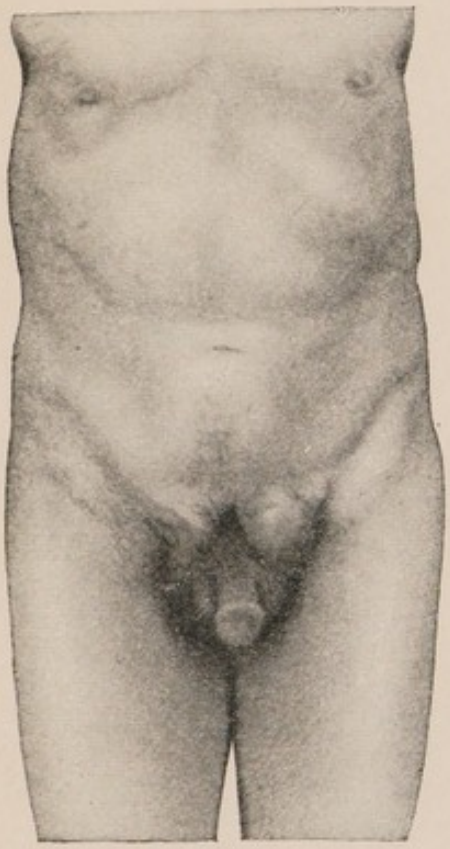

Fig. 41.

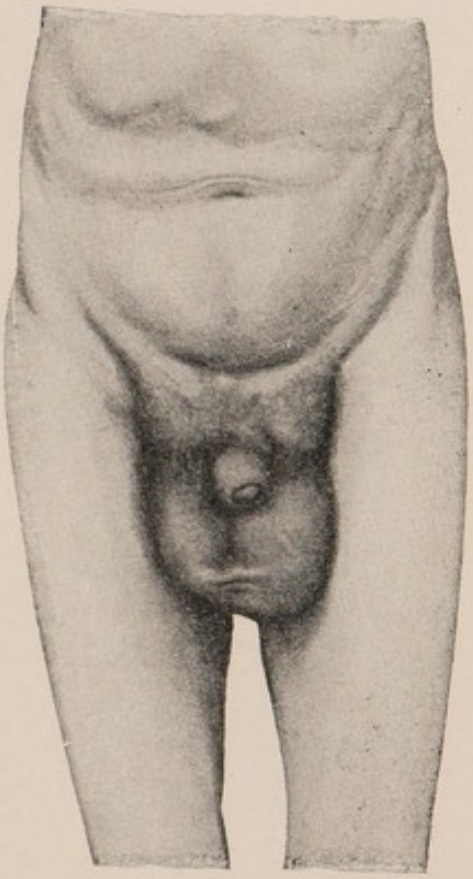

Fig. 42.

Fig. 41.—A commencing inguinal hernia: A protrusion about the size of a walnut is seen at the situation of the left external abdominal ring.

Fig. 42.—A bilateral external inguinal hernia which has stopped in its descent at the root of the scrotum and has on both sides attained the size of a hen's egg. This patient also exhibits a small subperitoneal lipoma, which is seen somewhat to the right of the linea alba and midway between the umbilicus and the xiphoid process.

hernias, and almost all of the internal inguinal hernias are observed in the later years of life. We have already learned that the abdominal wall is particularly weak in the region of the internal inguinal fossa (page 29), and it can

PLATE 4.

Acquired External Inguinal Hernia.—In this case the vaginal process of the peritoneum has closed in a normal manner, so that the tunica vaginalis propria surrounds the testicle at the bottom of the scrotum and a new process of peritoneum has been protruded into the scrotum alongside of the spermatic cord. The cavities of the hernial sac and of the tunica vaginalis propria do not communicate, but their outer surfaces lie in immediate contact with each other.

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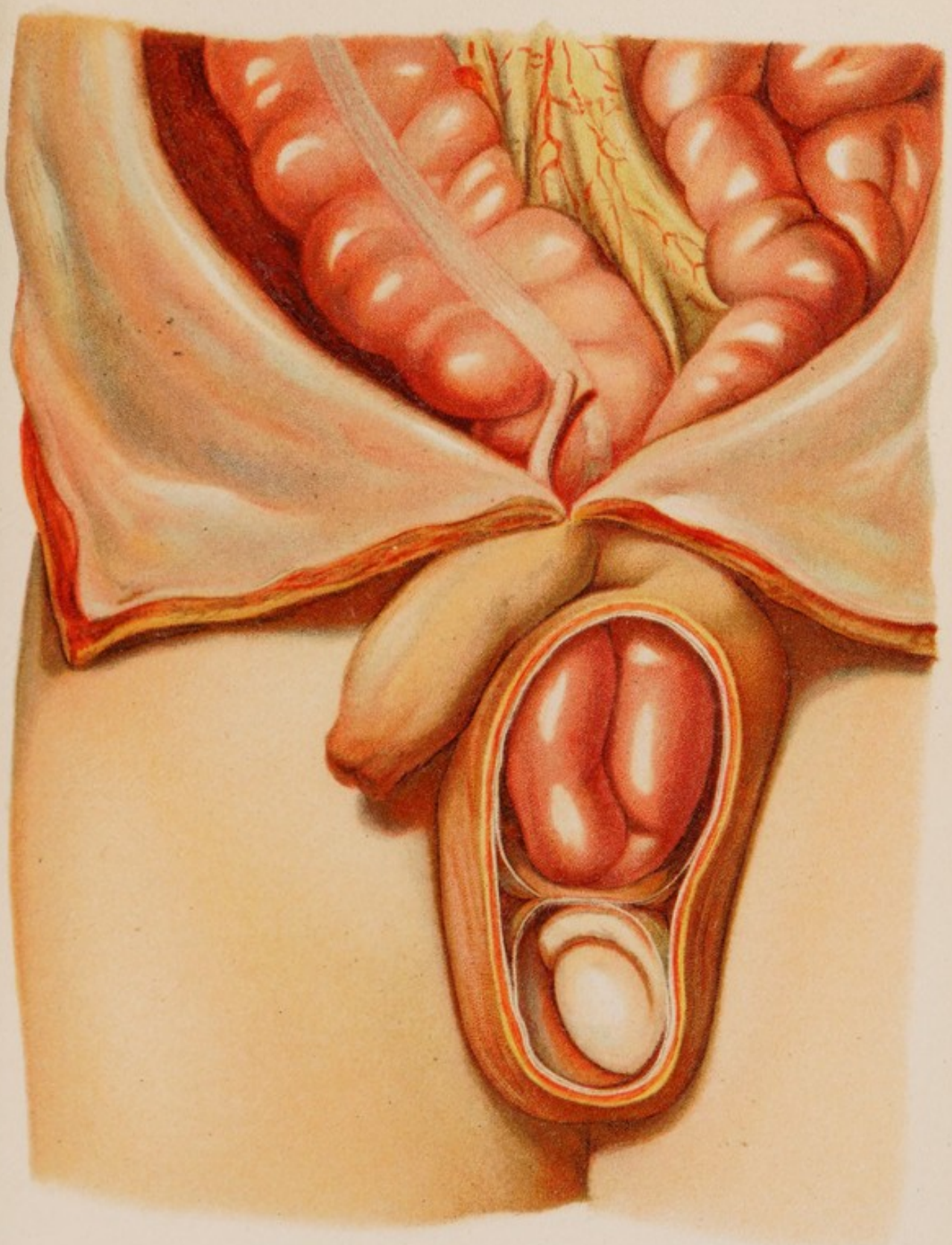
readily be understood why this location should be a seat of predilection in advancing years when the abdominal walls become relaxed and when a chronic bronchitis or some similar cause may frequently augment the intra-abdominal pressure. It is by no means uncommon for these hernias (direct) to be bilateral. Since the internal (direct) inguinal hernia holds no relation to the spermatic cord, it does not follow the course of the latter, and consequently does not descend into the scrotum (Fig. 48). [The shape of the direct inguinal hernia is nearly always globular, and this is quite characteristic of this variety.—Ed.] In very rare cases where the internal (direct) inguinal hernia is particularly large, a scrotal form is sometimes observed, but these cases are marked exceptions.

THE DIAGNOSIS OF INGUINAL HERNIA.

From the points which have been emphasized in the first portion of this work it should be determined whether the tumor in question is a hernia, and then to answer the following questions:

Why is the hernia under discussion an inguinal hernia?

Is it an external or an internal inguinal hernia?



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With what other affections could the condition be confounded?

The first question is easily answered if the hernia follows

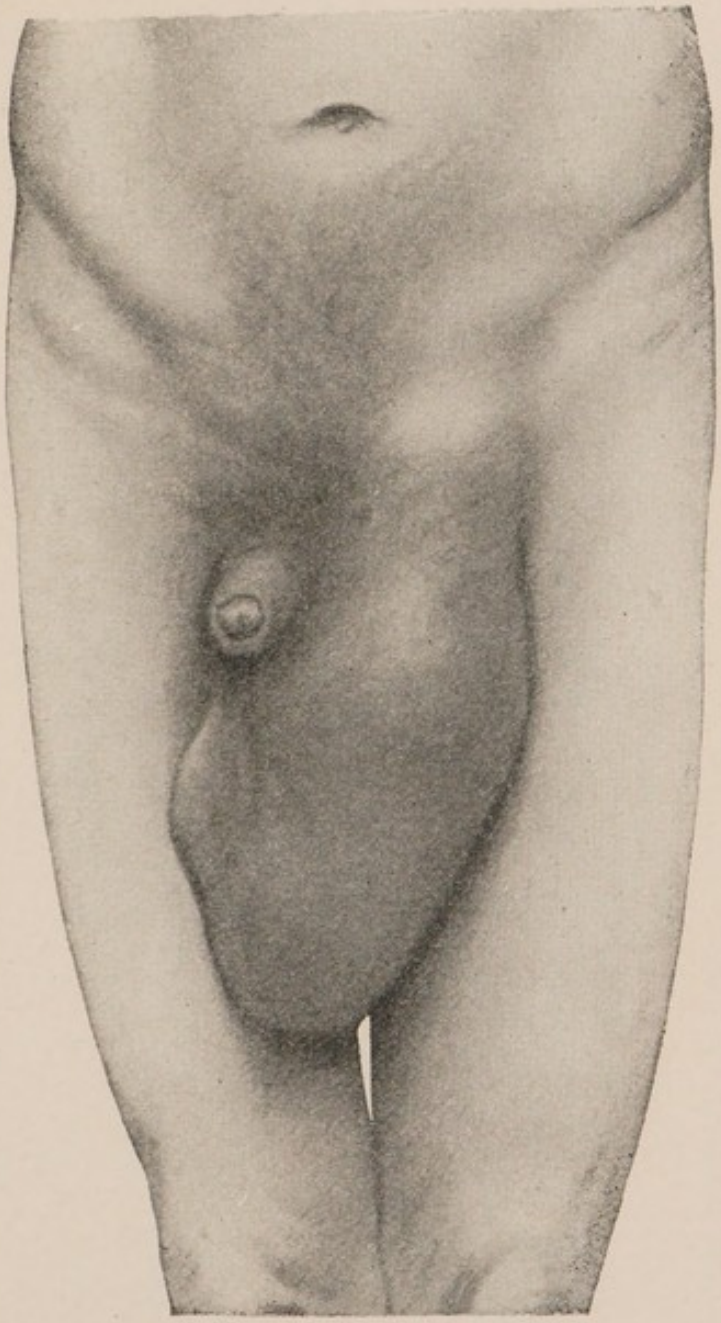

Fig. 43.—Large left-sided scrotal hernia. The hernial tumor is not sharply circumscribed, but seems to gradually merge into the surrounding tissues. The skin of the penis has not yet been utilized to cover the hernia. The testicle of the right or healthy side can be distinctly recognized at the root of the scrotum.

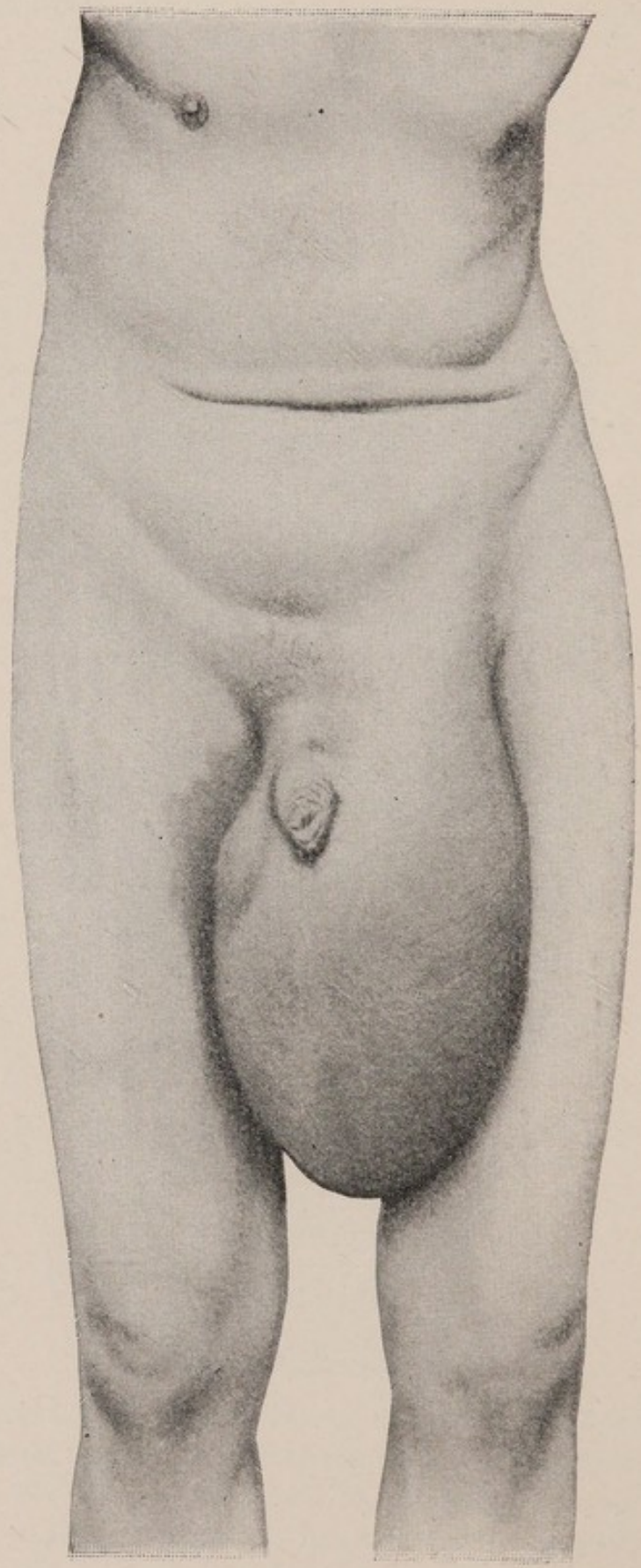

Fig. 44.—Large left-sided scrotal hernia with distention of the skin of the scrotum and of the penis so that the latter organ appears markedly diminished in size. In this case also the location of the right testicle at the root of the scrotum can be easily discerned.

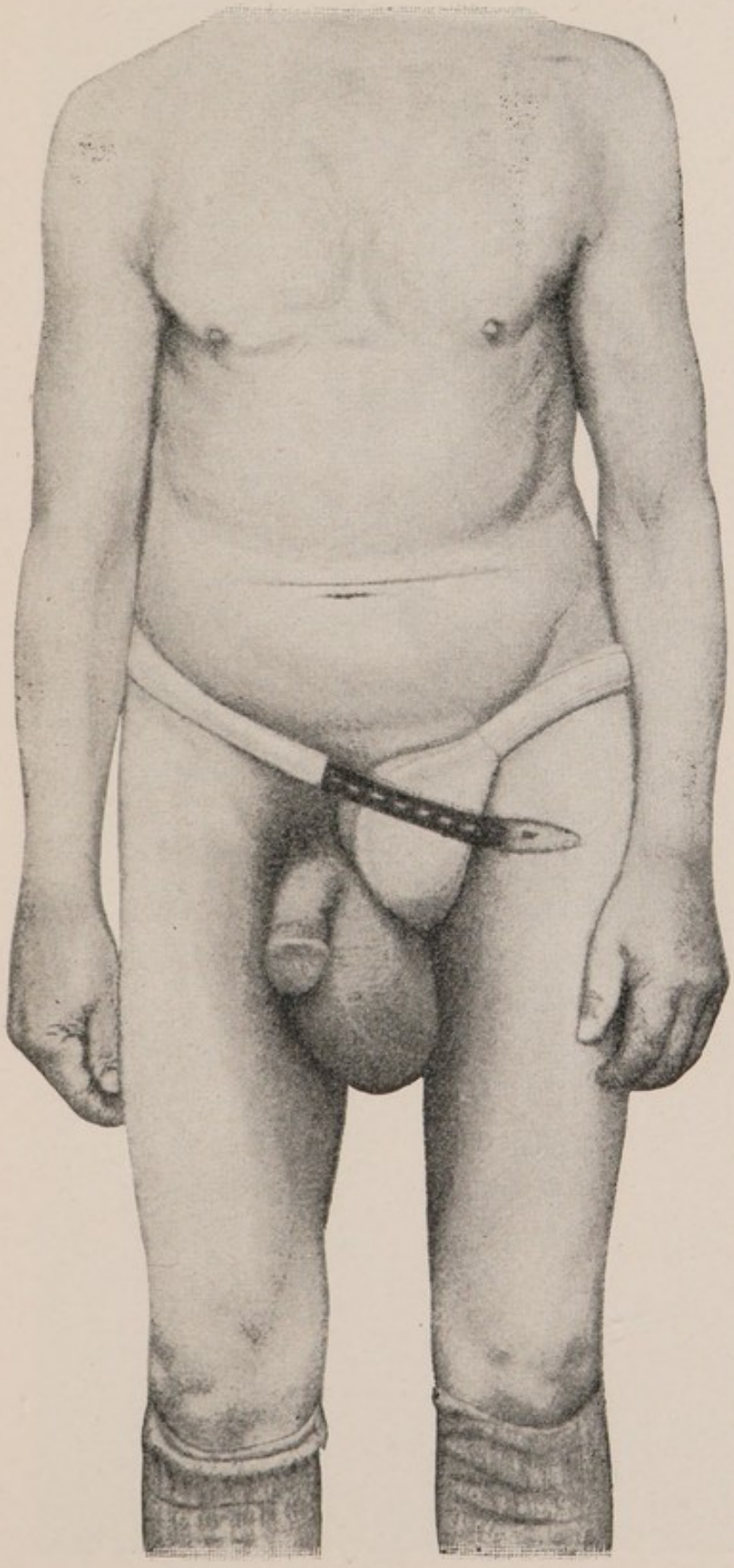

Fig. 45.—Shows the same patient as does Fig. 44. In this case the radical operation was contraindicated by the advanced age of the patient and by a chronic bronchitis. The hernia was reduced and a truss applied. The penis has now assumed its normal size. This picture is a proof that even large hernias, if reducible, can be very well retained by means of an appropriate truss.

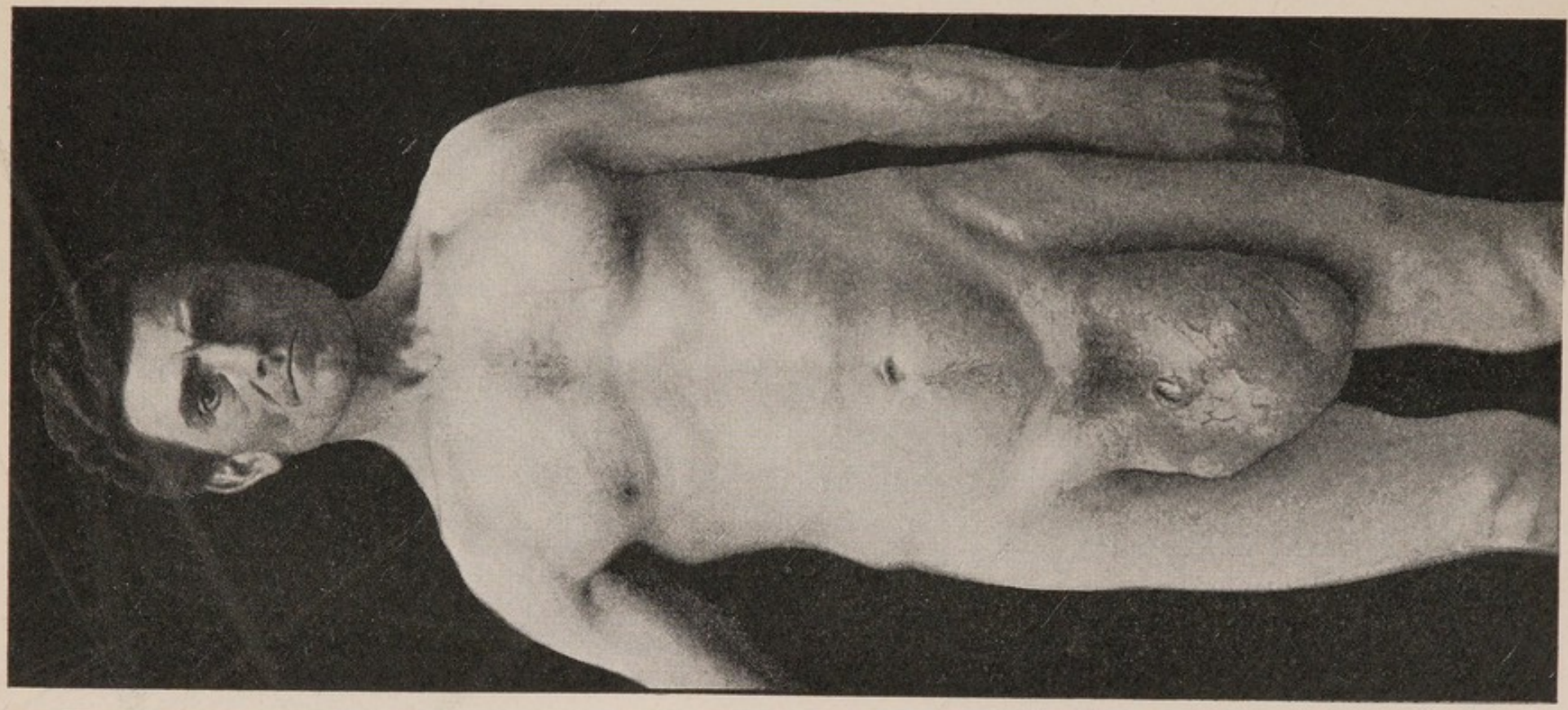

Fig. 46.—Large left-sided scrotal hernia in which the skin of the scrotum and of the penis is so markedly distended that the latter organ is indicated only by a dimple. The left testicle is distinctly outlined from the hernial tumor at the bottom of the scrotum ; the right testicle is recognized in its normal position.

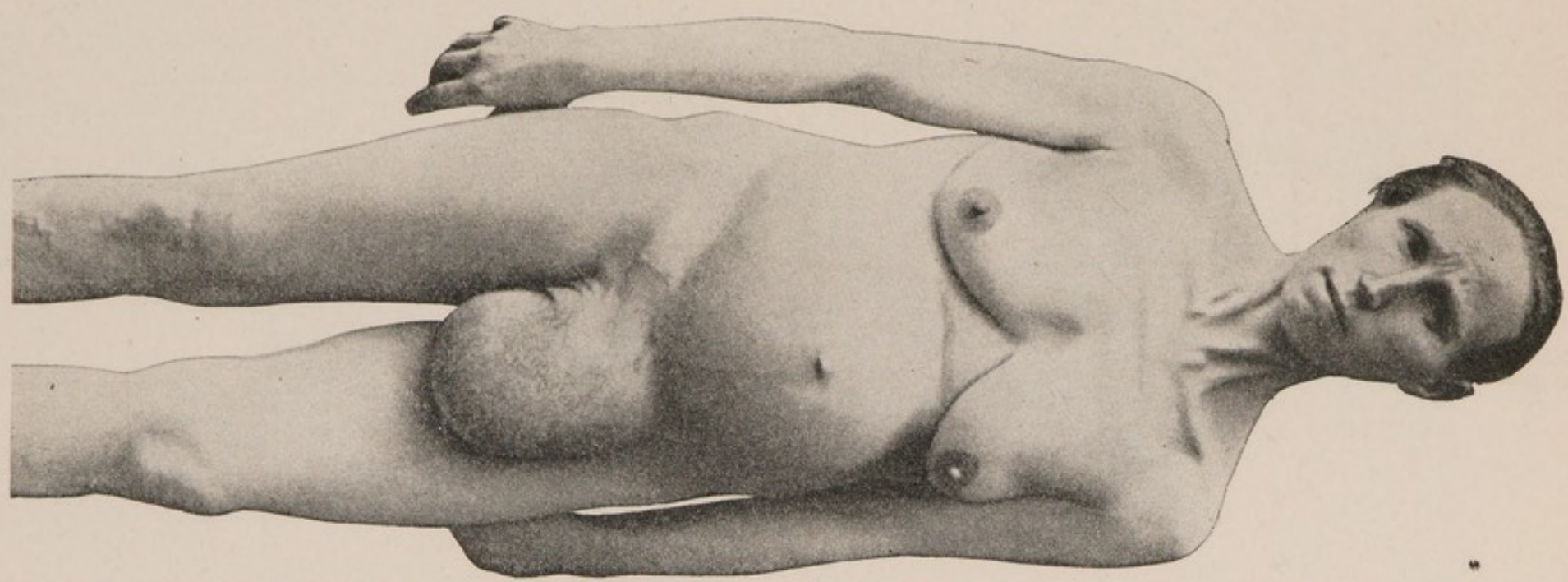

Fig. 47.—Labial hernia : An inguinal hernia, the size of a child's head, distending the left labium majus of a woman in the seventh month of pregnancy. (The influence of pregnancy upon the origin and enlargement of hernias has been considered on page 55.)

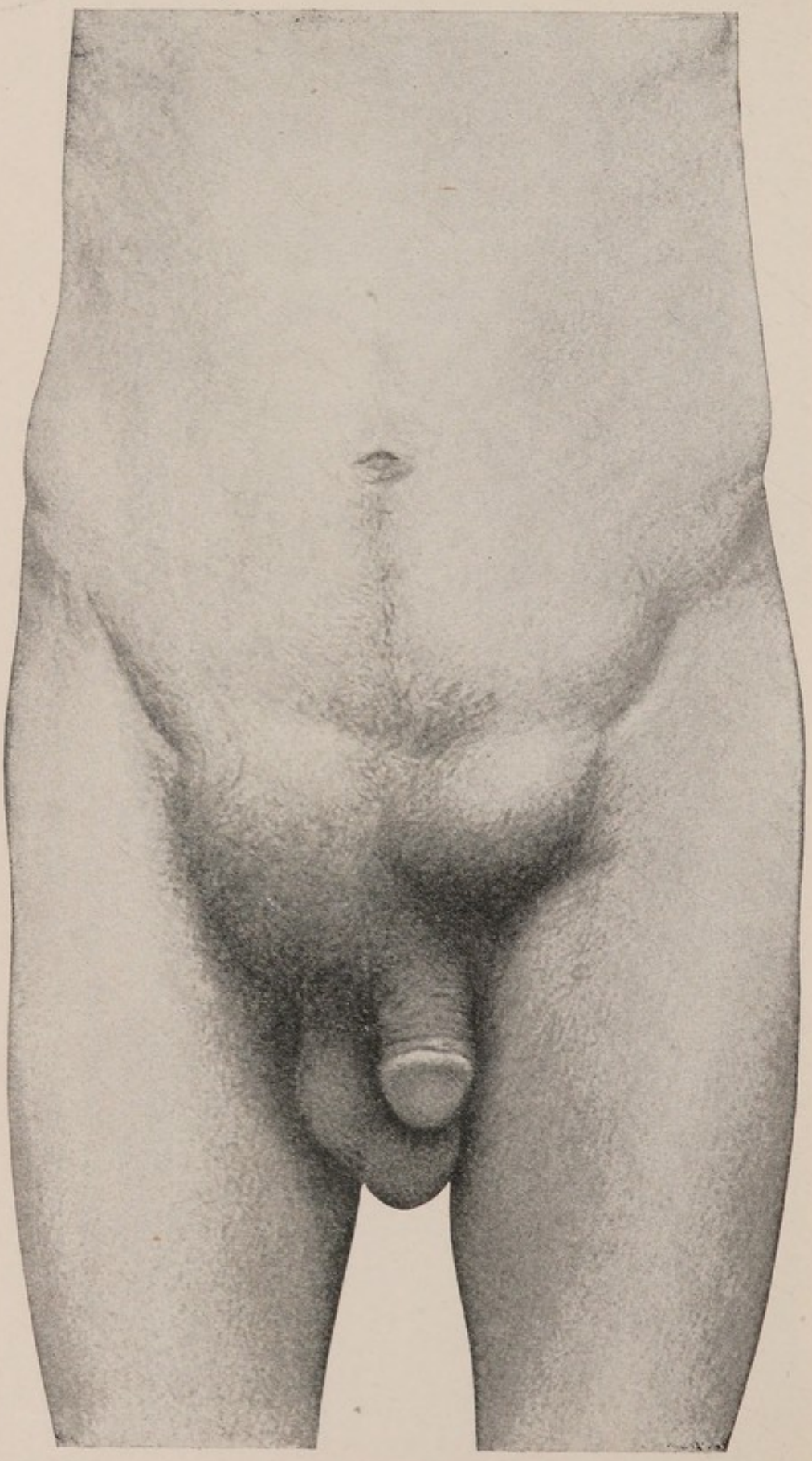

Fig. 48.

Fig. 48.—Bilateral direct or internal hernia: The enlargement upon the right side is as large as a man's fist, while that upon the left has attained the size of a goose-egg. In spite of the considerable size of the right-sided hernia it has not descended into the scrotum, and this is characteristic of the direct as compared with the oblique variety of inguinal hernia. The small and non-distended scrotum is seen below the hernial swelling.

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the spermatic cord or is found in the scrotum, since nothing but an inguinal hernia can take this path. If the hernia is of moderate size and situated in the groin, the answer is more difficult. It must be borne in mind that the hernias of youth, particularly in the male, are almost without exception inguinal hernias, and that in adult life femoral hernia is much more common in women than in men. [In 9600 cases of hernia in children under fourteen observed in the Hospital for Ruptured and Crippled, 60 were femoral.—Ed.] If the hernia is reducible, there is but little difficulty, since the position of the hernial orifice can easily be determined. If the hernial orifice is above Poupart's ligament, the hernia is inguinal; if it is below, the hernia is femoral. If the hernia is irreducible, the decision as to its variety may be most difficult, and there are, indeed, cases in which it cannot be determined with certainty whether the hernia is inguinal or femoral until the hernial orifice has been exposed at operation (see Femoral Hernia).

In very large scrotal hernias it is not always easy to determine to which side the hernia belongs. In figure 46 the scrotum has become so much distended that this question can only be decided after careful examination. There are two points which serve as guides: first, the side upon

which the hernia passes into the abdominal cavity; and, second, the location of the testicles. The testicle of the healthy side remains in its original position, as shown in figures 43 and 44, while upon the side of the hernia the testicle is usually pushed down to the deepest and most posterior part of the scrotum (Fig. 46).

If the hernia is not too large, the course of the hernial canal will indicate whether the hernia is external or internal. If the hernia is external, the canal passes upward and outward; while if it is internal, the canal passes directly backward through the anterior abdominal wall. We have already learned that in small children the inguinal canal passes directly through the abdominal wall, but this is offset by the fact that the internal (direct) inguinal hernia is an affection of advanced life, and is but rarely encountered in children. In adults the increasing size of the hernia gradually dilates the inguinal canal, and finally causes it to lose its oblique direction. In these cases, however, we are aided by another characteristic to which attention has previously been called: while the increasing size of the external oblique inguinal hernia causes it to descend into the scrotum, the internal direct inguinal hernia usually stops at the root of the scrotum. The external inguinal hernia, moreover, is to the outer side of the deep epigastric artery, while the internal inguinal hernia is to its inner side, and it is consequently to be assumed that by the introduction of the finger into the hernial canal, the relation of the deep epigastric artery to the hernial orifice could be determined. As a matter of fact, a distinct pulsation of this artery is so rarely obtained that this method of differentiation is often of no value.

An inguinal hernia could be mistaken for a dislocated testicle, for swollen lymphatic glands, for a psoas abscess, for a tumor of the testicle, for a subperitoneal lipoma, and particularly for a hydrocele. In making a diagnosis all

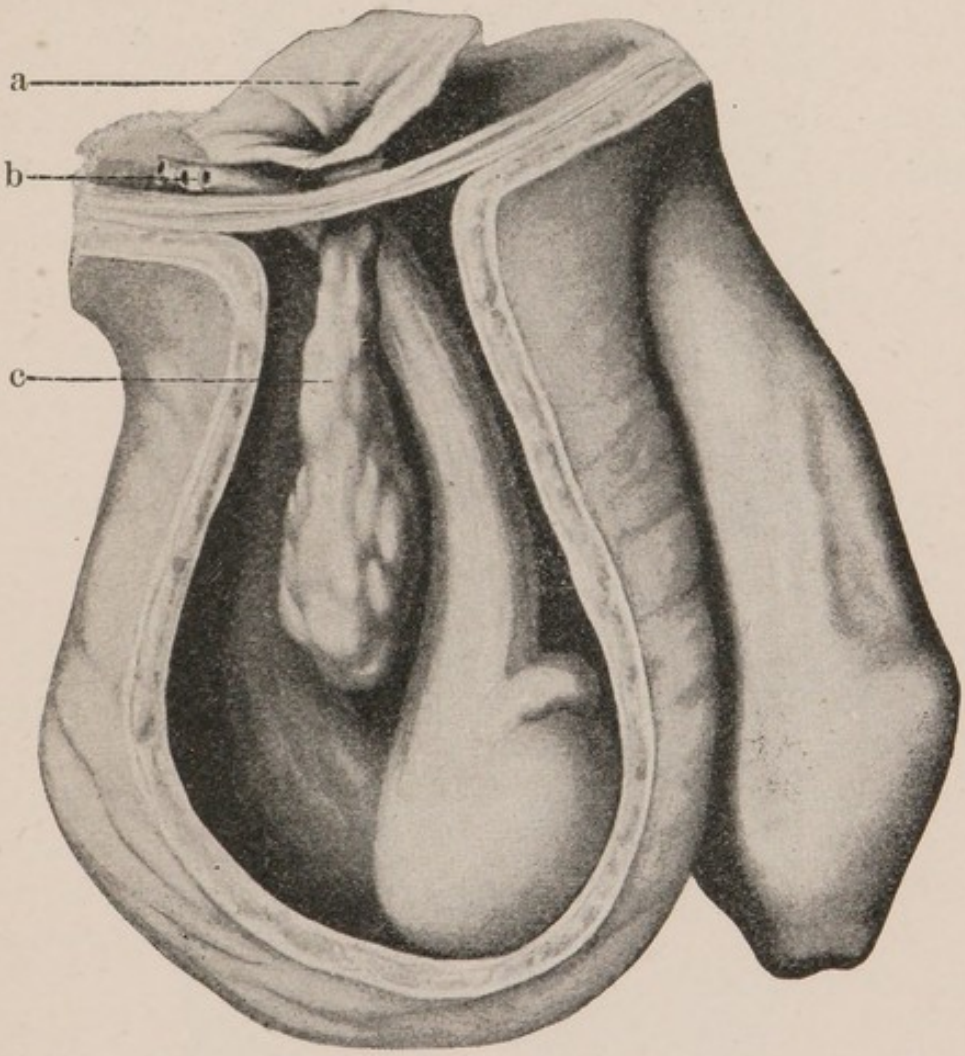

Fig. 49.—A subperitoneal lipoma of the inguinal region. The traction of the lipoma upon the parietal peritoneum has produced a funnel-shaped hernial sac. a, Hernial sac; b, spermatic cord; c, subperitoneal lipoma.

of these conditions must be borne in mind or mistakes of a most disagreeable character may result. The patient will be anything but grateful to the surgeon who mistakes a testicle which has descended only as far as the groin for a

hernia, and who forcibly attempts to replace it within the abdomen, when a glance at the empty scrotum upon the affected side and palpation would at once reveal the

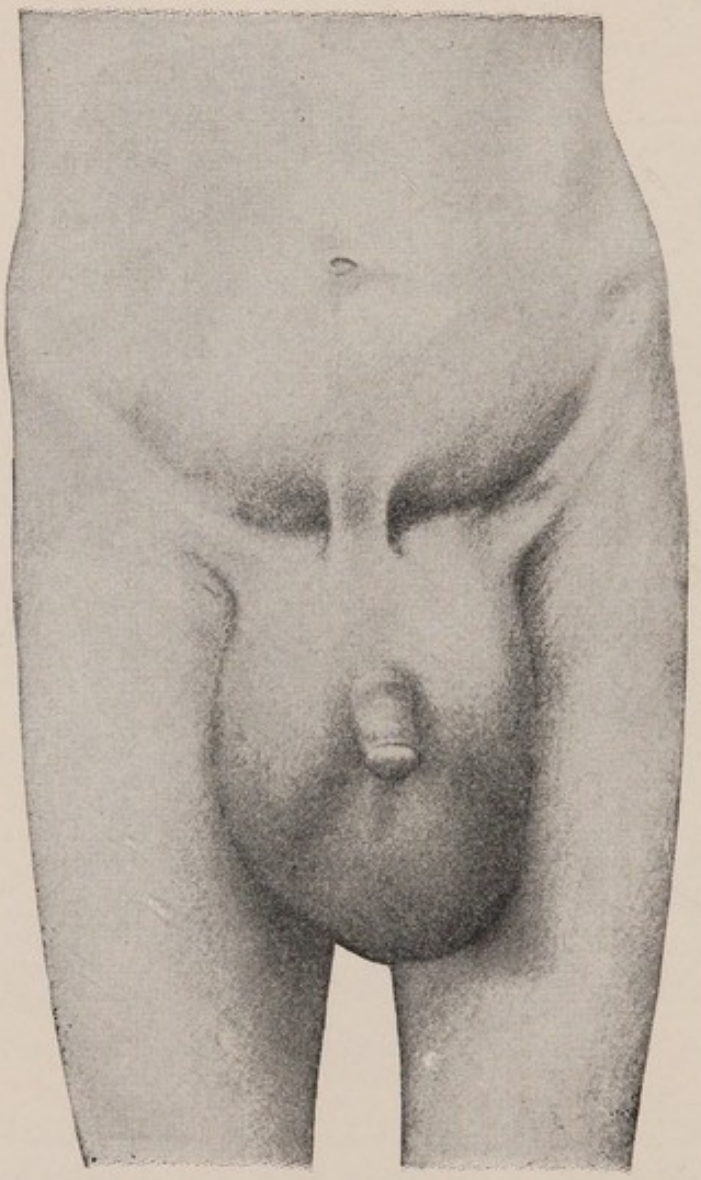

Fig. 50.—Bilateral hydrocele of the testicle. The sharp definition of the scrotal swelling from the abdominal wall should be noted as compared with Figs. 42–46.

absence of the testicle. [In most cases of partially descended testis there is also a hernia above the testis.—Ed.] Subperitoneal lipomas occur much more rarely in the inguinal

than in the femoral region, but they are occasionally observed (Fig. 49), and may give rise to errors in diagnosis.

It must be remembered that hydroceles are not so very rare in the female, and it may be said that the differential diagnosis which must be most frequently made is that between this condition and an inguinal hernia. Some of the points of difference have already been given under the general diagnosis of hernia (page 58), and at this place it will be sufficient to tabulate side by side the main features of the two conditions.

Inguinal Hernia.	Hydrocele Testis.
Anamnesis.	
The tumor appears suddenly during an augmentation of the intra-abdominal pressure; or gradually, in which case the swelling is first noticed in the abdominal wall and the enlargement is toward the testicle.	The swelling develops more slowly, not rarely after a contusion of the scrotum or inflammatory changes in the epididymis. The swelling commences in the bottom of the scrotum and gradually spreads toward the abdomen. With a single exception—hydrocele communicans—they do not suddenly change in size.
Inspection.	
The swelling seems to be directly continuous with the tissues of the abdomen (Fig. 43).	The swelling is usually sharply circumscribed from the abdomen (Fig. 50).
The swelling is not translucent; in rare cases in very young children it may be translucent.	The swelling is translucent; if the walls are very thick, or if spermatic fluid or blood is present, it may not be translucent.

Fig. 51.—a, An ordinary hydrocele testis. The tunica vaginalis propria is distended by a collection of fluid ; the parietal peritoneum passes smoothly over the internal abdominal ring.

b, In spite of the constriction of the vaginal process and the formation of the tunica vaginalis propria, the parietal peritoneum has not retracted into the peritoneal cavity, but remains adherent to the outer surface of the tunica as a congenital hernial sac—one of the rarer forms of the congenital inguinal hernia.

c, The walls of the vaginal process have become adherent in several situations, and this has resulted in the formation of a number of sacs. At the bottom of the scrotum is a hydrocele of the testicle, above this are two hydroceles of the spermatic cord, and still further upward the herniel sac is encountered.

d, The bottom of the scrotum is filled by a hydrocele of the testicle. The hernial sac has descended into the scrotum until it lies in close contact with the sac of the hydrocele.

e, In this case a hydrocele of the testicle has formed, and the subsequently descending hernial sac could only partly displace the posterior portion of the sac of the hydrocele, probably because the hydrocele was adherent to the anterior wall of the scrotum. It will be seen that an incision made anteriorly would first expose the hydrocele and then the hernia.

PALPATION.

If an attempt is made to draw the tumor away from the abdominal wall between the thumb and index-finger, a portion of the tumor is felt passing into the abdominal cavity.	If the same attempt is made, nothing is felt between the tumor and the abdominal wall but the constituents of the spermatic cord.
The tumor may be replaced.	The volume of the tumor remains unchanged upon pressure (with the exception of a hydrocele communicans).

PERCUSSION.

Under certain circumstances a tympanitic note is obtained.	Always dull upon percussion.

A hydrocele of the spermatic cord may also be mis-

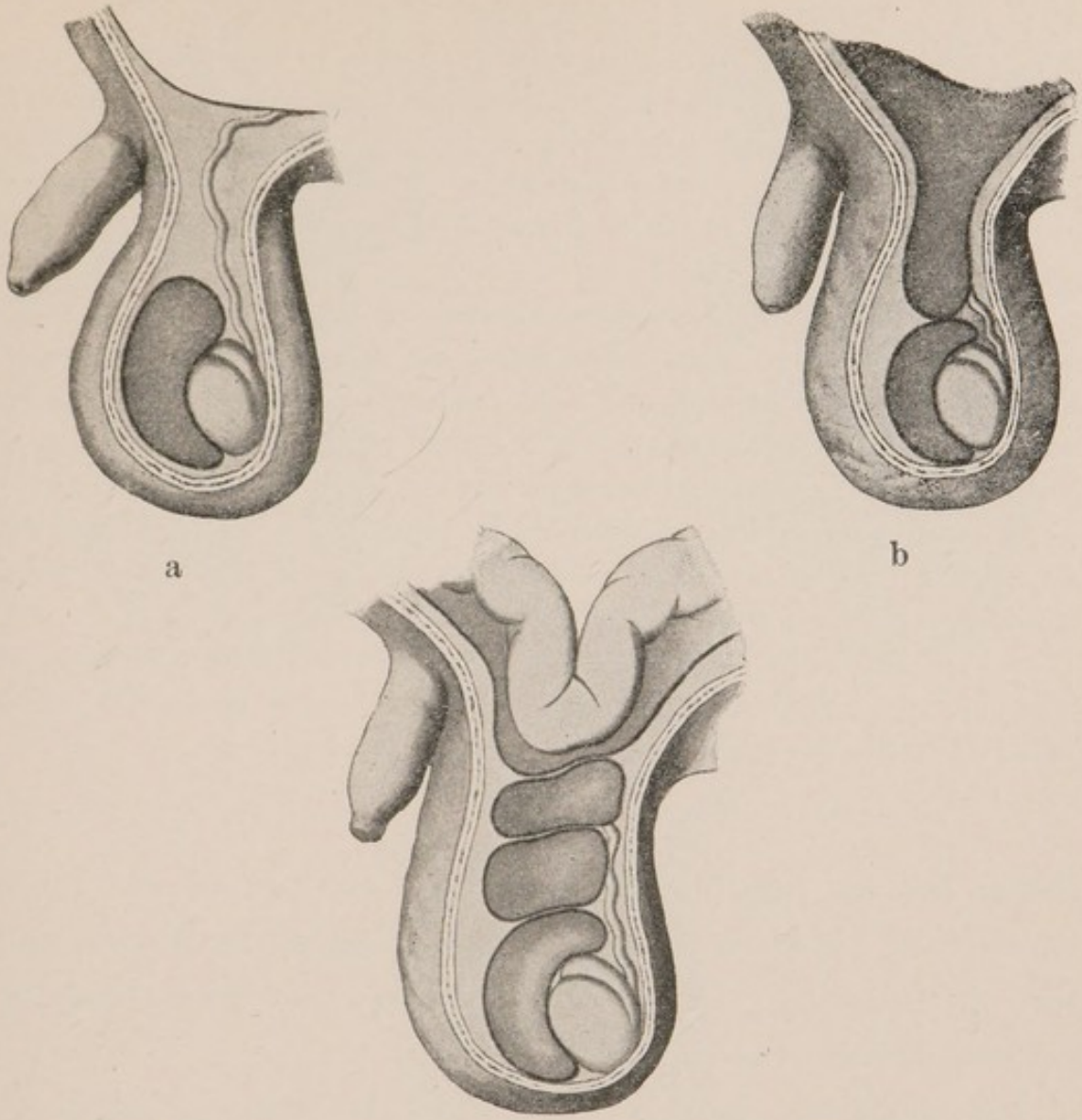

Fig. 51.

Fig. 52.—f, The hernial sac in its descent has invaginated the sac of a previously formed hydrocele, so that the lower portion of the hernia is surrounded by the hydrocele. This form is known as an encysted hernia, and occurs in a similar manner in connection with the hydrocele of the cord.

g, As a result of an incomplete descent of the testicle the obliteration of the vaginal process has failed to take place. A hydrocele communicans has formed, and this has been secondarily converted into a hernial sac by the descent of a coil of intestine. This condition is sometimes known as hydrocele hernialis.

h, This figure is the counterpart to figure 51, e. In this case the scrotal hernia existed first, so that the hernial sac is situated in front of the subsequently formed hydrocele.

i and k represent other combinations of hernia with hydrocele of the cord. In i the hernia has stopped just above the hydrocele, while in k the hernia has passed down in front of the hydrocele.

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taken for an inguinal hernia. On account of the loose connection between the sac of this form of hydrocele and the surrounding tissues, the swelling can sometimes be pushed up into the inguinal canal.

The diagnosis may be quite difficult even during operation, on account of the simultaneous occurrence of hydrocele and hernia. Such combinations of the most varied character have been observed, and they are partly due to anomalies in the closure of the vaginal process of the peritoneum. It may happen, for example, that the tunica vaginalis propria is formed in the normal manner, but that the parietal peritoneum, instead of retracting as usual within the abdominal cavity, has remained adherent at the point of constriction (Fig. 51, b). In such a case an anatomic condition would exist which we have learned to regard as typical of acquired inguinal hernia, and yet the sac would be congenital. The walls of the vaginal pro-

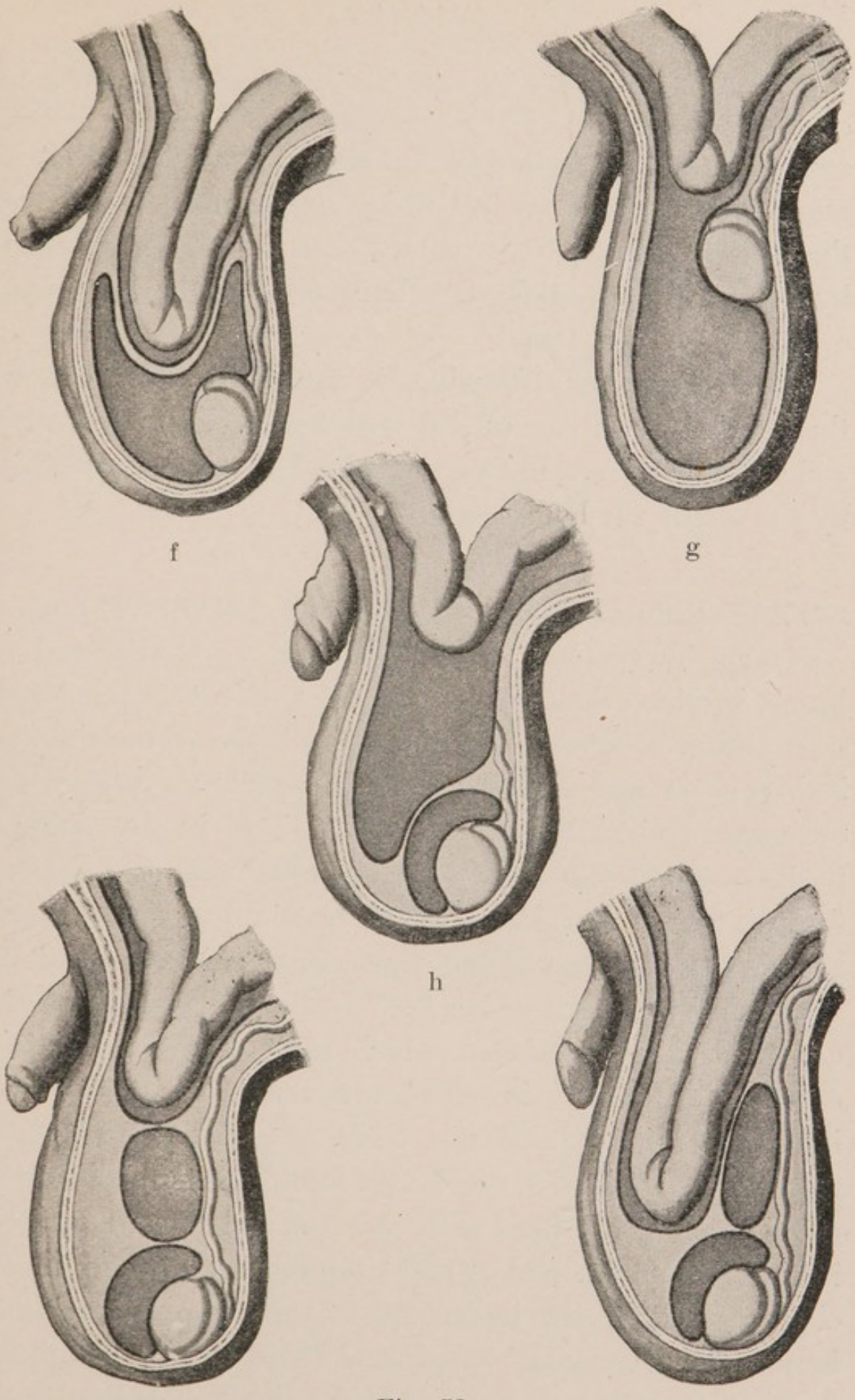

Fig. 52.

Fig. 53.—A sketch of a bilocular inguino-properitoneal hernia.

cess may become adherent in several places, so that a number of sacs are formed which are situated one above the other. Figure 51, c, shows such a case in which a hydrocele of the testicle, two hydroceles of the cord, and a hernial sac were found.

The diagrammatic drawings in figures 51 and 52 show the manifold relations of different hydroceles to a hernia, which may be above, in front of, behind, or even surrounded by the sac of the hydrocele.

INTERPARIETAL INGUINAL HERNIA (INTERSTITIAL).

By an interparietal inguinal hernia we understand a hernia in which that portion situated within the abdominal wall pushes in between the individual layers of the abdominal parietes and enlarges in this direction. While the ordinary inguinal hernia, even when large in size, simply pushes aside the layers of the abdominal wall as it passes through them, the interparietal hernia insinuates itself between two layers of the abdominal parietes. And if strangulation supervenes in such a case, the same anatomic conditions are reproduced which exist after a reduction *en masse* (Fig. 32). In addition to the publication of two interesting cases from the clinic at Kiel, Göbell has recently collected the previously known facts in reference to this remarkable form of hernia and aided considerably in the clear understanding and simplification of the nomenclature. Either the incomplete or the complete inguinal hernia may develop an interparietal diverticulum. All these forms of interparietal hernia may be either monolocular or

Fig 53.

bilocular; *i. e.*, the entire sac may be situated between the layers of the abdominal wall, or a diverticulum may extend in this direction while the remaining portion of the hernia follows the spermatic cord or the round ligament and descends into the scrotum or the labium majus as the case may be. Interparietal hernia, like the inguinal variety, is more common upon the right than upon the left side.

Three different forms of interparietal hernia are to be differentiated: (1) Properitoneal inguinal hernia (Krönlein); (2) interstitial inguinal hernia (Goyrand); (3) superficial inguinal hernia (Boyer, Küster).

1. The **properitoneal inguinal hernia** (*hernia inguinalis properitonealis*, or *hernia inguino-properitonealis*) insinuates itself between the peritoneum and the transversalis fascia. There are two subvarieties of this form described —the iliac, in which the protrusion occurs toward the iliac region, and the antevesical, in which it is in front of the bladder. According to Göbell, 69 positive instances of this variety of hernia have been observed up to the present time; 67 were in men, 2 in women. Only 7 were reducible, the remainder were strangulated, and the great majority were bilocular.

2. In the **interstitial inguinal hernia** (*hernia inguinalis interstitialis*) the hernial sac may be: (1) Between the transversalis fascia and the transversalis muscle; (2) between the fibers of the internal oblique muscle; (3) between the internal and external oblique muscles; (4) between the external oblique muscle and the transversalis fascia, the internal oblique and transversalis muscles having been pushed aside.

The interstitial inguinal hernia is by far the most fre-

PLATE 5.

A Right-sided Strangulated Bilocular Iliac Properitoneal Inguinal Hernia.—From an anatomic specimen from the body of a female fifty-nine years of age (Prof. Nauwerck, Chemnitz): a, Afferent intestine; b, efferent intestine; c, ligamentum teres uteri; d, parietal peritoneum; e, seat of constriction; f, properitoneal inguinal hernia; g, the smaller peripheral portion of the hernial sac; h, Poupart's ligament; i, femoral artery; k, femoral vein.

The smaller external portion (about $\frac{1}{5}$) of the bilocular hernial sac is situated immediately above Poupart's ligament; the larger portion (about $\frac{4}{5}$) has lifted up the parietal peritoneum from the transversalis fascia in the region of the inguinal canal, as shown by the displaced ligamentum teres, and is located between the parietal peritoneum and the transversalis fascia. The hernial sac has been partially cut open, exposing the dark red strangulated intestinal coil. Above the seat of constriction are seen the distended afferent and the collapsed efferent intestine.

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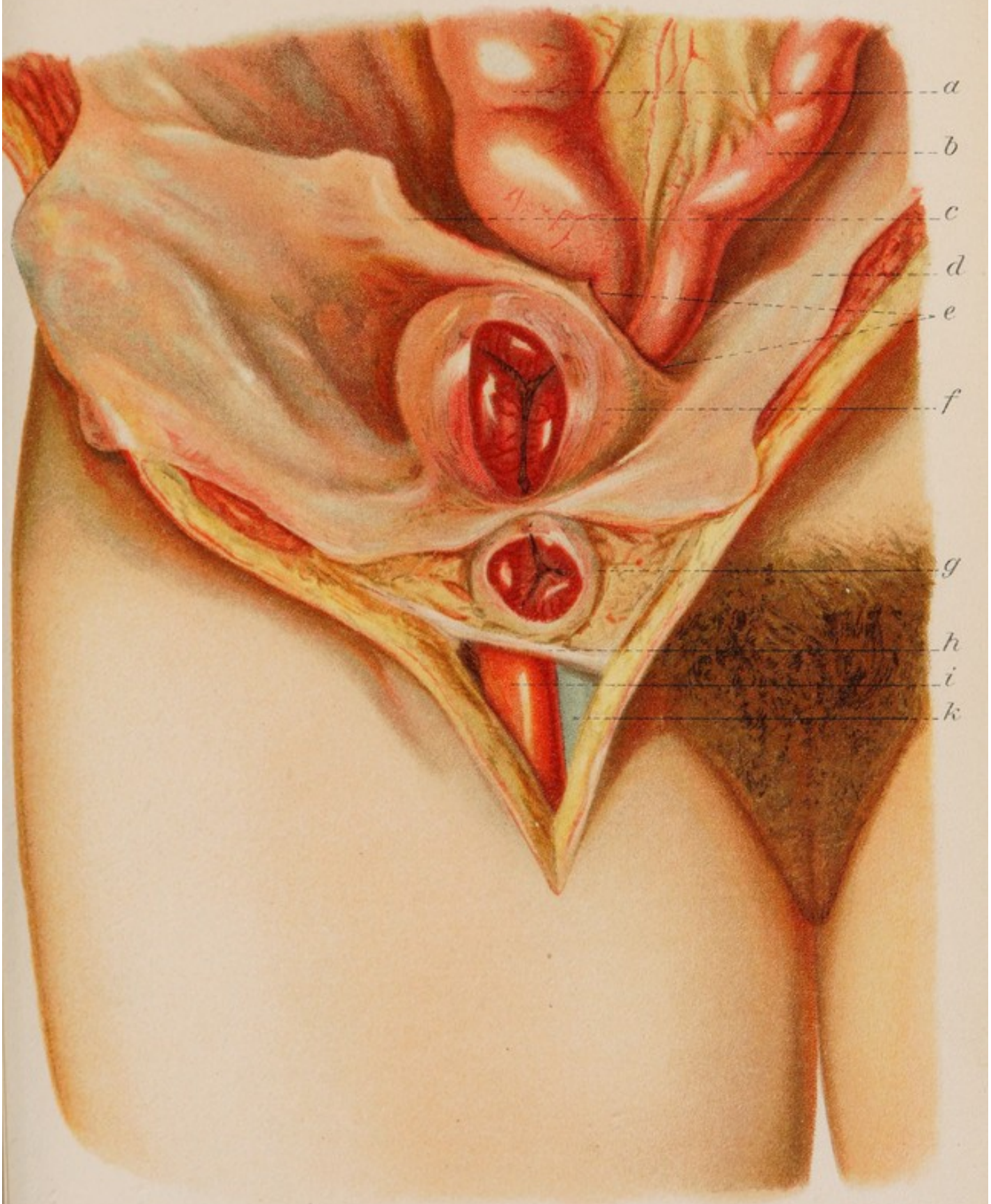
quent variety of the interparietal inguinal hernias. According to Göbell, 199 cases have been described up to the present time; 162 were in men, 37 in women.

3. The **superficial inguinal hernia** (*hernia inguinalis superficialis*) is situated between the aponeurosis of the external oblique muscle and the skin. All the cases which have been carefully examined were found to be congenital hernias with malpositions of the testicle, and Küster previously stated that this combination is characteristic of this variety of interparietal hernia. There are only 14 cases of this form on record at the present time, and the reason why the number is so small is probably because this variety has not impressed itself upon many as a distinct and peculiar form of hernia. [I have just operated upon a typical example of this variety of hernia. The patient, a boy aged ten years, had a double inguinal hernia, both sides being the same form.—Ed.]



Lith. Anst. F. Reichhold, München.

In the monolocular form of the properitoneal and interstitial inguinal hernia the diagnosis is made by the presence of a swelling in the inguinal region which extends laterally beyond the location of the inguinal canal, and which presents the general symptoms of a hernia. The free external abdominal ring can be palpated, and yet the swelling becomes more marked when the patient strains or coughs. After reduction the internal abdominal ring also may usually be palpated. In the bilocular form the hernial tumor has an hour-glass shape, the constricted portion being situated at the external abdominal ring. After the reduction of the hernial contents situated external to the external abdominal ring, the same condition is present as exists in the monolocular form. The superficial variety behaves somewhat differently. In contrast to what has been said of the other forms, they fill up only when the external abdominal ring is open and remain empty when this ring is closed by the finger.

Almost all of these diagnostic points refer to reducible interparietal hernias; if the hernia is irreducible or strangulated, the diagnosis becomes much more difficult and frequently impossible until the time of operation. These hernias are to be treated upon the same principles as those which apply in the ordinary forms of inguinal hernia.

TREATMENT OF INGUINAL HERNIA.

The Treatment by Means of a Truss.—The indications for the treatment by means of a truss and the methods of its manufacture and application have been already given in the section upon hernia in general (page 64). At this place it will consequently be sufficient to point out the spe-

cial requirements of a truss for an inguinal hernia. In spite of the innumerable highly praised jointed, adjustable, and spring pads, the simple pad, covered as previously described and firmly connected with the spring of the truss, continues to be the best of all varieties. The size and form of the pad as well as the strength and direction of the force exerted by the spring, however, must be adapted to the individual case. It is of particular importance that the pad should not only close the external abdominal ring, but that it should also exert pressure upon the entire inguinal canal as far up as the internal abdominal ring. This end may be best attained in the majority of cases, according to Graser, by a wedge-shaped pad, the lateral thick portion being placed over the internal abdominal ring and the inner and thinner portion over the inguinal canal.

In small hernias and those which are moderate in size, a perineal strap is unnecessary if the pad and spring are correctly adjusted, as has previously been described (Fig. 54, a and b). In large scrotal hernias, in which the pad should close the canal as in all other varieties, compression upon the hernial region is best attained by extending the pad downward and adding a perineal strap (Fig. 54, c). Care must be taken, however, that this extension does not press against the pubic bone, since this would prevent the pad from pressing upon the inguinal canal.

In ordering a truss from an instrument-maker the following facts must be stated, although it should be particularly emphasized that in the great majority of cases the presence of a thoroughly competent individual is essential to adapt the truss to the patient. Many a truss which has originally been regarded as useless may be easily adjusted

by a slight bending or twisting of the spring. The necessary facts for the maker of the truss are:

1. Age, sex, and occupation of the patient.

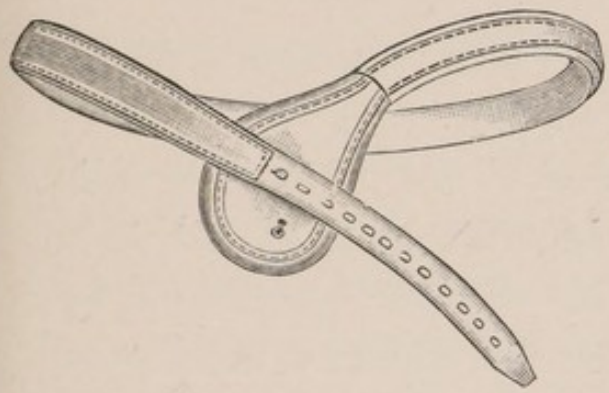


Fig. 54, a.—Single inguinal truss without a perineal strap.

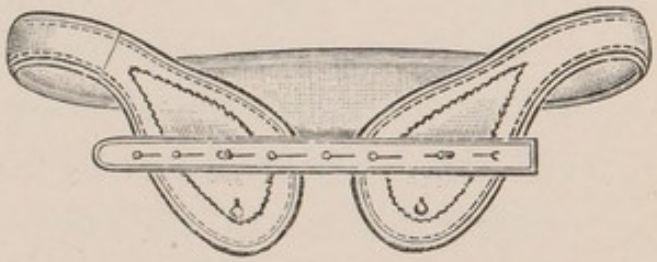


Fig. 54, b.—Double inguinal truss without a perineal strap.

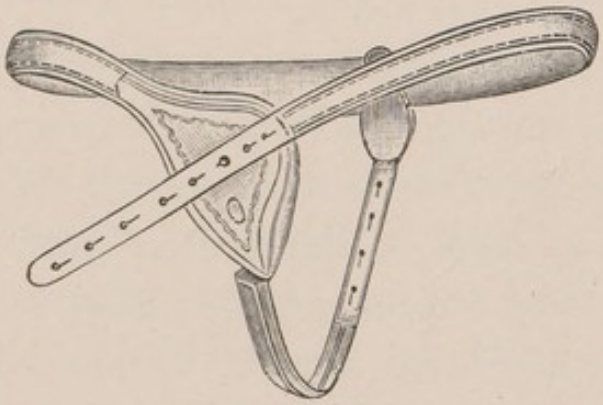


Fig. 54, c.—Truss for a scrotal hernia, with a padded extension at the inner and lower portion of the pad and with a perineal strap.

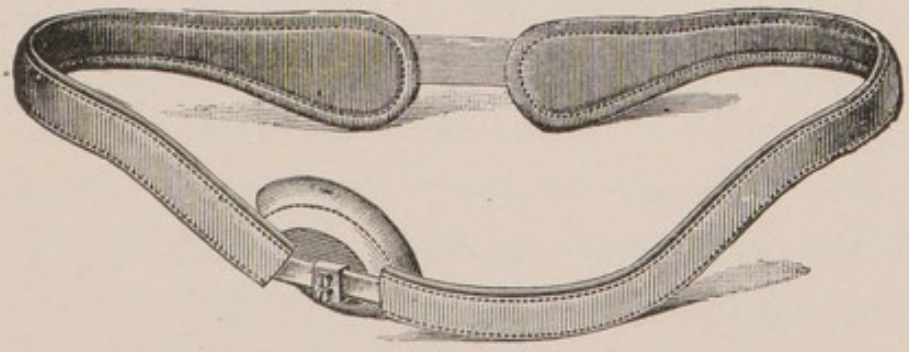


Fig. 54, d.—The Pomeroy truss.

2. Is the inguinal hernia internal or external? Direct or oblique? Right-sided, left-sided, or bilateral?

3. How many fingers may be comfortably introduced into the hernial orifice?

4. How far has the hernia descended? Into the scrotum or labium majus?

5. Is the pressure necessary to retain the hernia during coughing strong, moderate, or slight?

6. What is the circumference of the pelvis at a point midway between the anterior superior spine of the ilium and the great trochanter? This distance is measured by placing the end of the tape over the center of the hernial orifice and carrying the tape about the body midway between the anterior superior spine and the great trochanter back to the starting-point.

The Radical Operation for Inguinal Hernias.—Although a great many different methods of performing the radical operation have been suggested, the number which is actually employed at the present day is very small. In fact, only two or three methods need be considered if we disregard the large number of operative procedures which are merely more or less justifiable modifications. As it is not our purpose to enumerate and carefully study all the methods recommended, we will limit ourselves to the consideration of those of Bassini and Kocher, since they have stood the test of experience and are the operations most generally adopted. Macewen's operation, although less frequently employed, will also be described, since it depends upon a different principle.

Whether silk, catgut, kangaroo-tendon, silkworm-gut, or silver wire is chosen as the suture material in the different operations depends largely upon the habit of the individual operator; and as the material selected has no

great determining influence upon the result obtained, general rules upon this subject cannot be formulated. [I believe that the choice of suture material is a matter of great importance. It has been fully demonstrated that in a certain proportion of cases non-absorbable sutures buried in the hernial canal cause sinuses to develop at long intervals after operation. These sinuses are slow in healing, and the prolonged suppuration so weakens the canal that a recurrence takes place. A large series of such cases has been observed at the Hospital for Ruptured and Crippled, and reported by Dr. Bull and myself. Better results have been obtained by chromicized tendon or catgut, and I believe that non-absorbable sutures should be discarded in all operations for the radical cure of hernia. —Ed.]

Bassini's Operation.—Bassini aims, by his operation, to completely close the hernial canal within the abdominal wall,—*i. e.*, the inguinal canal,—and to form a new canal for the cord which shall correspond as much as possible to physiologic conditions. His radical operation is composed of three steps:

First step: The pillars of the external abdominal ring and the aponeurosis of the external oblique muscles are exposed by an oblique incision corresponding to the course of the spermatic cord. The aponeurosis of the external oblique muscle is now incised up to a point above the location of the internal abdominal ring, separated from the underlying tissues, and the two flaps turned back to either side. The hernial sac is now separated from the spermatic cord by blunt dissection and completely isolated from the surrounding tissues, particularly in the vicinity

Fig. 55.—First step of Bassini's operation: The cutaneous incision and the division of the aponeurosis of the external oblique muscle over the entire inguinal canal have already been made and the two aponeurotic flaps reflected to either side. The hernial sac has been extirpated, nothing but its stump being visible in the outer angle of the wound. The spermatic cord is elevated upon a blunt hook. The outer flap of the aponeurosis of the external oblique muscle is directly continuous with Poupart's ligament, which is recognized by its yellowish, glistening, and tendinous appearance. Beneath the inner aponeurotic flap is seen the conjoined tendon of the internal oblique and transversalis muscles. The external border of the rectus muscle is situated to the inner side of the inner angle of the wound, and is not visible in the illustration. The sutures which are to obliterate the inguinal canal have been introduced but not tied.

Fig. 56.—Second step of Bassini's operation: The spermatic cord and the retracted aponeurotic flaps are in the same position as shown in the preceding figure. The entire inner edge of the muscular mass has been firmly united to Poupart's ligament, only the lowest suture still remaining untied. In this manner the posterior wall of the new inguinal canal is formed.

Fig. 57.—Third step of Bassini's operation: The posterior wall of the new inguinal canal is now completely closed. The spermatic cord lies in its new position. The anterior wall of the new inguinal canal is formed by the reunited aponeurosis of the external oblique muscle. One suture still remains untied.

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of the neck of the sac, so that every trace of a funnel-like diverticulum disappears. After the hernial contents have been reduced, the sac is opened at some distance from the neck, any adhesions between the sac and contents separated, the protruding portions of omentum ligated *en masse* and extirpated, and the hernial sac ligated as high up as possible—preferably by the method of double ligation described upon page 72. [If the omentum is easily reducible and not adherent, we believe it should seldom be

Fig. 55.

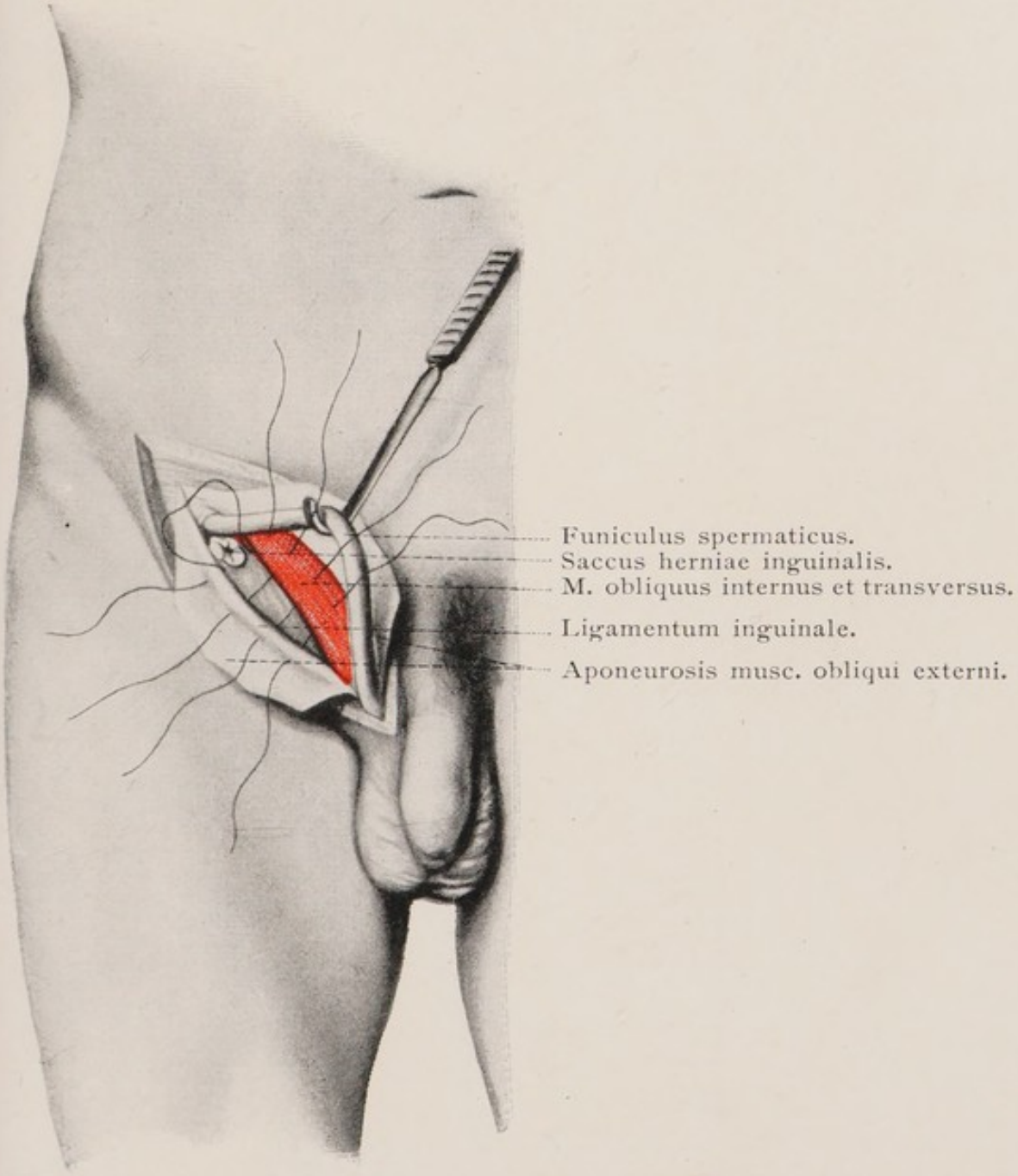
Funiculus spermaticus.
Saccus herniae inguinalis.
M. obliquus internus et transversus.
Ligamentum inguinale.
Aponeurosis musc. obliqui externi.

Fig. 56.

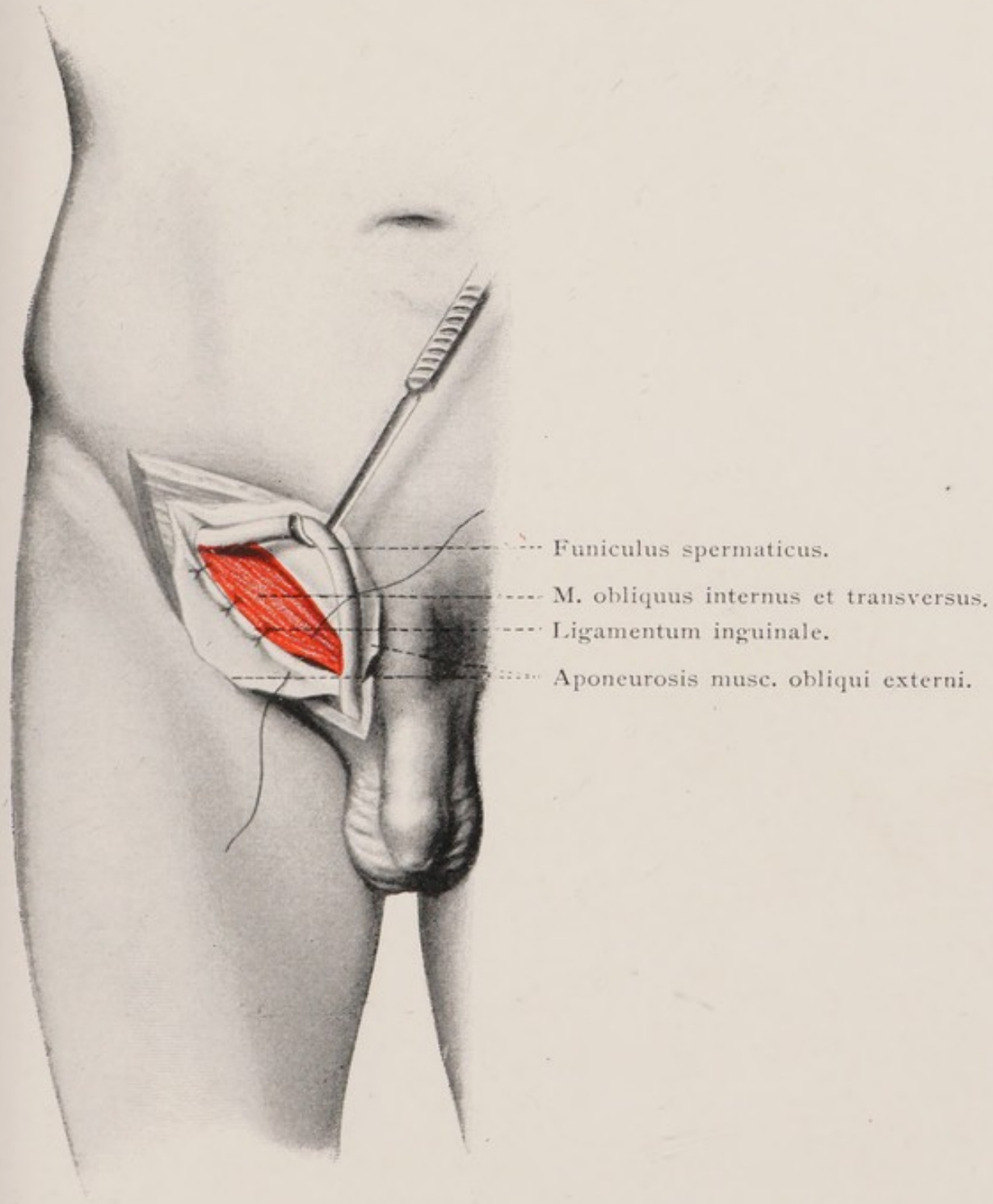
Funiculus spermaticus.
M. obliquus internus et transversus.
Ligamentum inguinale.
Aponeurosis musc. obliqui externi.

Fig. 57.


Aponeurosis musc. obliqui externi.
M. obliquus internus e transversus.
Funiculus spermaticus.

removed. When removed, it should be tied off in small portions and never ligatured "en masse," a procedure which has caused death in a number of instances.—Ed.] The sac is then cut off one centimeter below the ligature and the stump is buried in the abdominal cavity.

Second step: The isolated spermatic cord is lifted up and held to one side. The two flaps of the aponeurosis of the external oblique muscle are held back by retractors, and the whole mass of muscle situated internally—the larger upper portion, composed of the internal oblique and transversalis muscles, the smaller lower portion, composed of the rectus muscle—is united throughout its entire extent with Poupart's ligament by four or five interrupted sutures, so that only a sufficient opening for the spermatic cord is left in the upper and outer angle of the wound (Figs. 55 and 56).

Third step: The spermatic cord is laid upon the newly formed posterior wall of the inguinal canal, and the two flaps of the aponeurosis of the external oblique muscle are sutured over it, thus forming the anterior wall of the new inguinal canal.

The operation is concluded by the suture of the cutaneous wound.

Kocher's Operation.—Kocher wishes to avoid the splitting up of the inguinal canal which must be made in Bassini's operation and performs an operation which he designates as the lateral displacement method, and which may be divided into four steps.

First step (Fig. 58): The skin is incised in the direction of the inguinal canal, the length of the incision being somewhat greater than that of the canal. The incision is

not to be carried down any further than is necessary for the isolation of the hernial sac from the spermatic cord and the separation of the sac from the surrounding tissues. An

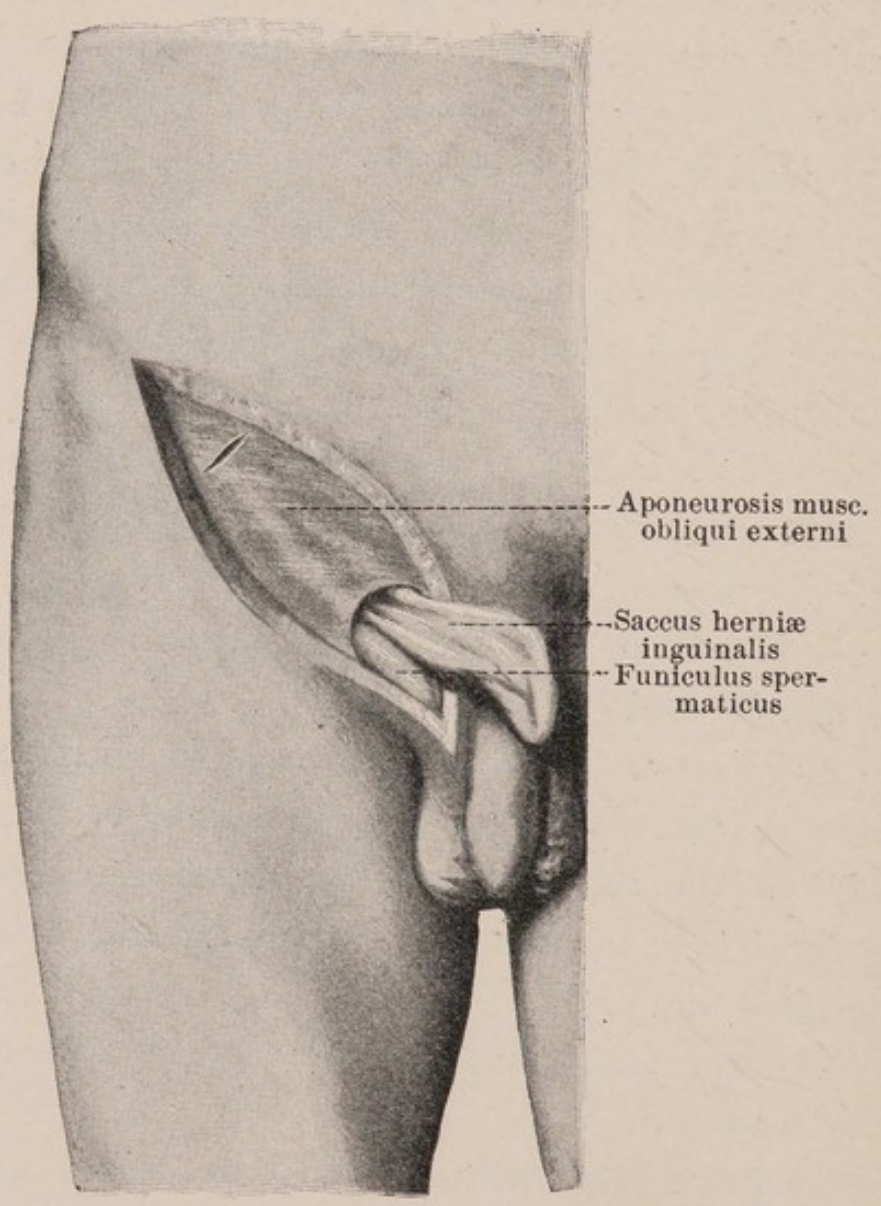

Fig. 58.—First step of Kocher's operation.

incision at right angles to the course of the inguinal canal is now made somewhat to the outer side of the region of the internal abdominal ring. (From an oversight, the lateral situation of this incision in the illustration has not

been made sufficiently distinct.) The hernial sac is isolated and its contents reduced as in the first step of Bassini's operation.

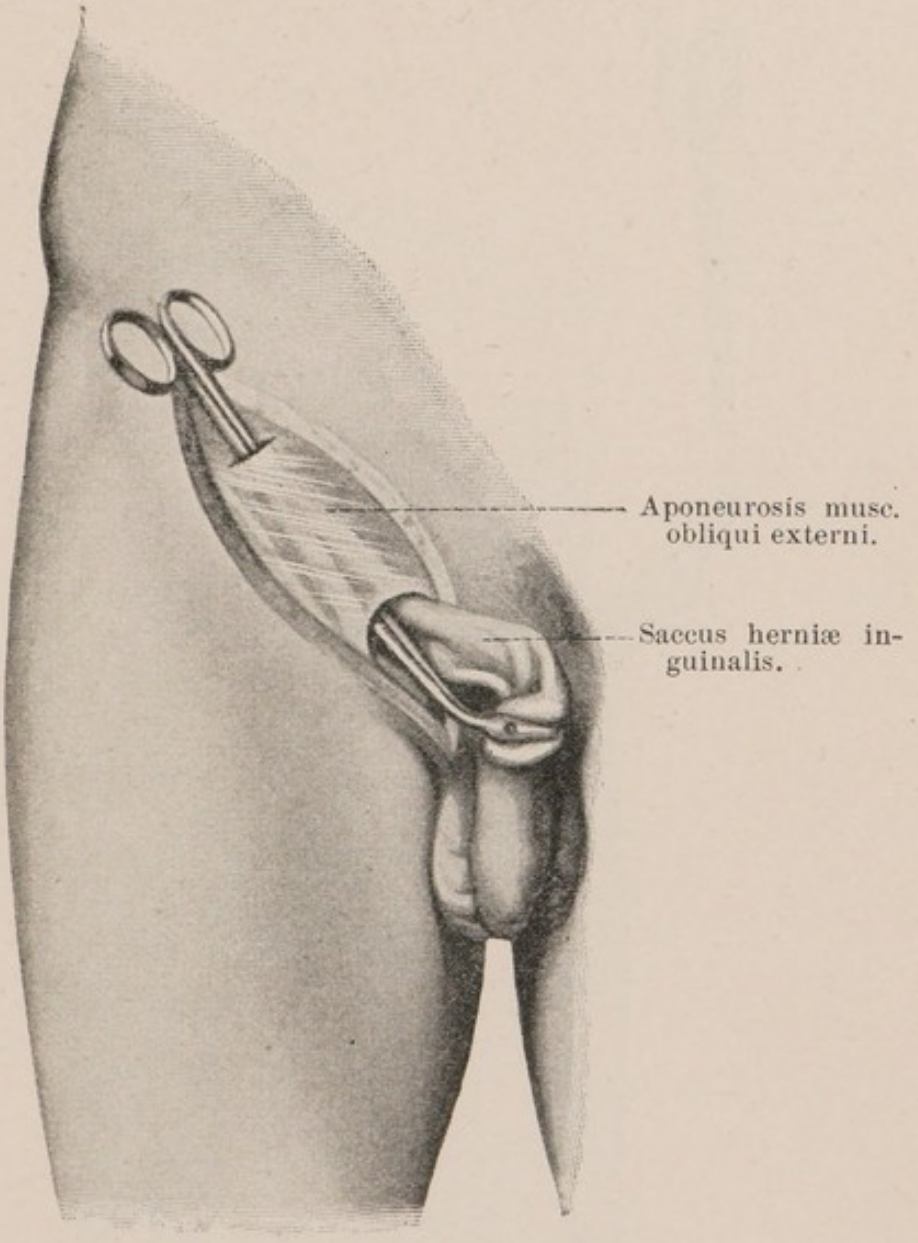

Fig. 59.—Second step of Kocher's operation.

Second step (Fig. 59) : A curved dressing-forceps is now introduced into this lateral opening, carried through the inguinal canal, brought out at the external abdominal ring

in front of the spermatic cord, and made to grasp the tip of the isolated hernial sac.

Third step (Fig. 60): The entire hernial sac is drawn

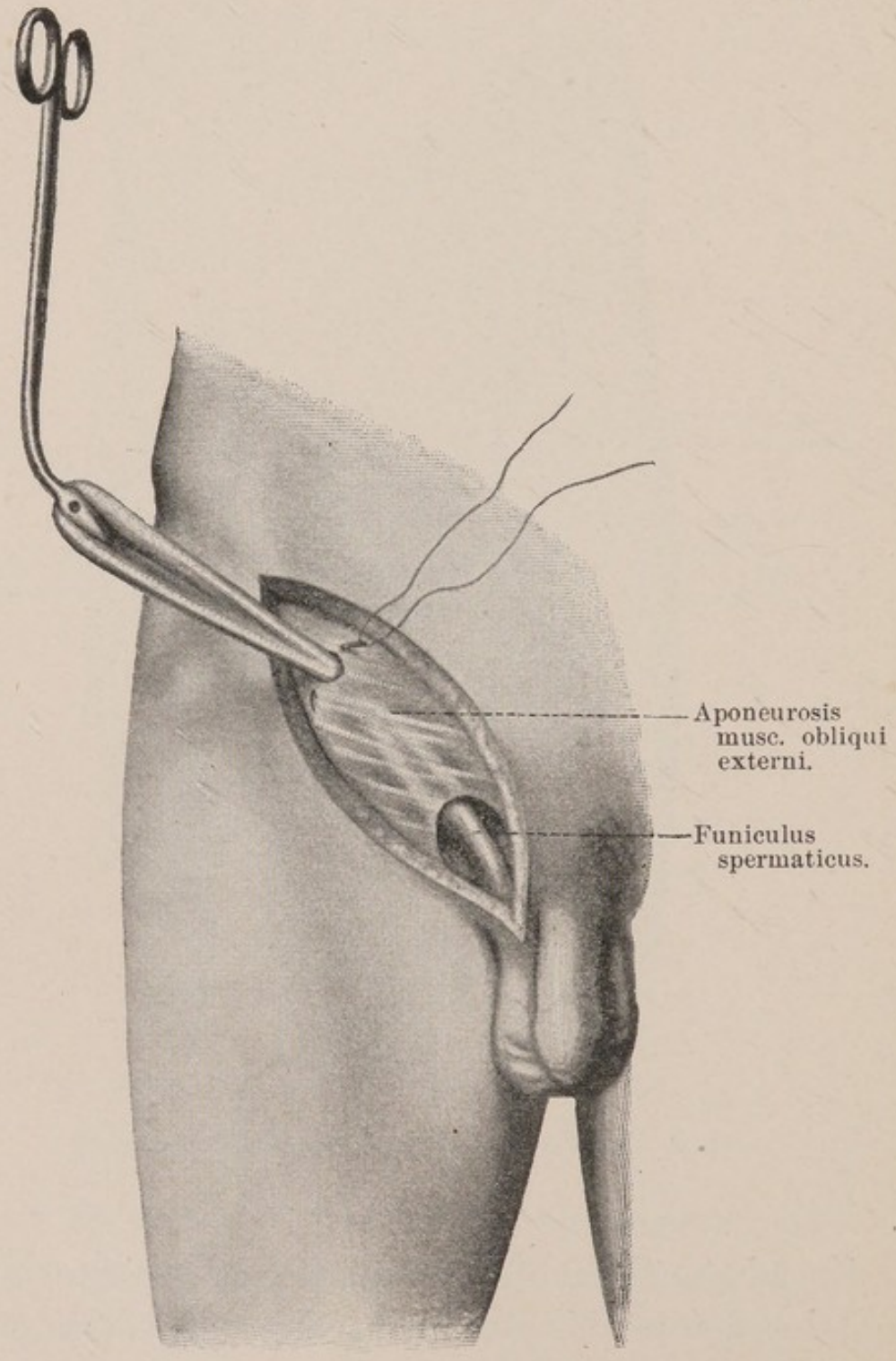

Fig. 60.—Third step of Kocher's operation.

back through the inguinal canal and out through the small lateral opening. The sac, instead of passing inward and downward, now runs in the opposite direction, and the funnel-like neck of the sac is forcibly drawn into the small

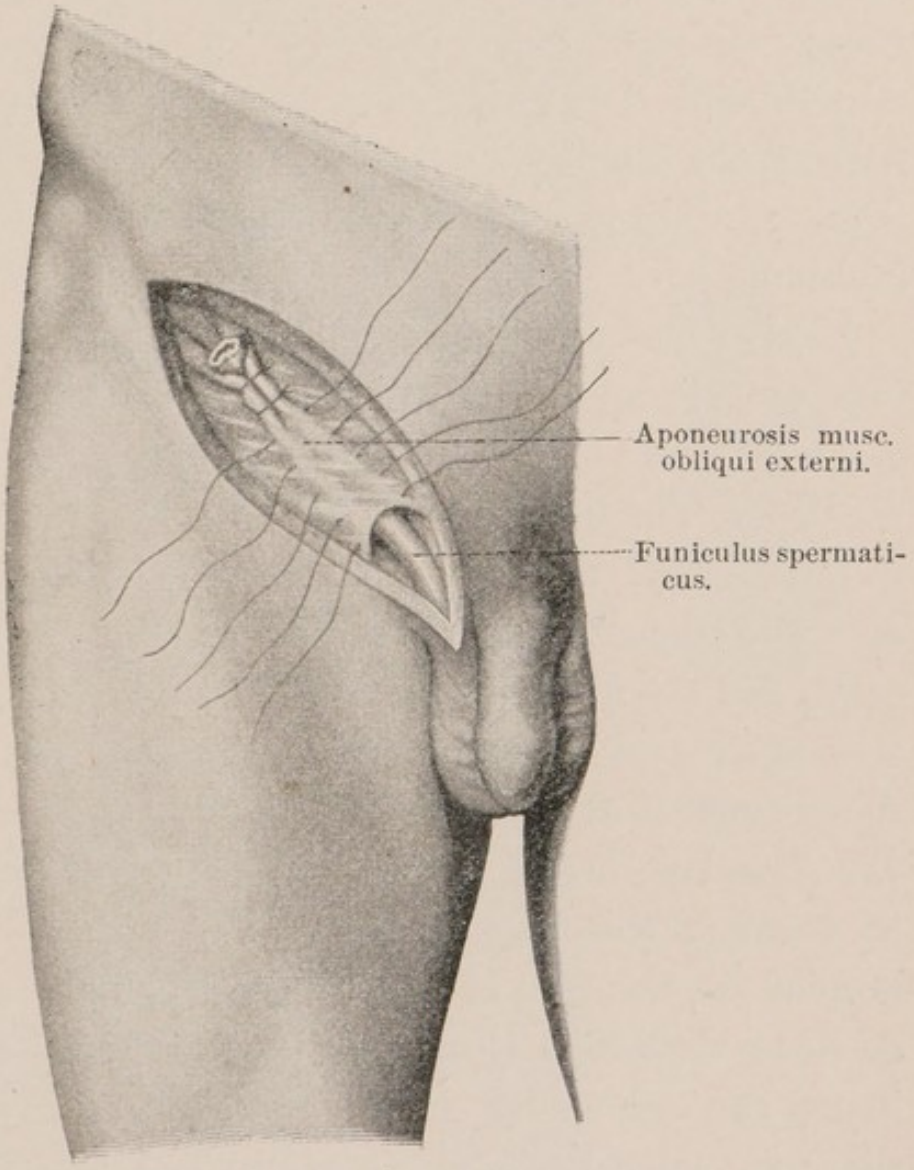

Fig. 61.—Fourth step of Kocher's operation.

opening in the external oblique muscle. A suture is now passed around the portion of the sac situated within the abdominal wall and firmly tied.

Fourth step (Fig. 61): The neck of the sac is still more

securely fixed by a second and sometimes a third suture which passes more superficially through the approximated fibers of the aponeurosis of the external oblique and through a portion of the neck of the sac. The sac is then cut off beyond these sutures and a row of deep sutures is passed through the aponeurosis of the external oblique muscle and the underlying muscular tissue in order to narrow the inguinal canal throughout its entire extent. The operation is completed by the suture of the cutaneous incision.

Kocher has obtained still better results by a modification of this operation which he has recently published, and which he designates as the invagination displacement method. The first step of the operation is carried out as in the original method. In the second step, however, not only the aponeurosis of the external oblique muscle is incised, but the fibers of the internal oblique and transversalis muscle are also divided upon a grooved director and the peritoneal cavity is opened in the depth of the wound. The dressing-forceps is introduced into the peritoneal cavity through this opening, carried into the interior of the hernial sac, the apex of which is seized, and the sac, instead of being drawn back through the inguinal canal, is invaginated throughout its entire length and pulled out through the small lateral wound. The parietal peritoneum is also drawn out of the wound by means of two or four hemostats and the sac is tied off as high up as possible by the method of double ligation previously described. The operation is completed as in the lateral displacement method.

Macewen's Operation.—Macewen attempts to firmly

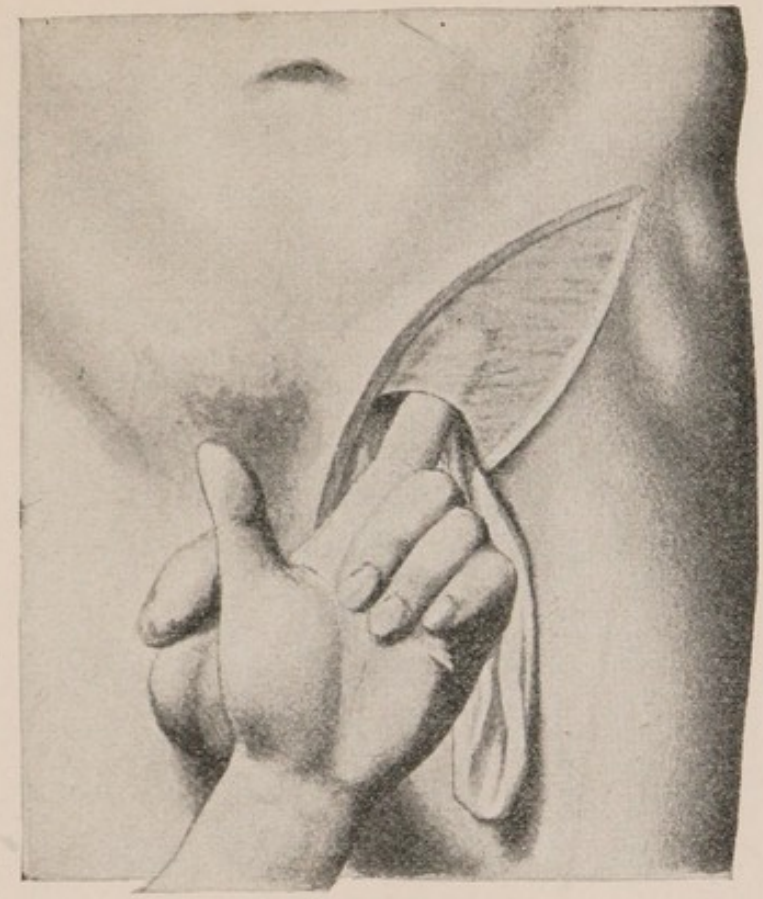

Fig. 62.

Fig. 64.

Fig. 63.

Figs. 62, 63, 64.—Radical operation of Macewen, I.

close the hernial orifice by plugging it with the sac, which he stitches into a pad and places behind the internal abdominal ring.

First step (Fig. 62): Cutaneous incision in the course of the inguinal canal, isolation of the hernial sac, and reduction of its contents as in other operations.

While the empty hernial sac is drawn down, the operator introduces his index-finger in the inguinal canal and separates the neck of the sac from the walls of the canal and from the spermatic cord. The parietal peritoneum is also separated from the abdominal wall, by means of the finger, for a distance of about $1\frac{1}{2}$ cm. from the internal abdominal ring.

Second step (Fig. 63): As shown in figure 64, the sac is stitched into a pad with a long catgut suture which is introduced through the fundus of the sac and then carried through the entire length of the sac up to the external abdominal ring by what might be termed a longitudinal purse-string suture. The free end of this suture is threaded into a needle resembling Deschamps' aneurysm needle, which is then passed through the inguinal canal to the abdominal side of the anterior abdominal wall. The suture is now passed through the abdominal wall from within outward at a point about 3 cm. above the upper margin of the internal abdominal ring. By traction upon the suture and digital pressure from below, the sutured sac which has been converted into a pad is placed behind the internal abdominal ring. The end of the suture is fixed either by passing it repeatedly through the musculature of the abdominal wall, or by tying it to the subsequent cutaneous suture.

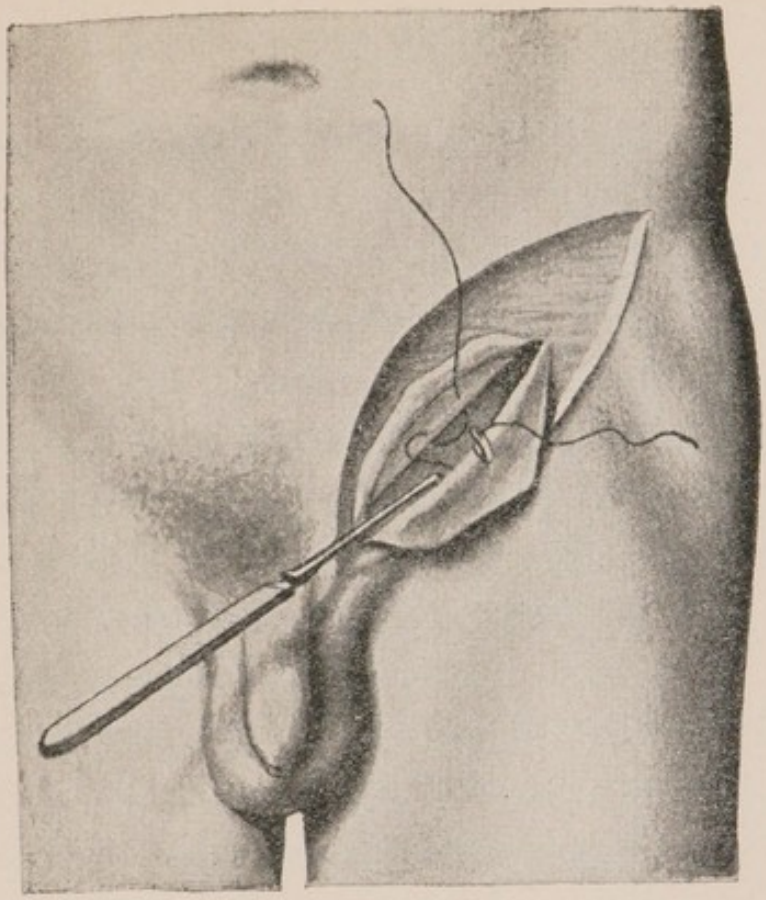

Fig. 65.

Fig. 67.

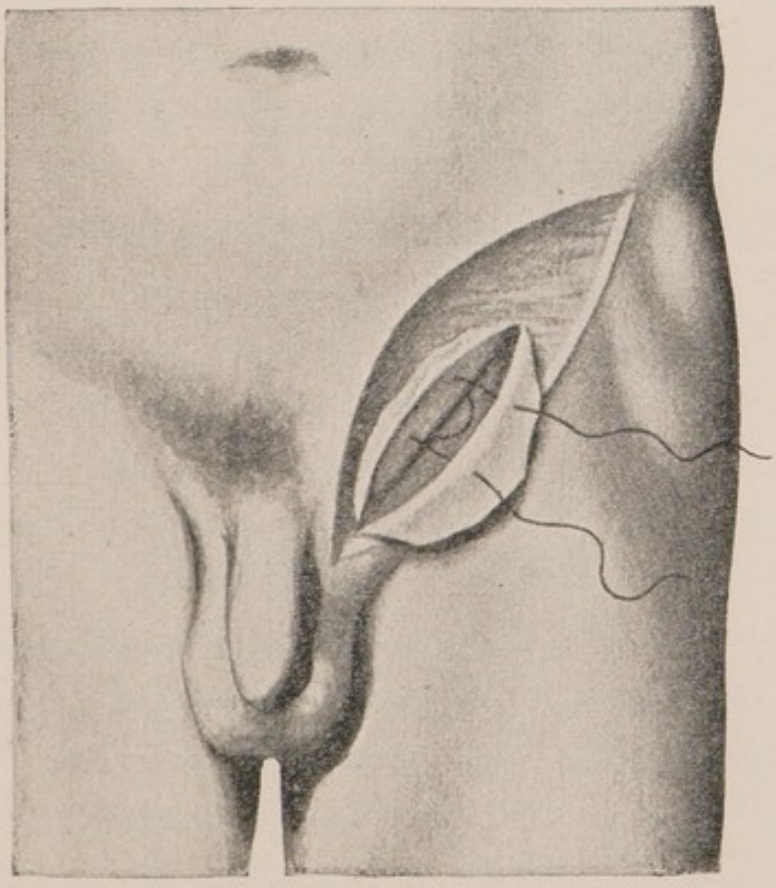

Fig. 66.

Figs. 65, 66, 67.—Radical operation of Macewen, II.

Third step: The inguinal canal is now closed by a mattress suture. The free end of a strong catgut suture is first passed from within outward through the inner wall of the inguinal canal by the same needle that has previously been employed.

Figure 66 shows the completed mattress suture, the ends of which have also been passed through the outer wall of the inguinal canal and now are ready to be tied. If the inguinal canal is very much dilated, a second mattress suture may be introduced. In passing these sutures particular care must be taken to avoid including the spermatic cord. Figure 67 diagrammatically indicates the cushion-like covering of the internal abdominal ring.

The radical operation of the external inguinal hernia in the female is easier, since there is no spermatic cord and the entire inguinal canal may consequently be completely closed by the sutures. In all cases care must be taken that the round ligament is not divided, since such an event could be followed by disturbances of fixation of the uterus.

[The operation for the radical cure of inguinal hernia in the female gives by far the best results of all varieties of hernia.

Up to February, 1902, I have operated upon 165 cases of inguinal hernia in the female, and although the cases have been very carefully traced, not a single relapse has thus far been observed. The method which I have employed is practically the same as Bassini's method in the male. The sac is always carefully dissected from the round ligament and removed high up on a level with the general peritoneal cavity. The round ligament is allowed

to drop back into the lower angle of the wound and is never transplanted, as advised by Kelly and others at the Johns Hopkins Hospital. The internal oblique is sutured to Poupart's ligament by interrupted sutures of kangaroo-tendon and the aponeurotic layer closed by a continuous suture of the same material; the skin wound is closed with catgut. The dressing is held in place by a firmly applied spica bandage. I have allowed these patients to sit up at the end of ten days, and to leave the hospital, in most cases, at the end of two weeks.

All of my cases with the exception of 13 have been traced and no relapse has been seen. This would seem sufficient evidence to prove that the method is satisfactory.—Ed.]

The radical operation of an internal inguinal hernia is performed in a similar manner. Since the spermatic cord is situated external to and outside of the region of the hernial orifice, its treatment does not enter into the question, and, after the usual ligation and extirpation of the sac, the hernial orifice may be completely closed by suture. In some cases the ligation of the deep epigastric vessels cannot be avoided.

FEMORAL HERNIA.

Femoral or crural hernia is far more infrequent in the male than is the inguinal variety, and it is also much more rarely observed in the male than in the female. According to the calculation of Berger, only 5.6 % of all males with hernias have the femoral variety, the corresponding percentage among females being 32.7 %. If this latter

percentage is compared with that of the inguinal variety in all hernias of the female,—44.3%,—it will be seen that the inguinal hernias are also more common in the female than are femoral hernias.

ANATOMY.

If we briefly review what has already been said of the anatomy of the anterior femoral region in the general consideration of the hernial orifices, we see (Fig. 2) that the superficial fascia below the inner third of Poupart's ligament exhibits a number of sieve-like perforations. This portion of the superficial fascia is known as the cribriform fascia, and gives passage to the great saphenous vein as it passes from the inner side of the thigh to empty into the femoral vein. After the removal of the superficial fascia (Fig. 3) the fascia lata is exposed, the sharp concave falciform process of which forms the outer border of the saphenous opening. This opening is situated just beneath the cribriform fascia, and through its inner portion may be seen the femoral vessels inclosed in a common sheath. The femoral vein lies to the inner, the femoral artery to the outer side, only a narrow edge of the latter being visible. To the inner side of the vein there is almost always a lymphatic gland, which is known as the gland of Rosenmüller (Fig. 4), and it is in this situation that the femoral hernia makes its external appearance. To thoroughly understand the course taken by this hernia, however, we must first direct our attention to the bony and ligamentous framework which forms the foundation of its place of exit (Fig. 68). The bony arch situated between the anterior superior spine of the ilium and the spine of the pubis has

its concavity directed upward and is bridged over by Poupart's ligament. The space between the ligament and the bone is divided into two halves by the iliopectineal fascia, which branches off from about the middle of Poupart's ligament and is inserted into the iliopectineal eminence.

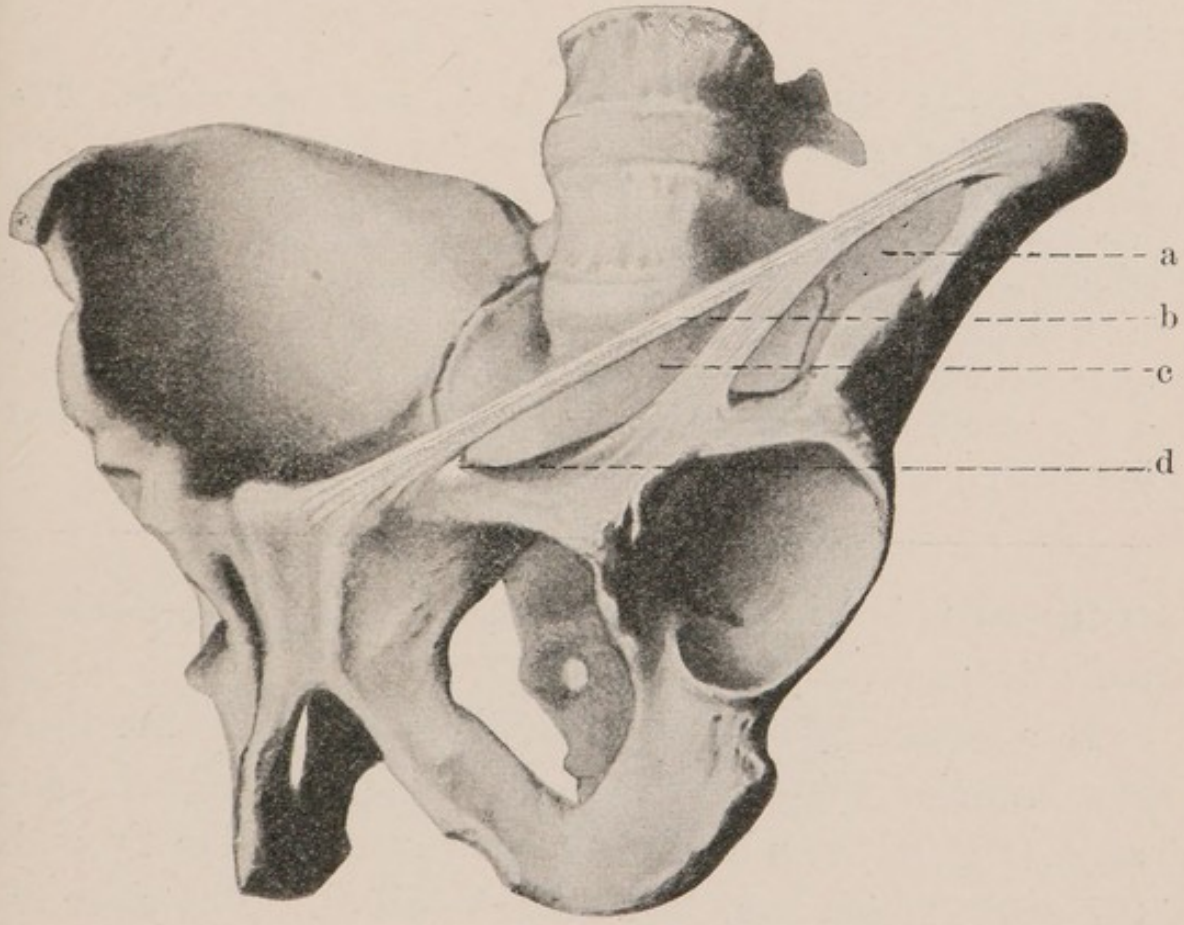

Fig. 68.—Bony pelvis showing the muscular and vascular spaces formed by Poupart's ligament and the iliopectineal fascia : a, Muscular space (*lacuna musculorum*) ; b, Poupart's ligament ; c, vascular space (*lacuna vasorum*) ; d, Gimbernat's ligament.

The outer half is completely filled by the iliopsoas muscle, and is known as the muscular space (*lacuna musculorum*) ; the inner half gives passage to the femoral vessels, and is known as the vascular space (*lacuna vasorum*). The angle which Poupart's ligament forms with the horizontal ramus

Fig. 69.—Oblique section through the pelvis from the anterior superior spine of the ilium to the iliopectineal eminence: a, Anterior superior spine of the ilium; b, iliopsoas muscle; the place of approximation of the iliac with the psoas muscle in which lies the anterior crural nerve is recognized by a narrow edge of connective tissue; c, Poupart's ligament; d, anterior crural nerve; e, femoral artery; f, femoral vein; g, lymphatic gland of Rosenmüller; h, Gimbernat's ligament; i, spermatic cord (or ligamentum teres uteri, as the case may be).

Fig. 70.—A right-sided femoral hernia, seen from within. The right anterior pelvic wall is seen, together with a portion of the anterior abdominal wall—the right rectus muscle, and a part of the right sacrum. The peritoneum has been removed with the exception of that surrounding the mouth of the hernial sac. The hernial sac itself lies close to the inner side of the external iliac vein: a, Deep epigastric artery; b, rectus abdominis muscle; c, parietal peritoneum; d, the mouth of a femoral hernia; e, pubic symphysis; f, external iliac artery; g, external iliac vein.

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of the pubis is filled by a small arched ligament—Gimbernat's ligament.

In a section passing through the pelvis from the anterior superior spine of the ilium to the iliopectineal eminence (Fig. 69) may be seen the structures passing through the spaces which have just been described. The place of exit of femoral hernia is to the inner side of the femoral vein, where the lymphatic gland of Rosenmüller is situated in the illustration.

In order to see the place from which the peritoneal protrusion occurs we must look at the inner side of the anterior abdominal wall (Fig. 39). The peritoneum has been removed in the vicinity of the femoral vessels and a number of perforations are seen in the underlying transversalis fascia, particularly at the point of exit of the external iliac

Fig. 69.

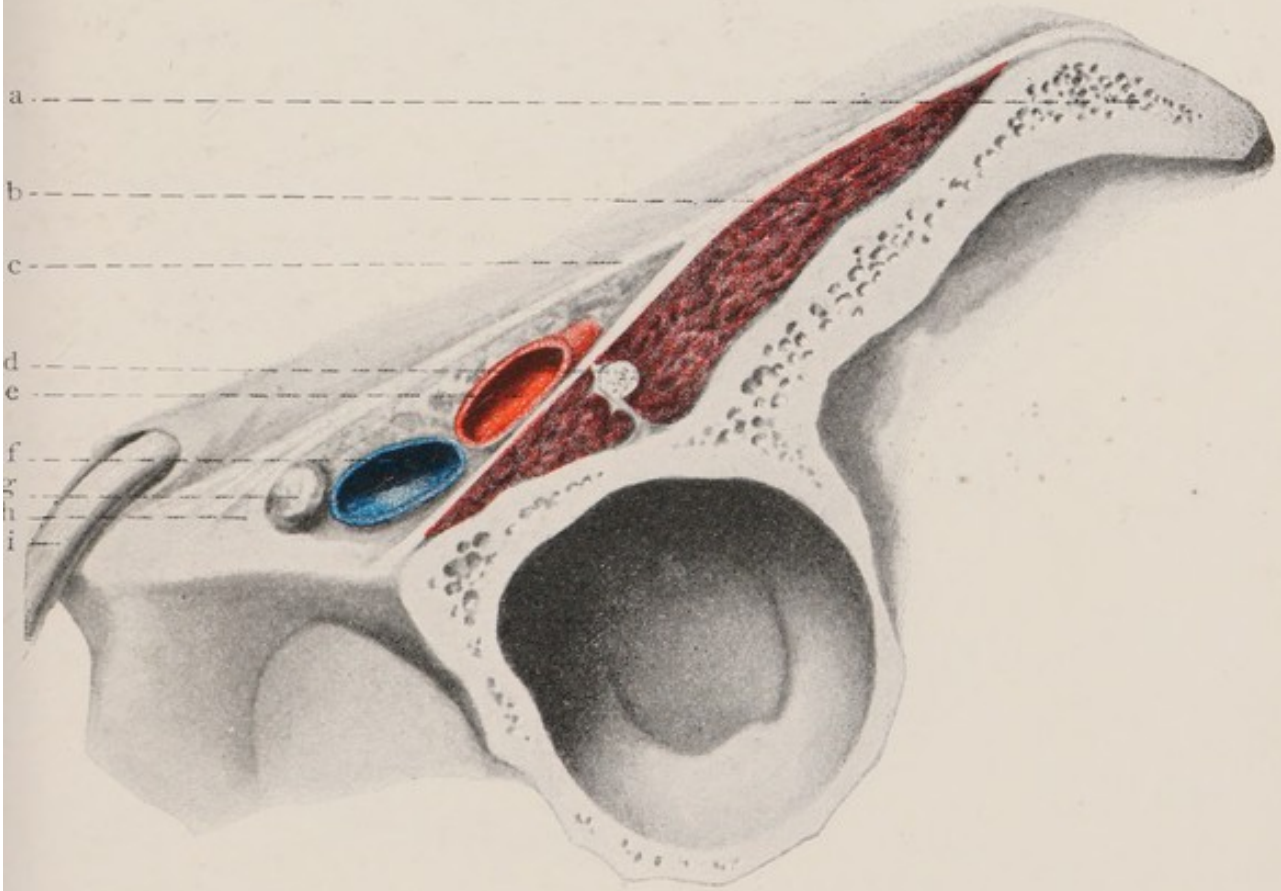
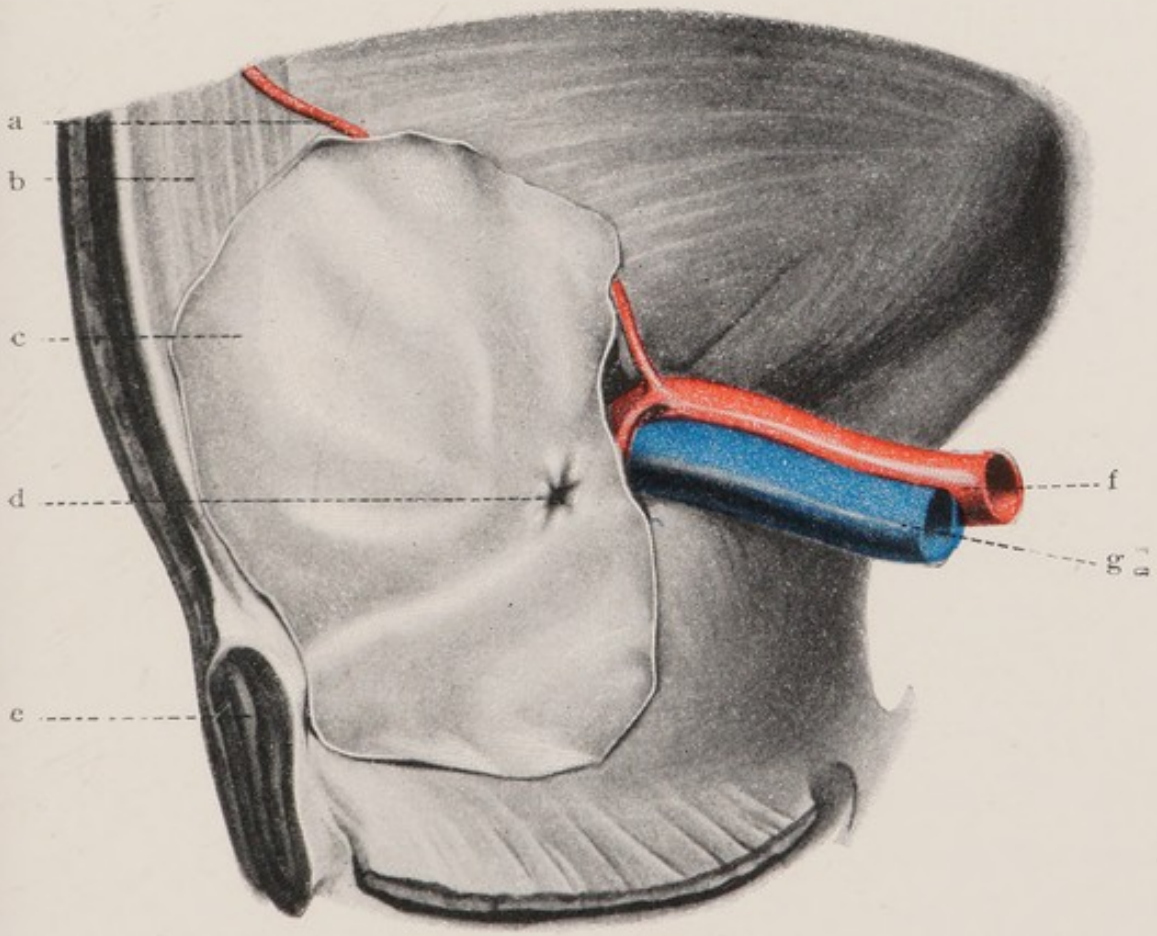


Fig. 70.



artery. Following the suggestion of Cloquet, the portion of the transversalis fascia to the inner side of the external iliac vein is known as the septum crurale. The complement to this picture is found in figure 70, which represents a femoral hernia seen from within.

The path which the femoral hernia takes from the mouth of the sac to the saphenous opening is called the femoral canal, although a pre-existing canal, like the inguinal canal, for example, does not exist. The descending hernia must make its own canal by protruding the different fascias and pushing aside the lymphatic glands and loose areolar tissue which normally fill up the space. After the hernia has descended in this manner it appears externally as shown in Plate 6.

From the preceding statements it follows that the hernial coverings are rather thin, consisting only of the portion of transversalis fascia designated as the septum crurale and of the cribriform fascia, which is occasionally somewhat reinforced by the loose areolar tissue situated beside the vein. Although the hernial coverings are sometimes thickened by inflammatory changes, they are frequently so thin that they can scarcely be recognized as such, and the isolation of their individual constituents is altogether out of the question. In operating upon femoral hernias, particularly in patients in whom the cutaneous covering is thinned and relaxed, the surgeon must consequently be prepared to encounter the hernial sac immediately underneath the skin.

It has previously been repeatedly emphasized that the subperitoneal areolar tissue is particularly well developed in the femoral region, often giving rise to the formation

PLATE 6.

A Right-sided Strangulated Femoral Hernia.—a, Efferent intestine; b, iliopsoas muscle; c, afferent intestine; d, Poupart's ligament; e, anterior crural nerve; f, femoral artery; g, femoral vein; h, spermatic cord; i, femoral hernia; k, sartorius muscle; l, pectineus muscle; m, adductor longus muscle. The hernial sac protrudes along the inner side of the femoral vein, outside of the sheath of the vessels. The anterior wall of the sac has been removed, exposing a dark red, cyanotic intestinal coil.

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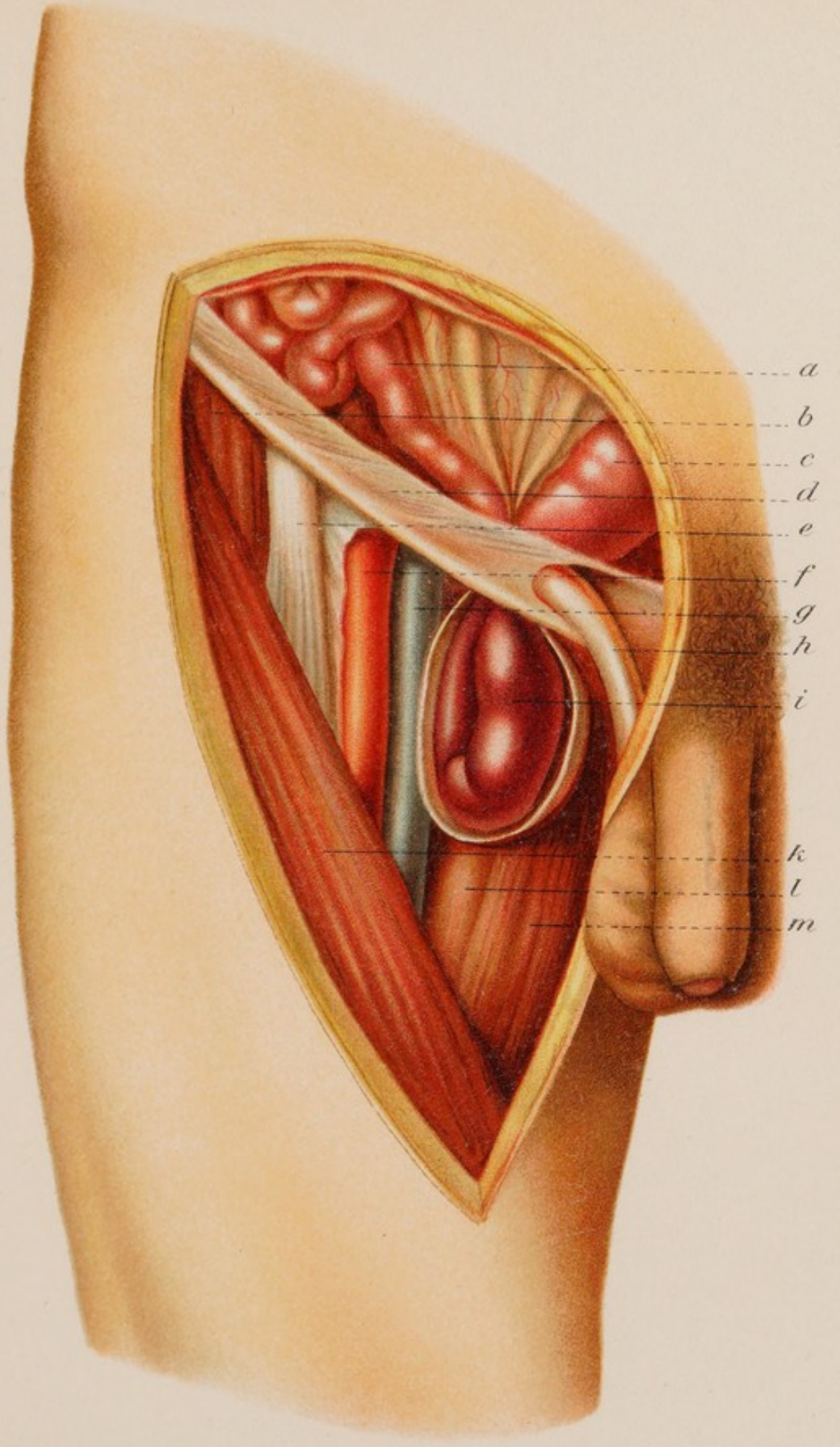
of subperitoneal lipomas, and their frequent occurrence in this situation furnished Roser with an argument for the development of the hernia from the traction produced by the pedicle of such a tumor.

THE DIAGNOSIS OF FEMORAL HERNIA.

If the general symptoms of hernia and the anatomy of the region involved are borne in mind, the diagnosis of femoral hernia will not be difficult in the majority of cases. The differentiation of a femoral from an inguinal hernia, which has already been briefly given in the diagnosis of inguinal hernia, will almost always be easy if the course of Poupart's ligament is observed. When the position of the neck of the hernia has been defined, and when the pubic spine has been palpated and connected with the anterior superior spine of the ilium by an imaginary line, the variety of the hernia may readily be determined, since a hernia below this line will be femoral, while one above it will be inguinal. This is specially true of hernias of moderate size in the inner half of the groin, in which it cannot be seen at a glance whether the hernia is inguinal or femoral (Fig. 71). Inspection is particularly deceptive



Lith. Anst F. Reichhold, München.

if the femoral hernia extends upward, as it enlarges and assumes a position in front of Poupart's ligament. The

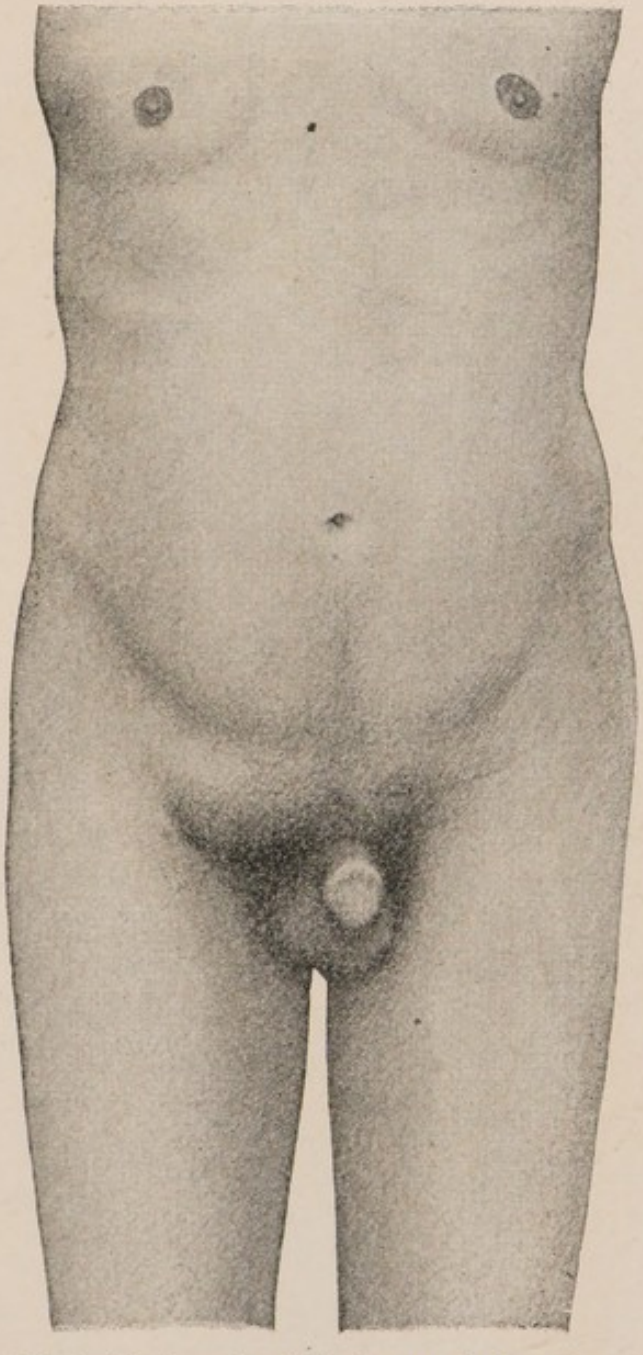


Fig. 71.—A right-sided reducible femoral hernia, about the size of a hen's egg, which has extended upward so that it is situated in the inner third of the inguinal region. The decision as to whether this hernia is inguinal or femoral cannot be made at first glance, and is only possible after an exact determination of the course of Poupart's ligament. Radical operation. Recovery.

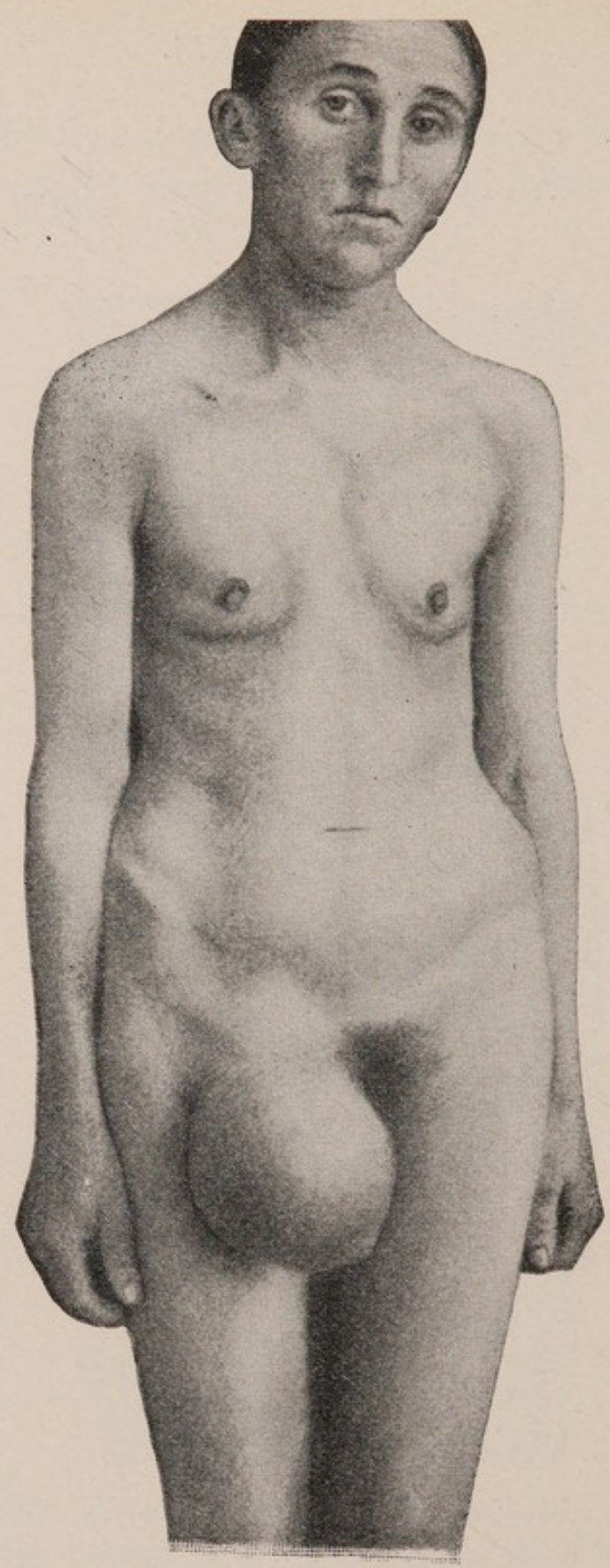


Fig. 72.—A right-sided femoral hernia, larger than a man's fist, which could be completely reduced and well retained by a truss. The hernia is situated in the upper and inner portion of the femoral region and has pushed the labium majus toward the median line.

diagnosis becomes more difficult in fat individuals with pendulous abdomens, in whom the position of Poupart's ligament cannot be determined either by direct palpation

Fig. 73.—A right-sided irreducible femoral hernia which contained nothing but a thick mass of omentum. Radical operation. Recovery.

Fig. 74.—A bilateral femoral hernia in a woman seventy-five years of age.

The right-sided hernia, about the size of a child's head, was strangulated. Its shape was very irregular and the contours of the individual intestinal coils could be distinctly recognized through the greatly relaxed and withered skin. The contents consisted of the cecum and of a convolution of intestinal coils which were matted together by adhesions. Herniotomy. The reduction of the hernia was impossible until after the incision had been extended upward through the abdominal wall. Recovery.

The left-sided hernia, situated in the upper and inner portion of the femoral region, shows the same tendency to irregular protrusion as that observed upon the right, the skin being drawn in over the middle of the hernia. The contents could be returned to the abdominal cavity, a gurgling murmur being heard at the time of reduction; one finger could be comfortably introduced into the hernial orifice. The swelling immediately below the center of Poupart's ligament was caused by an enlarged lymphatic gland. The irregular shape of both hernias was probably due to the fact that the cribriform fascia was not pushed in front of the hernia as a whole, but that the hernial sac protruded externally through a number of openings in the fascia.

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or by the line connecting the anterior superior spine of the ilium with the spine of the pubis. If a hernia possessed by such an individual becomes irreducible or strangulated, it will readily be seen that the diagnostic difficulties are greatly increased. The presence of cysts and their combinations with femoral hernias obscure the diagnosis much more rarely than is the case in the inguinal region. As there is no structure analogous to the vaginal process in this situation, such cysts are always due to constrictions and sequestrations of portions of the hernial sac.

Femoral hernias are usually of moderate dimensions; they rarely attain the size of a man's fist, although they have been observed extending as low down as the knee.

Fig. 74.

Among the affections which might be confused with femoral hernias should be mentioned subperitoneal lipomas (see page 47), swollen lymphatic glands, psoas abscesses, and the enlargements in the femoral region produced by varicose veins. This latter condition in particular may closely simulate a femoral hernia. The varicosity varies in size from that of a hazelnut to that of a goose-egg, and corresponds exactly to the situation in which femoral hernia appears, since it is located at the junction of the internal saphenous with the femoral vein (Fig. 75). Since the swelling disappears under slight compression and becomes somewhat more tense when the intra-abdominal pressure is markedly increased, an inexperienced observer could easily mistake it for a femoral hernia. The diagnosis can always be made, however, by attention to the following points: When the tumor has disappeared under pressure, it returns immediately after the removal of the finger, and a humming murmur is heard, which is still more distinct when a stethoscope is placed over the part; inspection of the legs will always reveal extensive varicosities of the veins in this situation. [The peculiar thrill which is pathognomonic of femoral varix is greatly emphasized by having the patient cough while the fingers are lightly pressing upon the swelling.—Ed.]

In addition to the typical femoral hernia which has just been described there are several other varieties. Figure 76 shows a specimen belonging to the Pathologic Institute of Göttingen in which there are two peritoneal diverticula lying side by side in the usual location of a femoral hernia. Similar double hernias have also been observed in other hernial regions (umbilical region, Froriep).

In some cases the femoral hernia may leave the abdom-

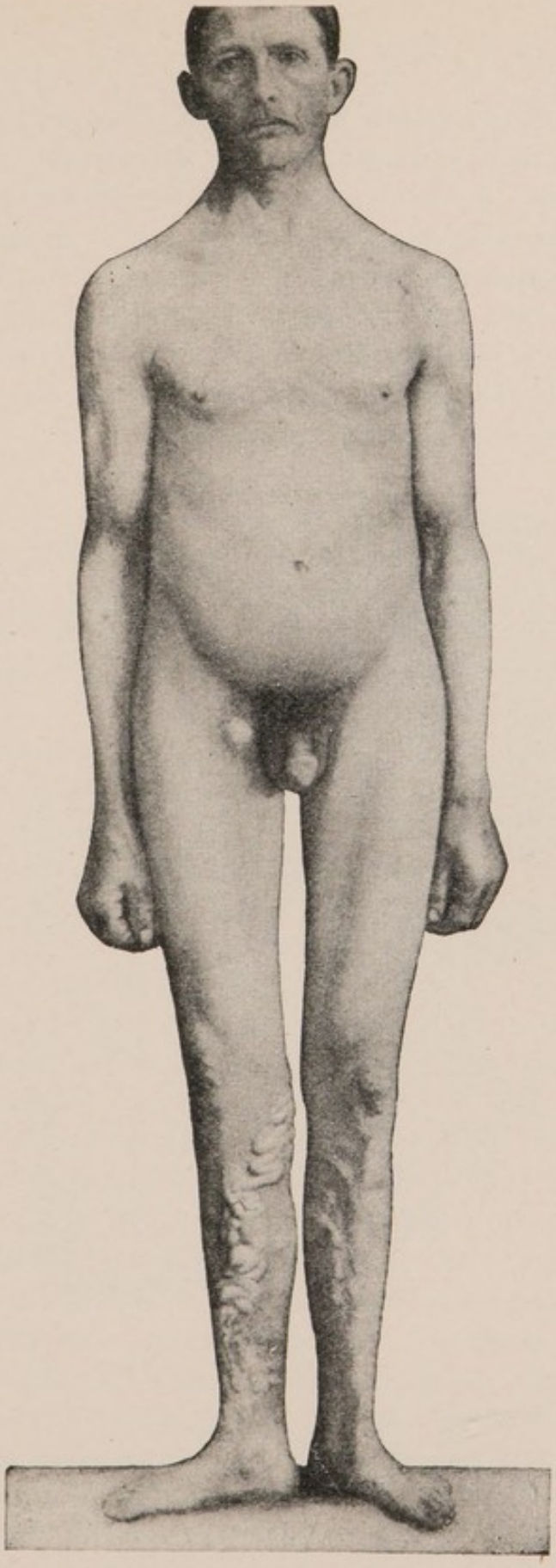

Fig. 75.—A swelling, the size of a walnut, in the right groin, due to a varicosity ; marked varicosities in both legs, particularly upon the right side.

Fig 76.—Double femoral hernia, seen from within: a, Parietal peritoneum; b, deep epigastric artery; c, external iliac artery; d, external iliac vein; e, the orifices of both hernial sacs; a small strand of omentum passes into the inner hernial sac; f, obturator artery; g, omentum; h, symphysis pubis. The greater portion of the parietal peritoneum has been removed, particularly behind the mouths of the sacs, where only a narrow margin has been left. This specimen also shows an anomaly of the obturator artery which arises from a short trunk in common with the deep epigastric artery.

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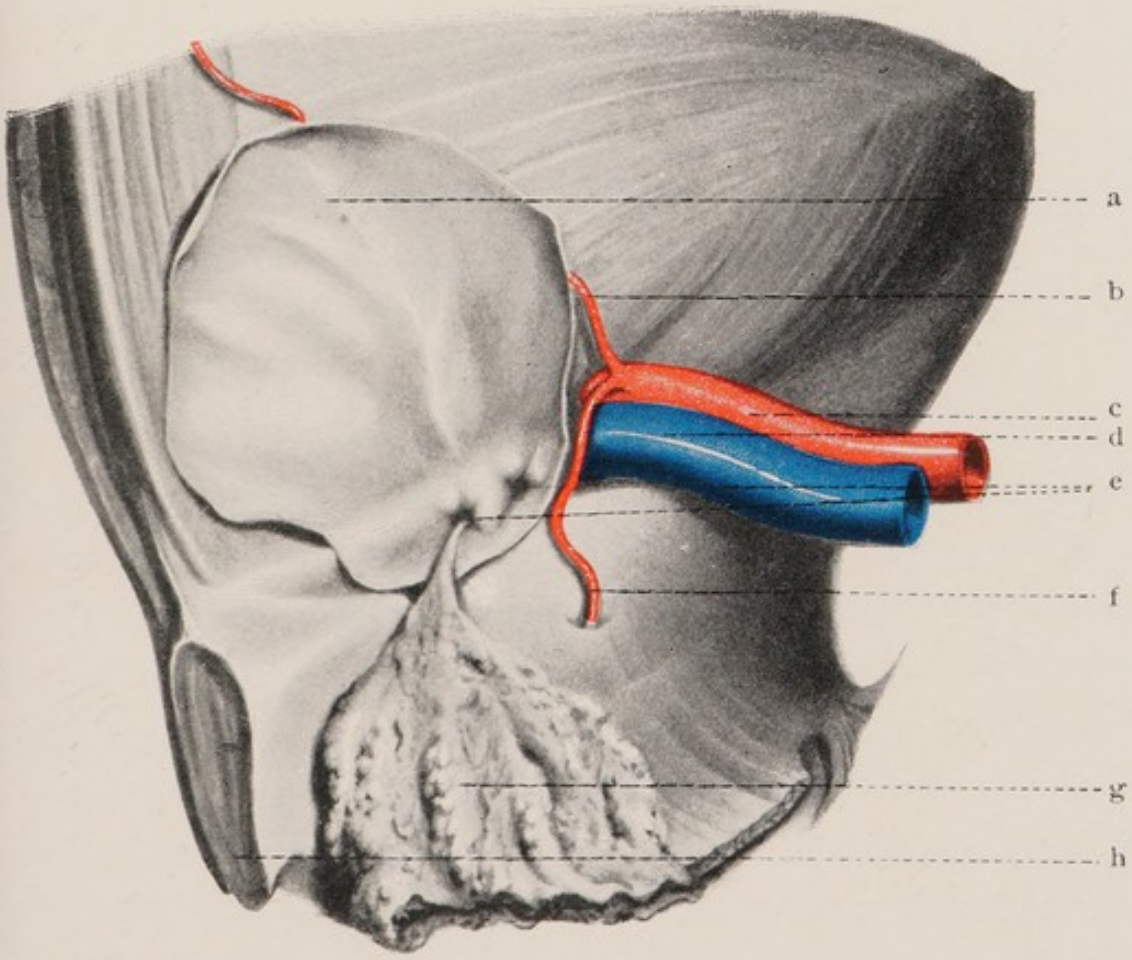
inal cavity at the usual situation and then pursue an abnormal course, passing through an opening in the pectineal fascia and enlarging either between the pectineus muscle and its fascia or between the fibers of the muscle (Cloquet, B. Schmidt, and others).

At this place should be mentioned the properitoneal femoral hernia (*hernia cruro-properitonealis*), which is analogous to the properitoneal inguinal variety. This form is much rarer than the properitoneal inguinal hernia; in the great majority of cases it is bilocular, and occurs mostly in women.

In still other cases the femoral hernia leaves the abdominal cavity by an atypical route. It may pass through an opening in Gimbernat's ligament; such a variety was first described by Laugier, and subsequent cases were reported by Cruveilhier and others. Another form, usually described under the name of external femoral hernia (*hernia cruralis externa*), was first described by Hesselbach. The nomenclature of this variety is inexact, since some authorities (Hesselbach) apply the name to hernias which pass out through the muscular space (*lacuna musculorum*), while others so designate all hernias situated to the outer side of the femoral vessels, and consequently include some of those which are found within the vascular space (*lacuna vasorum*). Still other authors (Linhart) classify femoral hernias according to their relation to the deep epigastric artery, and call all hernias to the outer side of this vessel external femoral hernias. Such a nomenclature would consequently include those hernias which leave the abdominal

Fig. 76.



cavity to the outer side of the deep epigastric artery, but which come down in front of the femoral vessels, instead of to the inner side, and which push the femoral sheath before them as they descend (*hernia cruralis prævascularis*). The development of such hernias after traumatism has been recently pointed out by Narath, who saw them arise after the reduction of congenital dislocations of the hip. Bähr has also seen external femoral hernias (according to Hesselbach's classification) develop after traumatism.

THE STRANGULATION OF FEMORAL HERNIAS.

Although what has been said of strangulation in general applies to this variety of hernia, there are many features characteristic of strangulated femoral hernia which deserve particular mention. In the first place, femoral hernias are frequently very small and may be easily overlooked. It consequently follows that the femoral region should be most carefully examined in every case which presents the general symptoms or signs of intestinal occlusion. If such a course is pursued, the surgeon will frequently have the satisfaction of immediately locating the cause of the disturbance in a small more or less sensitive tumor, sometimes scarcely larger than a hazelnut, situated internal to the femoral vessels. The rigid walls of the femoral canal (the pubic bone behind, Poupart's ligament in front, Gimbernat's ligament to the inner, and the femoral sheath to the outer side), together with its narrowness, contribute greatly to the development of a very firm strangulation, which is usually of the elastic variety. The same factors also make taxis much more difficult in the great majority of cases than in a strangulated inguinal hernia, for example, and this procedure must consequently be employed most cautiously

and without the application of too much force. As a further consequence of the narrowness of the femoral canal hernias of the intestinal wall are observed more frequently here than elsewhere. There are also certain points which must be borne in mind in performing herniotomy. The cutaneous incision is made in a longitudinal direction, and is so planned that its center corresponds to the neck of the sac. Great caution must be exercised in making this incision, since we have seen that the hernial coverings are often very thin, and sometimes apparently absent, so that the operator immediately exposes the subperitoneal areolar tissue or the hernial sac itself. The subsequent steps of the operation are easier than in inguinal hernia, inasmuch as the hernial sac may almost always be readily isolated from the surrounding tissues by blunt dissection. After the hernial sac has been opened in the customary manner and its contents inspected, the operator next proceeds to divide the constriction. Since profuse and even fatal hemorrhages were formerly greatly feared during this step of the operation, brief mention should be made of some anomalies of the origin and course of the blood-vessels situated in this region. The deep epigastric artery, instead of coming from the external iliac just behind Poupart's ligament, may arise higher up and then run along the upper margin of the neck of the sac. The obturator artery, instead of being given off from the internal iliac, may arise from the external iliac either directly or indirectly by a trunk common to itself and the deep epigastric artery; in both instances the anomalous obturator artery lies immediately to the outer side of the neck of the sac. This common branch of origin of the obturator and deep epigastric may

be so long that it lies just above the sac, while the obturator artery itself lies immediately to the inner side. Since the femoral vein lies just external to the hernia, the neck of the sac may be completely surrounded by a vascular wreath, and this condition was formerly so feared that it received the name of *corona mortis*. It consequently follows that the constriction in strangulated femoral hernia should be divided only from without inward, so that any hemorrhage may be immediately recognized and controlled.

THE TREATMENT OF FEMORAL HERNIA.

The Treatment by Means of a Truss.—The statements made in reference to the treatment of inguinal hernia by a truss apply to a great extent to femoral hernia, but the exact application of the truss is more difficult, since it is more apt to be displaced by the movements of the hip-joint. In an inguinal hernia the truss must be so applied that its longest diameter corresponds to the course of Poupart's ligament; in the femoral variety the long axis of the pad must be more vertical, and the pad itself should be smaller and narrower. If the patient allows himself to be treated exclusively by an instrument-maker, and if this individual, as not infrequently happens, is unable to decide as to whether the hernia is inguinal or femoral, he sometimes tries to solve the difficulty by employing a large pad which almost covers both hernial orifices. Berger states that the French instrument-makers have constructed a special truss for such doubtful cases which they call an inguino-femoral truss, and which, if the truth were told, is not suitable for either an inguinal or a femoral hernia.

In order to avoid displacement of the pad every femoral

truss should be provided with a perineal strap, which, in contradistinction to that of the inguinal truss, is attached to the outer edge of the pad and is carried horizontally about the thigh (Fig. 79).

The data which must be given to the instrument-maker are similar to those necessary in the inguinal variety, the pelvic circumference midway between the anterior superior spine and the great trochanter being particularly required.

The Radical Operation.—The exposure of the hernial

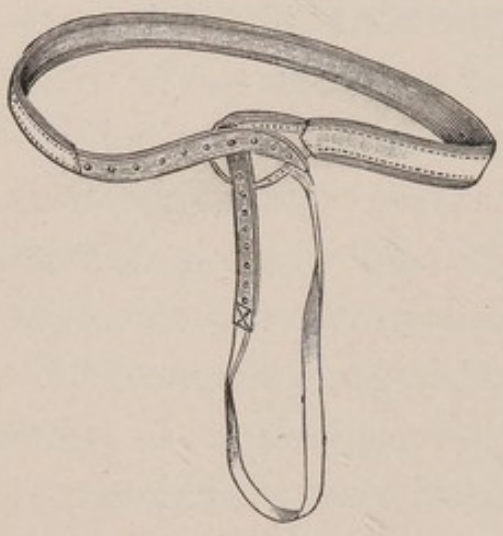


Fig. 77.—Single femoral truss.

Fig. 78.—Double femoral truss.

sac, the reduction of the contents, and the highest possible ligation and extirpation of the sac are carried out in the radical operation of femoral hernia as has previously been described in the section upon hernia in general, and in that upon inguinal hernia, by a longitudinal incision over the hernial tumor. For the closure of the hernial orifice, however, special methods are necessary which are adapted to the special anatomy of the femoral region. If the hernial orifice is small, it may usually be firmly and permanently closed by stitching the pectineal fascia, or, still better, the

superficial layers of the pectineus muscle itself, partly to Poupart's ligament and partly to the falciform process of the fascia lata. In introducing these sutures particular

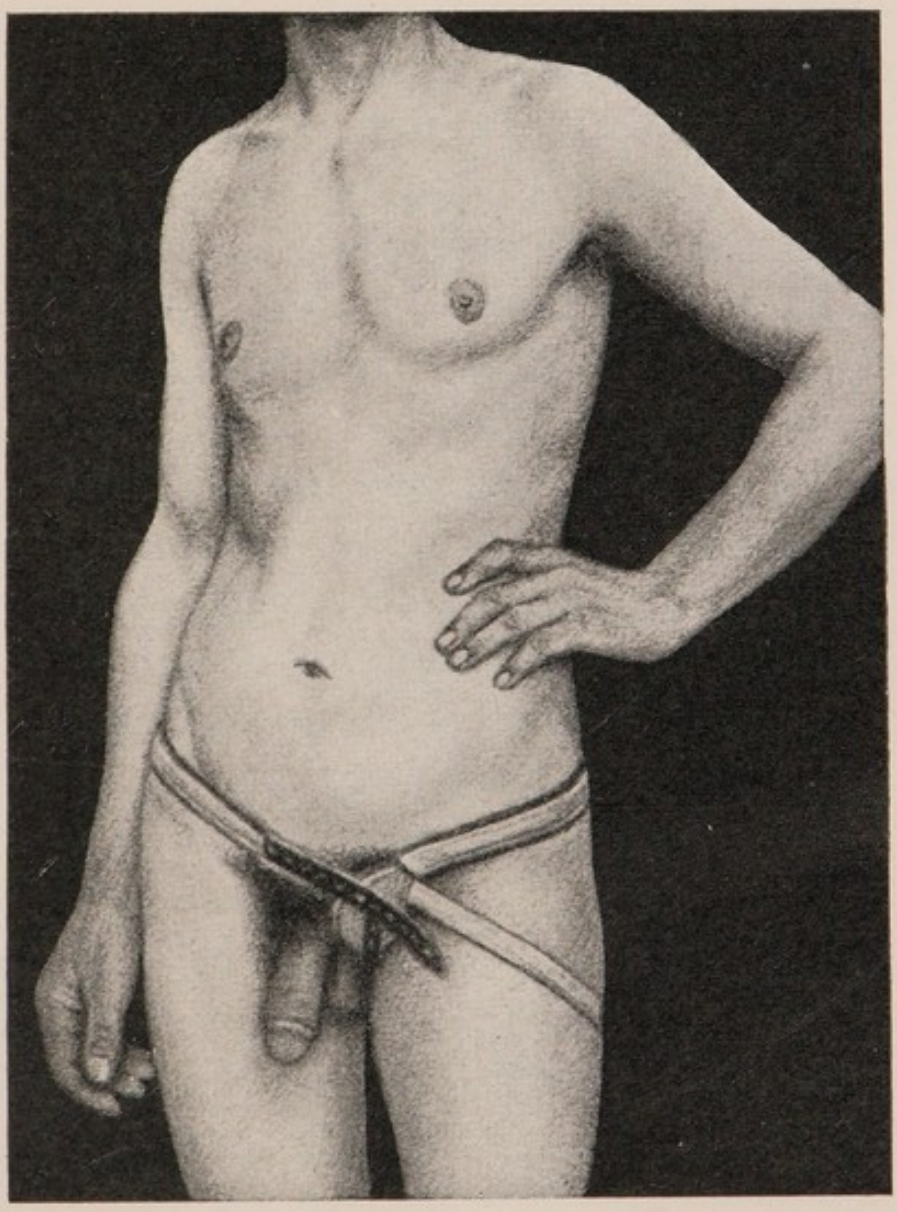


Fig. 79.—This illustration shows the method of application of a femoral truss, the perineal strap passing horizontally about the thigh.

care must be taken to avoid puncturing the immediately adjacent femoral vein.

Bassini performs this operation by making an incision

immediately below and parallel to Poupart's ligament, and passes the stitches not only through Poupart's ligament and the pectineal fascia, but also through the periosteum of the horizontal ramus of the pubis.

[I believe that Bassini's operation for femoral hernia and the so-called purse-string method meet the requirements better than any of the more elaborate methods that have been brought forward from time to time.

I have personally operated upon 65 cases of femoral hernia, in 16 of which Bassini's method was used. In all the others I employed the so-called purse-string method, originally proposed, I believe, by Cushing, of Boston. I consider the purse-string method superior to Bassini's in most cases, except possibly those with a very large opening. During the past three years I have employed this method uniformly in all cases, without selection, and in 49 cases in which I have used it during the past eleven years, not a single relapse has been observed.

The technique in brief is: First, to thoroughly free the sac well beyond the neck; it is then transfixed and tied off so high up that when it retracts there is no longer any funicular process. A purse-string suture of chromicized kangaroo-tendon is introduced through Poupart's ligament or the inner portion of the roof of the crural canal, from which it passes downward into the pectineal fascia and muscle, forming the floor of the canal, then outward, picking up the fascia lata overlying the femoral vessels, and finally upward through Poupart's ligament, emerging about $\frac{1}{2}$ inch from the point of introduction. On tying this suture the floor of the canal is brought into perfect apposition with the roof and the femoral opening is obliterated.

This method is much simpler than Bassini's, and in uncomplicated cases can be easily performed in ten to fifteen minutes. The only relapse that I have had in the 65 cases of femoral hernia followed an operation by Bassini's method in a woman thirty-five years of age. This, however, was also the only case of femoral hernia in which suppuration occurred, and this fact, doubtless, was responsible for the relapse. At present, five years after the operation, the patient has merely an exaggerated impulse and has never worn a truss.—Ed.]

Kocher employs the same displacement method in femoral hernia that he has described for the inguinal variety. An incision parallel to the inner third of Poupart's ligament exposes the hernial sac, which is completely isolated up to the femoral ring. A small opening is now made above Poupart's ligament in the dense tissue of the outer pillar of the external abdominal ring; a dressing-forceps is passed through this opening, behind Poupart's ligament, and down into the hernial sac, the fundus of which is seized, pulled out through the opening, and sutured as in inguinal hernia. The hernial sac is fastened in the femoral ring by passing a suture through Poupart's ligament and the pectineal fascia, together with the pubic periosteum, in such a manner that it includes the sac. Poupart's ligament is then stitched firmly to the pectineal fascia by two or three sutures, so that it acts as a support and extension of Gimbernat's ligament; these sutures cannot be introduced immediately alongside of the femoral vein, since such a complete closure of the femoral ring might result in thrombosis. The superfluous portion of the hernial sac is extirpated.

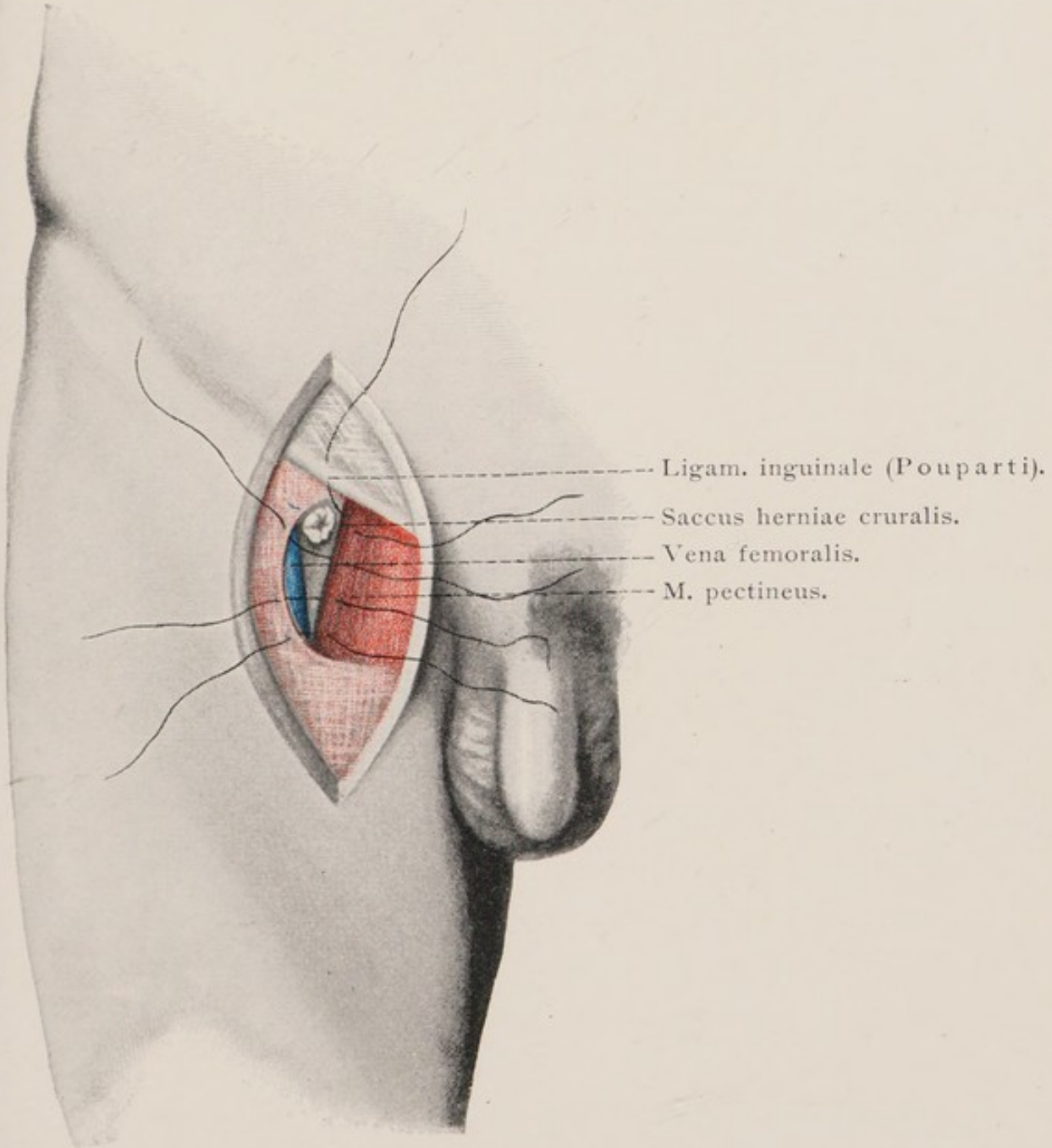
Fig. 80.—The radical operation for femoral hernia. The stump of the hernial sac has not yet slipped back into the abdomen and is seen below Poupart's ligament to the inner side of the femoral vein. The hernial orifice is to be closed by four sutures which pass from the pectineus muscle and its fascia to Poupart's ligament and the fascia lata.

In a large femoral hernia with a wide hernial orifice the methods just described will not be sufficient, and the femoral ring must be closed by some variety of plastic operation.

Such a method has been published by Salzer, who, after extirpating the sac and burying the stump in the usual manner, forms a short, broad, firm flap from the pectineal fascia, the pedicle being situated above. The free edge of this flap is stitched to the middle third of Poupart's ligament, avoiding all tension, and thus forms a new firm fibrous septum crurale. Since the pectineal fascia is very frequently an extraordinarily thin connective-tissue membrane, Schwartz's modification of Salzer's method is more appropriate, and consists in making the flap from the entire thickness of the pectineus muscle and then stitching this flap firmly to Poupart's ligament (Fig. 81).

If the femoral hernia is still larger, if it hangs down upon the thigh, and if several fingers can be comfortably introduced into the hernial orifice, the osteoplastic operation first employed by Trendelenburg and Kraske is to be recommended. A flap consisting of periosteum, cartilage, and bone is chiseled out from the pubis, extending beyond the symphysis if necessary. This flap retains its connection with the pelvis by the periosteum and is loosened sufficiently to allow it to be stitched in front of the hernial

Fig. 80.


Ligam. inguinale (Pouparti).
Saccus herniae cruralis.
Vena femoralis.
M. pectineus.

orifice without tension. Although suppuration may cause this bone flap to become necrotic, and although it may be absorbed in the absence of suppuration and thus make the result a questionable one, the employment of this method would seem justifiable, since different authors have operated upon a series of cases and attained permanent cures where it was impossible to close the large hernial orifice by any other procedure. [We are strongly of the opinion that a femoral hernia of such great size that it cannot be cured by the simpler methods described had better not be operated upon than be treated by the extensive osteoplastic methods. Though an occasional cure may result, the failure to cure leaves the patient in far worse condition than prior to operation.—Ed.]

Attempts have recently been made by Witzel to obtain a firm closure of the hernial orifice by the introduction and inclosure of foreign bodies—*heteroplasty*. Witzel formed a close network of silver wire which heals in the wound as a firm pad and forms a permanent closure of the hernial orifice. A sufficient length of time has not yet elapsed to allow us to judge of the permanency of the results obtained by this method. [This is based on the same principle as Phelps' "wire mattress" method in inguinal hernia. From the results thus far observed, as well as from theoretic considerations, such methods are of doubtful value.—Ed.]

All operative procedures which include a detachment of Poupart's ligament should be condemned on account of the danger of the secondary development of an inguinal hernia.

Fig. 81.—The radical operation for femoral hernia: a, Poupart's ligament; b, femoral artery; c, the stump of the sac which has not yet been buried in the abdominal cavity; d, femoral vein; e, the flap from the pectineus muscle; f, sartorius muscle; g, adductor longus muscle. The two sutures which have been passed through the pectineus muscle and Poupart's ligament indicate the manner in which the muscular flap is secured in front of the hernial orifice.

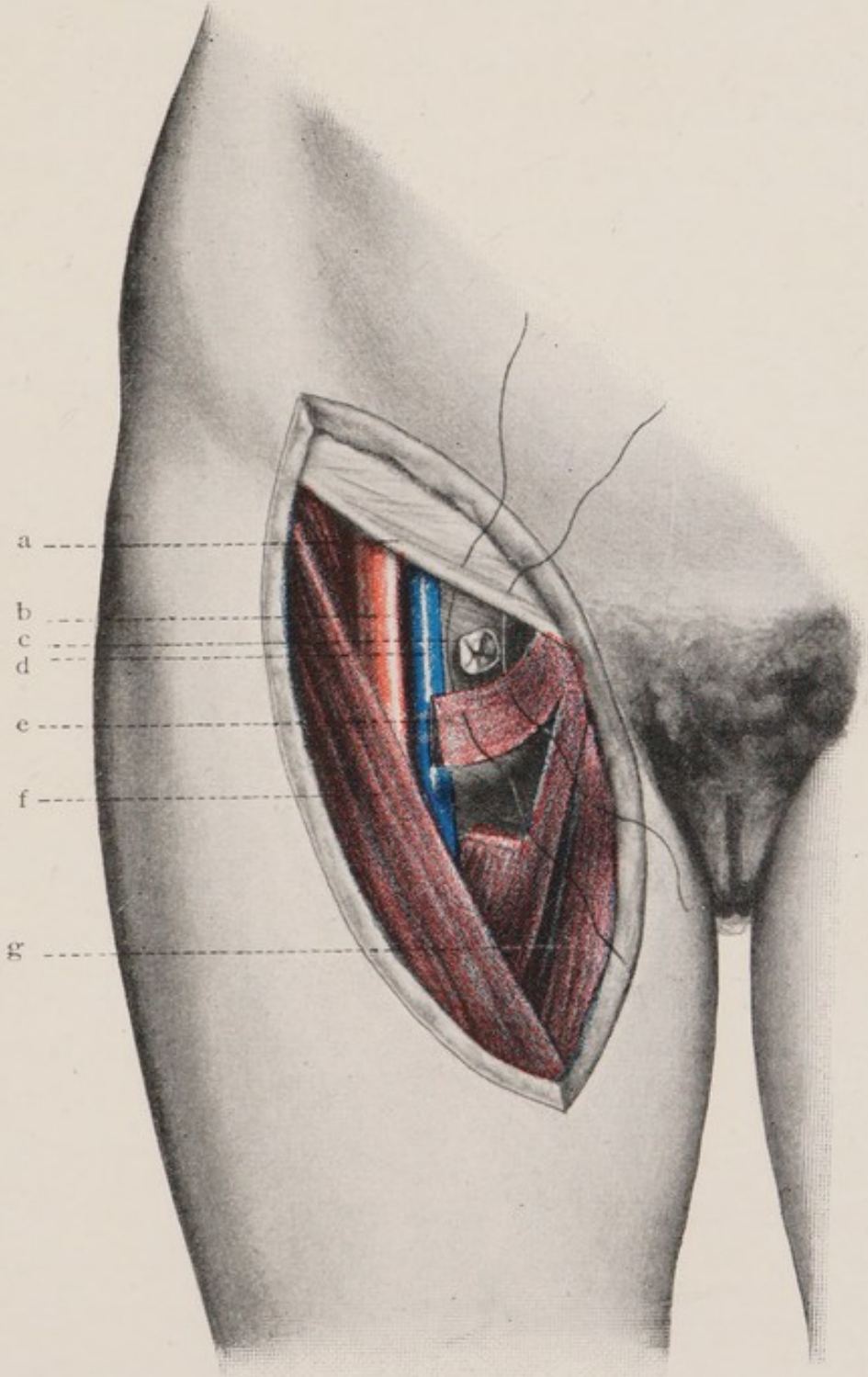
UMBILICAL HERNIA.

Umbilical hernia is far more frequent in children than in adults, and occurs particularly in girls. In order to obtain a correct idea of the distribution and frequency of these cases of umbilical hernia, it is therefore more appropriate to consider the two sexes in two classes, under and over fifteen years of age. The following figures, from Berger's statistics, show the relative percentages of umbilical hernias:

	Over 15 Years.	Under 15 Years.	Total.
Males	2.15%	22.42%	5.46%
Females	22.16%	65.24%	27.34%
Total	7.45%	31.02%	11.02%

The forms in which umbilical hernia may appear are so distinct that they must be sharply differentiated, and are worthy of separate consideration. They are: (I) The congenital hernia of the umbilical cord; (II) the umbilical hernia of children; and (III) the umbilical hernia of adults.

Fig. 81.



I. THE CONGENITAL HERNIA OF THE UMBILICAL CORD.

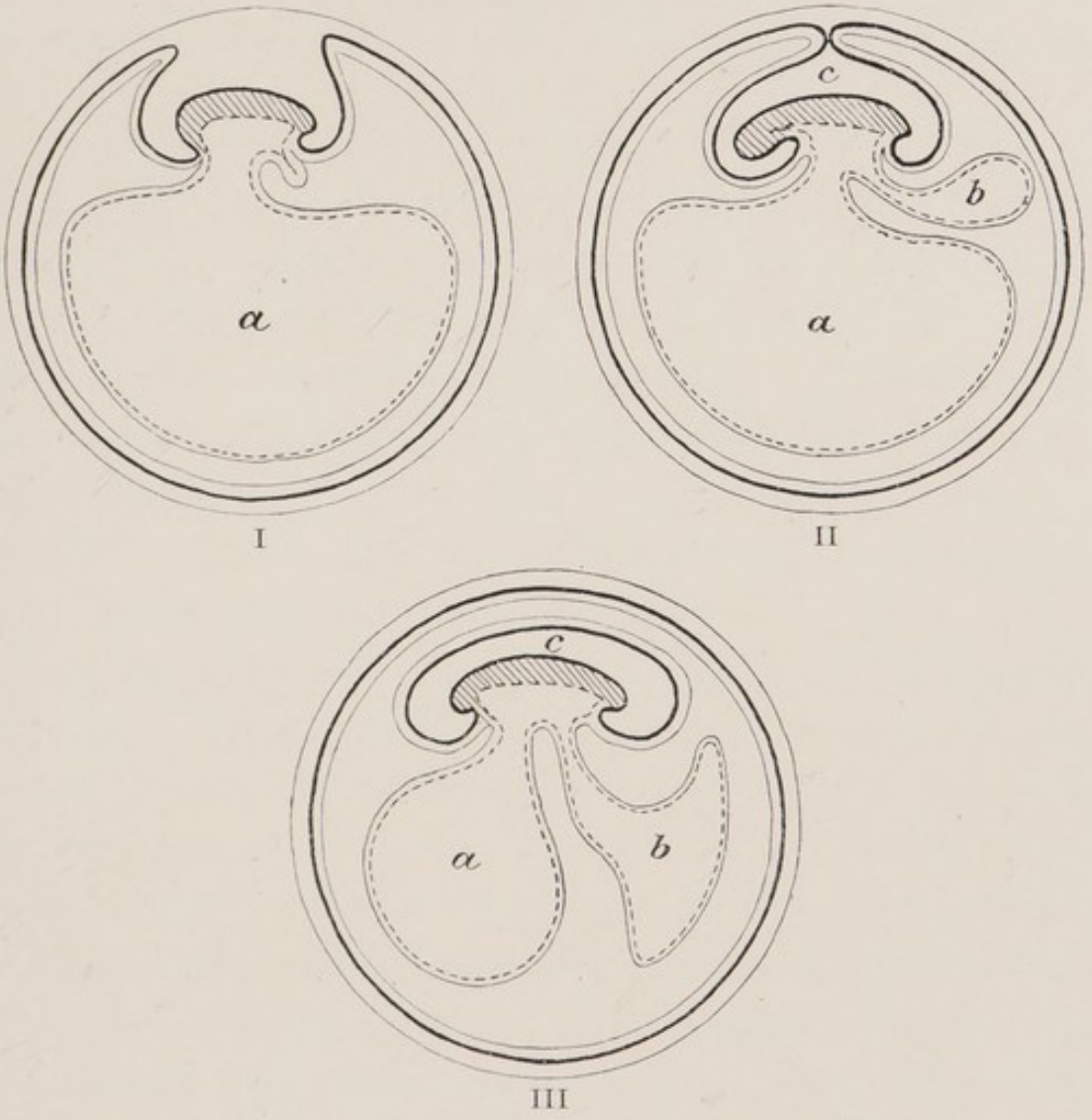
Strictly speaking, the hernia of the umbilical cord (*hernia funiculi umbilicalis*) must be classified with the malformations, since the peritoneum and viscera are not abnormally protruded, but they remain lying in front of the anterior abdominal wall, as is the case in an early stage of intrauterine life, and the normal closure does not take place. The formation of the umbilical cord as illustrated in the diagrammatic drawings in figure 82, taken partly from Gegenbauer, will be of value in obtaining a clear understanding of this process.

It will be seen that in a certain stage of development the anterior abdominal wall is open in the region of the navel, and also that a portion of the intestine may develop outside of the abdominal cavity. If this opening in the anterior abdominal wall is not closed at birth, a condition exists which, strictly speaking, must be designated as *ectopia*, but which is usually called a hernia of the umbilical cord. As a further indication that such a case is actually one of ectopia, it frequently happens that, in addition to intestine, the liver, or even the liver alone, the stomach, the pancreas, or the spleen may be found as contents of the hernial tumor. The coexistence of other malformations, such as hare-lip or congenital fissures in other regions of the body, is by no means unusual.

The outer covering of the hernia of the umbilical cord is formed by the distended tissues of the funiculus,—*i. e.*, by a thin layer of the jelly of Wharton,—and behind this is situated the hernial sac, which, according to French authors (Berger), is a thin non-vascular membrane corresponding

In figure 82, I, is seen the longitudinal section of an embryo, the ventral surface of which is continuous with a sac (a), lined by entoderm and invested by mesoderm, which is called the yolk-sac. At the tail-end of the embryo is seen also the commencing protrusion of the allantois, while over the back of the embryo the ectoderm is raised up in folds which subsequently unite and form the amniotic cavity. In figure II the allantois has grown larger and assumed the shape of a tube (b) communicating with the hind-gut. The folds of ectoderm are in contact over the dorsal surface of the embryo ; they fuse with each other in this situation and form the amniotic cavity (c). In the further course of development (Fig. III) the amniotic cavity enlarges from the formation of amniotic fluid, the allantois acquires vessels, the subsequent umbilical vessels, and further changes are observed in the yolk-sac and in the allantois, since both of these structures become constricted to narrow stalks as they pass into the abdominal cavity. This process becomes still more apparent in figure IV. The yolk-sac (a) has become much smaller and is connected with the abdominal cavity, strictly speaking with the hind-gut, only by a narrow canal, the omphalo-mesenteric duct ; the allantois, which originally received the secretions of the Wolffian bodies, does not entirely lose this function, since a portion of this structure remains permanently as the urinary bladder. The narrow duct connecting the distal portion of the allantois with the hind-gut is known as the urachus. In figure V the formation of the umbilical cord has been completed. The amniotic cavity (c) has become greatly enlarged and forms a sac, filled with amniotic fluid, about the embryo ; the blood-vessels of the allantois have combined with those of the decidua to form the chorion and subsequently the placenta. The abdominal cavity has become closed with the exception of the point of entrance of the umbilical cord, which is composed of the remains of the omphalo-mesenteric duct, of the urachus, and of the umbilical vessels. After the chorion has formed the entodermic portion of the urachus (u) remains only for a short time, while its outer connective-tissue layer becomes transformed into the jelly of Wharton which surrounds the umbilical vessels. The remains of the yolk-sac (a) are known as the vitelline vesicle, while the omphalo-mesenteric duct becomes obliterated toward the end of fetal life and loses its connection with the intestine. The intestine has drawn back into the abdominal cavity and, if the development is normal, there is no longer a trace of the former open connection between it and the yolk-sac situated outside

Fig. 82.



of the abdominal cavity. It should be mentioned that in pathologic cases the omphalo-mesenteric duct may either remain as an umbilico-intestinal fistula or it may become obliterated, with the exception of its intestinal end, which is then designated as Meckel's diverticulum (Fig. 13).

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in its position to the peritoneum, and which, like a true hernial sac, is directly continuous with the parietal peritoneum. The entire covering is as thin as a transparent veil, so that the underlying structures may be distinctly recognized. The coverings of the umbilical hernia are sharply defined from the skin of the abdomen, which is usually continued upon the umbilical cord for a short distance, rarely more than one centimeter.

The size of umbilical hernias is subject to the greatest variation. If only the convexity of an intestinal coil protrudes, it may be quite difficult to decide that the small swelling, scarcely as large as a hazelnut, is a hernia of the umbilical cord, while in other cases there is an eventration of almost all of the abdominal viscera, and between these two extremes a large number of intermediate degrees will be observed. If there is the slightest thickening at the commencement of the umbilical cord, the greatest care must be exercised in its ligation to avoid including the convexity of an intestinal coil.

Immediately after birth the circulation in the umbilical cord ceases from the sudden fall of the blood pressure, and the stump of the ligated cord becomes necrotic, shrivels up, and is cast off after several days, leaving behind a small granulating surface. The coverings of a hernia of the umbilical cord naturally undergo the same fate ; they dry up and are cast off, sometimes by a foul suppurative pro-

PLATE 7.

Hernia of the Umbilical Cord.—The child represented in the illustration was brought to the surgical clinic at Göttingen on March 27, 1900, five hours after its delivery. In the umbilical region there was a round tumor the size of an apple which was connected with the abdomen by a pedicle eight centimeters in circumference. The skin of the abdomen was continued upon this pedicle for a distance of almost three centimeters, where it ended as a sharp border, beyond which a transparent membrane, as thin as paper, covered the remaining portion of the tumor as far as its distal extremity, where the coverings were drawn out like a funnel and became continuous with the ligated umbilical cord. The umbilical vessels could be felt as a cord on the lower surface of the tumor. A convolution of intestinal coils, distinctly recognized through the hernial coverings, could be reduced into the abdominal cavity, a gurgling murmur being heard at the time of reduction.

The child was immediately anesthetized, the cutaneous ring about the base of the pedicle was circumscribed by an incision, and the entire hernial sac and its coverings were extirpated. The abdominal cavity was then immediately closed by four sutures passing through the entire thickness of the abdominal wall and the small wound was covered with an airol-adhesive plaster dressing. After an uneventful recovery the child was discharged April 11, 1900.

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cess, so that the abdominal viscera are exposed. In these cases the consequent suppurative peritonitis usually brings about a rapid and fatal termination. It is only when the hernia of the cord is very small, and when the sloughing of the coverings is slow enough to allow the formation of firm adhesions between the protruding viscera and the parietal peritoneum, that a spontaneous cure is possible.

From an etiologic standpoint it is scarcely possible to separate the fissure-like formations of the anterior abdominal wall from the typical hernia of the umbilical cord which has just been described. They are situated just above the navel, however, and consequently cannot be des-

Lith. Anst. F. Reichhold, München.

ignated as hernias of the cord. The viscera do not protrude into the base of the umbilical cord, but displace this structure downward as a whole, as is shown in Plate 8.

The Treatment of Congenital Hernia of the Umbilical Cord.—In very small hernias of the cord recovery may be obtained without operation by aiding the process which has previously been designated as the spontaneous cure. This is done by carefully disinfecting the umbilical region, reducing the hernia, covering the hernial orifice with a sterile piece of gauze, and supporting the abdominal wall by strips of adhesive plaster, as shown in figures 87 and 88.

If the hernia of the umbilical cord is larger, however, a cure will scarcely ever be obtained without an operation performed at the earliest possible moment.

The radical operation for hernia of the umbilical cord introduced by Lindfors in 1881 had few adherents in the beginning, but now has a large series of cures to its credit, and these are particularly worthy of note in view of the great dangers incurred. In 1900, Hansson published a collection of 73 cases treated in the antiseptic period in which there were:

6	deaths	in	11	cases	treated	by	conservative methods;
0	"	"	2	"	"	"	simple ligation;
1	death	"	5	"	"	"	percutaneous ligation;
0	deaths	"	5	"	"	"	extraperitoneal operations;
17	"	"	50	"	"	"	radical operation.

Total, 73 hernias of the cord with 24 deaths, a mortality of 32.8%.

This table also shows the different measures which have been adopted in the operative treatment of this affection. The simple ligation of the pedicle of the hernial tumor be-

PLATE 8.

A Sagittal Section of a Newborn Child with Ectopia of the Liver.—The liver, together with the gall-bladder, protrudes through a fissure extending from the navel to the xiphoid cartilage in the median line of the anterior abdominal wall and causes a spherical swelling as large as the fist the outer covering of which is formed by a bilaminar, thin transparent membrane. The inner lamella of this membrane is continuous with the parietal peritoneum. The umbilical cord is unchanged throughout and displaced downward.

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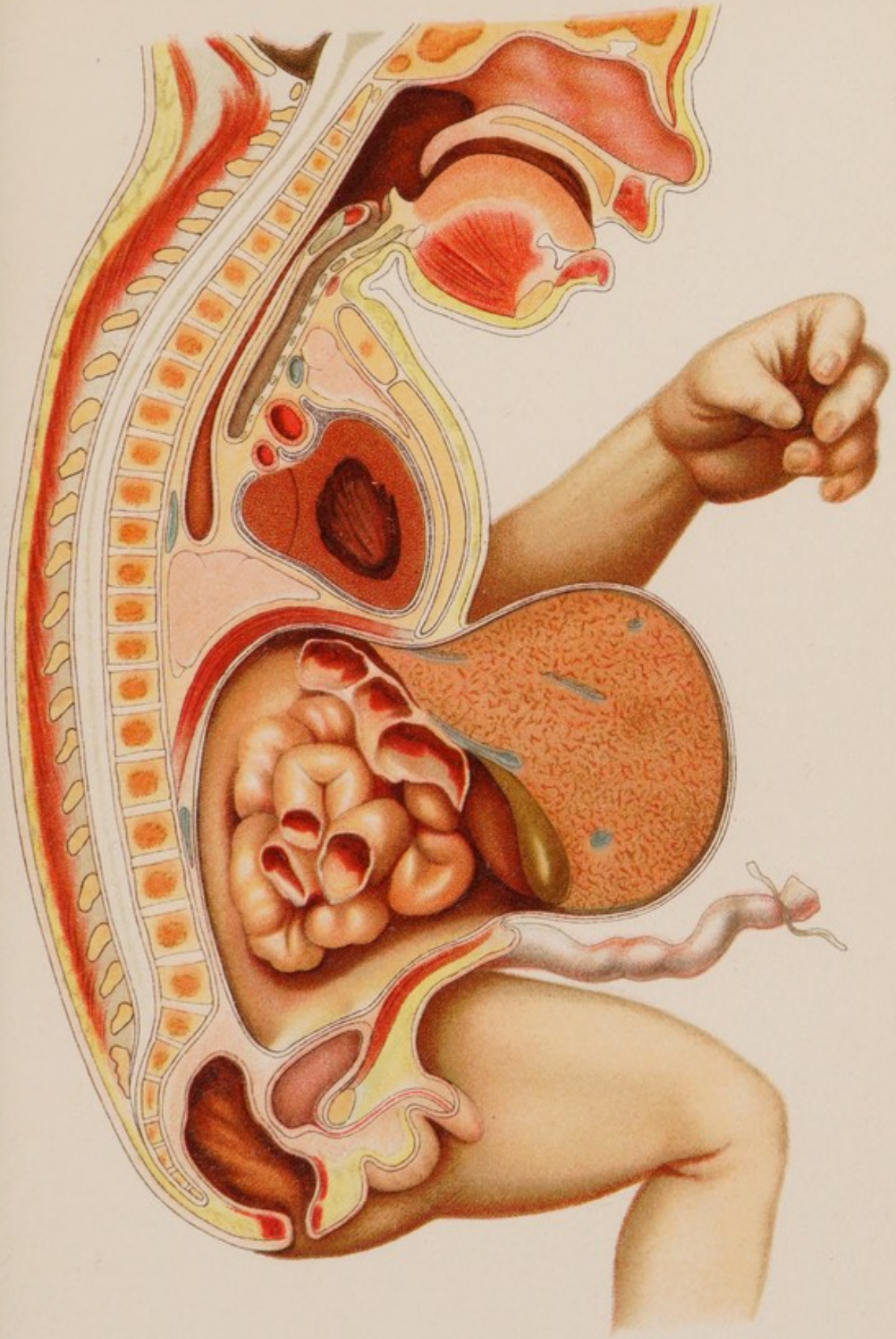
yond the cutaneous margin and the percutaneous ligation of Breus are worthy of little recommendation, since the parts ligated cannot be seen and there is consequently danger of including portions of viscera within the ligature. A second objection is that these methods, even though successful, do not close the abdominal opening. A better operation is the extraperitoneal method employed by Olshausen, who cuts through the skin only at a small distance from the cutaneous margin and draws back the amnion and the jelly of Wharton from the hernial sac. After the replacement of the sac, which is stitched into several folds, the wound is closed by a number of deep and superficial sutures. Even in this method the operation is partly done in the dark and the hernial contents cannot be inspected. For this reason the majority of surgeons perform the radical operation of Lindfors, which consists of the following steps: The opening of the hernial sac, the reduction of the contents, the circumcision of the umbilical ring close to the cutaneous margin, the extirpation of the superfluous portion of the hernial sac together with its coverings, and the closure of the abdominal wound, either layer by layer (peritoneum, muscle and fascia, skin)



Lith. Anst. F. Reichhold, München.

or by sutures passed through the entire thickness of the abdominal wall.

If the hernia of the umbilical cord is very large, so many viscera protruding that the abdominal cavity is too small to allow of their reduction, the outlook is naturally very bad. Even in such cases attempts have been made to effect a cure by a partial resection of the protruding liver (Arndt-Runge).

II. THE UMBILICAL HERNIA OF CHILDREN.

If the development of the umbilical cord is normal, the umbilical ring in the newborn is so small that it only allows space for the passage of the umbilical vessels. The umbilical cord sloughs off a few days after birth, leaving behind a small granulating surface which rapidly cicatrizes and becomes covered with epithelium from the cutaneous margin. The circular umbilical ring can still be easily felt, the upper margin more distinctly because the umbilical vein is more loosely attached in this situation than are the arteries which are firmly adherent to the lower margin. Since the umbilical scar is composed only of the skin, the transversalis fascia, together with some reinforcing fibers designated as the umbilical fascia, and the peritoneum, and only becomes smaller and more firmly closed as the child grows, it is readily understood that this thin scar may yield when the child cries and lead to the development of a hernia. To clearly understand the origin of this variety it is important to remember that the umbilical hernia of children does not develop until the navel has cicatrized. On account of the loose attachment of the umbilical vein at the upper margin of the umbilical ring,

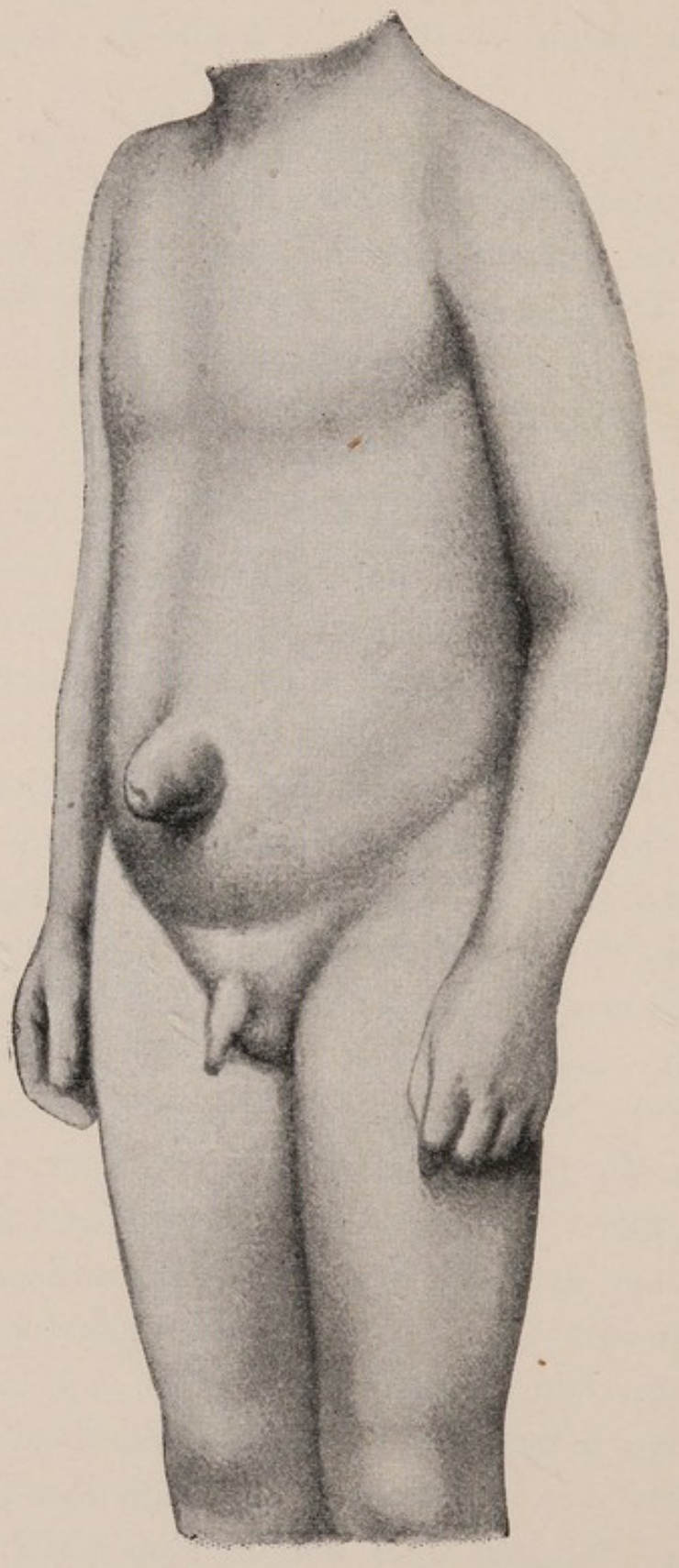


Fig. 83.—An umbilical hernia in a child three years and six months of age : The hernia is almost as large as a walnut and conical in shape. The skin of the umbilicus is greatly distended and a small scar is still visible upon the extreme convexity of the hernia.

the hernia usually protrudes between this margin and the vein.

The umbilical hernia of children usually remains quite small, and is often so diminutive that it is entirely overlooked. In these mildest cases the hernia protrudes as a swelling, varying in size from that of a pea to that of a bean, only during crying or sneezing, and goes back spontaneously as soon as the augmentation of the intra-abdominal pressure ceases. The umbilical hernias as large as a cherry or walnut (Fig. 83) also do not usually appear until the patient strains. It is only in very rare cases that the umbilical hernia of children assumes still larger dimensions.

When the hernias are small, they are usually spherical in shape; if they become larger, they ordinarily assume a conical form. In the beginning the skin of the umbilicus is unchanged in form and appearance, but as the hernia increases in size it gradually becomes flatter, distended, and only recognizable as a small flat scar upon the extreme convexity or upon the under surface of the hernia. The umbilical ring, seen from within (Figs. 84 and 85), is almost always circular and possessed of a sharp margin. In this form of hernia strangulation is extremely rare.

The small umbilical hernias frequently undergo spontaneous cure by the subsequent contraction and complete closure of the umbilical ring during the course of the first and second years.

The Treatment of Umbilical Hernia in Children.—On account of the small size of these hernias, and of their tendency to spontaneous cure, operations are but rarely necessary. The treatment must be commenced as early as

possible, however, in order to keep the hernial orifice closed by an appropriate support, and in this manner aid

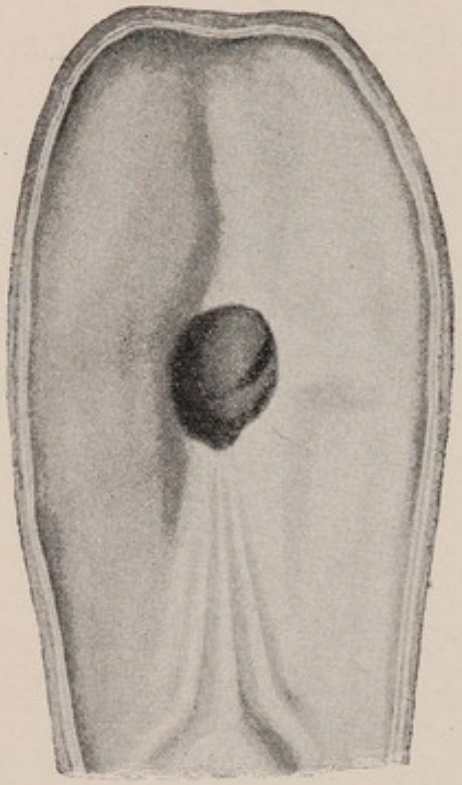


Fig. 84 represents a view from within of a section of the anterior abdominal wall of a child, less than one year old, affected with an umbilical hernia. The situation of the navel is recognized by the three folds of peritoneum which converge toward it from the bladder ; and as the hernial contents have been removed, the interior of the sac is exposed. The umbilical ring is markedly dilated ; its margin is sharp and almost circular.

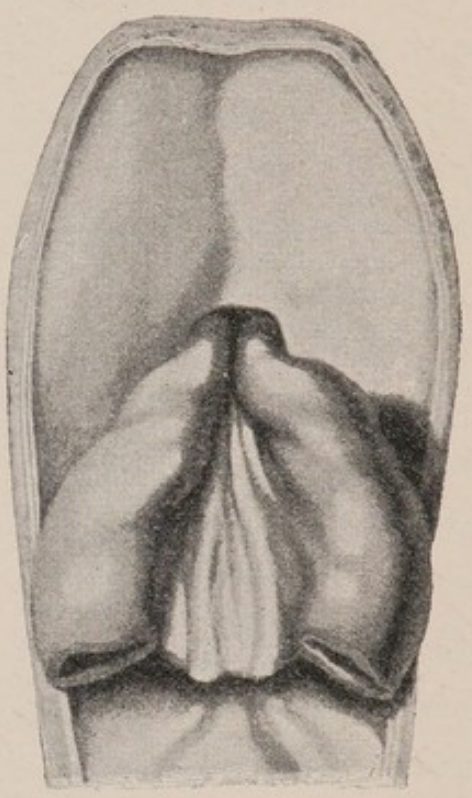


Fig. 85 shows the same specimen with an intestinal coil as the contents of the hernia.

the natural tendency to recovery. These hernias are found chiefly in children under one year of age, and as all varieties of trusses are more or less impracticable at this time,

since too much pressure is necessary to keep them from changing their position, other methods of retention must be employed. The most appropriate one is the adhesive plaster dressing, which meets every requirement and has the additional merit of simplicity. As in the application of any other retentive apparatus, the hernia must first be reduced and the adhesive plaster may then be employed in one of two ways. The first method is to make a pad of ten or twelve folds of adhesive plaster so that a small disc about three millimeters ($\frac{1}{8}$ of an inch) thick is obtained. This disc is then cut out so that its diameter is at least one centimeter greater than that of the hernial orifice. A pad as large as a quarter will usually be sufficient. The pad is fastened over the umbilical ring by means of two or three strips of rubber adhesive plaster eight to ten inches in length. A better method is that shown in figures 86 and 87. After the hernia has been reduced, the navel is invaginated and the neighboring skin raised up in two folds, which are fixed in this position by means of three strips of adhesive plaster eight to ten inches in length. None of the strips should pass entirely around the abdomen. [At the Hospital for Ruptured and Crippled we have for many years employed a strip of plaster two inches wide entirely encircling the abdomen. A pad consisting of a wooden button, $1\frac{1}{4}$ inches in diameter and covered with plaster, is applied over the hernia. This method has given very satisfactory results.—Ed.] If the rubber adhesive is of good quality, such a dressing may remain unchanged for two or three weeks without irritating the skin, and the children may be bathed without loosening the strips. Before the application of a fresh dressing, all

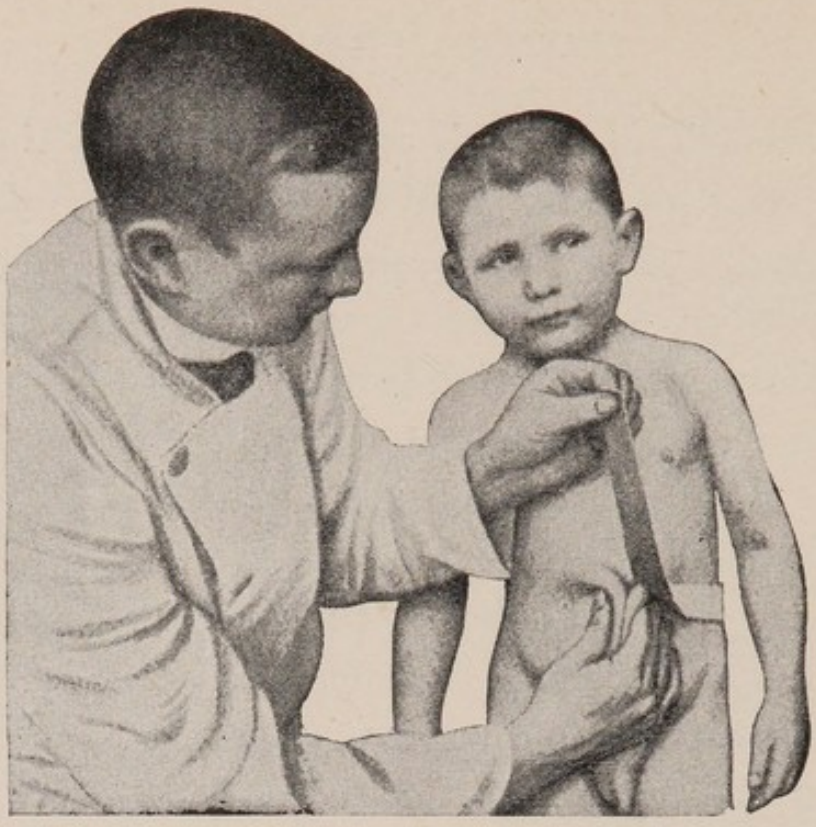


Fig. 86.—The application of an adhesive plaster dressing for umbilical hernia: The right hand has invaginated the navel and drawn the adjacent skin into two folds; a strip of adhesive plaster is applied to the left side, stretched tightly across these folds to retain them in position, and secured upon the right side.

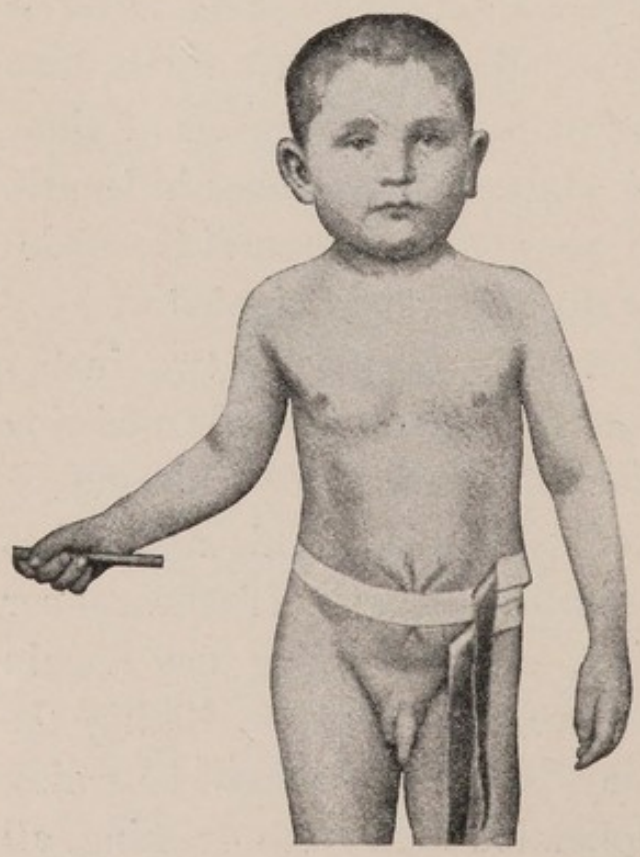


Fig. 87.—The first strip has been applied and two overlapping strips, one above and one below, have been partly adjusted. They are to be drawn over and secured upon the left side, as was the first strip.

particles of adhesive must be carefully removed with ether, and it is also well to postpone the general bath until this time.

If the children are somewhat older, some of the rubber trusses (Fig. 88) found in the shops may be employed. These trusses are made of soft rubber throughout, the hernial orifice being covered by a flat rubber pad which has an elevated central portion. This elevation must, of course, be larger than the diameter of the hernial orifice, so that it does not project into the hernial ring like a cone,

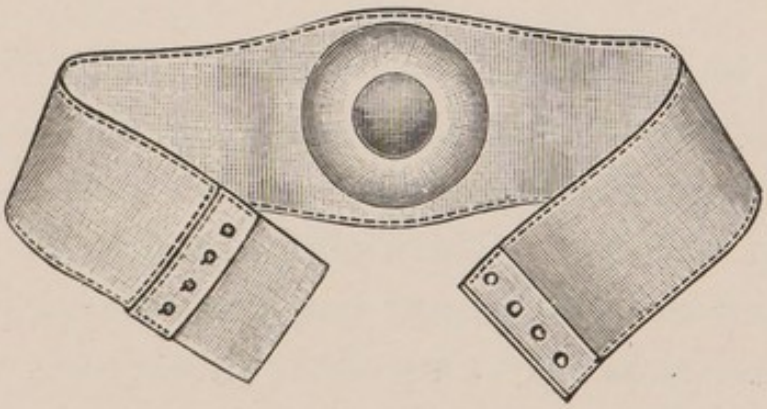


Fig. 88.

in which case it would only dilate the mouth of the hernia. The truss is provided with eyelets so that it may be laced at the back.

The treatment just mentioned must sometimes be continued for a long period of time, since a complete cure may be expected even after several years.

The radical operation is indicated if the hernia shows no tendency to recovery in spite of several years of treatment with retentive dressings, and particularly if it commences to enlarge. The operation is best performed by first cutting around and completely removing the navel

(*omphalectomy*); the hernial sac is then extirpated and the wound closed like any laparotomy wound in the linea alba. The borders of the recti muscles should be freely exposed, and it is best to pass the sutures through all the layers of the abdominal wall. The sutures should be introduced from within outward through the peritoneum, the recti muscles and their aponeuroses, and the skin; none of the sutures should be tied until all of them have been introduced. [We believe that better results will be obtained by suturing the wound in layers. It is seldom necessary to operate under the age of fourteen years.—Ed.]

III. UMBILICAL HERNIA IN ADULTS.

The causes of the development of this form of umbilical hernia differ essentially in their nature from those of the other two varieties. The umbilical region has attained a normal degree of firmness, but has secondarily become relaxed and yielding. One of the chief causes of development is the distention and relaxation of the abdominal wall that occurs after repeated pregnancies, and the great majority of cases of this variety are consequently observed in women. Other causes, however, may produce the same effect. Increasing obesity, for example, may cause the umbilicus to project more and more until it becomes so distended that a hernial protrusion results. This is particularly liable to occur when an obese individual rapidly emaciates, since the distended abdominal wall becomes completely relaxed by the emaciation. Occasionally an antecedent suppuration may diminish the resistance of the umbilical scar and lead to the development of a hernia (Fig. 89). While these hernias are small it may some-

times be determined that they do not protrude through the navel itself, but to one side, and this variety has consequently been called a parumbilical hernia. This difference completely disappears, however, with the increasing size of the protrusion. These hernias frequently grow to a considerable size, not infrequently reaching that of a man's fist, of a child's head, or attaining still larger dimensions. They ordinarily have a broad base in the umbilical region and a spherical form which sometimes becomes somewhat conical at the distal extremity of the protrusion.

The longer the large umbilical hernia of the adult exists, the more exposed it is to injurious influences, since the coverings consist only of peritoneum, transversalis fascia, and distended skin, and the exposed position of the hernia favors all sorts of mechanical irritation such as that produced by the rubbing of the clothes. The herniated viscera are frequently adherent to each other and to the wall of the sac; the hernia becomes irreducible, and if the inflammatory phenomena continue diverticula are not infrequently formed by the adhesion of folds of the hernial sac. In addition to all this, septa may be formed dividing the hernial sac into a number of loculi which may be filled with fluid and walled off by adherent omentum (König). It is therefore easily understood that considerable difficulty may be encountered in operating upon one of these large umbilical hernias.

Strangulation is not uncommon in the umbilical hernias of adults, and, from the reasons previously stated, has a graver prognosis than strangulation occurring either in inguinal or in femoral hernia. Isolated cases may be particularly complicated by the strangulation of an intestinal

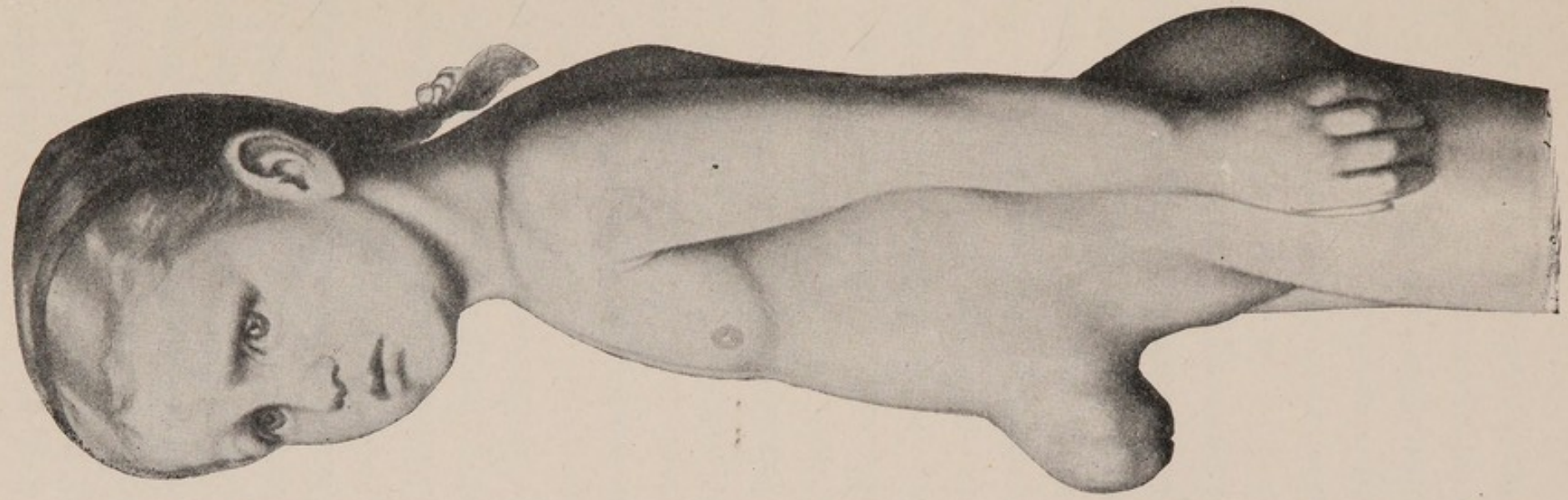


Fig. 89.—An umbilical hernia in a child five years of age : In spite of the youthful age of the patient, this hernia must be classified with those of adult life on account of its etiology. The child was perfectly healthy until it was four and one-half years of age, when a hernia developed after a suppuration in the umbilical region, the origin of which could not be determined. Within a few months the hernia attained the size of a goose-egg, as shown in the illustration. The hernia was reducible and the umbilical scar could still be recognized as a dimple upon the lower surface of the distal extremity of the hernial protrusion. Radical operation. Recovery.

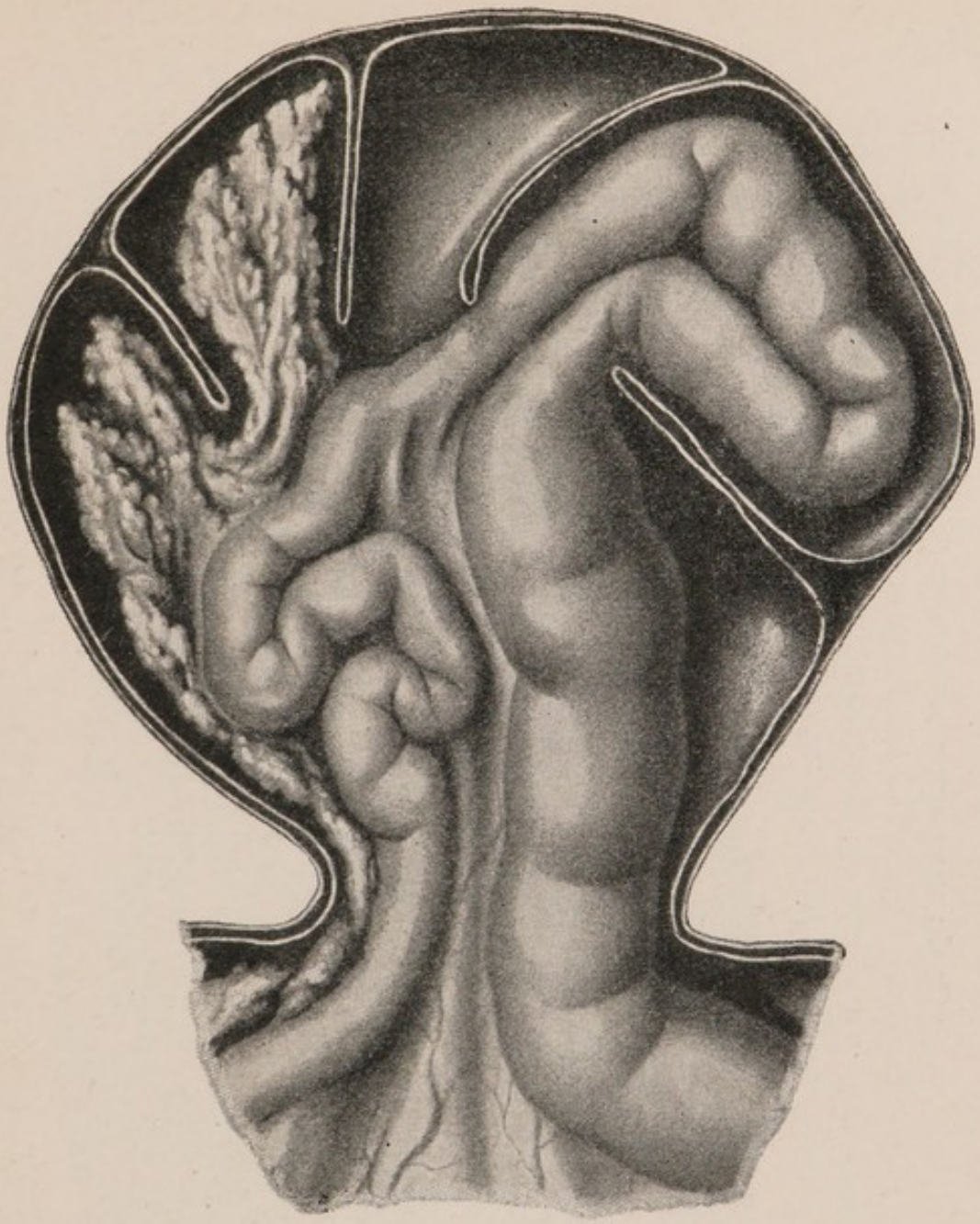


Fig. 90.—A semi-diagrammatic section through a strangulated umbilical hernia in an obese woman, who had suffered from the umbilical hernia for the previous fifteen years. The symptoms of strangulation had existed for nine days. When the herniotomy was performed, unchanged intestine and omentum were found in the hernial sac, which possessed a number of diverticula, and it was not until an attempt was made to draw the intestine forward that an intestinal coil was found which had passed into one of these diverticula and become strangulated in this situation. The illustration shows a number of septa, and in one of the diverticula formed by these septa is seen the strangulated intestinal coil. Two of the other diverticula contained omentum, while the remaining portion of the sac contained the distended afferent and the collapsed efferent intestine. A similar case has been described by Riedel.

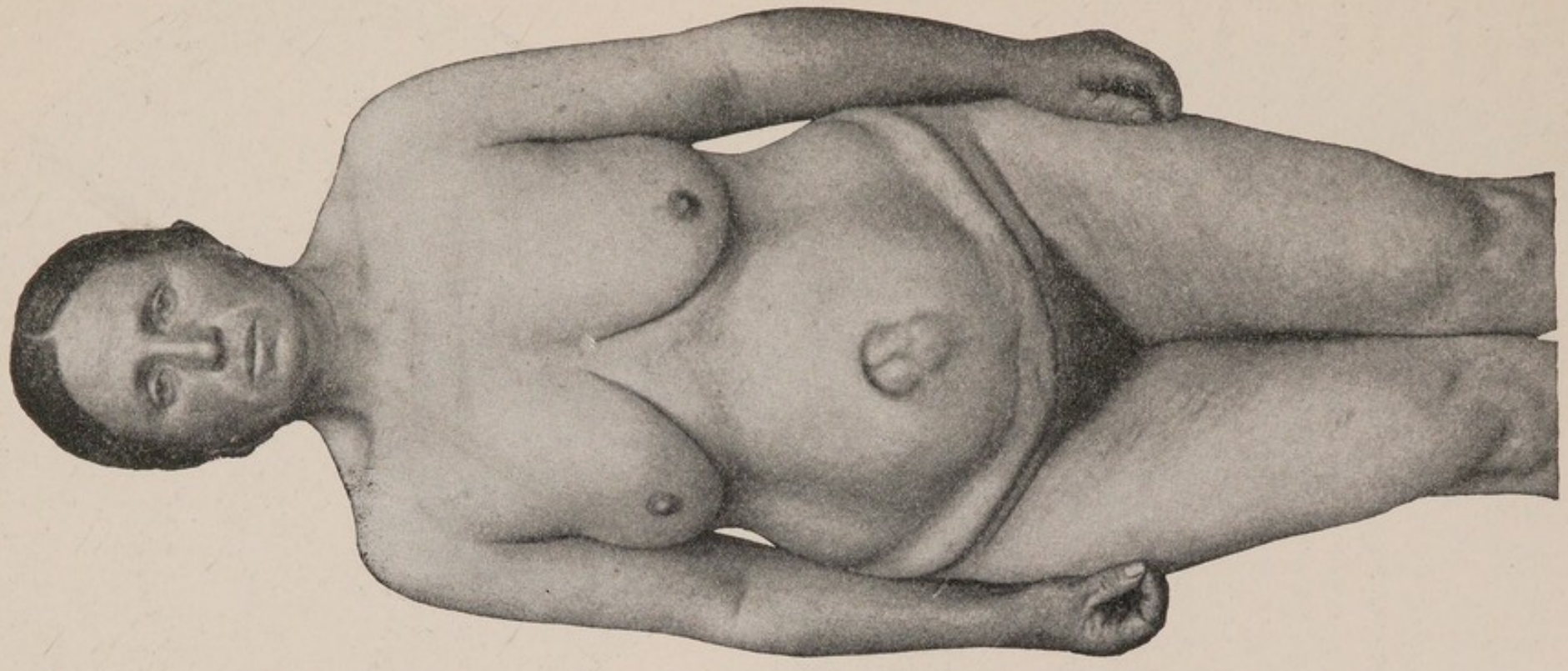


Fig. 91.—A subperitoneal lipoma in the umbilical region : A flat protrusion, about the size of a dollar, is seen which involves the lower circumference of the umbilicus. Inspection shows that the protrusion is divided into three lobes which could be distinctly palpated. The diagnosis of a subperitoneal lipoma was confirmed by operation. There was no hernial sac behind the lipoma.

coil within a diverticulum of the hernial sac (Fig. 90), the remainder of the hernial contents being found in the sac in a non-strangulated condition. [The mortality of operations for strangulated umbilical hernia is fully 50%.—Ed.]

In the differential diagnosis many affections must be considered. Solid tumors in the umbilical region, appearing either primarily or as metastatic deposits from a primary focus which is usually situated in the gastro-intestinal tract, will rarely cause confusion if they are carefully examined. It is much more likely that a subperitoneal lipoma in the umbilical region (Fig. 91) will be mistaken for an umbilical hernia. It is true that the umbilicus itself is a scar, and as such contains no subperitoneal areolar tissue, but the immediately adjacent subperitoneal areolar tissue not infrequently grows and forms a lipoma which enlarges toward the navel and finally assumes its position. If the differential points given on page 62 are borne in mind, however, it will almost always be possible to form a correct diagnosis.

The Treatment of the Umbilical Hernias of Adults.—As long as the hernias are reducible, abdominal bandages or trusses may be employed, not with the idea of curing the hernia, but for the purpose of alleviating the symptoms and preventing the enlargement of the hernia. For this purpose a pad adapted to the curve of the abdomen is employed which should have a flat elevation upon its inner surface in order to exert a firmer pressure upon the hernial orifice. It must again be emphasized that this elevation must be larger than the hernial ring (Fig. 92), so that it cannot form a conical projection into the mouth

of the hernia. Straps are fastened to a number of buttons upon the outer surface of the pad, with which it is buckled firmly about the abdomen. In order to hold the pad in position, perineal straps must frequently be employed, which are usually very irksome to the patient. If the hernia is irreducible, and if any contraindication to an operation exists, the patient must wear an abdominal suspensory such as that employed for the so-called pendulous abdomen. An abdominal bandage has been described by

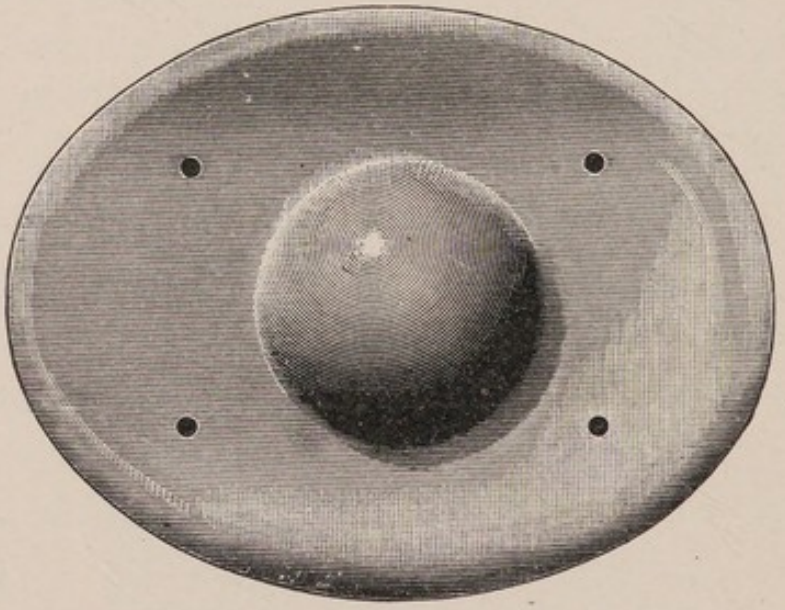


Fig. 92.

Hoffa, which prevents any displacement and at the same time furnishes a good support for the hernia (see also page 262). The fixation of this dressing is furnished by two metallic supports, similar to those employed in a scoliosis-corset, which are molded to fix the crests to the ilia, and to these supports is fastened the abdominal bandage, which accurately corresponds to the form of the individual.

The radical operation is indicated in all those forms in which the hernia is increasing in size, and if possible it

should be performed at a time when the previously described inflammatory changes have not yet taken place. The prospects for recovery, in reference to the operation in general, to the healing of the wound, and also to the development of recurrences, are much more favorable if the hernia is still small, if it is reducible, and if no inflammatory changes are present. A marked advance in the technic of the radical operation was made by Gersuny, who suggested opening the sheaths of the recti and uniting the internal borders of these muscles in addition to the customary sutures of the hernial orifice. Since the fibrous tissue of the dilated umbilical ring remains, and may easily give rise to a recurrence, it is, however, more appropriate to perform omphalectomy as perfected by Condamin and warmly recommended by v. Bruns. [The more recent method, described by Piccoli and by Blake of New York, of overlapping the recti muscles, seems to offer advantages over other methods.—Ed.]

In spite of every precaution recurrences are observed more frequently than in other hernial regions, since the causes of the development of the hernia, such as obesity and relaxation of the abdominal wall from pregnancy, continue to exert their influence after the operation. If the hernia is irreducible or annoying on account of its size, the operation has at least the advantage that an appropriate abdominal bandage, always applied after operations upon such cases, prevents the reappearance of the troublesome symptoms.

In comparison to the previously described varieties of hernia there are others of rarer occurrence, an exact knowledge of which is of no less importance, particularly in ref-

erence to the early recognition of strangulation in these situations.

OBTURATOR HERNIA.

An obturator hernia is one which passes through the obturator canal and appears upon the anterior surface of the thigh. Since the discovery and first description of this form of hernia by Arnaud de Ronsil (1720), a rather large number of cases have been recorded, but the total number is comparatively so small that the description of individual cases is still considered worthy of being published. With the exception of numerous cases in which the affection was first recognized at operation or upon the postmortem table, the diagnosis has hardly ever been made unless strangulation was present, and this explains the fact that Berger could discover only one obturator hernia among 10,000 hernia patients who were ordered trusses at the Central Bureau of Paris.

ANATOMY.

The obturator foramen is almost completely closed by a striated membrane,—the obturator membrane (Fig. 93), —which is only patulous in its upper and outer portion where the obturator canal gives passage to the obturator vessels and nerve. The upper boundary of this canal is formed by the obturator sulcus upon the inferior surface of the horizontal ramus of the pubis.

The pelvic surface of the obturator membrane is covered by the obturator internus muscle, in which there is a fissure, corresponding to the obturator canal, for the passage of the vessels and nerve. The hernia, after passing

through the obturator canal alongside of the vessels, comes in contact with two rigid muscles, the obturator externus and the pectineus, and this accounts for the fact that a protrusion is not visible externally until the hernia has attained a relatively late stage of development. The

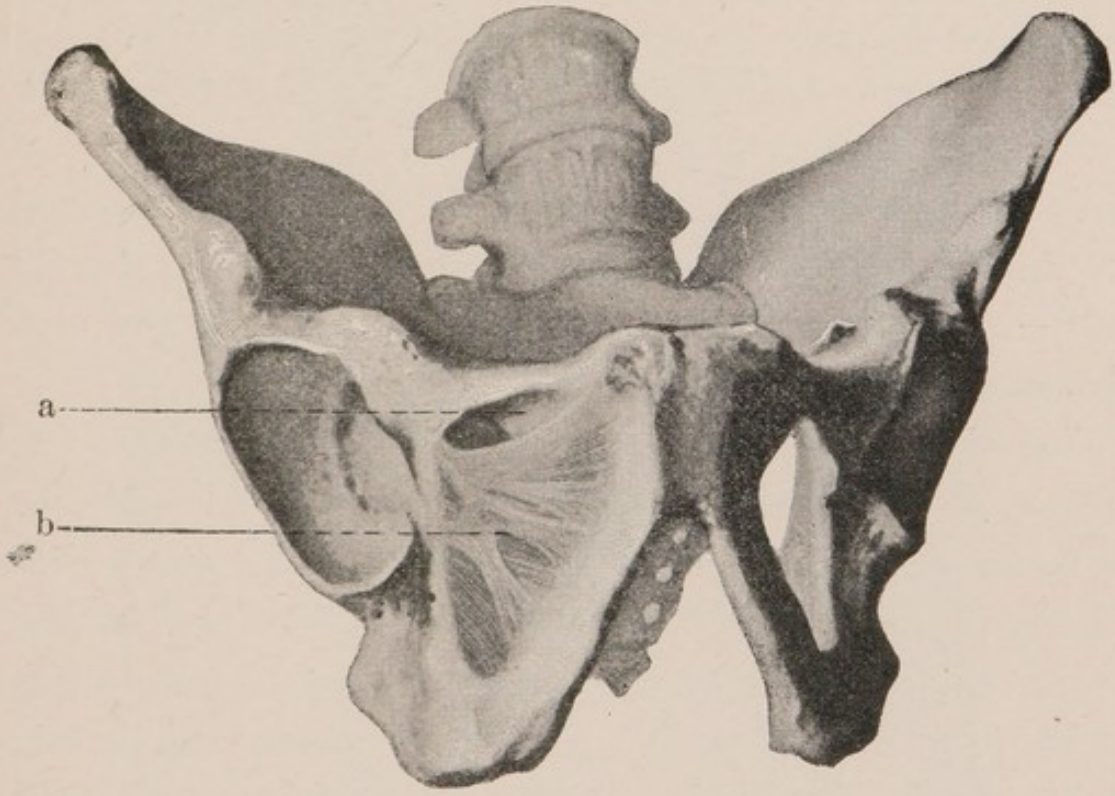


Fig. 93.—A bony pelvis in which the obturator membrane (b) has been left in the right obturator foramen. The membrane entirely fills the foramen, with the exception of an opening (a) which is designated as the obturator canal. It is through this opening that the obturator hernia escapes, the obturator vessels and nerve being pushed to one side.

obturator externus muscle arises from the inner and lower margin of the obturator foramen; its fibers are in immediate contact with the obturator membrane and pass directly outward to the trochanteric fossa. In front of the obturator externus is the pectineus muscle, which arises from the horizontal ramus of the pubis and passes from

Fig. 94.—Anterior view of an obturator hernia: A part of the pectineus and the entire obturator externus muscle have been removed, exposing the bony pelvis and a portion of the obturator membrane. The iliopsoas and pectineus muscles have been drawn apart, and between them lie the stumps of the femoral vessels. The sac of the obturator hernia has been opened and an intestinal coil is seen within. a, Poupart's ligament; b, iliopsoas muscle; c, femoral artery; d, femoral vein; e, spermatic cord; f, upper stump of the pectineus muscle; g, sartorius muscle; h, obturator hernia; i, obturator membrane; k, adductor longus; l, lower stump of the pectineus muscle.

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above downward and from within outward to be inserted into the femur below the lesser trochanter. The hernia itself and its relations to the neighboring muscles and vessels are shown in figure 94.

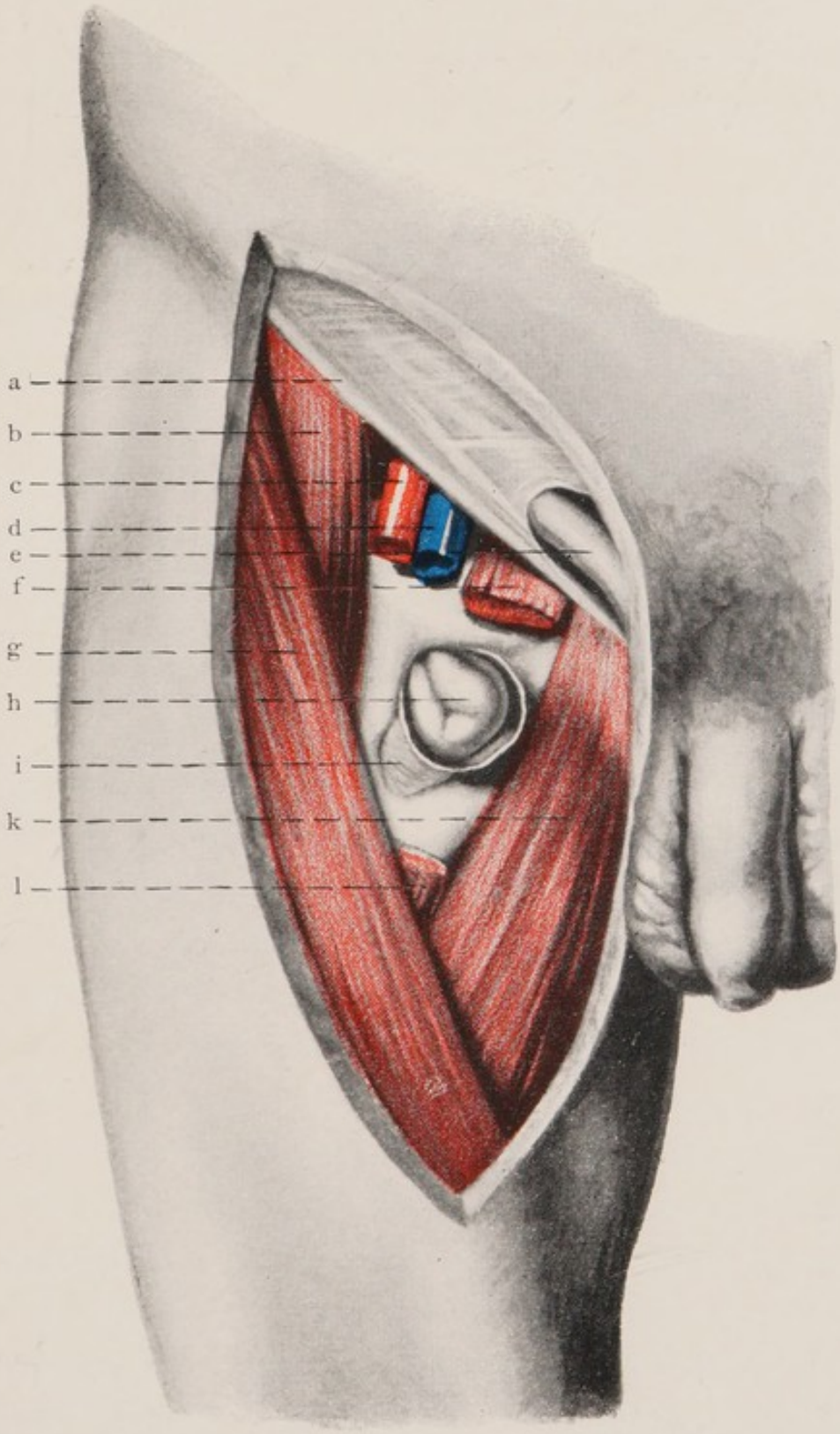
The size of the hernia is usually inconsiderable on account of the narrowness of the obturator canal, and, for the same reason, hernia of the intestinal wall may easily develop in this situation. Owing to the position of the hernia behind the muscles, the visible external swelling is flat and obscurely defined. It is only when the hernia attains a considerable size that it thins and distends the overlying muscles or pushes between their individual fibers; in such cases a large protrusion may develop which extends upward and is usually regarded as a femoral hernia.

Subperitoneal lipomas are not rare in this situation.

THE DIAGNOSIS OF OBTURATOR HERNIA.

From what has been said of the anatomy of the part, the depth of the hernia protected by overlying muscles and the consequent difficulty of diagnosis have been sufficiently emphasized. There are, nevertheless, characteristic

Fig. 94.



cases in which an exact diagnosis may be made, although they are usually those in which strangulation is present. The most important indication of the presence of an obturator hernia is the Howship-Romberg symptom, which is produced by the pressure of the hernial protrusion upon the obturator nerve. Since the anterior branch of this nerve, after supplying the gracilis, adductor longus, and adductor brevis muscles and perforating the deep fascia, furnishes sensation to the inner side of the thigh as low down as the knee, compression of this nerve causes intense pain and sometimes paresthesias which are referred to the area supplied by the terminal sensory filaments. A glance at the inner surface of the anterior pelvic wall in a case in which an obturator hernia was present will clearly show the relation of the hernial sac to the obturator nerve (Fig. 95).

The hip-joint is frequently slightly flexed in order to relax the muscles, and any attempt to change this position is extremely painful. If in addition to this symptom there is a flat sensitive elevation in the region of the pectineus muscle and signs of intestinal obstruction, the presence of a strangulated obturator hernia may be inferred with a fair degree of certainty. Even under these conditions the diagnosis is not absolutely certain, since it is possible that suppurations proceeding either from the pelvis (Landerer) or from the peritoneum (Kronlein) may pass outward through the obturator canal and even simulate the symptoms of intestinal occlusion by irritating the peritoneum. An obturator hernia may be differentiated from one of the femoral variety by the fact that it is situated below and internal to the location at which the femoral hernia

Fig. 95.—A frontal section through the pelvis in a case of obturator hernia. The inner surface of the anterior pelvic wall is shown; the entire peritoneal lining has been removed with the exception of the portion surrounding the mouth of the obturator hernia. The hernial orifice is below and to the inner side of the femoral vein; the obturator vessels and nerve are in immediate contact with the neck of the sac, being situated between this structure and the transversalis fascia. a, deep epigastric artery; b, spermatic artery and vas deferens; c, femoral artery; d, femoral vein; e, Poupart's ligament; f, urinary bladder, g, sac of the obturator hernia; h, obturator nerve; i, obturator vessels; k, seminal vesicle; l, rectum.

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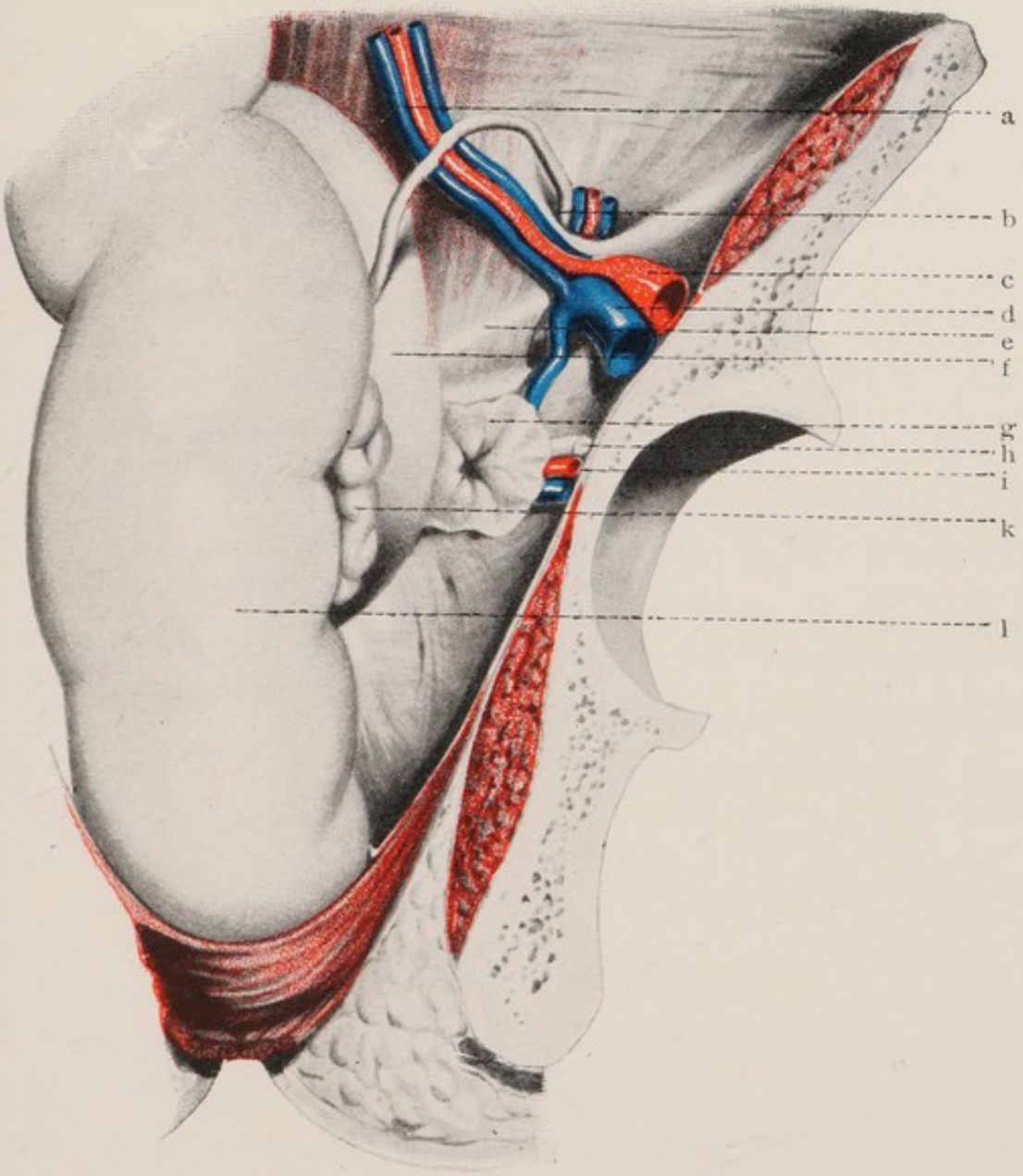
usually makes its appearance. In spite of all these signs, however, there are cases in which laparatomy is performed on account of intestinal obstruction, and the presence of a strangulated obturator hernia is not recognized until the time of operation.

THE TREATMENT OF OBTURATOR HERNIA.

Since our present methods do not enable us to accurately diagnose a non-strangulated obturator hernia in a larger percentage of individuals than formerly, we can scarcely speak of a radical operation, and hardly more of a treatment by means of a truss. It will consequently suffice if we consider the treatment of strangulation occurring in this region. If a diagnosis of strangulated obturator hernia has been made, or if there is a suspicion that such a condition exists, an incision should be made in the anterior femoral region and the diagnosis confirmed. The incision for the relief of the constriction should be nothing more than a notch, since the obturator artery always lies directly against the neck of the sac, usually to the outer side. The hernial canal is sometimes so narrow that the strangulated

Fig. 95.



intestinal coil can be drawn forward only with difficulty and shows a tendency to slip back into the abdominal cavity. In such cases it is best to open the abdomen above Poupart's ligament, and the intestinal coil can then usually be drawn out, thoroughly inspected, and resected if necessary, the peritoneal cavity being previously walled off by packing sterile gauze about the gangrenous intestine. The operation is terminated by extirpating the hernial sac and, if the depth of the wound will allow it, the closure of the hernial orifice by several catgut sutures.

The results so far obtained in the treatment of obturator hernia cannot be said to be satisfactory, and this is mainly due to the difficulty of making an early diagnosis. In 105 cases of obturator hernia collected by H. Schmidt, no operation was performed in 62 patients; 43 cases were operated upon with 17 cures, 13 by a femoral incision, 3 by laparotomy, and one by a combination of the two methods. An artificial anus was made in 4 cases, all ending fatally; intestinal resection was necessary in 5 cases, one of these terminating in recovery.

SCIATIC HERNIA.

The extreme rarity of this variety of hernia may be seen from the fact that Garrè was able to collect only 11 undoubted cases observed prior to 1892. It is true that a larger number of cases have been published as instances of sciatic hernia, but a portion of these must be excluded, since they were really perineal hernias. The sciatic hernia has received its name from the fact that it passes out of the pelvis through one of the sciatic foramina. Figure 96

shows a lateral view of the pelvis with the greater and lesser sacrosciatic notches and the lesser and greater sacrosciatic ligaments which respectively convert these notches into foramina.

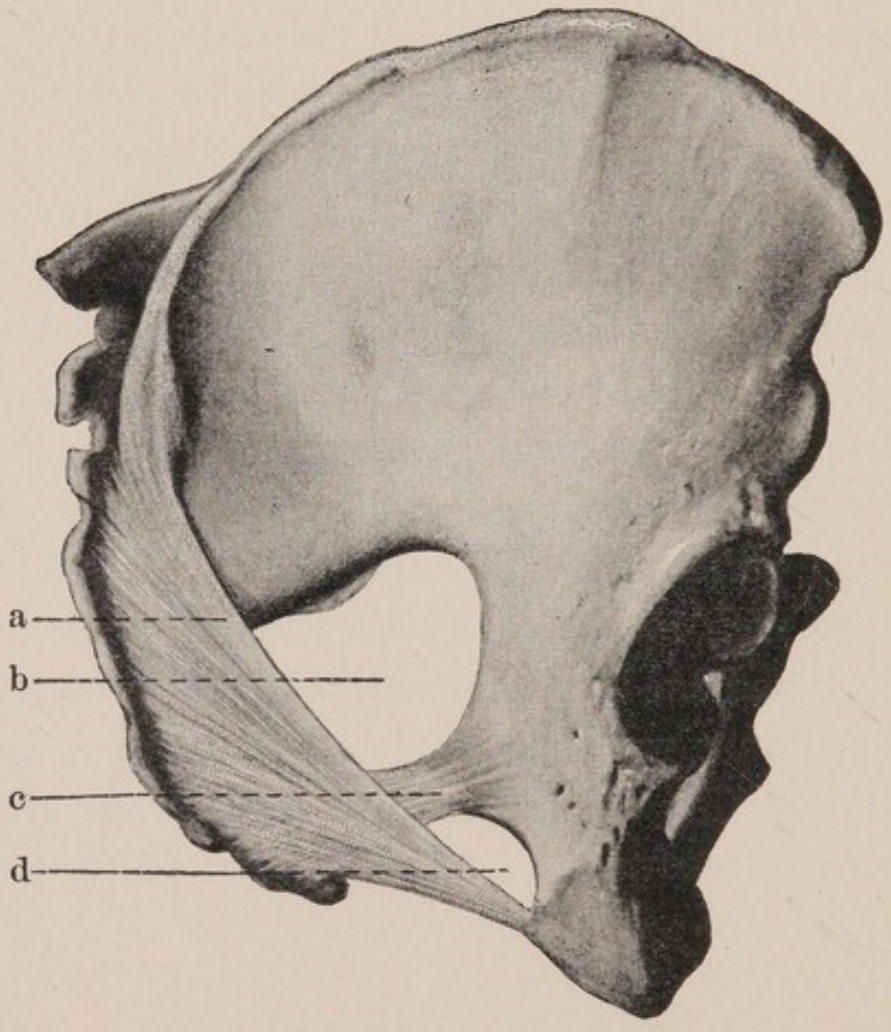


Fig. 96.—A lateral view of the bony pelvis: a, Great sacrosciatic ligament; b, great sacrosciatic foramen; c, lesser sacrosciatic ligament; d, lesser sacrosciatic foramen.

The larger portion of the great sacrosciatic foramen is filled by the pyriformis muscle, which arises from the inner surface of the sacrum and is inserted into the trochanteric fossa of the femur. The gluteal artery passes out through the great sacrosciatic foramen above the pyriformis, while

the sciatic artery and nerve emerge through the same foramen, but below this muscle (Fig. 97). The lesser sacrosciatic foramen is filled by the obturator internus muscle, which arises from the inner surface of the obturator membrane and from the border of the obturator foramen, passes out through the lesser sacrosciatic foramen, and then turns at a right angle to be inserted into the trochanteric fossa. A sciatic hernia may pass out from the pelvis at one of three places: (1) Through the great sacrosciatic foramen alongside of the gluteal artery (above the pyriformis); (2) through the same foramen alongside of the sciatic artery (below the pyriformis); (3) through the lesser sacrosciatic foramen. According to Garrè, the most important anatomic method of differentiating a sciatic from a perineal hernia is by its position above the great sacrosciatic ligament. Both these hernias appear externally at the lower border of the gluteus maximus. In order to avoid confusion, Garrè recommends that only those hernias which pass out through the lesser sacrosciatic foramen should be designated as sciatic hernias, while the other two, passing through the great sacrosciatic foramen above and below the pyriformis, should be known as the superior and inferior gluteal hernia respectively.[1] Of these three varieties, the superior gluteal hernia is the most frequent, and an ovary has been found in such a hernial sac in three instances.

[1] TRANSLATOR'S NOTE.—This classification may seem confusing to the English mind, but its apparent complexity may be readily explained by the differences between German and English anatomic nomenclature. The gluteal artery of English and American works is known as the superior gluteal by the Germans, while the sciatic artery is known as the inferior gluteal. According to Garrè's classification, the superior gluteal hernia passes out with the gluteal artery, while the inferior gluteal hernia follows the sciatic artery.

Fig. 97.—A lateral view of a sciatic hernia (superior gluteal hernia): The gluteus maximus muscle has been divided and thrown back, a portion of the gluteus medius has been removed, and the hernial sac has been opened, exposing an intestinal coil. a, Gluteus medius muscle; b, gluteus maximus muscle; c, gluteal artery; d, gluteus minimus muscle; e, sciatic hernia (superior gluteal hernia); f, pyriformis muscle; g, sciatic artery; h, great trochanter; i, sciatic nerve. The three muscular bundles situated below the pyriformis are, from above downward, the superior gemellus, the obturator internus, and the inferior gemellus.

These hernias are usually small, and sometimes so insignificant in size that no external swelling is visible. The largest sciatic hernia as yet observed had attained the size of a child's head.

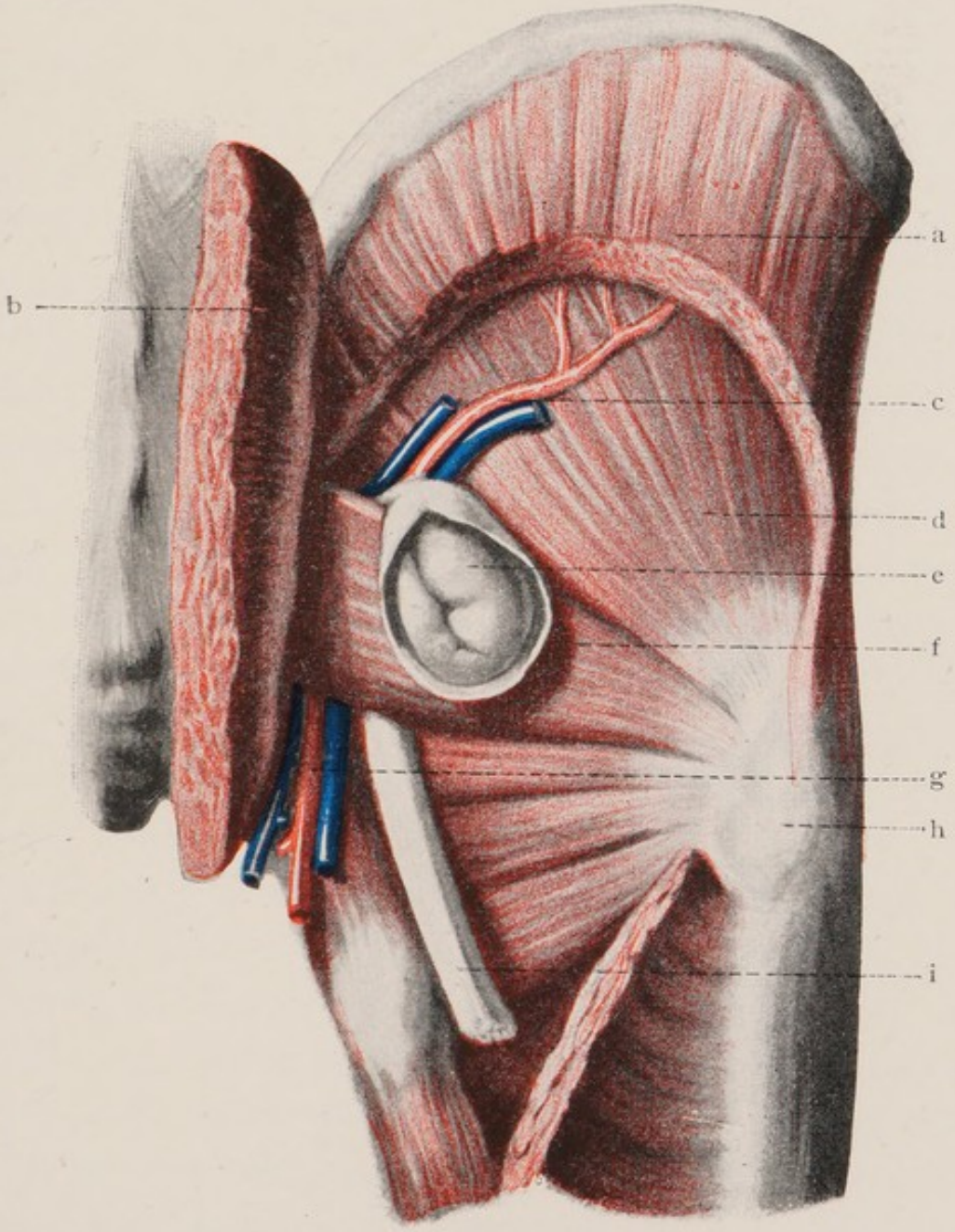
Three of the cases collected by Garrè had undergone strangulation.

PERINEAL HERNIA.

All hernias which protrude through the muscular floor of the pelvis toward the perineum are designated as perineal hernias, and receive special names according as to whether the skin, the vagina, or the rectum is pushed in advance of the hernial protrusion.

The partition between the peritoneal cavity and the pelvic outlet is formed by a funnel-shaped muscular mass, which passes from the lateral walls of the pelvis to the lower end of the rectum and is known as the pelvic diaphragm. The individual muscles forming this diaphragm are the coccygeus and the pubic and iliac portions of the levator ani. The urogenital tract passes through the pubic portion of the levator ani muscle and a narrow slit is not

Fig. 97.



infrequently found between the iliac portion of the levator ani and the coccygeus. The space in the pubic portion of the levator ani for the passage of the urogenital tract is bridged over by the urogenital diaphragm, the foundation of which is the deep transverse perineal muscle. The upper and lower surfaces of the pelvic diaphragm are covered by the superior and inferior fascias of the pelvic diaphragm respectively. The space below the pelvic diaphragm, between it, the skin of the perineum, and the tuberosity of the ischium, is known as the ischiorectal fossa, and is filled with loose areolar tissue about the lower end of the rectum. Every perineal hernia must pass through the pelvic diaphragm, either between the coccygeus and the levator ani muscles or between the fibers of the levator ani. The hernia then passes downward in the ischiorectal fossa (Fig. 98) until it causes a protrusion of the skin of the perineum (*perineal hernia*). The hernia may protrude toward the rectum (*rectal hernia*), toward the vagina (*vaginal hernia*), or toward the posterior portion of the labium majus (*pudendal hernia*).

According to Ebner, who published a monograph upon perineal hernia in 1887, the main requisite for the development of this variety is a congenital low position of the peritoneal fold in the space of Douglas—the recto-vesical fold in the male, the recto-uterine fold in the female. Although the opposite opinion is held by certain authorities, Ebner denies that a laceration of the perineal muscles by an injury, such as a fall from a height, can exert any influence upon the development of this hernia. "A trauma or gross mechanical lesion is no more able to produce a perineal hernia than is a fissure in the levator ani

Fig. 98.—Diagrammatic frontal section through the pelvis, exposing the rectum (a). The pelvic diaphragm (b) is seen passing from the inner surface of the true pelvis to the lower end of the rectum. This diaphragm is perforated on one side by the protrusion of a hernial sac which is still situated within the ischiorectal fossa. a, Rectum; b, pelvic diaphragm; c, parietal peritoneum; d, sac of a perineal hernia.

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alone; a congenital or pre-existing peritoneal fold is necessary in all cases. If a mechanical lesion occurs, it may cause either a separation of the pre-existing fissure in the levator ani, allowing the intestine, which already rests upon the pelvic floor to protrude, or it causes the hernial sac, which has already protruded through the levator ani, to become filled with intestinal coils." At all events, it will consequently be seen that such an accident may exert a deleterious influence upon the hernia.

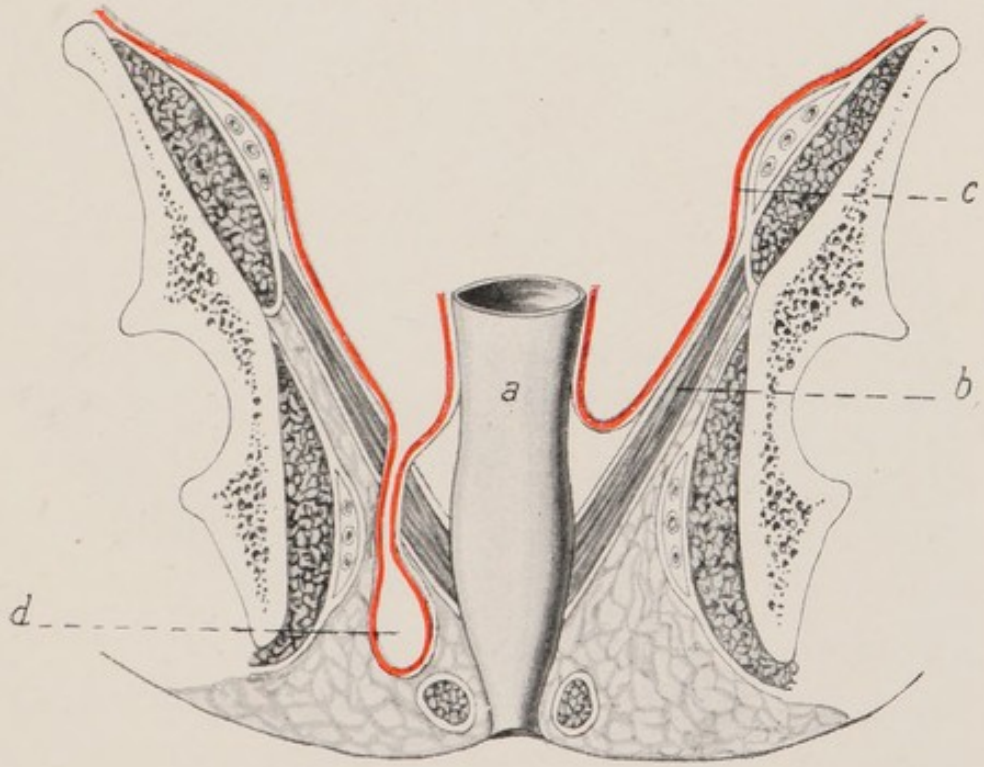
A perineal hernia may appear in any of the following forms:

1. In the male the hernia descends between the bladder and the rectum and causes a protrusion of the skin of the perineum.

In the female the hernia develops between the uterus and the rectum, and appears either near the anus or in the posterior portion of one of the labia majora. Such hernias appearing between the anus and the tuberosity of the ischium will consequently protrude externally, like a sciatic hernia, below the lower border of the gluteus maximus.

2. The hernia protrudes toward the rectum or vagina and pushes one of these structures in advance of it, so that a prolapse of the organ occurs (the prolapse hernia of Rose). In this manner a rectal hernia (Fig. 99) or a posterior vaginal hernia may arise.

Fig. 98.



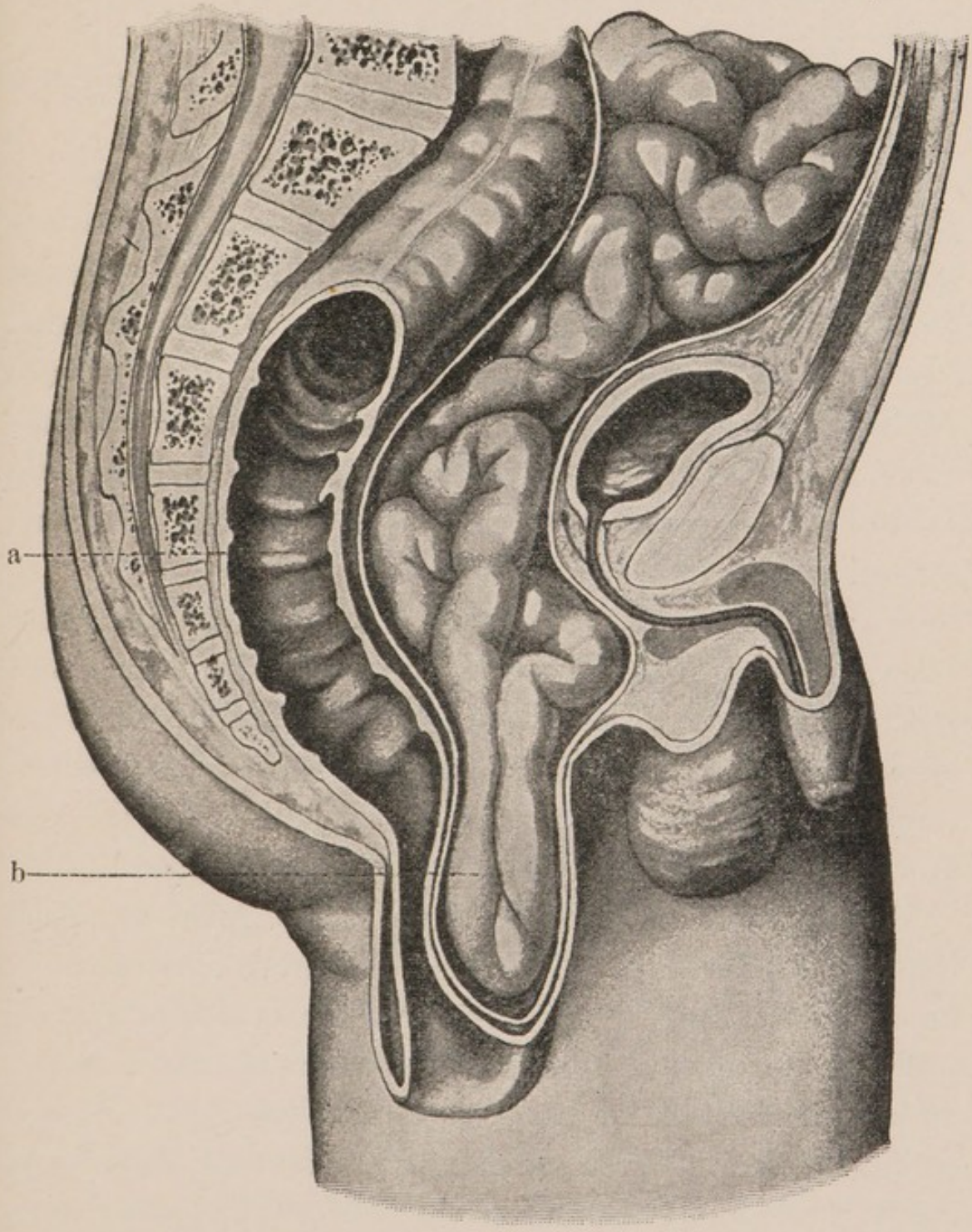


Fig. 99.—A semi-diagrammatic sagittal section of a male pelvis revealing a perineal hernia (a prolapse hernia of the rectum). The prolapsed rectum (a) has been partly cut open and the recto-vesical space has been distended by the downward protrusion of a large hernial sac (b) which contains a convolution of intestinal coils.

3. In the female the peritoneal protrusion may occur in the space between the uterus and the bladder, so that a prolapse hernia of the anterior vaginal wall (anterior vaginal hernia) is produced.

In addition to these completely developed forms of perineal hernia, incomplete forms also occur, since the hernia may remain in the ischiorectal fossa or protrude toward the bladder without causing a visible external swelling. Hernias are also observed in the perineal region which protrude through the scars resulting from the sacral operation for the removal of the rectum; these are called sacral hernias by Hochenegg, who has described several such cases.

A perineal hernia may attain a considerable size. Hager, for example, described one case, the hernia protruding alongside of the rectum, the longitudinal diameter of which was about 48 centimeters, while the greatest transverse diameter was about 24 centimeters. Hernias of such dimensions are, of course, extremely rare.

The diagnosis of perineal hernia is of great practical importance, for it is clear that disastrous consequences must ensue if such an apparently harmless rectal or vaginal prolapse is supposed to be due to an abscess or to a polyp. It has happened that such cases have been either incised or ligated, according to the nature of the supposition, and the intestine has either been opened or completely constricted by a ligature. In addition to a careful consideration of the general symptoms of hernia, the presence of a gurgling murmur upon reduction should be particularly sought for as a sign of the presence of an intestinal coil.

The performance of the radical operation is made most

difficult by the deep position of the hernial orifice and by the relaxation of the pelvic diaphragm. Records of such operations are extremely scanty at the present time.

[INGUINO-PERINEAL HERNIA.

There is another variety of hernia, which Sultan does not mention, and which, in fact, is seldom described in any of the text-books on hernia—namely, inguino-perineal hernia. This name I have used in describing a hernia associated with mal-descent of the testis. I have observed six cases of testis in the perineum, in four of which there was an associated well-developed hernia, the latter following the course of the testis and appearing in the perineum rather than in the scrotum. In one of these cases which I have reported, the hernia was the size of a cocoanut and the testis very small and ill developed. In this case the testis, together with the entire pouch, consisting of sac and skin, were removed and the wound closed in three layers. The patient remained well for three years and then death resulted from drowning. In the other three cases the testes were apparently fully developed, and in these cases, by preserving a sufficient amount of peritoneum, it was possible to make a perfect tunica vaginalis. I then formed a new pouch with the finger in the hitherto empty scrotum, into which the testis with its new tunica was transplanted. The patients made a good recovery and have remained well up to the present time.—Ed.]

DIAPHRAGMATIC HERNIA.

Strictly speaking, the majority of the so-called diaphragmatic hernias should not be designated as such if we adhere to our original definition, according to which every abdominal hernia must have a sac. The detailed collections of cases given us by Lacher (1880), Thoma (1882), and Grosser (1899) show that the great majority of these so-called hernias have no sacs; in Grosser's collection of 433 cases, for example, only 40 had sacs. The diaphragmatic hernias differ from ordinary hernias in still another respect, since they are congenital in the majority of cases and are dependent upon an arrested development of the diaphragm. We may consequently differentiate the following varieties:

True	diaphragmatic hernia		(with a sac);
False	"	"	(without a sac);
Congenital	"	"	(true or false);
Acquired	"	"	(true or false).

According to Cruveilhier, whose view is supported by Thoma, another pathologic condition, usually designated as diaphragmatic hernia, would be better described by the term "diaphragmatic eventration." This is produced by a marked protrusion of the attenuated left half of the diaphragm into the left thoracic cavity. "In this manner a sac is formed consisting practically of connective tissue, which fills a large part of the thoracic cavity and looks not unlike an actual hernial sac" (Thoma).

The diaphragmatic hernia mostly affects the left side,

probably because the liver furnishes a protection for the right side of the diaphragm.

In order to become acquainted with the situations in which the hernias of the diaphragm usually protrude we must briefly review the normal structure of the inferior surface of the diaphragm (Fig. 100).

The diaphragm is composed of three muscular portions,—the sternal, costal, and lumbar,—which are united by a central fibrous plate, the central tendon. A narrow fissure exists between the sternal and costal portions (Fig. 100, b), and there is a second one of varying size located between the costal and lumbar portions (Fig. 100, h). The lumbar portion of each side is composed of three crura—an internal, an intermediate, and an external. The aortic opening lies between the internal crura of the lumbar portions, that for the esophagus is embraced by the same crura, while that for the vena cava is situated in the right half of the central tendon. The sympathetic trunk passes between the external and intermediate crura of the pars lumbalis.

Disregarding the cases in which the entire diaphragm or its tendinous center are wanting, hernial orifices have been observed in the following situations, which are given in the order of their frequency: (1) Central tendon; (2) the muscular portion, particularly in the posterior inferior portions; (3) the fissure situated between the sternal and costal portions; (4) the esophageal opening; (5) the fissure situated between the lumbar and costal portions; (6) the point of passage of the sympathetic trunk.

From what has been said, the following possibilities must be borne in mind in considering the development of a diaphragmatic hernia. A congenital defect in the dia-

Fig. 100.—A view of the inferior surface of the diaphragm: a, Sternal portion; b, fissure between the sternal and costal portions; c, costal portion; d, central tendon; e, inferior vena cava; f, esophagus; g, lumbar portion; h, fissure between the lumbar and costal portions; i, aorta; k, psoas muscle; l, quadratus lumborum muscle; m, sympathetic trunk.

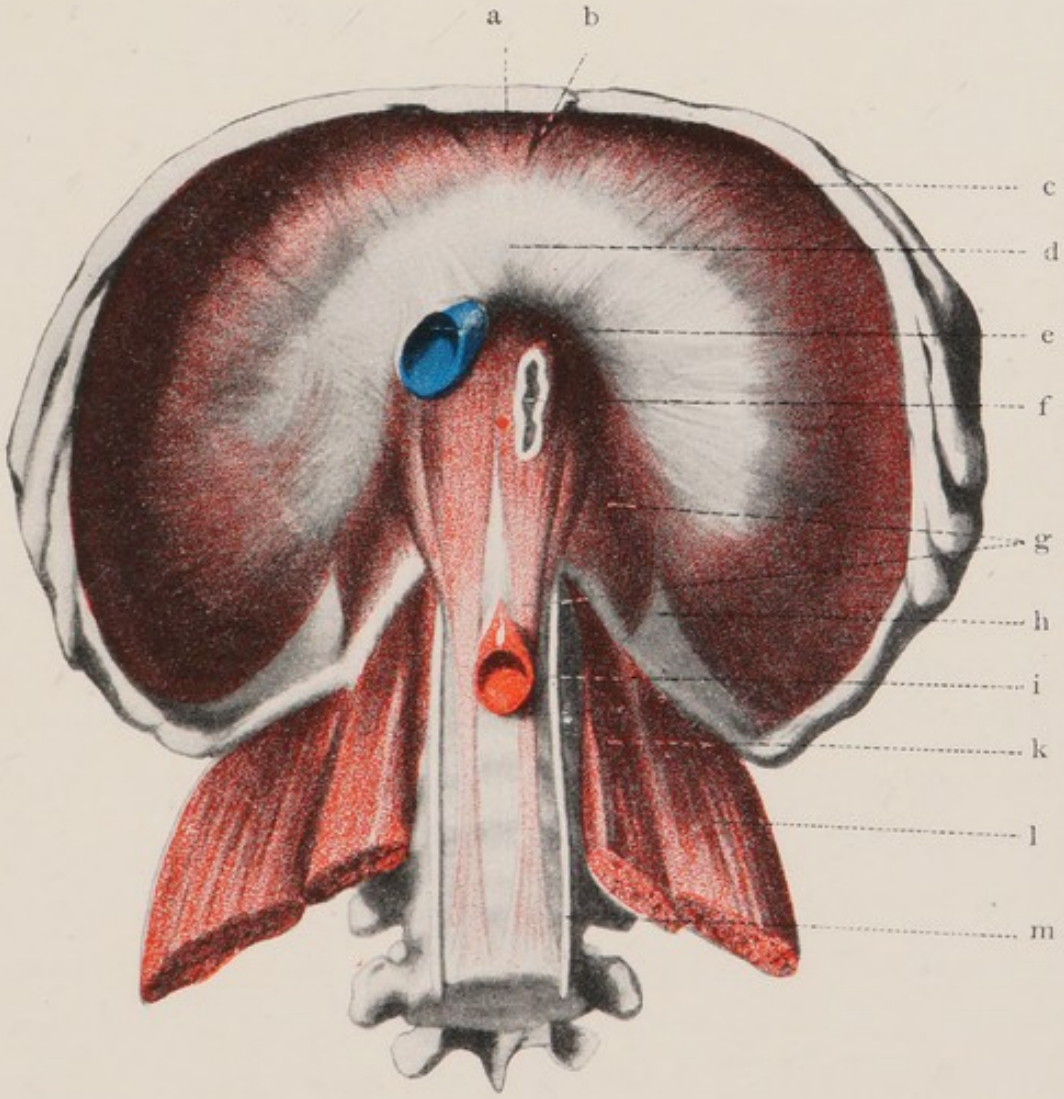
phragm may exist and the abdominal viscera are situated within the thoracic cavity at birth or enter it during extra-uterine life; a hernia acquired later in life may pass through one of the previously mentioned fissures, probably favored by a traumatism which has led to a dilatation of one of these fissures. Still another possibility is furnished by injuries of the diaphragm from punctured or gunshot wounds or even from a contusion; if the diaphragm is completely perforated, a diaphragmatic hernia without a sac results, while if it is only penetrated, so that the parietal peritoneum remains intact, the diaphragmatic hernia is provided with a sac. The following figures, furnished by the collections of Thoma and Grosser, give an idea of the relative frequencies of the different varieties of diaphragmatic hernia.

Of 433 diaphragmatic hernias there were:

Congenital Hernias.					Acquired Hernias.	
True Hernias.		Eventrations.	False Hernias.		True.	False.
Right.	Left.	Left.	Right.	Left.		
10	20	8	33	181	10	171

In spite of the considerable number of diaphragmatic hernias which have been reported, the diagnosis has been made in the living scarcely more than six times. Leichten-

Fig. 100.



stern diagnosed one case correctly, and quite recently Hirsch had a case in which the diagnosis made by a physical examination was confirmed by skiagraphy in a most interesting manner.

As the stomach is very frequently displaced into the thoracic cavity, gastric disturbances play the chief rôle in the symptom-complex. The patients complain of gastric pains which appear after eating and radiate to the thoracic region. These attacks of pain alternate with periods of comparative good health, and are to be partly referred to the temporary occurrence of strangulation.

A clear note like that of intestinal tympany may be demonstrated by percussing the affected half of the thorax, and is particularly distinct if the stomach is inflated or if air is pumped into the intestine through the anus. According to Hirsch, a high position of the diaphragm may be excluded by the more marked protrusion of the affected side of the chest. In the ordinary left-sided diaphragmatic hernia, the displacement of the heart to the right is so characteristic that the possibility of the existence of a diaphragmatic hernia should be borne in mind in every case of isolated dextrocardia. The more viscera in the thoracic cavity, the greater the compression exerted upon the heart and lungs; and in those hernias which develop suddenly, particularly the traumatic variety, death may occur at once or very quickly, being preceded by symptoms of violent dyspnea and marked cyanosis. Under certain circumstances, individuals with diaphragmatic hernias may reach an advanced age, but they are always in danger of having a strangulation from any kind of excessive exertion.

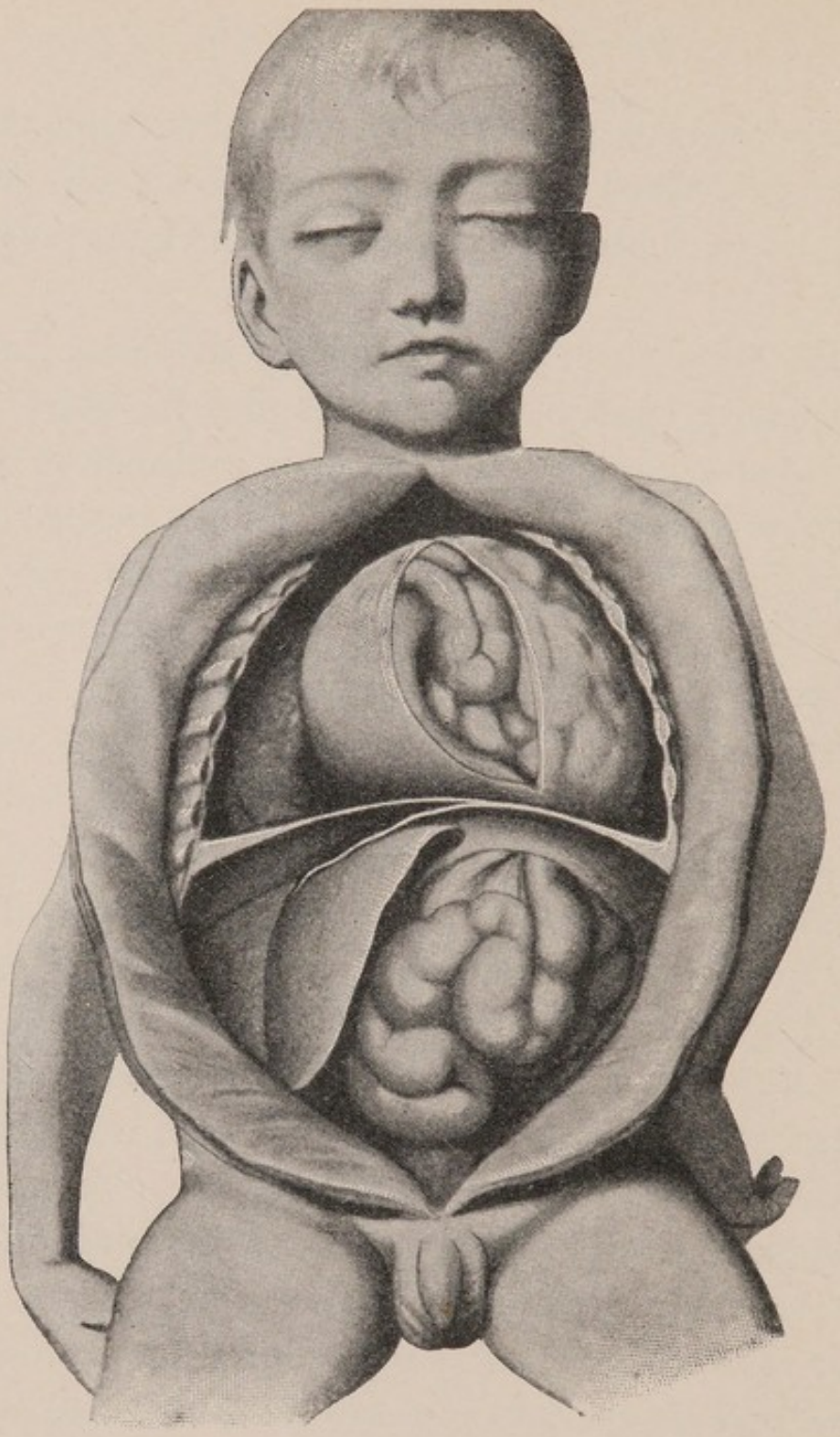


Fig. 101.—A newborn child with a true left-sided congenital diaphragmatic hernia. At the autopsy, performed at the Pathologic Institute at Göttingen, the hernial sac, which was half the size of a fist, was found to contain the stomach, the spleen, and the greater portion of the small intestine. A finger could be comfortably passed through the defect in the diaphragm, which was situated about 1½ centimeters to the left of the esophageal opening. The cecum and vermiform process were found at the left side of the vertebral column covering the left kidney.

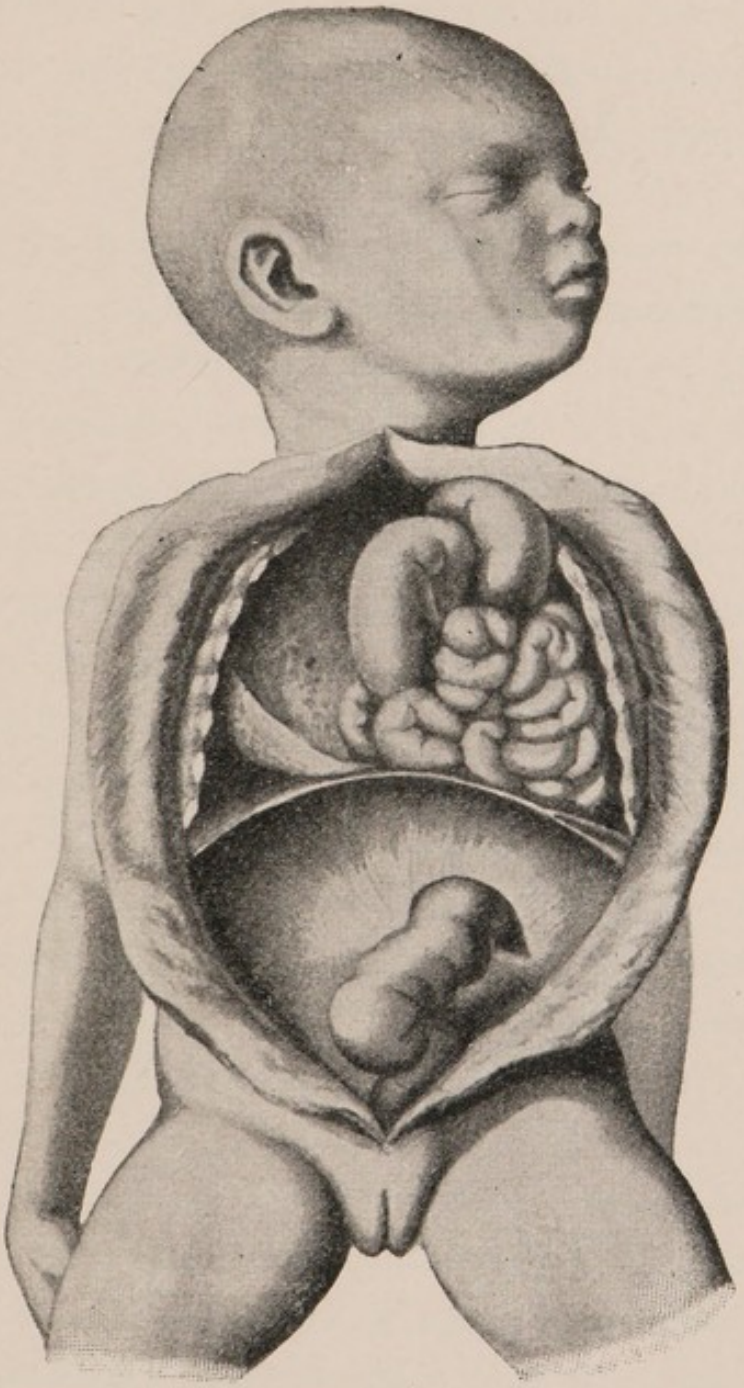


Fig. 102.—A newborn child with a false left-sided congenital diaphragmatic hernia. The defect involved the posterior and inferior part of the left half of the diaphragm and was limited to the muscular portion. It was circular in shape, had a smooth edge, and was about $2\frac{1}{2}$ centimeters in diameter. The hernial contents consisted of the liver, all of the small intestine, and the greater portion of the large intestine with the cecum and vermiform process.

In addition to the stomach and colon, omentum, small intestine, liver, duodenum, pancreas, spleen, and kidney have also been found as contents of a diaphragmatic hernia.

Up to the present time, treatment has been instituted only in strangulated diaphragmatic hernias. Under such conditions a laparotomy has been performed, the viscera drawn back into the abdominal cavity, and an occasional recovery obtained. It has repeatedly happened, however, that the strangulated diaphragmatic hernia has not been found in spite of the performance of laparotomy. If the diagnosis of a strangulated diaphragmatic hernia has been surely made, Perman suggests the exposure of the hernial orifice in the pleural cavity by making a horseshoe flap out of the thoracic wall; sufficient space may be obtained by resecting the ribs to allow of thorough inspection, reduction of the hernia, and suture of the hernial orifice. To the best of my knowledge, this suggestion has not yet been practically tested.

VENTRAL HERNIA.

All of the hernias appearing on the anterior abdominal wall, with the exception of the umbilical and the inguinal, are designated as ventral hernias, and these are subdivided into the median ventral hernia, or hernia of the linea alba, and the lateral ventral hernia.

HERNIA OF THE LINEA ALBA.

Although the importance of this variety of hernia, first described by Garengeot (1743), and made the subject of an

excellent description by A. G. Richter, of Göttingen (1785), was early recognized, it did not receive general attention until during the last twenty or thirty years. The description of these hernias is inseparably connected with a consideration of the subperitoneal lipomas, which show a marked predilection for this location, because they may easily be mistaken for hernias and because both a hernia and a lipoma may coexist in this situation. These hernias are far more commonly observed above the umbilicus, midway between it and the xiphoid process, than below the umbilicus, and this is due to the anatomic structure of the linea alba, which is formed by the union of the layers of aponeurosis in the median line of the body. The connective-tissue fibers from both sides interlace and form a dense network with lozenge-shaped interstices. The linea alba which is thus formed becomes broader as it passes from the xiphoid cartilage to the umbilicus, and is rather thin in this situation, while below the umbilicus it becomes narrower and at the same time increases in thickness. The hernias appearing above the navel are also known as epigastric hernias. Those hernias which occur immediately to one side of the median line are also included under the designation of hernias of the linea alba, since they do not exhibit any clinical differences from this variety. The frequency of epigastric hernia is shown by the statistics of Berger: In 10,000 patients with hernia he found 137 of the epigastric variety; 117 of these were in males over fifteen years of age, 12 were in females of the same age, and 3 were in boys and 5 in girls who were under fifteen years of age.

It has previously been mentioned that subperitoneal

lipomas (Fig. 103) are of frequent occurrence in this situation. The exact ratio which they hold to true hernias may be learned from the series of cases collected by Plöger, who found that in 77 so-called epigastric hernias only 46 were true hernias, the remaining 31 cases being lipomas. The lipomas vary in size from that of a pea to that of a hen's egg, although they rarely attain the latter

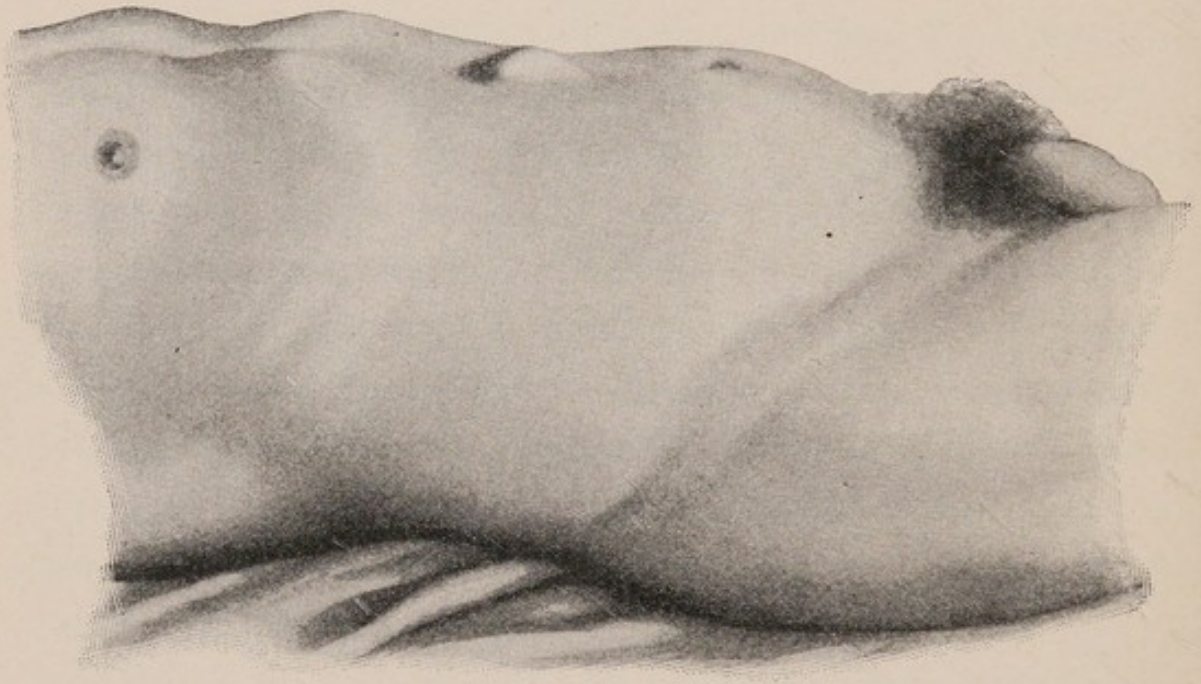


Fig. 103.—A subperitoneal lipoma resembling an epigastric hernia situated midway between the umbilicus and the xiphoid cartilage.

dimensions (see also Fig. 42). The fissure in the linea alba through which the lipomas protrude is almost always transverse; this is best observed in small lipomas, since the increasing size of the tumor must cause the orifice to dilate and assume a more or less circular outline (Fig. 16). It occasionally happens that several such lipomas are situated one above the other. The diastasis of the recti muscles which is not infrequently encountered has no more to do

with an actual hernia than has the supra-umbilical eventration [1] which was repeatedly found in children by Berger, and we may consequently omit its consideration.

It was formerly supposed that the stomach was very frequently found within the true hernias, since the patients complain particularly of gastric disturbances and because the tumor is usually situated in the gastric region, but we have previously learned (pages 44 and 48) that these disturbances may be reflexly produced by traction upon the peritoneum. As a matter of fact, there are only a few cases in the literature in which the stomach has been certainly demonstrated as the contents of such a hernia ; the hernial sac usually contains omentum and, more rarely, a coil of small or large intestine. If the hernial sac is empty, it is usually very small and connected with a subperitoneal lipoma.

Figures 104 and 105 illustrate a particularly rare case of strangulated epigastric hernia. The hernial protrusion, almost as large as a man's head, was situated above the umbilicus somewhat to the right of the median line. All the signs of strangulation were present, and at the herniotomy the sac was found to contain strangulated omentum in which a malignant tumor was present.

In very rare cases congenital apertures in the linea alba may have something to do with the development of epigastric hernias (Cooper), and it may be said in a general way that the same causes which are active in the formation of

[1] "Supra-umbilical eventration is characterized by the protrusion of the supra-umbilical peritoneum and the abdominal viscera through the interspace between the recti muscles when the child cries or when it flexes the thighs upon the abdomen" (Berger).

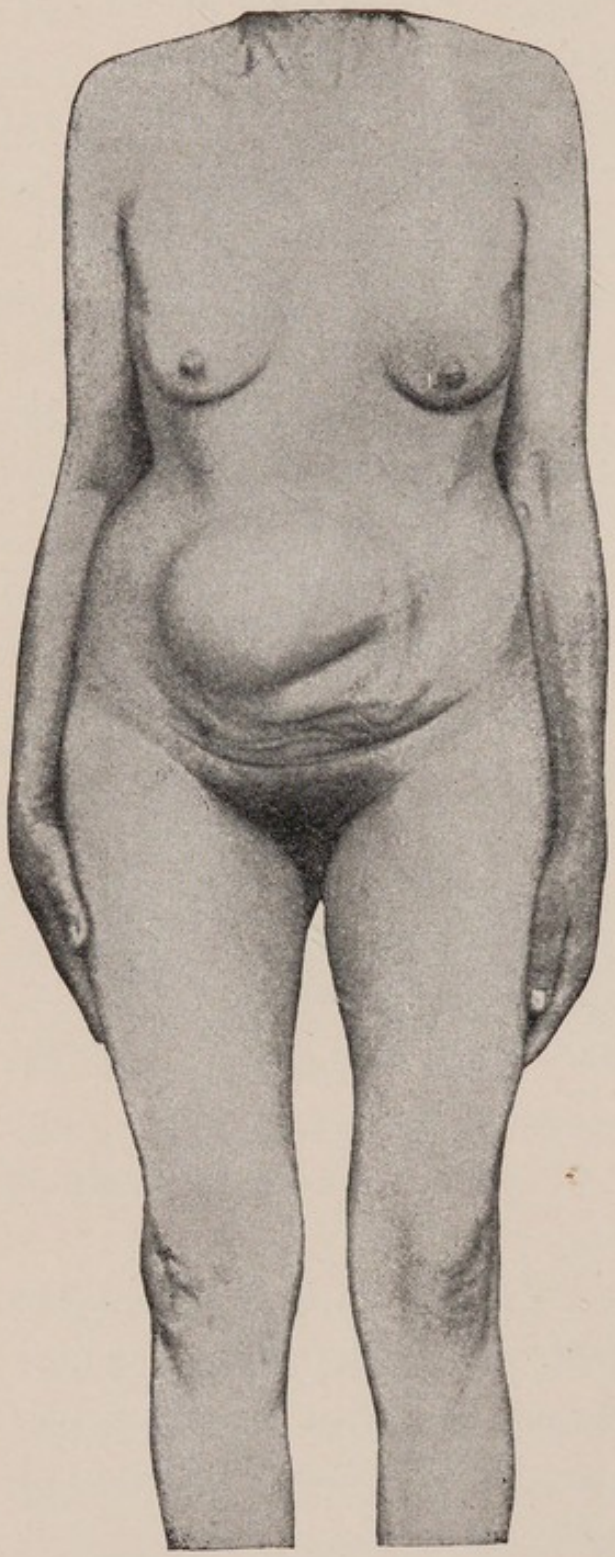


Fig. 104.

Fig. 105.

Fig. 104.—Anterior view of a patient with a strangulated epigastric hernia.

Fig. 105.—A lateral view of the same patient. The patient was fifty-one years of age and for the past eight years had had an irreducible epigastric hernia as large as a goose-egg. Six days before her admission to the surgical clinic at Göttingen the hernia suddenly increased in size and caused violent pain. Since this time absolute constipation existed and there was frequent vomiting.

The examination of the unfortunate woman revealed a tumor immediately above the umbilicus, almost as large as a man's head, which extended on both sides of the median line and particularly toward the right side. The overlying skin was red, thickened, and adherent. The tumor was very sensitive to pressure and gave a dull note upon percussion. The umbilicus was unchanged and situated upon the left side of the inferior surface of the tumor.

At the operation, which was immediately performed, the incision into the hernial sac gave exit to a bloody hernial fluid and exposed a large mass of abnormal omentum. After the hernial orifice, which was five centimeters (two inches) in diameter, had been enlarged by an incision the omentum was ligated in sections and extirpated. The sac was also removed and the abdominal wound closed with interrupted silk sutures, which were passed through all the layers of the abdominal wall.

Microscopic examination showed that the extirpated mass was a malignant omental tumor, partly of alveolar structure, which had originated in the peritoneal endothelium.

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other hernias must exert an influence in the development of this variety. A particular influence is assigned to trauma by many, and in certain cases this cannot be denied. It is questionable whether a single trauma can ever form a hernial sac. It is much more probable that a small, unrecognized lipoma draws the peritoneum out into a funnel-shaped diverticulum so that the hernial sac is already formed when the traumatism occurs. It will be readily understood that such a pre-existing sac may suddenly be-

Fig. 106.—Multiple lateral ventral hernias. This patient was thirty-nine years of age and had borne five children without exhibiting any abnormality of the abdominal wall. At about the fourth or fifth month of the sixth pregnancy she fell and struck her abdomen against a pile of rubbish. Soon after this accident she noticed the appearance of an umbilical hernia. After the birth of the sixth child the umbilical hernia gradually enlarged ; it was no longer reducible and was finally operated upon. About eight weeks later she caught cold, and the coughing caused a new hernial protrusion above the scar resulting from the operation. She was then operated upon a second time. She again became pregnant, and during and after this pregnancy other hernias developed at several locations in the abdominal wall.

When the patient was examined at the surgical clinic at Göttingen, she had a most marked pendulous abdomen and a linear operative scar which commenced above the umbilicus and extended downward in the median line for a distance of 12 centimeters ($4\frac{3}{4}$ inches). In addition to a diffuse protrusion of the upper portion of the operative scar and of the region immediately above it, three sharply circumscribed lateral ventral hernias were observed. The first of these was as large as a child's head and situated upon the right side ; its contents could be reduced, a gurgling murmur being heard at the time of reduction, and three or four fingers could be comfortably introduced into the hernial orifice. The second hernia was below, and the third to the left of the operative scar. The latter two hernias were only half as large as the first ; they were readily reducible and their hernial orifices were large enough to admit one or two fingers.

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come enlarged and filled with viscera by an injury which produces an excessive tension of the anterior abdominal wall and, at the same time, a violent augmentation of the intra-abdominal tension. It is worthy of note that the epigastric hernias developing without preceding injury are usually observed in strong healthy men in the prime of life who do the heaviest kind of work. Völckers has recently laid particular stress upon this fact, and regards the strenuous occupation as the chief cause of development of such hernias. The continuous heavy work is supposed to

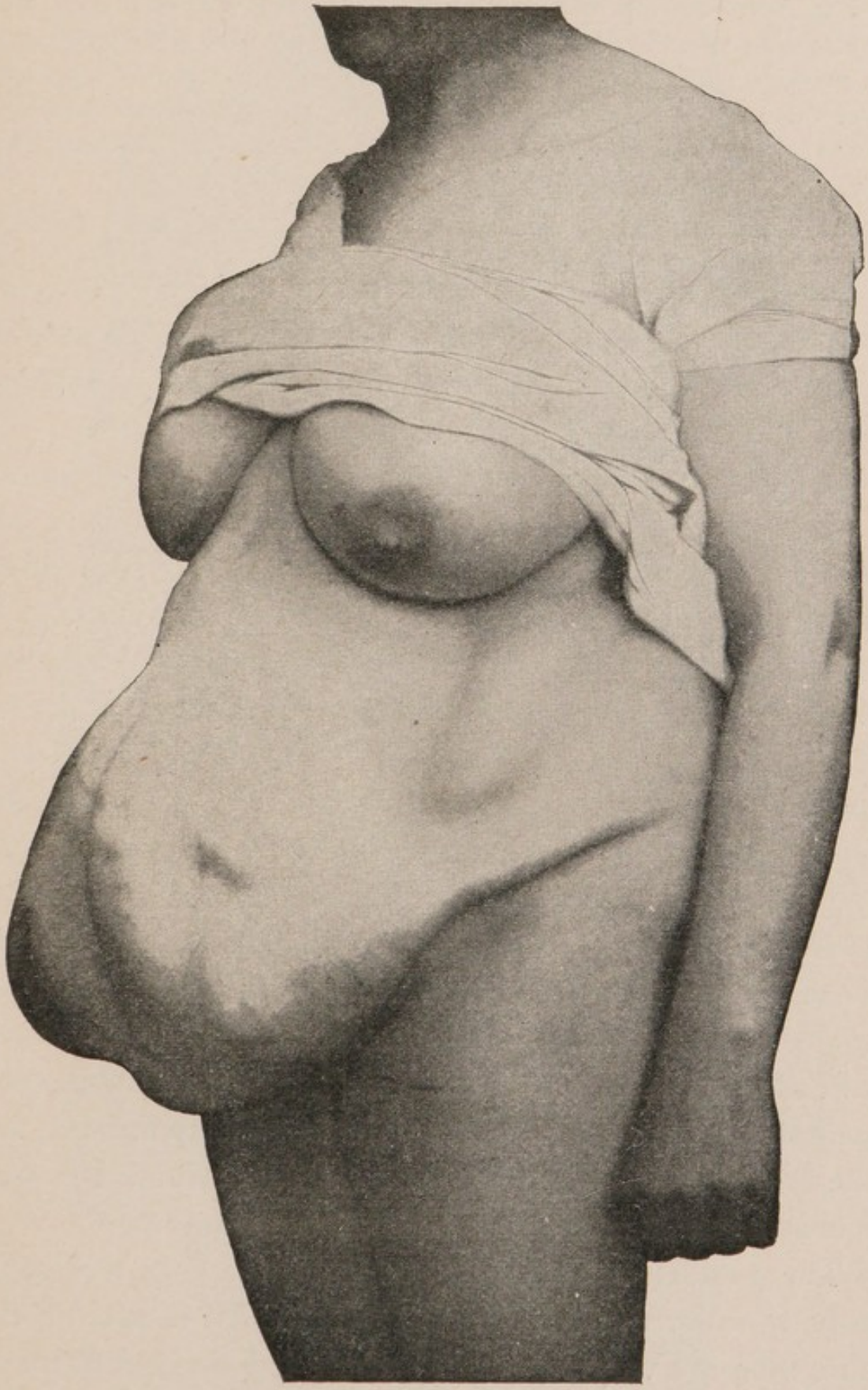

Fig. 106.

Fig. 107.—Hernia of a scar after laparotomy. This patient was twenty-four years of age and had had her vermiform process removed on account of recurring attacks of appendicitis. About six months later three small hernias developed at the sites of the stitch-holes; they varied in size from that of a hazelnut to that of a walnut, two being to the right and one to the left of the operative scar.

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act as a series of slight traumatisms, by which the solidity of the linea alba is impaired until one of its meshes is sufficiently dilated to allow of a protrusion of peritoneum or of the escape of a small subperitoneal lipoma.

A hernia of the linea alba sometimes causes indefinite dragging abdominal pain, which, though occasionally referred to no particular abdominal organ, is more often definitely localized in the gastric region. This symptom is usually designated by the patient as "a pressure in the pit of the stomach," but it may be so severe that they speak of "violent cramps in the stomach." Anorexia, eructation, and vomiting are also frequently observed. All of these symptoms may be concomitant with and yet not dependent upon the presence of a hernia of the linea alba or of a subperitoneal lipoma. It frequently happens that a subperitoneal lipoma is found by chance in individuals to whom it does not cause the slightest inconvenience. A most careful examination of the stomach should be made in all such cases, however, since it is possible that the symptoms are due to a graver disease, and that the subperitoneal lipoma is only an accidental and irrelevant concomitant.

The radical operation is practically the only treatment to be considered, since completely reducible hernias of the linea alba are very rare, and because it is most difficult to construct and apply a truss that will not become displaced.

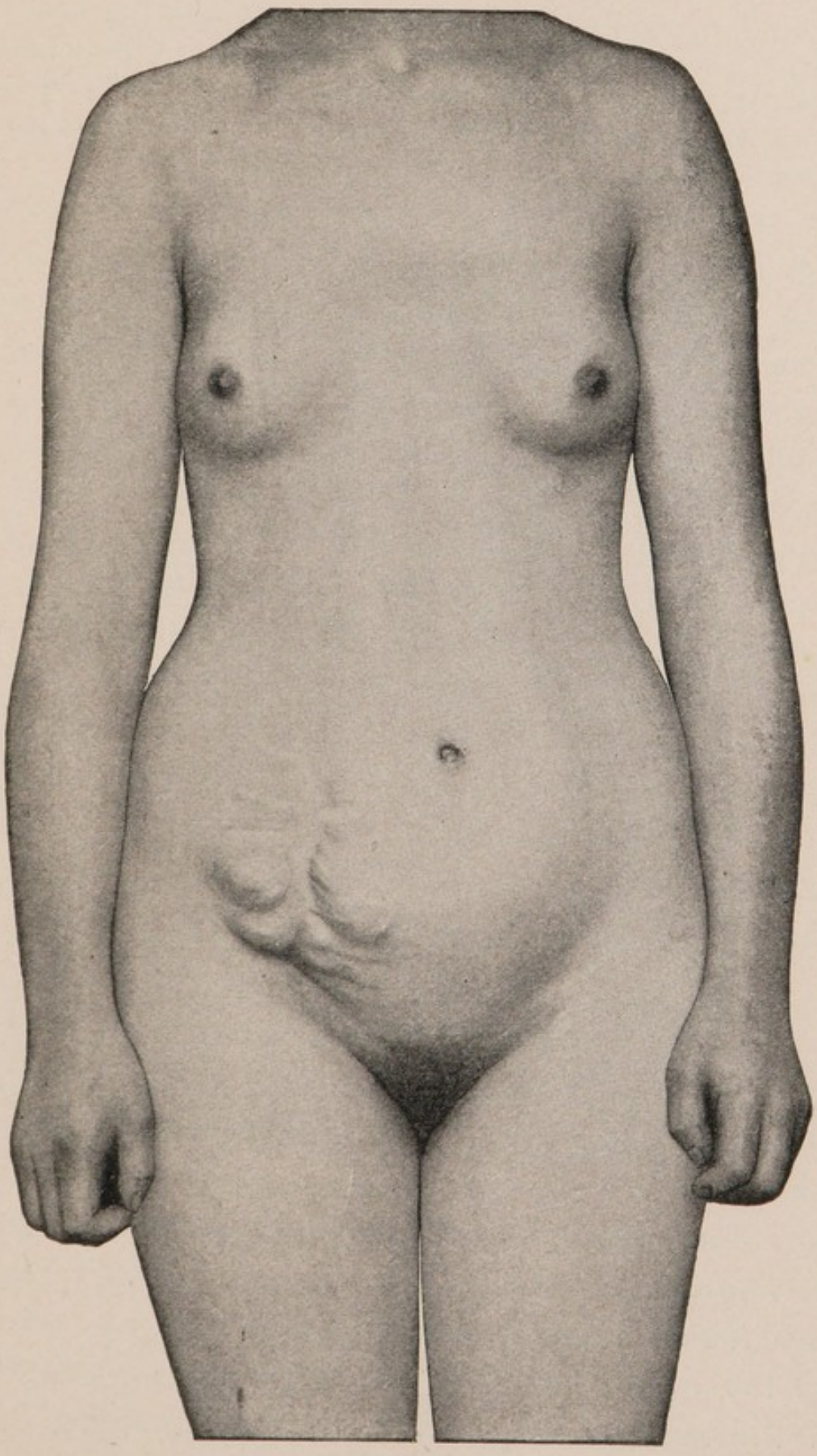


Fig. 107.

Fig. 108.—Petit's triangle and Braun's space : a, Latissimus dorsi muscle ; b, external oblique muscle; c, Braun's space ; d, Petit's triangle ; e, gluteus maximus muscle. Upon the left side there was also an opening analogous to the one upon the right (c). This left-sided opening gave passage to a lumbar hernia, while the one upon the right side was empty.

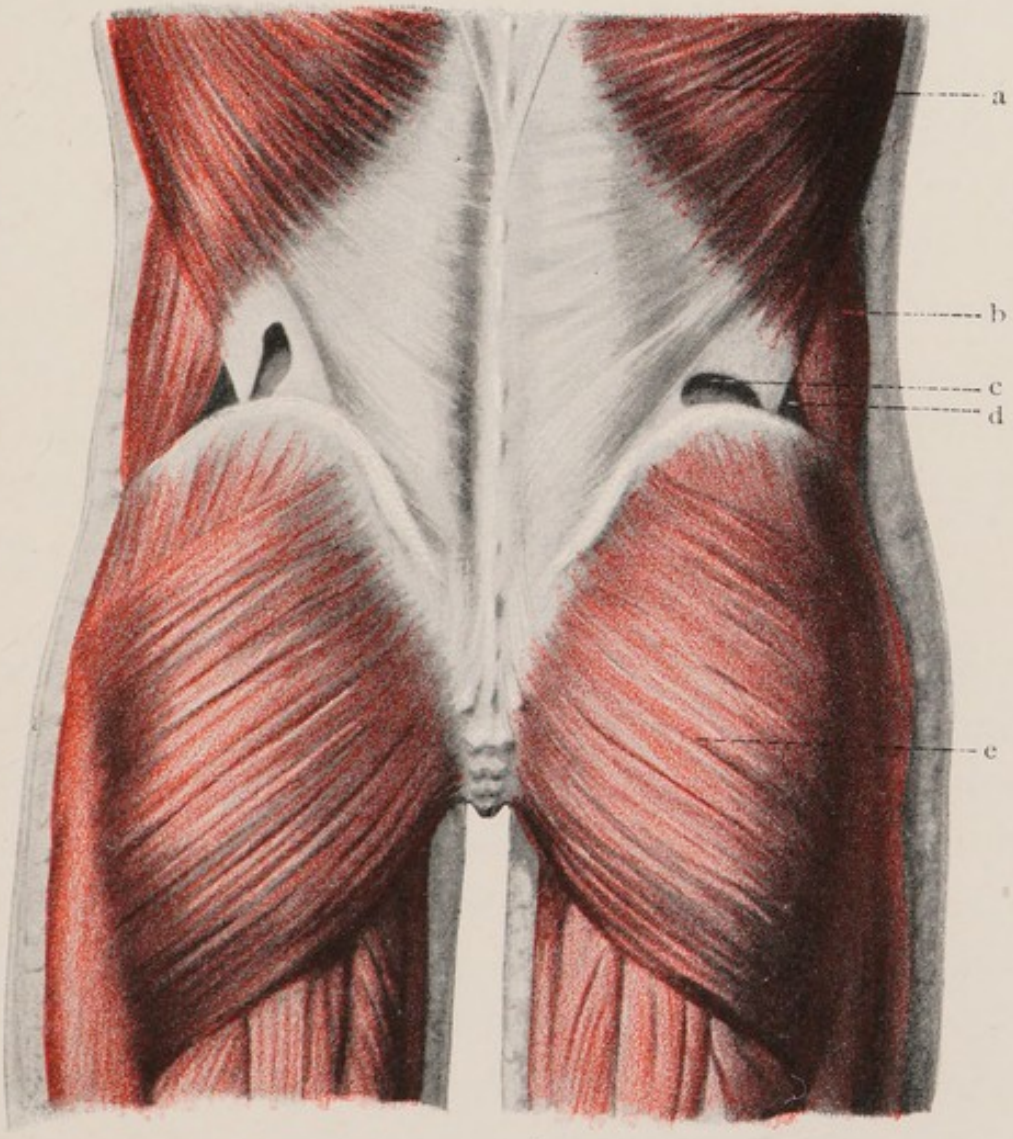
Even though the case is apparently nothing more than a simple subperitoneal lipoma, it is always best to open the abdominal cavity, since this is the only certain method of determining whether the lipoma has a small hernial sac behind it in which a tip of omentum may be adherent. If such a condition should exist, the symptoms will not disappear until the adhesion has been broken up or the piece of omentum ligated. The operation is completed by the exact closure of the abdominal wound, which is best attained by passing the sutures through all the layers of the abdominal wall.

If the lipoma is extirpated without opening the abdominal cavity, the edges of the transverse slit in the linea alba should be approximated with one or more sutures before the cutaneous wound is closed.

LATERAL VENTRAL HERNIA.

A lateral ventral hernia may appear at any situation in the lateral abdominal wall, but it nevertheless has its seats of predilection. One of these is at the semilunar line (*linea semicircularis Spigelii*) which marks the insertion of the transversalis muscle into its aponeurosis (Fig. 5). These hernias most frequently appear between this line and the outer border of the rectus muscle (Fig. 106). Next in order of frequency is the lateral region of the

Fig. 108.



abdomen, and in very rare instances these hernias have been observed to the outer side of the semilunar line or in the lower portion of the aponeuroses of the oblique muscles.

The most important factor in the development of lateral ventral hernias is the marked distention of the abdominal wall which may be produced by repeated pregnancies, by ascites, and by rapid emaciation in very obese individuals. Traumatisms which have produced a subcutaneous laceration of the muscles may lead to the formation of hernias, as may also the distention of the scars which result from perforating wounds of the abdominal wall or from operations (Fig. 107).

Strangulation is occasionally observed in lateral ventral hernias, but it does not differ from strangulation occurring in other situations.

The operative treatment of large ventral hernias promises but little, since the causes which led to the development of the hernia are equally active after the operation. The conditions are different in the moderate-sized hernias of scars in young individuals. In the majority of such cases a permanent cure may be attained by the extirpation of the scar and by the exact suture of the abdominal wound, which should be performed layer by layer, as is the case in all laparotomy wounds not made in the median line. Two layers are usually sufficient: the first set of sutures are of catgut and are passed through the peritoneum and the entire thickness of the abdominal muscles and their aponeuroses; the second set of sutures approximates the edges of the cutaneous wound.

The treatment by means of a truss may be easily carried

out in the majority of small ventral hernias, and particularly in the hernias of scars. A flat pad should be employed which resembles those used in umbilical hernias. Good results do not follow the use of trusses for large hernias in individuals with pendulous abdomens, and in such cases some form of abdominal supporter must be employed (page 228). In the case illustrated in figure 106 an abdominal supporter constructed by Mahrt and Hörning, of Göttingen, was most satisfactory. The most important part of the support was an elongated quadrilateral frame made of steel strips, which was so applied that the long sides were situated immediately to either side of the spinal column in the lower dorsal and lumbar region. The frame was well padded, and to its upper extremity were attached two padded straps, the free ends of which were passed around the shoulders and buttoned on the frame. The actual suspensory was provided with four straps upon each side which were fastened to the sides of the steel frame. The entire apparatus was so constructed that it could not be displaced and the pressure was so evenly distributed over a large portion of the vertebral column and the shoulders that it caused no annoyance whatever.

LUMBAR HERNIA.

A lumbar hernia is one which makes its appearance in the lumbar region. Since Braun (1879) critically studied and analyzed the previously known cases of lumbar hernia, 29 in number, and from his own observation pointed out a new path by which this variety could develop, a series of individual observations and also a number of collections

(Grange and Besendonk) have been published upon this subject without causing any actual change in the fundamental views established by Braun.

In the dissection of the posterior lumbar region (Fig. 108) a triangular space (Fig. 108, d) is found in a number of cases which is known as the triangle of Petit. This triangle is bounded by the crest of the ilium, the latissimus dorsi muscle, and the external oblique muscle ; its floor is formed by the internal oblique and transversalis muscles and by the transversalis fascia. This triangle of Petit was the only known or even suspected site for the escape of a lumbar hernia ; at the present time, however, we are forced to believe, from a large series of cases,—51 in the collections of Grange and Besendonk,—what Braun was able to state in his time: namely, that postmortem examination and exact dissection have never yet irrefutably proved that Petit's triangle formed the hernial orifice in any case. A similar statement may be made in reference to the muscular aperture described by Grynfelt and Lesshaft. Just above Petit's triangle a weak place is rather frequently found which is covered only by the latissimus dorsi ; it is bounded anteriorly by the external oblique, posteriorly by the iliocostalis, above by the serratus posticus inferior and the end of the twelfth rib, and below by the internal oblique. Lesshaft named this space the superior lumbar triangle, and believed that it must be considered as one of the locations at which lumbar hernias made their appearance. No absolute proof has as yet been furnished that a hernia has ever protruded through this space, and an external examination in the living subject (Bayer) fails to demonstrate such complicated anatomic

details. On the contrary, Braun, in an autopsy upon an individual with a left-sided lumbar hernia, was able to demonstrate a hernial orifice (Fig. 108, c) situated in the tense fibers of the latissimus dorsi, and as an analogous opening almost as large in size was found upon the other side, he regarded this opening as a congenital predisposition to a hernia. Since then Hutchinson and Wyss have both had an opportunity to carefully study a case of lumbar hernia at autopsy: in the first of these cases the hernia passed through the aponeurosis of the transversalis and the latissimus dorsi, and the hernial contents consisted of descending colon and coils of small intestine; in the second case the hernia escaped through an aperture in the external oblique, internal oblique, and transversalis muscles, and the sac contained the ascending colon.

In addition to the previously mentioned possibility of a congenital predisposition and of injuries of the lumbar region producing lacerations of the muscles, suppurations in the neighborhood of the crest of the ilium exert quite an influence upon the development of the lumbar hernias. In the majority of the cases which have been carefully examined it has been found that the hernia appeared at the site of a preceding suppurating fistula, which was usually due to a gravitation abscess, but which occasionally resulted (Wolff) from an osteomyelitis of the pelvis. Why the pus should pursue this course, and whether it follows a preexisting path, have not been decided at the present time.

If the possibility of the occurrence of a hernia is borne in mind, the diagnosis will usually be made without difficulty, since the reducibility, the gurgling murmur upon reduction, the tympanitic note upon percussion, and the

enlargement of the hernial protrusion upon augmentation of the intra-abdominal pressure will admit of no other interpretation. In spite of all this, errors have occurred, since the hernia has been repeatedly mistaken for a lipoma or an abscess, and, in one case in which the latter diagnosis was made, the subsequent incision wounded the intestine.

Lumbar hernias have frequently been treated with bandages, the most important part of which consisted of a flat pad placed over the hernial orifice, and it has been repeatedly observed that the mouth of the hernia became markedly smaller under the influence of such a support. Although a number of strangulated lumbar hernias have been operated upon, but two non-strangulated cases have been made the subject of surgical intervention. In one case Owen performed a radical operation by suturing the hernial orifice with catgut; the second case was operated upon by Küster, who closed the orifice with a pedunculated skin-muscle-bone flap.

INTERNAL HERNIAS.

According to Brësike, internal, retroperitoneal, or intra-abdominal hernias include all those which arise within the abdominal cavity, whether they develop in normal peritoneal recesses, or in abnormal peritoneal recesses arising in a physiologic manner. It will be seen that this variety does not include the hernial sacs which result from pathologic processes, such as the formation of adhesions. Since Treitz (1857) directed attention to the intra-abdominal hernias and to the locations in which they are chiefly found, our knowledge of this variety of hernia has been greatly

extended and the statistics at our command largely increased.

The lesser peritoneal cavity (*bursa omentalis*) may be regarded as a pre-existing hernial sac; other places in which an intra-abdominal protrusion of the peritoneum may occur are the peritoneal recess at the duodeno-jejunal angle, at the cecum, at the sigmoid mesocolon, and at the anterior abdominal wall in the vicinity of the bladder. We may consequently differentiate five varieties of internal hernia: (1) Hernia of the foramen of Winslow; (2) hernia of the duodeno-jejunal recess; (3) hernia of the retrocecal and ileocecal recesses; (4) hernia of the intersigmoid recess; (5) retrovesical hernia.

1. The hernia of the foramen of Winslow is not very frequent, having been observed only eight times, according to Maydl; the hernias were strangulated in one-half of these cases. The rarity of the hernia is explained by the narrowness of the opening, which, on account of the position of the liver, of the transverse colon, and of the transverse mesocolon, will allow of the passage of an intestinal coil only under certain circumstances. According to Merkel, it is to be supposed "that either an abnormally long mesentery or a retardation of the normal process of fixation of the colon must exist if portions of the intestine are present in the lesser peritoneal cavity."

2. At the transition of the duodenum into the jejunum a number of peritoneal diverticula are found, chiefly upon the left side, none of which are constant. It is of practical importance to remember that all of the previously described left-sided hernias of this region have been found in the *recessus duodeno-jejunalis sinister* or *venosus*. This

peritoneal pocket was named by Brösike, and may be recognized by the fact that the inferior mesenteric vein, and occasionally the colica sinistra artery, run in its upper margin. Figure 109, A, represents a duodeno-jejunal recess. In these cases the peritoneal pocket is usually deeper at birth, but it is not until later in life that it gradually becomes distended by the entrance of portions of the viscera. According to Maydl, the literature contains about 50 undoubted cases of this variety of hernia. To these must be added some rare cases in which the hernia developed to the right of the plica duodeno-jejunalis; the last publication upon this subject is one by A. Neumann.

These hernias vary in size between that of a walnut and that of a man's head. When they attain the larger dimension, the neck of the hernial sac descends so low that sometimes it is situated immediately alongside of the cecum and can only be recognized as the recessus duodeno-jejunalis by the course of the above-mentioned vessels. Figure 110 represents such a hernia which caused no symptoms whatever during life and which was accidentally discovered at the Pathologic Institute at Göttingen by an autopsy upon a man twenty-four years of age who died of pulmonary tuberculosis.

3. According to Waldeyer, there are three peritoneal recesses about the cecum. The parietal peritoneum as it passes to the anterior surface of the cecum forms a fold which is called the *plica cæcalis;* the pocket below it is the *fossa cæcalis*, and from this diverticulum a *recessus retro-cæcalis* sometimes extends behind the cecum. The second pocket is situated at the inner side of the cecum immediately above the ileocecal junction, and is called the

recessus ileocœcalis superior; it is very flat and without any practical significance, since it has never yet been observed to contain a hernia. The third pocket is formed by the

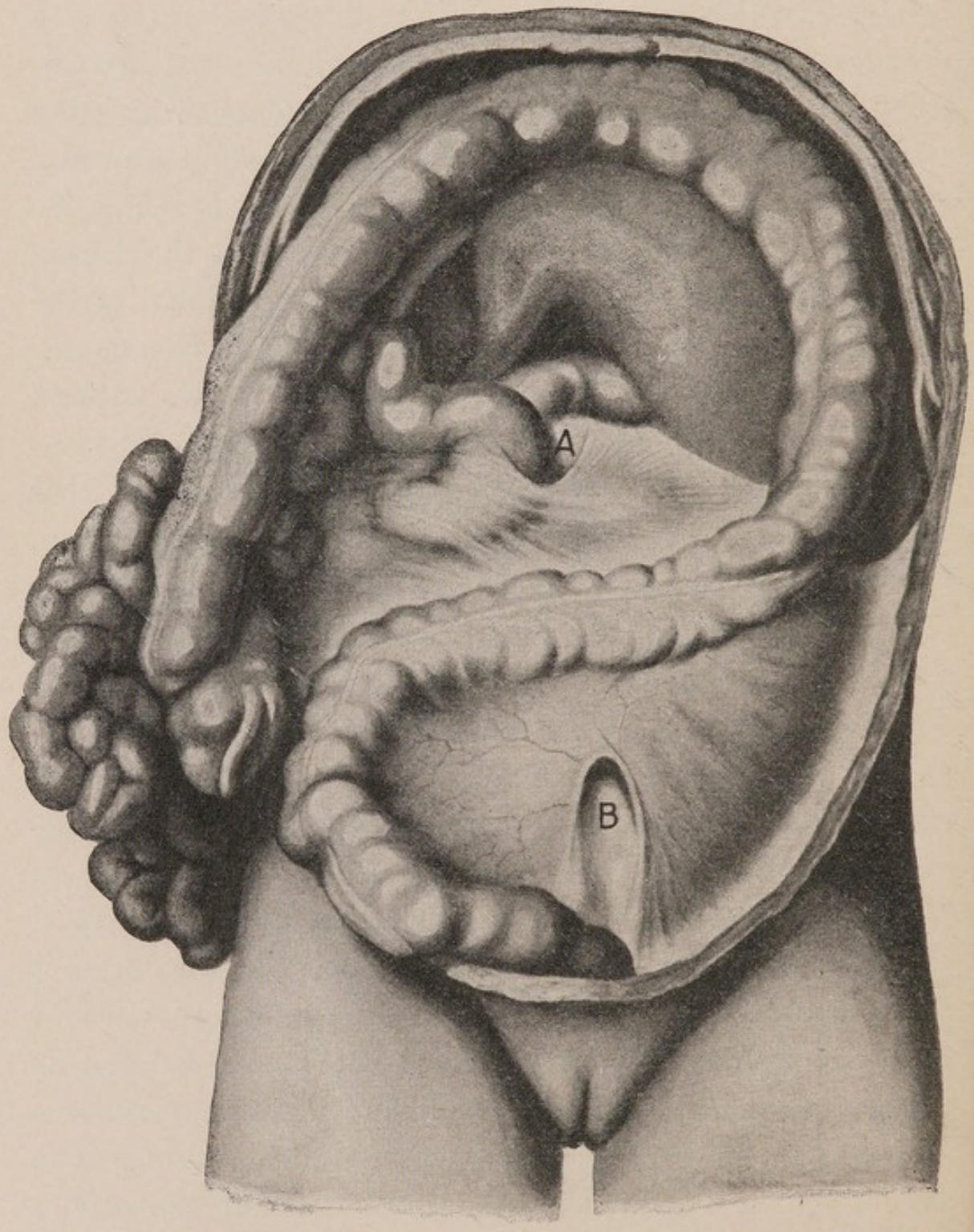


Fig. 109.—Recessus duodeno-jejunalis (A) and intersigmoideus (B).

plica ileocæcalis as it passes from the mesenteriolum of the appendix to the anterior surface of the ileum. It is called the *recessus ileocæcalis inferior* or *ileo-appendicularis* (Fig. 111), and has been observed to contain hernias.

There have been only a few examples of a retrocecal hernia; the last description of a carefully examined case was published by A. Aschoff. Up to the present time there have been recorded but three cases of ileo-appendicular hernia (Snow, Nasse, and Riese).

4. If the sigmoid colon is raised and drawn over toward the right side, the entrance to a small fossa is sometimes observed at the root of the sigmoid mesocolon; this fossa is situated behind the parietal peritoneum, and is known as the *recessus intersigmoideus* (Fig. 109, B). Hernias into this pocket are extremely rare, only two cases, according to Jonnesco, having been observed.

5. In the vicinity of the bladder, in rare cases, the plica vesico-umbilicalis lateralis (Plate 2) is so strongly developed that a peritoneal pocket is produced which may lead to the formation of a hernia. Linhart, Aschoff, and Kaufmann have each described such a case of retrovesical hernia, or, as it is called by Klebs, hernia retro-peritonealis anterior. Another and very remarkable case of retrovesical hernia has been recorded by Saniter; in this instance the retroperitoneal hernial sac was directed toward the pelvic floor, without showing any tendency to pass between the fibers of the levator ani muscle like a commencing perineal hernia.

Internal hernias cause no symptoms until they become strangulated, and even then they exhibit such scant characteristics that, with the exception of a case of Stauden-

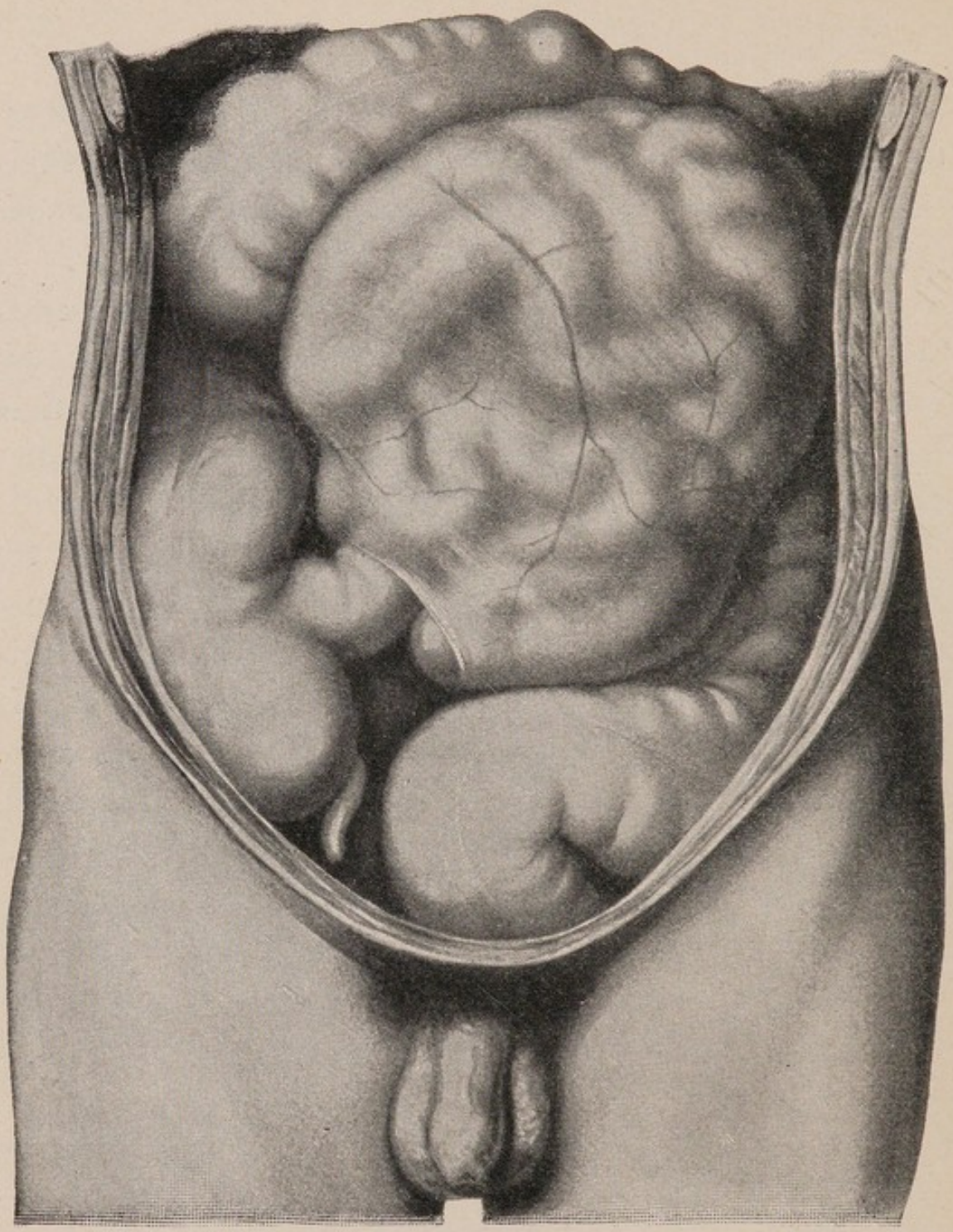


Fig. 110.—Hernia duodeno-jejunalis. When the abdominal cavity was opened, the entire small intestine, with the exception of a small portion of the jejunum above and of the ileum below, was found in a retroperitoneal hernial sac. The coils of small intestine could easily be drawn out of the hernial sac, as no adhesions had formed. A white cicatricial ring passed from the edge of the mouth of the sac to the root of the mesentery. The hernial orifice was limited above by the inferior mesenteric vein and below by the colica sinistra artery, showing that the hernia was situated within the recessus duodeno-jejunalis (Aschoff).

meyer, it has never yet been possible to make the diagnosis with even a fair degree of probability. An intestinal obstruction arising from other causes will usually produce exactly the same symptoms.

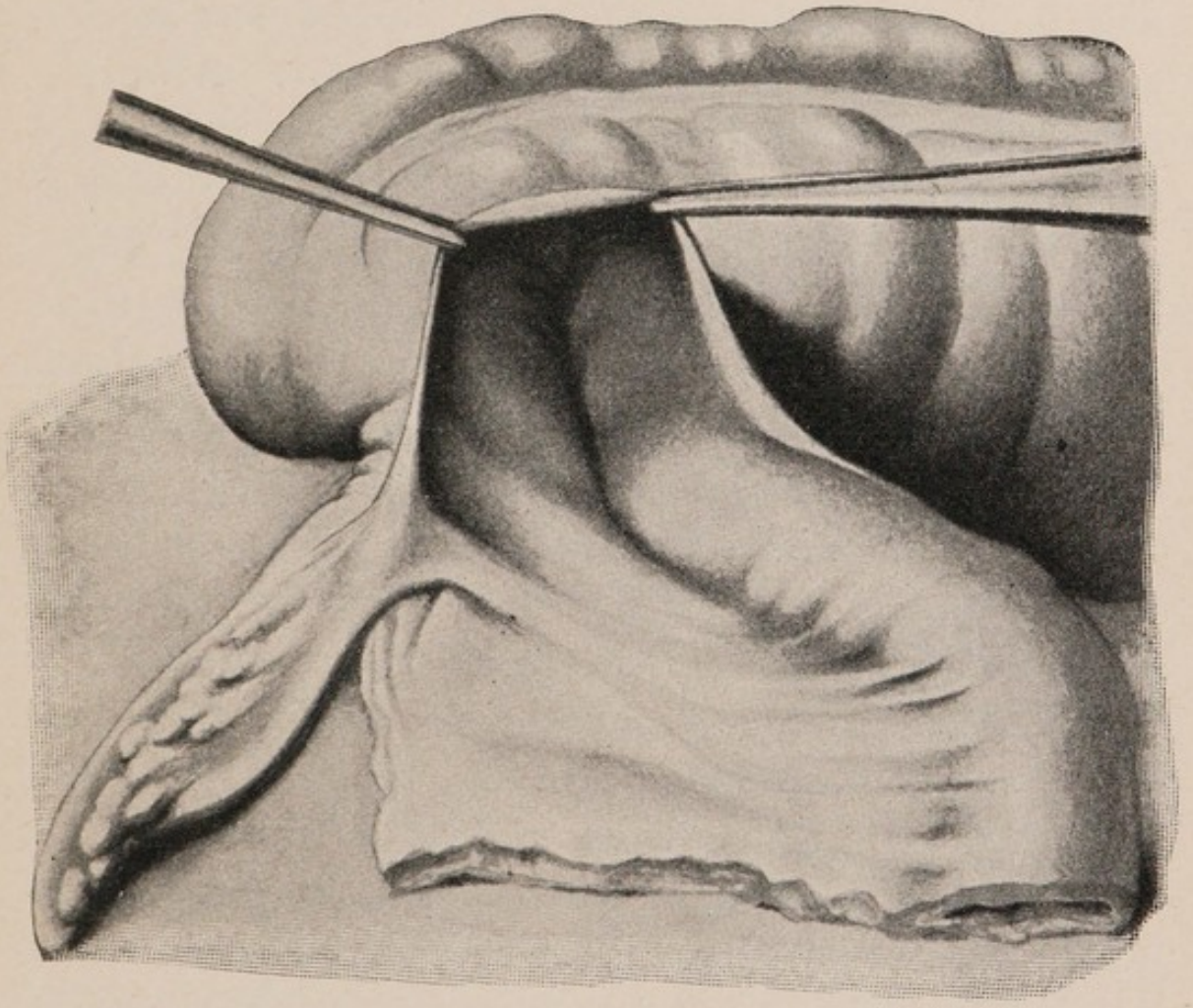


Fig. 111.—An unusually deep recessus ileocæcalis inferior or ileo-appendicularis. In order to better expose this recess, its upper border has been raised with two forceps and the ileum twisted upon its longitudinal axis.

The treatment is that of every intra-abdominal intestinal obstruction. As soon as the diagnosis has been certainly made the removal of the obstruction and consequent recovery can only be expected from a laparotomy

performed at the earliest possible moment. The possibility of such internal hernias should be borne in mind during the laparotomy, and if other causes for intestinal obstruction are wanting, the favorite sites of their occurrence should be carefully palpated. The hernial orifice must be situated at the point to which the distended afferent and the collapsed efferent intestines converge. After the hernia has been found and the strangulation relieved, it must be decided whether the hernial orifice should be closed, and, if so, the method of suture. Neumann and Nasse closed the orifices in their cases with sutures, but Riese mentions a case published by Schott in which the walls of the recessus ileo-appendicularis spontaneously became adherent and formed a cyst which caused a fatal ileus by pressing upon the intestine. Such a possibility is also to be feared after a suture of the hernial orifice. Since the extirpation of a retroperitoneal sac is not practicable, particularly in large hernias, I would recommend, for hernias of the cecal region and of the intersigmoid fossa, that the cavity should be packed for a certain length of time so as to excite the formation of granulation tissue and an adhesion of the walls. In the other varieties of internal hernia it would probably be better to entirely disregard the closure of the hernial orifice.

The results obtained in the treatment of strangulated internal hernias have been greatly improved in the last ten years. While Jonnesco (1890) stated that the three cases previously operated upon terminated fatally, as did all of those which were not operated upon, Riese (1900) reported nine cases operated upon in the antiseptic period with four recoveries.

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