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The fascias of the pelvis

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THESIS.

THE FASCIAE OF THE PELVIS

By

IRA N. CROW.

1914.
In 1815, Velpeau wrote on the pelvic fascias. Since then there has been a great deal written concerning the peritoneal folds and the extra-peritoneal fascias of the pelvis. There are a great many variations of the attachments and relations of these structures. The fact that man has assumed the upright position has necessitated certain readjustments and modifications in the plans of nature of these folds and fascias as compared to homologous structures in the lower animals. Although the general shape of the pelvic cavity in either man or beast is essentially the same, nevertheless the one placed nearly vertical while the other in a nearly horizontal plane partially accounts for some of the modifications in the anchorage by these fascias of certain viscera. Specific examples will be detailed later.

The pelvic cavity must not only be powerfully constructed in order to transmit the body weight to the lower extremities, and furthermore to furnish an adequate bony protection in both sexes to certain very important distensible viscera, but in addition in the female must also serve as a passage and outlet to the foetus. Therefore the anchorage of these viscera must be most efficient, and so it follows that a thorough study and clear understanding of these fascias and their spacial anchorage as ligaments becomes a topic intensely interesting and vastly important. Especially is this true from an operative
point of view when it becomes necessary to reattach or reconstruct these torn or overstretched ligaments, in order that normal relations of the viscera might be regained.

The pelvic girdle is a very strong arch composed of the two os innominata united in front at the symphysis pubis articulation and bound together posteriorly by the great key-stone, the sacrum. This bony arch surrounds the pelvic cavity which in the erect position is a cylin
drically shaped affair with the plane of its in-
let upwards and forwards while that of its outlet is downwards and forwards. The pelvis is divided into the false or pelvis major and the true or pelvis minor. This paper will have to do only with the fascias of the pelvis minor which outlined briefly is that part of the pelvis below the superior border of the symphysis pubis anteriorly and the ilio pectoneal line laterally and the promontory of the sacrum posteriorly. At this time it might be pro-
fitable to consider the proper position of the pelvis of the human female when in the erect posture. A glance at Figure I, PLATE A will show this. It will be seen that the anterior superior spine of the ilium is in the same vertical plane (a) as the spine of the os pubis and that a plane (b) passed horizontally through anterior superior spine of the ilium will pass through the upper border of the great sacro-sciatic notch and through the sacrum posteriorly at the articulation of its second and third pieces. Furthermore a plane (c) passed horizontal-
ly through the upper border of the body of the os pubis will pass through the spine of the ischium and posteriorly
at the articulation of the sacrum with the coccyx. Usually the articulation of the second and third pieces of the coccyx is in the same horizontal plane (a) as the lower border of the articular surface of the symphysis pubis. Thus it will be seen that the true pelvic cavity is formed by more or less complete bony wall, the deficiencies in which are filled in with membranes, ligaments and muscles; as, laterally we have the obturator membrane, while postero-laterally we have from above downward the pyriformis muscle the sacro-tuberus and the sacro-spinus ligaments. The latter having in relation to its internal surface the ischio-coccygeus muscle.

Figure I, plate B, will show the appearance of the outlet of the pelvis minor. Note the bony arch in front composed of the descending ramii of the os pubii, and the inferior ramii of the ischii, while posteriorly we see the coccyx and the great sacro-tuberus ligaments. The pelvic cavity has a concave floor made up largely of the two, right and left, levator ani muscles united in the medium line; the coccygeous muscle covering the antro-superior surface of the sacro-spinus ligament posteriorly; and the trinangular ligament anteriorly. These structures give the viscera a hammock-like support. The diamond shape pelvic outlet can be divided into two triangles by an imaginary line slightly concave anteriorly connecting the two tuberosities of the ischii (a) Figure I, PLATE B. The anterior space is known as the urogenital triangle, while the posterior as the rectal triangle. This imaginary line practically outlines the posterior
border of the so called triangular ligament, the inferior layer of which fills in behind the symphysis pubis and between its ramii and is known as the "fascia diaphragmatic urogentialis inferior", (Cunningham). There are a series of muscles lining the wall of the pelvic cavity. Laterally, Figure II, PLATE A, the obturator internus (b), postrolaterally the pyriformis (d) and coccygeus (f) while on the pelvic surface of the fascia diaphragmatic urogentialis inferior, we find anteriorly the sphincter urethrae membrane and posterior to this the transversus perinei profundus (a) Figure I, PLATE C.

The fascia which covers over these muscles and forms a complete lining for the pelvis minor is continuous with that lining the pelvis major and the abdominal cavity above. This fascia gets attachment to the periostum forming a firm anchorage wherever the muscles are absent, as on the posterior of the os pubis; above the origin of the obturator internus on the ilio-pectoneal line; to the anterior border of the great sacro-sciatic notch; to the spine of the ischium as it projects into the pelvic cavity between the obturator internus and the pyriformis muscles; and below at the outlet of the pelvis it is attached to the inferior border of the ischial ramii and tuberosities and to the inferior edge of the sacro-tuberosous ligament. This fascia has various names according to the muscles which it covers, for example, laterally it is known as the obturator fascia; postrolaterally the pyriformis and coccygeus while antro-inferiorly that part of the pelvic fascia covering over the pelvic surface of the sphincter urethrae membranaceae and transversus perinei profundus is known as the superior layer of the triangular ligament, or "The fascia diaphragmatic urogentialis superior", (Cunningham). (c) Figure I, PLATE C. (c) FIGURE
PLATE D: and (b) Figure I, PLATE H. Thus it will be seen that the pelvic fascia is somewhat complicated in its distribution because of its relation to the pelvic floor and viscera, that is, the rectum and urogenital tract.

The obturator fascia (a) Figure I, PLATE D, a very dense membrane as compared to some of the others is continuous over the ischial spine with the fascia covering the coccygeus, Figure I, PLATE D. It is attached to the periosteum along the anterior border of the great sacro-sciatic notch from its superior border down nearly to the tip of the ischial spine, where it passes over and forms the superior edge of the coccygeus fascia (d) Figure I, PLATE D. It is attached below to the lower part of the ischial ramii and tuberosities. In the lower part near the inferior edge of the inferior ramii of the ischium, the obturator fascia splits to inclose the pudic vessel and nerve as they come forward toward the urogenital triangle. This channel is known as Alcock's canal and is situated about one and one-half inches above the inferior border of the ischial tuberosities. The obturator fascia is further modified by a conspicuous thickening known as the tendinous arch of the pelvic fascia, which arch extends from the back of the symphysis pubis to the spine of the ischium.

This tendinous arch is important, firstly, in that it gives origin to a part of the levator ani muscle, (i) Figure I, PLATE C; (c), Figure II, PLATE D; (h), Figure I, PLATE H; (f), Figure I, PLATE K; and (f), Figure I, PLATE L, which origin however often extends up beneath
the pelvic fascia; and secondly it is very important in that it furnishes a firm attachment for the fascial investments of the genito-urinary tract, (c) Figure I, PLATE E, (j), Figure I, PLATE F, and (i) Figure I, PLATE G, a detailed description of which will be given later. Occasionally the middle part of this tendinous arch is free so that one can slip a finger down behind it. This may be the occasion of a hernia at times. Reinforcements in the nature of thickenings may be seen at times radiating up from the arcus tendineus toward ilio-pectoneal line. The obturator fascia is perforated in the upper part of the obturator foramen (b) Figure I, PLATE D, for the passage of the obturator vessels and nerves. There are other perforations for the parietal branches of the hypogastric vessels.

It is interesting to note that while we find the obturator fascia continuous with the fascia covering the ischio-coccygeus muscle and very dense in as much as there is considerable strain put on it, that the fascia (c) Figure I, PLATE D, (g), Figure II, PLATE D, covering the pyriformis is comparatively loose. Here we find not nearly the amount of strain but do find imbedded in this fascia some of the branches of the internal iliac vessels and the sacral plexus of nerves. The ischio-coccygeus muscle occupies a small fossa. It is covered over on its pelvic aspect by the continuation of the obturator fascia over on it and is known as the coccygeus fascia. On its posterior surface its fascia unites with the sacro-spinous ligament.

I shall next take up a very interesting part of this subject,—the pelvic floor. Let us consider it first.
from a mechanical point of view as I believe it will help to fix the importance of the fascia and ligaments in our minds. Mechanically the pelvic floor can be divided into two portions, the anterior tense or fixed, and a posterior relaxed, both equally important. That the anterior portion be fixed is quite necessary, as much as we know that the pelvis contains certain distensible muscular viscera as the bladder, rectum and in the female the uterus, which must contract in order to expel their contents. Therefore, it is necessary for them to have a fixed point of anchorage from which to act. The bladder is anchored to the back of the body of the os pubis by the pubo-prostatic and the pubovesical ligaments (i), Figure I, PLATE F, and (e), Figure I, PLATE G, to the triangular ligament or "the fascia diphragmatica urogenitalis superior" by the capsule of the prostate gland, (i), Figure I, PLATE I. It is also attached to the anterior part of the tendinous arch of the obturator fascia by the lateral true vesical ligaments, (j), Figure I, PLATE F, and (i), Figure I, PLATE G. The vagina which is also attached to the tendinous arch (i), Figure I, PLATE G: (e), Figure II, PLATE I, and to the triangular ligament, through these attachments affords an indirect anchorage to the uterus, (in as much as) the uterus is continuous with it. A detailed description of these anchorages will be given later.

The anal canal (h), Figure I, PLATE I, and (i), Figure II, PLATE I, is fixed, but not nearly as firmly as the urogenital tract, in the posterior part of the aperture of the pelvic floor. The rectum, (e), Figure I, PLATE I, and Figure II, PLATE I, is continuous above with the anal canal. Its longitudinal muscle coat (b), Figure I, PLATE J,
extends away down getting attachment to the perimysium of the bundles of muscle of the external sphincter and even passing through the external sphincter and gaining anchorage to the subcutaneous tissue (c) Figure I, PLATE J. The rectum is further anchored by its fibrous sheath becoming continuous with the upper layer of the pelvic fascia on the levator ani muscle and to the sacrum and coccyx (d) Figure I, PLATE F, and (a) Figure I, PLATE G.

The pelvic floor is formed from behind the symphysis pubis posteriorly by successively (1) the fascia of the urogenital diaphragm and transversus perinei profundus and the sphincter muscle of the membranous urethra, between them, the later enclosing the urethra, and the vagina in the female; (2) the perineal body; (3) the two right and left levator ani muscles and the external sphincter muscle of the anus on each side of the anal canal; (4) the ano-coccygeus body between the anal canal and the coccyx, containing the main insertion of the right and left levator ani and external sphincter muscles. The right and left levator ani muscles and their fascias play a very important part in the structure of the concave floor of the pelvic cavity. In a general way the levator ani arises from the posterior aspect of the body of the os pubis, (a) Figure II, PLATE D; (c), Figure I, PLATE K; (c), Figure I, PLATE L; and (a), Figure I, PLATE M; the tendinous arch (i) FIGURE I, PLATE C; (c), Figure II, PLATE D; (a), Figure I, PLATE E; (f), Figure I, PLATE K, and (f), Figure I, PLATE L of the obturator fascia described above, and the spine of the ischium. Occasionally the levator ani has an extensive bony origin from the back of the body of the os pubis, (a), FIGURE I, PLATE M. This forces the so called white line or tendinous arch to take a course more obliquely as it
extends across the obturator fascia toward the ischial spine (b), Figure I, PLATE M. These fibers sweep downward and backward from this threefold origin so as to form a muscular diaphragm with an intra-pelvic and a perineal surface to be inserted into (1) the central point of the perineum (2) the external sphincter around the anus and the ano-coccygeal raphae behind the anus and (3) the lower sacral and coccygeal vertebrae, (g), (h), Figure I, PLATE C; (g), Figure I, PLATE E, Figure I, PLATE H: (c), Figure I, PLATE I: (c), Figure II, PLATE I; (e), Figure I, PLATE J, Figure I, PLATE K and Figure I, PLATE L.

The levator ani is described as being divided into four portions. The pubo-rectalis; the pubo-coccygeus; ilio-coccygeus and the ilio-sacralis, (g), Figure I, PLATE C, Figure I, PLATE H, Figure I, PLATE K; (b), Figure I, PLATE L. The first two parts are best developed. The last two are the most rudimentary and represent the remains of the flexor cauda of the tailed animals. The pubo-rectalis or levator prostate (h), Figure I, PLATE C: (f), Figure I, PLATE H: (c), Figure I, PLATE K and (c), Figure I, PLATE L, is the part inserted into the central point of the perineum. The pubo-coccygeus portion Figure I, PLATE C, and Figure I, PLATE H and (b), Figure I, PLATE K, is the portion inserted into the anus and ano-coccygeal raphae. The extreme anterior fibers arising from the arcus-tendineus may send some fibers reflected up on the wall of the rectum (c), Figure I, PLATE L, and the rest continue to the ano-coccygeal raphae. The posterior edge of the levator ani is overlapped by the ischio-coccygeus muscle, while its anterior edge is in relation to the fascia diaphragmatic urogenitalis superior, however, at the outer side it is raised above
the fascia diaphragmatic urogenitalis superior, developing a fossa between it and the so called triangular ligament, (e), Figure I, PLATE C, and (d), Figure I, PLATE H. This is due to the fact that the origin of the levator ani from the tendinous arch is at a higher level than the fascia diaphragmatic urogenitalis superior. In the female the pubo-rectalis fibers hug the side of vagina, that is, are in close relation to it but are not inserted into it, (h), Figure I, PLATE C, while in the male, we find in the anterior part of the prostate gland within its capsule a few bundles of coarse fibers of striated muscle, (a), Figure II, PLATE N, (low power), (h), Figure II, PLATE N, (high power). These are sketches from the human prostate gland below the entrance of the ejaculatory ducts. These coarse striated fibers undoubtedly come from the levator ani muscles. All the rest of the prostate gland is filled quite profusely with bundles of non-striated muscle fibers, (d), (g), Figure II, PLATE N. Some of the fibers of the levator ani pass down along the anal canal to the external sphincter getting firm anchorage in the white fibrous tissue about the muscle bundles of the external sphincter, (b), Figure I, PLATE E: (c), Figure I, PLATE I: (g), Figure I, PLATE J. These fibers elevate the external sphincter and perineum in parturition and defication. The pubo-rectalis fibers of the right and left levator ani muscles are separated by a narrow aperture or cleft about one and three-fourths inches long which extends from the symphysis pubis to the ano-coccygeal body. Through this aperture passes the anal canal urethra and in the female the vagina. In parturition this aperture greatly distends by the passage of the foetal head. The superior concave pelvic surface of the levator ani muscle occupies the lateral part of the pelvic
floor. Its inferior convex surface forms the oblique medial wall of the ischio-rectal fossae, the lateral wall of which is formed by the obturator fascia covering the pelvic surface of the obturator internus muscle, a detail of which has been given above. The levator ani muscle is covered on both surfaces by the pelvic fascia. That covering its perineal surface called the anal fascia is thin and of very little consequence, while that covering its intra-pelvic surface is thick and strong and quite important. At the origin of the muscle, the fascia is continuous with the obturator fascia, thus forming the conspicuous thickening, the arcus tendineus described above. At the insertion of the levator ani muscle, the fascia covering the pelvic surface is anchored to the perineal body over which it passes to become continuous above the raphae of the insertion with the layer of the opposite side. At the postro-lateral surface, the fascia joins the fascia enclosing the coccygeus muscle, while at the antro-inferior border, the enveloping fascia of the levator ani muscle becomes continuous with the superior fascia of the urogenital diaphragm described above.

Thus we see that the walls and floor of the pelvic cavity is completely invested by fascia. I shall next take up the description of some of the special supporting fascias and ligaments which hold and maintain in proper position the viscera contained in the pelvis, that is the rectum, the bladder, and in the female, the uterus. In a general way, there are three structures holding these viscera in place, namely, the peritoneum, the extraperitoneal tissue, or fascia propria and the pelvic vessels and nerves. These viscera must be so lodged that they may fill and empty. Therefore they are not bound down
by the pelvic fascia but are so supported that they can withstand the violent movements and pressure to which all abdominal viscera are subject during active muscular and respiratory efforts. It might be said in a general way of the peritoneum covering over these viscera, that in order to allow this free visceral movement, the parietal pelvic peritoneum is loosely attached, while over the bladder, uterus and rectum, it is fairly firmly bound down. Thus when these viscera are distended, the reflections of the parietal peritoneum being attached by an extremely lax layer of subserous tissue readily allows the viscera to expand and mount up from the pelvis. The peritoneum extends down on the anterior side of the rectum to within three inches of the anus, or to the level of the ischial spine, (f), Figure I, PLATE I, and (g), Figure II, PLATE I, which we know is in the same horizontal plane as the superior border of the symphisis pubis and posteriorly at the junction of the sacrum with the coccyx. At this level we have another very interesting structure, the right Houston valve. Posteriorly, the peritoneum leaves the rectum about five inches above the anal canal, or in fact this is where the rectum begins and is in front of the body of the third sacral vertebrae. This is important to keep in mind for in excision of the rectum more of the bowel can be removed on the posterior than on the anterior part of the tube without opening into the peritoneal cavity. Furthermore it will be seen that carcinomatous and other spreading ulcers are more apt to invade the peritoneal cavity when they are situated in the anterior wall of the rectum. The rectum in both sexes extends down to the floor of the pelvis where the anal canal begins. It
occupies a special channel known as the rectal channel and is surrounded as is the pelvic urogenital organs by the extra-peritoneal fascia or fascia propria, (a), Figure I, PLATE F, and (f), Figure I, PLATE G.

We are indebted to Velpeau for this most excellent term for the extra-peritoneal fascia, for it was he who first described it as the fascia propria. We find it filling in all about the organs between the peritoneum internally and the fascia lining the pelvic cavity externally. It is undoubtedly developed along with the blood vessels as they find their way to the viscera within this region. This fascia for many reasons is very important. In it, we find besides the vessels mentioned above along which it develops, the visceral nerves and plexuses; the ureters and the ductus deferentes. It forms a sort of pad of packing for the organs uncovered by the peritoneum. Especially is this true about the bladder and prostate gland; and here particularly in relation to the symphysis pubis and the pubo-prostatic ligaments. In both sexes it forms in relation to the rectum a thick sheath practically devoid of fat, which encloses the lower part of the rectum completely down to its termination in the anal canal. Here it gains attachment to the fascia covering the pelvic floor around the margin of the anal canal. It also anchors the rectum posteriorly to the sacrum as mentioned above. This is a point worth remembering, for in excision of the rectum by the Kraske method, one can sweep the knife around the rectum from behind following in this fascia and shell the tube as it were out of this sheath with nothing to fear except the hemorrhoidal vessels of which the right
and left branches of the superior, closely embrace the rectal wall about one-half the distance down where they pierce the wall and follow in the sub-mucosa. The right is a little posteriorly, while the left is slightly anteriorly placed. In the female in addition to the packing about the bladder and sheath for the rectum, the fascia propria forms the base of the matrix of the broad ligament. It also occurs as a layer practically free from fat which loosely connects the anterior surface of the cervix uteri with the base of the bladder.

Owing to the fact that the pelvic viscera have such an abundance of blood supply, they get a considerable support from the vessels. These vessels come in from the lateral and posterior aspect.

The arrangement of the fascias in relation to the genito-urinary viscera is quite different from that of the rectum. I have already mentioned in describing the outlet of the pelvis, that it was divisible into two different parts. The posterior or dorsal comprises the ischio-rectal fossa. This rectal triangle is characterized by its looseness and distensibility and serves for the passage of the anal canal. How different the anterior or ventral part; the urogenital triangle for the passage of the genito-urinary tract! This is characterized by firm fixation to the pubic bone. So also in viewing the pelvic cavity from the abdominal aspect we find that while in the posterior part a rectal channel exists in which the rectum is free to distend or collapse, in the anterior part the viscera are firmly fixed at their base by a special dispensation of the pelvic fascia which forms the so called suspensory ligament for the prostate gland and the
prostatic urethra in the male and, for the vagina and urethra in the female. The anterior limit of the rectal channel is formed by two crescentic folds of pelvic fascia known as the suspensory ligament, which arises near the ischial spines from the general fascia covering the pelvic wall and sweeps across the median plane curving anteriorly meeting with its fellow of the opposite side in the mid line. It has a posterior free border through which the ductus deferens, vesical vessels and nerves pass. This suspensory ligament has two folds, a posterior and a superior which have separate lateral attachment to the general pelvic fascia. Between these folds there is a large plexus of veins. In the male the posterior layer called the recto-vesical layer passes across the pelvis between the prostate gland and the rectum. The inferior border of this layer of fascia is firmly attached to the perineal body between the base of the fascia of the triangular ligament and the beginning of the anal canal, thus forming the anterior wall of the rectal channel. It forms a sheath for the vesiculae seminales and the ductus deferentes, which sheath effectually separates these structures together with the bladder from the rectum. However, the vesiculae seminales rest directly against the bladder. The superior layer (j), Figure 1, PLATE F, receiving lateral origin from the arcus tendineus throughout its whole length, and extending forward as far as the symphysis pubis sweeps over the prostate gland to become attached along the line of junction of the prostate gland with the bladder. Thus forming the ligamentum prostaticum latteralis. "It contains numerous bundles of muscle fibers in its anterior part and forms a sheath for the
passage of the inferior vesical vein along the lateral surface of the prostate gland,"(Cunningham). In front of the bladder we have the ligamentum pubo-prostaticum medium, (i), Figure I, PLATE F, formed by this same superior layer of fascia stretching from the back of the symphysis pubis; of the arcuate ligament of the pelvis, and the superior fascia of the urogenital dia-phragm to the neck of the bladder and the prostate gland. This ligament is composed of several layers separated by large veins, the pudendal plexus, which connect the inferior vesical veins with the dorsal vein of the penis and the hypogastric vein. This ligament is continuous across the median line with its fellow of the opposite side and where these two meet just behind the symphysis pubis a hollow occurs which is known as the cavum Retzii.

Owing to the success which has attended enucleation as a means of treatment of enlarged prostate, much discussion has recently taken place concerning the ensheathing structures. The term capsule has been given to the outer fibro-muscular stratum of the gland, while the term sheath has been applied to the enveloping fibrous structure derived from the pelvic fascia. At only one point is this sheath normally intimately adherent to the capsule and that is along the anterior or pubic surface. It is very important to know the formation of the prostate sheath, not only because it is the guide to enucleation of the gland but also because it determines the course of prostatic abscesses. The fascia prostatica is composed of (1) the superior fascia of the urogenital diaphragm on which it rests (2) by the general pelvic fascia covering the intra-pelvic surface of the levator
ani on each side as the levator ani sweeps under the edge of the prostate gland, Figure I, PLATE H, and Figure I, PLATE K, and (3), it is completed above and behind by the two special layers of the pelvic fascia detailed above, that is the superior and posterior layers of the suspensory ligament of the prostate. By means of these structures, the prostate gland and the prostatic urethra are given a firm anchorage to the walls and floor of the anterior part of the pelvis.

In the female, the pelvic fascia assumes, of course, practically the same general relation to the vagina and urethra as it does to the prostate and urethra in the male. A fold of fascia, crecentric in shape, (f), Figure I, PLATE G, springing from the general pelvic fascia in the region of the ischial spine, curving anteriorly, sweeps toward the median line to the lateral fornix of the vagina and in front of the rectum where it meets its fellow of the opposite side. As in the male, we find this fascia separating into two layers, a superior and posterior. Between these layers are numerous vessels, which along with the visceral nerves pierce its free edge. The posterior, recto-vaginal layer passes behind the vagina midway between it and the rectum. Its inferior border is firmly anchored to the perineal body in the floor of the pelvis between the base of the fascia of the triangular ligament and the beginning of the anal canal. Thus it forms the anterior wall of the rectal channel. The superior layer, like that in the male takes its origin from the arcus tendineus and is attached medially to the neck of the bladder. This forms the lateral pubo-vesical ligament (j), Figure I, PLATE G. A continuation of this lateral pubo-vesical
ligament meeting its fellow of the opposite side in front behind the body of the os pubis, forms the anterior pubo-vesical ligament, which as in the male is divisible into several layers separated by veins. An intermediate, urethra vaginal, layer of fascia passes between and separates the vagina from the urethra. This septum has a few strands of non-striated muscle fibers which probably originate from the longitudinal muscular coat of the vaginal wall, which we know is best developed in its anterior aspect. I might mention here, although these two points will be discussed more fully below, that a few strands of non-striated muscle fibers are found in the recto-vaginal partition, probably developed from the vaginal wall and from the cervix of the uterus. Thus it will be seen that the urethra and the vagina like the prostate gland and urethra in the male are firmly anchored by means of these layers of the pelvic fascia and the fascia propria and its ligaments to the pelvic walls and floor in its anterior portion, leaving the bladder and uterus free to distend and collapse, yet giving them a firm anchorage at their attachment from which to contract in expelling their contents. In connection with this, I believe it worth while to emphasize the so called sacro-uterine and the recto-uterine ligaments. I have already mentioned that the fascia propria fills in all around the base of these viscera; from the matrix of the parametrium and broad ligaments a sheath for the rectum, ligaments for the bladder and prostate and pads of fat wherever needed; gains attachment to the levator ani below; the obturator internus
latterally, and the peritoneum above. The general course of its fibers is from the cervix and fornix of the vagina latterally and toward the sacrum, spreading out to the various points of attachment. Covering over the fascia propria and all of the viscera to which it is bound down tightly, fitting in and over all the irregularities, much as paper fits the wall is the peritoneum. Therefore, wherever there is a fold in the fascia propria, there will be a fold in the peritoneum. The fascia propria, while abundant in the human female is practically absent in the lower animals, which habitually assume the horizontal position, for in these animals, the uterus is either double, or bicornuate, there being none, or only a slight modification of the primitive Mullerian ducts. Consequently, the uterus being long and slender, its weight is distributed along two extensive peritoneal attachments, often as far forward as the kidney. The condition found in the cat or dog affords a very good example of this type of folds. It is very obvious that such an arrangement requires only a very slight support from the peritoneal folds and there is very little necessity for fibrous ligaments and muscle fibers. Therefore these folds are thin and transparent. The substance between them is principally areolar tissue. There is not the abundance of fibro-elastic and muscle tissue that is found in the uterine supports of the human female, and what little muscle or fibrous tissue that does exist is rudimentary. The fibro-elastic tissue in these folds in the state of rest remains a
diffuse mesh-work. When traction is made, condensation is made along the line of traction and the meshwork becomes an elastic cord. The resiliency or elasticity of this tissue causes the fascia to resume its mesh-work character as soon as the traction is released. The sacro-uterine ligament is formed from the mesh work by traction in this manner; for with increased concentrated weight, there is a demand for a better support. This condition is brought about in the animals which assume the upright position, for here we find the uterus and its appendages sinking down into the pelvic cavity and contracting into a nearly solid mass. Therefore, coincidently with this re-arrangement, we have a re-adjustment of the support with the development of abundant fibro-elastic and muscle tissue within the folds of the peritoneum.

Somers and Blaisdell, in the Journal A. M. A., October 4ht, 1913, Page, 1249 mention the fact that "In the monkey, the uterus is undivided and that the anatomic conditions are similar to those in the human female. Here with the sinking down of the uterus, we find the recto-vaginal folds changes to a sacro-uterine ligament and in other respects, the structures are human in character but to a less marked degree."

The muscle fibers situated between the folds of the peritoneum constitute the true recto-uterine muscle. Histologically, some of these fibers may be found attached directly to the peritoneum. In fact, a few are found within the fibrous layer of the peritoneum. This latter fact is thought by Blaisdell to be new, but we find the condition in many of the peritoneal folds where traction is bought upon them. These strands of
non-striated muscle fibers found within the recto-uterine folds undoubtedly originate as I have mentioned above, from the walls of the uterus and the vagina. Consequently, the strands would be more numerous near the point of origin than in the more remote parts of the folds. Therefore in as much as they have a double point of origin, their action must be twofold. Those from the uterus supporting the cervix uteri keeping it from collapsing anteriorly and inferiorly, while those from the vagina lifting the fornix posteriorly and superiorly. See schematic drawing, (c) and (d), Figure II, PLATE M.

In as much as these muscle strands are composed of non-striated fibers, they must necessarily respond to reflex stimulation. Blaisdell has demonstrated that a distinct mass of fibers in this fascia extends from the anterior two-thirds of the sacro-uterine fold down to the vault of the vagina. These fibers help to sustain the vault like character of the posterior and lateral fornices. It is interesting to note that the fibrous portion of the peritoneum wherever found over these folds is somewhat thickened. Thus it will be seen that these folds composed of thickened peritoneum; non-striated muscle fibers, and especially arranged fibers of the fascia propria not only support the uterus and vaginal vault from behind, but because of their inherent elasticity and resiliency restore them to their normal position when pushed or pressed down. That these ligaments play a very important part in the anchorage of the uterus and vaginal vault is further demonstrated, I believe, when we consider the condition of old age where we find a general wasting of muscle tissue; the
fibrous tissue losing its elasticity and resiliency and being replaced largely by fat, for it is in this condition that we find the extreme prolapses of these viscera with the excessive elongation of their ligaments.

Bovee in American Gynecology, July, 1902 published a series of very interesting articles on the sacro-uterine ligaments. He shows that as far back as 1850, efforts were made to utilize them in operations on the prolapsed uterus. Whether approached by the abdominal or vaginal route, the ligaments were shortened without actually isolating them. He, however, exposed them by the vaginal route, dissected them out and shortened them by doubling them on themselves. Although at that time, his articles created considerable interest and discussion, I think too little attention has been given them since by surgeons. They are definite, practical structures, and are accessible, although many seem to think otherwise.

I believe that a definite knowledge of the relation of the pelvic fascias and their special dispensation as ligaments for anchorages of support to the pelvic viscera is absolutely necessary in order to form a sound basis of treatment in restoring the proper support to these prolapsed viscera, and offer this as an apology for the efforts put forth in the preparation of this thesis.
Plate A.

Fig. 1.

Fig. 2.
PLATE A.

FIGURE ONE.

(a) anterior superior spine and the spine of the os pubis in the same vertical plane
(b) anterior superior spine; upper border of great sacro-sciatic foramen and articulation of second and third pieces of sacrum in the same horizontal plane
(c) spine of os pubis; spine of ischium and articulation of sacrum and coccyx in the same horizontal plane
(d) plane of cut sections of PLATE G, and PLATE F.
(e) lower border of articular surface of the os pubis and articulation of second and third pieces of coccyx in the same horizontal plane

FIGURE TWO.

(a) great sacro-sciatic foramen
(b) Obturator internus muscle
(c) obturator foramen
(d) pyriformis muscle
(e) openings for sacral nerves
(f) ischio-coccygeus muscle
(g) sacro tuberous ligament
(a) representing the division between the uro-genital and the rectal triangles.
a) bulbo-cavernosus muscle  
b) ischio-cavernosus muscle  
c) fascia diaphragmatic urogenitalis inferior  
d) superficial transversus perinei muscle  
e) fassa under triangular ligament  
f) obturator internus muscle  
g) levator ani muscle  
h) pubo-rectalis portion of levator ani muscle  
i) arcus tendineus  
j) sacro-tuberous ligament  
k) coccygeus muscle
PLATE D.

FIGURE ONE.

(a) obturator portion of the pelvic fascia
(b) obturator foramen
(c) pyriformis fascia
(d) showing coccygeus portion of pelvic fascia continuous with the obturator portion of pelvic fascia
(e) sacro tuberous ligament

FIGURE TWO.

(a) obturator fascia
(b) obturator foramen
(c) showing origin of levator ani muscle from the arcus tendineus of the pelvic fascia
(d) cut edge of levator ani muscle
(e) fascia diaphragmatic urogenitalis superior
(f) fascia diaphragmatic urogenitalis inferior
(g) pyriformis fascia
(h) coccygeus fascia
(i) sacro tuberous ligament
(j) obturator fascia in lateral wall of ischio-rectal fossa
Plate E.

Fig. 1.

(a) bladder
(b) levator ani muscle
(c) fascia surrounding the vesiculae seminales
(d) arcus tendineus
(e) obturator fascia
(f) rectum
(g) external sphincter muscle
Plate F.

Fig. 1.

(a) fascia propia
(b) pelvic fascia
(c) ureteral opening
(d) attachment of rectum to sacrum
(e) rectum
(f) blood vessels cut
(g) urethral opening
(h) obturator membrane
(i) ligamentum pubo-prostaticum medium
(j) ligamentum pubo-prostaticum lateralis
Plate G.

Fig. 1.

(a) attachment of rectum to sacrum
(b) rectum
(c) pelvic fascia over obturator internus muscle
(d) ureteral opening in bladder
(e) ligamentum pubovesicalis medium
(f) fascia propria
(g) cervix of uterus cut
(h) urethral opening
(i) ligamentum pubovesicalis lateralis
(a) dorsal vein to penis
(b) fascia diaphragmatic urogenitalis superior
(c) urethral opening
(d) fossa between triangular ligament and levator ani muscle
(e) ischio coccygeus muscle
(f) pubo-rectalis portion of levator ani muscle
(g) prostate gland
(h) arcus tendineus
(i) obturator internus muscle
(j) sacro-tuberos ligament
Plate I.

Fig. 1

(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
(j)
(k)
(l)
PLATE I.

FIGURE ONE.
(a) bladder
(b) prostate gland
(c) illustrating course of levator ani muscle
(d) urethra
(e) rectum
(f) right Houston valve
(g) external sphincter muscle
(h) anal canal
(i) fascia propria filling in between the rectum and the prostate gland and the bladder

FIGURE TWO.
(a) uterus
(b) bladder
(c) illustrating course of levator ani muscle
(d) urethra
(e) vagina
(f) rectum
(g) right Houston valve
(h) external sphincter muscle
(i) anal canal
(j) fascia propria filling in between the rectum, vagina and bladder
(a) internal circular muscular coat of the anal canal
(b) outer longitudinal muscular coat of the anal canal
(c) insertion of outer longitudinal coat in perimysium of external sphincter muscle
(d) epithelium of anal canal
(e) levator ani muscle fibers
(f) levator ani muscle fibers cut obliquely
(g) insertion of levator ani muscle fibers in fibrous tissue of the perineum
(h) external sphincter muscle cut transversely
Plate K.

Fig. 1.

(a) ischio-coccygeus muscle  (d) pyriformis muscle
(b) pubo-coccygeus portion of levator ani muscle  (e) obturator internus muscle
(c) pubo-rectalis portion of levator ani muscle  (f) arcus tendineus
(g) prostate gland
(a) ischio coccygeus muscle
(b) ilio-coccygeus and the ilio-sacralis portion of the levator ani muscle
(c) pubo-rectalis portion of the levator ani muscle
(d) pyriformis muscle
(e) obturator internus muscle
(f) arcus tendineus
Plate M.

Fig. 1.
(a) showing extensive bony origin of the pubo-rectalis portion of the levator ani muscle
(b) showing the oblique course of the arcus tendineus due to this extensive bony origin

Fig. 2.
(a) uterus
(b) vagina
(c) showing course of muscle fibers from uterus in the sacro-uterine folds
(d) showing course of muscle fibers from vagina in the sacro-uterine folds
Plate N.

fig. 1

fig. 2
PLATE N.

FIGURE ONE.

(a) strands of non-striated muscle fibers in the sacro uterine folds
(b) mesh-work of connective tissue
(c) outer longitudinal muscle coat of rectum
(d) inner circular muscle coat of rectum
(e) submucosa of rectum
(f) mucosa of rectum
(g) band of condensed connective tissue

FIGURE TWO.

(a) showing location of striated muscle fibers in the anterior portion of the human prostate gland
(b) capsule of prostate gland
(c) alveoli of glands in prostate
(d) septum between lobules of the prostate gland
(e) lumen of urethra
(f) showing how the ducts of the glands lead to the urethral opening
(g) showing non-striated muscle cells in the interlobular septi (high power drawing)
(h) detail of striated muscle fibers found in the anterior portion of the human prostate gland (high power drawing)