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A N I N Q U I R Y

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AN INQUIRY
INTO THE NATURE OF THE UTERINE SUPPORTS
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and Physician in Charge of Diseases of Children at the Columbia Dispensary.

There exists great diversity of opinion among Anatomists and Gynæcologists as to what properly constitutes a uterine support, and, especially, as to the particular function, utility and extent of action of the special organs and tissues to which this supporting power is ascribed. Some hold that all the pelvic viscera, together with its fascias, its membranes and its muscles, must be comprehended within this designation—that the pelvis must be viewed as a whole, and that each and every organ and tissue is an essential part of the supporting framework, while others limit the power or function of support to the uterine ligamentous appendages.

I cannot accept the limitations which ignore the agency of any part of this whole, though each part may and does possess and exercise distinct and peculiar functions, or which deny to any part all other power than the mere execution and preservation of its normal

healthy inherent function. In the study of human anatomy, and of the purposes of the various parts thereof, it must not be forgotten that all organs and tissues are animated by a living principle, and that contiguous and adjacent organs and tissues bear to each other correlative and reciprocal agencies, acting together in the harmonious fulfillment of a natural purpose, and, at the same time, each for itself performing the special functions of its organization.

The position and relationship of the bladder, rectum and uterus, with their attachments, membranous coverings and folds, together with their connections with the vagina and peritonæum, must be viewed as a whole, this whole must be considered in its relations and attachments to the bony frame, and the pelvis, with its visceral contents, must be viewed as a part of the body, both with reference to its position as a part, and its relations in all the movements of the entire body, to enable us to reach a philosophical conclusion in regard to the supports proper of the uterus, the particular power of each, and as to the nature of the cause of malposition.

In regard to uterine displacements authors do not correctly and distinctly trace the relationship of cause and effect. Every conceivable influence, recognized co-existing lesion, or associated mal-relation has been denominated a cause of displacement, when, in fact, such morbid condition was simply an effect of the operation of a primary cause, which primary cause might have produced any one of the existing conditions antecedently to the others, or all simultaneously, or each might

have followed consecutively in the chain of alterations, consequent upon the continuous operation of such cause. To illustrate: It is insisted by some that cystocele is the initial mal-relation in the causation of procidentia, and that relaxation of the utero-sacral ligaments is the morbid condition primary to retroversion, whereas clinical observation, as well as sound reasoning, demonstrate that cystocele does not necessarily precede, as a cause, procidentia, nor ligamentous relaxation a retroversion. The uterine displacement and associated mal-relation may occur *pari passu*, or either may follow the other, or both may be consecutive results of the persistent action of a primary cause.

Prof. T. Galliard Thomas has very comprehensively summarized the usually assigned causes of uterine displacements as follows:

1. Influences increasing the weight of uterus.
2. Influences weakening the uterine supports.
3. Influences pressing the uterus out of place.
4. Influences exerting traction on the uterus."

These influences operate mechanically. It is alledged that tight clothing is an influence pressing the uterus out of position, pregnancy an influence increasing weight of uterus, rupture of the perinæum an influence weakening uterine supports, and shortening of uterine ligaments an influence exerting traction upon the uterus; and, in fact, these are frequently the circumstances and structural alterations co-existent with uterine displacement, but if they constituted the primary causes it is amazing that any woman should escape. If pregnancy operates through the mechanical agency of weight, and

tight and heavy clothing, and muscular effort through that of pressure, it seems marvellous that so many women should escape injury. The comparative infrequency of uterine mal-position does not justify the conclusion so universally received, that these influences are the chief and essential agencies.

I do not mean to under estimate the agency of the mechanical forces—weight, pressure, traction, and loss or diminution of supporting power in the causation. I concede that displacement cannot occur independently of the operation of one or more of these forces, but I deny the acknowledged sources of the power.

Statistics show that much the larger portion of displacements occur subsequently to parturition, and that the liability to occur increases in proportion to the frequency of and to the quickness of recurring pregnancies. Hence it would seem to follow, as a logical sequence, that uterine displacements, either primarily or secondarily, were due to the alterations in the texture and position of the pelvic organs and tissues, consequent upon the physiological changes which occur during gestation and to parturition. So likewise may like results follow any pathological lesion of the uterine tissues, which augments its volume and increases its weight. But displacements occur in virgins, and in married but nulliparous women, and when there is neither augmentation of volume nor increase of weight; and, notwithstanding the greater proportion of displacements occur in child-bearing women, yet, comparatively, a small portion of the child-bearing suffer from any such injury. Hence the conclusion is irresistible, that, though preg-

nancy and parturition may produce such changes in the relative position of the pelvic viscera—such mal-relation of the parts as may facilitate the operation of these forces and even favor their development—it is essential that some additional force or agency should be developed or brought into action.

If these premises be correct, it is evident that an investigation into the effects of pregnancy and parturition upon the anatomical arrangement and relation of the pelvic viscera and adjacent organs and tissues, will furnish the solution of the *modus operandi* of this essential force. Whether the displacement occurs in a virgin or subsequent to parturition, the same mal-relation of parts must co-exist and the same consecutive alterations must occur. The same mechanical force, be it weight, traction or pressure, acting to the same extent, in the same direction, developed under like conditions, will produce like results in the virgin and in the child-bearing. Then what are the effects of pregnancy and parturition? In discussing these results reference is only had to the physiological and anatomical changes which the pelvic and contiguous organs and tissues undergo as a necessary consequence of pregnancy.

The gravid womb increasing in volume in consequence of the proliferation of its tissues and development of the foetus, gradually fills the pelvic cavity, presses upon the adjacent viscera, distorts their forms, alters their position, and occasionally their structure. During the earlier months the pregnant womb descends, but subsequently ascends the plane of its inclination, and at the expiration of the sixteenth week, it has risen above, though

not resting upon the linea ilio-pectinea. This elevation may, in some measure, be due to the relative position and peculiar adaptation of the growing womb and pelvis, or else how account for the primary movement of descent and subsequent ascent of the organ, with accumulated weight and bulk. The gravid womb, conoidal in form, presents its greatest admeasurements to the pelvic brim, with apex below. Development is greatest and most rapid in the body and fundus. Yet, in the absence of actual co-aptation of the uterine walls with the margin of the brim, its ascension of the plane of its inclination cannot be explained upon the bare supposition that its elevation is due to a power in nature to adapt its position to its growth. To do so, the conoid, with apex in the pelvic cavity, must impinge against the margins of the pelvic brim, or else the body, which adapts position to size, is without a fulcrum. Hence there must be some inherent power of elevation, some force sufficient to overcome the force of gravitation, to maintain the growing organ upon an inclined plane and to carry it up the plane, and, furthermore, to overcome the resistance offered by its attachments. To accept this elevation as the illustration of a mere mechanical force, growing out of the peculiar anatomical relation of the impregnated uterus to the pelvic cavity, by which the apex of a cone constantly and gradually increasing in dimensions, is the lower part in its ascension from a cavity of fixed and unalterable dimensions and shape, is altogether unphilosophical, and involves the doctrine of co-aptation and impingement of the uterine and pelvic surfaces, a relation known not to

exist, except as a casualty. This elevation, which I assume to be a physiological process, stretches and elongates the vaginal columns, round and broad ligaments, and cervical attachments. Whether the increase of the superficial area of these parts be due to attenuation or development, it is a physiological process and not one of violence. The abdominal walls are distended—the evident effects of this distention being most manifest between the umbilicus and pubis; the bladder is pressed forward and downward, thus narrowing or constricting its opportunity for distension, thereby creating, when in a state of repletion, an additional force or power directly expended upon the anterior vaginal column, which being superadded to the traction of the elevated cervix produces still greater elongation of the vagina, vesico-uterine and pubo-vesico-uterine ligaments. But the most remarkable increase in superficial area of any of the tissues, is that which the peritonæum undergoes. Being the peripheral covering of the greater portion of the uterus, and forming, by its duplications, the anterior and posterior uterine excavations, and by a transverse fold the broad ligament, “into which the uterus is implanted,” adhering to all the organs, tissues and muscles, it is involved in all the changes of position, shape and size which they undergo; and especially is the attenuation marked in the portions constituting the vesico-uterine ligament and Douglas’s space. So great sometimes may be the attenuation and diminished contractility of these folds that Scanzoni has known a rupture to follow from the pressure of a loop of intestine. It is during parturition that the vagina and

perinæum suffer the greatest distention, not unfrequently even to laceration and rupture.

The resulting effect of these alterations in these adjacent organs and tissues admits greater mobility of the non-gravid womb, and increased pressure from the intestines into the uterine excavations, in consequence of their enlargement, and, anteriorly, admits the pressure of the intestines directly upon the anterior vaginal column, in consequence of the elongation and relaxation of the vesico-uterine ligament, which is but a peritonæal fold.

Nature has wisely provided the tissues concerned in these physiological processes with the inherent power of adaptation to the necessity incurred. Whether it be, as is the case with the uterus, by a proliferation of tissue, or, as seems more probable as regards the *facias*, membranes and muscles, an attenuation of fibre, it is an indisputable fact that the power of restoration to a normal anti-pregnant condition is not an equally developed inherent power in all the tissues involved. The uterus, having reached its greatest development at the close of gestation, expels its contents and returns, by a process of involution, to its normal position and size, though pregnancy and parturition impress decided modifications on its size and form. The weight of a nulliparous womb varies from one to one and one-half ounces, of a child-bearing from one and one-half to two ounces. The anterior and posterior walls become more convex, and the superior margin rises above the insertion (Bennet) of the fallopian tubes, with which they are nearly rectilinear in the virgin. So to a less extent do the round

ligaments—they being a continuation of the uterine muscular tissue. “The vagina,” says West, “undergoes hypertrophy during pregnancy.” “It grows longitudinally to allow the womb to ascend high up above the pelvic brim; transversely to afford space for passage of the child in labor, room for which could not be obtained by any mere stretching of a membranous canal;” and that it fails to follow the womb in its involutions, remaining longer, wider, and with thicker walls than previous to conception. Scanzoni says, “the excess of volume and temporary elevation of the inferior part of the womb which pregnancy occasions, produce a dilatation and a notable lengthening of the vaginal canal, which are always accompanied by a distension of its walls. It is during parturition that this distention attains its greatest degree, and the puerperal retraction is not always sufficiently complete to allow the walls of the vagina to resume all the tonicity which naturally belongs to them. When pregnancies are frequent the walls become still more lax and supple, and easily yield to pressure.” The peritonæum and perinæum never resume, though contracting to some extent, their virgin condition, but remain relaxed, attenuated and flaccid. The peritonæum is found lying in folds at the bottom of the uterine excavations, “wrinkled and loose in the elongated Douglas space,” and the abdominal walls exhibit ample evidence of continued relaxation. These conditions are aggravated by every recurring pregnancy, and the peritonæum and vagina may, by the repeated operation of the cause, attain that degree of relaxation and tenuity as to lose all power of contractility.

or escape the necessity of any future development or attenuation to accommodate the dimensions of a recurring pregnant womb. Scanzoni mentions having observed a relaxation of the uterine appendages and adjacent tissues, which would allow elevation of the uterus two inches above its normal position into the abdominal cavity, by pressure against the os tinæ. Such are results of pregnancy and parturition, but they are insufficient to account for displacements. If so, such would be the inevitable sequence of frequent, and, perhaps, of every pregnancy, and the after life of child-bearing women would be burdened with the ailments and suffering incident thereto. They are conditions precedent to postpartum displacements that develop and facilitate the operation of the necessary force. The resulting mal-relation of the uterine excavations and of the vaginal columns favor the descent of the intestines, and consequently augments the weight and pressure of the abdominal viscera, but so long as the equilibrium of pressure is maintained, the uterus being of normal size, harm cannot result. In the normal virgin condition there is no pressure of the abdominal viscera upon the anterior vaginal column, except through the medium of the bladder, for the peritonæal fold, constituting the vesico-uterine ligament does not lie upon the anterior vaginal column, consequently, it is only subsequent to pregnancy or to some agency which may produce a like attenuated condition of this membranous attachment, that any intestinal pressure or force can be brought to bear directly upon the anterior column, or even, but to a very limited extent, upon the anterior

uterine wall, through the anterior uterine excavation. In the posterior excavation, even in the normal virgin condition, there is always a portion of intestine lying loosely upon the posterior vaginal column. Nature seems to have so shaped and constructed the uterus, and to have adjusted the pressure from the surrounding and superincumbent viscera as to protect and preserve it *in situ naturali*. It occupies nearly a central position in the pelvis, not in contact with any solid or hard substance, is "suspended in the midst of tissues, which, from their construction, and their pultaceous, watery and gaseous contents afford a secure nidus."* Weighing about an ounce,† it is "delicately and unstably poised in its position," supported "on every side by the soft and elastic structures which everywhere surround it as closely as if it were enveloped in a fluid."‡ "Its long axis (Sims) should stand at about right angles to that of the vagina," or, according to Hodge, at an acute angle. The bladder occupies the anterior angle, so that the degree of the angle increases with the distention of that viscus and lessens with its subsidence. It is a "flattened cone," "a hollow conoid," presenting its broadest surfaces in its anterior and posterior axial deviations to the pressure of the superincumbent and surrounding viscera. The increased mobility obtained by the relaxation of connected parts admits greater

* Hodge.

† Duncan, Researches in Obstetrics, p. 4.

‡ Weight of nulliparous womb is from 1 to 1½ oz., child-bearing from 1½ to 2 oz. Bennet on The Uterus, p. 26. Duncan, Researches in Obstetrics, p. 2, says the unimpregnated uterus weighs about 1 oz.

axial deviations, and consequently increased liability to variations of pressure from the surrounding organs, invites, as it were, the destruction of that equilibrium of pressure which is essential to the maintenance of its delicately poised position. Its longitudinal axis is coincident with or parallel to the axis of the plane of the pelvic brim, forming with the vagina, at the point of junction anteriorly (Klob) an angle of 155° , and* upon itself at the point of union of cervix and body an angle of 165° , so that the line of gravitation, which, in its relations to its attachments and to the adjacent organs, is through the line of the longitudinal axis, would, according to the natural tendency of all bodies, be through a line drawn vertical to the horizon through its centre of gravity. Its centre of gravity being supposed (Duncan) to be the centre of its mass must be a point above, and the vertical line of gravity must be anterior to the point of cervical attachments. The plane of the brim inclines at an angle of 60° , and the longitudinal axis, vertical to this plane, inclines at an angle of 30° to the horizon, the angles being in opposite directions, the two incident lines form with themselves a right angle, but with the horizon angles bearing always the proportion to each other as 2 to 1—that is, if the angle of inclination of the uterus be 30° the angle of inclination of the plane of the brim will be

* Meadows (Manual of Midwifery, p. 42) denies that there is ordinarily any "curvature whatever in the general direction of the uterine canal," and maintains that the "normal axis of the uterine cavity is identical with that of the pelvic brim or inlet," being represented by a line forming with the horizon an angle of 30° . Bennet, who first pointed out the existence of these angles, asserts that they are obliterated by child bearing.

60°. This relation, though not mathematically accurate as thus expressed, is accepted as the established rule of normal anatomical construction, and is constant and unvarying, except so far as it may be disturbed by exigent oscillations, within a limited arc, of a body so delicately poised amidst contiguous organs subject to such fluctuating conditions as the female pelvic viscera. Then, so long as the coincidence or parallelism of the normal uterine axis and of the axis of the plane of the brim is maintained, so will the uterine axis approach the horizontal line in direct proportion with the approach of the plane of the brim to the vertical line, consequently, as the inclination of the plane of the brim, and, in fact, of the pelvis, increases or diminishes, so, reversely, will the uterus approach or recede from a vertical line. Now, what is the practical application of this relation? The axis of the body is represented by a line touching the 3d lumbar vertebral articulation and passing through the symphysis pubis. The body, in the erect position, is balanced upon the ilio-femoral articulations, and "the centre of gravity of the parts above is nearly vertically over the ilio-femoral articulations."* These articulations, the points of support, are the points about which the forward and backward movements of the trunk take place, and, it must follow, that as the trunk movement is forward or backward the centre of gravity of the parts above varies from the vertical line passing through these articulations, and the uterus approaches or recedes from a vertical line, the obliquity of the pelvis and of the

* Duncan, *Researches in Obstetrics*, p. 40.

plane of the brim to the vertebral column being maintained, or but very partially disturbed, in consequence of the slight mobility of the lumbar vertebral articulations. Thus the longitudinal uterine axis is made either to approach parallelism to the axis of the body, thereby receiving directly the pressure of the superincumbent viscera through its long axis, or to approach a horizontal position at right angles with the axis of the body, thereby receiving the weight and pressure upon its posterior surface. Whatever mal-position or mal-formation of the body, or mal-relation of parts, whether congenital or acquired, that approximates the uterine longitudinal axis to the axis of the body or to the horizontal line, evolves a force that disturbs the equilibrium of pressure, which nature has so accurately adjusted for the maintenance of the uterus *in situ naturali*. Any permanent disturbance, or destruction of the normal axial relations of the pelvis with the body or with its viscera, or interruption of the natural correlation of the pelvic contents become factors in the causation of uterine displacements.

These preliminary suggestions bring me directly to the consideration of the mode and manner of evolution of the essential force or forces concerned in producing uterine deviations, for I maintain that these displacements find their causes in the action of new forces generated by anatomical mal-relation, or in the irregular or disturbed operation of normal forces consequent upon anatomical mal-relation; and, *per contra*, that the uterus finds its support *in situ naturali* in forces due to normal anatomical construction and arrangement.

But I must for the moment depart from the consideration of these axial relations, to study the natural correlation of the various pelvic viscera, and the utility of the various parts thereof as factors in maintaining the uterus in its natural position, that I may the more clearly elucidate the propositions just stated. There exists another relation of parts which has heretofore escaped the attention which it demands. The locality of cervical attachments is the only stable (not positively fixed) point of the uterus—here is the axis of rotation. Anterior to these attachments lies the greater length, weight and bulk of the uterus. If preponderance determined its rotary movements, the fundus and body would surely rotate anteriorly around this axis, but such is only exceptionally the rule, for antiversion, though claimed by some to be the normal position of the virgin womb, is, comparatively, a much less frequent casualty than retroversion. Certainly the position of the bladder, with its constantly recurring conditions of collapse and repletion, acts as a barrier to anti-version, and forces a descending fundus back to its natural site; but that is seeking an explanation too remote from and independent of the organ itself, implies that the uterus is maintained *in situ naturali* by the least scientific of all mechanical contrivances, a mere prop, and presupposes that the varying condition of the anterior excavation is entirely regulated by the extent of vesical repletion, the varying amount of pressure of the intestines upon the anterior uterine wall being, consequently, estimated at nothing. I concede that vesical repletion, which is, frequently, by the force of habit or per-

sonal neglect carried to an extraordinary extent, may become an auxiliary to the force or forces developed by some pre-existing mal-relation. It is a law in physics that weight operates through the line of gravitation, and traction through the direction of the force, and, furthermore, that a body suspended by an attachment to its centre of gravity will hang in exact equipoise, so also will it maintain equipoise if supported by its centre of gravity. So, if the cervical attachments of the uterus were affixed at points respectively opposite its centre of gravity, its normal position of exact equipoise could be easily understood, but the anatomical arrangement does not fulfill this condition. Weight preponderates anteriorly to these attachments, consequently, as in physics, the tendency should be for the greater weight, the body and fundus, to rotate anteriorly, and for the lesser weight, the cervix, to rotate posteriorly. Yet, the uterus being *in situ naturali*, the equipoise is exact. The anatomical arrangement of these attachments furnishes a beautiful illustration of another law of physics, and readily solves the problem of uterine equipoise. To facilitate the elucidation of this law the posterior ligaments and vaginal column may be regarded as the upper or suspensory attachment, and the anterior vaginal column as the lower or supporting attachment. In physics, if the body gravitates unequally equipoise may be restored either by correcting the *irregularity* of weight or by diminishing the leverage of the preponderating portion, which may be accomplished by moving the suspensory attachment to such point toward its distal end as may secure, by the counter traction of

the upper and lower attachments, perfect counterpoise. This is the precise arrangement of the vaginal attachments to the uterine cervix—the posterior column, together with the utero-sacral ligaments, being attached nearer the fundal extremity. The respective points of attachment constitute the points around which the body and fundus rotate in anterior and posterior axial deviations, according as either may become the centre of rotation, the force being always greater in posterior rotation, because the posterior or suspensory attachment approaches nearer the distal end of the preponderating part. The rotary movement thus secured is peculiar. It is doubly rotary, perhaps more properly a reciprocating vibratory motion (not a pendulum-like motion, for that is a to and fro vibration upon a single fixed point), more like a double see-saw motion, each attachment alternately constituting the fulcrum of movement and the counterpoising power. The curvilinear arrangement of these attachments affords greater amplification of the oscillatory movements of the uterus, and without compromising in any degree their counterpoising power, yet antagonize each other in their opposite tendencies to produce anterior and posterior axial deviations, while, as traction acts through the direction of the force, the probable power of the posterior attachments in promoting descent, (the direction of the force approaches the direction of the longitudinal axis,) is antagonized by the counter power of the anterior attachments, which, though not acting in an opposite direction, must by virtue of their anatomical arrangement impede descent so long as the long uterine axis is main-

tained in its normal relations to the axis of the plane of the pelvic brim. And thus it is that prolapsus cannot occur except with antecedent or simultaneous inversion of the anterior vaginal column, which inversion of its normal curvilinear course destroys the utility of its supporting power, and facilitates the co-operation of other perverted forces.

The peculiar anatomical arrangement of the cervical attachments admirably and wonderfully exemplifies the economy and utility of nature's handiwork. Whilst it admits greater mobility and adds elasticity to mobility, it secures restoration of the natural equipoise, for as the body and fundus may rotate about either fulcrum, the counterpoising force of the other attachment restores it to its normal site, consequently, so long as the natural relation of the parts is preserved, this peculiar force generates and maintains the force necessary to secure the uterus *in situ naturali*, that is, so far at least as regards the anterior and posterior axial mal-positions. But how is the excess of force acting posteriorly, or rather tendency to retroversion, produced by the construction of the cervical attachments, aided by any auxiliary force derived from vesical repletion compensated for? Too much power is ascribed to the bladder in supposing its distension to act by pressure, whereas the anatomical arrangement of its peritonæal coat, which to a considerable degree fastens the organ in a forward and upright position, prevents any very considerable pressure backward against the uterus unless it is distended far beyond its usual and normal size, and its anterior and forward elevation, when in a

state of repletion, is increased by the relaxed condition of its peritonæal attachments to the abdominal parietes, thus admitting the intestines to wedge in between the latter and this viscus; and as the distention and consequent elevation progress, so must the tension of the vesico-uterine ligament increase, and its traction force thus enhanced, must antagonize the pressure force derived from repletion. The action of vesical repletion is twofold. Situated in the angle formed by the uterus with its anterior cervical attachments, roughly estimated at 155° , which angular obtuseness favors the suggestion of its auxiliary agency in promoting retroversion, it operates upon both arms of the lever constituted by the uterus and anterior vaginal column, the posterior cervical attachments being the fulcrum, and converts, by virtue of this anatomical arrangement, the lesser into the greater arm of the lever. Whatever effective force or power is evolved by vesical repletion must operate at the bas-fond as at the fundus of the bladder, and the leverage being greater at the bas-fond the effect is obviously equal, if not greater, than upon the body and fundus of the uterus, the shorter arm of the lever; and more especially is this true in view of the attachment of the peritonæal coat to the abdominal parietes, which limits the elevation of that viscus. Consequently, we find here a force to oscillate the uterus about the point of posterior cervical attachment to accommodate the replete viscus, while, *pari passu*, with the accumulating force of increasing distension is being generated a counter force by the pressure of the enlarging viscus downward and forward upon the greater arm of the lever,

sufficient to counteract the pressure backward, and to restore the natural equipoise. The anatomical construction generating these forces seems to warrant the conclusion that the see-saw uterine motion takes place simultaneous with vesical repletion and collapse; thus perfect consonance of action is secured between the movements of the bladder and the uterine counterpoising mobility, and thus also the utility of the loose and indirect vesico-uterine attachment is clearly defined. The dipping of the anterior excavation limits this attachment and affords, by the necessary peritonæal reduplication, and the filling of the vesico-utero vaginal interspace with areolar tissue, the amplest arrangement for vesical distention and elevation, without direct injury to either of these adjacent organs. If the bladder was directly adherent to any part of the uterus, and the vesico-uterine ligament direct in its course, distention of that viscus below the ligament would be limited by the tensibility of such structure, or else the uterus would follow the bladder in its elevation. The normal movements of both organs, though *correlative*, are independent, and the power finding its origin in the exigent movements of the bladder is expended harmlessly in the direction of and auxiliary to the counterpoising movements of the uterus. The latter organ rotates on its transverse axis following the changing conditions of vesical repletion and collapse. The tendency to retroversion is further obviated by the structure and direction of the round ligaments. Rising* laterally from

* Klob, Pathological Anatomy of Female Sexual Organs.

the margin of the fundus, their course is in a convex bend anteriorly and externally to the point of attachment in the loose tissue of the pudenda. Their origin at the fundus and convex course affords another beautiful illustration of nature's adaptation of means to the conservation of purpose and to frugal utility. Constituting, as they obviously do, the main guide stays to the gravid womb in its gradual ascension of the parietal inclined plane, yet they subserve other purposes in limiting the lateral distention of the bladder and guiding its upright elevation, for it rises within their curves, and adds its auxiliary restraint to the backward pressure of a distended bladder, and, by the very nature of the anatomical arrangement and construction, this restraining force augments in direct proportion to the force of distention, for as distention may increase laterally the convexity of their curves is increased, thereby increasing the power of traction upon the fundus, thus antagonizing the backward pressure. Again, we find a force threatening injury creating its own counterforce, and yet fulfilling all the purposes of nature. But there is a point beyond which their utility may cease, and their power become perverted to an agent of serious danger. The moment the fundus uteri in posterior oscillation passes, in the arc of rotation, beyond the point of their greatest tension, though the nature of their pudental attachments and the relaxation consequent upon continued tension favor further rotation, that moment their power, acting in the same direction, carries the fundus down the arc of rotation towards the posterior cul de sac, and vesical distention, acting as be

fore by increasing the convexity of their course, becomes auxiliary to this perverted force, which is further aided by the accumulated weight of the abdominal viscera which is gradually, as the posterior descent of the fundus progresses, transferred from the posterior to the anterior uterine surface; and still another factor, passive in its mode of operation, is found in the relaxation of the peritonæal coat of the bladder, the result of pathological changes or of attenuation from inordinate and habitual vesical distension or utero-gestation, which, while its attachments to the pubis, bladder and uterus are never disturbed* by womb displacements, ceases to offer its conservative resistance to the forces now perverted; and, even if its normal structure and superficies be maintained, the tension to which it may be brought by the traction of the retro-verted body may generate a force which, acting through the medium of vesical repletion, may so alter the direction of the forces that rotation may be converted into descent, preceded by vaginal inversion.

The agency of the broad ligaments in maintaining the uterus in the median line is so obvious that I need not pause to consider it, and that they constitute important accessory aids in resisting versions and flexions is equally obvious. Savage† has demonstrated upon the cadaver that these ligaments constitute the last obstruction to complete prolapsus. Hence, as they are formed by transverse folds of peritonæum, into which

* Savage on the Female Pelvic Organs, p.

† Anatomy of the Pelvic Viscera, Plate XI.

the "uterus is implanted," which folds undergo very considerable attenuation or development during utero-gestation, and possess, if at all, to a very limited extent the power of involution, it becomes manifest that in this anatomical mal-relation a new force, passive but potent, finds its origin in the lessened resistance to descent and increased bilateral mobility afforded to the womb.

The relations of the uterus and rectum are also important. Situated behind and below, and, when viewed in regard to their anatomical position, above the uterus, and, when considered in its relation to line of descent, under the uterus, a casual observer would conclude that impaction would necessarily offer obstruction to both retro-version and prolapsus, yet clinical experience teaches absolutely the contrary. Hence the force thus called into operation is not one of pressure. Rectal impaction must begin below, at the anal end, and accumulate upwards in the line of the gut; thus, it is obvious, that any pressure upon the womb must first be expended upon the os and cervix in the direction of the longitudinal axis, and, subsequently, as it may increase, upon the broad posterior surface. Hence elevation and antiversion would, necessarily, be the primary deviation, *reposition* following removal of rectal distention; but this is not the resultant mal-position, which comes clinically to our notice. The utero-sacral ligaments, "*crescentic* prolongations of sero-muscular *platysma*, containing besides muscular fibres from the vagina and uterine cortex,"* arising from the posterior

* Savage.

† Kolrausch.

uterine surface, at a point opposite the internal os, encompass the rectum on both sides, proceed in a semi-lunar course to their attachment to the sacrum, about one and a half† inches from its apex, a point obliquely above the pelvic attachment of the anterior vaginal column, so that while they are, to a certain extent, in another and obvious relation suspensory, they also possess a force acting through the direction of their attachments, and this force is augmented by inversion of their normal *erescentic* arrangement, whereby the weight of superincumbent viscera is increased. The effect of rectal distention, (the normal contractility of these ligaments being destroyed by the continuous tension of their muscular filaments,) is relaxation, attenuation, stretching, consequent inversion of their anatomical arrangement and augmentation of weight from the downward pressure of the intestines in the Douglas space. Now, supposing a force to be acting simultaneously through the longitudinal axis, (which is favored by the consequent movement forward of the cervix due to the loss of power and elongation of these ligaments,) the direction of the uterine deviation would necessarily be through a line median to the two forces, except so far as it might be interrupted by the normal action of the other attachments, or effected by the perversion of their normal operation. Hence retro-version or descent would occur according as one or the other of the two forces was the more powerful, the direction of a body being always through the diagonal median to two equal forces, and approaching the direction of the greater of two unequal forces crossing each other acutely. This law in

physics is verified by the fact that prolapsus cannot occur beyond the impingement of the os against the posterior vaginal wall without retro-version, whereby the median line of motion is deflected anteriorly and downwards. This demonstration furnishes a direct and positive contradiction to the accepted theories in regard to the causation of descent and retro-version, inasmuch as it becomes apparent that cystocele is not necessarily a pre-existing, co-existing, or consecutive mal-relation with descent, and that retro-version is not the necessary resultant displacement from relaxation of the utero-sacral ligaments, except so far as such deviation of the fundus may occur as descent proceeds through the axis of the vagina. In all cases of descent the condition of the perinæum presents important considerations, either facilitating or impeding the operation of these perverted forces.

“The motion of a body is in the direction of the force that produces it, and is proportional to that force,” (Arnott.) The uterus, in its physiological ascent and descent, moves through the line of its longitudinal axis, ordinarily, a line perpendicular to the plane of the brim—up and down a line acutely inclined to the line of gravitation. Whatever force or forces are engaged in this regular and symmetrical movement, and whatever their origin, they act through the direction of the longitudinal axis. The cervical and other attachments possess an inhibitory agency, limiting the extent of the descending and ascending motion, and it seems evident that this restraining power—the result of the conjoint operation of all the attachments in harmonious action)

cannot also constitute the forces employed in the rising and falling of the womb, having their origin in the alternate contraction and relaxation of the uterine appendages, for this physiological movement is always, invariably, through the same axis, even though its normal axial relation is subject to constant variations incident to the fluctuating conditions of the adjacent viscera. While descent might be explained upon the hypothesis of contraction of the cervical attachments, ascent cannot be accounted for upon the supposition of the immediate subsequent relaxation, for clinical observation teaches the contrary result from relaxation, and during the menstrual period when physiological prolapsus occurs as the result of the increased weight of the uterus, the physiological ascent and descent is not disturbed in the regularity of the alternating movement. Admitting, for the sake of the argument, that descent is the result of pressure having its origin in the descent of the diaphragm in inspiration, there must be some force other than its withdrawal in expiration, to produce ascent. The force that carries a body down an inclined plane will not elevate it, nor will a body carried down such a plane reascend upon the withdrawal of the force, nor will a body ascend in a vacuum. The uterus neither rests at the point where the impelling force is expended, nor descends, according to the law of gravitation, but ascends the inclined plane. Surely there is some force active and direct, other than any which can be attributed to its appendages, or to pressure from below, which occasions this ascending motion.

The important factor in the maintenance or perversion of these normal forces is the "retentive power of the abdomen," to which attention was first called by the distinguished Edinburg obstetrician, J. Matthews Duncan. That some such power does exist seems obvious, or how explain the synchronous ascent and descent, through its longitudinal axis, of the uterus during respiration. The anatomical arrangement and construction of its ligaments and attachments, which admits this regular and constant movement along a plane inclined at 30° to the horizon—a movement which absolutely opposes the law of gravitation, precludes the supposition of their exclusive agency, inasmuch as the point of tension of no one of them can be reached either in this physiological descent or ascent. Without stopping to investigate the sources and nature of this "retentive power," it is sufficient for the present purpose to recognize the important part which the abdominal walls play in the maintenance of its integrity.

And, now that I have presented the correlative relation of the female pelvic organs and endeavored to demonstrate the existence and *modus operandi* of certain forces essential to the maintenance of the uterus *in situ naturali*, and their perverted action and the origin of other abnormal forces in the causation of malpositions, I must recur to the consideration of the relation of the pelvis with the trunk.

At page 16 I submitted the following proposition, to wit: Whatever mal-position or mal-formation of the body, or mal-relation of parts, whether congenital or acquired, that approximates the uterine longitudinal

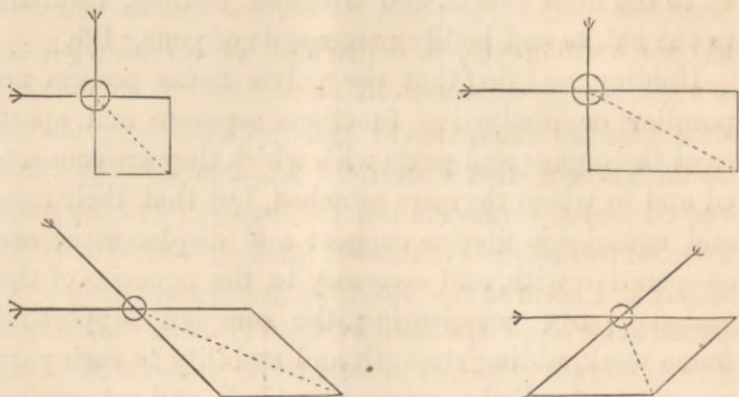
axis to the axis of the body or to the horizontal line, evolves a force that disturbs the equilibrium of pressure, which nature has so accurately adjusted for the maintenance of the uterus *in situ naturali*, and, consequently, favors displacement.

Descent, in the relation in which it is now being considered, is synchronous (or nearly so) with inspiration, consequently as the bulging of the abdominal walls, as pointed out by Hutchinson, follows, in the female, thoracic expansion, so uterine descent corresponds with this physiological bulging of the abdominal walls, and thus must the "retentive power" be diminished by the bulging. If this be the normal coincidence of the component movements of a purely physiological process, it surely is logical to conclude that relaxation of the abdominal parietes, (which is but another expression for abdominal bulging,) favors, facilitates, and may produce uterine descent. But, apart from any relation which the relaxation of the abdominal walls, (a necessary consequence of, and increased by, every recurring pregnancy,) may bear to "the retentive power of the abdomen," the diminished action of the abdominal muscles, (which is in proportion to the extent of distention and relaxation,) favors the gravitation of the abdominal viscera, especially of the intestines. Hence, a new force may be brought into action, which, (according to the direction of its action,) may occasion, (either alone or in synchronous co-operation with other new or perverted forces,) uterine displacements. If the relaxed and protuberant walls permit descent of its visceral contents through the axis of the body, surely there must be augmented

pressure upon the womb through its longitudinal axis, if into the vesico-uterine space, upon its anterior surface and anterior cervical appendages. These considerations present a ready explanation of the infrequency of uterine displacements in young and virgin females, though that is the period of life in which the organ is subjected to the most violent and irregular jostling, incident to the habits and bodily movements of young life.

Holding, as I do, (that the pelvic fascias possess no peculiar or distinctive functions separate and apart from the organs and parts with which they are connected and to which they are attached, but that their uses and agencies in uterine support and displacement are co-operative with, and accessory to, the agencies of the various parts constituting the complex supporting frame work, adding strength and stability to each part separately, to all the organs as a whole, and subserving the important purpose of uniting the pelvic organs with the pelvic frame, thus fastening and establishing their relation with the trunk,) I deem it unnecessary, here, to consider their anatomical arrangement in detail. And space forbids, nor is it essential to this inquiry, that I should enter upon the discussion of the agencies which the structure, conformation, position, size and density of the uterus contribute to its maintenance *in situ naturali*. In viewing the wonderful mechanism of the human body, of every organ and tissue, I cannot resist the conclusion that the physical qualities of each part ~~has~~ been wisely adapted to the maintenance of position as well as to the due performance of function. have

To enable the reader the more readily to comprehend the law of force or forces producing motion, to which reference has been so frequently made, referring, for a more comprehensive demonstration, to Arnott's Elements of Physics (pp. 55th sec.), I submit the following diagrams from the same author:



The forces are represented by the arrow-heads; the body by the circle at the crossing of the direction of the forces; the direction of the body by the dotted lines. In the square and two irregular parallelograms the forces are equal, though crossing each other at a right, acute and obtuse angles; in the regular parallelogram the forces are unequal, but cross at right angles.

Accepting the conclusion of Weber that the body, in the erect position, is balanced upon the ilio-femoral articulations, and the theory of Duncan that the line of gravitation of the parts above is through a vertical line passing through these articulations, or the more commonly accepted view that the line of gravitation is through the axis of the body, as previously described;

it is perfectly evident that the vertical line of pressure of the super-incumbent viscera cannot be through the longitudinal uterine axis, but may be deflected from the anterior abdominal walls, against which it must impinge, through the line of the longitudinal axis, upon and against the fundus, and also, in a direct line, upon its attachments. Hence, it is that, usually, in virgins, and not unfrequently in *multiparæ*, when the uterus is healthy, that posterior axial deviations are the immediate result of some violent and sudden shock to the trunk, whereby this deflected force is momentarily increased beyond the natural resistance of the antagonistic influences, or is expended upon the anterior uterine surface, because the intestines are forced below the normal relation of the long axis. The same deflection of force would follow, as surely, though not with such momentum, relaxation of the abdominal parietes, which permitted such descent of the intestines below the umbilicus, as would change the line of vertical pressure to the direction of the longitudinal axis. Retro-version and descent may result from such deflection of the natural force of gravitation of the abdominal viscera, to which may be added the auxiliary force derived from muscular contraction or increased pressure of the super-incumbent viscera; and thus it is that abdominal tumors, enlargement of the abdominal viscera, accumulation of fluid in the peritonæal cavity, tight and heavy clothing, diminished thoracic expansion, unusual and violent effort may occasion uterine mal-position—their agency being always enhanced by the inevitable mal-relation of parts consequent upon pregnancy. Thus it

also is that sudden prolapsus is chiefly the result of abdominal pressure, concussion, straining, carrying heavy weights, lifting, stooping, &c.

A roomy and an insufficiently oblique pelvis are considered predisposing causes of prolapsus uteri—the former admits increased pressure; the latter favors the operation, and increases the power, by increasing uterine inclination, of the gravitating force, whether acting through its vertical or deflected line. Any departure from the normal dorso-lumbar curve, either by increasing or diminishing the anterior arch is also a predisposing cause. Increased curvature augments the force of impingement against the anterior surface of the abdominal walls, and, consequently, the deflected force against the pelvic organs; lessened curvature, by diminishing pelvic inclination, thus approximating the uterine long axis to the vertical line of pressure of super-incumbent viscera. I have condensed from Rokitansky the following observations, bearing upon the relation of the pelvis to the spinal column. Every primary curvature is compensated by a second curve in the opposite direction, which generally occupies the part of the column immediately adjoining the first. The compensation generally equals the primary curve. Lordosis, arising from too great pelvic inclination is compensated for by increased backward inclination of the pelvis. Distortions of the spine diminish both thoracic and abdominal cavities. The chest is lengthened and flattened from before backwards by excessive pelvic inclination. The pelvis is always oblique in lateral curvature and loses its natural bi-lateral symmetry—

the transverse diameter being always increased. Pelvic capacity is generally increased in angular curvature, its height elevated, inclination decided, due to diminished capacity of the abdominal cavity, caused by depression of the thorax. Extraordinary anterior curvature in the loins involves a corresponding excessive inclination of the pelvis, and when compensating and consequent upon too great inclination, causes still greater pelvic inclination. These observations show how the normal relation of the uterine and corporeal axes may be disturbed by certain alterations in the natural conformation of the spinal column. As these relations may be disturbed the centre of gravity and line of gravitation are altered, and as the pelvis and pelvic organs constitute the objective against which the force of gravitation of the super-incumbent viscera is always expended, their normal relation must suffer in proportion as the uterine supports are weakened or overcome. Pelvic inclination and dorso-lumbar incurvation bear a direct and positive relation to each other, either, in excess, being compensated by an excess of the other. If the pelvic inclination be the primary mal-conformation its dorso-lumbar compensation seeks its compensation in further pelvic inclination, so the cause and effect re-act upon each other, producing alternately further inclination and greater spinal curvature. If the suggestion, that the force of impingement of the abdominal viscera against the anterior walls is increased by increased incurvation of the dorso-lumbar curve, be in conformity with the laws of force and motion, which force of impingement derives additional power from the dimin-

ished capacity of the abdominal cavity, always co-existing with spinal distortion, and as the uterine inclination (to the horizontal line) is diminished in direct proportion with the increase of pelvic inclination (to the same line), it must follow that increased force is expended in the direction of diminished resistance, that is, that the same mal-conformation which generates the additional force ultimately expended upon the uterus and appendages, so presents these parts to that force, that the resistance which its natural position and attachments offer, is diminished in direct proportion to the degree of force thus evolved. Such being the resultant issue of this mal-conformation, it would seem, *per contra*, that the opposite deviation of the normal dorso-lumbar curvature, would be unattended with uterine displacement. The difference is only in the form of deviation. Lessened pelvic inclination with increased uterine inclination is the natural relation with diminished dorso-lumbar curvature. The action of the pressure force of the super-incumbent viscera upon the objective, the pelvic viscera, becomes, consequently, more direct for the obliquity of the axis of the pelvic brim to the axis of the body or vertical line of pressure is diminished, and the longitudinal uterine axis approximates the vertical course of the gravitating force. Hence, it is universally conceded that abnormal anterior pelvic deviation is a predisposing cause of displacement.

In setting forth the principles herein stated, I am not unmindful of the fact that so long as they are not corroborated by actual, linical observations, which accu-

rately trace the histories of cases of uterine displacements, showing their connection with the anatomical anomalies, which through the perversion of the normal forces, predispose to the results deduced, that I may incur the criticism of those who adhere to the dogmas and follow the lead of men whose learning and experience entitle them to pre-eminence of opinion. I might, if space permitted, quote, from many distinguished authorities, isolated paragraphs, which go to show, that the inquiries to which I have endeavored to direct special attention, are not original with me; various authors, in discussing the subject of uterine displacements, have so nearly approached, in their multitudinous array of causes, the views here thrown out, that I am compelled to forego all claims of originality, and to be content with the simple claim of endeavoring to trace and illustrate the relationship of cause and effect.

And while I fail to furnish positive demonstration, by giving clinical histories, there are many facts and circumstances, which must have come to the knowledge of every observant practitioner, which go far towards establishing the verity of these conclusions. It must be apparent, to even a casual observer, that the curvatures of the spine change with the advance of life, and that the alterations are more marked in the child-bearing women. The woman during gestation adjusts the centre of gravity to the increasing dimensions and weight of the pregnant womb by throwing back the head and thorax, and that the frequent repetition of this process of adjustment, through frequently recurring

pregnancies should work some fixed mal-conformation of the normal spine, is not only a fair inference from a study of the natural laws of the human economy, but is verified by actual observation, and as the primary departure from the normal curvature always finds its compensation, and usually in the part immediately adjoining, and, more especially, as any increase of the ordinary anterior curvature in the loins involves a corresponding excess of pelvic inclination, the thinking reader will readily discover that I am not entirely destitute of clinical facts. The equipoise of the body upon the ileo-femoral articulations must be preserved, and Duncan has called attention to the fact that while "the small and especially short bodied women" seek the adaptation of the centre of gravity by moving backwards the head and shoulders, another class, the "tall and long bodied," seek it by "moving forward the supports," which is accomplished "by diminishing the angle which the pelvis forms with the horizon." "In this diminution of the inclination of the pelvis, forward movement of the ileo-femoral articulation takes place, and the equipoise is restored without any backward motion of the upper part of the trunk. This change in the pelvis is analagous to that taking place in old age, when the forward stoop is counterbalanced by it."* While there may be many typical illustrations of these two classes of women, the probability is, that in a majority the two arrangements exist, one "in complement to the other." Another important fact in this connection, perhaps also first pointed out by Duncan, though

* *Researches in Obstetrics*, Duncan, pp. 40, 41.

it must have generally arrested the attention of gynæcologists, is that where the adjustment is effected by backward inclination of the head and shoulders, the hips become very prominent, indicating, as suggested by the same author, "a probable considerable obliquity of the pelvis." In the other class the "hips are generally flat, indicating, of course, lessened obliquity and pelvic elevation. These observations illustrate and demonstrate the existence of the mal-conformations consequent upon pregnancy, and verify the suggestions made above relative to the perverted relation of the pelvic and corporeal axes. The same mal-relations will follow acquired habits of carriage, which may produce like changes in the natural configuration of the body, and so, likewise, must alterations ensue from persistently excessive indulgencies of certain positions. Sitting upon the sacrum, instead upon the upper part of the femur, must inevitably affect a change in the normal relation of the pelvis and spinal column, and excessive dorsal recumbency must surely work alterations in the normal spinal curvatures, especially in lessening the dorso-lumbar arch.

Time and space forbid the further pursuit, at present, of this interesting and suggestive inquiry. Hereafter, I may resume the work, now so abruptly terminated, and seek to show the practical utility of the study of the laws of force and motion, in their application to the investigation into the causes of uterine displacements, and how they may be utilized in the treatment. For the present, I must be content, if I can induce others to the study of the philosophy of the question.

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