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ON THE

STATICS OF PREGNANCY.

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In considering the points of this subject which I propose to discuss, I shall adopt the following arrangement:—

1. The Position of the Uterus.
2. The Position of the Fœtus in Utero.
3. The Position of the Pregnant Female.

In the course of these remarks it will be observed, that as much labour is spent in clearing the field of errors and misconceptions as in establishing the truth.

Before commencing, I must guard the reader from supposing that in defining angles, &c., I wish to imply the real existence of mathematical exactness in the subject. When I use numbers in this way, it is merely to express a near, perhaps, the nearest approximation to the reality. And I resort to them in order to facilitate the application to the anatomical circumstances so expressed of mechanical principles, which can be illustrated only by mathematically exact statements.

I. The Position of the Uterus.

In the healthy unimpregnated female, the uterus, an organ of about two and a half inches in length, generally lies with its fundus near the centre of the imaginary plane of the brim

of the pelvis, and having its long axis in a direction corresponding to the axis of the brim, that is, an imaginary line drawn at right angles to the plane of the brim from its centre. (See Fig. 2.)

The unimpregnated uterus, weighing about an ounce, is so delicately and unstably poised in its position, that the common description of it as *floating* there, is an extremely apt and happy use of that term. In accordance with this, we find that the first change produced by the increase of its weight and bulk in pregnancy, is that it sinks in the pelvis. Gradually increasing in size to dimensions greater than those of this bony ring, it rises out of that cavity, and is described as coming to rest upon its brim. But the uterus cannot without risk of misapprehension be described as resting upon the brim of the pelvis. These words imply that in pregnancy, the mass and weight of the uterus repose upon the alternately soft and muscular, or harder and bony walls of the brim in the living female.

It must be remembered, that the brim of the pelvis is in the erect, the attitude understood in all such discussions, much nearer vertical than horizontal, being inclined to the horizon at an angle, (see Fig. 2), of above 60°,[1] a position in which it is evident it can give no support in the ordinary acceptation of that term. If we turn to the body to be supported, we shall find its circumstances totally inconsistent with this description. The long axis of the uterus is in all the earlier months of pregnancy inclined to the horizon at about the same angle as the axis of the brim, that is, an angle of about 30°, (see Figs. 2 and 4) to the horizon. In the latter months the angle of inclination of the upper part at least, exceeds 30° somewhat. (See Fig. 6.) From its nearly oviform shape, with the small end lowest, and the nearly uniform density of its contents, it may be predicated that its centre of gravity is nearly the centre of its mass. Now every body tends to fall in a vertical line from the horizon, passing through its centre of gravity. A necessary condition for the support of any body is that its centre of gravity be supported. This necessary condition is not fulfilled to the pregnant uterus by the pelvis. Consequently, the pelvis cannot be correctly described as *the* part supporting the uterus.

The pregnant uterus is supported on every side by the soft and elastic structures which everywhere surround it, as

[1] The brim of the bony pelvis has an inclination of 60° to the horizon, according to the researches of Nægele on the female. This angle is increased by the psoæ and iliaci muscles, which cover the sides of the brim, being thicker superiorly than inferiorly.

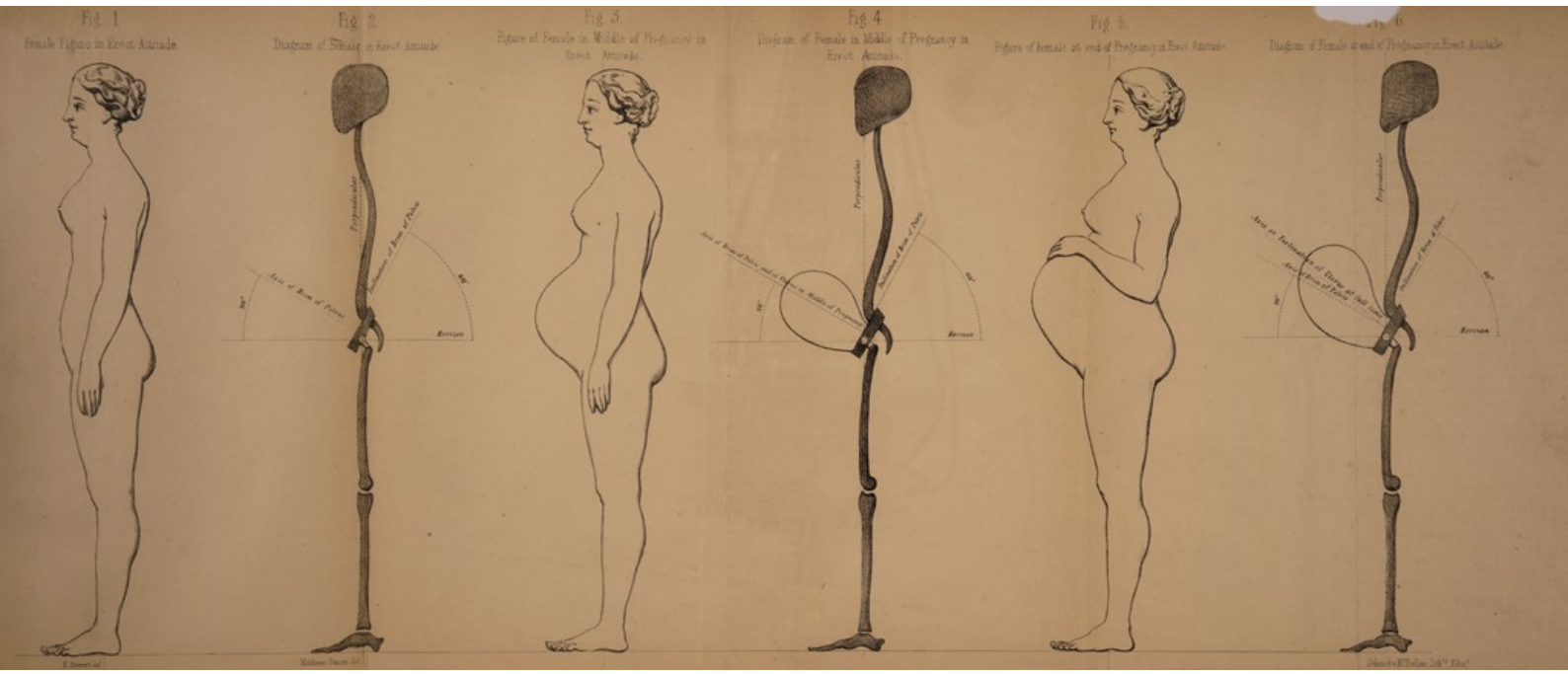
Fig. 1
Female Figure in Erect Attitude
Fig. 2
Diagram of Female in Erect Attitude
Perpendicular
Axis of Brim of Pelvis
Inclination of Brim of Pelvis
90°
30°
Horizon
Fig. 3
Figure of Female in Middle of Pregnancy in Erect Attitude.
Fig. 4
Diagram of Female in Middle of Pregnancy in Erect Attitude.
Fig. 5
Figure of Female at end of Pregnancy in Erect Attitude.
Fig. 6
Diagram of Female at end of Pregnancy in Erect Attitude

closely as if it were enveloped in a fluid. No single part can be described as *the* part supporting it. But with this qualification, the nearest approximation to a correct statement of the conditions of its equilibrium is the following:—It reposes upon an inclined plane formed by the anterior abdominal wall, and is prevented from moving down the plane by the pelvis. To be at rest upon an inclined plane, a body must have a power exerted upon it to arrest its motion down the plane. In the pregnant female, this is the power exercised by the brim of the pelvis. The power required to resist the pressure down the plane, (that is, the pressure on the brim of the pelvis,) is to the vertical pressure on the inclined plane, (that is, the pressure upon the anterior abdominal wall,) as the height of the plane to its length. Now, in an inclined plane, which rises from the horizon at about an angle of 30°, the pressure on the plane itself (that is, on the anterior abdominal wall) must be greater than the pressure in the direction down the plane in the proportion of 87 to 50.[1] Thus it is found that the chief support of the uterus is the extensive, equable, soft and elastic abdominal wall, not the comparatively limited, unequable, hard and inelastic pelvic brim.

It is not necessary to point out at any length the evident application of these views in explaining the production of anterior obliquity of the pregnant uterus, or of pendulous belly. It is upon the anterior abdominal flap that the chief weight of the pregnant uterus reposes, and this part is consequently most liable to be morbidly displaced by this pressure. "There is an affection," . . (says Montgomery,)[2] "constantly mistaken for and treated as local inflammation; I speak of a pain felt at either side about the margin of the ribs, and arising from the dragging of the muscles at their insertions in that situation, especially of the oblique at their superior attachment." The same circumstances as throw the weight of the uterus on the anterior abdominal muscles, remove the main pressure of the organs from the brim of the pelvis, through which it would otherwise be more liable to prolapse than it really is.

It is here necessary to point out that great misconceptions are entertained in regard to the position of the uterus, in different positions of the female. For instance, in attempting to disprove the gravitation-theory of the position of the fœtus in utero, to which we shall have afterwards to allude, it has

[1] For this calculation, as for other kindnesses, I am indebted to Mr J. Elliott, Lecturer on Natural Philosophy.

[2] Signs and Symptoms of Pregnancy, p. 7.

been argued[1] that that doctrine presupposes that the mother's body is in the vertical position, in order that the gravitation of the fœtal head may have the effect attributed to it, and that the horizontal position assumed during repose, or from other causes, ought to afford many more chances than the statistical results show, of the head assuming, by gravitation, other positions than the ordinary one. This argument, to have any force whatever, must imply that in the vertical position of the female, the uterus is vertical, or nearly so; and in the horizontal or recumbent posture, horizontal, or nearly so. But this is very wide of the truth; nay, it is totally opposed to it.[2] In the erect position of the female, the uterus is, in all the earlier months of pregnancy, not vertical, but inclined to the horizon at a moderate angle of about 30°. (See Fig. 4.) In the latter months of pregnancy, the uterus is generally, though not always, directed at an angle somewhat nearer half a right angle (see Fig. 6), by the resistance of the anterior abdominal wall to its growing in its

[1] M. Dubois, who speaks of the "almost vertical direction of the uterus in the erect position," adds—"We cannot refrain from remarking, that there is a considerable number of women who, for the sake of their health, pass the greater part of their pregnancy in a position almost horizontal; and although, even in this position, the uterus may maintain something of its ordinary direction, nobody will believe that the slight inclination, which its walls offer, is sufficient to favour the descent of the head towards the uterine orifice. We are, nevertheless, not aware that, in these circumstances, the presentations of the head are less common than otherwise."—*Mem. de l'Acad. Roy. de Med.*, tom. ii. p. 270.

Dr Simpson, following Dubois, states this still more strongly. "The doctrine of gravitation" (says he) "presupposes that the mother's body is in the vertical or upright position, in order that the gravitation of the fœtal head may have the effect attributed to it. But during the hours of sleep and rest, her body is placed horizontally, and not vertically, and ought to afford many more chances than the statistical results shew, of the head falling by mere gravitation into other positions and localities, than its usual and normal locality in the cavity of the cervix uteri. Besides, most practitioners have repeatedly seen patients restrained to the horizontal position for months before labour came on, without this position of the mother producing any deviation from the common position of the fœtus."—*The Attitude and Positions of the Fœtus in Utero*, p. 7.

[2] "Whoever" (says William Hunter, *On the Gravid Uterus; Rigby's Ed.*, p. 6), "has any tolerable notion of the shape of the abdomen, and situation of the cavity of the pelvis, must understand that the axis of the uterus is very far from the perpendicular line, its lower end being turned backwards, and its upper end, in proportion, turned forwards. This obliquity changes with the attitude of the body, and from many other causes. When erect, the weight of the uterus presses the fore part of the abdomen into a greater rotundity, and then the axis of the uterus approaches nearest to the transverse or horizontal line; and in a recumbent position, the contrary happens from a similar cause."

"Owing" (says Montgomery, *Signs and Symptoms of Pregnancy*, p. 6) "to the oblique attachment of the pelvis to the spinal column, and the projection of the sacrovertebral junction coming in contact with the posterior surface of the uterus as it increases in size, and begins to ascend out of the pelvic cavity, that organ cannot rise perpendicularly, but its fundus is inclined forwards with its

Fig. 7.

Diagram of Female in supine position in Middle of Pregnancy.

Fig. 8.

Diagram of Female in supine position at end of Pregnancy.

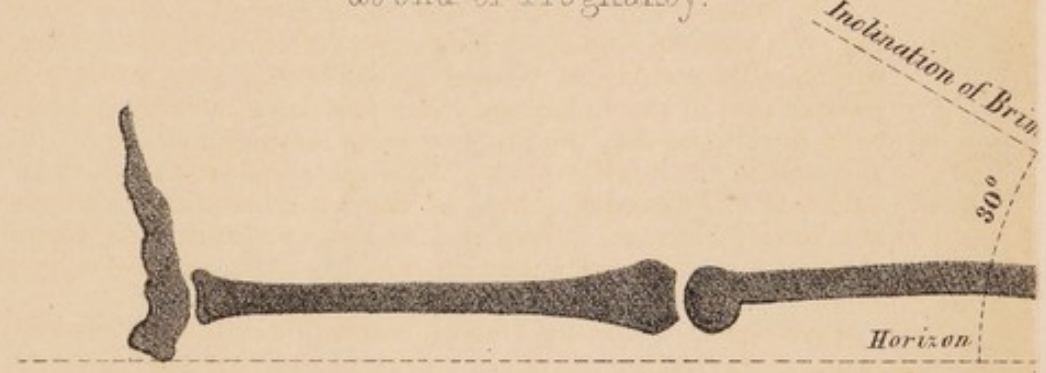

Fig. 9.

Diagram of Female in Middle of Pregnancy in best position for Ballottement.

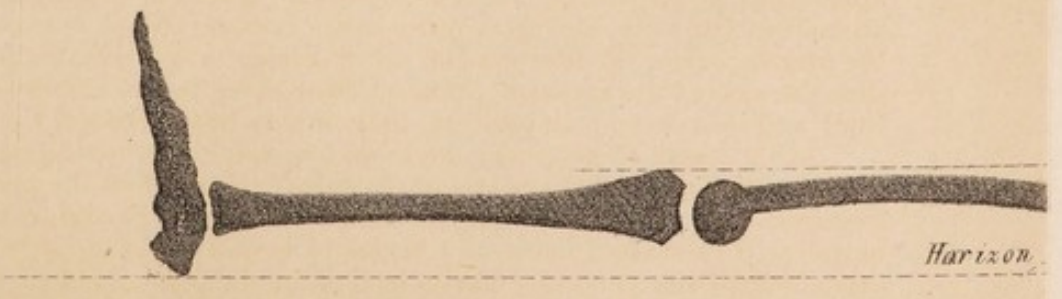

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Fig. 7.

Diagram of Female in supine position in Middle of Pregnancy.

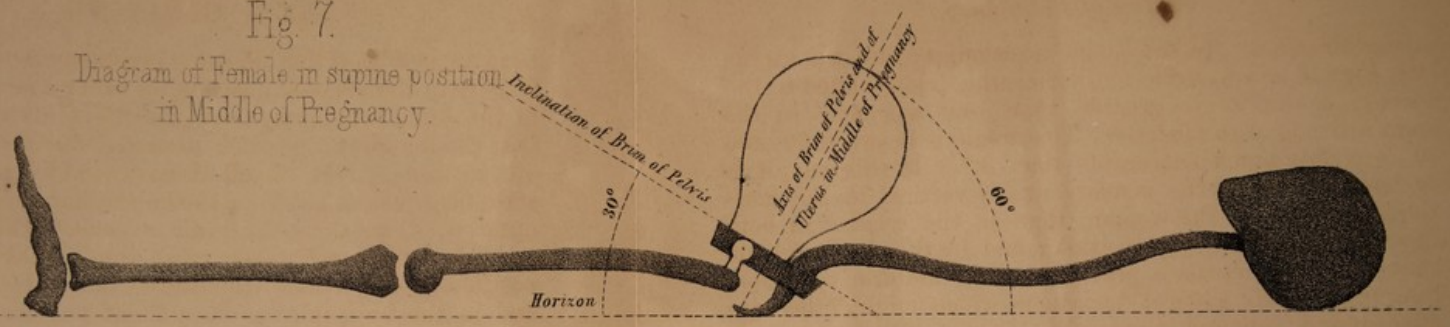


Fig. 8.

Diagram of Female in supine position at end of Pregnancy.

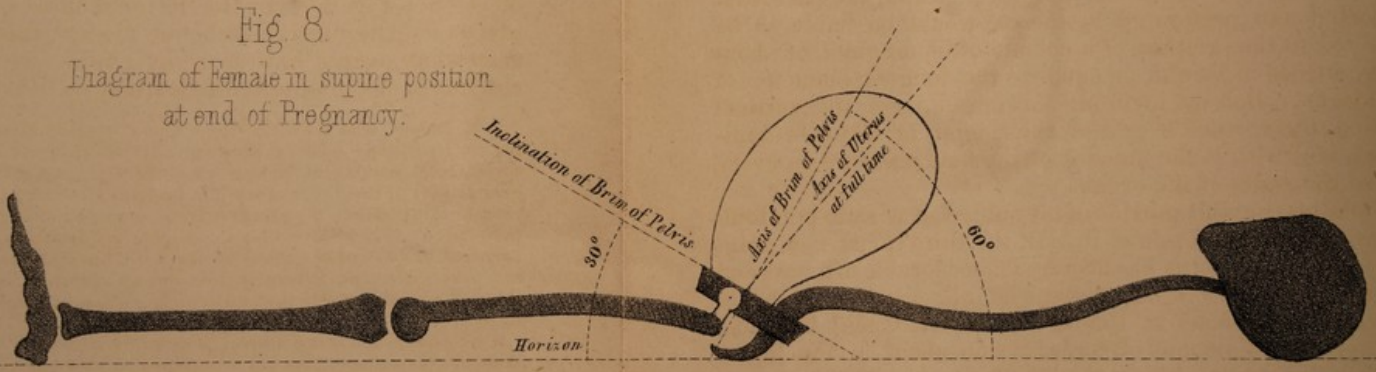
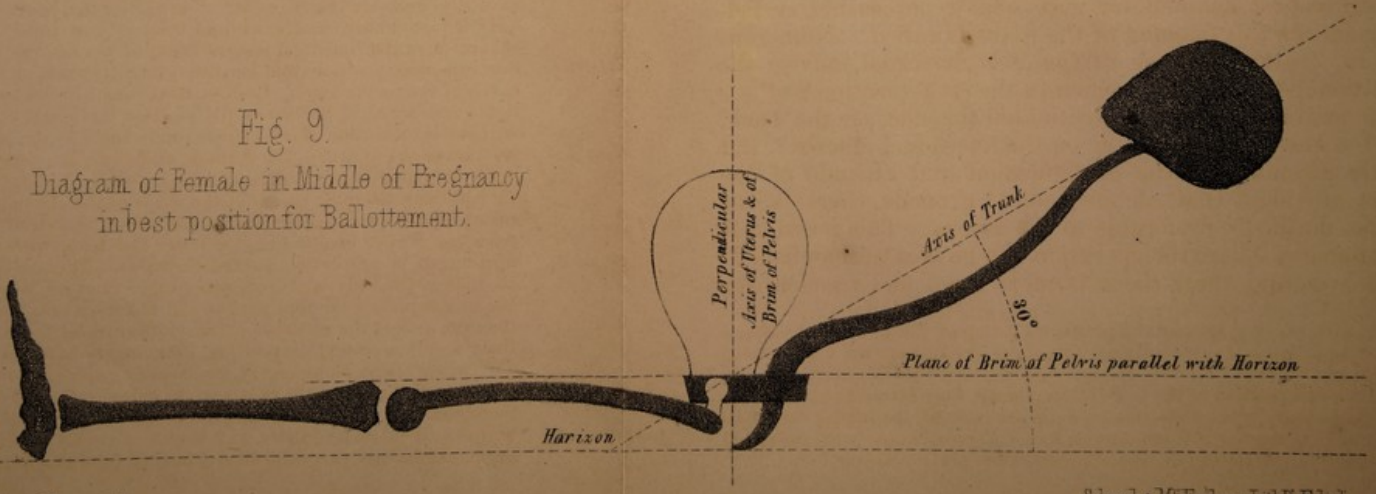


Fig. 9.

Diagram of Female in Middle of Pregnancy in best position for Ballottement.



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earlier direction. In the supine position, we find the uterus (see Figs. 7 and 8) to be not horizontal, but inclined to the horizon at an angle greater than that assumed in the erect attitude of the female. This angle is between 60° and 30°, probably much nearer 60° than 30°. In this way, it is evident that the uterus is more nearly vertical in the horizontal position of the woman, than in the erect. In both cases it is in an oblique position; and by this beautiful arrangement, the uterus is preserved, in a uniform condition, free from many statical variations which might otherwise affect it suddenly and injuriously.

The fact, that in none of the ordinary positions of the female is the uterus vertical, insures for the organ a considerable hydrostatical advantage. If the uterus were at any time vertical, then the lower part of the organ, the part least supported and perforated by the os, would be liable to be subjected to the pressure of a column of liquor amnii of about twelve inches in height, or equal to the longest diameter of the uterus. But by inclining the organ from the vertical position, the vertical height of the column of water is diminished, and with it the amount of the fluid pressure on every part of the walls of the organ.

Before leaving this portion of my subject, I wish to pointout one practical application of it. In the third quarter of pregnancy, when the fœtus has acquired considerable firmness and weight, and before it has become at all closely adapted in form and dimensions to the uterine cavity, it may be made, by a very small amount of force, to bob about in the liquor amnii. Various positions of the female have been recommended as best adapted for successful repercussion or ballottement, as this bobbing of the fœtus is called. Numerous authors, especially those of the French school, advise the practitioner to place the woman in the erect position; others recommend the horizontal position on the side, on the back, with the shoulders raised, or on the knees and elbows. But a little attention to the configuration and attitude of the uterus will show that, on mechanical grounds, there is one position decidedly preferable to the others. This position is that of course where the operation can be best accomplished; in other words, where there is most room and freedom for

anterior surface lying against the peritoneal lining of the abdominal parietes —a relation of parts which continues unchanged throughout the whole period of pregnancy."

"In the erect position of the body" (says Robert Lee, *Lectures on Midwifery*, p. 91), "especially if the abdominal muscles are relaxed, the fundus uteri falls forward, so that the axis of the uterus forms a great angle with the spinal column and brim of the pelvis, and approaches the horizontal line."

the motion. In regard to the uterus itself, this is evidently its long diameter in a vertical direction. Its long diameter offers most space; and if in any other than a vertical position, motion in it would be impeded, not only by the liquor amnii, but also by the fœtus's own friction on the wall of the uterus to which it gravitated, and on which it would, to some extent, move. Now, in what position of the female is the uterus placed, with its long diameter vertical? We have already said that the organ develops itself forwards and upwards nearly in the direction of the axis of the pelvic brim in all the earlier months of pregnancy, at least. If, then, we place the brim, which, in the erect attitude, is inclined to the horizon at an angle of 60°, in a horizontal position (see Fig. 9), then the uterus will be vertical. For this purpose, the axis of the female, or at least the trunk, must be deflected to the same amount from the vertical line; that is, so as to form an angle of 30° with the horizon (see Fig. 9). Nægele, indeed, has pointed out that, in a position between that of sitting and recumbency, the superior plane of the pelvis will be horizontal in a well-formed woman. This can easily be effected, in actual practice, by propping the female with pillows on a couch. It is the position I have often found to be actually best adapted for the diagnosis of pregnancy by ballottement.

II.—Position of the Fœtus in Utero.

To give point to my description of the position of the fœtus, I may first state that it is often described as being the opposite of that of the adult. It is said to carry its body vertically, but with the head placed undermost; in other words, it is said to stand upon its head. To show that these descriptions are entirely wrong, it is merely necessary to observe that the fœtus at the full time is closely adapted to the cavity of the uterus, and to recall to mind what has been already said in regard to that organ. It will thus be observed that in the erect and supine positions of the female, the fœtus, near the full time, lies obliquely to the horizon, that in neither attitude is it at all nearly vertical or horizontal, but in a position about midway; and that in the erect position of the female (see Figs. 4 and 6), it is more nearly horizontal than in the supine (see Figs. 7 and 8). The mature fœtus is nearly horizontal, in ordinary circumstances, only when the woman lies flat on the side. It is vertical, only when the trunk is inclined to the horizon at an angle of about 30 degrees.

From this position of the adult fœtus in the axis of the

brim of the pelvis, several minor advantages might be pointed out as accruing to itself. But we shall here merely observe that this fact is an important element in the mechanism of parturition, the fœtus being thus placed in the direction most favourable for the uterine efforts to overcome the most important mechanical difficulty of labour, the passage of the brim.

In the same way, as we have found the nearest (though far from absolutely) correct explanation of the equilibrium of the gravid uterus to lie in the mechanical principles of the inclined plane, so shall we find these similarly applicable to the case of the fœtus. As we described the uterus to derive support on all sides from the organs environing it, so we find the fœtus to be much more perfectly supported by the bland and warm liquor amnii, in which it neither *stands* nor *carries* itself, but reposes floating in almost perfect equilibrium. It is, however, specifically heavier than the liquor amnii. It therefore sinks in this fluid,[1] and it does so with an almost unappreciable force. In accordance with the doctrines of the inclined plane, this minute force is subdivided between the plane on which it lies, the anterior wall of the uterus, and the brim of the pelvis, the latter bearing the smaller share. The same hydrostatical circumstances of the floating fœtus which relieve the uterus almost entirely from the pressure at particular points of a body which might obstruct its circulation, or otherwise injure it, do also, in the same degree, relieve the child from pressure which might be painful or irritating to it. By this beautiful arrangement, also, the cord is safe from liability to pressure which might be fatal to it.[2] Again, the protection (says Dr Arnott[3]) given to the tender fœtus by the liquor amnii is such, that a blow from without is expended on the surrounding water and cannot reach the fœtus. During labour these

[1] At the full time sometimes so very little liquor amnii exists that it can scarcely be described as floating. The minuteness of the weight or force with which the fœtus generally presses on its supports can be understood by any one who has used the sign of ballottement. In performing this operation, the accoucheur, passing the finger per vaginam, generally succeeds in pressing the lower wall of the uterus against the presenting part of the child with some difficulty. With the point of his finger in this position, he jerks the presenting part of the fœtus. It immediately bobs up against the hand he has placed over the anterior abdominal wall, and drops down again on the point of his finger. If an accoucheur who has done this will try how he can move, with his hand similarly placed, a body weighing in air as many pounds as the fœtus does, he will then understand how nearly the fœtus must be in perfect equilibrium, and with how little of its weight it presses upon the uterus.

[2] I do not here enter into other provisions against this accident, the chief of which probably lies in the fact that the besoin de respirer, or the sensation of irritation analogous to it in the fœtus, excites it to motions which may relieve the cord from the asphyxiating pressure.

[3] Physics, vol. i. p. 688.

same waters perform important functions, which belong, however, to hydrodynamics, not to hydrostatics.

The head of the living fœtus, at and near the full time, is generally its lowest part or that nearest the brim of the pelvis. The frequency of this when compared with the other positions at or near the full time, is such that it claims to be called the natural position of the child in utero. The evidence on which this important statement rests is twofold; for, first, we can by vaginal examination at this time feel the fœtal head in that place, diagnosing it from other parts of the child; and, second, we know that, (to use the words of the admirable W. Hunter) in the last two or three months of gestation the child is commonly so much straitened for room, and so compactly adapted to the oblong figure of the uterus, that it cannot change its general position, either by its own efforts, or even by accidents happening to the mother.[1] It is on this last ground that accoucheurs do with justice adopt as an index of the numerical frequency with which the head lies lowest in the end of pregnancy, the ascertained numerical frequency of presentations of the head at the commencement of labour.

It is here necessary to make a digression in order to consider the statements of the distinguished M. Dubois and his numerous followers, in regard to the position of the fœtus in utero when not at or near the full time. These statements are founded upon statistics of the presentations of premature children in the course of miscarriage or abortion. They have been chiefly adduced in the writings of Dubois and others, who have attempted to disprove the gravitation theory of the position of the fœtus in utero. The statistics show that the earlier the fœtus is expelled from the uterus, it is the less likely to present the head as the first part born. But by an unwarrantable and quite unsupported step in reasoning they have been represented as proving the position of the fœtus in utero. These statistics are valuable, simply as indicating the presentation not before but only during parturition of premature children, and if such is the case they are utterly valueless in the discussion of the question of the position of the fœtus before labour, or of its causes, into which they have been dragged.

I have already shown why the presentation in early labour, of the fœtus, at or near the full time, is a very exact and trustworthy indication of its position before labour, and that, in many cases, we can easily verify the identity of the presentation in labour with the part lying lowest before labour.

[1] Gravid Uterus, p. 61.

But we have no evidence whatever that the presentation in a miscarriage or abortion, is identical with the part lying lowest before miscarriage, and we have no means whatever of reasoning from the one to the other. On the contrary, the more round and globular shape of the uterus in the middle months of pregnancy (see Fig. 11), the non-adaptation of the child to the uterus, the great mobility of the child and the greater abundance of liquor amnii in these months, are some of the mechanical elements in these early stages of pregnancy, which render it almost absurd to reason, from the presentation of a premature child during birth, as to its position in the uterus before the process of its expulsion commenced.

There are no collections of ascertained facts in regard to the actual ordinary position of the fœtus in utero in the middle months of pregnancy. We can only reason in regard to it from comparing the position of the fœtal heart with the shape and site of the uterus, from feeling in some cases the position of the limbs or of the head in utero, from the questionable results of post-mortem examinations in these months, and from the statical knowledge which we can bring to bear upon it *a priori*.

It is not my intention, on this occasion, to enter into the whole subject of the causation of the attitudes and positions of the fœtus in utero. That would lead me into many questions very wide of a statical inquiry. My object at present is, merely to point out the great and predominating influence in their production, namely, that power of gravitation which all bodies, alive or dead, must obey.

I have already incidentally shown, in the course of this paper, that the main arguments used against the gravitation theory are founded in error. When rightly considered, they either afford no argument whatever, or else evidence against the side they are intended to support. These arguments are based on the erroneous notion that the gravitation of the head to the lowest part of the womb, can have effect only when the woman is upright, and is rendered abortive when she is horizontal. They also are made to derive support from the reasonings founded upon the erroneous belief that the lowest part of the child, during a miscarriage, was with certainty lowest before the miscarriage commenced.

Another specious argument adduced against the gravitation theory, requires only a few words to show its imperfection. If gravitation (it has been said) were the cause of the normal position with the head lowest, then this position should be found with more certainty when the gravitation of the head, from any cause, was proportionally greater than

natural. In cases of intra-uterine hydrocephalus, the child's head is larger and heavier than usual; and sometimes it is so to an excessive degree. But this increased gravitation (it is added)[1] does not render head presentations in these cases more common than usual, but the very reverse; as has been shewn by Dr Thomas Keith in his essay on this subject. But this argument, when justly applied, is made to tell most decidedly in favour of the gravitation theory. The altered circumstances of a hydrocephalic fœtus have been altogether misapprehended. The hydrocephalic head, although truly much larger and heavier in air, is probably lighter and more buoyant in water. In this question we have to do with hydrocephalic children only while immersed in liquor amnii. The larger the head is in these circumstances, the lighter and more buoyant it is, and the other extremity of the child is proportionally heavier. The fluid effused in hydrocephalus[2] is specifically lighter than brain, and therefore, renders the head more buoyant than it is under natural circumstances. It is also in all probability specifically lighter than liquor amnii, and consequently its accumulation will have a more decided effect in elevating the head. In this way it is demonstrated that the four times greater frequency of preternatural presentations in cases of hydrocephalic children, proves, rather than disproves, the influence of gravitation in deciding the position of the fœtus.

[1] "If the physical gravitation" (says Dr Simpson) "of the head of the child were the cause of the normal position with the head lowest, then this position ought to be found with more frequency and certainty when the gravitation of the head from any cause was rendered proportionally greater than natural; with less frequency and certainty, when from other causes the gravitation of the cephalic extremity of the infant was rendered proportionally less than natural. The very contrary, however, of all this is the truth. In cases of intra-uterine hydrocephalus, the child's head is larger and heavier than usual; and sometimes it is so to an excessive degree. But this condition of the head, this increased preponderance and gravitation of it, does not render head presentations in these cases more common than usual, but the very reverse."—*Attitude and Positions of the Fœtus in Utero*, p. 9.—Extracted from Monthly Journal of Medical Science for 1849.

[2] I lately had an opportunity of procuring hydrocephalic fluid from a living child still in utero. I had drawn off the water in order to facilitate delivery; and I am indebted to Dr George Wilson, for a careful examination of the fluid. He found its specific gravity at 60° Fahr. to be 1007·9. The specific gravity of fœtal brain I do not know, but that of the adult varies between 1030· and 1050· (See *Dr Skae's Paper on the Weight and Specific Gravity of the Brain in the Insane. Monthly Journal of Medical Science, October* 1854.) In an experiment I lately made on a fresh fœtus at the full time, which had been exposed to the air for about 24 hours, I found the specific gravity of the entire body to be nearly 1050 at 44° Fahr.; and that of the head, when separated, to exceed that of the headless trunk. The specific gravity of liquor amnii of a premature ovum, is stated by Dr Rees at 1008·6 (see *Churchill's Midwifery*, 3d Ed. p. 93). But it, no doubt, varies in different cases, and probably in the same case at different times.

Again, it has been argued that anencephalic children, with the whole brain and arch of the cranium wanting, are still often found presenting naturally, whereas it has been thought that this great deficiency should render presentations of the head less frequent than natural in these cases.[1] What is the fact, as to the greater or less frequency of the presentations of the head in these cases, I do not know. But whatever it may be, the argument is very inaccurately used. For even without the head altogether, the upper end of the trunk is the heavier. "Without descending to minutiæ"[2] (says W. Hunter) "it must be observed that the trunk is very small in proportion to the head, and the lower part of the body when compared with the upper; thus, the upper part of the trunk of the body is small with regard to the head, the lower part of the trunk is small in proportion to the upper part, and the lower extremities are small in proportion when compared with the arms."

I lately tried the experiment of floating in a solution of salt, of nearly its own specific gravity, a fresh decapitated fœtus, and found that it floated obliquely, with the neck very decidedly lowest. But before any argument applicable to the case of healthy pregnancy can be derived from observing the presentations of acephalous or anencephalous children, it is necessary to take notice not merely of the presentation in such cases, but the shape of the uterus, the quantity of liquor amnii, and of any abnormal circumstances in such abnormal pregnancies affecting the statical condi-

[1] The confused and erroneous reasoning of authors on this subject is well illustrated in their discussing the position of anencephalous monsters.

"Let us add" (says Dubois, *Mem. de l'Acad. Roy. de Med.*, tom. ii. p. 270) "that, if the laws of gravity had so great an influence upon the position of the fœtus, then the anencephalous, deprived of the greater part of the brain, should offer almost constant exceptions to the ordinary rule. Their head being much lighter, should, in fact, occupy the upper part of the uterus, and their pelvic extremity, drawn by its greater weight, should be approximated to the uterine orifice; but such is not the case. We cannot however deny, that the cephalic extremity of these fœtuses presents first in labour less frequently than is observed with those who are well formed. It is not impossible that the preponderance of the pelvic extremity may have some effect in these anomalies, but we are of opinion that it is only an accessory cause."

We find Dr Simpson agreeing with Dubois in this argument. He says (*Attitude*, &c., p. 8), "If the physical gravitation of the head of the child were the cause of the normal position, with the head lowest, then this position ought to be found * * * * with less frequency and certainty, when from other causes the gravitation of the cephalic extremity of the infant was rendered proportionally less than natural * * Anencephalic fœtuses, with the whole brain and arch of the cranium wanting, are still often found presenting naturally. I have been present at the birth of three anencephali that had reached the full term of pregnancy. All of the three presented with the deformed and diminished cephalic extremity over the os uteri."

[2] On the Gravid Uterus, p. 62.

tions of the fœtuses. Till this be carefully done, we can base no reasonings upon the presentations of anencephalous children whose statical circumstances we do not know.

Further, it has been attempted by Dubois and others[1] to shew that the position assumed by the fœtus when immersed in a fluid, or rather when allowed to fall through a mass of water, is inconsistent with the gravitation theory. It has been shown, in these ill-devised experiments, that the part of the fœtus which reaches the bottom of the vessel first is not the head, as these authors fancy should be the case if the gravitation theory were correct, but is the shoulder. But the fact is, that the line of descent through a fluid of nearly equal specific gravity with the body descending, is in the case of the fœtus, as in all other bodies, not a vertical line in the long axis of the body, drawn from what is the absolutely heaviest part, but a vertical line from the centre of buoyancy to the centre of gravity. (See Fig. 10.) The same fact is expressed in the hydrostatical principle, that a body floating and immersed is in stablest equilibrium when the centre of gravity is vertically below the centre of buoyancy, —*i.e.*, the centre of gravity of the fluid displaced. These very experiments, and numerous other facts, show that the centre of gravity is much nearer the cranium in the fœtus, and especially when in the fœtal attitude, than it is in the adult; that it is, in fact, near the upper part of the back, and nearer the posterior than the anterior surface of the child. The centre of buoyancy of the fœtus will be very nearly the centre of the oval figure which encircles the fœtus. (See Fig. 10.) Both these centres will be liable to constant variations with the varying dimensions and specific weights of different parts of different fœtuses, and with the varying attitudes of the parts of the same fœtus. But allowing for every variation, it is evident, that if these two centres be in the case of the fœtus placed in the same vertical line, the fœtus will be inclined obliquely to the horizon, as we find it to be in its ordinary position.[1]

The experiments of Dubois and Simpson, involving as they do, rapid motion in falling through water, are fitted to afford results of a very small degree of value or reliability. So far as they go, they point to the fact of the descent of the fœtus, shoulder lowest, or, to speak more correctly, following the

[1] "When a human fœtus of the latter months" (says Dr Simpson) "is placed experimentally in fluid, in descending through the fluid the head does not turn and fall first to the bottom of the containing vessel, as the theory of gravitation takes for granted that it would. Thus, if a dead new-born fœtus be plunged into water, contained either in a vessel shaped like the uterus, or in a large bath, the part which gravitates and strikes the bottom of the vessel or bath first, is

Fig. 10

Position of the adult Foetus in utero &
of any similar body if supposed floating freely in
a fluid of its own density.

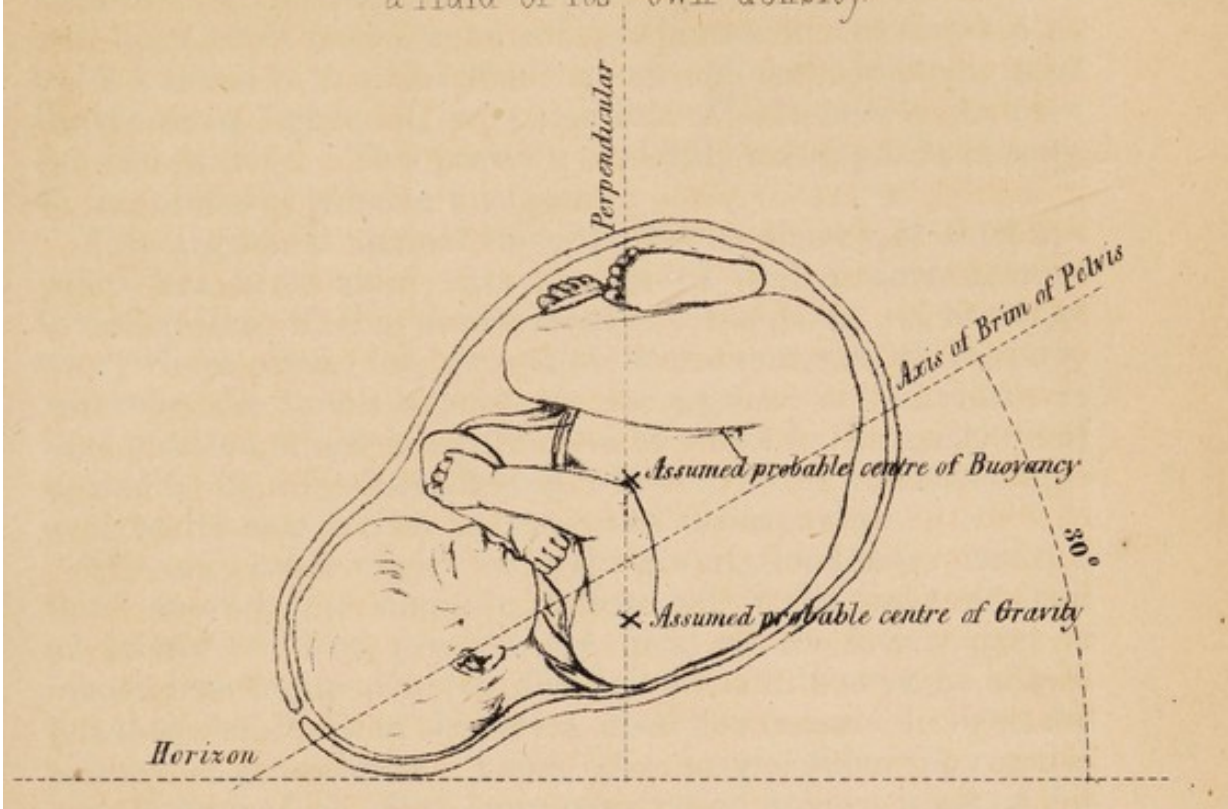

Fig. 11

Uterus & Foetus about Middle of Pregnancy.

shoulder. In an experiment I lately performed with a fresh, still-born adult fœtus, retained by threads in the fœtal attitude, I found it to poise itself in an oblique direction, head lowest as in figure 10, in a solution of salt nearly its own specific gravity. This position evidently corresponds closely to the ordinary uterine position.

This argument against the gravitation theory, it thus appears, has been quite misapprehended, and a more correct investigation of the circumstances reveals to us here, as everywhere else, the beautiful arrangements of Nature, whereby the fœtus reposes in its sojourn in the womb in that position which is easiest and securest to the mother and to itself,—in a position, indeed, which requires no effort whatever on its part for its adoption and maintenance.

The only other objection to the gravitation theory, which I think deserving of mention, is founded on the fact that dead or putrid children present the head as the lowest part in labour less frequently than the living; and it must be admitted that the death of the fœtus does not remove it from the agency of gravitation. From these propositions the conclusion is jumped at, that mere gravitation cannot account for this difference in ordinary position of the putrid and the living, for it is evident that gravitation should affect live just as it does dead matter. But here it has only to be pointed out that the major proposition of the syllogism is an assumption, and that this argument is a reasoning in the dark.[1] The assumption is one very highly improbable, namely, that a dead or rather a putrid child, is in the same condition, *quoad* gravity, as a living one.

the back or scapula, and not the head. M. Dubois first pointed out this fact, as the result of numerous experiments which he had made on fœtuses from the fourth to the ninth month: and in several instances in which I have repeated the experiment, I have found the same result."

[1] Dr Simpson follows Dubois in this line of argument. I shall quote the words of the former in illustration of it.—(See *Attitude and Positions, &c.*, p. 9.)

"When the child dies *in utero*, it still continues to be subjected to the same physical laws as when it is alive. The mere death of the fœtus does not in any way remove it from the agency of gravitation. When all its vital actions have ceased, the body should in fact be more subject than heretofore to all influences, such as gravitation, which are merely physical in their character. The dead infant ought, therefore, as frequently as the living, to have its head placed as the presenting part over the *os uteri*, provided the mere physical gravitation of the head were the reason and cause of that position. Experience however, amply proves that this is not the fact. In other words, experience proves that malpositions of the child, or the presence of other parts than the head at the cervix and os uteri, is in the latter months a far more frequent occurrence when the child is dead than when it is alive. . . . The position of the fœtus in utero, with the head lowest, is a vital action, &c. . . . What (he subsequently adds) is the nature and character of the muscular action by which the fœtus assumes and maintains its position in utero with the head lowest?"

We know that in the adult, at least, the circumstances of death and putridity produce great changes *quoad* gravity. What the changes are in the fœtus in similar circumstances we do not know. Till we do know, we must be content, without attempting to reason as if we did.

Before proceeding with correctness to argue, from the fact of frequent malpresentations of dead children, as to the causes of the ordinary presentation of the head, we must take carefully into account not only the new circumstance of death in these cases, but also all other circumstances in pregnancies with dead children, which are, or may be, statically different from the circumstances of healthy pregnancy. Among these are prematurity, quantity of liquor amnii, the shape of uterus, and the shape of the fœtus. I have already said that those who use this argument have not directed their attention even to the altered statical relations produced by death and putridity of the fœtus. I regret to have only a single observation to adduce in advancing this question towards solution. So far as it goes it tells against the argument of the opponents of the gravitation theory. I floated in a solution of salt, of about its own specific gravity, a six months' fœtus, born dead, and with the skin peeling off. The position it assumed was exactly the reverse of that taken by the fresh child at the full time, and which I have already described. The putrid fœtus floated with its long axis directed obliquely to the horizon, and with its head highest. In labour it presented the breech.

The position of the fœtus at the full time is, in the great mass of cases, fixed and determined about the end of the seventh month of pregnancy. This arises from the fact that about that time the size and shape of the fœtus become so nearly and closely adapted to the size and form of the uterus, that it cannot change the position of its trunk in any material degree. After this time the position of the fœtus must be one determined by gravitation, for it is impossible to conceive its reposing in any other.

All the knowledge we possess of the position of the fœtus, after it has entered the second half of pregnancy, leads us to believe that its head lies ordinarily lowest. Before the seventh month it is still capable of having its position in utero changed, by changes merely in the attitude of the mother, and probably it possesses the power of effecting temporary changes, at least, by its own unaided movements. But the fœtus is generally in a state of repose, and not producing motions in its limbs or body. In this state of repose, in a fluid of nearly its own specific gravity, it is impossible to

conceive of its maintaining any position but under the influence of gravity. Its position must at all times be mainly, if not entirely, caused and determined by statical circumstances. It is quite conceivable, that while still comparatively free in the uterus it may, by virtue of its very easy mobility in the dense liquor amnii, change its position. If this occur at a time when its dimensions are beginning to approximate to those of the uterus, having overcome some resistance of the uterine walls by the force of its own muscular efforts, or otherwise, as by accidents to the mother, it may not gravitate back to its old and ordinary position; and thus a preternatural presentation may be produced. But it is to be remembered that the same hydrostatical circumstances which give great comparative force to the muscular efforts of the fœtus, render its position in the same degree difficult of retention, and will in the same degree tend always to subject it to the influence of gravitation. The uterine walls are everywhere smooth and glabrous, and rounded; and the fœtus lies in this cavity with its legs, its chief organs of locomotion, elevated; circumstances which appear to render its maintenance of any position but that of gravitation a greater feat than ever was performed by a rope-dancer. With all the advantages of its new circumstances, the child after birth cannot assume or maintain any position. How much less could it be expected to do so in the uterus, and under circumstances so disadvantageous for the fulfilment of such a function. Those authors who, with Dubois, strive to prove that the position of the fœtus is determined by its own motions, have first to prove that it could maintain any position whatever against gravity, without such constant efforts as voluntary muscles are incapable of, and of the actual presence of which no evidence can be furnished.

III.—Position of the Pregnant Female.

The researches of Weber have shewn that in the erect attitude of both sexes in ordinary circumstances, the body is accurately balanced upon the two ilio-femoral articulations, the atlanto-occipital and sacro-lumbar articulations being in the same transverse-vertical plane with the ilio-femoral articulations; the knee-joint and ankles being also in it (see Fig. 2). This adjustment and balancing of the trunk upon the ilio-femoral articulations must, in the impregnated female, be gradually disturbed and changed more and more till the full period of pregnancy arrives. At this time the weight of the entire gravid uterus and contents is superadded to that of the anterior parts of the body, which in the

virgin state balanced the posterior parts upon the ilio-femoral articulations, the fulcrum of the pelvic lever. To restore the balance a corresponding amount of weight must be added to that upon the posterior arm of the pelvic lever. The weight added in front is probably about from twelve to fourteen lbs. avoirdupois,[1] and to restore the equipoise a corresponding amount of the upper part of the trunk and of the head must be moved backwards, so as to increase the weight behind (see Figs. 4, 6, and 12). These theoretical observations must have been frequently confirmed by every observant eye in actual life. It is then to be remarked that the protuberant abdomen is rendered apparently more so by the attitude of the woman being as if excessively erect.[2] To the necessity for this new adaptation, the increased anterior development and weight of the mammæ will contribute. In small, and especially short-bodied women, this change is most evident, a circumstance easily explained by the greater prominence forwards in such of the uterine tumour, and by their not being able otherwise to adapt the trunk to the new circumstances, as can be done with greatest facility in tall or long-bodied women. Some few women, especially those last alluded to, are enabled to conceal to a certain extent their gravid condition by not assuming this change of attitude, nature securing by a different mechanism (see Fig. 13), the equipoise of the trunk upon the lower limbs.

In the mechanism of the erect position, the centre of gravity must be vertically above the ilio-femoral articulations, or points of support. (See Figs. 12 and 13.) In the virgin this centre resides in the lower part of the lumbar division of the spinal column. The addition of the weight of the gravid uterus, and contents, in front, would move this centre forwards. This

[1] Ramsbotham (*Obstetric Medicine*, p. 82,) calculates the weight of the contents of the gravid uterus at between nine and ten pounds. In accordance with this notion, I have drawn up the following approximative statement of the probable average weight of the gravid uterus and contents:—

	lbs.	oz.
Fœtus, ...	7	0
Placenta, Cord, and Membranes,	1	5
Liquor Amnii, ...	1	8
Uterus, as weighed post partum,	2	0
Blood in Uterine Sinuses, &c., say,	1	0
	12	13

[2] "From this obliquity of the uterus" (says Montgomery, *Signs and Symptoms of Pregnancy*, p. 7,) "the direction of the centre of gravity is changed, and instead of falling between the feet, it falls in front of them, in consequence of which the person has an inclination to fall forwards, and in order to prevent this is under the necessity of throwing back the head and shoulders, and assuming that pompous air which is so often unjustly attributed to a wish to make a display of her condition."

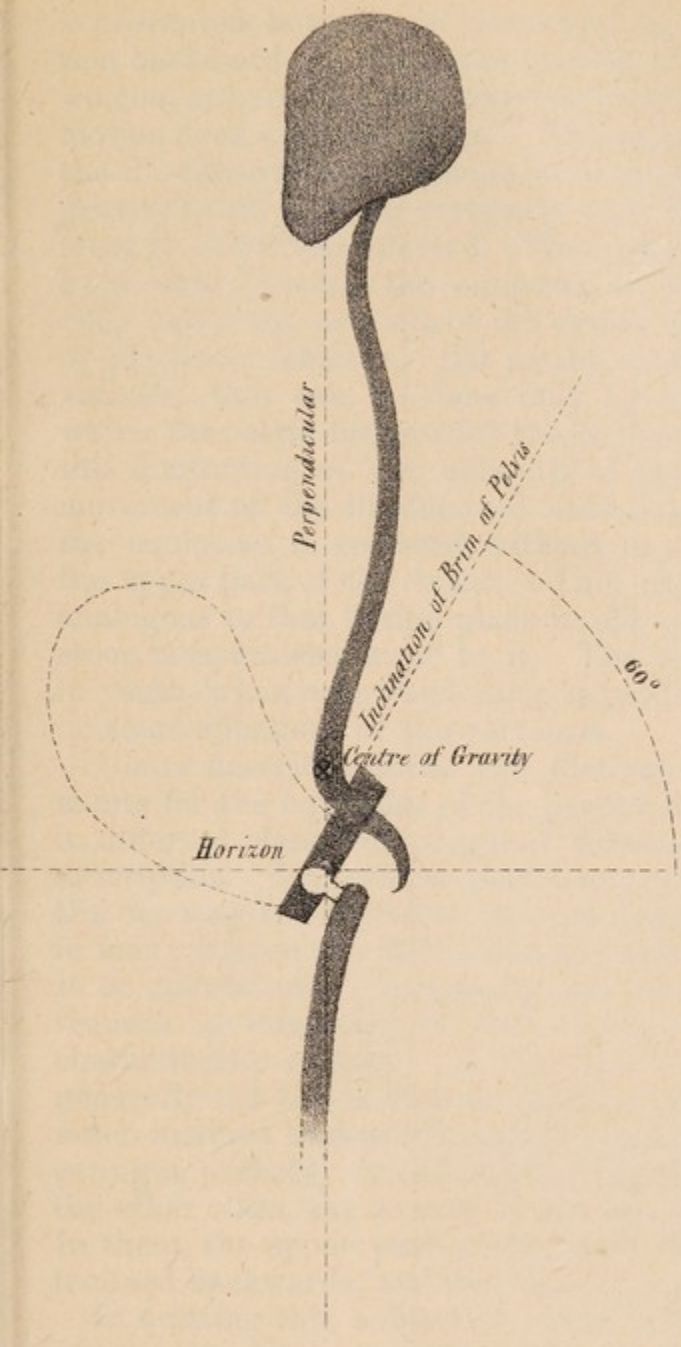

Fig 12

Diagram of adaptation of Pregnant Female to Erect attitude_Centre of Gravity remaining in usual site.

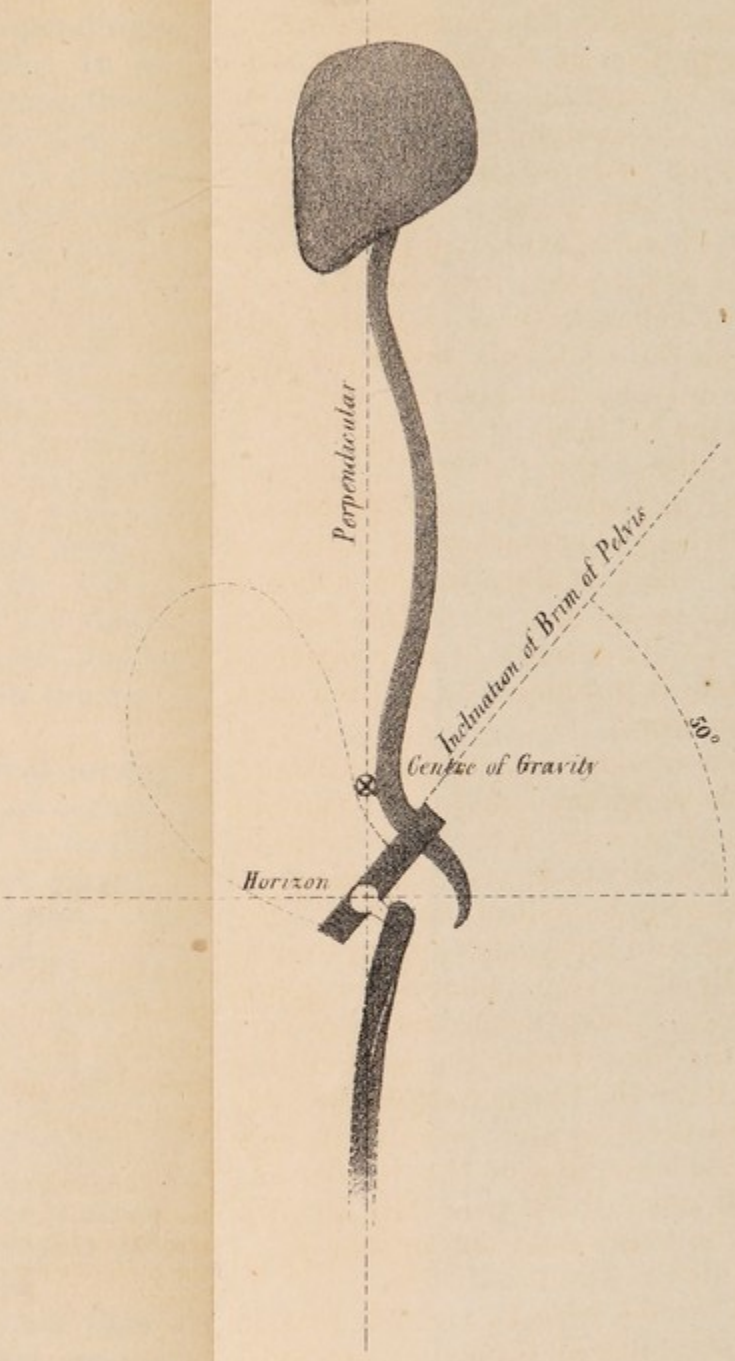

Fig 13

Diagram of adaptation of Pregnant Female to Erect attitude_Centre of Gravity being displaced forwards.

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is prevented, however, in most cases by the corresponding motion backwards of the upper portion of the trunk. In some women, either from voluntary or involuntary causes, this last motion does not take place. The equipoise of the body upon the ilio-femoral articulations, or restoration of the centre of gravity to its position vertically over these points of support, must be otherwise effected. This can evidently be done only by moving forward the supports, so that they may be vertically under the new site of the centre of gravity, in this class of pregnant females. But as the acetabula are fixed bony sockets, this can be done only by diminishing the angle which the pelvis forms with the horizon. (See Fig. 13.) In this diminution of the obliquity of the pelvis, the forward movement of the ilio-femoral articulations takes place, and the equipoise is restored without any backward motion of the upper part of the trunk. This change in the pelvis is analogous to that taking place in old age, when the forward stoop is counterbalanced by it. The same is also observed in youth, when a forward stoop is produced, as in the course of some affections of the vertebræ.

I have described these two distinct mechanical arrangements for the equipoise of the pregnant female, as occurring in different classes of pregnant women, merely to facilitate description. It is evident that in any case a certain amount of the one may be adopted as the complement of the other. But in many women the distinction and separation appears really to be maintained. In casually observing numerous pregnant females in this point of view, I have remarked two very characteristic classes. In the first class, the women are generally not tall in stature, have the upper part of the body much inclined backwards, and the hips also prominent, indicating a probably considerable obliquity of the pelvis. In the other class, the women if not tall are generally slender. In them, the upper part of the trunk does not appear to be inclined backwards, and the hips are generally flat.

In quitting this subject, I would wish to remark that in framing our views as to the obliquity of the pelvis, we must be guarded against the error of arriving at conclusions too absolute and strict. For, it appears to me that the inclination of the pelvis is liable at all times to vary in the same manner, as I have described it sometimes to do in pregnant females. Moreover, the observations of Zaglas, Wood, and others, show that the innominate bones are far from being immoveably fixed to the sacrum,[1] and are capable of certain motions upon it,

[1] See Dublin Quarterly Medical Journal for August 1854, for a full discussion of this subject.

which are capable of being turned to advantage in establishing the equilibrium necessary for the erect position.

The last statical consideration, which I shall dwell upon, in connection with the position of the pregnant female, is one of practical importance, and which may be turned daily to account in actual practice.

I have already pointed out that the attitude of the gravid uterus is inconsiderably changed by the woman shifting from the erect to the supine posture, or *vice versa*. But though this be the fact, as regards the mere attitude of the uterus, yet great changes take place in it, in regard to its liability to vascular congestion, and other phenomena connected therewith. When the woman is recumbent, the blood is easily returned to the heart from the uterine sinuses, and there is little danger of vascular engorgement taking place. When the woman stands the return of blood is not so easily effected, it having now to overcome the increased resistance involved in the change of the position of the vena cava, from being nearly horizontal to being nearly vertical. Of this circumstance clinical illustrations abound in the practice of obstetrics. A woman of delicate fibre, and easily made to miscarry, may require to maintain the horizontal position for the whole, or a part only of the period of pregnancy. In some such cases the assumption of the erect attitude for the shortest time induces engorgement of the uterine sinuses, separation of the placenta, hemorrhage, and abortion, or miscarriage. Hemorrhage, again, is induced in some cases of ulceration, and polypus, only by continuation in the erect attitude; in the same way colour often reappears in the discharges after delivery, on the first getting up; and all uterine hemorrhages are aggravated by the erect attitude. To the same cause also are to be attributed many inflammatory affections of the uterus, and many of the uterine pains attending disease in this region.