A CONTRIBUTION TO THE MECHANISM OF DESCENT AND FLEXION IN VERTEX PRESENTATIONS.

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In the mechanism of descent and flexion in vertex presentations, there are three points which are very unsatisfactorily dealt with in the text-books and other literature of the subject.

These are: the method by which flexion is produced, in the presence of a normal or excessive amount of liquor amnii; the causation of descent behind the unbroken membranes; and the mechanism of descent and flexion in those cases in which the head enters the pelvis, in a state of flexion, during the last few weeks of pregnancy and before the advent of true labor.

An attempt to clear up the obscurity which surrounds these questions is the object of this paper.

FLEXION.

In the mechanism of flexion, it is generally admitted that, if descent be due to the force of direct contact between the breech and fundus, flexion is explained by the transmission of the greater part of that force through the vertebral column to the condyles of the occiput, but the occurrence of flexion in cases where such contact is impossible has hitherto met with no satisfactory explanation.[1]

[1] Certain authorities explain the occurrence of flexion, in cases where direct contact is impossible, by the statement that "as the pressure is proportional to the height of the fluid, in the case of partial flexion, the force directed against the occiput is greater than that exerted upon the frontal end of the head." That this position is utterly untenable is shown by these facts: that the pressure does not vary in this way except in so far as the influence of gravity upon the liquor amnii is concerned; that the maximum difference due to this cause can never exceed half an ounce to the square inch, a force hardly sufficient to overcome friction, in the case of a body subjected to the great pressure of the contracting uterus; and that this excess of pressure, slight as it is, is exerted against the part which is lowest in a vertical line and not necessarily upon that which is the more deeply engaged in the parturient canal.

Thus: in an O. L. A. position, with the woman upon her back, the excess of the force, such as it is, is directed against the forehead and not against the occiput.

If now it can be shown that the general fluid pressure of the liquor amnii is concentrated upon the condyles of the occiput in a precisely similar manner, we have reached an explanation which accounts for the occurrence of flexion in all cases of labor.

To prove that this concentration occurs, let the condition of the fetus at the beginning of labor be represented by Figure 1, remembering that it is surrounded upon all sides by the liquor amnii. Let A, A′, B, B′, C, C′, etc., represent the sum of the

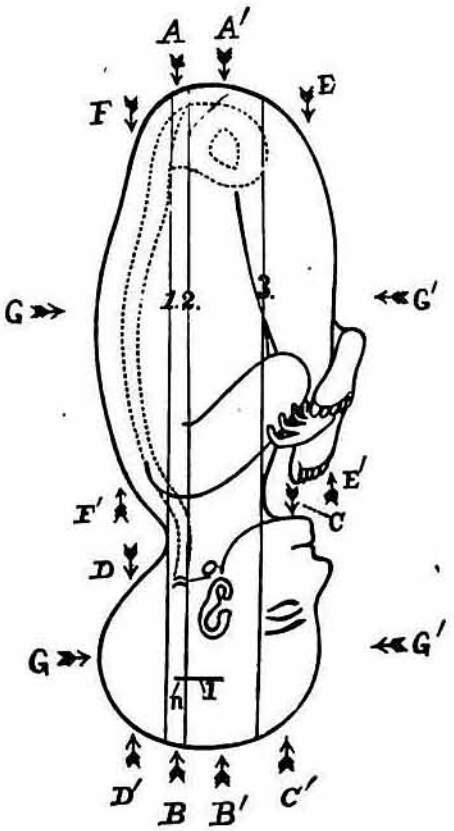

FIG. 1.

uterine forces transmitted by the liquor amnii to the superficial areas opposite which they are placed. Let the lines 1, 2, and 3 represent planes passed through the occipito-atlantoid articulation (*o*) and the anterior and posterior points of junction between the head and body, parallel to the long axis of the fetus. Let *n* and *l* represent the perpendicular distance from *o* to the centres of the areas subtended by B and B′ respectively. Then C=C′, D=D′, E=E′, F=F′, G=G′,[1] and these resistances be-

[1] If a solid body be immersed in fluid in a closed vessel and subjected to pressure, the sum of the forces exerted upon it in any given direction is equal to the sum of the forces exerted in the opposite direction.

ing opposite and equal, and moreover transmitted directly to each other at all points, produce no tendency to motion.

Similarly $A+A'=B+B'$, but, owing to the superiority in the consistency of the vertebral column over that of the soft parts of the fetus, these forces, though opposite and equal, are transmitted to each other only by the vertebral column and the occipito-atlantoid articulation; and, therefore, though no motion of the fetus as a whole can result from their activity, motion of its parts about the fulcrum at *o* not only can, but must take place, for the resultant of $B=B\times n$[1] and that of $B'=B'\times l$; but now, as the pressure is equal at all points,[2] and as the surface at B′ is greater than at B, B′ is greater than B; also *l* is greater than *n*, therefore $B'\times l$ is greater than $B\times n$; therefore, since the greater force must prevail, the effect of the general fluid pressure is that the head tends to become flexed upon the chest.

Or, to use simpler though less precise language, the fetus being subjected to equal and opposite longitudinal pressures, transmitted to each other mainly through the occipito-atlantoid articulation, the force applied to the forehead acts at a mechanical advantage over that exerted against the occiput, and the result is a tendency to flexion—a tendency which becomes more marked in proportion as the pains become stronger.

This, I think, explains the causation of the preliminary flexion which is observed to take place at the beginning of labor before descent has occurred.

A similar argument shows that, owing to the eccentric position of the vertebral column, the same cause produces a flexion of the body upon itself in a forward direction. This movement is, however, self-limited by the fact that, so soon as the body is bent to a degree which shortens the long diameter of the abdominal cavity, no further flexion can occur without lateral bulging of the abdominal walls, which is prevented by the lateral fluid pressure.

Thus we see that, under the influence of the fluid pressure

[1] We are justified in considering that the forces B and B′ act on the ends of the lever *n l*, with the fulcrum at *o*, because the effect of a force is the same, whether it be evenly distributed over a given surface or concentrated at its centre.

[2] If a fluid be contained in a closed vessel and subjected to pressure, the pressure is transmitted equally in all directions, and to all points.

alone, the fetus tends to assume the most compact form possible, *i. e.*, with the body bent and the head flexed.

The mechanism which governs the further production of flexion during the second stage is almost exactly similar to that which causes this preliminary flexion. Thus if we examine the conditions which exist, after this preliminary flexion has been effected, after the head has engaged, and the membranes have ruptured, we find them to be as follows: the restraining force is now the resistance of the pelvic walls or os, applied at R and R′ (Fig. 2), while the propelling force remains as before, con-

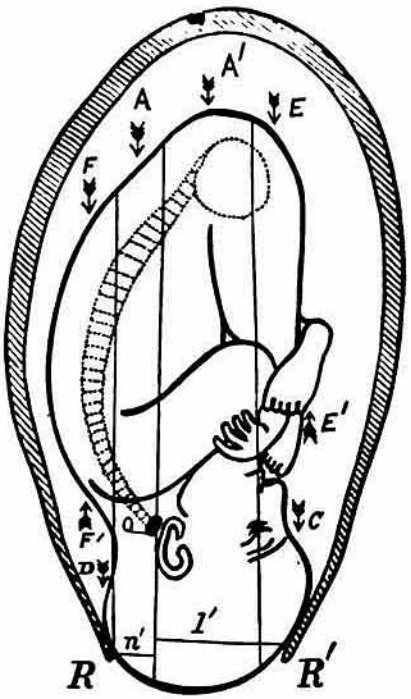

FIG. 2.

centrated for the most part upon the occiput,[1] which must therefore be the first to descend, by overcoming the resultant $R \times n'$, while the forehead is detained by the greater resistance $R' \times l'$. The effect of the irregular shape of the fetal head as described by Galabin undoubtedly acting as an auxiliary cause.

Flexion, then, is explained for all cases by the fact that the force applied to the breech is transmitted mainly to the occipital end of the head, whether it be the force of direct contact or that of fluid pressure. It must also be remembered that whenever the force of gravity is an assisting cause of flexion, the weight of the whole body is exerted against the condyles.

[1] The force D+A+A′ is exerted against the occipital end of the head, while the sinciput is propelled only by the force C.

DESCENT.

On considering the mechanism of descent, we find that in the ordinary course of labor the os becomes considerably dilated before descent begins, that after the os is tolerably well dilated, the membranes rupture; the head then settles down against the os, driven by the pressure of the fluid behind it, and the presenting segment being then no longer subjected to the intrauterine pressure, and opposed only by the resistances of the parturient canal, descent begins under the driving force of the uterine fluid pressure behind.

This may be called the normal mechanism of descent. There are other cases, however, in which no such timely rupture occurs, but in which the membranes remain intact until late in labor.

In these cases, after a longer or shorter period of delay, the head advances to a point at which it rests against the os, and by a ball-valve action, cuts off the connection between the "fore-waters" and the uterine cavity; the presenting segment is then no longer exposed to the increased intrauterine pressure during the pains, and descent therefore goes on, much as though the membranes had broken. The degree of descent necessary for this "cutting off of the fore-waters" varies in different cases from a mere passage of the superior strait to complete descent even to the perineum, according to the varying dilatability of the os and size of the head.

It is only with this preliminary descent, previous to the "cutting off of the fore-waters," that this paper is concerned.

It is generally admitted that, until the membranes have ruptured, the contractions of the uterus act upon the ovum as a whole; but, I think, the corollary to this proposition, that during this time the fetus receives absolutely no motive impulse from the fluid medium by which it is surrounded, has not been sufficiently insisted upon.

As was said above, it is a well-known law in physics, that if a solid body be immersed in fluid and exposed to pressure, the force exerted against it in any given direction is equal to that exerted in the opposite direction, and again that, if two forces be opposite and equal, no motion can result from their activity. Now the condition of the solid body named in these laws is precisely the condition of the fetus so long as the membranes

remain unruptured and the "fore-waters" are not cut off, as is shown diagramatically in Fig. 3, where the forces marked A are opposed by the equal and opposite forces B, and can therefore have no share in the production of descent.

It is to be remembered, however, that the fetus is still subjected to the influence of gravity (in the ordinary position of the mother), and it is certainly conceivable that, in cases of easy adaptation, the head may, under the influence of gravity

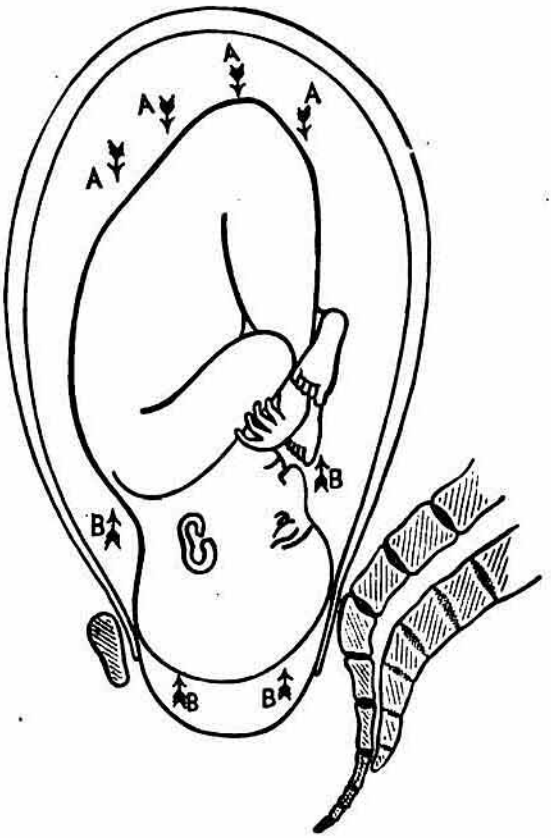

FIG. 3.

alone, settle low enough to come in contact with the os, and by a ball-valve action "cut off the fore-waters" and so bring the fluid pressure into play.

In the greater number of cases, however, the force of gravity must be powerless to overcome the resistance of the superior strait and thus effect the engagement of the head, and for these cases we must find some other explanation to account for the descent of the head.

Lahs has argued that contact between the breech and fundus can never occur in the presence of a normal amount of liquor

amnii; but, with all respect for his high authority, I think it can be shown that in these cases such contact not only can, but must occur, for as the membranes emerge from the os and begin to distend the vagina, a considerable quantity of liquor amnii is withdrawn from the uterine cavity by their expansion, this diminution of the uterine contents must be followed by retraction, and if thus the long axis of the uterus is shortened while the breech is held, by the arrest of the head, at its original elevation in the abdomen, contact between breech and fundus must soon occur, and the contractile force of all the longitudinal fibres of the uterus is thus concentrated upon the breech. So soon as this force has produced sufficient descent to cut off the fore-waters, the influence of the fluid pressure is brought into play and descent goes on as though rupture had occurred.

It is to be remembered, by the way, that though the force of direct contact is undoubtedly sufficient to drive a normal head through a normal inlet, it is much less powerful than the fluid pressure, since the one is produced by the contractions of the longitudinal fibres alone, while the other is due to the exertions of the uterus as a whole; a fact which explains the longer course of dry labors and labors with unbroken membranes.

DESCENT AND FLEXION BEFORE LABOR.

There remain for consideration those cases in which the head, in a state of more or less complete flexion, enters the pelvic cavity and may even proceed to the inferior strait during the latter months of pregnancy and before the advent of labor.

The mechanism of these cases is similar to those just described, with the substitution of the tonic tension of the abdominal walls for the contractions of the uterus.

Thus, if the intra-abdominal pressure be sufficiently strong, the lower segment of the uterus with a portion of the liquor amnii will be urged in the direction of least resistance into the pelvic cavity, the uterus as a whole descending, while the fetus is arrested by the contact of the head with the pelvic brim. It is evident that no great advance of the uterus can take place without the occurrence of contact between the fundus and the breech; but so soon as this exists, the intra-abdominal pressure is directly transmitted to the breech, and if it be sufficiently strong will cause flexion and descent.