left apex are coarser, and moist *râles*, diminishing in distinctness, are heard down to the very base of the lung.

December 1st, 1889 (eighth day of illness). The *râles* at the back of the lung are less distinct to-day. Bowels moved; motions loose and pale, but not offensive.

December 3rd, 1889 (tenth day of illness). At the left apex the dulness is more pronounced, and the movements there are distinctly diminished. For the last two nights the patient, who has been inclined to wander slightly all along, has been markedly delirious, talking constantly, and he has had very little sleep. The tongue is dry, coated, brownish, and tremulous.

December 4th, 1889 (eleventh day of illness). Bowels moved last night, the motion being solid, and nearly of the natural colour.

December 8th, 1889 (fifteenth day of illness). Patient's general condition is somewhat worse. He rambles constantly night and day, and sleeps very little. The hands tremble, and he occasionally fumbles with the bedclothes. The albumen, although diminished, is still present in the urine.

December 11th, 1889 (eighteenth day of illness). The *râles* have almost entirely disappeared from the front of the left lung, but they are abundant at the base posteriorly, and very similar in character to those which were at the apex. At the right base there is now some dulness on percussion, and an abundant, fine, subcrepitant *râle* is heard.

December 13th, 1889 (twentieth day of illness). On the right side a subcrepitant *râle* has now appeared at the level of the nipple. On the left side a sonorous *râle* is heard in the supra-clavicular, and a few faint mucous and sibilant *râles* in the infra-clavicular, region.

December 17th, 1889 (twenty-fourth day of illness). With the exception of a slight sibilus at the right base, the *râles* have entirely disappeared from the chest. Slight delirium still persists, although the temperature has for some days been subnormal. Patient is very drowsy, and sleeps constantly, being, however, easily aroused to take nourishment. The albumen in the urine is no longer present.

December 21st, 1889 (twenty-eighth day). All physical signs of disease have disappeared from the chest, and all special treatment by drugs has been stopped. He remains very prostrate, and there is still occasionally slight delirium.

December 27th, 1889 (thirty-fourth day). Though still very weak, he is picking up flesh and strength considerably, and is now perfectly conscious and observant of what is going on around him.

January 7th, 1890 (forty-fifth day). He has been steadily and rapidly improving and gaining strength, and has to-day been allowed, for the first time, to rise for an hour.

On January 23rd, 1890, I requested my colleague, Professor Gairdner, to examine this patient's chest, which he kindly agreed to do, and in a letter to me he says: "I have examined G. H., and find that there is nothing that can be very definitely stated as abnormal in the physical signs in his chest."

SOME RECENT RESULTS FROM THE STUDY OF LABOUR BY MEANS OF FROZEN SECTIONS AND CASTS.

[WITH LITHOGRAPHIC PLATES.]

Read in the Section of Obstetric Medicine at the Annual Meeting of the British Medical Association, held in Birmingham, July, 1890.

By A. H. F. BARBOUR, M.D., F.R.C.P.E.,

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[Concluded from page 1004.]

PART II.—RESULTS FROM STUDY BY MEANS OF CASTS.

We have seen that freezing fixes structures as they were at the time of death; that a section lays bare relations under a given line, showing things just as they are—nothing being left to the imagination; that by making sections at short distances through and through the pelvis, and putting the results of all together, we make the pelvis practically transparent; and that by taking one section and repeating it in different cases at short intervals of time while labour is going on, we can follow the process all through, reading labour from stage to stage, as if we were turning over the pages of a book. But a section gives only limited information, inasmuch as it shows relations only in a given

plane. If, however, starting again from the frozen cadaver, we have casts made, we shall have a permanent record of the form of surfaces and also of bulk or capacity when we are dealing with a mass or cavity. We used this method, at Dr. Hart's suggestion, in the case of two of these preparations, the eighth-month pregnancy and the second stage of labour. As a section had already been made, the blocks (still frozen) were put together, but separated by plates of glass corresponding in thickness to the portions removed by the saw. The foetus, still frozen, was in each case then lifted out and a cast taken of it, the liquor amnii being then also removed from the genital tract, a second cast was taken of the tract itself, and it is these casts which we have now to study.

Figs. 1 and 2, Plate V (in the description on the Plate, for *side view* read *front view* and *vice versa*), give us, therefore, an accurate representation of the capacity and contour of the interior of the uterus at the eighth month of gestation, the foetus lying with the breech downwards. The uterus is pear-shaped. While its form suggests that of a pear, its dimensions are, however, more nearly that of a globe, the greatest vertical circumference being $22\frac{1}{2}$ inches and the greatest transverse $20\frac{1}{2}$ inches. The narrower lower segment is occupied by the breech of the foetus, and the fundus is more prominent to its right side over the foetal head.¹⁰ The lower segment bulges more downwards on the right side, because the breech position of the child's body made its left buttock lower than the right. The curvature of the uterus in side view is due to the moulding of its posterior surface on the promontory of the sacrum. The extent of the placental area is shown by the dark shading. The bulk of the cast is $137\frac{1}{4}$ cubic inches, which therefore represents the total cubic capacity of the uterine cavity.

The cast of the foetus is shown in Plate V, Figs. 3 and 4. The remarkable feature in it is the disposition of the limbs. The leg is extended on the thigh and the foot partially extended on the leg, so that the lower limbs are thrown up on the trunk and the toes stick out. While the forearm is flexed on the arm, the upper extremity as a whole is thrown out from the chest—this being more marked in the right arm, which was "held up" in an odd fashion, the fingers being extended at the metacarpo-phalangeal joints. The attitude of this foetus (partial extension) is the opposite of what we usually find *in utero*, and the occurrence of breech presentation along with it is noteworthy. I know no better explanation of the cause of the position of the foetus *in utero* than what William Hunter said: that the foetus is "adapted to the figure and circumstances of its habitation;" and the extension of limbs in this case makes the breech distinctly the smaller part of the foetal ovoid, which therefore, as Sir James Simpson¹¹ pointed out, accommodates itself to the narrower lower segment of the uterus. The bulk of the foetus is $111\frac{1}{4}$ cubic inches, and, deducting this from the cubic contents of the uterine cavity, we have rather more than a pint as the amount of liquor amnii and cord in this uterus.

The cast of the genital tract from the second stage case is given in Plate VI, Figs. 3 and 4. We have here to do with not merely the interior of the uterus, but with the dilated cervix and vagina as well; in fact, this cast shows the surface of the whole tract from fundus to vulva. The value of these plates cannot be over-estimated. They are the first drawings which have been obtained of the "fully-developed" genital passage. The child's head has descended to the vulva and is dilating it, the stretching of the perineum and anus being beautifully seen in the frozen section, Plate II, Fig. 1; in another pain it would have been born. We have, therefore, labour at its most interesting stage. Further, the membranes are ruptured, as they are not in the other sections described from this stage, and we can therefore follow their disposition after rupture; the preparation is unique.

After the cast had been taken, when the preparation was partially thawed, so that the os externum, the bladder, and the attachment of the membranes could be made out, we had the drawing given in Plate VI, Fig. 1, made; it is not of value for making measurements, because the margin of the os externum was lifted and the portion of the bladder within the pelvis artificially opened out so as to show these structures better, but it gives a very good idea of the appearance of the genital canal. The drawing of the placenta below (Plate VI, Fig. 2) was also made

¹⁰ As the foetus lay with its back anterior, the drawing of it in Fig. 3 is the reverse of that of the uterus in Fig. 1.

¹¹ While Hunter makes this statement, he also adopts the gravitation theory in another part of his writings as explaining why the foetus should be found head downwards. The condition found in this case goes entirely against the gravitation theory.

after the preparation had been thawed, so as to determine if the placenta was separated and the appearance of its site. The thawed preparation shows that the placenta is not separated, and demonstrates the large venous sinuses beneath its site which were not visible in the frozen section, their lumina being obliterated (compare Plate II, Fig. 1).

In the partially thawed preparations we can make out, also, the condition of the membranes; and we find that they have been stripped off the lower segment as far as the retraction ring. In Chiari's section, in which, though the membranes were not ruptured, the second stage had advanced until the bag of membranes was at the vulva, a similar condition was found. So that we may say that the separation of the membranes in the second stage extends up to the retraction ring, but not beyond it.

Returning, now, to the cast itself, we see in the side view (Plate VI, Fig. 3) two well-marked furrows, the upper of which corresponds to the bulging of the uterine muscle at the retraction ring. We can follow this furrow round in the front view towards the right side, where it becomes obscured by the prominence of the child's arm, which makes a still deeper groove at a higher level. This retraction ring divides the genital tract into two nearly equal portions, there being rather more above than below it. The lower of the two furrows corresponds to the neck of the child, below which is a fainter groove representing the os externum. The position of the os internum could not be determined, even on careful microscopic examination.

The front view (Plate VI, Fig. 4) shows an irregular contour to its right, corresponding to the limbs of the foetus, the curious bulging which throws the fundus to the right of the mesial plane of the body being over the folded-up lower extremities. The more regular contour on the left is over the back of the foetus. The placental area is roughly quadrilateral, and is about 22.7 square inches in extent. The position of the orifices of the Fallopian tubes, which are 7½ inches apart, is indicated. Taking the central point between them as the centre of the fundus,¹² we find that it lies 1½ in. to the right of the middle line, that is, 1½ in. to the right of the plane of the vertical mesial frozen section. We must make allowance for this divergence in estimating the length of the uterine axis, and measurements of the length of the walls should be made on the cast, not on the frozen section.

Starting from the centre of the fundus, we find the respective lengths of the areas of the genital tract marked out on the cast to be as follows:

1. Measured along the axis of the uterus: to level of retraction ring, 7½ in.; from retraction ring to os externum, 3 in.; from os externum to vulva, 4½ in.; making a total length from fundus to vulva of 14½ in.
2. Measured along the posterior wall: from fundus to retraction ring, 6½ in.; from retraction ring to os externum, 2½ in.; from os externum to vulva, 7 in.; making a total length from fundus to vulva of 16 in.
3. Measured along the anterior wall: from fundus to retraction ring, 9½ in.; from retraction ring to os externum, 3½ in.; from os externum to vulva, 2 in.; making a total length from fundus to vulva of 15 in.
4. Measured along the lateral wall (over the back of the child): from fundus to retraction ring, 9½ in.; from retraction ring to os externum, 3 in.; from os externum to vulva, 4½ in.; making a total length from fundus to vulva of 17 in.

Looking at these figures, we see that the lateral measurement taken as a whole is the longest, and this is due to the antero-posterior flattening of the upper part of the uterus, which gives a longer measurement along the side wall. Below the retraction ring, the lateral measurements are a mean in length as they are half-way in position between those of the anterior and posterior walls respectively, which is what we should expect. Putting aside the lateral wall and fixing our attention on the anterior and posterior, what strikes us in the figures is the relatively great length of the posterior wall below the os externum and its shortness above the retraction ring—these two compensating one another so far that there is only 1 inch of difference between the total lengths of the anterior and posterior walls. As regards the portion below the os externum, we have a posterior vaginal wall of 7 inches and an anterior of 2 inches; before labour we have a posterior length of 3 inches and an anterior of 2 inches; hence, while the anterior wall has not changed, the posterior has

been greatly elongated. As regards the part of the wall above the ring, we have a posterior length of 6½ inches and an anterior of 9½ inches—that is, the posterior has retracted so as to be two-thirds of the anterior; and we see this difference of the amount of retraction in the relative thickness of these walls in the frozen section. This greater retraction of the posterior wall has been at the expense of the vagina, not of the lower segment, for this portion is longer anteriorly than posteriorly.

So much for the length of the different portions of the genital tract measured on the cast. As regards the circumference, we measured it at three points—os externum, retraction ring, and greatest circumference of the body of the uterus—and found it to be at these levels: 13½ inches,¹³ 14½ inches, and 18½ inches. The cubic capacity of the tract from fundus to retraction ring is 105½ cubic inches; from fundus to os externum, 133½ cubic inches; and from fundus to vulva (that is, whole genital tract), 160½ cubic inches.

Summing up the information derived from this cast, we note that its contour shows us that the uterus during the second stage of labour moulds itself in the interval between the pains to a great extent upon the child. Comparing the front view of this cast with the front view of the one during pregnancy, the peculiarity of contour is still more striking; and we may say generally that while the pregnant uterus (the same holds true of the first stage uterus in the intervals between the pains) moulds itself on the spinal column and pelvis, the uterus during the second stage moulds itself on the child. At first sight, it might seem that this moulding of the uterus was simply due to the pressure of the parts of the child on the uterine wall softened *post mortem*; but we have satisfied ourselves that the *post-mortem* changes are not sufficient to account for this.¹⁴ Nor is the uterus disposed on the child, as a flaccid sac would be; it resembles more the way in which a sac with elastic walls would fit itself all round on a body of irregular shape. In fact, this peculiarity in the disposition of the uterus must be due either to such a property of the walls, or to their being so limp that intra-abdominal pressure has moulded them on the foetus.

The measurements of the uterine wall made upon this cast show that in this case the shortening due to retraction had affected the posterior wall more than the anterior. Whether this is due to the situation of the placenta on the anterior wall, one cannot say. The measurements from the os externum to the vulva also show that the posterior vaginal wall has become elongated and thinned, while the anterior has been but little affected; from its relation to the foetal head and the direction of the uterine force one would expect the posterior wall to be more stretched than the anterior, but simple stretching due to the direction of the uterine force backwards is not sufficient to account for the difference between the walls; and I should associate the thinning and elongation of the lower part of the genital tract with the shortening and thickening of the upper part. It is a remarkable fact that the anterior vaginal wall is neither thinned nor shortened. This shows that when the uterus contracts it does not pull against the anterior vaginal wall; and with this agrees the fact that the neck of the bladder has not altered its position. It must be through the attachment of the uterus in front to structures higher up than the anterior vaginal wall, most probably it is the round ligaments which are pulled upon anteriorly. Posteriorly, it is quite otherwise. Here I think there is distinct evidence that the vaginal wall is pulled upon, so to speak, by the contracting uterus.

The greater bulk of this cast as compared with that of the foetus shows us that there is still a certain quantity of liquor amnii in the uterus, and it is interesting to note that it is found between the breech and the uterine wall (see the vertical mesial section). This shows that the foetus is not forced onwards by the direct action of the uterine wall on the breech, but by the general increase of pressure while the uterus contracts.

In the cast of the foetus, of which the front view is given Plate VIA, Fig. 5), we note that the length of the foetal mass, measured directly from breech to vertex, is 13 inches. The flexure of the spinal column, and also of the head on the chest, is less pronounced than in pregnancy. On the head the position of the

¹³ Not 14½ inches, as in Laboratory Report.

¹⁴ We have not time to discuss this here, but the examination of various sections, and especially of the parts most exposed to pressure, shows that the *post-mortem* changes are slight, for example, the posterior wall of the uterus is not compressed in this section, although it was frozen on the back. Further, that the muscular wall cannot be much softened *post mortem* is shown by the way in which it has left its impression on the back of the child, both at the retraction ring and the os externum.

¹² The measurements given in the Laboratory Report were taken from a point in the cast corresponding to the vertical-mesial section, and hence differ somewhat from those given here.

anterior fontanelle is indicated, and on the right side of the head there is a groove running backwards from the supraorbital ridge to above the ear, corresponding to the os externum. Further, the beginning of a deep furrow is seen below the left arm, which furrow passes round the back and corresponds in position to the retraction ring. The occipito-frontal diameter of the head measures $4\frac{1}{2}$ inches, the occipito-mental $5\frac{1}{2}$ inches, and the suboccipito-bregmatic $4\frac{1}{4}$ inches; while the occipito-frontal circumference is $12\frac{1}{4}$ inches, and the suboccipito-bregmatic $12\frac{1}{4}$ inches. The head is rotated on the body towards the left side, and that to such an extent that, while the body of the child was transverse in the mother, the posterior fontanelle was somewhat in front of the anterior end of the right oblique diameter of the pelvis.

The most remarkable features of this cast are the length of the foetal mass and the disposition of the head. The trunk is distinctly more extended than that of the foetus *in utero* before labour. For the sake of comparison, I have given in Plate VIA, Fig. 6, an exact reproduction of two foetuses taken out of the uterus at full time. These are both from preparations hardened in spirit, and the foetal mass is therefore reduced as a whole by the shrinking in spirit, and we must remember this in comparing them with the frozen foetus in Plate VI, Fig. 5. But the spirit does not affect the general contour, and great care was taken in lifting out these foetuses not to disturb their actual attitude. Putting alongside of them the frozen foetus in the second stage we are at once struck with the difference in contour, which, from being ovoid, has become that of an elongated cylinder. This extension of the trunk of the foetus in the second stage of labour has been recognised clinically, but this is the first direct anatomical demonstration of its occurrence.

The head of the foetus is partially rotated on the body, and also partially extended. The partial rotation is what we should expect from the mechanism of labour; but the slight extension is in direct opposition to the hitherto received view of the flexion of the head in labour. A study of other frozen sections made before the membranes had ruptured had led me to doubt the occurrence of flexion as a movement in the mechanism of labour; and I looked forward to what this preparation would show with peculiar interest, because it was quite possible that the rupture of the membranes might produce a different state of affairs; but in this foetus we have an undoing, not an increase, of the attitude in pregnancy. This might be ascribed to the position of the arms below the chin, and here the foetuses on Plate VI, Fig. 6, are of special interest, as showing how the attitude is influenced by the arms of the child being underneath the chin; in the lower one the arms are across the face, while in the upper one they have the same disposition underneath the chin as in the foetus from the second stage. Putting, then, this latter foetus alongside of the frozen one, we see in the frozen one a diminution instead of an increase of flexion. This frozen foetus, therefore, confirms my view that flexion of the head is the result of the normal attitude of the foetus *in utero*, and forms no part of the mechanism of labour in a pelvis of normal dimensions. That flexion occurs in a *justo minor* pelvis I think there is no doubt, but in the normal pelvis I believed the so-called flexion is the result of the rotation of the head bringing the occiput more into the axis of the canal and more within reach of the examining finger, thus making it appear to dip although it does not really do so.

Some of the results of the study of these sections and casts are entirely new, while others are a confirmation of what has been ascertained before. It must be remembered that conclusions drawn from a limited number of sections are by no means final; they must be revised and corrected as new sections are obtained. There are two general considerations I should mention before summing up these results: (1) Sectional anatomy is invaluable for teaching purposes; if we had a complete series, we could present the facts of labour to the student without any theorising, and he would commence his clinical work on a sure anatomical basis. (2) The difference between frozen sections and the living subject is not so great as one would imagine; there are changes after death, but these are not of such a nature as to invalidate the conclusions to be drawn. I shall not go into this question, but would refer you to the Laboratory Reports of the Royal College of Physicians of Edinburgh, in which Dr. Webster discusses the question fully.

To sum up, then, the results:

1. The shortening of the antero-posterior diameters of the bony pelvis by the soft parts is for the conjugate, at the brim $\frac{1}{2}$ inch, in the cavity $\frac{1}{2}$ inch, at the outlet $\frac{1}{2}$ inch; and for the oblique dia-

meter, at the brim almost 1 inch, and in the cavity still more, due to the projection of the obturator internus.¹⁵

2. The cellular tissue at the base of the broad ligaments is compressed by the sinking down of the uterus after delivery, so as practically to close the abundant sinuses.

3. The peritoneum is, during the second stage, lifted out of the pelvis anteriorly and somewhat elevated posteriorly, returning after labour to its original position.

4. The bladder is in part elevated, so that, while its neck does not change its position, a portion of the organ becomes abdominal.

5. The uterus in the interval between the pains shows a certain plasticity, like the uterus in pregnancy, but with this difference, that, while the uterus in pregnancy moulds itself on the spinal column and bony pelvis, the uterus during the second stage moulds itself on the foetus.

6. In retraction, the uterine wall becomes shorter and thicker, but not in the same ratio; while the vertical circumference of the walls is diminished by one-third, the thickness of the walls is increased to four times.

7. The lower portion of the anterior uterine wall is thinner than the rest before labour begins; this thinning is increased during labour. A corresponding thin part develops posteriorly. There is, therefore, in normal labour (that is, with no pathological resistance) a separation of the uterine wall into two parts.

8. The boundary line between these two parts persists when no contraction is present, and should therefore be called the "retraction," and not the "contraction" ring.

9. As a deduction from the foregoing it follows that once a body in the genital canal has passed below this ring, it will no longer have active muscle in the wall of the canal to operate upon it.

10. While the anterior vaginal wall retains, during labour, its usual length and thickness, the posterior extends to more than twice its former length and becomes very thin.

11. The foetus is elongated during the second stage by the straightening of the spinal column.

12. The flexion of the head becomes, during labour, less pronounced than it was during pregnancy.

13. Rotation of the head takes place before that of the shoulders, and is therefore independent of it.

14. The process of the moulding of the head consists in a pushing of the occiput underneath the parietal bones, and a distortion of the plastic head towards its unsupported part.

15. The placenta does not become separated as a result of the diminution of its site during the second stage.

16. The membranes become separated, during the second stage, up to the retraction ring but not above it.

[NOTE.—In the first portion of Dr. Barbour's paper (BRITISH MEDICAL JOURNAL, November 1st) the third line on p. 1004, col. 1, was, by a printer's error, misplaced. Its proper position is on p. 1003, between lines 2 and 3 from the bottom of col. 2.]

THE EMPLOYMENT OF THE ELECTRO-MAGNET IN OPHTHALMIC SURGERY: ADDITIONAL CASES AND REMARKS.

By SIMEON SNELL,

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In previous communications¹ I have recorded thirty-seven cases in which the electro-magnet had been employed. I propose to add to this number another thirty-seven,² thus bringing the total up to seventy-four.

The instrument used by me, and which it is needless to describe afresh, is depicted in the woodcut. I can repeat what I have said before respecting it: "Increased experience has rendered more positive the opinion before expressed, that it meets well the objects we have in view."

The cases are described sufficiently in detail, and it is only in-

¹⁵ The measurements for the antero-posterior diameters represent the soft parts compressed as the second stage is in progress; those for the oblique diameter represent the uncompressed soft parts as in pregnancy.

¹ BRITISH MEDICAL JOURNAL, 1881, vol. i, p. 843; 1883, vol. II, p. 957; 1885, vol. I, p. 884; and *The Electro-Magnet and its Employment in Ophthalmic Surgery* (Churchill).

² The three cases recorded in addendum bring the number up to forty, and the total to seventy-seven.