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PART I.

ORIGINAL COMMUNICATIONS.

ART. I.—*Researches into the History of the Umbilical Cord in the Human Subject.* By FLEETWOOD CHURCHILL, M.D. Licentiate of the King and Queen's College of Physicians in Ireland; Physician to the Western Lying-in Hospital; and Lecturer on Midwifery, &c. in the Richmond Hospital Medical School, Dublin.

HAVING some time ago contributed some observations upon the length of the umbilical cord, and its influence upon parturition,* it has appeared to me worth while comprising in one essay all the facts on record which bear upon the history of this structure, most of which were unnoticed in the paper alluded to.

The funis during fœtal life is the connecting link between the mother and child, and may be compared to the stem of a tree, through which nourishment is transmitted from the root (the placenta) to the branches (the child.)

Its functions are limited to fœtal life, and its existence terminates with its functions.

It has been stated by Professor Burns of Glasgow, that "when the ovum is first visible in the uterus there is no cord, the embryo adhering directly to the involucra; but it soon recedes, and within the sixth week a cord of communication is perceptible."† Hunter

* Dublin Journal, Vol. ii. p. 21. † Principles of Midwifery, 9th edit. p. 228.

previously made a similar statement. This, however, has been controverted by other authorities, and most recently by Breschet and Velpeau; and as the result of many examinations, they conclude, that at the earliest period a cord is perceptible if the ovum be perfect; and the latter author attributes the contrary description to their being taken from imperfect or injured ova. As far as I have had opportunities of examination, I must concur with M. Velpeau. It is generally visible about the fifteenth day, when it rather exceeds the length of the fœtus. Up to the third week it is thin and cylindrical; from the third to the ninth it increases in size, and we find two or three vesicular swellings with narrower intervals,—the last swelling persisting the longest.

It contains at this period the vitelline duct, with the omphalo-mesenteric vessels, a portion of the urachus, the fœtal intestines at its umbilical extremity, the blood-vessels, and some gelatine.

About the end of the second month the intestines are enclosed in the abdomen, and the vitelline duct and urachus are obliterated, so as scarcely to be detected afterwards.

If we examine the funis at the termination of pregnancy, we shall find much that is interesting and important in its connections, structure, and varieties. It takes its origin from the surface or circumference of the placenta. Osiander* has carefully examined the point of connection in 36 cases. In two it took its rise from the circumference, forming what has been called a battledore placenta; and in one only, exactly from the centre of the cake. In most cases it was about two inches from the edge, (the majority of placentæ being about six inches in diameter.) The other extremity is inserted into the umbilicus, nearly in the centre of the entire length of the child, but so much nearer to the pubis, as the child is under the full time. (Velpeau.†)

The thickness of the cord varies according to the quantity of gelatine it contains. It is generally about as thick as the little finger, but sometimes much thinner; and Mauriceau‡ mentions having seen it as thick as his arm. Froriep§ remarks, that its size and thickness are in an inverse ratio to the increase of the child. I am not aware that this has been verified by other authors; and it is certainly contrary to the few observations I have made.

Nothing can be more variable than the length of the cord. Dr Davis‖ says, that a cord of two inches long has been met with.

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* Handbuch der Entbindungskunst, Vol. i. p. 482.
† Traité Complet de l'Art des Accouchemens, ed. de Bruxelles, p. 167.
‡ Malad. des Femmes Grosses, Obs. 301.
§ Handbuch der Gebürthülfe, p. 155.
‖ Obstetric Medicine, p. 1080.

Guillemot, * one of two inches and a-half; Montault, † one of four inches; Meissner, ‡ one of five inches; Mauriceau, § Baudelocque, ‖ and Morlanne, ¶ one of six inches; Haighton, ** one of seven inches; and Dr Montgomery, †† two of eight or nine inches.

Dr Hamilton remarks, ‡‡ "Two cases have occurred to the author where the naval string was naturally so short, that it became necessary to tie it, and to cut it within the vagina, consequently its length could not have exceeded six inches."

On the other hand, M. Baudelocque §§ saw one of 46 inches; M. Heritier, one of 57 inches, which was coiled five times round the neck; Morlanne, ‖‖ one of five feet; Dezeimeris, one of 28 inches in a fœtus of four months; and Velpeau, ¶¶ another of 31 inches at six months.

These cases, however remarkable, being isolated, afford us no means of judging of the frequency of their occurrence, nor of the ordinary length of the funis. I have been able to find but few tables of measurements in any authorities to which I have access. Adelmann of Fulda has given 49 cases; Henne of Copenhagen, 130, in Siebold's Journal of Midwifery; and Osiander, *** 32, making in all 211. To these I can add 263 cases from the records of the Western Lying-in Hospital and my own practice, making a total amount of 474. The measurements were as follows:

In	6	the cord was	12 inches long.	In	8	the cord was	26 inches long.
	2	-	13		5	-	27
	12	-	14		12	-	28
	22	-	15		2	-	29
	37	-	16		13	-	30
	10	-	17		3	-	31
	117	-	18		1	-	32
	15	-	19		3	-	33
	45	-	20		7	-	36
	21	-	21		1	-	42
	37	-	22		1	-	46
	12	-	23		1	-	48
	70	-	24		1	-	54
	10	-	25				

* These, No. 120. Paris.
† Archives Gen. de Med., Vol. xxix. p. 567.
‡ Progrès des Accouch. au 19me siecle.
§ Mal. des Femmes Grosses, Obs. 640.
‖ L'Art des Accouch. Vol. i. p. 251.
¶ Journal des Accouch. Vol. ii. p. 18.
** Lancet, 1828, Vol. ii. p. 227.
†† Dublin Journal, January 1834, p. 433.
‡‡ Practical Observations, Part ii. p. 69.
§§ L'Art des Accouchm. Vol. i. p. 252.
‖‖ Gardien Traité des Accouchm. Vol. ii. p. 165.
¶¶ Embryologie, p. 58.
*** Handbuch der Entbindungskunst, Vol. i. p. 504.

Thus we find that the most frequent length was 18 inches, the next 24, and the next to that 20 inches, so that we may agree with those writers who state the average length of the cord to be between 18 and 24 inches. Extremely short cords must be very rare, and scarcely to be calculated on in practice, since out of 474 cases none were under 12 inches. Only four were above 3 feet.

Siebold in his report of the Marburg Lying-in Hospital, states that the shortest cord was 13 inches, and the longest 42 inches.

I have no data by which to test the observation of Osiander, that male children have generally longer cords than females.

As to the anatomical structure of the cord:—It consists of two arteries and one vein,* imbedded in a semifluid jelly, and inclosed by two membranous sheaths† derived from the amnion and chorion. The latter forms the inner sheath, and the former the external one. It has been advanced by some physiologists, that the outer coat or amnion is a prolongation of the epidermis of the fœtus; but this representation is refuted by the existence of these membranes before the closure of the abdomen.

The colour of the sheath is generally whitish, but occasionally it is found yellow, brown, or greenish.

The umbilical vein is of larger calibre than either artery, but having weaker parietes, so that when cut across it collapses. It has neither knots nor valves, but in it are sometimes formed by dilatation, pouches resembling varices. (Osiander.) It carries blood of a dark purple colour, with very little if any excess of oxygen.

It is formed by the concentration of the smaller placental vessels, and after entering the abdomen by the umbilicus, it terminates at the liver, transmitting its contents partly through the hepatic veins, and partly through the *ductus venosus*.

The two arteries arise from the hypogastrics, are much smaller, though longer than the vein, and having much thicker coats, in consequence of which their mouths remain open if the cord be cut across. In their course through the funis, they wind spirally from left to right (eleven times out of twelve; Velpeau,‡) and form false knots or loops, which are said to be more numerous in first children. In Germany the "priestesses of Lucina," take these knots as an augury, indicating the number of children a woman is to have.

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* Gardien observes, that this arrangement ceases when the vessels subdivide in the placenta, there being then only one artery to each vein. Traité compl. des Accouch. Vol. ii. p. 165.

† Vagina funiculi umbilicalis, Osiander. Investitura, Hoboken. Intestinalium, Bankeri.

‡ Embryologie, p. 60.

On arriving at the inner surface of the placenta, each artery divides and subdivides until their branches terminating in, and interlacing with, the radicles of the umbilical vein, together form the mass of the placenta.

There is no perceptible difference in colour between the blood they carry, and that returned by the umbilical vein.

By all British authors, I believe, and by most continental, the pulsation of these arteries is said to be exclusively derived from the fœtal heart, and dependent upon it; but this is denied by Osiander, who contends that they have an independent action at least under certain circumstances. In support of this view, he adds in a note, "More than once I have seen the artery pulsate, when the placenta, placed in a glass vessel of warm water, was brought into contact with the positive pole of a galvanic battery, or even when the water in which it was placed, was so influenced. The umbilical artery of a still-born child has also been found pulsating, when no pulsation could be detected in the heart, and when it was found impossible to re-animate the infant."* The arteries, he further observes, continue to pulsate, if the placenta be separated from the uterus and placed in warm water.

After the birth of the child, if the cord be not divided, its pulsations cease naturally about fifteen minutes after respiration is fully established.

At the fœtal end of the cord, we may detect more or less of the obliterated urachus.

A long-continued controversy has been maintained, as to whether the funis possesses lymphatics or nerves; and though the evidence in favour of their presence is in my mind tolerably satisfactory, yet, as demonstration is not easy, there remains room for scepticism in those so inclined.

Lymphatics are stated to have been seen by Everhard, Pascoli, Needham, and Röslin, according to Schroeger.† They were demonstrated by Wrisberg, as pointed out by his pupil Michaelis.‡ They were afterwards seen by Ultini,§ and Reuss. Hunter, Hewson, Cruickshank, and Mascagni failed in detecting them, and disbelieved their existence.

Osiander injected them with quicksilver in April 1803, and also subsequently.‖ He could never find them at the extremities of the funis, but merely infers their connection with the placenta and fœtus.

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* Handbuch der Entbindunkskunst, Vol. i. p. 489.

† De Functione Placentæ Uterinæ, ad virum illustrem S. T. Soemmering epistola. Erlangen, 1799.

‡ Observ. circa placentæ ac funiculi umbilicalis vasa absorbentia. Gott. 1700.

§ Ueber die Einsaugenden Gefässe des Mutterkuchens, in Meckel's Archiv. Vol. ii.

‖ Handbuch der Entbindungskunst, Vol. i. p. 494.

The following extract from the Dublin Journal,* contains a summary of the results of Fohmann's experiments, by the late Dr William West of this city. "The funis consists, its blood-vessels excepted, of a tissue of absorbents, which is so close that the point of a needle cannot be introduced into any part of it without wounding one." "To fill them with mercury, nothing more is necessary than to pierce the sheath with a small lancet, and then inject the metal through a fine tube." "By injecting with mercury the tissue of absorbents at the placental extremity of the funis, and driving the metal towards the placenta with the handle of a scalpel, we may sometimes succeed in injecting a net-work of absorbents that is spread out between the placenta and its investing membrane. I never saw any vessels rising from this net-work, and ramifying into the membrane (the chorion) as has been observed with respect to the sheath of the funis; and I but seldom discovered any branches penetrating the parenchyma of the placenta. Whither they proceed when they do penetrate, I have not been able to make out; but I am inclined to think they reach its uterine surface.

"On the passage of the tissue of absorbents of the funis into the abdominal region of the fœtus, the superficial ramifications at the distance of a few lines from the umbilical ring, become so very minute as to be scarcely discoverable by a strong lens, even when injected with mercury. On the other hand, the deeper seated vessels gain in strength what they lose in diameter, so that we can employ the handle of the scalpel to drive the mercury onward through them, without any fear of their rupture. On reaching the umbilical ring, they become somewhat larger; and some of them run into the dense tissue of absorbents between the epidermis and the cutis, of which the sheath of the funis is only a continuation. The rest unite into branches, which proceed under the cutis, and at the distance of some lines from the umbilical ring, generate a lymphatic trunk, which, running in a circular direction, forms another ring." And in the next Number of the same Journal,† we find the following notice. "In the last Number of this Journal we inserted a notice of Fohmann's discovery and successful injection of lymphatics in the placenta and funis of the human race. More recently, a similar investigation has been undertaken, and with an equally satisfactory result, by Dr Montgomery of this city, who has succeeded in injecting with mercury great numbers of these delicate vessels, running along the cord, and, for the most part, following the spiral course of the umbilical arteries."

The existence of nerves, like that of lymphatics, has been the subject of a long-continued dispute, and on either side of the ques-

* Vol. v. p. 293. † Ibid. p. 482.

tion great names are arrayed. They have been demonstrated in the funis of calves by Larrey (in 1812) and Teichmeyer, and also by Sir E. Home* and Kilian.†

I do not find, however, that the knife of the anatomist has been able to do more than to detect them at the abdominal insertion of the cord, though arguments have been adduced strongly confirming the inference, that they actually accompany the entire developement of the umbilical vessels to their termination. (Schott.)

Osiander believes in their presence, and mentions, as in favour of this opinion, the occurrence of spasmodic action of the abdominal muscles, when the cord is divided; the action of galvanism, and inflammation attacking the vessels, &c.

In 1826, Dr J. A. C. Schott‡ published a very good summary of the evidences on this subject, concluding in favour of the presence of nerves in the fœtal cord. His reasons for this belief I extract from a review of his work in the Dublin Journal.§

"1. The irritability of any part, it will be admitted (he says) is in proportion to the nervous power allotted to it. Now, of all arteries, those in the umbilical cord appear to be the most irritable, therefore they must be supplied with nerves.

"2. Osiander, Senior, considered (and Dr Schott agrees with him) that the arteries of the cord have in some degree an independent action, founded upon his observing a pulsation in the cord after the heart had ceased to beat. Naegele records a similar fact. But independent action involves necessarily the presence of nerves.

"3. The nutrition of any part must essentially depend upon nervous influence. Now the arteries themselves increase with the elongation and augmentation of the cord, and must consequently be thus influenced."

In addition to the above considerations, Dr Schott adduces the evidence of pathological conditions of the cord as necessarily involving the existence of nerves.

It would be desirable to possess demonstrative proof of their presence if possible; but in the absence of that, I think the arguments from physiology and pathology very conclusive.

The vessels of the cord, with whatever nerves it may be endowed, are imbedded in a quantity of thick serosity, contained in a cellular web, something in the manner of the vitreous humour of the eye. This has been called the jelly of Wharton, and upon the amount of this substance depends the thickness of the cord. It

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* Philosophical Transactions, 1825.
† Ueber die Kreislauf des blutes im Kinde. Carlsruhe, 1816.
‡ Die Controverse ueber die Nerven des Nabelstranges und seiner gefässe, &c.
§ Vol. x. p. 457.

is sometimes colourless and transparent, in other cases yellowish or reddish, but without any effect upon the growth of the child.

It is rather more abundant towards the fœtal end of the cord, and the cells in which it is contained being of various sizes, gives the appearance of pouches to different parts of the cord.

When the cord is cut across, a great portion of the serosity escapes, and if care be not taken to secure by a tight ligature the fœtal portion, fatal hemorrhage may be the consequence of this diminution in bulk.* So much for the ordinary structure of the funis. There are, however, some very curious and important deviations from it, which it may be well to notice briefly.

1. The vessels of the cord may divide at two, three, or four inches from the placenta, or even near the abdominal extremity instead of being inserted into that organ together. (Deneux, Velpeau.)

2. Instead of one vein and two arteries, there have been found two veins and but one artery—one vein and one artery, (Baudelocque, Marin, Blandin, Velpeau,) or three arteries. (Osiander.)

3. Two cords have been observed, attached to one placenta, in the case of a single child.

4. The vessels are sometimes partly or wholly closed.

5. Many cases are on record of the entire absence of cord and *umbilicus*; but upon these Velpeau throws great doubt.

A case of an acephalous fœtus recently occurred at the Western Lying-in-Hospital, which had formed adhesions by the back of the neck to the placenta, from which a funis arose, and passing round the right side of the neck, was inserted into the depression between the face and neck, just about the spot where the angle of the jaw should have been, had there been no malformation. The vessels of the cord passed behind the clavicle and ribs down into the chest and abdomen. There was a depression, or *cul de sac*, about the proper situation of the umbilicus. This is the most remarkable deviation from the usual course of the funis which I have ever seen.

Chaussier† relates one where the placenta was attached to the liver, and another is on record in which it adhered to the abdomen.‡

6. Capuron mentions that when the umbilical ring is imperfectly closed, the sheath of the cord sometimes contains a portion of the intestines.§

7. In the case of twins, the placentæ and cords are generally distinct; but sometimes a cross branch establishes a communication between the two.

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* Burns, Principles of Midwifery, 9th ed. p. 228.
† Bulletin de la Faculté, Vol. v. p. 313. ‡ Guillemot, These, No. 120.
§ Cours d'Accouchemens, p. 130.

8. The cord may be inserted into a smooth part of the chorion, instead of into the part where the placenta is forming, and the fœtus perish for lack of nourishment.

9. The cord (at an early period) may be so twisted as to diminish the calibre of the vessels and impair the nutrition of the fœtus.*

10. The vessels of the cord may become varicose, or the sheath of the cord may contain hydatids. (Burns.)

11. The coats of the vessels may give way and excessive hemorrhage result. (Burns.)

12. The cord may be torn across by the mother's falling or receiving a violent concussion. (Levret, Baudelocque, Burns.)

The external arrangement of the cord may also vary from its ordinary condition.

1. In addition to the false knots or loops formed by the vessels of the cord, as already noted, we sometimes find real knots, either single or double.

Baudelocque has given a plate of each,† and Osiander cases of both.‡ Matthias Saxtorph has published upon the subject a very interesting memoir,§ in which several cases are related. In one, the fœtus presented with the shoulder, and was turned and delivered successfully. On the cord was found one of these knots (not formed during the turning) which was drawn tight. The vessels were injected with wax, which passed readily through the vessels implicated in the knot. When untied, it still curled into a circular shape, and the inside of the circle was flattened. The calibre of the vessels was somewhat diminished.

A second case was more remarkable. A lady of rank was frightened on returning home from church, and the shock occasioned the evacuation of the *liquor amnii* four weeks before she gave birth to a healthy lively child, upon whose funis was found a *double* knot drawn tight. The motions of the child were not felt after the discharge of the waters. An injection passed through the vessels of the knot, though with rather more difficulty than under ordinary circumstances. Saxtorph considers that the evacuation of the *liquor amnii* saved the life of the child, by lessening the cavity of the uterus, and diminishing the stress upon the knot. Mr Rogers‖ remarks that he found these knots no obstacle to the injection of the placenta through the cord.

Judging from the appearance of the knot when untied, there

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* Montgomery, Signs of Pregnancy, p. 263.

† L'Art des Accouchemens, Vol. i. p. 255.

‡ Abhandlungen und Nachrichten, S. 211.

§ Von der Knoten und Verschlingungen am Nabelstrange lebender Kinder. Gesamm. Schriften, p. 187.

‖ Lancet, 1829, Vol. i. p. 162.

can be little doubt that it is formed at an early period of utero-gestation, favoured by the length of the cord, the quantity of *liquor amnii*, and the small size of the child, permitting an extent of motion, impossible afterwards. Undoubtedly, a knot may be formed, as Professor Burns suggests,* "by the child passing through a coil of it during labour," or by a want of due care in turning the child; but these are not the true knots of which we are now speaking, and when untied, do not assume a circular form.

These knots are spoken of as highly dangerous to the life of the child, if not always fatal. Levret remarks,† "On trouve quelquefois le cordon ombilical noué d'un vrai nœud; on en a vû de tortilles en double; on en a même trouvé, qui etaient entierement separés du placenta: quand une de ces trois circonstances arrive, l'enfant perit ordinairement avant terme, ou il nait du moins fort emacié." And more recent authors have repeated this opinion more or less modified. Baudelocque, Saxtorph, and Gardien differ from this view, and state that little or no danger results from this disposition beyond the varicose state of the vessels, on either side of the knot, if it be drawn tight. This position is established by the fact that children are born healthy, who for months have been subjected to all the consequences of such knots.

2. The funis may be coiled round the child's neck, extremities, or body, in consequence of its excessive length, and the movements of the fœtus *in utero*. If the length of the cord be very great, several coils may be found. I have quoted from M. Heritier, a case where it was five times round the neck. An artificial coil may be formed during the expulsion of the child, or in turning.

As to the frequency of this occurrence; Richter of Moscow met 27 examples out of 624 cases;‡ Siebold, at the Berlin Clinique, 21 out of 137 cases,§ and Kluge 63 out of 268. ‖ I give these on the authority of M. Velpeau, as I have not the documents to refer to. Out of 242 cases, of which notes were taken under my own superintendence, it occurred 63 times. Thus, in 1271 cases, there were 174 examples of coiling, or rather more than one in seven.

As to the *physiology* of the cord; after the second month, it is merely a sheath containing the vessels of fœtal nutrition, and transmitting the impure blood to the placenta for renovation, and afterwards returning it to the child.

The arrangement is in one respect at least analogous to that for

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* Principles of Midwifery, p. 228.
† L'art des Accouchemens, §. 306.
‡ Synopsis prax. obstetr. p. 417.
§ Bulletin de Ferussac, Vol. xxi. p. 41.
‖ Ibid. p. 402.

the lungs subsequent to birth, viz. the impure blood is conveyed to its destination by arteries, and when renovated is returned by the vein, contrary to what occurs in every other structure of the body. I may repeat, that though we have every reason to suppose that a process, analogous to aeration in the lungs, is carried on in the placenta, yet no similar difference can be observed between the colour of the blood in the veins, and that contained in the arteries. The blood in both is of an equally dark colour, or nearly so.

Connected with the cord, there are two *medico-legal* questions which I must not pass over.

1. We have already seen that the umbilical insertion of the cord, which at the earliest period of fœtal life is near to the pubis, gradually recedes from it, and approaches the ensiform cartilage. In the words of Velpeau,* "Le point du ventre qui donne insertion au cordon ombilical est d'autant plus eloigné de la poitrine ou d'autant plus rapproché du pubis, que la grossesse est moins avancé." According to the researches of Chaussier and Bigeschi, this gradual elevation of the umbilicus appeared to have brought it, at the time of birth, to the centre of the whole body. Consequently, any falling short of this point would indicate prematurity; and the test was proposed to be used in those cases where a doubt exists of the completion of pregnancy.

Dr Montgomery† observes, "The situation of this middle point was first proposed as a test of the age of the fœtus by Chaussier, and his observations have been since confirmed by several others.‡ From the trials I have made of this test, I attach considerable value to it."

The accuracy of the measurement upon which the test is founded has been lately called in question by M. Moreau, Professor of Midwifery at Paris. He is stated § to have measured carefully 500 children born at La Maternitè, and to have found out of this number, only four instances of cords inserted exactly in the centre of the whole length of the body. In the remainder the point of insertion fell, on an average, from eight to ten lines below the middle. In a few children born about the sixth or eighth month the cord was inserted into the middle point.

Though this circumstance may not be adequate to disprove the evidence of high authority in favour of Chaussier's test, it is quite sufficient to throw a doubt upon his facts, and to require additional investigation. I am sorry that as yet I can contribute nothing to the elucidation of the question.

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* Traité complet de l'art des Accouchemens, ed. de Bruxelles, p. 167.

† Exposition of the Signs and Symptoms of Pregnancy, &c. p. 264.

‡ Capuron, p. 172. Hutchinson pp. 6–14. Fodoré, Vol. ii. p. 149. Burns, p. 114–118. Metzger by Ballard, p. 168. Beck, ed. 5th, p. 180 et seq.

§ Lançette Française, No. 140, 1837. Lancet for Feb. 10, 1838.

2. In cases of children found dead under suspicious circumstances with knotted cords, it has been supposed that they might be formed after death to conceal infanticide, by throwing the suspicion upon them as the cause of death: and it is a matter of some consequence to ascertain whether they could produce such serious effects, and also how the artificial knots may be distinguished from natural ones. (Saxtorph.)

As far as the evidence of individual cases can go, we have seen reason to disbelieve in any injurious consequences resulting from these accidental formations, and we have the highest testimony to the same effect. (Baudelocque, Saxtorph, Osiander, Gardien.)

Further, it appears possible to come to a pretty accurate conclusion in most cases, as to the ancient or recent formation of the knots. In all such cases, we should carefully examine whether the cord be tight or loose, and whether the vessels on either side be swollen or varicose. The vessels should then be injected without untying the knot, and notice taken of the manner in which the injection passes, whether freely or with difficulty. The cord may then be untied, and we should observe whether it remains loose or curls into a circle at the knot, and whether the inside of the circle be flattened.

If the knot be moderately loose, and the vessels on either side varicose; if the injection pass easily, and the cord curls when untied, and the inside of the circle be flattened, we may conclude that the knot is of old standing, and also that it could not have caused the death of the fœtus.

If, on the other hand, the knot be drawn very tight, so that the injection cannot pass; if there be no varicose state of the vessels; no flattening of the inner surface of the knot, and no curling round when untied—the evidence is in favour of the recent formation of the cord, either during the delivery or subsequently, and more or less against the supposition of its having caused death.

There are several ways in which the cord has been supposed to exert a powerful influence upon parturition.

1. It is stated by early writers, and repeated again and again by their successors, that a *short cord* may impede the progress of labour, by retracting the head of the child at the termination of each pain; may cause inversion of the uterus; detach the placenta, or may itself be ruptured; and by some these consequences are spoken of as if they were of frequent occurrence.

Supposing the cases of extremely short cords, for instance under six inches, to be perfectly correct, it is clear that there would be danger of premature detachment of the placenta, or rupture of the cord; but I do not believe that labour would be retarded, or that the uterus would be inverted.

Again, it is doubtful whether a child could be delivered with a

cord only six or seven inches long, unless the labour were premature; so that here we have a similar danger of placental separation and rupture of the funis, with perhaps more risk of inversion.* But the remedy (as in Dr Hamilton's cases) is within our reach, viz. cutting across the cord after the head is born.

We learn from Dr Montgomery's cases that a child may be safely expelled whose cord measures from eight to nine inches; and now, if we consider the frequency of the occurrences of cords shorter than this, we may pretty nearly estimate the amount of danger.†

In 474 cases which I have detailed, there was no cord under 12 inches.

In Siebold's Report of the Berlin Lying-in-Hospital there was none under 13 inches.

If we could estimate the results of the experience of Guillemot, Montault, Meissner, Mauriceau, Baudelocque, Morlanne, Haighton, &c. who have each given one example of a very short cord, and ascertain the proportion of those individual cases to the whole, we should find it very slight indeed.

And if further we should think it not unfair to take such published reports of hospitals and private practice as are noted for their accuracy, and yet in which there is no mention of a single short cord, (short enough I mean to cause accidents,) and add them to the other estimates, and then divide the total by the number of short cords on record; the results would show the extreme rarity of such cases, and more than justify Naegele's statement, that the cord is rarely or never so short as to hinder labour, or to entail any serious consequences.

2. Precisely similar dangers have been attributed to the coiling of the cord around the child's neck or limbs, and this because it was fancied that the loss of length by the coil would make the case equivalent to one with a short cord. Had this been true we should have had many accidents on record, for the coiling is a frequent occurrence. Out of the 1271 cases I have already enumerated, there were 174 examples of this disposition of the cord, or rather more than one in seven; and yet there is no hint of any inconvenience or accident. The explanation is quite easy, if such

* Inversion was the more readily attributed to the stress upon a short cord, in as much as its occurrence after the birth of the child was in almost every case supposed to depend upon undue pulling of the cord for the purpose of removing the placenta, but it has been recently shown by my friend Mr Radford of Manchester, (Dublin Journal, Vol. xii. pp. 26–315) that it may occur without the cord being touched, and that probably many cases have been attributed to this cause which were really instances of spontaneous inversion.

† In speaking thus, I am assuming that the case is a head presentation, (as I believe all those referred to were;) if, however, the feet should present, a longer cord will be necessary for the extrication of the infant, as the distance is greater from the navel to the crown of the head, than from the navel to the buttocks.

cords be measured, for it will be found that this coiling never takes place with a short cord, very rarely with one of the ordinary length; and most generally when the cord is some inches beyond the common standard. I am sorry that I can only refer to my own documents in support of this statement.

Of the 63 cases of coiling (out of 242 patients,) noted at the Western Lying-in-Hospital, none were under 18 inches long, and only two so short as that; the most common length was 24 inches. In one funis of 30 inches, and in another of 42 inches, it was twice round the neck. Out of a considerable number in private practice, it never occurred in a cord under 20 inches.

The single coil is a loop extending from the umbilicus round the neck and back again, and when tight will not occupy more than seven or eight inches, and a second will not require more than five or six inches additional, leaving of the shortest cord with which the single coil was formed 10 inches free, and in the cases of double coiling respectively, 16 and 28 inches free.

Thus, taking the shortest cords which were twisted round the neck, we find them equivalent, not to the cases of extremely short cords occurring naturally, but to those of ten inches and upwards; and we have already seen that from these we cannot anticipate any unpleasant consequences; for that in Dr Montgomery's case and others, a funis of eight or nine inches permitted the safe delivery of the child without any interference.

It does not therefore appear to me unwarrantable to conclude, that, as a coil is not formed unless the cord be 18 inches long or upwards, none of the accidents attributed to it are to be feared, and further, that though it may be desirable to slip the coil over the child's head or shoulders, when possible to relieve the stress upon it, yet it cannot be a matter of the practical importance which it is sometimes represented to be.

Baudelocque* and others have supposed that, if the coil be drawn tight, an arrest of the venous blood returning from the head of the child would be likely to occur, and to end in cerebral congestion or apoplexy. This may be the case if the tightening take place during labour, in consequence of the cord not descending freely along with the body of the child, though, as the pressure can be relieved the moment the head is born, I should rather doubt whether the serious consequences which he describes actually ensue; but we have positive evidence, that the tightening during intra-uterine life is perfectly innocuous, in the fact related by Professor Busch in his Report of the Berlin Lying-in-Hospital.† He met with a case where the cord had been twisted so tightly round the neck, that a deep groan was observed at birth; but the accident had not injured the growth or health of the infant.

* L'Art des Accouchemens, Vol. i. p. 254.

† British and Foreign Medical Review, April 1838, p. 579.

When referring to Baudelocque's opinion, Velpeau remarks that there are no facts on record which substantiate the supposed danger.

3. The cord may be prolapsed either at the commencement or during labour. Though by no means of unfrequent occurrence, its comparative frequency varies very much.

Mad. Boivin* mentions its occurrence 38 times, (25 times before and 13 during labour,) out of 20,517 cases. Twenty-five cases were turned, and in 13 the forceps were used. Twenty-nine children were saved, and seven lost. Two were putrid.

Mad. La Chapelle† met with 23 cases out of 15,652; 13 were treated by the forceps, and 10 by turning; 17 were saved, and six lost. M. Baudelocque ‡ out of 17,499 labours, reports 41 cases of prolapsed funis. Dr Bland§ gives one case of prolapse in 1897 cases of labour.

Dr Merriman, gives 11 cases in 2947 labours.‖ Dr Granville, one case in 640 labours.¶

Richter of Moscow,** found four in 624, and Mazzoni,†† 18 in 450 cases. Dr Clarke,‡‡ in his report of the Dublin Lying-in Hospital, met with 66 cases of prolapsus of the cord in 10,387 deliveries, but the Doctor does not believe that all the cases of this kind were recorded in the registry. Seventeen children were born alive.

Dr Collins,§§ in his valuable report of 16,654 cases, occurring in the same hospital between the years 1826 and 1833, states that 97 cases of prolapsed funis occurred, 12 of them in twin cases (*i. e.* I presume the cord of one of the twins prolapsed,) 24 children were saved, seven were putrid.

At the Coombe Lying-in Hospital in this city, Mr Gregory reported in 1830,‖‖ that since its commencement in February 1829, 691 patients had been delivered, among which there were seven funis presentations, four of which were lost.

At the Wellesley Dispensary, Dr Samuel Cusack ¶¶ reported in 1830, five cases of prolapse of the funis in 398 labours, and all appear to have been lost.

In the reports of this institution for the year 1832,*** 1833,†††

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* Memorial, p. 354.
† Pratique des Accouch.
‡ L'Art des Accouchemens.
§ Philosophical Transactions, 1781.
‖ Appendix to Synopsis, p. 335.
¶ Report of Westminister Dispensary, p. 25.
** Synopsis Prax. Med. Obstet. p. 416.
†† Statistica Ostetrica di Santa Maria Nuova di Firenze, 1833.
‡‡ Transactions of College of Physicians, Vol. i. p. 398. Collins, Practical Treatise, p. 346.
§§ A Practical Treatise on Midwifery, p. 342.
‖‖ Dublin Hospital Reports, Vol. v. p. 572.
¶¶ Ibid. Vol. v. p. 494.
*** Edinburgh Medical and Surgical Journal, No. 117 p. 295.
††† Dublin Journal, Vol. v. p. 367.

by Dr Maunsell there were two cases of prolapse of the funis in 839 labours. No mention is made of the result to the children.

In the Western Lying-in Hospital, 31 Arran Quay, Dublin, between November 1, 1835, and December 31, 1837, there were 616 women delivered, and two cases of prolapsed funis. Both children were lost.

Dr Beatty reports,* that six cases of prolapse out of 1182 labours occurred at the new Lying-in Hospital, between April 1834 and August 31st 1837. Four of the children were lost.

If we add these together, they amount to 90,983 deliveries, and 322 cases of prolapse of the cord or in every 282½.

It must always be remembered, when speaking of the results to the child of this accident, that in lying-in hospitals, many of the cases do not seek admission till some time after the occurrence, when the chance of a safe delivery is diminished, and some not until the cord has ceased to pulsate. Twenty-two such cases occurred out of the 73 unfavourable ones Dr Collins has recorded.†

Many circumstances have been assigned as likely to cause or to favour the occurrence of this complication.

1. Malposition of the child. Smellie in his plate of this accident has represented the child lying across the uterus, with the umbilicus at the upper outlet, and the cord hanging down in the cavity of the pelvis; and Froriep regards this as an exact explanation. After a careful examination of the cases I have seen, and a tolerably extensive investigation into those recorded by authors, I can find no facts at all in support of this view, and must therefore attribute the explanation rather to Smellie's ingenuity than to his experience.

2. It would appear that a small child, with a large quantity of the *liquor amnii*, by allowing the head of the fœtus to move away from the brim of the pelvis during the latter months, will favour the escape of a loop of the funis. (Boer, Mauriceau.) ‡

3. The sudden twisting of the membranes, and the forcible rush of a large quantity of *liquor amnii* may have a similar effect, and especially when aided by an untoward position in the mother. (Boer, Busch, Capuron, Baudelocque, Gardien.) §

4. It will be favoured by a presentation of the feet or knees, as they do not fill up the upper outlet, (Naegele,) ‖ and even where the cord does not descend at the commencement of labour, it may before the breach enters the pelvis. Naegele is not correct, however, in stating that it occurs most frequently with footling cases.

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* Dublin Journal, Vol. viii. p. 66, Vol. xii. p. 273.

† Practical Treatise, p. 346.

‡ Von Geburten unter welchen die Nabelschnur vorfallt, in L. J. Boer's Works, Vol. ii. p. 156.

§ Traité des Accouchemens, Vol. ii. p. 414.

‖ Lehrbuch der Geburtshülfe, p. 283.

5. Naegele adds, irregular shape or irregular action of the uterus.

6. Excessive length of cord forms undoubtedly an important element; but it requires other conditions also, since in the cases of the cords of from 36 to 54 inches which I have noticed, no prolapse occurred. *

7. I may add from my own observation, that I have found in several cases of prolapse, that the placenta was situated low down on the side of the uterus, and in some few others, that the funis was inserted into the lower edge of the placenta.

There are cases, however, which are not traceable to any of these causes.

In all cases of prolapsed funis, the child is in the utmost danger from the moment the upper strait of the pelvis is filled by the part of the child descending, in consequence of the pressure upon the cord, just as in footling cases. The effects of this pressure are in proportion to the time it is continued, if the cord be not partially shielded from it by its situation. Several explanations of the proximate cause of death have been given (Gardien, Velpeau, &c.); but as they are only hypotheses, I shall omit them.

There are but few cases in which the child escapes safely when the labour is left to the natural powers. In those in which I have seen this happy result, the pelvis was very large, the child of a moderate size, and the pains very violent, so that the second stage of labour occupied but a very short space of time. The same result will obtain in those cases where the cord is shielded from pressure, by being lodged in the angle at the junction of the sacrum and ileum. (Busch.) The chances will be still greater, if the patient has borne previously five or six children.

Treatment.—The means to be adopted will depend entirely upon the state of the prolapsed cord. Should it exhibit marks of putrefaction, or be without pulsation, it will be useless to interfere because hopeless, as regards the life of the infant, and the labour may be allowed to terminate naturally.* Capuron † advises us not to interfere at once, even though the cord should pulsate, but rather to wait until the pulsations become feeble. It will certainly be desirable that the *os uteri* should be as much dilated as

* It might not unfairly be asked, says Naegele, why prolapse of the cord does not always take place, since the length is sufficient, and its specific gravity greater than the *liquor amnii*. He explains it by referring to the fact, that when the membranes first give way, only that portion of the *liquor amnii* which is anterior to the head, escapes, whilst the larger portion and the cord are retained by the tight fitting of the head in the upper strait. (Handbuch der Geburtshulfe, p. 104, 285.)

† On this point Dr Collins remarks, "From such (the opinions of Denman and Burns) I most respectfully differ, as I cannot see any advantage whatever, in permitting the patient to endure the pain and distress of labour for hour after hour, which must be accompanied with some risk, when by lessening the head, we can, without the least injury, terminate the labour." Practical Treatise, p. 380.

† Cours d'Accouchemens, p. 335.

possible; and if we discover the prolapsed cord before the rupture of the membranes, it will be well to postpone their rupture until that object be effected.

Various modes of management have been proposed.

1. We are advised to push the cord upwards, beyond the brim of the pelvis, and there to retain it with one or two fingers, until the upper outlet be filled by the descending head.

This would seem easy and certain, but in practice it is not so; for the pains which force down the head, force down the cord also, and, besides, there is some risk of displacing the head. This reposition is still more difficult, if any other part than the head present. On the whole, I believe I may say that it rarely succeeds.

2. It has been proposed to return the cord and to hook it over the limbs of the child. This might also succeed, but it is a very difficult and a somewhat dangerous operation, and I am inclined to agree with Dr Burns, that "if the hand is to be introduced so far, it is better at once to turn the child." * It is but right to add, that Sir R. Croft succeeded twice in this way.†

3. Various mechanical expedients have been contrived for retaining the cord when replaced. Thus inclosing the cord in a leather bag and pushing it beyond the head of the child, was recommended by Mackenzie,‡—attaching the cord to the extremity of a canula by Ducamp, of a catheter by Dudan,§ the reductor by Aitken, a thin elastic flat rod of steel by D. Davis,‖ or a modification of some of these contrivances was suggested by Champion, Favereau, and Guillon.) ¶

4. Osiander, Busch, Hogben,** and Hopkins†† propose to retain the cord by introducing a piece of sponge after its replacement.

5. Dr S. Merriman has twice succeeded in saving the infant, not by returning the cord, but by placing it in the angle formed by the junction of the sacrum and ileum, where it is in a great measure shielded from pressure.

6. If we determine to try the preceding plan, or if the advance of the head preclude any attempt at reposition, or, lastly, if the cord come down during labour, we may increase the chances of safety by applying the forceps, and hastening delivery as soon as the head is within reach. (Merriman, Busch, ‡‡ Boivin.)

7. If the patient have had children before, and if the pelvis be roomy and the soft parts well dilated, perhaps the best chance for the child is in turning, (Boer, Burns,) particularly, of course, if there should be a mal-presentation. (Boivin.) §§

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* Principles of Midwifery, p. 433. † Merriman's Synopsis, p. 99.
‡ Merriman, p. 99. § Revue Med. 1928, Vol. iii. p. 502.
‖ Elements of Operative Midwifery, 1825, p. 170.
¶ Velpeau, Traité des Accouchm. p. 342. Ed. Brux.
** Obstetric Studies, 1813, p. 62. †† Accouch. Vade Mecum, 1814, p. 193.
‡‡ Siebold's Journal, Vol. xvi. part 1, p. 200. §§ Memorial, p. 226.

But as this operation is not without hazard to the mother, we should accurately estimate the favourable or unfavourable probabilities as regards the child before we attempt it.

Mad. Boivin turned the child in 25 cases, and used the forceps in 13 out of the 38 cases she has recorded; and saved 29 children. Mad. Lachapelle in 23 cases used the forceps 13 times and version 10; 17 children were saved.

As far as I can learn, all these were head presentations.

In one case Dr Collins saved the child by returning the cord and retaining it by the hand in the vagina; in another by enclosing it in a linen bag, and retaining it in there by introducing a piece of sponge.

No matter what means are adopted, the mortality, especially in hospital practice, will be very considerable; thus out of 244 of the cases I have referred to, 152 were lost and 90 saved.

Should the delivery have been completed within a short time after the cord has ceased to pulsate, it will be our duty to employ for some time the usual means for resuscitating the child; so long as the heart beats ever so faintly, there is hope.

So much for the influence of the cord upon parturition.

After the birth of the child, the pulsation in the arteries continues for twelve or fifteen minutes, gradually diminishing in strength as respiration becomes more perfect, until at length it ceases entirely. It is not customary in Great Britain to wait for its cessation, but as soon as respiration is sufficiently established, one or two ligatures are put upon the cord and it is divided.

On the continent, however, a different practice prevails. Many writers object to ligatures altogether, on the ground that they may lead to local congestion, or otherwise injure the child, and that they are perfectly unnecessary for the purpose of restraining hemorrhage, (Capuron);* and we are referred to the habits of animals in proof of this latter assertion.

That the cord may be left without a ligature, and yet no hemorrhage follow, we have the express testimony of Capuron and others; and I recollect seeing several cases delivered under M. Capuron's superintendence, in which this practice was adopted without inconvenience. But, on the other hand, every practitioner must have met with instances of alarming hemorrhage in consequence of the

* "Quant à la ligature du cordon qui tient au fœtus, la raison physiologique et l'experience s'accordent à en prouver non-seulement l'inutilité, lorsque la respiration est bien etablie, mais encore le danger, lorsque l'enfant est menacé d'apoplexie. S'il est donc essentiel alors de couper le cordon ombilical aussitot que l'enfant est né, rien ne presse d'en faire la ligature. On pourrait même absolument s'en dispenser dans la suite, si l'on n'avait à craindre qu'un maillot trop serré ou des cris aigus ne vinrent à suspendre la respiration, et à faire jaillir le sang par les extrémités des arteres ombilicales."—Cours des Accouchemens, p. 246.

ligature becoming loose, and as this is the case, it would be extremely rash to incur the risk when the prevention is so easy. I totally disagree in the danger attributed to the ligature, except in those cases in which congestion (from tedious labour, &c.) exists at birth, and then, before applying the ligature, it is always wise to allow a small quantity of blood to escape. As to the lesson supposed to be taught by animals, Dr L. J. Boer* has well observed that the circumstances are totally different,—that a sufficient time is allowed to elapse between the birth of the young animal and its separation from the after-birth,—that the separation is generally effected at a distance from the umbilicus,—and that the cord is exposed to the cold air, &c.—and Dr William Hunter's observations give the *coup de grace* to this hazardous practice. "A ligature upon the navel string," the Doctor remarks in his manuscript lectures 1752, "is absolutely necessary, otherwise the child will bleed to death; and when tied slovenly, or not properly, it will sometimes bleed to an alarming quantity. As we are to take such vast care to secure the navel string, you will naturally ask,—how brutes manage in this particular? I will give you an idea of their method of procedure by describing what I saw in a little bitch of Dr Douglas's. The pains came on, the membranes were protruded: in a pain or two more they burst, and the puppy followed. You cannot imagine with what eagerness the mother lapped up the waters, and then taking hold of the membrane with her teeth, drew out the secundines; these she devoured also, licking the little puppy as dry as she could. As soon as she had done, I took it up, and saw the navel string much bruised and lacerated. However, a second labour coming on, I watched more narrowly, and as soon as the little creature was come into the world, I cut the navel string, and the arteries immediately spouted out profusely: fearing the poor thing would die, I held it to its mother, who drawing it several times through her mouth, bruised and lacerated it, after which it bled no more. This, I make no doubt, is the practice of other animals."†

The ligature is to be applied about two inches from the body of the child and drawn very tight. An examination should be made before it is finally covered up, to see if there be any draining, as the escape of the gelatine often slackens the ligature, and if necessary another should be applied nearer to the abdomen.

It is customary in these countries to tie the cord a second time nearer the placenta, with a view to prevent hemorrhage, in

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* Bemerkungen ueber das unterbindung der Nabelschnur in the second Vol. p. 148 of his work, "Natürliche Geburtshülfe und Behandlung, &c." See also Froriep's Handbuch der Geburtshülfe, p. 360.

† Merriman's Synopsis, p. 21, note.

case there should be a second child, and a vascular communication between the placenta. It is a matter of precaution, not of necessity. It is said by some French authors, that allowing the cord to bleed facilitates the expulsion of the placenta. I am not prepared to speak decidedly on this point, but I know that it weakens the cord, and unfits it for much traction.

As to the portion of cord that remains attached to the abdomen of the infant, it speedily dies, and gradually dries up and drops off. I have kept an account of the period of its decadence in 49 cases, and it occurred as follows:

In 1	case it fell on the	2d day.
1	.	3d.
7	cases, .	4th.
20	.	5th.
10	.	6th.
2	.	7th.
3	.	8th.
3	.	9th.

Thus the 5th and 6th days are the ordinary periods of its attachment.

My friend, Dr Montgomery, informs me that he has had one persistent until the fifteenth day, and Dr Brem has seen one at the thirteenth day.

When it falls, the umbilicus requires to be protected from friction by a pad of soft rag, smeared with a little simple ointment or cold cream, otherwise it may be attacked by inflammation and swelling, and severe ulceration (Naegelè). This, however, is easily subdued by emollient or very slightly stimulating applications.

A much more serious matter is the occurrence of hemorrhage, from the cord having been separated or pulled away before the vessels are completely closed. It is extremely difficult to stop the bleeding, and sometimes impossible, without cutting down upon the bleeding artery and tying it; a most undesirable operation in a young infant. As a striking example of this accident, I shall quote a case related by George Pout, Esq. Market Street, Beds, and with that conclude this paper.

"On the 4th of September 1831, I was sent for early in the morning by a lady of the name of White, requesting my immediate attendance, as her child had been bleeding all night from the navel. On my arrival I found, from the state of the linen, the hemorrhage must have been very considerable, and I endeavoured to ascertain the cause, by introducing a pair of dressing forceps within the navel, as far as possible, and then opening them, to stretch the integuments, but, not being able to see from whence the blood came, I plugged up the opening with lint, &c. and used pressure by means of adhesive plaster and a roller."

In spite of the most judicious treatment, the child died, "having bled to death, as the linen clearly proved. This was a full healthy male child, about ten days old. The funis came off as usual, and without the slightest appearance of any thing more than common, on the sixth day. The bleeding commenced on the eighth day, and continued till death. What renders this case most remarkable is, that this lady had lost two children before, under exactly similar circumstances. Upon dissection after death. I found the umbilical vein full of blood, in a fluid state, and nearly as large as a goose quill. Both the umbilical arteries were sufficiently pervious to admit a probe, and the left still containing a plug of coagulated blood, from which it would seem the bleeding took place. They were both so much retracted within the integuments, that it must have been impossible to have stopped the bleeding by pressure." *

In any similar case, Mr P. proposes to cut down upon the artery, and to tie it. The actual cautery has also been proposed, and might be successful; but it has struck me that if the navel were stretched open, and filled with plaster of Paris, either in powder or moist, it might effectually plug the vessels, as it would become solid, and adherent to the skin. I do not know whether this has been tried, but it seems worth the experiment.

I fear that these intractable cases are more frequent than one would suppose. A young friend has just informed me that he has met two such, which continued to bleed, in spite of all attempts to plug the navel, and which finally proved fatal.

104, *Stephen's Green, Dublin.*
June 20, 1838.