ART. VIII.—*The Uterine Dilator.* By HORATIO R. STORER, M. D.

IN January last I took occasion through the pages of this Journal to call the attention of the profession to various incidental questions connected with artificial dilatation of the uterus.

At that time the only means known of directly attaining this end was by the use of expansible tents. I make this statement advisedly; for the elastic bougies of McIntosh and the unyielding ones of Simpson, the spring knife of the latter, the hollow tubes used by Wakley for urethral stricture and adopted from him by Baker Brown, and the instruments of Drs. Graham Weir and Rigby with expanding metallic blades, have all of them proved inefficacious or hazardous. The first two on the list are slight in their immediate action and excessively wearisome to both operator and patient; those subsequently mentioned are often difficult to use and at times still more so to control. Where there are cutting blades there is danger of hemorrhage, and where the divisions of the instrument act only by pressure it falls unequally and not upon the whole circumference of the cervical canal.

It is with pleasure, therefore, that I proceed to announce an additional method of dilating the uterus, far more controllable, effectual, and reliable in its action, so far as I am aware new in its application to this organ, capable of being applied to its body as well as to the cervix, and probably destined to effect a complete revolution in the treatment of many forms of obstetric disease.

There are various objections to the use of expansible tents for dilatation of the uterus, of whatever material they may be made. These objections are so decided in the case of sponge, that for nearly five years I have been engaged in a series of experiments, having for their sole object the discovery of an available substitute.

Early in 1855, in a paper read before the Medico-Chirurgical Society of Edinburgh, and reported in the *Association Medical Journal of London*,[1] I proposed the use of mucilaginous tents, and suggested for this purpose the inner bark of our native slippery elm (*ulmus fulva*).

Several months later, allusion was again made to the necessity of a safer and more controllable agent for dilating the uterus than sponge.[2]

In November of the same year I published a paper upon the subject in the *Boston Med. and Surg. Journal*,[3] stating, as I had previously done, my dissatisfaction with the agent then proposed, except for cases, like

[1] May, 1855, p. 446.

[2] Preface to Simpson's Obstetric Memoirs and Contributions, Sept., 1855.

[3] Nov., 1855.

mechanical dysmenorrhœa, requiring a comparatively small amount of dilatation.

The article of January last, to which I have already alluded, again pointed out the importance of this inquiry.

Though the earlier of these communications, which were based upon experiments with other mucilaginous agents than elm, were quoted at some length in several foreign journals[1] besides that in which the first appeared, an English physician, Dr. Aveling, of Sheffield, has lately renewed the proposal of mucilaginous tents,[2] apparently ignorant that in this he had been anticipated by over three years. Gentian root, however, the substance he recommends, is among the agents I had previously made use of, and had thrown aside as comparatively worthless. The root of the officinal gentian, as is well known, contains scarcely a trace of mucilage; the spurious root, ranunculus thora, often sold for the gentian,[3] and undoubtedly referred to by Aveling, affords a larger percentage, but is greatly inferior in this respect to elm.

The uterine dilator now presented to the profession acts by fluid pressure, and is a modification of an instrument suggested for the female urethra by Spencer Wells, of London,[4] which in its turn was taken from the dilator for urethral stricture invented by Arnott and further modified by Thompson. It is a curious fact in the history of the various means thus far proposed for dilatation of the uterus that they have all without exception been based, directly or indirectly, upon some method previously in use for the treatment of strictures of the male urethra.

The instrument consists essentially of three portions: a distensible sac, the dilating medium—a hollow staff, for support and as a channel of communication to and from the aforesaid sac—and an external source of supply. By the aid of the staff, the sac is introduced undistended into the cavity of the cervix or of the uterus itself as may be desired, and by its enlargement any amount of dilatation may at once be effected.

In Mr. Wells' apparatus, the first of the portions described consisted of rubber tubing; and the third, of a common syringe.

Against rubber, however, even when vulcanized, there are objections for all purposes requiring its exposure to the fluids of the vagina. It is apt to be chemically acted upon by these, to become offensive, and from absorption of the products of its decomposition there is danger of pelvic cellulitis. It is also necessarily somewhat bulky; the thinnest qualities being liable to tear if exposed to any considerable amount of distending force, especially if increased by external pressure. I have, therefore, supplied its place by

[1] Glasgow Med. Journal, April, 1856, p. 116; Braithwaite's Retrospect, January, 1857, p. 247, &c.

[2] Med. Times and Gazette, June, 1858, p. 653.

[3] Griffith, Med. Botany, p. 461.

[4] Med. Times and Gazette, July, 1858, p. 84; with wood-cut.

gold-beater's skin, and in practice have found the membranous sheaths sold for the prevention of pregnancy to be admirably adapted for the purpose; an end certainly much better than that to which they are usually applied.

The staff, if the uterus is unimpregnated, should be of silver; a hollow tube of sufficient length, some ten inches, to enable it to project externally, of an internal diameter varying with the case, and perforated laterally at its further extremity. In these respects a male catheter might suffice, were it not that the curve must be extremely slight, to correspond with the axes of the female pelvis.

Where the uterus is displaced, unless it is immovably fixed by adhesions or by the pressure of some morbid growth, the same curve may be used, provided that, if necessary, the organ has been reduced by the sound; if this cannot be done, a curve especially adapted to the displacement may be required.

In pregnancy, however, where the dilatation is for the purpose of inducing premature labour, the tube should be of larger size than would otherwise be necessary, or it should be flattened, to guard against laceration or a pressure too sharply defined. Near the close of gestation, when the cervix is nearly effaced, the tube, if circular, should be at least the sixth of an inch in diameter. The employment here of the ordinary flexible catheter, gum elastic, will generally be found preferable; as this, by means of its wire stylet, can be made to assume any desired curve during introduction. After the wire has been withdrawn, the flexible staff occupies so little space and is so yielding that it can occasion no injury to either mother or child.

For the ordinary syringe I have substituted the elastic pump of Higginson, as preferable in every respect. When attached, it forms with the remainder of the instrument a continuous tube; there is no unnecessary manipulation of the stopcock when the pump is in action, nor is there the liability of injecting with the fluid a quantity of air, which in case of the rupture of the sac might give rise to a serious result.[1]

For uterine dilatation a different mode of attaching the sac to its staff is necessary than in treating stricture of the urethra. A movable ring, bevelled on the edges and conformable in its position to any given case, is applied to the circumference of the staff. It should consist of gutta percha, which best answers the various indications, perfectly retaining its position without being too unyielding; yet easily moved whenever required, after softening by hot water. The sac having been slipped over the staff, it is fastened to it and confined within any desired limits by a pair of ligatures, the one above and the other below the ring just described; a third ligature is applied more externally, to confine the otherwise loose outer extremity of the membranous sheath.

[1] Reid, Physiological, Anatomical, and Pathological Researches, p. 578. Simpson, loc. cit., i. p. 719; ii. p. 73.

To the upper end of the staff a flexible tube is attached, of sufficient length, by extending beyond the bedclothes, to prevent any exposure of the patient, and fitted with a stopcock, by which the amount of pressure can be regulated at will. To the outer portion of this stopcock the pump is joined by a small rubber coupling, which readily permits its removal.

For the dilating agent a liquid is essential; it should be slightly warmed, lest too sudden a shock be communicated to the mother or fœtus; its temperature, however, soon becomes raised to that of the blood. The presence of air should be carefully guarded against, for the reason already given, sudden death having followed its introduction into the uterine sinuses; air has, indeed, been proposed in a French journal as a dilating agent for the os; but for this purpose its use is not only of doubtful feasibility,[1] but unjustifiable.

Previously to introduction the sac should be thoroughly discharged of air by reversing the ends of the pump, then well lubricated and wound smoothly about the extremity of the staff. As it becomes distended it successively assumes a fusiform and globular shape, while the further it is introduced the more readily it will retain itself within the uterine passages.

I will now proceed to relate a case, so far as I am aware the first instance in which fluid pressure, as such, has been employed for artificial dilatation of the uterus. The instance of the uterine douche, to excite premature labour, cannot be alleged in contravention of the above statement. That method, as usually applied, is confined to the vagina, producing its effect of relaxing and opening the cervix wholly indirectly, by reflex action, or if also by upward pressure, yet to a limited extent; Kiwisch, indeed, thought that the relaxation was merely in consequence of absorption of the injected fluid. In the rarer cases, where the stream of the douche is actually thrown into the uterus, the intention has been to produce detachment of the membranes, and thus alone does this method act; most of the fluid being immediately discharged again by the simple tonic pressure of the uterine walls. Similar reasoning applies to the ingenious combination by Graham Wier of the two plans of Hamilton and Kiwisch—its action being merely to the same end, "separating the membranes to some distance from the vicinity of the os;"[2] while the caoutchouc bottles that have also been used seem always to have been placed in the vagina, and to have acted merely reflexively. They cannot, therefore, be considered in the light of a direct uterine dilator.

Distension of a retained placenta by injections of water through the funis, as in a case of my own at the Boston Lying-in Hospital,[3] might seem somewhat analogous to the method now proposed, but it is not in any respect.

[1] Gardner, On Sterility, p. 148.

[2] Edinburgh Med. and Surg. Journal, April, 1855; "Case Book," p. 40.

[3] Boston Med. and Surg. Journal; Lying-in Hospital Reports, 1855.

CASE. Mrs. N——, aged 31, of West Roxbury, a healthy and robust woman of middle height, came under my charge, March 17, 1857; then in labour at the full time.

On inquiry, I found that she had previously been confined thrice, and that on each occasion the child had been removed by craniotomy.

Upon examination, the os proved fully dilated and the presentation normal; but the head had not yet entered the pelvic brim, though the labour had been present for many hours. After further waiting, no advance having been made, the long forceps were applied, but without avail. Complete anæsthesia was now produced, and the child turned; delivery of the trunk was effected, but no efforts were able to release the head, and it eventually became necessary to lessen it by perforation beneath the chin.

Although the patient was cautioned against a recurrence of pregnancy, she presented herself at my office in the latter part of November, 1858, again over three months gone; to choose between premature labour and the Cæsarean section.

On April 13, 1859, with the assistance of my friend, Dr. Nathan Hayward, of Roxbury, who was also with me in her former confinement, I commenced the induction of premature labour; somewhat over eight months having elapsed since the last catamenia, and the capacity of the pelvis having been increased as far as possible by mild cathartics and a sparing diet.

Upon examination, the os was found elevated, situated anteriorly, and the cervix almost entirely effaced. After careful exploration with the double stethoscope, it was decided that the placenta was attached to the left of the fundus uteri, and a little posteriorly.

9.30 P. M. The instrument above described was now introduced within and above the os, and the sac, previously adjusted to the size of a pigeon's egg, was inflated. No sensation of pain.

10.30 P. M. Instrument easily withdrawn; still distended to the full extent, the os having been correspondingly dilated. Upon being reintroduced, the size of the sac was doubled, and the patient then left for the night.

April 14, 8 A. M. Has had a comfortable night. Pulse 84; skin cool and moist. The instrument was again withdrawn, fully distended; by measurement the sac being 3½ inches in length by 2 inches and 4 lines in breadth. The diameters of the sac were now still further increased. As yet no pain. Fœtal circulation unaffected.

11.30 A. M. Pulse 96. The sac was found partly protruded into the vagina, but still distended. Upon its reintroduction, slight uterine contractions were observed.

12 M. Pains distant, but somewhat increased in severity. It was discovered, on allowing the sac to drain itself under the normal pressure of the uterus, that a pain could be almost instantaneously excited by refilling it, as was also the case upon its sudden discharge. During one of these experiments the sac was burst under the compression of a pain, and a new membrane was substituted.

2 P. M. Bowels cleared by an enema. Pulse 100. A slight sanguineous show upon withdrawing instrument, which was, however, reintroduced. Fœtal circulation unaffected. At no time has the sac afforded any offensive odour.

15*th*, 3 A. M. Patient awakened by the occurrence of smart uterine contractions, by which the dilator was expelled into the vagina. From this moment the labour regularly progressed; chloroform being administered during the pains.

8 A. M. Os fully dilated. Presentation footling, as had been hoped.

9 A. M. Membranes artificially ruptured; and with consecutively recurring pains the knees, breech, shoulders, and head were with difficulty delivered.

The child, a boy, lived for two hours after birth, and was lost in consequence of the compression to which it had been subjected while passing the pelvic brim. The effect of this compression was evidenced at the time by excessive and convulsive fœtal movements. The fœtus was 19½ inches in length, and its cranium 4 inches in lateral diameter.

Hemorrhage subsequent to delivery had always been excessive, and was so now; but the patient's recovery has been better than ever before.

In reviewing the above case, several points are noticeable; the unusual elevation of the os, into which a tent could only have been introduced with difficulty, the rapidity of dilatation, the freedom of the sac from offensive odour when withdrawn, the absence of discomfort to the patient, and the fact that exosmotic transudation of the fluid and consequent emptying of the sac did not take place. It would have been preferable that the trial case had been with a pelvis free from deformity, as the labour, though here but six hours, might then have been shorter, and the results of the treatment proportionately more striking.

I am satisfied, however, that the method is an excellent one, and that for the induction of premature labour, it approaches nearer than any other to the character of the normal process at the full period of pregnancy. It is equally well adapted for cases of rigidity of the os uteri, of premature rupture of the membranes, and for all complications where it is desirable to produce immediate dilatation and the completion of the first stage of labour.

Upon being introduced within the pregnant uterus and distended, the sac acts in a threefold manner; reflexively, as a foreign body—reflexively and directly, by separating the membranes from the uterine walls—and directly as a fluid wedge, by dilating the os; in each of these three respects, the effect of our being in proportion to the amount of distension applied. The dilatation, it should be noticed, is here *from above downwards*, while the tent dilates from below upwards.

In the case that I have reported it was noticed that, by suddenly evacuating the sac, uterine contractions were at once occasioned, just as frequently occurs upon puncturing the fœtal membranes; and that after a certain period they were also determined by rapidly refilling the sac, or by increasing the amount of distending force. The possibility of a greater or less degree of distension affords all the advantages, without the drawbacks, of a successive gradation of expansible tents; while, after the sac has been introduced above the os and filled, it cannot possibly be discharged or withdrawn, unless intentionally, until the requisite amount of dilatation has been effected. The sac is of course liable to laceration under great distension or during a pain; but this accident can with care almost certainly be prevented.

Being introduced by the staff, the position of the instrument, anteriorly, posteriorly, or laterally, in relation to the fœtal membranes, can also be determined as perfectly as where labour is induced by their detachment with the sound or bougie; a matter of no small importance.

Upon presenting the central mass of the elastic pump to the stethoscope, the continuity of the column of water remaining unbroken by the stopcock, I am quite confident that the sounds of the fœtal heart were rendered much more distinctly audible. This experiment is an interesting one, and in cases of premature labour may be made productive of a practical result. My friend, Dr. Keiller, of Edinburgh, has proposed a curved vaginal stethoscope, which, however, it is difficult at an early period of labour to bring in direct contact with the bag of amniotic liquid. The fluid column now described is but a further development of the same principle.

The indications for dilating the uterus where pregnancy does not exist, I have already adverted to in my previous papers. This instrument will be found of advantage in all cases where any other form of dilator can be introduced—if, indeed, the canal of the cervix is at all pervious. Should, however, complete occlusion exist, whether congenital or resulting from adhesive inflammation following injuries during labour, attempts at criminal abortion, amputation of the cervix, the improper employment of caustics, &c., its use should be preceded by a perforating trocar. In all other cases of cervical occlusion requiring treatment for dysmenorrhœal symptoms or to assist impregnation, the dilator will be found to avail; such are spasmodic constriction, general or polypoid congestion of the mucous membrane, hypertrophy and induration of the cervical tissue. If occlusion is caused by an uterine flexion, the case is one for the sound and stem pessary rather than for dilatation, unless the pressure shall have also organically narrowed the uterine canal. Other diseases of the neck of the uterus to which treatment by the dilator is applicable, vesicular polypi, uterine hemorrhoids, cervico-vesical and other fistulæ, will readily suggest themselves to the practitioner.

In affections involving the body of the womb, the need of an efficient dilator is no less evident, and I have no question that this instrument may be readily used in some forms of uterine disease hitherto considered beyond our aid. Congenital atrophy, for instance, and that other variety resulting from super-involution after delivery, to which the application of mere mechanical irritation by the sound or a galvanic stem pessary has thus far alone been possible, are both cases in point.

In the reduction of chronic inversion the dilator is also indicated; and for both diagnosis and treatment in all affections of the uterine cavity—fibrous and other tumours, whether intra-mural, sessile, or pediculated, carcinomatous disease, moles, hydatids, &c.; but the consideration of these points, illustrated by experimental cases, I shall reserve till a future period.

BLUE HILL, MILTON (NEAR BOSTON), May 16.