On the muscular action of the pregnant uterus.

I propose to treat in the following pages of the muscular action of the pregnant uterus and its appendages, and of its effect upon the ovum. I undertake the task well aware of the numerous difficulties I must necessarily encounter in such an enquiry. For in the whole field of medical science there is perhaps no question equally important and equally neglected. Such a consideration might well deter anyone, and especially a beginner, from probably so complicated a question. But I believe that the difficulty is more an apparent one than existing in reality. The enquiry it appears to me is not only manageable, but promises to prove sooner or later a question as fertile for scientific researches as any one in physiology.

I shall treat the subject in the following three divisions:

I. The muscular action of the uterus, as far as it is concerned in the conduction of the ovum.

II. The action of the uterus during the residence of the foetus in that cavity.

III. The expulsion of the foetus.
I. The Conduction of the Ova.

The ovum, after leaving the ovary, is taken up by the Fallopian tube, and conducted through it to the uterus. The motion of the ovum has been said by some authors to depend merely on its vitality, by others on the ciliated epithelium, by others again on muscular contraction. But to the first of these opinions it might be justly remarked, that the vitality, at least as far as we are able to judge, is not at all in proportion to its liability of being retained in the tube. The impregnated ovum may become fully developed and never reach the uterus, and on the other hand, ova may be and not unfrequently are thrown off by sterile women.

The movement of the ciliated epithelium, as assisting the conduction of the ovum, must still be considered a matter of great doubt, some physiologists maintaining the movement of the epithelium to be directed towards the uterus, others towards the ovary.

But even if their direction towards the uterus were undeniable, their effect could only be considered necessary but not essential, not as if they were not sufficiently powerful to...
propel the exceedingly small ovum, but, because the tube in its structure contains muscular fibres, which we cannot conceive to be there without any function being assigned to them, for an organ not nourished will soon waste away, and there is no nutrition without activity. The only function of the tube we know of, is the conduction of the ovum, the only action of muscles is contraction, it is therefore reasonable to suppose, that muscular contraction will be used as means for conveying the ovum.

The precise nature of the contraction of the two sets of muscular fibres, is not yet distinctly determined. It is however probable, that more especially the circular fibres act, propelling upon the ovum, but that their action is adjusted by the longitudinal fibres, which by stretching the tube give to its canal a more direct course. But be that as it may, the propelling powers must always be directed towards the uterus, and as these powers are emanating from the muscular coat, and probably with equal intensity from every part of its surface, the acting forces must be directed in oblique lines joining in the central part of the canal.
neares to the uterus than at the place of
origin.

Thus arrives the ovum at the crisiunatum
vium, which— it is said by some authors— is shut
up by the decidua. This membrane, being drawn
inwards and constituting the decidua reflexa,
takes up the ovum. Others however main-
tain, that the or uterinum is open and that
the ovum, being taken up by some fold of the
decidua gives rise to new deposition of matter
by the irritation if occasions. That new for-
mation is the decidua reflexa.

Without entering into any lengthy discursin
of this subject, it may suffice to remark, that
the former of these opinions is in direct oppo-
sition to the facts as seen in examinations,
the, as having been found in all cases, which
are— it is true—not very numerous, to be pedoopen. (1)

According to the second opinion above men-
tion the ovum, after arriving at the uterine crisiun of
the tube, is here allowed to take the course it
pleases, either to remain quietly on the uterine
extremity of the Fallopian canal, or to ascend
upwards to the fundus, or to descend downwards
to the crisiunum internum? Nay even some ad-
(1). Sämtliche Forschungen und Entwicklungsgeschichte
gehalten in der Universität zu München 1848-49

Compares also J. Lee's Clinical Lectures and Hunter on the gravid uterus.
vocates of the latter explanation admit the great probability of the event, descending to the most dependent part of the uterus; and, although well acquainted with the rarity of such an occurrence, they find sufficient reason to adhere to their own explanation, effecting, that the other excludes the possibility of the formation of placenta praevia.

And such an objection can justly be made, and is perfectly sufficient, to abandon the former opinion altogether; but although the second supposes explains the formation of placenta praevia, it is wholly incapable, to assign any reason for the rarity of such an occurrence. If the seat of the placenta be dependent on casualties, the fundus and the mouth of the womb would equally often serve for that purpose.

We have stated above, that the conduction of the ovum through the Fallopian tube is effected by the muscular action of the tube, we ought now to consider the function of muscular fibres somewhat more closely. We know, that muscular fibres are possessed of contractibility i.e. that their elements have the power of changing their mutual position if that power originate in the muscle or be conveyed to it through the medium of the nervous system.
is a question wholly indifferent for our purpose.
It suffices to know that, by muscular contraction
something more is effected than a mere change in
the position of the muscular elements. The power
generated in that process is not only sufficiently to
bring on a new arrangement of the molecules, as it is
done by the chemical power of decomposition, but
there is a surplus power generated, which cannot
be used, neither to bring on that change more
rapidly, nor to make it more distinct. Nay even
the amount of visible contraction is not at all
proportionate to the amount of surplus power
generated, and, although in some measure dependent
on the number and strength of muscular fibres,
the latter are not the only conditions to regulate
its intensity. An athletic man for instance
may crack to-day in his hand a pretty hard stone
to-morrow suffering from simple headache he is
unable to crack a nut. He uses the same
muscles, he lends his hand in the same way to
the same point, but he does not succeed.
Or take a dancer for instance labouring under some
emasculating disease and confined to his bed for
many a long month till him to stretch his leg
and you will see one straight line from hip
As too as if he were still on the stage. Take him then from his bed, ask him to stand on his feet — and he falls together. But he is not in want of nervous energy, nor at a loss to use his muscles with the greatest ability and in consequence with the best advantage.

Or think of a labouring man, who is daily in the habit to carry fifteen, twenty stone on his back, promise him thousands' riches if he carry thirty, five and he will starve. What is the conclusion we draw from this?

"The amount of surplus power generated, is not proportionate to the amount of visible contraction, but always dependent on the combined influence of the nervous system and the more or less developed state of muscularity."

We may even go further and justly doubt any dependency of muscular power on visible muscular contraction. In the terms of the muscle: active contraction of the fibres is — to say the least — an another question, but that in this state a force emanates from the fibres has no one attempted to deny. But, on the other hand, if tonus be affected by vital contraction, it were the most striking proof for the truth of our allegation. To slight as this power may be, which becomes apparent in every moment of time, it is obvious, that as the tonus may remain
tained for an almost unlimited period, the whole amount of power will suffice by far any power which might be generated by the most energetic but momentaneous contractions. (2)

Most muscles of the body, and perhaps all, are not only generators of power but in the same time mechanical contrivances. It is obvious that their mechanical effect will be greatly influenced by the more or less instantaneous play of the machinery, but it must be remembered in the same time, that even by the most perfect mechanical contrivance not the smallest atom of power is gained. The progress of the mechanical sciences has shown how to liberate powers but not how to produce them, just as the most refined Chemistry will never show how to produce an atom of oxygen. The mechanical arrangement of the muscles must therefore be limited only to regulate the time and place when and where action becomes apparent, but it has no influence whatever upon the amount of power which is brought into play.

The last point we have to consider in regard to muscular action is the dependency of its direction on the nervous influence. The peristaltic and antiperistaltic movement of the intestines gives us an instance of this
[2] Compare Mr. Shon's views on the function of the fibrine in blood and on vital forces in general.

Dr. Shon's Lectures on the Practice of Medicine delivered at the University of Edinburgh
1830-31. (Mr. Mood's notes)
(3) Dubre; Part des accouchemens. Paris 1844
Vol. I
kind. The same muscles of the stomach, which under normal circumstances propel the contents from the cardiac to the pyloric extremity, will under some alterations of the nervous influence act in the opposite direction from the pyloric to the cardiac.

At a new time, that we look back to the event which we have left on its arrival at the origium entericium tubae. We have stated above, that the event has been conducted whether by the muscular action of the tube, that all the forces emanating from its fibre must be directed obliquely to the central line and join the latter at a place nearer to the uterus than at the point of origin. The action of the tube is more taken up by the uterus, which showing the same muscular arrangement, and acting under the same nervous influence or under the same idea, the contraction of the utus will contract just in the same way as the tube, and generate forces emanating from its muscular coat and directed towards the cavity. Or the uterine tubes the differences in the amount of muscles above an imaginary line, which would continue the direction of the tube, to the amount of muscles below are about existing—very slight. But even a slight difference will here suffice to decide the direction of the event, if it have to ascend upwards to the fundus, or to
descend downwards to take its seat in the body of the uterus near the solarian orifice. Whenever it takes its seat, there it will be kept by the same force which conducted it thither, as long as that muscular force is acting. But when either no difference exist in the neighbourhood of the orificium uterinum, or the superabundance of force coming from the lower part is only sufficient to counteract the gravity, the ovum will proceed in the imaginary line above mentioned. But the further it proceeds, the more it will see the proportion of muscular action from below to muscular action from above, and the surer it will be seated in the fundus.

The ovum, when coming to the walls of the uterus, is here imbedded into the decidua; and kept in its position by the muscular action above decidua and by the formation of the decidua reflexa it becomes attached to the uterus.

The conduction of the ovum being fulfilled, the ovarian and tubarian action subsides, and a new set of phenomena begins.
II. The muscular action of the uterus during the residence of the fœtus in that cavity.

In the foregoing chapter we have considered the conduction of the ovum and the share taken in that process by the uterus, we have now to consider the uterus as that organ, in which the fœtus is developed. But we may first remark, that the development of the fœtus in utero cannot be considered as a second stage of its tubarian life, but that these are two wholly different processes, which in regard to the place in which the greatest number of animals are much more distinctly separated than in the human species. It is therefore quite unjustifiable to consider the Fallopian tubes as mere appendages of the uterus, or the uterus as a mere prolongation of the tubes. The action of the uterus, although in some measure auxiliary to that of the tubes, as we have shown above, in the conduction of the ovum— is essentially directed towards another purpose. Its characteristic function is to carry as that organ, in which the fœtus becomes developed, so far as to make it for extra-utrine life.

The uterus is a muscular organ, and in ra...
...ing in size during the whole process of pregnancy. The growth of its muscular fibre must not be constantly going on. But growth is nutrition and nutrition is dependent on action; the muscular fibres of the uterus must therefore be in activity. Contraction is the only function of muscles we know, and we have seen above, that contraction always implies liberation of power, the intensity of which is not dependent on the more or less active change in the position of the elements of muscular fibres, as far as we can judge of it by sight. On the same principle we pointed even to the probability, that muscular may be generated without any visible change in the muscle. It is consequently wholly indifferent for our question if the uterus during pregnancy show muscular contraction or not.

It is reasonable to suppose, that the uterus as a muscular organ will have its fibres arranged in such a manner, that they act most advantageously or to speak technically— that no power is lost. As the muscular power of the uterus is directed towards a cavity, and the forces are emanating from every part of its walls, loss of power can only be avoided when no two forces counteract one another; that...
is, when all terminate in one centre. That central point we do not conceive to be the mathematical centre of the cavity of the uterus—which could only exist, if that cavity were a globe; but we mean that point, up to which the forces emanating from the muscular fibres might reach or overcome a certain amount of resistance.

As a power in reality cannot cease acting, only expended, it is obvious, that in that central point, the amount of forces must be = 0, and when we consider those forces passing through the same medium, and consequently liable to the same expenditure, it follows, that every concentric globe will enclose the same amount of force from every particle, which generates muscular power. It is obvious, that only if the uterus be a globe, the same surface could generate the same amount of force; and on the other hand, that the amount of muscular power generated by a given extent of surface will be proportionate to its distance from the central point.

When now in fig. 1, A represents the wall of the uterus, B the decidua vera, C the central point and CD, CE, CF the direction of the muscular powers, it is obvious, that the latter will have a tendency to
propel the ovum towards C. And that would not
decidedly be effected, if the ovum—instead of being
attached on the walls of the uterus—should happen
to be in the middle of the uterus, as represented by
X. But the effect is quite different upon the ovum,
which is attached to the uterine walls and sur
rounded by the fluid contents of the vagina re
flexa, and which is not growing in one particular
direction but equally in all and consequently also
along the uterine parietes. For the forces meeting the
ovum have to pass through the fluid, to reach the ping
whether they are directed. As in an enclosed fluid
on which any force is applied, the pressure exerted is
equal in all directions, it is obvious, that only those
forces, which become apparent externally to the ovum
and its envelope, will be able to produce a locom
otive effect. But most of the forces, which come in
contact with the ovum, do so at their place of origin
and are consequently wholly ineffectual, as regards lo
comotion. Only a very small extent of surface, not
in immediate contact with the ovum, will supply
locomotive powers—provided the ovum protrudes into
the cavity, as it is generally represented, with a con
vex surface. But even these forces might be neutral
ized by the Hydro-urion, which fills up the
favity between vesical reflection and vera, but in the whole, we cannot deny that such an occurrence appears to us rather improbable.

It is possible therefore that in this stage some slight degree of danger exists, that a separation of the ovum from the walls of the uterus might take place, but that danger is most effectually obviated as soon as the ovum by its growth has reached the central point. Here the fluid bag meets with forces coming from the opposite directions, which are more than sufficient to neutralize the forces by which it was previously acted upon. If now the ovum, as it is commonly the case, has become attached to the fundus or the upper half of the body of the uterus, the force which acted upon it, gave to it, if any direction, the direction downwards. But the forces with which the ovum has now come into contact, equally directed towards the central point, will impede to it the direction upwards. And that direction will be the more readily taken, as the ovum, increasing in size, is soon in immediate contact with every part of the wall of the upper half of the uterus, and the locomotive effect of forces coming from that part consequently annihilated. A further consequence of the same circumstance is, that the ovum rising within the uterus
will necessarily raise the uterus, which is soon brought to exceed greatly the cavity of the pelvis.

Simultaneously with these alterations in the position of the uterus, alterations in its shape occur. From a pear shape it has passed to a globular form, and lastly, especially by the changes which are effected in the neck of the uterus— it takes an ovoid appearance. But as soon as every particle of the muscular tissue of the uterus has been called upon, to partake in the formation of the cavity, further development will no more be attended by alterations in the shape, provided that no part of the uterus be acted upon by a stimulus peculiar to that part only. The ovoid shape of the uterus, on the other hand, corresponds with the shape of the ovum, and the uterine walls will therefore closely surround the latter. The consequence will be, that all forces emanating from the muscular coat come immediately into contact with the ovum and the surrounding bag of membrane, and are consequently deprived of all horizontal effect. There is now no force in action, which might propel the ovum and the uterus upwards; moreover, to counteract the gravity, the uterine tumor must needs subside. The subsidence of the abdominal tumor gives the first indication, that
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Labor is approaching. The uterus now again encloses in the pelvis, without the means of changing position or shape, will soon be arrested in its further development. The stimulus however to its further growth is not removed; the cranium in its interior tends to increase in size, and its expulsion thus becomes an absolute necessity.

It is now right to consider the different opinions which have been brought forth to explain the supersession of labor. These explanations may be conveniently arranged under four heads. The cause of labor is believed to rest firstly with the fetus, 2ndly with the uterus, 3rdly with the woman, and 4thly it is supposed to be dependent on a certain still undefined law of periodicity.

1. Labor is induced by vital action of the fetus. Setting aside the different opinions brought forth to explain by what circumstances the fetus is induced to make its exit, it is obvious that when the fetus happens to die before delivery, labor cannot be called forth by it. For such cases, the fetus is generally known off from the uterus ten or fourteen days after death has taken place. But if the fetus should happen to die just before delivery, the date of the commencement of labor will not be altered at all. (Dr. Simpson) (3)

2. In regard to the uterus affording the exciting cause
of labor, three opinions have been held. According to one of these, labor was considered as excited by the elastic retraction of the over-distended uterus. But the dilatation of the uterus is firstly not prompt, and secondly over-distension - if at all occurring - would certainly appear much sooner in cases of double and triple birth - otherwise to the development of the os uteri the retarding cause of labor. But the fibres of the os uteri are sometimes more, sometimes less, developed, and on the other hand even expansion of the cervix does not necessarily interfere with the punctuality of labor (Dr. Simpson). There is still a third opinion, which requires to be noticed under this head, viz: that the uterus just at full time has acquired such a development and organization which enables it to expel the foetus. This latter explanation is obviously based on wrong observations, for the uterus is at seven months certainly not less able to expel the ovum than at the full term.

3) Since the ovular theory of menstruation has been more generally adopted, and the close connection between menstruation and ovulation established, it must be considered a natural consequence of the doctrine, that an occurrence, which from the remotest time has been held to bear a decided relation to the menstrual period, is now regarded as con-
sequent of changes occurring in the ovary. But as long as we are unacquainted with any change in the ovary supervening at that particular period, we cannot derive an explanation from the above theory. On the other hand, the close relation between the period of pregnancy and the intervening between the mensturations, seems to be more an apparent one than existing in reality.

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It appears from this table of Schweig (in which we have intentionally omitted the cases which occurring in mere instances might be considered by a mere suspicious observer as deviating from the state of health) that only one-seventh (\(\frac{1}{7}\)) part of healthy women menstruate on the 28th day and half as many as early as on the 25th day. The birth menstrual period would therefore only in 5% coincide with the 25th day, in half as many the same 28th day would be 5 days after the eleventh menstrual period.
It is obvious therefore, that the punctuality of labor cannot be dependent on the occurrence of the tenth menstrual period—setting wholly aside, that labor does not commence on the 250th day after the appearance of the last catamenial blood, without eighty and some days after that term but that labor will come on with equal punctuality in women who did never menstruate.

Dr. Tyler Smith goes still much further in the inference he arrives at in his catamenial periods. For him labor is not only coincident with or consequent of but the tenth menstrual period itself accompanies with the same sexual excitement. (258) As this author considers coitus and menstruation as perfectly analogous processes, it is more difficult to understand, how he could arrive to such conclusions. For although in many animals the interval between two coitations is a twelfth month, the term of pregnancy is considerably shorter. As for the sexual excitement arising during labor, we must profess that we have great doubts on this point, which certainly the instance alleged by the author cannot destroy. The hen in laying shall manifest great sexual excitement by calling the cock. The laying of the egg however bears no analogy to labor, and can only be compared, if comparison can be dispensed with, to the passage of the ovum through the Fallopian tube.

Dr. Simpson, whose most valuable remarks in
(5) Mr. Taylor Smith on Divination and Rhetorics

London.
regard to the different explanations of the cause of labor we have pretty closely followed, in the preceding consideration, (especially under No. 2,) adds two more observations, which he declares to contain a general objection to any explanation, which might overwrite the supervision of labor to causes created by pregnancy. The first of these observations is the following: Animals having admitted the male during the time of heat but without secrecy -- at the time, when labor in the impregnated one would set in, prepare the nest, but the animal and the inclination for the young is so extremely great, to induce the animal to steal the puppies of other bitches or even the young of a cat. And spurious pregnancy. Dr. Simpson remarks, is not without analogue in the human female.

As conclusive as that objection at first sight might appear, it must not be forgotten, that in the human female the occurrence of spurious pregnancy cannot be considered in any way more astonishing than many other of the innumerable forms, under which Epistaxis appears. In the human female, where we are acquainted with the various arrangements of mind, with the influence of fancy, we cannot be at a loss to account for the strange phenomenon of spurious supervision of labor, as we are quite well aware, that the individuals by their knowledge of the relations existing between pregnancy and labor, are capable to regulate the fancy and to direct the occurrence. In
Short, in the human female we conceive spurious labor to be mere consequence of spurious pregnancy, and it is not in any way more astonishing that a woman after the ninth month fancies to be in labor as if in the twelfth week she would suppose herself to be three months pregnant.

It might still be questioned, if not the same remarks be applicable to animals, and certainly there exist some curious facts, which do not justify a direct denial. But we may well refrain from any inference. For in animals the period of conception and of labor is not as variable as in the human female. The time, when conception takes place and when labor sets in, is defined distinctly and equally for the whole species. It is probable therefore that these two periods do relate not only to the individuals but to the whole species in toto. Animals we might say are consequently exempted from the necessity of calculating the term of pregnancy. It follows, that if animals could only fancy to be pregnant, labor will supervene in them with equal punctuality as in the human female.

And there is no reason to disbelieve such a supposition, if an animal may have conveyed to its nervous system the impression of being satisfied after having filled the stomach with wood and chalk and other substances from which it cannot derive any nourishment, why should it not be equally liable to fancy itself pregnant after unsuccessful
16) We might add, that the crying of the animals cannot be considered a symptom of labor, as it is not an infrequent attendant on mere sexual excitement.
The above stated objection consequently proves only, that the period of labor in animals is coincident with certain nerves unconnected with impregnation, and that a state of excitement in the generative system may exist independent on the condition of uterus in every. Of what kind that excitement may be, we do not know, but the most prominent symptom we are acquainted with, the extreme inclination for the genitae, bear no relation to labor, and are not therefore not be induced to it, the supervision of the latter. (b)

The second general objection of Dr. Simpson is the following: In some animals, and not rarely in the sheep, when labor is obstructed and parturition cannot be effected, the pain after a while die away, and the foetus is retained forever in utero transformed into a shapeless mass.

Dr. Simpson hence infers, that neither uterus nor foetus, nor every can be the excitor of uterine contractions, as none of them is capable of effecting delivery. And refining that objection more; quite conclusive, if the uterus could only require the stimulus to expel the foetus, for then its action could not cease, before that effect be accomplished or the organ itself destroyed. But if the expansive effect of uterine contraction be dependent on a distinct relation between foetus and uterus, any disturbance in the relation may lead to cessation of labor.
We see therefore no necessity of referring the cause of labor to circumstances external to animals,avy or fat. To a visible, still undefined, law of periodicity has been pointed to, but as that—up to the present time at least—is nothing but a mere term, it cannot furnish us with an explanation. Nay, we believe, that we are not at all entitled, to look towards that point, as whence light shall come. For in almost every instance, where science has more closely investigated into the relative existing between the different universal agents and particular occurrences, we have come to the conclusion, that the influences once confidently believed to be exerted by the former are in reality not existing. The much spoken of, almighty influence of the moon and of the periods of the year, is now reduced to very limited boundaries.

It will therefore be right for us, to be on our guard, and to attribute any occurrence only with reluctance to any cause, which, for a long time to come, will remain uncertain, and which besides are not by liable to fail, as other forms of more limited extent.
(F.) Dr. Henderson’s Lectures on General Pathology.
III. The expulsion of the foetus.

We have seen in the preceding chapter, that at the full term of pregnancy ovum and uterus have each arrived at such a state of development that the further growth of the ovum can no more be attended by corresponding changes in the uterus, nor is the uterus capable of undergoing any change without encroaching upon the ovum. The harmony, which previously existed between ovum and uterus, is now destroyed, the development of the one organ, previously the condition sine qua non of the growth of the other, is now hostile to the same. The ovum, in short, has become a foreign body to the uterus and alike to every living tissue the uterus reacts against that foreign imprecation. Action of a muscular organ, equally with reaction, is contraction of its fibres, but the two processes are thus far different, that the former may perhaps be accomplished without physical effort or at least physical change. In reaction however mechanical changes are inseparable from vital effect. It is as if vitality unprovided against the imprecation call up all their forces in attendance to encounter the unforeseen occurrence.
Instances of this kind are apparent wherever injury is done to a part. In the kid artery, the blood coagulates above the ligature. It is surrounded by living tissue, in connection with the blood column of the whole body and consequently not deprived of any condition, which is essential to its life. The coagulation of the blood is accordingly a vital act, or at least, the physical attendant of a vital occurrence, and if vitality is lost in the coagulum, death was subsequent to coagulation, not the cause of it.

Mechanical or physical changes are equally manifest under the impression of reaction in every other part or tissue. Accordingly whatsoever may have been the changes undergone by the uterus during the whole period of pregnancy, or if there were any changes at all attending the production of its muscular power, it is obvious, that as soon as that state has arrived, which is now under our consideration, mechanical changes cannot be dispensed with. In short, the action of the uterus is attended by shortening of its muscular fibres by diminution of its cavity.

Then Fig. X. represents the walls of the uterus.
B. The bag of membranes and F. the fetus, the body of the uterus, in order to keep its bulk, will contract in the direction of the lines AE, EC, FG, FC, FG, the cervix however in the direction of the lines AO and PH. That is as well a physiological necessity as corresponding to its anatomical arrangement. A physiological necessity, because the cervix is contracting in the direction of the dotted lines AC and OE would necessarily rise during contraction, which is not the case. It corresponds to its anatomical arrangement, as the ac uterus is the centre of circular fibres.

The lines mentioned above as indicative of the direction, in which the muscular fibres contract, are naturally also indicative of the direction of the pressure exerted. When we now divide the body of the uterus into pyramids, represented in the longitudinal section by FDE, ECD, VEHE CMC, and HED the contraction would manifest itself by shortening the axis of the pyramids or in other words by bringing the base nearer to the apex. There is however one space left in the cavity of the body of the uterus, which a plane laid across the entrance to the cervix will make a pyramid, where no such action is going on, as
prepare exerted against the apex, for the uterine tissue forming the base of the other pyramids is here wanting.

When now labor is commencing, the first impulse of the contracting uterus will be imparted to the Liquor Amnii. The direction of the pressure it exerts is towards the centre of the cavity, but as we have shown in one of the preceding chapters, any power acting upon a fluid has no other effect than to displace it. The Liquor Amnii driven away from its situation will in consequence, irrespectively of the direction of the forces which are the source of its locomotion, escape to that part, where no such forces are in action; that is as we have seen to the space represented in Fig. II by ABCD, and which is situated immediately above the uterine. As the contraction of the uterus is still proceeding, the extent of the cavity consequently increased and the contents the same as when the uterus was of greater size, it is obvious that the increasing pressure will protrude a loop of the amniotic sac through the exit.

The protruding bag of membranes is according to the opinion of almost all authors of great
assistance in the dilatation of the os. As to the
means, by which this assistance is afforded, the
question is still open to conjectures; the notion which
most generally prevails is, that the bag of membranes
acts on the principle of the wedge. This opinion
is however erroneous, which we shall endeavour to prove
presently.

If the action of the amniotic bag were on the prin-
ciple of the wedge, it is obvious, that—the force remain-
ing the same—that wedge will be the most effec-
tual, which is of the strongest material or in
other words, the tougher the membranes the more
effectual. This is however so far from being true,
that toughness of the membranes is universally
admitted to be a cause of delay.

On the other hand if the amniotic bag were a
wedge, its effect would be the more readily accom-
plished, the less strong the part is, on which it acts.
But this also is opposed to experience, and for
this reason it has become a general practice of
obstetricians, to warn their pupils, not to expect speedy
dilatation of the os from the thinness of the os
alone.

Thirdly if the amniotic bag were acting as a
wedge, its mechanical effect would be dependent
on its progress, and it would be quite ineffectual if not advancing. That is equally opposed to experience, for pains may be quite successful in dilating the size of the protruding bag of membranes remaining the same as before the pain.

A more close consideration of the action of the wedge in general will further show, that the application of this mechanical contrivance for the dilatation of the os cannot be unattended by danger or must, at least interfere with the natural process.

When only III. ABC represents a wedge, A the direction of its force, EF the opening to which the wedge is applied, and ED, EF the margins of this opening, the direction of the forces which become apparent at E and F will then be found in erecting perpendiculars upon the sides AC and BC resp. in E and F.

EG and FH of our figure represent the directions. It is obvious that the resistance given by the walls of the uterus will be equally represented by EF and FH. If now the wedge be suddenly removed. AC and BC will have a tendency to ascend. Suppose now HE and FT represent the os uteri, ABC the amniotic bag, and W the walls of the uterus, the os uteri would have a tendency to ascend and really ascend, when the action of the bag was removed.
either by cessation of a pain or by the breaking of the membranes. But that is certainly not the case.

The mechanical action of the bag of membranes is based on a perfectly different principle. If we suppose that the first pain have produced a loop of the bag of membranes through the os uteri, and we have now a new pain commencing, the fluid, which is collected in the lower part of the uterus, and in the cervix, will be pressed upon by the proceeding contraction from above downwards. The equilibrium of the fluid is in this way destroyed and undulations arise, which traverse the whole fluid and consequently pass also through the os uteri. Undulations passing through an opening become reflected, ed ed, the extremities, which have passed the margins of the orifice, receive a circular inflexion from these margins and pass off laterally. The direction of the forces, which thus act upon the os might accordingly be represented in the following diagram.
Upon the whole we believe, that the mechanical use of the bag of membranes, in the dilatation of the os, is very much exaggerated. It appears to us, that the principal use of this contrivance, is the elastic cushion it affords, which by the simple arrangement described above, is capable of retaining the dilating effect, which itself is accomplished by other means. It is obvious, that an elastic apparatus will for such a purpose be most excellently adapted. For its elasticity will enable it, to distribute its action equally, in regard to space and time, and in the same degree efficient in retaining the dilatation of the os as the most unyielding body, it is not so likely to be followed by the unfavorable consequences, which under other circumstances would be unavoidable, if the action became intense.

The dilatation itself however is in all probability effected by other means, although we do not deny that the membraneous bag and the current of the fluid contained therein are also in this part of the process of active assistance.

When in Fig. IV is represented a vertical section of the uterus and ABCE represents the walls of the uterus, AD and CE the walls of the os, then ABDE will now have been above not contract equally as every
point, and as AD, PE do not ascend during contraction, it is obvious that the deceasing size of the cavity will be least dependent on the contraction of the lower part of the uterus and to the greatest extent on the contraction of the fundus, or in other words, F will approach proportionally much more to F than either AD, or PE, as is represented by ABC. When we now suppose the uterus divided by many vertical sections into numerous bands of uterine tissue and the same figure IV representing one of these bands, the effect of an uterine contraction would be equally represented by AB'C, and when we straighten FBB'E as is done in Fig IV a', ABC will show all illustrative of the manner in which ABC contracts.

It is now apparent, that AB'C in contracting follows an undulatory movement, and that forces are acting upon ABC tending to produce undulation. As AD, and PE are continuous and contiguous with AB'C, and A to C nodal points, it is obvious, that these same forces will impede to AD and PE the respective directions of AF and CE. Yet is true, that the undulation ABC, AB'C never appears complete, but that does not depend on the conditions of undulation being wanting, but on the process being interrupted when in the stage G AB'CF.
In regard to the causes which give rise to the in
perturbation just at this stage of the process, only this
much can be said, that they are obviously connected
with the innate power of muscles, contractility. The
present state of knowledge does not enable us to venture
an hypothesis, how that action be produced.

The question, where uterine contraction commences,
is closely allied to the preceding consideration. The
opinion of its commencement in the fundus over its
origin probably to the more decided and consequently
sooner felt advance of the fundus compared to the
other parts of the uterine wall. The notion of its
commencement in the neck however arose in all pro-
ability from here being the nodal point, i.e. point
of rest, which distinctly contrast with the other
advancing part of the wall, and thus led to
the belief, that here the pains originate.

It is almost unnecessary to state, that for
us the whole question has no existence.

We come now to the last point, which we intend
to treat at present, namely the periodicity of the uter-
ine contractions. There is perhaps no question in
the whole physiology of parturition which is
more involved in darkness than the present one.
The periodicity has been ascribed to the rhythmic
Mueller's Handbuch der Physiologie des Menschen. Vol. II.
action of all muscles, when under the influence of
the sympathetic. But although the experiments of Dr.
Simpson make it, exceedingly improbable, that uterine
contractions are in any way dependent on the cerebral spinal
nerves, it must not be forgotten that—as it is admitted by
Dr. Simpson himself—the experiments alluded to cannot
yet be considered conclusive. We must add, that even
if the contractions were dependent on the sympathetic
only, it will still be questionable whether that influence
suffices to explain rhythmic contraction. Various rea-
sons have been given for such an explanation, but we
cannot consider them conclusive. In doubt, it is very
improbable, that a muscle shall loose and regain its
irritability a hundred and more times in one minute
but is it not equally improbable that nervous influence
should be interrupted so often in the same space of
time. The most able advocate of the opinion, that sym-
pathic contraction is dependent on the state of the nerva
—we allude to Johann S. Mueller—supports his cause
by an hypothetical explanation, the probability of
which has so greatly favoured the adoption of the
opinion, that we might justly be allowed to direct
our objections against this hypothetical exclusively. [8]
The circumstance, that numerous ganglia are
met with in the course of the sympathetic nervou
gested to Professor Mueller the idea, that these ganglia might in regard to the nervous fluid have a function similar to that of semi-conductors in regard to electricity. If so, the nervous fluid might be considered as continually evaporation, but collected by the intervening semi-conductors it will be liberated from their hold and act upon the muscles in intervals.

With such an hypothesis, we admit, it might be explained why the heart, for instance, is beating seventy times in a minute with equal force and equal rapidity and at the utmost it might suffice to explain an increase or decrease in the rapidity of the heart action, but it is quite untenable when we come to consider, that also the strength of the heart action might be suddenly altered unconnected with changes in the muscularity of the heart.

We have somewhat enlarged on this point, because we consider it of the utmost importance that no explanation be admitted in the science of medicine as long as it can profitably be avoided, which puts any question beyond reach of exact investigation; if we were to admit an explanation like the preceding, we would be obliged, to abstain perhaps for ever, but for many years at least from an enquiring the peculiarities or morbid arrangements of the rhythm
To resume: the question not only how rhythmic contractions are produced, but also whether rhythmic contractions are in any way connected to the organic system of nerves, is consequently still open to investigation.

We have intentionally omitted, to speak of the peculiarities in the periodic return of pain and their duration; and the laws relating to them, as eliminated by M. Lacombe, because we consider an enquiry relating to it far beyond reach of the present state of knowledge, provided uterine contraction be considered rhythmic in that sense, which is most commonly attributed to it.

But when we conceive such uterine contraction as excited by its own stimulus, we might perhaps venture to explain the law of M. Lacombe above alluded to. Our explanation is naturally based on hypothesis, but we do not conceive that to be an objection. If the hypothesis prove untrue, the explanation will fall; and can consequently not lead to deception. This is not the explanation, which is based on an hypothesis, that is to be avoided, but the hypothesis, which completes an explanation; for the latter seems to be unshaken, when its appendage has dropped.

All the conditions, which are to be fulfilled by an hypothesis, are: probability, and we believe...
that the following one is possessed of that property.

We suppose that vitality imparts a certain tolerance against foreign invasion to every living part or tissue, which tolerance is in proportion to the amount of vital forces. In the same time it prevents the occurrence of mechanical or chemical changes equally in proportion to the same forces. (1)

If this, it follows, that at the beginning of labor where vital forces are most vigorous, the mechanical changes occurring will be least intense. After the pain vitality is diminished by the mechanical changes, which did occur, reaction will consequently sooner take place, and the amount of mechanical changes accompanying that reaction will be greater. On the third pain coming on vitality is still less, reaction still sooner and mechanical changes still more intense and so on.

The above will explain the law of M. Saccombe, that the interval between the pains is in inverse ratio to their duration.
(9) Compare also the modern theories of inflammation.
We have endeavored to show in the preceding pages that the muscular action of the uterus is the main agent.

10th in conducting the ovum and securing its attachment at such a point of its walls, where its development is attended with the greatest safety, for the fetus itself as for the mother.

20th in producing the expulsive effort at full term. Both in effecting the delivery.

We have in the same time tried to prove that the amniotic bag, in assisting the dilatation of the cervix, is insufficiently by the distention of its fluid contents, that the main agent in the dilatation itself however is the same contraction of the uterus, which produces the expulsive effect and which we have pointed to an explanation of the peculiar relations existing between the duration of the pains and their intervals.

We quit the subject with the wish, that if the remarks which we have given prove valuable, it might not be considered as proof of the ability of the subject itself, from which we are convinced a more able observer might elicit many an important fact regarding the physiology of parturition.