

*On the Signs of Pregnancy during the earlier months of Gestation : and on the existence of a new Animal Principle in the Urine during that State.* By JAMES STARK, M. D., Fellow of the Royal College of Physicians, Edinburgh.

Most of the writers on midwifery and on legal medicine state, that pregnancy cannot with any certainty be detected till the movements of the foetus are distinctly perceived within the womb. This does not, in general, happen till the fourth month is completed, or even later. Hence Dr Gooch† states, that we should “never give an opinion till six months have elapsed;” Beck, ‡ that “an opinion should seldom be hazarded before the end of six months;” Blundell§ would rather “wait ten or twelve months, than give an erroneous opinion;” whilst Orfila,|| Foderé,¶ Mahon,\*\* Capuron,†† Burns,‡‡ Velpeau,§§ and a host of others, all agree that no certain sign exists by which pregnancy may be detected before four complete months have elapsed, and

\* Foedera, Conventiones, Literae et cujuscunque generis Acta Publica inter Reges Angliae et aliosquosvis Imperatores, Reges, Pontifices vel Communitates. Vol. xi. (London, 1710,) p. 635.

† Practical Compendium of Midwifery, 12mo. London, 1831, p. 103.

‡ Elements of Medical Jurisprudence, 6th edition. London, 1838, p. 133.

§ Principles and Practice of Obstetricy. London, 1834, p. 172.

|| Traité de Medecine Legale, 4 Vols. 8vo. Paris, 1836, Vol. i. p. 261.

¶ Traité de Medecine Legale, 6 Vols. 8vo. Paris, 1813, Vol. i. p. 435.

\*\* Traité de Medecine Legale, Paris, 1801, Vol. i. p. 153.

†† Cours Theorique et Pratique d'Accouchemens. Paris, 1816, p. 107.

‡‡ Principles of Midwifery, 9th Edition. London, 1837, p. 242.

§§ Traité Complet de l'Art des Accouchemens, 2 Vols. 8vo. Paris, 1835, Vol. i. p. 191.

quickening, or the living motion of the child, be accurately ascertained. Even Dr Montgomery, in his elaborate work on the "Signs and Symptoms of Pregnancy," and Dr Evory Kennedy, in his instructive "Observations on Obstetric Auscultation," speak in very vague terms of the signs by which pregnancy may be detected before three months have been completed.

As it is, however, of the utmost importance, especially in a medico-legal point of view, to be able to ascertain the existence of pregnancy at an early period, and as I am not acquainted with any work which professes to give a detail of symptoms on which reliance can be placed, till three months at least have elapsed, I hope the present imperfect detail of the results of my own experience, will induce others who enjoy more extensive opportunities of observation to verify the statements which I now venture to lay before the profession.

The following remarks are intended to apply solely to the signs of pregnancy during the first three months of gestation, as I think that no one who has attentively perused the works of Drs Kennedy and Montgomery, and had a little practical experience, could fail to detect the presence of pregnancy after this period.

I adopt Dr Kennedy's division of the signs of pregnancy, viz. *1st*, Those which depend on the representation of the individual supposed to be pregnant, and *2d*, Those sensible to the medical attendant.

*1. Representative Signs.*—These are extremely variable and numerous, and scarcely two women will be met with in whom pregnancy declares itself by the same sensations. All or almost all of them may be entirely wanting, and, on this account, I shall notice them very briefly. It is commonly stated, that, at the moment of conception, involuntary shudderings, with an indescribable feeling of pleasure and tendency to fainting, occur, which are succeeded by a feeling of languor and lassitude, together with a peculiar thrilling sensation or vermicular motion in the bowels, or with slight colic pains. These are far from being constant symptoms, and I have reason to believe that they are the exceptions, not the general rule. Few women can tell the week or month, far less the day on which they conceive; and M. Dubois\* states that, of 100 pregnant women whom he examined, no fewer than 38 could give not the slightest clue as to the period when they became pregnant, and the others only calculated the period of their conception from the time when they had last menstruated.

Soon after impregnation, however, in most cases, though not always, sickness is experienced on rising in the morning, and is also excited by the tightening of the clothes or pressure on the stomach. Retching and vomiting sometimes attend, together with a depraved, excited, or diminished appetite. The nausea

\* Orfila, *Medecine Legale*, Vol. i. p. 256..9.

is peculiar ; as, after vomiting, it completely disappears and leaves a craving desire for food. Faintings, febrile feelings, quickened circulation, flying pains in various parts of the body, toothache, headach, numbness, and cramps in the lower or upper extremities, constipation or diarrhœa, and irritability of the bladder, are common occasional symptoms. The most important of this class of symptoms are the suppression of the menstrual discharge, and the peculiar sensations experienced in the mammæ. In almost every case shortly after impregnation, peculiar sensations are experienced in the breasts. These have been generally described as a sensation of creeping or formication, with a fulness and heat in the interior, and an itching over the surface, which causes the woman frequently to put her hand to the breast to relieve the unpleasant sensation. I have been frequently informed by those who have born several children, that this was the first sign they experienced, by which they were made aware they were again pregnant ; and this before they were able to judge whether they really were so from the suppression of the menstrual discharge.

The suppression of the menstrual flux generally takes place from the date of impregnation, but not always. In some instances it continues for a few months, and then disappears till after delivery ; in others it continues during almost the whole of pregnancy. It has been much disputed whether the discharge which appears during pregnancy, at the monthly periods, be really true menstuous fluid or not. I have not the slightest doubt that it is so, as I have met with two cases in which I had opportunities of satisfying myself that the discharge was perfectly natural, and not to be distinguished from the true menstrual flux. In the one case, a scrofulous woman with red hair and fair skin, it continued always for the first three months after impregnation, and I witnessed this fact during three pregnancies. In the other case the discharge was just as regular for seven months, when it stopped, but returned immediately on delivery. This woman was very swarthy, with black hair and eyes, and it occurred during two pregnancies. I have also seen coloured discharges attending the progress of pregnancy, but never was able to discover that they observed periodical returns. It may, however, be stated, as a general fact, that, during pregnancy, the menses are suppressed ; and if this were found occurring in a married woman, together with several of the above symptoms, it would amount to strong presumptive proof that she was pregnant.

2. *Sensible Signs.*—These are by far the most important, and, in fact, are the only ones by which the physician ought to be guided in forming his opinion on any case presented to him. If the woman is married, the representative signs, if borne out by the sensible ones, will go far to guide the medical attendant ; but

if the woman be unmarried, it is always best to follow Dr Gooch's advice—"never believe their tongues." The sensible signs, then, which I purpose to notice in succession, are those connected with the mamma, nipple, and its areola, the shape of the abdomen, state of the uterus, the stethoscopic indications, and the examination of the urine.

Almost immediately after conception the mamma begins to enlarge, and becomes the seat of increased action. The veins are full and distended; the glandular structure becomes more developed, the whole breast enlarges, and one or more of the glandular lobules may be felt hard, enlarged, and painful on pressure. The whole of the glandular lobules are not equally affected; in general two or three only in each breast; and this appears to arise not so much from secretion of milky fluid within these structures, as from irregular determination of blood and congestion within these parts. This appears to be especially the case in a first pregnancy. In a woman who has born children, milk often remains in the gland from one pregnancy to another, and may be drawn from her nipples at this early stage; and even in those in whom the breast remains flaccid, I have in almost every instance during the first month detected one or more of the lobules enlarged and somewhat indurated, so that I am inclined to regard this state of the breast as pretty constant, and one which, when taken along with other symptoms, is of great value.

About the middle or end of the second month, these hardened lobules become softened, and the breast presents a more uniform resistance to the hand; the distribution of blood, in fact, appears to be more uniform, and the local congestions, to which cause I referred the occurrence of the partial lobular enlargements, appear to abate.

During the third month, the breasts continue progressively to enlarge, and milk to be secreted within the glandular structure from which it may be expressed. They present a uniform enlargement; the glandular lobules are rarely the seat of painful sensation, and are scarcely to be distinguished from the other parts of that structure. In women who have born many children, however, and whose breasts remain flaccid, the only change observable at this period is, that the hardness of the lobular structure has disappeared, and that, though the breast remains soft and flaccid, milk may be drawn from the nipple.

The nipple from the commencement of pregnancy participates in the increased action of the other structures of the breast. It becomes more prominent and larger,—in fact, undergoes a kind of erection, and projects from the breast more than formerly. This is especially remarked in women who have had children, in whom,

after lactation, the nipple shrivels into a dry, wrinkled, little knot or button, and sinks, from the pressure of the clothes, into the substance of the breast. The skin around the base of the nipple at the same time becomes softer, and is bedewed with a moist unctuousity, sensible to the touch. During the first month, the glandular follicles which are seen around the nipple, but very small in the virgin state, become enlarged, and can be sensibly detected when the point of the finger is passed over them. At this period, in a first pregnancy, these bodies are not very sensible to the sight, and their colour does not differ from that of the immediately surrounding skin; but in subsequent pregnancies, even by the end of the first month, they are seen of a smooth aspect, and a whiter or paler-yellowish tinge than the surrounding skin.

In a first pregnancy, it is not in general till towards the end of the second month or the beginning of the third, that these glandular follicles are found presenting all the characters which they afterwards assume. They are then seen varying in number and size surrounding the base of the nipple, and extending for a greater or lesser space around it. Their size varies from that of a millet to that of a hemp-seed, and they assume during this period a paler, sometimes a redder hue than the surrounding skin. They also present a smooth polished-looking surface, and the skin which surrounds the nipple and them is evidently softer, moister, and more unctuous than that of the surface of the breast. It is to this portion of skin surrounding the nipple that the term *areola* has been applied.

During the third month these characters are more marked and easily recognized, and the glandular follicles are more distinctly formed, and differ in colour from that of the surrounding areola.

*Areola.*—For the first six weeks of a first pregnancy, little or no change of colour is usually perceptible on the areola. If, however, the person be of a dark complexion, with dark hair and eyes, about the end of this period a pale rosy hue may be seen spread over the nipple and areola, most generally, however, occupying the nipple only. In fair persons, no perceptible change of colour has taken place. By the end of the second month, however, in dark or brown-haired women, the pale rosy tint is in general distinctly perceptible both over the nipple and the areola, but in fair people it is still difficult of recognition. This change of colour of the areola is most easily recognized when the breast is looked at from a distance of a few feet, when the slightest change of colour may be detected; whereas, on a close examination, I have several times found I had overlooked it. By the middle of the third month, or ten weeks after conception, the areola has usually assumed a leaden hue or a deeper rose, with a tinge of dirty yellow or brown, and is so apparent as to be detected the moment

the breast is exposed. If, however, the person be fair, the tint, though in substance the same, is still faint, yet quite distinct enough to make it be easily recognized. I have frequently been astonished at the difference in tint which the recurrence of the menstrual period produced. Thus I have found that when the breast was examined the ninth week, (or the week before the third monthly period from the last appearance of the menses,) the areola could scarcely be distinguished as differing in colour from the surrounding breast, whilst the very next week, from the monthly period having arrived, the areola was seen quite distinctly. From this period the areola gradually deepens in colour, till, in swarthy women, it becomes almost black; in others, of all varying shades, from that to a dirty rose or brownish rose hue. Both in fair and dark women it is in general quite distinct by the end of the third month; but in neither is the tint so deep as after the next menstrual period, for it is at these periodic times, it seems chiefly to deepen its tint.

Such are the changes which the areola presents in a first pregnancy. But nothing of what is stated above can apply to the areola of a woman who has born children. In her, the areola once produced, never entirely fades, so long as she remains capable of procreating; and though I have in some cases seen the colour nearly vanish when the period was long which intervened between the nursing of one child and the conception of another, still it was always visible, and few who have examined the female breast could have failed to recognize many marks by which it would be known that the woman had once been pregnant. The glandular follicles, too, once enlarged, never entirely disappear during the procreating period of life, and the areolar surface is seen traversed by a reddish white, shining, cicatrix-looking, irregular net-work of lines, which remain during life. This is an important fact for the medico-legal inquirer; for, I know of no disease which will give rise to the formation of the coloured areola, with the enlarged glandular follicles; so that when the remains of these characters, together with the cross lines above alluded to, are observed on a breast, the only conclusion is that the person had once been pregnant.

In the woman who has previously born children, by the end of the first month the glandular follicles, which had considerably shrivelled since last pregnancy, have again assumed nearly their original enlarged and smooth appearance, and contrast remarkably with the darkened areola. In them, very soon after conception, certainly after the first menstrual period, the cuticle over the areola becomes perceptibly softer, and moister; the old cuticle covering it is in process of being cast off in scales; and the colour, whatever tint it may have previously been, is perceptibly deeper. In those fair

persons in whom it had nearly disappeared, it is usually as deep by the end of the second month as it is by the third in those who are pregnant for the first time ; but in the dark-complexioned, I have frequently been unable to detect any increased depth of hue after the second month, the areola being then perfect in all its characters. In general, however, the third month has elapsed before it has attained its full perfection.

Scarcely any writer on midwifery notices this difference of the time of appearance of the areola in those who are pregnant for the first time, and those who have born children, and yet the circumstance is important ; for, if it be allowed that the areola takes four months to become perfect in all its characters, in a first pregnancy, we would be apt to be led astray by expecting to find an enlarged and apparent uterus whenever we detected a dark areola ; and thus, this, which, when rightly applied, is a most valuable sign, would fall into disrepute. Whoever consults the works of Burns, Blundell, Kennedy, Velpeau, and Orfila, will be fully sensible that the small consideration in which these authors respectively hold the appearance of the areola, results from this circumstance. They observed that the areola once produced remained more or less permanent, and they drew the conclusion that its appearance could never again serve to indicate a pregnant state. They overlooked the marked difference between the areola of the pregnant mother, and the areola of the mother who was not bearing, and, because their own observation had not led them to notice the differences of these two states, they rejected this sign of pregnancy altogether.

But there are other reasons which these authors assign for their neglecting the areolar signs, and these are, that a coloured areola occurs in some uterine affections, and that several females never have any coloured areola, either during pregnancy or during lactation. Each of these points shall now be noticed.

Almost every writer who has noticed the signs of pregnancy has remarked, that a dark areola may occur in virgins during particular diseases, such as dysmenorrhœa, diseases of the uterus, &c. Hence it follows that Gooch and others, attending merely to the change of colour, allowed themselves to be misled by confounding the coloured nipple or areola of the one with the greatly altered areola of the other. That it is perfectly possible to distinguish between the one and the other, my own limited experience has proved. I have only met with three cases in which there was a coloured nipple and areola, and no pregnancy existed ; but the character of the areola, taken in connection with the other symptoms, was sufficient to enable me to distinguish them.

The first case occurred in the month of August 1835, and was the means of directing my attention more especially to the chang-

es in the areola produced by pregnancy and by disease. A young woman of 18 was supposed by her parents to be in the family-way, and they wished to force the young man who was suspected to be the cause, to marry her if it was proved she was so. It is unnecessary to relate the case in full. She had many of the symptoms referred to pregnancy, as suppression of the menses, swelled abdomen, painful breasts, frequent attacks of headach and vomiting, &c. I declined giving an opinion the first time I saw her, but a fortnight after, called back again and found the nipples dark and surrounded by a coloured areola, precisely of the same appearance as that surrounding her eyes. The nipple was, however, small, shrunk, not projecting, the areola dry and wrinkled, the glandular follicles not enlarged, but the breasts painful and with a knotty feeling. I was informed, however, that she had a severe attack of bilious vomiting and purging, severe pains in the back and loins, and that the menstrual fluid had appeared in small quantity. No doubt, therefore, existed regarding the nature of the case.

The second case was in a chlorotic woman, who had been married for many years, and had never had any children. It was one of the best marked cases of chlorosis I have ever seen, and, as I attended her for months afterwards, I can speak positively of the fact of her not being pregnant at the time I attended her. In her the nipple and areola were at every menstrual period though no menstrual secretion appeared, of a faint watery black colour, but there was no turgescence of the nipple, no moistened and softened state of the areola, and no enlargement of the glandular follicles.

The third case was in an unmarried female, 36 years of age, who was labouring under medullary sarcomatous disease of the uterus, which proved fatal. She had a retracted nipple with a dark areola; and my attention was first directed to it, in consequence of her neighbours having asserted from this circumstance that she was with child. She lived for about eight months after I first saw her, and at the time of her death the uterine tumour had increased to about the size of a child's head, and was found to consist entirely of morbid parts,—the body of the uterus being studded with tubercles of different sizes in various stages of softening, and a large ulcerated fungoid bleeding mass filling its cavity,

The character, then, of the areola in all these cases was recognized as different from the areola which attends pregnancy, so that I quite agree with Dr Montgomery in regarding the presence of an areola with the characters above described as indicating a state of pregnancy; and I have no hesitation in asserting, that, in every case where a well-characterized areola is found, there also will the uterus be found to contain a fœtus.

I now turn to the last objection to the areolar test, in order to



show that the want of a coloured areola in some women ought never to be held as an objection to its presence in others indicating a state of pregnancy in them.

The entire absence of all colour from the areola is far from being uncommon. I have at this moment, (9th November 1841.) under my care, no fewer than two patients, in neither of whom, either during pregnancy or lactation, has the slightest change been observed in the colour of the nipple or areola. The one is very fair, with light hair; the other very dark, with hair originally of a jetty black, now gray. In both, however, all the other characters of the areola are well-developed, at least sufficiently so to make them be easily recognized. From the examination of the breasts alone, taken in connection with the representative signs, I was able in one of these cases to indicate the occurrence of pregnancy at a period which, calculating from the time of delivery, must have been about two months, certainly not more, after conception; and I believe that, if the breasts were more frequently examined by practitioners, it would be found that the absence of a coloured areola is far more common than it is usually supposed to be. In two classes alone of patients have I met with this anomaly; in the very fair, and in those whose hair has become gray in early life.

For individual anomalies it is impossible to account. Dr Montgomery met with a case of pregnancy, in which the glandular follicles were not developed, but the dark areola was, and all the other characteristic marks. But because such cases may possibly occur, we ought not to reject a sign which, while it is one of the most constant, is one of the earliest met with in pregnancy, and which, if more generally attended to, might perhaps render the ascertaining the presence of pregnancy at an early period nearly as sure as the stethoscopic examination does at a later period.

That practitioner, however, would be highly culpable who would form his opinion from one or two favourite signs or symptoms. His opinion ought to be formed from a consideration of every ascertainable symptom,—both those which are narrated by the patient, and those which come under his own observation. Regarding the question of pregnancy, in most cases where the woman has no object to serve by concealing her real symptoms, her narration may greatly aid our diagnosis; and it may be unnecessary to make any further examination than into the state of the breasts. Where the woman has an interest in concealing her pregnancy, or in declaring herself pregnant, although she be not, the above-noticed signs must not be trusted to alone; but others ought to be conjoined, which, from all bearing on the same point, render that certain which, from one or two signs only, might be left undecided.

Considerable stress is usually laid by writers on midwifery on the sharpening of the features and the bloached countenance sometimes observed during pregnancy. These appearances are not very general; but, when they are present in one who was previously healthy, they ought to be taken into consideration amongst with the other appearances.

*Abdominal Enlargement.*—The swelling of the abdomen is a symptom of pregnancy of much greater importance. Very shortly after conception, the abdomen is observed to become more tumid than formerly. This, of course, cannot be owing to any increase in the size of the uterus, but to the sympathy which the stomach and bowels have with this organ, this sympathy being shown by the sickness, nausea, vomiting, and copious flatulent eructations, together with the windy distension of the bowels. During the first two months of pregnancy, this swelling of the abdomen is rarely wanting, and is frequently a very marked symptom, and possesses characters which I have never seen imitated by any other female disease. At the same time that the abdomen is tumid or greater in bulk than formerly, there is also observed to attend it a peculiar flatness over the anterior, and what would otherwise be the most prominent part of the swelling. Most works on midwifery notice a flattening of the abdomen as a symptom of pregnancy, but then, from their descriptions, it does not appear that they ever remarked that the flatness only appears at that time when the actual volume of the abdomen is enlarged. They all attribute it to the sinking of the uterus in the pelvis during the early months of pregnancy; yet one moment's reflection must convince every one, that the sinking of such a small body as the uterus during the first two months, even though it took place to a much greater extent than it was supposed to do, is quite unable to explain the marked flattening of the abdomen. But the fact is, that the fundus of the uterus does not sink in the pelvis at any stage of pregnancy. The flattening of the abdomen, then, only occurs after it has become considerably increased in volume, and, as far as my observation goes, seems to be caused by the recti muscles of the abdomen opposing a greater resistance to the distending force than the transverse muscles; and, as the swelling at this time consists entirely of flatus, this is pressed against the least resistant parts of the abdominal cavity, and so gives rise to the appearance of flattening by jutting out at the sides, whilst it is tied firmly down in front. This peculiar flat tumidity of the abdomen is most observable during the first two months of pregnancy, and in general, after this period, disappears to such an extent as to make it doubtful if the person be pregnant. About the middle of the third month, however, slight fulness at the lower part of the ab-

domen begins to manifest itself, and by the end of the month is sufficiently apparent to be recognized both by the hand and the eye. As a woman often adjusts her dress so artfully at this period as to render it extremely difficult to recognize any increase of size in the abdomen, it ought to be borne in mind that, by taking a lateral view of her shape when she is desired to pass before us, the enlargement may be detected from the increased lateral breadth at the haunches; and if a manual examination be allowed, the fact may be easily ascertained.

*State of the Uterus.*—Most authors on midwifery speak in very vague terms of the position and progressive enlargement of the uterus during the first three months; and almost all state that, for the whole of that period, the uterus is still confined within the pelvis.\* Even Orfila mentions that, by the end of the third month, the fundus of the uterus has only arrived on a level with the pubes. Orfila's description of the position and state of that organ for the first two months of gestation is the most precise I have seen, and is quite in consonance with my own observation. He states† that, during the two first months, the volume of the uterus gradually increases; its body becomes somewhat rounded and inclines backwards, whilst its neck approaches nearer to the vulva, and comes more within reach of the finger. Such is the result of his own observation; and then he adds, on the authority of others, that the uterine orifice becomes closed, whilst the margin of the lips become equal, and the orifice, from being a somewhat triangular cleft, becomes round and more gaping, the heat of the parts being also increased. In addition to these characters it might be added, that the lips and neck of the uterus have a softer and more spongy feeling than they have in the virgin state, and are evidently enlarged by increased vascular action, and the lips often gape, so that the tip of the finger may be introduced for a small way within them. The lengthening of the posterior lip of the uterus, so as to bring it on a level with the anterior, is a character to be met with only in women who have never before been pregnant. After the uterus has once been enlarged by pregnancy, the only characters to be depended on are those stated by Orfila, as the results of his own observation; all the other characters are equally met with in women who have born children, but who are not at the time pregnant.

It is requisite to notice, that it is during this condition of the uterus that what authors on midwifery call the "falling down of the uterus within the pelvis" occurs, to which they erroneously

\* Kennedy, p. 38; Blundell, p. 172; Baudelocque, Vol. i. p. 132; Burns, p. 244; Capuron, p. 117.

† Orfila, *Medecine Legale*, Vol. i. p. 246.

attribute the flattening of the abdomen. Now what is it that actually happens? Does the uterus really sink in the pelvis during the first months, or is the sinking only apparent? To ascertain this point we must first glance at the position of the virgin uterus in the pelvis, and especially as to its depth from the external orifice of the vagina.

The usual length of the virgin vagina is estimated to be anteriorly from the pubes three inches, and posteriorly from the fourchette four and a half inches. Into the further extremity of this tube, projects the mouth and a portion of the neck of the uterus. Such being its position, in general, about half an inch of its neck and its mouth, can be reached with the point of the finger. When the fundus of the uterus enlarges in consequence of pregnancy, it must occupy more room, and, as the bladder opposes its projecting forwards, and the promontory of the sacrum resists at first its rising upwards, it is necessarily thrown backwards against the rectum and hollow of the sacrum. As the body alone of the uterus continues to enlarge for the first two months at least, whilst the fundus is pressing against the hollow of the sacrum, and gradually following as it were its curve, the lower moveable part, or the neck and mouth, having nothing to resist their advance towards the vaginal orifice, are pressed downwards and forwards, so as to bring them more within the reach of the finger; so that sometimes, as Madame Boivin states, the neck of the uterus appears to have become greatly lengthened, as two inches nearly may be within reach of the finger. This lengthening, however, is merely apparent, and is owing to the body of the uterus being prevented from rising out of the pelvis, in consequence of its fundus being as it were held down by the bladder before, and the promontory of the sacrum behind, whilst the flatulent distension of the bowels oppose an additional obstacle to its immediate upward ascent. By the end of the second month, however, if the bladder be emptied, and the patient be thin, the uterus may be felt, by those who have a nice sense of touch, on a level with the brim of the pubes, so that at the very time when all authors assert that the uterus is sunk further down in the pelvis, it has actually risen to the extent of nearly two inches above its position in the virgin state.

If this were not the case, how does it happen that the very next month, nay, the very next week after the second month is completed, the neck is already felt shorter from having somewhat ascended, and its position somewhat changed? If it arose from the lengthening of the neck, and not from the enlarging body of the uterus being prevented from rising, the neck would still be within reach of the finger during the third month, and in persons

who died during this period of gestation, the lengthening of the neck would be apparent. But this is not the case. In no preparation of the gravid uterus during the first two months which I have yet examined, have I been able to detect any appreciable lengthening of the neck; and in every case in which I have had an opportunity of examining the living patient, I have been satisfied that the elongation of the neck was merely apparent, and, owing to the fundus of the uterus being at first prevented from rising much higher than during the virgin state, its increasing volume pushing downwards and forwards the mouth and neck. Here, then, is no depression of the uterus in the pelvis during the early stages of pregnancy, and, consequently, the flattening of the abdomen can never be attributed to this cause, but is evidently owing to that which I have assigned for it.

Such, then, is the state of the uterus during the first two months of gestation, and though a vaginal examination may teach us but little during that period, still in doubtful cases, especially if they be the subject of a medico-legal inquiry, it will always be advisable to make this examination, for if it gave no positive evidences of the existence of pregnancy, it might give valuable negative results.

During the third month, the uterus, gradually augmenting in volume, is found to have advanced upwards and forwards, so that the fundus during the early part of the month is found behind and on a level with or slightly above the level of the anterior brim of the pelvis, and in the latter portion of the same month from one to two finger-breadths above it. It is in a thin person distinctly perceptible, on a careful examination, by the end of the tenth week; but in all, unless they are very much loaded with fat, may easily be detected by the hand by the end of the twelfth week. The changed position of the uterus, as it lies then in the axis of the upper brim of the pelvis, throws the neck and mouth of that organ backwards; and as the fundus is no longer prevented from rising by the causes above-mentioned, the neck is found to have receded so far as to be nearly beyond the reach of the finger. If at this period a vaginal examination be made, and at the same time, with the other hand, pressure be made over the pubes, the enlarged uterus may be made to roll over the finger. I have never been able, however, to detect the dropping of the foetus on the finger (ballotement) during this month, though Burns\* asserts that it can; but as he is the only one known to me who has perceived this at such an early stage of pregnancy, it is possible he was mistaken. At this period of pregnancy, the foetus is too small to be distinguished floating in the cavity of the uterus, differing, as it does, so little in specific gravity from the fluid

\* Principles of Midwifery, 9th edit. p. 244.

which surrounds it ; and, by the almost unanimous consent of all observers, it is not till the end of the fourth month that this character becomes distinctly marked.

By the end of three calendar months, the uterus, in almost every case, may be distinctly felt, its fundus being two finger-breadths above the brim of the pubes.

*Auscultation.*—This has for many years past been reckoned one of the surest means of detecting the presence of a foetus in the uterus, and it is to Mr Kergaradec \* of Paris that the medical world are obliged for adding this most important element of diagnosis to those stated above. There is, however, a considerable difference of opinion as to the period of pregnancy when this means of diagnosis becomes available. Dr Kennedy states that he has heard the peculiar placental souffle by the end of the tenth week, and at all periods after that ; whilst others have not been able to detect it till the fifth month. It has also been much<sup>d</sup> disputed as to whether this sound was produced by the motion of blood in the placenta, or by that in the aorta and iliac arteries, or was occasionally heard over the placenta and occasionally over other parts of the uterus. It is not necessary to enter into this controversy, as I am satisfied, from repeated examinations with the stethoscope, that it is only present when the uterus is enlarged from the presence of a foetus ; but as to whether it is produced by the motion of the blood in its utero-placental circulation, or by the spiral vessels of the uterus itself, remains for further investigation. In the latter months of pregnancy, the sound is only perceived over the region where the placenta is on delivery found to be attached.

During the first ten weeks after conception, I have never been able to detect the placental souffle, but I have noticed it in the beginning of the eleventh week, and very distinctly in almost every case which I have examined towards the end of the twelfth week. Considerable care, however, is requisite in the use of the stethoscope at this early period of gestation, to enable us to arrive at any satisfactory results.

As this inquiry is limited to the signs of pregnancy during the first three months, it is not necessary to allude to the obstetric auscultation signs of a later period ; for these I refer to the excellent treatise of Dr Kennedy.

#### STATE OF THE URINE IN PREGNANCY.

The only point of inquiry now remaining, is the examination of the changes in the constitution of the urine produced by preg-

\* *Auscultation appliqué à l'étude de la Grossesse*, Paris, 1822.

nancy. Although these changes had been quite overlooked by the present race of physicians, till brought prominently before their notice by M. Nauche, in a paper read before the Society of Practical Medicine, in July 1831, it by no means follows that these changes were either unknown or unattended to by our predecessors. The state of the urine in disease attracted no small share of the attention of the medical men of all ages previous to the middle of the last century, and, although they had not the lights of chemistry to guide them to a knowledge of the exact nature of the changes which they observed in that compound fluid, still the attention they paid to the examination of its physical characters well deserves our imitation. Scarcely a disease known to Hippocrates, Avicenna, Galen, Oribasius, Aëtius, &c. was allowed to pass without a notice of the changes produced by it on the urine; and even the urine in pregnancy was not passed over without comment. Nay, so extremely minute and accurate is the description of a few of these writers, that Avicenna's\* description of the changes produced by pregnancy on that fluid, might be inserted instead of Nauche's, almost word for word; the only difference being that Nauche has clothed his supposed discovery in the attractive garb of modern chemistry.

As I have been unable to procure M. Nauche's original memoir, I am obliged to quote, at second-hand,† his observations on the peculiar matter which he describes as occurring in the urine of the pregnant female. From these it appears that M. Nauche observed that when the urine was allowed to stand for some time, a white flaky pulverulent grumous matter separated and formed a pellicle on the surface, which he considered to be the caseum, or peculiar principle of the milk formed in the breasts during gestation, and to which he applied the name of *Kiestein*. Upon what grounds he rested the assumption of this pulverulent deposit being *caseum* I do not find stated in any work, and so far as I know Mr Pereira,‡ and after him, Dr Kennedy,§ and Mr Kane, have the merit of challenging the accuracy of his observation. But Dr Kennedy and his friend, in correcting, as they imagined, one mistake, seem to have fallen into a more awkward one themselves, in mistaking a phosphatic salt for albumen.

In the year 1839, however, a new impetus was given to further investigation, by the publications of M. Equisier, in the *Gazette des Hospitiaux*, and their republication in *L'Experience* for

\* Liber Canonis, de Medicinis cordialibus et Cantia, &c. fol. Venetiis, 1555. Lib. iii. sen. xxi. Tract 1, cap. ii. F. p. 385.

† *Medico-Chirurgical Review*, Vol. xxxi. p. 228. *Lancet*, Vol. viii. p. 496. *L'Experience*, Vol. iii. 2d part, p. 61.

‡ *Waller's Edition of Denman's Midwifery*, p. 171.

§ *On Obstetric Auscultation*, p. 56.

July, and with notes by M. Tanchon, in the *Lancette Française* for June.\* M. Eguisier described very minutely the changes observed in the pregnant urine, and the peculiar matter to which the term *Keistein* had been applied. He remarked that the urine passed first in the morning was of a pale colour and slightly milky in appearance; that it reddened litmus, and was not coagulable by heat, nor by the usual reagents of albumen. When allowed to repose, a flocculent cloud, similar in appearance to carded wool, appears in the fluid, and a white flaky precipitate is deposited. After a period, varying from two to six days, little opaque bodies rise from the bottom to the top of the fluid, and at last increase so as to cover the whole surface. It is this substance to which the name *Kiesteine* has been given, and it is so consistent, that, by seizing it by one of its edges, the whole may be with ease removed. It has a white, opaline, somewhat granular look, similar to that of the congealed fat which collects on the surface of soups. In three or four days more the urine becomes turbid, and the pellicle breaks up; small pieces detach themselves from the general mass and fall to the bottom, in which way the whole disappears.

It is stated, that when this pellicle was examined by the microscope, it was found to consist of gelatinous masses of no determinate form; small cubical crystals were also detected in it when it had become stale, but these were not considered as essential parts of the pellicle.

The pellicle occurred in every case of pregnancy examined by M. Eguisier, and he states, that it may be met with from the first month to the end of the full term of pregnancy. He also states, that M. E. Rousseau recognized the same substance in the urine of some gravid females of the lower animals.

Dr Golding Bird† is the only other author, known to me, who has described, from his own observation, this peculiar matter of the pregnant urine. The chief additional information given by him, besides that of his confirming all their observations, was, that earthy phosphates were copiously thrown down from the urine on the addition of alkalies, and that the peculiar opalescent hue of the pellicle was chiefly produced by the presence of fine triangular prismatic crystals of the triple phosphate. These crystals the former authors had described as square, but this was no doubt owing to a hasty examination. The crystals were by both found to be most numerous when the pellicle was stale.

\* Short notices of these may also be seen in the *Medico-Chirurgical Review* for 1839, p. 228; and in this *Journal*, Vol. lii. p. 586.

† *Guy's Hospital Reports*, No. x. p. 15, for April 1840. Observations on the existence of certain elements of the milk in the urine during *uero-gestation*, and on the application of this fact to the diagnosis of pregnancy.



Dr Bird was unable to speak positively as to the nature of the peculiar animal matter of the pellicle; but he thought it came nearer caseum than anything else, especially when it was considered that a powerful cheese-like odour was occasionally exhaled from the urine during its formation and decomposition.

Such are all the detached observations known to me regarding this substance said to be so peculiar to the urine during pregnancy. Nauche, Eguisier, and Rousseau agree in stating that it exists in every case of pregnancy. Dr Bird, in thirty cases examined, found it wanting in three; but this seemed to depend on peculiarities of the state of the patients at the time, as he appears to have afterwards detected it in their urine after that state was removed.

None of the observers of this peculiar pellicle have, given any better reason for their belief that this matter is caseum than that, at a certain stage of its decomposition, it emits a strong disagreeable odour of decayed cheese.

In the course of a series of experiments I have again and again met with the very same odour from putrid urine, which, excepting in this single particular, had no other character in common. In so far as smell goes, it is impossible to distinguish pregnant from other urine; yet in chemical peculiarities, they have scarcely a single character in common.

The result of my observations regarding the constitution of the urine during pregnancy is, that, in almost every case, at some time or other, the peculiar pellicle may be met with; that it is more apparent in the earlier months than in the last two months; that the relative quantity of the pellicle which is to appear may always be judged of by the quantity of the precipitate which is deposited as the urine cools or stands; and that the quantity of earthy salts in general bear a relative proportion to the amount of the natural sediment, and of the pellicle.

How soon the kiëstein appears after conception, I have not been able to ascertain. Eguisier says he has seen it in four cases of pregnancy between the first and the fourth month, and Dr Bird met with it in a woman who supposed herself to be about the end of the second month. I have never had an opportunity of examining the urine of a pregnant female earlier than what was calculated to be six weeks after conception; but at this period it is quite distinct. It is more abundant, and the earthy salts are in greater quantity by the end of the second month; and I think I have never seen either the one or other in greater quantity than during the third month.

Though I have stated that the peculiar pellicle was met with by me in every case of pregnancy, I do not mean to assert that it will

in every case at every period be detected. Several exceptions have come under my notice during the last three years, and I had very lately no fewer than two specimens of pregnant urine at the same time, neither of which yielded a pellicle, though kept for eight days, and exhaling a most intolerable odour. I could not account for this in one of the cases, because the urine was in chemical composition precisely the same as other specimens of pregnant urine where the pellicle became apparent. In the other case the urine was found to have temporarily changed its chemical characters. Urine, however, collected from the same patients a few days after, yielded both of them the kiestein pellicle.

The greatest irregularities in the appearance of the pellicle seem to exist in that urine which is secreted during the last two months of gestation. That secreted during the earlier months, not only was found to furnish more uniformly a pellicle, but also in greater abundance than during the later months.

I have examined the urine in many diseases, and especially in those in which a pellicle forms on the surface of the fluid; and I know of no disease in which urine, with the chemical peculiarities about to be detailed, will furnish a pellicle like kiestein.

When the urine of a pregnant woman is allowed to stand some time, it deposits, in almost every instance, a copious sediment of a whitish colour, which, from being of a very light nature, appears floating loosely at the bottom of the vessel with prolonged rugged portions unequally projecting upwards. This peculiar appearance was well compared by Avicenna to shreds of cotton, and Wallæus, Fernelius, Rosinus Lentilus, Rega, &c. describe it as "*instar carptæ lanæ.*" This sediment is much more speedily deposited from the urine of those who are from one to four months pregnant; in them it is usually deposited immediately or a very few hours after cooling. After the fourth month, several hours, in most cases, elapse, before the sediment makes its appearance, and in the later months, I have seen twenty-four hours elapse before any considerable quantity had fallen.

When the sediment has been some hours or days at the bottom of the fluid, in most cases small irregular rounded particles may be observed hanging suspended, yet attached, over its surface; and it is these particles which ascend to the surface, and form the pellicle which has been termed kiestein, which soon breaks up and falls in particles to the bottom of the fluid. This peculiar appearance was also well described by Avicenna "*sicut grana ascendentia et descendentia;*" and by Wallæus,\* as "*parvæ particulæ paulo minus quam dimidium Pisi.*" This sediment appears to be

\* *Institutiones, Lib. ii. Cap. 6.*

much less abundant during the latter months of pregnancy; and in several instances which I have very lately inspected, the sediment which has subsided from the urine, is quite trifling, and contrasts most remarkably with the very abundant precipitate from the urine of women in the third and fourth months of pregnancy. The sediment has also a decidedly redder colour. In this remark the learned Avicenna has likewise forestalled us, for he tells us that, towards the end of pregnancy, the sediment assumes a reddish hue, whereas in the earlier month the hue was glaucous.

The very accurate description of Dr Bird of the peculiar pellicle which forms on the surface, as well as that of Eguisier, which has been noticed above, render any further description of it quite unnecessary.

The urine of the pregnant female then separates into two portions—a sedimentary and a fluid portion. And in the following remarks I shall first state the chemical characters of the sedimentary portion, next of the fluid portion, and, lastly, of the whole urine.

*Natural Sediment of Pregnant Urine.*—The fluid portion being drawn off, the sediment appears of a dirty-whitish yellow colour, with a fatty granular or grumous look, not unlike some kinds of purulent matter. It is not greasy to the feel, but rather gritty. When suspended in water and boiled, it is wholly dissolved, and forms a clear solution, with a slight urinous tinge, just, in fact, like very pale watery urine. As the fluid cools, nearly the whole is again deposited and subsides to the bottom. If the quantity of water be very great no sediment is deposited on cooling, the whole remains in the state of solution.

The sediment was therefore suspended in water by agitation, and *aqua ammoniacæ* added, when the whole was instantly dissolved, leaving the fluid quite clear. When muriatic acid was added to this ammoniacal solution, a copious precipitate instantly appeared, and left the fluid of the same turbid appearance as before the experiment.

To another portion of the sediment suspended in water ammonia was added so as to dissolve it, and then sulphuric acid was added so as to neutralize the ammonia. No precipitate appeared, but, on adding it in excess, very slight turbidity, merely to the extent of slight opalescence, was produced.

When sulphuric acid was added to the sediment suspended in water, the whole was dissolved, faint opalescence, as occurred in the last experiment, only appearing.

Nitric acid added to the sediment suspended in water produced a perfect clear solution.

Muriatic and acetic acids had no apparent effect on the suspended sediment.

*Aqua Potassæ* dissolved the sediment suspended in water, from which it was again thrown down by muriatic but not by sulphuric acid.

The sediment was dissolved in water by boiling, and whilst still boiling, alcohol was added, that, if albumen or caseum were present, they might be precipitated, but not the slightest change resulted; no precipitate appeared.

*Action of Ether on the Sediment.*—The sediment, still moist as it was obtained from the urine, was briskly agitated with an equal volume of sulphuric ether. On being allowed to rest, it separated into two parts, the upper or ethereal being of a dirty-white colour, and quite opaque, from the quantity of solid particles it held in apparent suspension, the lower watery portion being of a much whiter hue, and the precipitate in it presenting a loose flaky aspect.

When the ethereal portion was separated, and allowed to rest for some time, the ether, apparently quite pure, collected on the surface, and a thick gummy-looking fluid subsided. Some of this was poured on writing-paper, but gave no greasy stain. The remainder was therefore boiled, with the addition of a little water when the whole slowly dissolved; and, in proportion as the ether evaporated, and the gummy substance dissolved, a heavy bright-red crystalline sand fell to the bottom of the vessel. In one of the experiments, a few crystals only were formed during the boiling of the fluid, but, on its resting for an hour after, a pretty tolerable quantity of bright-red crystals were obtained. (Plate VI. Figs. 10 and 11). On cooling, the fluid assumed quite a milky hue from the appearance of a copious white precipitate, and, when a portion of this was poured on glass, it presented much the same appearance as a drop of watery milk would have done.

When *aqua ammoniæ* was added to this fluid with its sediment suspended by agitation, the whole was dissolved, and the fluid became clear and transparent, and the subsequent addition of muriatic acid only caused a slight opalescent hue, and, on being allowed to stand for a few minutes, a distinct but trifling precipitate appeared, which was removable by boiling the fluid.

The addition of *aqua potassæ* to the fluid, with its sediment suspended, also produced solution, and sulphuric acid subsequently added caused slight opalescence, also removed by boiling.

Nitric acid added to the fluid and suspended sediment caused its complete solution.

Muriatic acid caused scarcely any change at first, but slowly produced solution of the sediment, and after a while left the fluid nearly but not quite clear and transparent.

Sulphuric acid caused at first scarcely any change in the appear-

ance of the fluid. After a while however the sediment became dissolved, but the fluid still retained a light opaque hue.

Though such was the general result of the chemical examination of the ethereal portion of the sediment, on more than one occasion in which a more copious deposit than usual of the red crystalline particles had occurred, I was unable to procure marks of any reaction with either acids or alkalis on the fluid which remained; but in these cases, no white flaky deposit or sediment ever occurred on the fluid cooling after being boiled with water. The whole of the dissolved gummy-looking matter seemed to be resolved into the red crystalline-looking particles. This was only remarked when the sediment had remained above 24 hours covered by the urine before being examined.

When the lowest watery portion was minutely examined, a few large bright-red crystalline particles were observed at the bottom of the vessel; and when the fluid was boiled, in proportion as the ether in union with it was expelled, and the sediment was dissolved, more of these heavy bright-red crystalline particles fell to the bottom. Whilst hot, the fluid was of a pale colour, just like watery urine, and quite clear and transparent, but as it cooled, the white flaky precipitate again made its appearance, imparting to the fluid quite a milky appearance.

To some of this solution, when warm, ammonia was added; but no change apparently resulted; a precipitate appeared however on cooling.

The following experiments were therefore made with this fluid cold, the sedimentary deposit being merely suspended in it by agitation.

To some of this fluid, then, ammonia was added, when it instantly caused the whole of the suspended sediment to be dissolved, and left the fluid perfectly clear; but, on being allowed to rest for a few seconds, a copious flocculent precipitate made its appearance, which was not soluble in the fluid when brought to the boiling point. This showed that the precipitate which the ammonia had thrown down was of a perfectly different nature from that which it had dissolved; for that which it had dissolved was soluble in the fluid when boiling, but this which it had caused to be precipitated was insoluble in the boiling fluid.

When muriatic acid was added to the fluid in which was the precipitate thrown down by the ammonia, the whole was dissolved with the copious evolution of white fumes, and the fluid was left quite clear.

The same occurred when nitric acid was added, the white fumes being evolved in nearly equal quantity. Sulphuric and acetic acids also dissolved the ammoniacal precipitate, but the white fumes were just distinctly apparent, and no more.

To some of the same fluid, with its precipitate suspended, sulphuric acid was added; but no change ensued. When, however, ammonia was afterwards added, the whole became dissolved; but on standing a little, another precipitate appeared, which was not soluble in the fluid when boiling.

Precisely the same occurred when muriatic or nitric acids were used.

When the fluid was in a state of greater dilution, or from some other cause, nitric and acetic acids dissolved the suspended precipitate; and sulphuric and muriatic acids partially dissolved the same, leaving only slight opalescent turbidity.

A portion of the natural sediment was exposed to a red heat on a plate of mica, when it gave off a strong ammoniacal odour, and became converted into a blackish-coloured hard ash.

Such, then, seem the chemical characters of the natural sediment of the urine of the pregnant female. It was soluble in water by the aid of heat, and soluble when cold by ammonia, sulphuric and nitric acids, but was insoluble in muriatic and acetic acids.

The chemical peculiarities of the urine freed from its sediment come next to be noticed.

*Urine freed from its Sediment.*—When the fluid is heated to the boiling point and alcohol added, no change occurs.

When ammonia is added to the urine freed from its sediment, a copious deposit takes place, which is soluble in muriatic and nitric acids with the evolution of copious white fumes, which fill the vessel in which the experiment is conducted; and is also soluble in sulphuric and acetic acids, but without any evolution of fumes.

No precipitation is caused, nor any apparent effect produced by the addition of either muriatic, acetic, nitric, or sulphuric acids. But if this portion of the urine be slightly acidulated with nitric acid, and oxalate of ammonia be added, a precipitate is thrown down.

When to this portion of the urine a solution of corrosive sublimate is added, a copious precipitation ensues, which is extremely soluble both in nitric and muriatic acids. This precipitate Dr Kennedy seems to have mistaken for albumen, and hence asserted that that animal substance always existed in the urine of the pregnant female.\* Corrosive sublimate, it may be remarked, is not the best test for the presence of albumen in such a compound fluid as the urine, for both phosphates and lithates strike a precipitate with it.

When a portion of this urine was evaporated to dryness, and water poured over it in small quantity to dissolve the soluble matters, a deep-coloured fluid was obtained, which, on the addi-

\* *Obstetric Auscultation*, p. 57.

tion of a drop of nitric acid, became converted into a solid mass of the scaly crystals of the nitrate of urea.

Having thus noticed the chemical characters of the two portions into which the urine of the pregnant female naturally separates itself, it only now remains to describe those of the urine taken as a whole.

*Entire Urine of the Pregnant Female.*—The urine when passed is usually faintly acid; apparently from the presence of lactic acid.

When the urine is heated the sediment is dissolved, but no turbidity is caused by raising the heat to the boiling point. As the urine cools the sediment is again deposited apparently unchanged.

When *aqua ammoniacæ* was added to the cold urine with its sediment suspended by agitation, the whole was dissolved, but in a second or two after, turbidity was again observable, which gradually increased, till a copious curdy or flaky precipitate made its appearance. This precipitate was not soluble in the fluid when raised to the boiling point, but was soluble in muriatic, sulphuric, nitric, and acetic acids. On the addition of muriatic and nitric acids, copious white fumes were evolved, filling the vessel in which the experiment was made; but were only feebly evolved on the addition of the sulphuric and acetic acids. The solutions resulting were very transparent when the nitric, muriatic, and acetic acids were used, but acquired a slight opalescent hue on standing, when sulphuric acid was employed to dissolve the ammoniacal precipitate.

When *aqua potassæ* was dropped into the urine with its sediment suspended by agitation, the fluid first became clear, and afterwards a precipitate appeared as in the last experiment, which was equally dissolved by sulphuric, acetic, muriatic, and nitric acids.

When sulphuric acid was added to the urine with its sediment, the whole was dissolved; and the same happened when nitric acid was used. But muriatic and acetic acids had no apparent effect on the sediment; the urine after their addition remained turbid as before. When the whole urine was treated by ether in the same way the sediment had been, the ethereal solution had the same appearance, and gave the same result.

These experiments clearly showed that the natural sediment of the urine was very different from that which appeared on the addition of an alkali; the natural sediment being soluble in the fluid when heated, and also in alkalies, but not in muriatic or acetic acids; whilst the latter precipitate was insoluble in the hot fluid, and was yet soluble in muriatic and acetic acids, the very agents which had a quite opposite action on the natural sediment.

To ascertain the presence of albumen or caseum, some of the

whole urine was boiled, and whilst still hot alcohol was added, but no change took place. To another portion similarly heated acetic acid was added, but equally without indicating the presence of any of these ingredients.

The chief sediments which are deposited from the urine, or occur as calculous deposits, are those of uric acid, urate of ammonia, oxalate of lime, phosphate of lime, ammonia-magnesian phosphate, carbonate of lime, cystic oxide, and xanthic oxide. To which of all these can the natural sediment of the pregnant urine be referred?

It cannot be uric acid, for any acid precipitates it from an alkaline solution,—whereas this natural sediment, though taken up by alkalies, is not precipitable by sulphuric acid; besides being soluble in acids, which uric acid is not.

It cannot be the urate of ammonia for precisely the same reasons.

It is not the oxalate of lime, for nitric acid, which has no action on the oxalate, instantly dissolves the sediment.

It cannot be the phosphate of lime, for muriatic acid, which dissolves the phosphate, has no action on the natural sediment.

It is not the ammonia-magnesian phosphate, for all acids dissolve that salt, whereas the muriatic and acetic acids have no apparent action on the natural sediment.

It is not carbonate of lime, for muriatic acid, which dissolves the carbonate freely, has no action on the sediment; and alkalies which have no action on the carbonate dissolve the sediment.

It cannot be the cystic oxide, for all acids dissolve that substance, whereas muriatic and acetic acids have no action on this.

And for the very same reason it cannot be the xanthic oxide.

If the sedimentary deposit from the urine of the pregnant female is not, and cannot be any of the substances recognized as the usual constituents of deposits from urine, the next object of inquiry is, to discover what it is, and what is its nature.

It was to enable me to separate this matter more completely from the other ingredients of the urine, that I first thought of using ether, as it was possible that this substance, which did not agree in chemical characters with any of the usual urinary sediments, might be an animalized matter. The consequent result of using the ether was what I had anticipated. It separated this matter from all the other ingredients of the urine, when the dissimilarity of the characters from any substance previously known to me strongly impressed my mind.

As the urine of pregnancy, however, gives out a putrid or strong odour, which more than one author has compared to decaying cheese, I thought upon trying the effect of mixing urine, whose chemical characters were known, with a certain proportion of milk,



and then to ascertain whether, on chemical analysis, the same results were obtained as from the examination of the pregnant urine.

My first experiment on such a mixture was made by mixing milk, drop by drop, with urine, on which no acid or alkali produced any sensible precipitate, till the mixed fluid had assumed the hue of pregnant urine with its sediment suspended by agitation. To appearance it was then precisely similar, and might easily have been mistaken for it.

On boiling some of this milky urine no change occurred, nor did the addition of alcohol to it when boiling produce any precipitate. Nitric acid produced a precipitate not affected by heating the fluid gently, but partially dissolved by boiling. This probably arose from the particles of the precipitate being more firmly agglomerated by the heat. *Aqua potassæ* added to this fluid whilst still hot produced no change.

When acetic acid was added to some of the milky urine, no very apparent change took place, though, on examining the fluid by transmitted light, small flocculent particles were distinctly seen floating through the fluid. No further change was produced by boiling the fluid. As it cooled, the precipitate became much more distinct.

Muriatic acid, when added to the milky urine cold, produced no apparent change, but on boiling it, a minute curdy precipitate was thrown down.

Sulphuric acid produced the same small-particled precipitate as muriatic acid, and after the fluid was shaken briskly, it separated as curdy flakes, and floated at the surface. Potash being added to this produced no change.

Ammonia caused no change on the appearance of the milky urine, not even when boiled.

This experiment was several times repeated with varied quantities of milk. When the milk was added in very small proportion no reagent produced any change.

I next mixed some milk with pregnant urine, from which the sediment was removed; as the latter apparently contained the whole, or nearly the whole, of the peculiar matter the nature of which I was anxious to find out.

Boiling produced no change on this milky pregnant urine.

Ammonia removed for an instant, but not completely, the greater portion of the turbidity, but immediately after caused the deposition of a copious flocculent precipitate, which was dissolved on the addition of sulphuric acid, but was immediately thereafter followed by the production of a flocculent precipitate, which rose to the surface of the fluid, leaving the fluid below quite clear. This last precipitate was not soluble in ammonia.

Potash had in every respect the same action on the milky pregnant urine.

Nitric, sulphuric, muriatic, and acetic acids, produced a copious flaky precipitate, which was not soluble in ammonia; but the addition of ammonia in excess caused the subsidence of an additional precipitate.

This experiment was often repeated, and always with the same result; only that, when the quantity of milk was very trifling, none of the reagents had any effect on it.

Thus it appears that the caseum of the milk when suspended in water is capable of being detected by acids, which produce coagulation, but is not affected by alkalis.

I now treated with ether the urine which I had mixed with milk, in the same way as I treated the pregnant urine itself; and found that the ether removed the whole of the animalized matter, or caseum of the milk from the urine, in the same way as it had done the peculiar matter of the pregnant urine.

The ethereal solution of the two could not be distinguished the one from the other. The ethereal solution of the milky urine was viscid, opaque, of a gummy look, and when heated first became somewhat clearer, but as the ether evaporated, and the heat rose, the fluid became more opaque from the formation of a white flocculent precipitate. No red crystals appeared, as occurred in the animalized matter of the pregnant urine.

When this ethereal portion cooled, the precipitate, which had fallen, gave to the fluid a turbid appearance; and when ammonia was added, the fluid became somewhat clearer, from part of the precipitate being dissolved, and then there fell a fresh precipitate, which was removed by nitric acid, leaving the fluid of its original turbidity.

Sulphuric acid caused an increased turbidity in the ethereal portion of the fluid from the production of a fresh precipitate, which was removed by ammonia, when only added to saturation of the acid, leaving the fluid of its former turbidity.

Chemical agents being thus unable to determine the exact constitution of the natural sediment, I had recourse to the aids of microscopic examination.

My experiments had taught me that the peculiar matter of the urine might be removed from the other ingredients by shaking a portion of the urine or its sediment with an equal portion of ether. This plan I therefore at first adopted. The ethereal solution was made, a small portion of it spread over glass, and examined by the microscope.

Upwards of sixty specimens of pregnant urine have been examined in this way, and in all of them globules somewhat similar to those of the milk were distinctly perceived. The whole ethe-

rial portion, in fact, seemed to be composed of globules floating in a viscid gummy-looking fluid, which was quite transparent. The globules, on the other hand, had a whitish hue, and when the light was thrown on their sides, the opalescent light which was reflected rendered them very easy of detection. These globules in every case were perfectly circular, and their colouring matter appeared to reside in their external envelope, as, by transmitted light, the globules appeared transparent in their centre, with a faint opalescent hue on their circumference.

These globules were dispersed over the glass in various groups, according as the layer of matter had been laid on thicker or thinner. Where the layer was thin, the globules were disposed singly for the most part, as in Plate VI. Fig. 1. Occasionally here and there, three or more globules lay in close contact, or were disposed in the form of round little globular bodies, but these could easily be seen to be formed of congeries of the very same minute globules, as in Fig. 2.

Where the layer of matter was thicker, the globules were disposed in very irregularly formed groups, all distinctly made up of the same minute globules,—the interstices between these groups being filled up with extremely numerous single globules, as in Fig. 3.

From the globules being so very numerous and distinct when removed from the rest of the urine by means of the ether, I was induced to examine the sedimentary portion dried on glass. I found it, when recent, to be composed entirely of globules, in no respect differing, either in their general appearance or mode of grouping, from those represented in Fig. 3. When, however, the sediment was allowed to rest a day at the bottom of the urine before being removed for examination, they usually assumed, when laid in a very thin layer over the glass, the appearance of angular lines, or masses connected with angular lines, the interspaces being also filled up with single globules. This appearance is represented at Fig. 4.

The entire urine, before it had deposited its sediment, was the next object of examination, lest it might be supposed that the appearances described were the result of chemical changes. Every specimen of pregnant urine I have examined has contained the very same globules in greater or lesser abundance, according to the period of pregnancy. The most part of the globules float singly, but here and there they are formed into clusters of two, three, or more, and are occasionally agglomerated into little irregular masses, the globules composing which are quite distinct, and of equal size, Fig. 5. They are also very evidently more transparent than when they are seen in the natural sediment, and bear a

much stronger resemblance to the globules of albumen, as seen in albuminous urine. Fig. 6.

The entire urine, with its deposited sediment suspended by agitation, was also examined by the microscope, and found to consist of globules in no respect differing in appearance from those existing in the fresh still clear urine, excepting that the globules had assumed a more opalescent hue, in this respect approaching more nearly the appearance of the true milk globule. They were observed grouped in all the varied forms represented in Figures 1, 2, and 3.

In order that these may be compared with the true milk globule, or globule of caseum, Fig. 7 represents the milk globule, which, to appearance, differs in no respect from the globule of the sediment of pregnant urine, either when it has been deposited naturally or removed by means of ether. The milk globule, however, as it exists naturally in the milk, is much more opaque than the globule of the sediment of pregnant urine before it is deposited as a sediment. The milk globule, after it has been coagulated by means of acetic acid added to boiling milk, is represented at Fig. 8, where it will be seen that, although the properties of the caseum be changed, the form of the globule is not. After the coagulation, however, the globules are apparently still more opaque. In this respect, the milk globule bears a similarity in its minute changes to the peculiar globule of the pregnant urine. Both, when precipitated from their solutions, become more opaque.

When milk, deprived of its oily parts, is agitated with ether, nearly the whole of the globules of caseum are removed, and when spread on glass and examined by the microscope, they present in every respect the same appearance as those represented in Fig. 8.

The ethereal solution obtained from the urine which had milk added to it, likewise exhibited the milk globule unchanged, and is represented at Fig. 9, the globules being disposed singly or in irregular groups and masses over the glass.

Such is the appearance of the sedimentary portion of the urine of the pregnant female when examined in the recent state, either whilst it is still held in solution in the urine, deposited as a sediment, or separated by means of ether. In all these states it is composed of distinct transparent or pellucid globules, which in their pellucid state bear a striking resemblance to the serous globule; but when in the sedimentary state, an equally strong likeness to the milk globule in recent milk.

The question, then, as to the precise nature of this substance, is limited to very narrow bounds. It is quite apparent, from its chemical properties, as well as its minute structure, that it differs essentially both from albumen and caseum, the two most analogous substances existing in animal structures. From albumen it differs in being solu-

ble in water by means of heat, which coagulates albumen, and from caseum, by being rendered soluble by sulphuric and nitric acids, which have a solidifying action on caseum. The only other analogous principle in animal structures, and one which is regarded as only a modification of albumen and caseum, is fibrin, from which it differs still more than from those above noticed.

There is another substance, however, occurring in animal structures, the characters of which it will be necessary to notice before drawing any conclusions as to the nature of this one, viz. Gelatine.

The characteristic marks of gelatine are, that it is soluble in boiling water, with which, on cooling, it forms a tremulous jelly. It is soluble in acids and alkalies, and is precipitated from its solution in water by means of tannin.

When a drop of its watery solution is examined by the microscope, it also presents the appearance of distinct transparent round globules, of the size of the milk globule. See Fig. 15. When ether is agitated with its watery solution, it also removes the gelatine as it did the caseum, albumen, and the peculiar matter of the urine; and on examining this by the microscope, the globules are seen to be unchanged in appearance.

Gelatine then resembles the peculiar matter of the urine of the pregnant female in so far as it is composed of similarly formed globules, is soluble in acids and alkalies, and in water with the aid of heat. The peculiar matter of the urine was therefore tested with solution of tannin, to ascertain whether any difference existed, in this respect, between them.

Some of the natural sediment was collected, still moistened with the urine, from which it was obtained, and decoction of nut-galls added to it, after it had been dissolved in water by boiling, and cooled down to blood-heat. A slight flocculent precipitate was occasioned, which rose to the surface of the fluid. When this was agitated with the fluid and boiled, the whole dissolved, leaving the fluid quite clear.

Here, then, were two especial distinctions, by which the peculiar substance referred to seems to be separated from gelatine; *first*, it was precipitated from its solution in water as it cooled, and, *secondly*, though a partial precipitation was occasioned by tannin, the precipitate was soluble in water on boiling it. The precipitation of gelatine by tannin is only rendered more solid, and more easily separable from the fluid, by boiling.

The conclusion, then, at which I arrived, was, that *this substance is a matter sui generis; an elementary substance or principle, forming, in some measure, a connecting link between the albuminous and gelatinous elementary principles.* I therefore propose to designate it by the name of GRAVIDINE,

from *gravidus*, big with young, as occurring during the state of pregnancy, and having had its nature first pointed out from examining the urine during that state; and also from *gravis*, heavy, denoting its precipitation, and falling down to the bottom of the vessel, as the fluid containing it cools.

The term *kiestein* I still use to express the pellicle which results from the decomposition of this peculiar animal matter.

M. Vogel, in a very instructive paper on animal chemistry,\* states, that "these three substances, albumen, fibrine, and caseum, present many points of resemblance in their properties. All can exist in two states, dissolved or coagulated, with this difference only, that fibrine coagulates of itself, on being removed from the living animal body; that caseum is so by some unknown process on the addition of rennet; and that the coagulation of albumen is especially produced by heat."

This discovery of a new elementary animal substance, for such I may term it, adds then a fourth to the substances which exist in two states. It is in its fluid state in the urine when still hot, and in its solid or coagulated state when deposited naturally on cooling, or when precipitated from an alkaline solution, by means of muriatic acid. Indeed, very nearly the same remark as to these animal principles, being capable of existing in two states, is applicable to gelatine, and perhaps all elementary animal principles.

It is from the decomposition of the globules which exist in the urine of the pregnant female that those changes result which terminate in the formation of the pellicle of *kiestein*. In proportion as the globules become decomposed, urates and purpurates become developed in the urine; and when the greater portion of these have broken up and have assumed new combinations, the triple phosphate makes its appearance, and then we have the beautiful crystalline appearance, so well described by Dr Bird, as being one of the characteristics of the pellicle of *kiestein*.

The globules of *gravidine*, however, pass through several changes before they arrive at that stage in which the triple phosphate becomes the leading or chief ingredient.

When the natural sediment was treated by ether, after having lain three or four days in winter, or two days in summer, at the bottom of the urine, and the ethereal portion boiled with a little water, a heavy, red, copious, crystalline sediment fell to the bottom of the fluid, which, on being examined by the microscope, exhibited distinct cubical crystals of a deep-brown colour, by transmitted light, evidently crystals of lithic or purpuric acid, or compounds with ammonia, Fig. 10, *a*. In other instances, the crystals assumed various forms of the rhomboid, as represented at Fig. 11,

\* Journal de Pharmacie for 1830, p. 590.

but still were all of the deep reddish purple or brown colour. A few globules of a large size and oval shape, with a clear centre and coloured circumference, were also observed, the nature of which I have not yet determined.

The watery portion of the same sediment which had been treated with the ether, and then boiled, also deposited a considerable quantity of bright red crystalline-looking sand, which on examination proved to consist of crystals of various forms, those of the different forms of the cube, rhomboid, and rhomboidal prism being much the most numerous. A few colourless triangular prisms of the triple phosphate were also quite distinct; a very few of the flat octohedrons, represented by Wollaston, as that which the oxalate of lime most frequently assumes; and one or two whose exact nature I could not even guess at. Several small globules were seen scattered over the surface; and in groups or single, large dark-margined oval globules with clear centres. The cubes, rhomboids, and rhomboidal prisms were all of the same deep brown or reddish purple as those above noticed, and were evidently either lithic or purpuric acid, or some of their compounds. All these forms are represented at Fig. 12.

In one of the processes employed, crystals resembling cystic oxide were produced in considerable quantity. A portion of urine, from which the greater portion, but not the whole, of the sediment had been removed, was evaporated to dryness by a very gentle heat; but towards the end of the process the heat was increased so as to drive off every remaining portion of moisture; water was then added, and heat again applied; and on removing some of this fluid, and examining it with the microscope, numerous beautiful large, more or less regular transparent six-sided crystals of cystic oxide were obtained. In many cases the crystals were of excessive tenuity, resembling six-sided plates. See Fig. 10, *b*.

When the pellicle of kiestein has fallen to the bottom of the vessel, and the whole urine is exhaling a most intolerable odour, scarcely any crystal is observed, but the colourless triangular ones of the triple phosphate, and the globules are evidently much diminished in number. It appears, indeed, that all the chief changes which result from the decomposition of urine result from the breaking up of these globules, and the elementary parts which compose them entering into new combinations.

This was most beautifully illustrated in a specimen of urine obtained the 16th of November, from a patient in the Royal Infirmary, who had a miscarriage 48 hours before. The urine when first passed possessed all the characters of that which occurs during the course of pregnancy, and one more—it was filled to saturation almost with urea. When a drop of the urine was dried on glass

the long crystals of urea were seen crossing it in all directions. See Fig. 13. The very next day, however, I observed that the copious sediment which had been deposited on cooling had become almost entirely dissolved; that the fluid of the urine had become much deeper in colour; and that when a drop was allowed to dry on glass, and was examined by the microscope, the urea had almost entirely disappeared, the globules were much less numerous, and, in place of the urea, there were numerous cubic and rhombic crystals of the lithic or uric acid. See Fig. 14.

As to the probable mode of formation of this peculiar matter in the urine during pregnancy, I am not prepared to give any opinion. Ever since the publication of the memoir of M. Nauche it has been regarded as a variety of caseum, and described as milk in the urine. Theory then found it easy to suppose that milk had been secreted in the breasts, but not having an outlet there was again taken up and thrown out of the system by the kidneys. As the matter, however, is neither milk nor caseum, but a peculiar and distinct substance, this explanation will not serve; and even Dr Golding Bird, though holding the milk theory, has mentioned several circumstances which seem subversive of it.

Such, then, are the facts which I have observed to be characteristic of the existence of pregnancy during the first three months of gestation; and, though somewhat contrary to the general belief, I am inclined to think, that, by due attention to them, a certain opinion may be given, if not by the end of the second, certainly by the middle of the third lunar month, that is, the end of the tenth week. At this period all the symptoms characteristic of pregnancy are present, and when the combination of the areola, enlarged uterus, placental souffle, and gravidine in the urine, occur, no doubt can remain as to the existence of a fœtus in utero. In many cases these signs, when carefully attended to and well marked, will enable the observant physician to form a decided opinion by the end of the sixth week; but it is extremely rare, indeed, that any one is asked to give a decided opinion at such an early period. In a medico-legal case again, where we are required to give evidence on oath, unless the other signs were from their combination quite conclusive, it would be better to wait till the end of the tenth week, by which time the enlarged uterus and the presence of the placental souffle would put the case beyond doubt.

#### *Explanation of Plate VI.*

Fig 1. Globules of gravidine removed from the natural sediment by means of ether.

Fig. 2. One of the forms of aggregation assumed by the globules of gravidine when dried on glass.



Fig. 3. The most common form of aggregation of the globules of gravidine, as seen in the natural sediment, or when separated by ether.

Fig. 4. Appearance which the globules of gravidine frequently assume when the natural sediment has been dried on glass.—Dr Prout, in his work on Urinary Diseases, represents globules assuming somewhat of this form as oxalate of lime.

Fig. 5. Gravidine globules as seen in the urine whilst still recent.

Fig. 6, *a*. Globules of albumen as seen in albuminous urine whilst in a fluid state. *b*. Ditto dried on glass; represented by Dr Prout as one of the forms which the triple phosphate assumes.

Fig. 7. Globules of caseum, as seen in milk after the cream has been removed.

Fig. 8. Globules of caseum after the milk has been coagulated by means of acetic acid.

Fig. 9. Globules of caseum removed by means of ether from urine with which milk had been mixed.

Fig. 10, *a*. Red coloured cubical crystals of lithic or purpuric acid deposited from the boiling solution of gravidine in ether.

*b*. Six-sided transparent crystals obtained from the watery extract of pregnant urine after the greater portion of the sediment had been removed. From their form and transparency they bear a strong resemblance to crystals of cystic oxide.

Fig. 11. Forms of the cubic and rhomboidal prisms deposited from the ethereal solution of gravidine when boiled. Probably lithic or purpuric acids or their compounds.

Fig. 12. Crystals of various forms deposited from the ethereal solution of gravidine which had become partially decomposed from remaining some days in contact with the urine. The triangular prisms appear to be the triple phosphate; the flat octohedron is supposed to consist of the oxalate of lime, that being the form commonly assigned to that salt. The others, which were of a clear but deep brown by transmitted light, but of a deep red by reflected light, appear to be either lithic or purpuric acid, or their compounds.

Fig. 13. Crystals of urea, and globules of gravidine seen in the urine of a woman who had a miscarriage 48 hours before.

Fig. 14. Cubic and rhomboidal crystals of lithic acid, replacing the greater portion of the urea and globules in the same urine after it had stood in a warm apartment for 24 hours.

Fig. 15. Globules of gelatine as seen in the jelly of isinglass, recent, or dried on glass.

