in others no more difficult operation can be undertaken. As an example of the latter, I may refer to one of the cases in which I was associated with Dr Affleck, and I do so the more readily because, as is unusual in such, it terminated fatally. A distinct finger-like process could be felt stretching towards the pelvis, but upon incising in the usual place this was found to be a thickened and matted coil of bowel. There had been many inflammatory attacks, and the adhesions were so old and tough, and the complications of bowel so intricate, that their dissection and separation occupied nearly two hours before the diseased appendix was reached. Even then it was a work of great difficulty to separate it from its surroundings. I found assistance in the discovery of the appendix after the cecum had been detected (in itself a work of great difficulty) by following down the longitudinal broad band. I also found it easier to dissect out the appendix by working from its base. I do not know, looking back on this case, whether or not I should have proceeded with the operation on discovering the condition of affairs. The shock was tremendous, and the patient sank on the second day, there being slight indications of peritonitis. I suspect that during the prolonged operation some error was committed, and that the peritonitis may have been septic. The operation was performed in the crowded general theatre. I am not in the habit of fearing prolonged exposure, even in such an atmosphere. Septic infection rarely comes from the air; but in this case there was necessarily much bruising of tissue, and its germicidal value was necessarily greatly lowered. I have the feeling that in private even such a case would have been successful.

III.—ON ABORTION.

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Before attempting to discuss the multifarious causes which may lead to and determine the premature expulsion of an impregnated ovum from its recognised habitat, the uterus, it is absolutely requisite that we should be familiar with those evolutionary changes which a healthy ovum placed under the most advantageous circumstances will display both before and after fecundation. Unless we possess this knowledge it is impossible for us to appreciate aright the manner in which some of the causes of abortion exert their influence. The need for this knowledge is greatly enhanced by the fact that there is hardly an action or a disease which has not been assigned as a cause of this untoward event. Whilst investigating this abstruse phenomenon we must never lose sight of the fact that we are dealing with an organic mass which is the product of two elements, one of which is derived from
the male and the other from the female parent; and that this germinal mass may be expelled from the uterus before it attains maturity, in consequence, it may be, of some physico-chemical disturbance emanating either from the sperm or the germ element. From the first moment of its existence every impregnated ovum bears within itself a principle of death as well as a principle of life; but it frequently happens that an ovum which is not perfectly healthy is fecundated, and in this case the principle of decay may assert its supremacy whilst embryonic development is proceeding, and the life of the foetus may be thereby destroyed. What is true of the ovum is also true of the spermatozoon; for in order that the process of ontogenetic differentiation may be completed, not only must the segmentation nucleus contain a certain amount of germ plasm, but its quality must be of a certain standard. If the quantity is too rapidly exhausted, or the quality is unequal to the demand made upon it, embryonic development may cease, and thereafter the immature product of conception will sooner or later be expelled from the uterus.

In the case of some of the Lepidoptera which reproduce by parthenogenesis, it is observed that all the eggs laid by an unfertilized female do not develop—some perish. Now, if the eggs which have failed to bring forth young are examined, it is remarked that in many the process of evolution has been arrested at very different stages,—the impulse to development had, in fact, been imparted, but the power to complete it had been withheld. Revelations of this character teach us that the growth of nuclear substance which is not unlimited and uncontrolled is regulated by physico-chemical influences of an extrinsic as well as an intrinsic nature, and that although segmentation and differentiation has been started, it does not follow that these operations shall be carried to completion.

It is now universally admitted that in the human female the ovary is the seat of origin of those cells which are destined to participate in the perpetuation of the race. In their early state these cells are simple. Each is composed of a transparent mass of protoplasin containing a very large nucleus and a nucleolus. To the nucleus and nucleolus respectively the terms germinal vesicle and germinal spot have been applied. From time to time much discussion has arisen regarding the order and manner in which these components of the egg make their appearance. Some believe, with Baer and Purkinje, that the germinal vesicle is the first in existence; whilst others, again, assert that this priority belongs to the germinal spot. All are agreed that the protoplasm or vitellus accumulates round the germinal vesicle, and that the vitelline membrane is produced simply by a coagulation of this material.

All germinal cells do not, as a rule, become ova; but the many subserve the few which attain this distinction. The ovum, like every other structure of the body, grows and is nourished; but it is noteworthy that the materials which feed it are chiefly derived,
directly or indirectly, from those neighbouring germinal cells which are not destined to become ova. In some cases, as in sepia, these abortive cells are actually devoured by the ovum; but, generally speaking, they form a special layer around the egg, and this structure is nourished by these so-called follicle cells, which elaborate material from the nutrient fluid. At first the protoplasmic body of the ovum is small compared with the nucleus or germinal vesicle; gradually, however, it increases in size as the ovum becomes more and more mature.

When the egg has completed its development in the ovary it is set free by a mechanism which varies according to the species that one observes. In birds, reptiles, fishes, and the vertebrates generally, the egg, by virtue of its own size, bursts its confining capsule and escapes from the Graafian vesicle; whereas in the mammals the ovum by itself never exerts a sufficient amount of pressure to produce this result, but its escape is effected through the agency of an exudation of serous or bloody fluid into the Graafian vesicle. It necessarily follows that if this secretion does not take place, or is insufficient in amount, the ovum cannot escape, and sterility results. In the case of the human female, as well as other animals, eggs exist prior to conception, and they are often expelled from the body even without being fecundated. It is therefore evident that, independently of any influence on the part of the male, an ovum when it reaches maturity may escape naturally from the ovary. The secretion, however, which causes the Graafian vesicle to rupture in a mammal may either accumulate gradually as the ovum ripens, or it may be poured out more or less suddenly during sexual intercourse.

We are not as yet cognisant of the time at which the ovum most probably escapes naturally from the human ovary. Considering, however, that rupture of the Graafian vesicle results from augmented tension, and that the greatest amount of tension in the genital organs exists just before an expected "period," I am of opinion that the egg makes its escape naturally from the ovary at or about the time when the menstrual discharge makes its appearance. The breach on the surface of the ovary is rapidly repaired. In consequence, however, of the cicatrices which are thus produced the ovary may eventually become so corrugated that the ova can no longer escape. For this reason, toward the end of the child-bearing epoch menstruation may continue to recur regularly for months, or even years, after the cessation of the process of oviposition.

The egg when extruded from the ovary is enveloped by certain structures which are called primary membranes. In reality two primary membranes are recognisable. One, the vitelline, is formed by the protoplasm which constitutes the body of the ovum; whilst the other, the chorion, is developed from the follicle cells. In the vertebrata two vitelline membranes are found. For one the term
"vitelline membrane" is retained; whilst to the other, which is perforated, the term "zona radiata" is applied.

It is not yet definitely settled what changes may take place in an ovum which has not been fecundated. In the case of an unfertilized ovum it is alleged that the germinal vesicle and germinal spot may both disappear; whilst other authorities assert that these structures only disappear if the egg has been fecundated. A third group of observers affirm that the vesicle continues after impregnation.

According to Fol the ripe ovum when detached from the ovary possesses a granular vitellus and is enveloped by a mucilaginous coat—the zona radiata. The germinal vesicle then occupies an eccentric position and contains a germinal spot. As a normal result of growth, and independently of fecundation, the following changes may now take place:—A spindle is formed which approaches a small prominence on the surface of the egg; out of this spindle is formed the so-called polar bodies or cells, whilst from the portion of the spindle which remains in the egg are found two or three clear vesicles. These vesicles rapidly unite and form a single nucleus. This nucleus, which is evidently a product of the original germinal vesicle, is called the female pronucleus. The egg, it would appear, is not in a fit condition to receive and respond to the influence of the sperm element until these changes have taken place,—until, in fact, the female pronucleus has been evolved. If, however, a spermatozoon approaches an egg in which these changes have occurred, it is remarked that the protoplasm of the egg begins forthwith to bulge at a spot pointing to the nearest spermatozoon. This prominence, or cone of attraction, is only developed when the sperm and the germ elements have an affinity for each other; but once it is formed it continues to grow until it coalesces with its partner. One spermatozoon only, it would appear, is requisite for a healthy evolution of the process of nuclear segmentation. When two or more spermatozoa fecundate an ovum, a monster or some other pathological product of conception is likely to be developed. Once contact is established between a spermatozoon and the cone of attraction, the ovum is incapable of being influenced by other spermatozoa, even although these be in close apposition with it. Immediately the two elements coalesce the body of the spermatozoon commingles with the substance of the cone, and nuclear division rapidly ensues. Cleavage takes place and two spheres are formed, one of which is larger than the other. The larger is the epiblast and the smaller the hypoblast. The hypoblastic sphere, again dividing, produces the mesoblast. The mesoblast splits into two layers, a splanchnic and a somatic; and it is from a fold of the somatic mesoblast and the epiblast that the amnion is developed.

When the impregnated ovum arrives in the uterus it becomes attached to the walls of this organ by peculiar processes or villi
which grow out from the ovum and fit into folds of the uterine epithelium. These villi, which continue non-vascular for nearly three weeks after their formation, nourish the embryo by absorbing material from the uterine tissue. At this early period fluid is even found in the amnion. Towards the end of the third week after conception the allantois, rapidly developing, thrusts its blood-vessels into the chorionic villi. Until about the sixth or eighth week—i.e., for three weeks—the ovum is practically covered by placenta. Towards the end of the second month those chorionic villi which are not destined to participate in the formation of the true placenta atrophy and finally disappear, leaving under ordinary circumstances no trace of their existence.

Having thus far cursorily dealt with these early evolutionary changes, a thorough knowledge of which is so essential for our guidance in discussing the phenomenon of abortion, we shall now turn our attention to and study those physico-chemical disturbances which may lead to and determine the expulsion of an immature product of conception from the body.

A woman, it must be borne in mind, does not become pregnant because she has ceased to menstruate, but she ceases to menstruate because she has become pregnant. In spite of this truism, the idea of the probable existence of pregnancy is not generally entertained until a menstrual period is missed. During the early days of pregnancy, however, it is quite possible that a woman, ignorant even of the fact that she has conceived, may miscarry without her knowledge. The process of evolution may be arrested at any stage; for, as I have already remarked, although the impulse to development is given, the power to complete it may be withheld. Early products of conception need not, however, be confounded with those casts of the uterus or shreds of membrane which are occasionally extruded by virgins and others, and which constitute the so-called membranous dysmenorrhea. These croupous exudations, whose minute structure is totally different to that of a blighted ovum, are never a direct result of insemination, although in some cases the tendency to their formation appears to be greatly increased by indulgence in sexual intercourse.

When abortion takes place it is often difficult, and sometimes even impossible, for us to determine the actual cause of this disaster; and yet it is evident that the physico-chemical disturbance inducing it must belong either to the sperm or the germ element, or be directly attributable to the mother herself. Once the spermatozoon has left the body of the male it can no longer be directly influenced by the vicissitudes to which the body of its parent may thereafter chance to be exposed. The woman, on the other hand, has not only to contribute her share in the formation of a segmentation nucleus, but she must harbour and nourish in her body for a more or less fixed period of time the impregnated ovum. During this sojourn the product of conception is liable to be affected by
conditions which may exert an influence upon the body of the mother. The nucleoplasm may be sufficiently endowed to complete its evolutionary changes, but these may be arrested at any moment in consequence of some physico-chemical disturbance which either did exist before or may have originated after impregnation, and for which the mother is solely responsible.

When men or women are exposed for a greater or less length of time to the influence of certain toxic agents the vigour of the reproductive elements begotten by these individuals is apt to be impaired. For this reason a fecundated ovum generated or impregnated by an individual whose constitution has been acted upon by lead, bi-sulphide of carbon, or other toxins, is exceedingly liable to be aborted. If the husband or the wife is employed at a lead factory, or is exposed to the fumes of bi-sulphide of carbon at an India-rubber work, abortion, it will be remarked, is a common sequel of pregnancy. So potent, in fact, is the influence of lead in the system in the production of this untoward event, that nearly 50 per cent. of the women who have for a length of time worked with lead fail, when they become pregnant, to carry the product of conception beyond the third or fourth month. Still more decided, even, is the deleterious influence of bi-sulphide of carbon on the organs of generation, for not only does intoxication by this compound predispose to abortion, but it tends to abolish the sexual desire and induce a state of impotence. The women, it is alleged, who bottle quinine, and who thus respire the dust of this powder, lose the aptitude for carrying the impregnated ovum to full time. I have been unable to verify the truth of this statement, although I am convinced that quinine given for a long period in large doses disturbs temporarily the organs of generation in a variety of ways. It is generally stated that syphilis is the most common cause of abortion. My opinion is that the influence of this disease is very much overrated, and I feel assured that if it did not so exclusively engage the attention of observers, the treatment of abortion would be attended with better results.

The impulse which urges the nucleoplasm to undergo segmentation and to finally produce an independent being is intimately bound up in the material itself. From the first moment of its existence the germ plasm carries with it the promise and the potency of the future. It is therefore evident that if the vitality of the segmentation nucleus is impaired either through the agency of the sperm or the germ element, embryonic development will cease as soon as the power of transformation is exhausted. The conditions, obscure though they undoubtedly are, which bring about this result are necessarily causes of abortion, for the uterus will not, as a rule, tolerate for long the presence of a dead ovum in its cavity.

Whatever brings about the death of the ovum is necessarily a cause of abortion. It sometimes happens, however, that it is
impossible to say whether the pathological change or changes which one detects in an aborted product of conception may be a cause or a correlative of intra-uterine death. In the case of hydatid mole, for example, it is still an open question whether the change which takes place in the chorionic villi precedes and determines the death of the ovum or is a concomitant of arrested embryonic development. Before discussing the many questions of interest suggested by this variety of abortion, the record of a fairly typical case which recently came under my observation may be worthy of attention. A woman, aged 25, who had been married seven years, was sent to me, at the Hospital for Women, by the late Dr Townsend on July 10th, 1892. She had borne five children, but had had no miscarriages. The last child was twenty-eight months old, and it had been suckled for sixteen months. Four weeks after weaning the menstrual discharge reappeared, and recurred regularly thereafter for five months. After this there was complete amenorrhoea for three months. When, however, the patient considered herself three months advanced in pregnancy a hæmorrhagic discharge made its appearance, and this discharge continued to flow more or less freely until July 11th,—i.e., for eleven weeks,—when a hydatid mole was expelled from the uterus. On July 10th, the day before this patient aborted, the summit of the uterus was on a level with the umbilicus. The consistence and configuration of the abdominal swelling was similar to that of an ordinary pregnancy. On palpation the tumour was felt contracting and relaxing. No uterine souffle nor foetal heart could be heard. The breasts were not enlarged, neither did they display the characteristics of pregnancy. The cervix was soft and the os closed. There was no evidence of constitutional disturbance other than what one would have expected simply as a result of eleven weeks’ continuous hæmorrhage. The mole was carried for six months, and the size of the uterus was similar to that of a normal pregnancy of like duration. From the cases I have seen, I am convinced that unless the product of conception is carried beyond the fifth month it is impossible to differentiate a case of hydatid mole from one of ordinary pregnancy, except when pieces of the pathological product are expelled from the uterus or are felt hanging through the os. After the fifth month the absence of the uterine souffle and of the foetal heart, together with the negative signs of the breasts, are of the utmost importance from a diagnostic point of view. It seldom happens, however, that a hydatid mole is carried longer than six months.

(To be continued.)