History of the development of the human ovum, with a comparative view of the development of the ova of mammalia and birds / translated and abridged from the German of G. Valentin ... by Martin Barry.

HISTORY

OF THE

DEVELOPMENT OF THE HUMAN OVUM,

WITH A COMPARATIVE VIEW OF THE

DEVELOPMENT OF THE OVA OF MAMMALIA AND BIRDS.

TRANSLATED AND ABRIDGED FROM THE GERMAN

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* "Handbuch der Entwickelungsgeschichte, &c."

The present article contains a part only of Dr Barry's translation of this work. It is intended to publish the whole of this translation soon in one volume. Dr G. Valentin has lately been awarded the Great Prize in the physical sciences, by the Academy of France, for a Memoir on a subject closely connected with that of the present work.

I. *The unimpregnated Ovum as contained in the Ovary.*

The ovum of the higher classes of animals contains, while it is in the ovary before impregnation, the following different parts, some of which undergo changes or disappear at the time when, in consequence of conception, the ovum leaves the ovary; others continue.

1. An external membrane enclosing and circumscribing the ovum, the membrane of the yolk, yolk-bag.

2. A more or less fluid content, the yolk.

3. A peculiar layer of granules, more or less widely spread over the surface of the yolk; the blastoderma.

4. A transparent vesicle filled with a pellucid lymph, imbedded in the centre of the blastoderma, lying on the internal surface of the membrane of the yolk, the germinal vesicle called also the Purkinjean vesicle, after its discoverer Purkinje.

The ovum receives from the ovary itself also,

5. A membranous envelope, consisting of a granular layer and a viscid matter united,—in which lie the blood-vessels; and

6. A covering, that proceeds from the substance of the ovary, for the most part granular, tough, compact and dense.

The egg of the bird, as best known, will serve as a basis for research, a standard with which to compare the results of investigations in the Mammalia and in Man. We follow in this the researches of Purkinje,* in some of which we have ourselves taken part, while the correctness of others, we can from our own observations confirm,—and in a very small degree extend the results.

If the smallest ova in the ovary of a bird be examined, for example in that of the domestic fowl, they are found of a pretty decidedly spherical form, and grayish-white in colour. The external enclosing membrane, as well as the lamella of the blood-vessels, it is very difficult to separate from the membrane of the yolk;

* Symbolae ad ovi avium historiam ante incubationem. Wratisl. 1825, ed. alt. Lips. 1830. 4.

and if this be accomplished, there is nothing perceived but a finely granulous opaque substance, which constitutes the whole content of the ovulum. If crushed by pressure, however, between two plates of glass, the perfectly transparent, and to all appearance structureless membrane of the yolk may be separated from its content. The latter consists of a fluid mass, which contains an immense number of very minute, decidedly round particles. The size of these transparent particles is so small, that they exceed but little that of the molecules of Brown. These granules, as Gruithuisen has observed, and which our own observations confirm, very often present molecular motions. In larger ovula, the homogeneous transparent mass, which unites the granules, is found to have increased in quantity, and to have assumed an oily consistence. This is shown partly from the fluid having acquired a higher degree of tenacity, and from the appearance in it of single round drops, like drops of oil or fat; partly also from these isolated globules, as well as the whole ovum, having received a more saturated yellow colour. This content is then usually called the yolk of the egg. More minutely considered, the yolk of the bird consists partly of the primary, very minutely granulous mass, partly of an oily matter. This enlightens us as to the condition of the ova of the Mammalia as well as of the lower vertebrated animals. In the latter, namely, these two substances are not mixed, as in birds, but more or less separated. Thus, in the ovum of fishes, as well before as during the impregnation and development of the embryo, there is found a viscid mass containing granules, which is generally called the yolk, and a drop, or several drops of oil, which perform an important part here during the whole period of evolution, as Cavolini, Carus, Rathke, and others, have observed, and as we shall, in another place, more particularly describe. In the ovum of the Batrachian reptiles, there are found single drops of oil, enclosed in an exceedingly granulous fluid mass. This has been observed also in the Ophidian and Chelonian reptiles. Of the Mammalia and Man, we shall presently speak more fully.

Besides the yolk and the membrane of the yolk, there are to be distinguished in somewhat larger ovula in the ovarium of birds, the germinal vesicle and the blastoderma, so that all the above-mentioned parts of the ovum can be presented with distinctness in an isolated form. The diameter of the smallest ovulum, in which we found this possible was $\frac{1}{6}$th of a line. We shall now describe the individual parts, from these to the largest, *i.e.* to those found at the moment in which the ovum separates itself from the ovary to enter the oviduct.

1. *The membrane of the yolk* is a transparent and structureless membrane, which, indeed, in many cases, presents on its inter-

nal surface a layer of very minute delicate globules, but which probably, as we shall soon see, does not belong to the membrane itself. It encloses, exactly, the ovulum loosened from the parenchyma of the ovary, and increases in size with the ovum itself, so long as the latter remains in or upon the organ. In no part of it is there visible the trace of a cicatrix. It presents rather a continuous sac, closed throughout, and conforms in its external shape, entirely to that of the ovum generally, and of the yolk in particular. It is therefore in smaller ova, of a roundish or elongated, in larger, always of a decidedly spherical, form. Extremely seldom only, are there slight traces of fibres to be perceived in it.

2. *The yolk*, in an advanced stage of the development, is a yellow fluid mass, of tolerably viscid consistence, and contains in the recent state a multitude of larger or more minute yellow globules of a decidedly spherical form, and of perfect transparency. Together with these globules, there is found distributed in it a multitude of smaller ones, which, as we have seen, precede in the time of their formation, the development of the true globules of the yolk, but which are present in relatively larger quantity at an early than at a later period. Through the influence of a high temperature, of alcohol, &c. the yolk is changed into a firm crumbling mass, which in its individual parts presents not an altogether irregular outline, though the mathematically determined form of crystals is wanting.

If the yolk be cut obliquely with sharp scissors, there is found in its middle a substance, essentially differing from the true substance of the yolk. It presents itself with a more or less decided circumference, and Purkinje concluded, from the conformation of its outline, that this mass passed through a canal in the yolk, which proceeded, at first pretty narrow, from the cicatricula to the centre of the yolk, here assuming a vesicular, widened form. In the second edition, however, he expresses doubts regarding the correctness of this view. Although in the fluid mass of the yolk, it is scarcely possible to decide regarding the form which the matter, found in its centre, may there assume, yet so much appears certain, that within the yolk there is generally contained a substance heterogeneous to it, which, according to Purkinje, consists of a multitude of globules, larger than those of the albumen. In the boiled egg, this matter is of a milk-white colour, and has a saltish taste. But whether the space in which this substance is contained, and which in newly laid eggs is most distinctly recognizable, whether this space have the shape assigned to it by Purkinje, or the somewhat different form figured by Burdach and Karl Ernst v. Baer, may never with certainty be determined.

3. *The foundation of the Germinal membrane.*—In the ovum of the fowl which is so far advanced in its development that it is leaving the ovary and entering the oviduct, there is seen through the membrane of the yolk a grayish white circular spot, which from early times has been known under the name of the macula or cicatricula. If the ovum be lacerated, and its content minutely examined, the cicatricula is found like a grayish white disk, which in its whole periphery is dense, granulous and opaque, but in the centre presents a clear non-granulous, and perfectly diaphanous point. This observation was made so long since as by Fabricius ab Aquapendente, Harvey, and others, and has been repeated with ease by very many other naturalists. Purkinje, who, in 1825, again entered upon researches on the unincubated egg of the bird, was so fortunate as to place the relation of this transparent, non-granulous point in a clearer light. He found, namely, that when he removed the dark granulous mass, by suction with a small tube, there remained a perfectly transparent vesicle, filled with a pellucid lymph, which had a decidedly spherical form, but being extremely delicate, was very easily lacerated, and its fluid escaped. As he found this, which later naturalists have named, after its discoverer, the Purkinjean vesicle, in the ova of the ovary, but could not see it in ova which had already entered the oviduct, he assigned to it the name of germinal vesicle. This germinal vesicle is imbedded in the granulous layer of the cicatricula, so that the latter forms a depression around it, but which depression, viewed from above, appears like a circle, surrounding the vesicle. With that portion of its surface directed outwards, the germinal vesicle touches the internal surface of the yolk-bag, without being organically connected with it. The disk which surrounds it consists of many minute granules, lying closely together, and united by a transparent, tenacious matter, appearing at first sight circumscribed in the form of a round or oval disk. But when this disk is examined with aplanatic lenses, while within the uninjured ovum, it appears probable that the granulous layer lying on the internal surface of the yolk-bag is a continuation of the disk, the granulous layer, situated between the yolk-bag and the yolk itself, every where embracing and enclosing the latter. The granulous membrane,—its thickened portion, the so-called cicatricula,—and the germinal vesicle, constitute those parts of the ovum which pass immediately into the original foundation of the embryo, the blastoderma or germinal membrane. We shall therefore assign to the tout ensemble of the parts now mentioned, the name of *Germinal membrane* (Keimanlage,) distinguishing in it,

1*stly*, *The granulous layer under the yolk-bag.*

2*dly*, *The cicatricula or thickened portion of this layer*; *and* 3*dly*, *The germinal vesicle.*

If it be easy to exhibit the three parts constituting the germinal membrane in large ova, a perception of them on the other hand, in the smallest ovula of the ovarium, is attended with almost endless difficulties. For the little, delicate vesicle, the germinal vesicle, bursts with every, even the most careful, manipulation; the granulous layer, lying internal to the yolk-bag, is scarcely with certainty distinguishable from the remaining content of the ovulum, (which as yet presents no yolk-granules) especially as the thickening of the same, in the neighbourhood of the cicatricula, is still entirely wanting, or very inconsiderable. It is remarkable, however, and a certainly established fact, that the germinal vesicle is relatively largest, in the smallest ova in which it can be shown, and that even absolutely, it then has, upon the whole, but an inconsiderably less volume, than when the ovum in the ovary has reached its highest degree of development. Purkinje found, in a series of micrometric observations, the following magnitudes.

Diameter in Vienna Lines.

	a. *the Ovulum*,	and b. *the Germinal Vesicle.*
1.	0,11000	0,05000
2.	0,12500	0,05500
3.	0,13125	0,06250
4.	0,14375	0,06875
5.	0,21875	0,10250
6.	0,22000	0,11256
7.	0,22500	0,10625
8.	0,23750	0,10750
9.	0,30000	0,12125

It is thus seen, from these relations in regard to magnitude, that the germinal vesicle, throughout, does not increase in size in proportion as the ovum grows, *i. e.* as the yolk especially acquires volume, but that at an earlier period, it is relatively larger than the yolk, and the outer envelope of the ovum, taken together. It is otherwise, however, with the cicatricula, or thickened disk, surrounding the germinal vesicle. The disk is wanting, or extremely delicate, when the germinal vesicle has already reached a considerable size and its destined form. Only by degrees, does the mass around the vesicle become thicker, so that it is in ova of one and a half to two lines in diameter, that, as a white spot on the yolk, the disk is first visible to the naked eye; whereas the germinal vesicle then already lies imbedded in the depression of this disk. The thin layer, lying on the internal surface of the yolk-bag, which is probably an attenuated continua-

tion of the disk, then admits with some decision of being recognized, when the germinal vesicle is certainly to be perceived.

The foregoing contains, perhaps, the most important part of the history of the ovum of the bird, so long as it is found in the ovary, from the first moment of its origin until the time when it leaves the ovarial stratum, and the vascular lamella, contained within the latter, to pass into the oviduct. We thought it required, first, to give this sketch in order to be able to understand, and justly to estimate, the phenomena occurring in the ovary of the Mammalia and of Man. The former, the ovary, consists, namely, of the peritoneal covering, of a more or less fibrous couch, (stroma of Baer,) and of blood-vessels. In this substance there lie inclosed a greater or less number of spherical or spheroidal vesicles, the size of which is quite different in different animals, as well as in individual parts of the same ovary. Although this structure of the ovary was known before the time of Regner de Graaf, the latter has the merit of having with evidence, pointed out, that after every impregnation these vesicles, in number corresponding with that of the future embryos, burst, discharge their content, and are then changed into a fleshy, yellow, or reddish mass. Hence these structures were called *vesiculæ Graafianæ*, or more correctly, since de Graaf himself, in many places, used the expression, *folliculi Graafiani*. The analogy with the ovary of birds was in this manner, to a certain extent, established; for it was pointed out that in Mammalia, that organ which, sometimes after the older authors, was called *testes muliebres*, sometimes after Steno, *ovaria*, discharged after impregnation, a certain number of ovula into the tubes like the ovary of birds. In the next place, it was to be maintained that the Graafian vesicles themselves were these ovula, as also in the ovary of birds, the yolk acquired very considerable volume before it passed into the oviduct. But Regner de Graaf himself had found, by a series of experiments on the first effects of impregnation in rabbits, that the ovula, in the earliest days after conception, so long as they were contained in the tubes, or in the horns of the uterus, were much smaller than the Graafian vesicles, especially as the latter, immediately after a fruitful connection, increased considerably in volume. He had therefore arrived immediately at the negative result, that the vesicles of the ovary themselves could not be the ovula passing over into the uterus. On the contrary, they burst at their point of greatest size, discharged their content, hence contained in the first place a cavity in their centre, and were gradually changed, as this cavity became filled up, into the *corpora lutea*. The next question then was, whether the folliculi contained in themselves the far smaller ovula, or only discharged a fluid, which

first in the tubes became enclosed by a membrane, and thus assumed the form of ova. Regner de Graaf was very near the just solution of this question, that the Graafian vesicle contained the ovulum already formed, and enclosed in a membrane, though he rather concluded, than by immediate observation supported, this answer.

Valentin, in the next place, shows by quotations from de Graaf, that the latter supposed the ovulum to be at first very large, to lie close upon the inner membrane of the vesicle, and during the period between the moment of conception, and the escape of the ovulum from the ovary, to lose considerably in size. De Graaf seems, however, to have regarded the fluid content of the vesicle as the ovulum, having, doubtless, been misled by the appearance of a more solid substance taking the place of the fluid, at the periphery of the vesicle, before the formation of the corpora lutea. The followers of De Graaf retrograded rather than advanced in the question, and it was particularly the authority of Haller that induced them to give up the idea of an already formed ovulum being contained in the Graafian vesicle, and to suppose that the ovulum was formed out of the substance discharged from the vesicle. It seems, however, certain, that Cruickshank had the opportunity for observing the ovulum, at the moment when it was about to rupture the vesicle, and to pass into the tube, and indeed he distinctly expressed his conviction that the projecting part was the ovum itself. The researches of Prévost and Dumas not only confirmed the experience of De Graaf, regarding the minuteness of the ova after their entrance into the tubes and uterus, but these distinguished naturalists spoke distinctly enough for the existence of the formed ovulum in the Graafian vesicle, and they appear, indeed, to have twice seen it there. Their words are: "Very probably the vesiculæ or the ova of the ovary contain in their interior the minute ovula of the cornua, which are there surrounded by a fluid intended, perhaps, to facilitate their descent into the womb. Twice in opening vesiculæ very far advanced have we found in their interior a small spherical body, a millimetre in diameter. But it differed from the ovula which we observed in the cornua, in being much less transparent."

The next requisite was now to show the circumstances of the already seen ovulum, within the Graafian vesicle, in the unimpregnated state, and the next step towards this was taken by a German naturalist, Karl Ernst v. Baer.* He saw, namely,

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* *De ovi mammalium et hominis genesi, Lips.* 1827. 4. and Commentary to this paper in Heusinger's Zeitschrift, ii. p. 125—194.

with the naked eye, in the Graafian vesicles of the dog, small white spots, which admitted of being displaced. When he examined these under the microscope, he found ovula similar in all respects to those found in the tubes. They had a diameter of from $\frac{1}{30}$th to $\frac{1}{20}$th, some, indeed, a diameter of only $\frac{1}{30}$th of a Paris line, (about $\frac{1}{32}$d, $\frac{1}{21}$st, and $\frac{1}{33}$d, respectively, of an English line,)—they were surrounded by a ring of granules, (*discus proligerus* of Baer,) or as if sunk or imbedded in a kind of depression in the granulous mass (*cumulus*). The examination of the Graafian vesicles of other Mammalia, as of the cow, swine, sheep, rabbit, and the like, and of Man, showed the same contained vesicle. That it was the ovulum of Mammalia was self-evident. But now there arose a new and equally important question. If, namely, the ovulum contained in the Graafian vesicle corresponds with the ovum of the bird in the ovary, how is it (the ovulum) related to the germinal vesicle of the Mammalia? V. Baer believed that the ovulum seen by him corresponded to the germinal vesicle of the rest of the animal world, and thus ascribed to it an ambiguous signification, for he regarded the ovulum, on the one hand, as the yolk, *i. e.* a persistent, on the other, as the germinal vesicle, *i. e.* a transient structure. The existence, indeed, of the ovulum of Mammalia within the ovary was thus placed beyond a doubt; but the analogy with the bird entirely failed, or was to be supplied by raisonnement alone. Seiler confirmed what V. Baer had seen, without adding any thing really new. Coste and Delpech, who have most recently written on the earliest development of animals, allow themselves, indeed, through insufficient theorems, to be led into many errors, yet have the distinguished merit of having decidedly pronounced the perfect analogy between the ovulum of Mammalia, and the ovum of the bird. Although they have entirely false notions of the germinal vesicle, as we shall fully show further on, yet they maintain having discovered in the unimpregnated ovum of the rabbit, on the surface of the yolk, and in the thickness of the germinal membrane itself, a minute vesicle, of such tenuity and transparency that it very closely resembled a soap-bubble: and that this was the true germinal vesicle contained in the ovum of the rabbit. This remarkable result induced me anew to enter upon researches on the already known ovulum of the Graafian vesicle. I was so fortunate as to find the germinal vesicle in all of the Mammalia examined, and completely to inform myself regarding the relations of the same, as well to the ovulum, as to the Graafian vesicle, in this class of animals. My experience on this subject, together with the drawings belonging to it, are contained in Bernhardt's paper, *Symbolæ ad ovi Mammalium historiam ante prægnationem.*

Wratisl. 1834, 4to. A short sketch of such part of it as is applicable here may not be unsuitable, especially as I report according to my own, most unprejudiced experience alone.

In the ovary of each of the Mammalia, there is found a greater or less number of spherical pellucid vesicles, the so-called *folliculi Graafiani*, (Graafian vesicles,) the greater part of which are situated near the surface of the organ. Their size is very different, as well in different animals, as in the same ovary of the same animal, since the older ones are sometimes four to five times, as in rabbits, dogs, cats,—sometimes eight to ten times, as in man,—sometimes ten to twenty times, as in ruminating animals,—sometimes thirty to fifty times, and still more, as in the swine,—larger than those recently formed, and this, too, independently of their increase in volume after impregnation. When situated close to the surface, they are covered by the peritoneum alone, when deeper, by the latter, and by the fibrous tissue of the ovary, and closely invested by a net-work of vessels, between which there is a granular membrane. They are everywhere closed, without a trace of processes, but intimately united with the substance of the ovary, so that in general it is not so very easy to dissect the vesicle freely out on all sides, without laceration. The Graafian vesicle itself in each of the Mammalia consists of the following parts.

1. *The outer Membrane.*—It is very delicate and intimately united with the enclosing strata which belong to the ovary, so that it is through maceration alone, as was found by Von Baer also, that it can be separated to a considerable extent. On its internal surface, there is a layer of tolerably dense minute granules, which perhaps constitute a proper membrane; yet this is here still more difficult to determine than on the internal surface of the yolk-membrane of birds. There is not any perceptible difference in the thickness of the outer enclosing membrane in any part of the Graafian vesicle; for the apparently greater tenuity of that portion of the surface directed towards the cavity of the abdomen depends on the envelope of the ovary, not on the membrane itself of the vesicle. In the smaller vesicles, however, it is relatively much stronger than in the larger.

2. *The fluid content of the Graafian vesicle* is a mass containing a great number of minute granules: it is of a very fluid consistence, and appears grayish or very slightly yellowish white in colour. In the recent state it always exactly fills the cavity of the vesicle, so that the latter is tense throughout, and has a spherical form. The fluid resembles albumen, since it coagulates, as Von Baer observes, with heat or alcohol, becoming a white albuminous mass. This fluid is not similar throughout, the granules being in many parts, towards the periphery, more

densely collected together, so that, especially if the vesicle be gently pressed between two plates of glass, there are seen in it, more or less spread out, isolated spots. In the rabbit, and in part also in the cat and swine, these isolated spots are decidedly round, and lie in tolerably regular spaces, so that the whole acquires the appearance of shagreen, or, more highly magnified, looks somewhat like the merenchymatous cells of plants. The cause of this is the following: There are found, according to Von Baer, in all the Mammalia, in the content of the Graafian vesicle, drops of oil, which we ourselves have had an opportunity of seeing very distinctly in the cow, cat, and rabbit. In the latter, the number of these pellucid, perfectly transparent, structureless drops, is very considerable. But each of them is surrounded by many closely collected granules of the vesicle, so that, as these peripheral accumulations press together, one is somewhat reminded of the cellular tissue of plants. Each of such granulous accumulations appears, in the uninjured vesicle, as a dark, almost black isolated spot. In the older vesicles, the content of which is naturally more considerable, the quantity of the fluid has become relatively greater than that of the granules. The colour is more pellucid, rather than darker.

3. *The Disk.*—We give this name to a part of the Graafian vesicle, which V. Baer, who considers the ovulum analogous to the germinal vesicle of birds, calls *discus proligerus* and *cumulus*. It is more or less circular, and surrounds the ovulum. Its size is pretty nearly in proportion to that of the ovulum, which rests upon or in its centre. Its substance consists of a multitude of closely collected granules, which are more or less transparent, and impart to the whole a grayish-white or yellowish-gray appearance. The disk varies in thickness and opacity. In the cat and dog it is so considerable, that it can be seen as a grayish-white spot in the vesicle within the ovary. This is also possible to a keen eye in the rabbit, but neither in ruminating animals, in the swine, nor in man, where the disk is to be perceived under the magnifying glass alone. Whether it be continuous and connected in a membranous form, with any part of the Graafian vesicle, does not admit with certainty of being determined, since, on the one hand, the parietes of the vesicle are too thick and opaque, and, on the other, after the opening of the same, the disk flows freely in the fluid without connection with any part except the ovulum. In the rabbit alone it appears distinctly, that the disk is surrounded by the above-described isolated spots, and even after removal of it out of the vesicle, there often remains around the disk, a ring of greater or less breadth, which consists of transparent globules, surrounded by masses of granules. It appears then, that, as seen out of the

Graafian vesicle and under the microscope, the disk is a lacerated, and, through handling, an injured structure. The granulous content of the vesicle probably lies more or less closely on the internal surface of its membrane, and is thickened only at the circumference of the ovulum to form the disk. Hence the latter never has a well-marked, round, external periphery, as would necessarily be the case, were it an independent isolated portion of the Graafian vesicle.

4. *The most important part of the Graafian vesicle is the ovulum.*—It lies as a perfectly spherical minute body, more or less deeply sunk in the centre of the disk, close under the proper membrane of the vesicle. That portion of its surface directed outwards generally touches the internal surface of the membrane of the vesicle, yet without being organically connected with it. Below its under surface is the disk, while its circumference seems freer, since the depression which the disk forms for the ovulum is greater than the latter itself, and hence there arises a circular space between it and the plain-like outspreading of the disk, which space is probably filled with a transparent fluid. There is nowhere seen a trace of any process, by which the ovulum is made fast or suspended to any part. It lies loose only, on the internal surface of the membrane of the vesicle, while it is more intimately connected with the disk, probably through the viscid pellucid fluid that occupies the space between them; for I have never been able to perceive the ovulum, without more or less distinct traces of the disk: only the latter is narrower, more delicate and transparent, the more recently formed the Graafian vesicle. It is remarkable, that the ovulum throughout does not keep pace with the Graafian vesicle in its growth. In small Graafian vesicles, it is, like the germinal vesicle in the egg of the bird, relatively very large; while in the older ones, though absolutely larger, it is relatively much less. The above-mentioned paper is accompanied by the micrometric results quoted further on. We shall, besides, return to this subject.

In order to become acquainted with the more precise structure of the ovulum, one must as much as possible separate the latter with the disk, from the remaining content of the Graafian vesicle, and gently squeeze them together between two glass plates under the compressor. But this proceeding requires above all things, patience, tranquillity, and some manual expertness, for the ovulum itself very easily bursts, and still more easily, the very delicate germinal vesicle contained in it. To find the germinal vesicle in the ovum of the Mammalia many vain attempts were made, as well by Purkinje as by myself, but they were unsuccessful, because undertaken in ova of ruminating animals and swine, in which this vesicle is extremely delicate, and

to be recognized only when the observer has already seen it in other Mammalia. Very lately, when, incited by Coste's assertions, I again entered this field of inquiry, I discovered it first in the ovulum of the cat, where it is strong and tolerably firm. I therefore recommend those who wish to convince themselves of the existence of this important structure in the Mammalia to examine first the cat. Since that time, it has almost never failed me, to exhibit the germinal vesicle in the ova of all the Mammalia which I have examined, for example of the dog, rabbit, squirrel, sheep, cow, mole, rat, and the like. I can here quote the authority of Purkinje also, who has likewise seen it in all the animals now mentioned. It is thus a fact which experience has firmly established, that the ovulum of the Mammalia also, contained in the Graafian vesicle, has its germinal vesicle, which is present there under the same circumstances entirely, as the germinal vesicle in the ova of other animals, in particular of birds. See the representation of the same in Bernhardt's dissertation quoted above. Tab. I. Fig. I. IV. VII. X. XVI. XIX.

In man alone, from outward circumstances, the germinal vesicle is very seldom to be perceived. As, usually, human subjects have lain a day, or longer, before they are taken up for examination, the first commencement of decomposition and maceration has already taken place, during this time, within the Graafian vesicle. This is easily recognizable in the ovulum also. Its content is usually clouded, without regular arrangement; no longer can a trace of the germinal vesicle be perceived, and the external periphery itself of the ovulum appears double, whilst, besides the circle surrounding the granulous content, there is visible yet another very delicate circle around the first. We must therefore candidly confess, that in very many examinations, we have only twice succeeded in observing, with all decision, the germinal vesicle of man.

In the ovulum itself of the Mammalia, there are to be distinguished the following parts.

1*stly*, *An outer membrane.*

2*dly*, *A granulous layer, internal to the same.*

3*dly*, *A perfectly transparent, half-fluid, content.*

4*thly*, *The germinal vesicle.*

We shall now go through the most important of what is to be remarked concerning these parts, in the order in which they have been named.

1*st*, *The Membrane of the Ovulum.*—It is always single, never shows in the recent state a trace of separation into several laminæ, has no granules, and presents no fibres of any kind. Its transparency appears to be somewhat lessened by a tinge of yellow. Its thickness is always found in all parts the same.

In the squirrel, for example, it amounted throughout to 0,000455 (Paris inch?) Through pressure of the ovulum between two plates of glass, this membrane is visible as a ring of greater or less breadth surrounding the ovum. If the pressure be continued further, the membrane bursts, and the content immediately flows out. In the Rodentia this always happens later than in the Ruminantia, in the swine, and in man. But if it have taken place, the transparent membrane is to be recognized only through the circle of shadow it casts, or in diminished light.

2. *Under the outer membrane of the ovulum, there is found a layer of decidedly spherical, very minute granules*, which, excepting in the region of the germinal vesicle, completely surrounds the content. In the periphery of the germinal vesicle, the granules are for the most part sparingly distributed, or altogether fail. But they are never found at the part where the germinal vesicle is applied to the internal surface of the membrane of the ovulum. Only in extremely rare cases have I seen the granules of equal size. This was met with most, proportionally, in the rabbit, squirrel, swine, and man. But even in the latter, they are often enough seen, in the same ovulum, sometimes so minute, that they can scarcely be distinguished from the molecules of Brown, sometimes ten times and more larger than the latter. Thus, for example, the largest granules in the ovulum of the cat had a diameter of 0,000202 Paris inch, (=0,000215 English inch.) Smaller ones, on the other hand, a diameter of 0,000076 Paris inch, (=0,000081 English inch,) while the smallest were of a size not to be measured. But another important question is, whether this granulous layer forms a peculiar membrane or not? The minuteness of the object, and the great delicacy throughout of its component parts, are such, that an answer must here be cautiously given. We have never indeed succeeded in exhibiting portions of such a granulous membrane. The decided manner, however, in which the granules always lie close to the periphery, while they are never found in the inner fluid content, and the more or less definite limits which they find in the region where the germinal vesicle is attached, warrant the conclusion, that the granules are held together by a firmer substance than the fluid content, soon to be described, and that thus there is formed a very soft and delicate membrane. But when Coste finds, on the one hand, what we have just stated, on the other, a resemblance to the more perfect yolk-globules of the bird, the analogy can relate to the circular form, and perfect transparency alone: in all other properties they differ.

3. *In the centre of the ovulum*, and, therefore, for the most part, inclosed in the above considered granulous layer, *there lies*

a perfectly transparent, pellucid, half-fluid and viscid matter, which, after laceration of the membrane of the ovulum, flows out in part more slowly than the layer of granules. It appears through maceration to lose some of its viscidity, and, besides, easily to acquire a more fluid form.

4. *The Germinal Vesicle* always lies close under the membrane of the ovulum, and is generally in part embraced by the layer of granules. Of its existence there can no longer be any doubt, as I have, sometimes alone, sometimes in company with Purkinje, Bernhardt, and others, observed it more than sixty times in the ovula of the most widely different Mammalia; indeed, with the exception of some of those of ruminating animals, I have hitherto sought it in no ovula in vain. But to discover it is not so very easy. That it can be made visible only through compression of the ovulum, we have above stated. One must learn, however, to observe the due degree of pressure, for if it be too weak, nothing is seen, at least not in a decided manner, the vesicle; but if it be too strong, the extremely delicate germinal vesicle bursts, even before the continuity of the outer membrane of the ovulum is destroyed, just so as in the smaller ova of birds, the germinal vesicle usually bursts before the laceration of the membrane of the yolk. Extremely seldom only, in the ovulum of the Mammalia, does the contrary happen, that the germinal vesicle comes free, and uninjured, out of the lacerated ovulum. I have hitherto had the opportunity for seeing this only three times, and have given a drawing of the appearance of the vesicle, under such circumstances, in the above-mentioned dissertation of Bernhardt. I recommend those to whom it is possible to use, besides, an aplanatic apparatus. If this be provided, the germinal vesicle, with some dexterity and practice in examinations of the kind, can scarcely escape notice. It is, just as in the egg of the bird, a transparent vesicle of a spherical or slightly oval form, and consists of a perfectly transparent, homogeneous membrane, and a not less transparent throughout colourless, and non-granulous content, which indeed is itself of more viscid consistence than the diaphanous fluid contained in the centre of the ovulum, though the viscidity of the former does not continue so long as that of the latter. If one succeeds, as in rare cases, in isolating the germinal vesicle out of the cavity of the ovulum, one may by further pressing, burst it, and thus here also separate from one another, its covering and content. The relative size of the germinal vesicle seems always to continue nearly the same. The absolute, on the contrary, adapts itself to the absolute size of the ovulum. Thus in the rabbit, where the ovula are relatively smaller than in beasts of prey, I found the germinal vesicle correspondingly smaller.

Concerning the relations in size of the parts of the Graafian vesicle and of the ovulum in the Mammalia and in man, I have selected the following measurements, taken with a screw-micrometer, in order to arrive at certain results on this important subject.

Tabular view of the Micrometric Observations made by myself on the parts of the Graafian Vesicle, and of the Ovulum, in different Mammalia and in Man.

(The measurements were determined according to Paris inches. They have been reduced by the translator to English inches.)

		Graafian Vesicle.	*Diameter of Ovulum.*	*Germinal Vesicle.*	*Miscellaneous Parts.*
I. *Vespertilio murinus,* .	1.	0,014560	0,003764		
	2.	0,016178	0,007549	0,001940	
II. Dog, .	1.	0,057485	0,004314		
	2.	0,006471	0,003450		
	3.	0,007549	0,003666		
Diameter of the pellucid fluid surrounding ovulum No. 1, and separating it from the disk, .					0,008628
III. Squirrel,	1.	0,025884	0,003559	0,001207	
	2.	0,026963	0,003774		
	3.	0,004314	0,002157		
	4.	0,008089	0,002696		
Diameter (?) of the membrane of the ovulum in No. 1,					0,000479
IV. Mole, .	1.	0,004961	0,003148		
	2.	0,006471	0,003472		
	3.	0,006578	0,003559		
	4.	0,006901	0,003882		
	5.	0,007549	0,003666		
	6.	0,010246	0,003774		
	7.	0,012081	0,004097		
	8.	0,021570	0,004205		
	9.	0,012942	0,005392		
	10.	0,023926	0,005392		
	11.		0,004955	0,001078	
	12.		0,005392	0,001671	
V. Rabbit, .	1.	0,004314	0,001204		
	2.	0,004961	0,001342		
	3.	0,005715	0,001239		
	4.	0,005823	0,001293		
	5.	0,005931	0,001401		
	6.	0,006039	0,001563		
	7.	0,006254	0,001725		
	8.	0,007010	0,001833		
	9.	0,007549	0,002048		
	10.	0,007765	0,001939		
VI. Swine, .	1.		0,005392	0,003559	

		Graafian Vesicle.	Diameter of Ovulum.	Germinal Vesicle.	Miscellaneous Parts.
VII. Cow,	1.		0,005176	0,002264	
VIII. Sheep,	1.		0,006686	0,004204	
IX. Cat,	from		0,005176 to 0,004636	0,001619 to 0,001509	

Semidiameter of the disk surrounding the ovulum.

Mean, 0,004205

Diameter of the globules contained in this disk, 0,000215 to 0,000080

X. Man,	1.	0,003126	0,001939	
	2.	0,003343	0,002048	

Diameter of the disk surrounding ovulum No. 1, 0,005931

From these measurements, the following results are determined:

1. It is obvious that the absolute size of the Graafian vesicle is subject to much greater variation than that of the ovulum.

2. The ovulum is, in relation to the Graafian vesicle, so much the larger, the more recently formed and smaller the latter.

3. The germinal vesicle does not follow in the Mammalia and in man, the same relations in size as in the bird, where in this respect, it is proportioned to the yolk-ball, just as the ovulum of the Mammalia is to its Graafian vesicle. It appears rather, as we shall in the parts of the embryo have frequent opportunities for seeing, to be laid down of a certain determined size, and upon the whole, to vary little according to its conditions in regard to age.

4. The size of the globules contained in the ovulum of the Mammalia differs much from that of the yolk-globules of the bird, but approaches more or less that of the minute particles found between the latter.

For several other more special relations in the above measurements, vide Bernhardt's dissertation already mentioned.*

Having now without any subordinate remark, without any tendency towards analogy, described the simple facts seen or discovered by others and by ourselves, we undertake, in the next place, to determine the signification of the parts named. This would admit of being stated with decision, did we possess a sufficient and complete analysis of the ovulum, that is found, soon after its exit from the ovary, in the beginning of the tubes. But so long as this is wanting, there must necessarily remain many gaps to be mentioned soon. Yet an accurate knowledge of the ovulum and of its parts, as contained in the Graafian vesicle, may enable us to arrive at no small degree of certainty on this subject.

* *Cap. vi. p.* 30–32.

K. E. v. Baer became embarrassed, as we may without arrogance maintain, because he was not acquainted with the germinal vesicle contained in the ovulum of the Mammalia, and therefore identified the former with the ovulum itself, and regarded the disk surrounding the ovulum, and contained in the Graafian vesicle, as the foundation of the embryo. It is but too obvious, however, from his work, how incapable he was of extricating himself, for although he gives several acceptations as possible, yet he is not able to carry through any one of them with decision, and is therefore not in a condition satisfactorily to answer the cardinal question, whether the ovulum of the Mammalia be, or be not, analogous to the ovum of the bird before impregnation. If we now attempt, according to our more perfect experience, to give information on this point, it may be most to the purpose, to pursue as carefully as possible the comparison between both classes of animals.

The advanced ovum of the bird agrees in a few points only with the advanced ovum of the Mammalia ; but, on the contrary, differs in most respects from it.

1. The external enclosing membrane, or the membrane of the yolk, is in both destitute of any perceptible internal structure, at the most, in the bird, endowed with a few complicated irregularly situated fibres, which are not easily seen. In no part is it through a particular process, &c. organically united to the neighbouring parts, but forms a perfectly closed and circumscribed sphere.

2. The greatest portion of the unimpregnated ovum or the yolk of the bird, consists of three different parts :

a. Of large oil-like, yellow, or yellowish yolk-globules.

b. Of very minute globules, distributed between the yolk-globules ; and

c. Of a transparent pellucid fluid, in which are found as well the globules of the yolk as the smaller globules.

Analogous to these parts, present in the ovum of the bird, grown, and ready to make its exit, there are found in the ovulum of the Mammalia and of man, the following :

a. The pellucid transparent fluid, which here seems to have a more oily consistence.

b. Particles, some of which are of equal size with the smaller particles of the yolk of birds, some rather larger.

On the other hand, there is here no trace of larger oily yolk globules.

3. In the central cavity of the yolk of the bird, there is found a peculiar half-fluid mass. There is present also an oil-like, perfectly transparent fluid, in the centre of the ovulum of the Mammalia. Only the central cavity in the latter is not nearly

so decidedly limited, indeed it does not generally appear to be certainly circumscribed, and separated from the granulous mass.

4. The germinal vesicle is found in the ovum of birds, as well as in that of the Mammalia, as a pellucid, diaphanous, extremely delicate vesicle, which consists of a structureless outer membrane, and of a uniform non-granulous fluid content. In birds, however, it is sunk into the disk, just as the ovulum of the Mammalia is sunk into the disk of the Graafian vesicle. In the latter, on the other hand, there is in the whole, a small part covered by the granulous content. Also the germinal vesicle of birds is much smaller in relation to the yolk, than the germinal vesicle of the Mammalia in relation to its ovulum.

Add to this, that the ovum of birds is enclosed by the coverings and substance of the ovary alone, while the ovulum of the Mammalia lies imbedded in the Graafian vesicle, and indeed in the disk of the latter.

From all this we can draw with decision the conclusion, that the ovulum of the Mammalia is entirely unlike the advanced ovum of birds. But a comparison of the advanced ovum of the Mammalia, with the early or primitive condition of the ovum of birds, leads to a sentiment almost directly the reverse. As we have in part, already seen above, the ovum of birds in the first stage of development is of a grayish white colour, and consists of a perfectly transparent fibreless yolk-bag, of minute globules, without a trace of the true larger yolk-globules, and of a perfectly transparent fluid mass, collected especially in the centre, which at the same time unites together the single particles contained in the ovum. The germinal vesicle is in relation to the ovulum, much larger than at a later period, while every trace of an imbedding of the same in the disk, as well as of the disk itself, entirely fails. Does not this description suit also, word for word, the ovum of the Mammalia? The resemblance here is most entire, and we therefore assume, confirmed as it is by certain observations, the following position.

The ovum of the Mammalia resembles perfectly the unadvanced ovum of birds, but essentially differs from it, so soon as the true yolk-globules have appeared in the latter.

It is self-evident, however, that we do not here speak of perfect identity, since the difference in the individualities of the Mammalia and of birds, renders such a thing impossible. Thus, for example, the particles contained in the ovulum of the Mammalia vary much more than those contained in the earliest forms of the ovum of birds. But there can be no doubt that nature has followed the above pointed out original idea in the structure of both forms of ova.

If it be thus shown that the ovulum of the Mammalia is, as

it were, an unadvanced, (or found in the earliest stage of development) ovum of the bird, this stands in perfect accordance with the whole evolution of the Mammalia. We shall afterwards see that, and why, the yolk of birds performs so important, that of the Mammalia a more subordinate, part. The immense difference in the perfection of the same organs, in the two different classes of animals, finds through our representation, a first, certain, morphological foundation; since we have pointed out, that the ovulum of the Mammalia remains standing upon a step in its progress, which the yolk of birds, at a pretty early period, passes over, and leaves behind.

On the other hand, there is found in the Mammalia, and in man, a peculiar formation, occurring in no other class of animals, viz. that the true ovulum is enclosed in another oval body, the Graafian vesicle. The function of the latter is indeed obscure, yet perhaps the intention of it may therein be sought, that in the Mammalia the idea of internal development is so far extended, that the ovulum itself in the ovary is particularly enclosed, and preserved in a structure belonging to the mother. For, according to what we shall bring forward regarding the formation of the corpora lutea, it is scarcely to be expected, that the Graafian vesicle and its contents have a very important influence after conception, and the exit of the ovulum from the ovary. As little can the disk, in which the ovulum is imbedded, exercise an important function in the after time. Compare below, on the formation of the *corpora lutea*,

II. *The ovum from the moment of its separation from the ovary, to the period when it becomes fixed in the uterus for the development of the fruit.*

The history of the egg of the bird must here also serve as a basis to which we may refer what has been discovered in the Mammalia. We follow on this subject also, the observations of Purkinje, who has most completely investigated this series of phenomena. When the ovum of the ovary has acquired a certain size, but still consists of the yolk-bag, the yolk, the disk, and the germinal vesicle, it begins to loosen itself from the ovary, in order to enter the oviduct. In this, however, there is shown a double change: 1*stly*, The membrane which belongs to the ovary, covered on its internal surface with blood-vessels, and forming the outer covering of the ovum while in the ovary, is lacerated at a certain spot, to admit of the free exit of the ovum. This spot is characterized, even in smaller ova, by a changed appearance. It becomes thinner and finer, and so by degrees soon disappears. But the opposite part of the ovum has, in the meantime, become considerably elongated, so that the ovum

about to make its exit, mostly hangs down from the ovary. *2dly*, The germinal vesicle becomes invisible. It probably bursts, and pours its fluid first of all into the disk. It is not, therefore, without reason that it has been regarded as analogous to the semen,—as a sort of female semen. The disk, which earlier, at the part where the germinal vesicle lay, shewed a transparent point, has now, at this spot, a white kernel. Prepared in this manner, the ovum passes into the oviduct, whilst the vascular covering belonging to the ovary remains seated in this organ. The ovum is carried along through the contractions of the oviduct, which at this time has a true, perfectly formed, muscular structure, and receives, during its progress, new enclosing formations, as the albumen, the chalazæ, the membrane of the shell, and the shell itself. It first passes into the commencement of the oviduct, which is marked by longitudinal folds of the mucous membrane. Here a secreted and very delicate layer of albumen surrounds and perfectly covers it, but above and below, *i. e.* at those parts where the distension caused by the ovum ceases, forms a very soft knot, from which there proceeds a string, that is closely encompased by the folds of the mucous membrane of the oviduct. The progress of the ovum continued through the peristaltic motion of the oviduct, takes place now in a spiral course, and hence the albumen also, which is always secreted immediately at the part where the ovum lies, assumes the spiral form. Of this, one may immediately convince himself, by taking an ovum from this part of the oviduct, and laying it in cold water, where the indurated albumen appears in the form of spiral blades, and admits of being stripped off. The threads at both ends of the ovum are likewise turned spirally round on their axis, and thus form the twisted organs of the perfect ovum, called chalazæ. The latter present densely twisted threads, which arise in the following manner: The first layer of albumen that is formed around the ovum, as soon as it has entered the oviduct, becomes indurated, and assumes a membranous form. This membrane, which immediately surrounds the yolk-bag, and was minutely studied by Dutrochet in particular, becomes more and more dense, more like the yolk-bag, and thus forms a continuation of the cords of the chalazæ. This representation of the origin of the chalazæ has been in all respects confirmed through his own observations, by Berthold.* When the ovum has now reached a certain part of the oviduct, to which the name of Isthmus has been applied, the mucous membrane of which, also, certainly differs from that of the preceding part of the oviduct, and is also marked on the internal

* *Isis*, 1829, p. 408.

surface with a circular boundary line, it is surrounded by a thick homogeneous layer of albumen, and furnished at both ends with the chalazæ. In the isthmus, *i. e.* in that division of the oviduct, from the marked spot mentioned, to the beginning of the uterus, so called, the membrane of the egg-shell is formed around the ovum. As the isthmus is a straitened part of the oviduct, it becomes, as soon as the ovum has entered it, so distended by the latter, that all folds of the mucous membrane disappear. This contributes probably, at least in part, to the secretion here, of a thin, but membranous layer, the membrane of the shell. The latter is found only so far on the ovum, as it has penetrated into the isthmus, which always happens with the pointed extremity first. Purkinje, who sacrificed more than thirty hens to his earlier researches, never found an ovum completely in the isthmus, but only in part in the latter, in part passed out of it. Very recently, we were both so fortunate as to find an ovum just in the isthmus, and thence to inform ourselves of the manner in which the membrane of the shell originates. In the upper part of the isthmus, namely, there arises the fibrous layer of the membrane of the shell, which nature as it were, spins at once. There are found isolated threads, each of which is probably the secretion of a mucous follicle of the isthmus, which threads are the more frequent, and the more intimately united, the deeper the part of the isthmus in which they lie. At the lower part, on the other hand, there is found in addition to this fibrous layer, a layer of granules, which occurs as a proper secretion. Besides this, there probably arises in the isthmus, the space filled with air found in the egg, and, indeed at a place where, immediately under the stricture of the isthmus, the folds of the mucous membrane are interrupted. From the isthmus, the ovum passes into the upper part of the uterus, where the shell originates, in the first place, through polygonal calcareous deposits, which continue to increase until they form a dense covering.—According to this representation, which rests entirely and solely upon observations, the ovum is taken up by the mouth of the tube. The first fourth of the oviduct secretes the *membrana Dutrochetii*, and the first rudiments of the chalazæ,—the remaining part as far as the isthmus, the albumen,—the upper part of the isthmus, the fibrous,—the lower, the granulous layer, of the membrane of the shell,—the greatest part of the uterus, finally, the egg-shell,—while the vagina is destined to perform the expulsion of the egg. The bird's egg brought forth in this manner consists, when it is fresh and normal, of the following parts,

1. Of the shell.
2. Of the membrane of the shell.

3. Of the albumen—three divisions of which have been distinguished,

a. A thin fluid portion immediately under the membrane of the shell.

b. A thicker, more viscid portion, between the thinner portion and the surface of the yolk.

c. A still denser portion in the neighbourhood of, and around the chalazæ.

With regard to the latter, it can scarcely be considered as peculiar. The first, on the other hand, does not arise until after the formation of the shell, and originates through the outer portion of the formerly equally viscid albumen assuming a more fluid condition.

4. Of the chalazæ.

5. Of the yolk-bag.

6. Of the yolk.

7. Of the mass contained in the centre of the yolk; and

8. Of the disk, germinal spot, germinal membrane at the commencement of incubation, or, according to the older appellation, cock's tread. This consists, however, as is afterwards distinctly shown, of two granulous layers, of the upper the true germinal membrane, and of another, which remains on the yolk, seems to be of subordinate importance, and is probably soon absorbed.

In now passing over to that period in the existence of the ovum of the Mammalia which corresponds wholly, or in part to that just treated of in the ovum of the bird, we think it proper, since conclusions at present can be drawn from isolated, and for the most part, incomplete experience alone, first of all, historically to quote the observations hereto appertaining, according as they occurred, and then, first, to point out the inferences, as well as the analogies with other animals, especially with birds. To this department belong the labours of those naturalists who wished to become acquainted with the first consequences of conception, and with the impregnated ova in the early conditions in which they had been met with either in their exit from the ovary, in their passage through the tubes, or indeed after they had passed into the uterus, without, however, having become fixed in, and in close contact with the internal surface of, the latter. The authors to be here reckoned are the following:

1. *Regner de Graaf* performed a series of experiments on the first effects of conception, which have been reached by few, and exceeded, it may well be said, by none of his successors. The results of his observations are briefly the following:*

* The tabular form has been introduced here, and further on, by the *translator*, as well for the sake of brevity as to present *at a glance* such changes as were of contemporaneous occurrence.

Time after coition	*Ovaries.*	*Tubes.*	*Horns of the Uterus.*
½ an hour.	No change in the Graafian vesicles, at the most, a little loss of transparency.		Presented no trace of semen, but were somewhat more reddened than in the unimpregnated state.
6 hours.	Graafian vesicles redder, and contained a viscid transparent fluid.		No trace of semen.
24 hours.	In one ovary there were 3, in the other 5 Graafian vesicles opaque, and tinged slightly red. At their surface there projected a kind of minute wart. When cut open, they presented a small quantity of transparent fluid, and at the periphery, a thick reddish mass.		
27 hours.	Similar wart-like projections as in the last, on the surface of the Graafian vesicles. On pressure, the latter discharged first a transparent, then a reddish dense fluid.	Each fimbriated extremity embraced the ovary.	Contained no ova, but were very full of blood, and their mucous membrane was loosened.
48 hours.	The wart-like projections more considerable. On pressure, some albuminous fluid was dischargedthroughthem; but the remaining reddish substance of the Graafian vesicles had become thicker, and was therefore less easily discharged.		
52 hours.	In the Graafian vesicles a glandular mass, the centre of which contained a cavity without fluid. No ovula found.	No ovula found. (Doubtless overlooked.)	
72 hours.	The wart-like projections had a minute aperture in the centre, and contained in their interior an empty cavity.	The fimbriated extremities very closely embraced the ovaries. Ovula out of the Graafian vesicles now found; extremely small, and consisting of two membranes, the one enclosed in the other, on laceration of which, there passed out an extremely transparent fluid.	
4 days.		The ovula had advanced further, and each contained more distinctly a vesicle inclosed in it.	
5 days.		The inner vesicular membrane still more recognizable.	

In six to seven days the ovula had considerably increased in

size ; De Graaf, however, was not in a condition to recognize in them an embryo. He failed to do this also, as, later, Prévost and Dumas, and Von Baer have likewise done, in ova of the eighth day, because the latter are then, on the one hand, already firmly fixed on the internal surface of the uterus, on the other hand, so extremely delicate, that, with the slightest injury, they are lacerated. In some ova of the ninth day the embryo presented itself to De Graaf as a faint cloudiness, whereas he distinctly saw it already forward in its development in ova of the tenth day. Had Regner de Graaf made use of the microscope in these examinations, science would, more than a century and half ago, have been enriched with results, which unfortunately in the present day, we discover to be still wanting.

2. Valentin then shows that the enquiries of *those who succeeded de Graaf* were not characterized by equal circumspection, pains, and fundamental research, and that the authority of Vallisneri, Kuhlemann, Haller, and others, suppressed the truth, that the ovulum itself was contained in the Graafian vesicle, and substituted for it the erroneous assertion that a fluid merely, without a covering, was poured out of the ovary into the tubes, or that, as Osiander even in the beginning of the nineteenth century maintained, the ovaries were not at all concerned in conception. Cruickshank, however, has the merit of having repeated and confirmed the experiments of De Graaf, but he added nothing really new, and through some errors, even darkened the subject.

3. *Prévost and Dumas* have more recently given a series of laborious and minute experiments on the first effects of conception in rabbits and dogs.* The following is from their observations :

Time after coition.	*Ovaries.*	*Tubes.*	*Horns of the uterus.*
4 hours.	No change either in dogs or in rabbits.	Lively motions of the animalcules of the semen.	
2 days.	Ditto, except that the Graafian vesicles had increased in size, and the central point of their surface had become more transparent.	Do.	
3 to 4 days.	Graafian vesicles still larger, sometimes from 7–8 millimêtres in diameter, in dogs.		
After 6 to 7 days.	The Graafian vesicles opened, so that an aperture was seen in their surface.		

* *Annales des Sciences Naturelles, Vol. iii. p.* 113–133.

Time after coition.	*Ovaries.*	*Tubes.*	*Horns of the uterus.*
8 days.	In one case, the Graafian vesicle found at the moment of bursting, and	ovula found in the tubes of 1½–2 millimêtres in diameter, of an elipsoidal form, and consisting of a single and transparent membrane & a pellucid fluid. At the upper part of the ovulum a flaky shield, much thicker, and furnished with very many minute wart-like elevations, having at one of its extremities an opaque, white, round spot, like a cicatrix.	
After 12 days.			The ovula are still smaller than the Graafian vesicles of the ovary, and, indeed, the smaller, the nearer they lie to the ovary. The embryo very distinctly perceived.
Later.			In more advanced ova, their two extremities are prolonged, horn-like, in the axis of the horns of the uterus: rarely such a horn-like prolongation issuing towards one side only. The ovum is throughout smooth, except in that part at which the fœtus is found.

Though in dogs the ovula do not pass into the tubes until the eighth day, this happens in rabbits on the third; and the ova of rabbits of eight days, are in that stage of advancement, in which ova of at least thirteen days are found in dogs.

4. *Karl Ernst von Baer* has made a series of observations in connection with this subject, especially in dogs. He thus often had the opportunity of observing an ovulum of half a line in diameter. Such ovula were perfectly diaphanous, and lay quite free, in the cavity of the uterus. Examined with the microscope, they were found to be, not entirely spherical, but of a somewhat elongated form. At first they appeared to have but a single membrane, but in less than a minute, the inner membrane separated itself at both extremities from the outer, so that there arose between both, a curved empty space. This separation proceeded to a certain point, at which the two membranes remained united. By degrees, the inner, and afterwards the outer membrane also, of the ovulum, collapsed. The outer membrane is semitransparent, furnished with minute warty elevations, and appears to con-

sist of two lamellæ. On the inner membrane, there is found a multitude of minute circular rings, which are diaphanous in their centre. These rings consist, as shown when they are more highly magnified, of many granules arranged in a circle, and not touching one another. There is shown, besides, a much larger, opaque, round spot, the germinal membrane, *blastoderma*, which can be seen already, as a white point, by the naked eye,—stands off somewhat from the inner membrane of the ovum,—and is surrounded by an extremely delicate space. (Hof.) Other ova of the dog, of $\frac{1}{3}$d of a line in diameter, were less diaphanous, and more spherical, than those just described. They likewise had two membranes, but on the outer one, the wart-like elevations were scarcely recognizable, whereas, the inner membrane presented minute spots, consisting of accumulations of granules. The germinal membrane was thicker than in the last case, and not, like it, even, but presented inequalities. At the mouth of the tube there was found, free, in the same uterus, a very minute white granule, which presented, under the microscope, an opaque kernel, with a pellucid ring. Was this an ovulum just passed out of the tube? V. Baer on that account examined the ovula of the tubes in the dog. They were somewhat smaller than this little body, and appeared like minute, yellowish-white points of $\frac{1}{15}$th of a line in diameter. In the centre, there was here found an opaque kernel, which itself consisted of many granules, and had a granulated surface. This kernel was surrounded by a narrow diaphanous space, and by a periphery furnished with granules, the membrane of which was scarcely visible.

5. *Coste** has most recently imparted something concerning his observations. According to him, the ova of the rabbit have already made their way into the oviduct two days after impregnation, and then appear perfectly similar to the vesicles enclosed in the folliculi Graafiani, (Graafian vesicles.) After four days they are in the horns of the uterus, free, however, and moveable, and one line in diameter. The germinal vesicle and the membrane of the yolk are still to be recognized, while the yolk is absorbed in proportion to the growth of the germinal vesicle. After five days, the ova are fixed in the uterus, and two lines in diameter. Their germinal membrane has now grown more than its contained germinal vesicle, which occupies only about a third part of the same, is appended in it at one point of the place of attachment of the ovum in the uterus, and here presents a cloud-like obscure, round, or elliptical spot.

Finally, we must mention the *cases in which human ovula are maintained to have been found in the tubes.* It is said that an observation of this sort was made so long since as by John Burns.

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* *Froriep's Notizen, Novemb.* 1833 *No.* 830, *Pp.* 241—244.

(The Anatomy of the Gravid Uterus, 1799.) Most recently Seiler, (Die Gebärmutter und das Ei des Menschen, 1832,) has described a case in which there was found, in the fimbriated extremity of the Fallopian tube, a flaky body, filled with a yellowish-white fluid, and furnished on its surface with a granule of a line in length, which body the author, though with very slender grounds, considers an ovulum. The same is to be said of another case, supposed to have been one of incipient graviditas tubaria.

In now undertaking to indicate the *continuous progress of the first appearances in their order, which present themselves after impregnation in the Mammalia*, we must not omit to call attention to the fact, that, notwithstanding the manifold endeavours above-mentioned, the subject is not only not exhausted, but still remains exceedingly defective and dark,—that the reports contradict each other in many essential points,—and that the microscopic examination of the delicate ovula is still incomplete. As in the ovum of birds, so in the ovulum of the Mammalia, we have yolk-bag, yolk, germinal vesicle, and perhaps at a later period, blastoderma also. All these parts constitute the ovulum contained in the Graafian vesicle, which ovulum, in consequence of conception, passes into the tubes. Immediately after impregnation, the flow of blood to the ovaries increases; the Graafian vesicles swell considerably, whilst, at the same time, the vascular covering of the latter, united with the external couch of the germen, becomes, by exuberant growth, a reddish dense mass. The ovulum advances more and more towards the surface; that part in the cavity of the Graafian vesicle on which it lies, seems to become attenuated, or in part absorbed, and thus, after the ovary has become embraced by the incipiently turgid tubes, the ovulum passes into the latter. According to Coste, the germinal vesicle does not here burst, but is persistent, and, indeed, enlarges by further growth. We must, however, doubt the correctness of this assertion. For, first of all, as, from our researches, we can decidedly maintain, the analogy of all other animals, avertebrate as well as fishes, amphibious animals, and birds,—in which the germinal vesicle bursts before the developement of the embryo,—declares the contrary. Also, it certainly would not in that case have escaped the notice of V. Baer and others, if it first considerably increased in volume, with enlargement of the ovum. At the same time, as we shall see further on, Coste manifestly still retains the idea conveyed by Rolando, that the embryo of the fowl is developed upon a vesicle; an assertion, the erroneousness of which is self-evident. According to analogy with the bird and the other vertebrated animals, albumen and the membrane of the shell should now form around the ovum before it is fixed

in the uterus. The albumen, which is not wanting in the Mammalia, very probably originates during the passage through the tubes. The enormous swelling of the ova, in their passage through the Fallopian tubes, is in part favourable to this. But an indication of chalazæ might perhaps be found in the lateral elongations, discovered by Prévost and Dumas, in very delicate ova of the dog. In the same way it may be presumed, that the membrane of the shell, or the chorion, originates in the tubes, entirely as the shell-membrane of the bird is formed first in the isthmus. Von Baer, indeed, supposes that the outer membrane of the ovulum, contained in the Graafian vesicle, becomes the chorion. But, on the one hand, all analogy is opposed to this, since, besides that, in such case, as he also maintains, the yolk-bag must be formed first in the tubes ; on the other hand, it was not until after maceration that he himself distinctly perceived another, outer membrane,—an appearance which is always repeated in the eggs of fowls which have not yet a shell-membrane. It would be interesting to determine, whether, for the secretion of these different structures, there occur also different conformations of the mucous membrane of the tubes.

When now the ovulum has passed out of the Graafian vesicle, the inner stratum of the latter, according to Von Baer, and in part also, according to Regner de Graaf, becomes, by exuberant growth, the so-called *corpus luteum*. This begins to take place while the ovulum is still contained in the Graafian vesicle. As soon, however, as the ovulum has left the vesicle, the greater part of the latter is filled with a reddish, fleshy mass. In the centre alone, under the opening, there is found a cavity, either empty or filled with an albuminous mass, which cavity seems to be largest in man. It appears that the opening now, first of all, closes, whilst afterwards the cavity becomes smaller, until, at length, it entirely disappears. There are thus found in the ovary, yellow, reddish or bluish, bodies, of greater or less size, which are known under the name of *corpora lutea*.

These *corpora lutea*, falsely so called, (for in different animals they have constantly different colours,) are universally and properly regarded in the present day as the surest sign of a destroyed Graafian vesicle, and of an escaped ovulum, and, therefore, of impregnation having taken place. Although their form and origin have been justly indicated by earlier observers, my own observations on rabbits enable me to add yet many not unimportant particulars. The process here is the following. In consequence of conception, there arises a considerable congestion of blood towards the ovaries in general, and towards single Graafian vesicles in particular. The latter become pervaded with nets of fine blood-vessels, and increase in volume, though the larger vesicles alone seem to be comprehended in the process. With the commencement of this change, however, there appears, from the

internal surface of the membrane of the vesicle, outwards, a reddish, fleshy mass, which takes in the whole circumference of the same, excepting the spot on which the ovulum is found, thus, with the exception of the most elevated point, covered by the peritoneum alone. By this, indeed, the quantity of fluid contained in the vesicle is necessarily reduced; but it does not diminish in equal measure, with the appearance of the reddish mass; becomes therefore relatively more abundant, and necessarily collects towards the side covered by the peritoneum alone. In this manner, that part of the vesicle covered only by the peritoneum, becomes pushed forth, while the ever-increasing reddish mass on the one hand, and the relatively too great quantity of the fluid of the vesicle on the other, operate as a *vis a tergo*. The ovulum itself reaches the most external point of the spot covered by the peritoneum alone. The latter becomes even thinner, and at last perforated, so that the ovulum slips out, whilst it is surrounded by very little, or none at all, of the fluid content of the vesicle. In the place of the vesicle, however, there is then formed a fleshy mass, with a small cavity in its interior, which, through a kind of duct, opens outwards. Now, the external opening becomes closed, through a small projecting wart, which appears at first still somewhat to increase in size, but afterwards, whilst the cavity in the interior becomes filled with the fleshy mass, diminishes, and at last entirely disappears; so that then, finally, there is presented a globular, uniform structure, the *corpus luteum*.

If we compare the processes through which nature works the discharge of the ova from the ovary of birds and Mammalia, it is easy to see, how she is compelled, by outward circumstances, to bring forth the same effects in different ways. In birds, this happens through simple enlargement of the ovum generally, and of the yolk in particular. But since this does not apply to the Mammalia, she makes use of the first formation of the *corpora lutea* and of the content of the Graafian vesicle, in order, by means of a *vis a tergo*, to attain the same object. Yet, in both cases, there work, besides a mechanical, also vital powers, since the peritoneum and the membrane of the vesicle, at the point of egress are not merely mechanically lacerated, but more in an organic manner absorbed.

From the progress now presented of the formation of the *corpora lutea*, it is clearly evident, that the content of the Graafian vesicle, immediately after impregnation, has a most subordinate influence, and perhaps none at all. In the same way, the disk of the vesicle, in which the ovulum lies imbedded, can by no means be indicated as the blastoderma.

For, firstly, it is very questionable whether it passes into the tube or not. My own experience is in favour of the latter, though it does not, with all needful evidence, prove it.

Secondly, the blastoderma can lie only internal, not external to the ovulum.

But the disk cannot, in any way, immediately pass into the ovulum. It hence appears to be almost certain, that the Mammalia before impregnation, possess no germinal disk, but merely a germinal vesicle. The same entirely is the case in the ovum of birds also, in the earliest stages of its development within the ovary.

After conception certain changes present themselves in the uterus and tubes, which are in part, a consequence of the universally heightened activity of these organs, in part, peculiar vital processes of the same. First of all, the whole system of the internal organs of generation becomes turgid. Many parts of the same, for example the *orificium uteri*, become almost black, from the quantity of the contained blood. The tubes and the horns of the uterus are distended, and the extremities of the former embrace the ovary. Whilst now the ovula are in the course of preparation to pass through the tubes, and to be fixed in the uterus, a process which in man appears to last 12 to 14 days ;—there are found in the uterus many changed appearances, and products of secretion. In the uterus of the Mammalia the folds and tufts arise in a peculiar manner, as will be stated more in detail further on, and a considerable quantity of viscid matter is secreted on the internal surface of the uterus. In man also, something analogous no doubt occurs. Thus Home and Bauer are said to have found, eight days after impregnation, a layer of effused lymph, on the internal surface of the uterus, which formed fibres of tolerable length. John Burns, and more lately K. E. v. Baer, have observed similar appearances. Edward Weber found seven days after conception the inner layer of the substance of the uterus much reddened, and covered with a paler, softer, layer, from half a line to a line in thickness, which consisted of very many small perpendicularly-standing cylinders, united together by a slimy membrane. All the cylinders ended with a round unswollen extremity. Many of them had a length of from two to three lines, whilst the layer, where this was the case, formed folds. Vide something on this subject, further on, in the description of the *decidua*.

Finally, there would here be to mention the remarkable *glimmering motions* (Flimmerbewegungen) which Purkinje and I discovered in the mucous membrane of the oviduct of amphibious animals, birds, and Mammalia. Since, however, this phenomenon belongs to the perfectly formed mucous membrane of the genitals in all stages of their existence, and besides, to that of the organs of respiration, it cannot be here fully and particularly considered. I therefore refer to the account which we have given of this discovery in Joh. Müller's Archiv, and to our paper; *de phœnomeno generali motus vibratorii. Wratisl.* 1825. 4.

SOME REMARKS AND INQUIRIES

CONCERNING THE

GERMINAL VESICLE

(VESICULA GERMINATIVA.)

TRANSLATED FROM THE GERMAN* OF PROFESSOR RUDOLPH WAGNER, OF ERLANGEN.

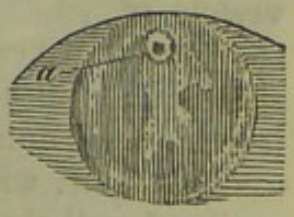
By MARTIN BARRY, M. D. M. W. S.,

PRESIDENT OF THE ROYAL MEDICAL SOCIETY OF EDINBURGH.

THERE is no doubt but that the acute *Baer* was wrong in regarding the entire ovum of the Mammalia and of man, as the germinal vesicle itself, a very pardonable error, considering the novelty and difficulty of the object, in which *Carus* † has followed him. *Purkinje* ‡ has already recently expressed his doubts of it, and this fortunate discoverer of the germinal vesicle in birds has justly explained the content of the Baerian vesicle as the yolk. Finally *Valentin*, § with the most successful talent for observation, and in connection with *Bernhardt*, has very lately exhibited the true germinal vesicle in the ova (Baerian vesicles) of very different Mammalia, and drawn a parallel between the entire Graafian vesicle, with its various contents, and the ovum of the bird. My less numerous researches accord perfectly in their results with those of Valentin, Bernhardt, and Purkinje; in the explanation of single parts, I can for the present do no more than receive their views. In the following I shall ask attention to a few points, which I recommend to my relative and colleague Valentin, for confirmation and further prosecution.

In *Fig.* 1. there is seen a Graafian vesicle of the sheep, slightly magnified, and represented as lying in the ovary; at *a* the minute ovulum surrounded by the known pellucid non-granulous space. In *Fig.* 2. is the ovulum with the Graafian vesicle, taken out. I found it $\frac{1}{13}$—$\frac{1}{20}'''$ in diameter (about ten of them hav-

Fig. 1.



* Müller's Archiv, Jahrgang, 1835, Heft iv.

† *Zootomie*, 2*d Ed. Tab. xx. Fig* 15. With neat delineation of the ovum of the swine.

‡ *Article Ei, in the "Berliner Wörterbuch," Band* x.

§ *Bernhardt Symbolæ ad ovi mammalium historiam ante prægnationem. Wratislav.* 1834. With a very good plate, drawn by Valentin.

ing been measured.) It is externally surrounded by a diaphanous membrane, which I with others, call chorion, without intending thereby to indicate the chorion as a covering of the fœtus. Between the chorion and the yolk-bag, there is a narrow diaphanous space. The yolk-bag presents a finely granulous mass, with single larger (probably fat) granules. With slight pressure, there appears the transparent germinal vesicle, *c*, which measures exactly $\frac{1}{30}'''$. It always contains a round, yellowish, apparently opaque, as it were granulous spot of $\frac{1}{200}'''$ in size, (diameter.) In *Fig.* 3, is particularly represented the germinal vesicle taken out of the yolk, with the spot. In *Fig.* 4, I have selected for comparison a somewhat maturer ovum of the rabbit, in which the yolk already contains numerous, large drops of fat. The ovulum generally measures $\frac{1}{13}'''$, but also from $\frac{1}{12}'''$ to $\frac{1}{20}'''$; the pellucid germinal vesicle, $\frac{1}{30}'''$ to $\frac{1}{70}'''$; the yellowish glimmering opaque spot, $\frac{1}{200}'''$. Once also I saw, instead of a single spot, two smaller ones, lying close together.

Fig. 2.

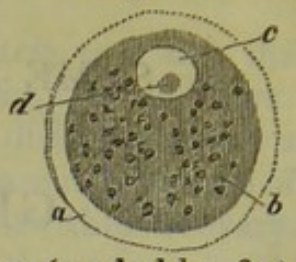
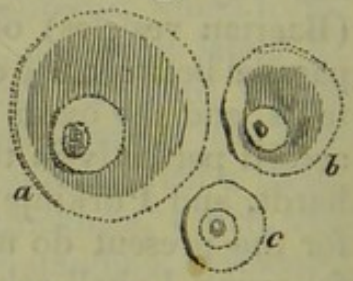


Fig. 3.

Fig. 4.

Fig. 5.



The spot has claimed my attention, because I have met with it in other classes of animals: whether constantly in vertebrated animals, I am still doubtful; but it is very distinct, for every observer in Phalangium opilio, ova of which, of different size and development, I have delineated in *Fig.* 5. At *a* is seen a larger ovum, with pellucid chorion, and opaque yolk, which has already arched over the germinal vesicle. On the latter is seated the granulous spot. At *b*, the yolk has just advanced, and at *c*, is not at all perceptible as a layer of granules. Here also the minute germinal vesicle of $\frac{1}{100}'''$, is furnished with the opaque spot: the germinal vesicle grows for a while together with the spot; and at *Fig.* 6, as well as at *Fig.* 3, there is such a germinal vesicle particularly represented.

Fig. 6.

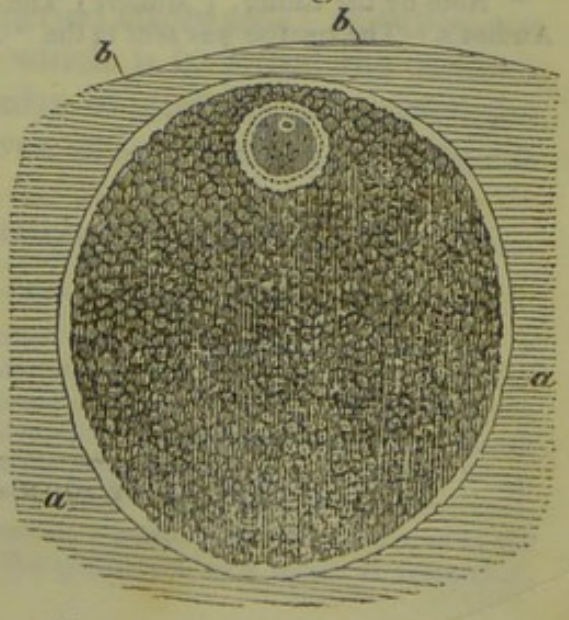
This spot, which I consider constant, at least in the Mammalia, I call the germinal spot *(Macula germinativa.)*

The germinal vesicle presents in the different classes of animals, various marks on its surface, which I shall point out in another place. I have now seen this germinal vesicle, besides in the animals named by Purkinje, also in Octopus, among

the Gasteropoda, only in Patella. With some practice and acquaintance with the parts, one may find this delicate structure also in animals that have lain in spirit: its content becomes in spirit dark and opaque, as for example in fishes. I have not yet found the germinal vesicle in our native snails; whereas, in Unio and Anodonta, it is very distinct and firm; hence these animals are to be much recommended for the first observation. It constantly presents (in these animals?) two spots circular in form, which intersect each other, (varieties rarely occurring,) the larger of them may bear a certain resemblance to the germinal spot. I have quite recently seen the germinal vesicle distinctly, though without any mark (on its surface) in the Ascaris, but it was very minute: I could not with decision see it in the remarkably formed ova of the Tænia, and as little hitherto in the Distoma. In the cra-fish the germinal vesicle is very distinct; the granulous spot I did not find, and discovered it to be wanting also in Cyprinus, Gadus, and the Batrachia, while I found it very distinct in some ova of Salmo. It may be, that I have overlooked or mistaken it; still more probable is it, that it passes through metamorphoses, and depends upon circumstances which are yet to me unknown.

That in the human ovum there is present a germinal spot, appears to me probable. What may be its meaning? Does it stand in a certain relation to the embryo? Is it perhaps still further organized? How remarkable is what we know of the compound organization in the Mammalian and human ovum; it is a true encasing, (Einschachtelung)—in the Graafian vesicle lies the vesicle of Baer, in the Baerian vesicle, the vesicle of Purkinje. Is the germinal spot again to have its content? Hitherto, with an enlargement of 800 times, (diameters) I have not been able to discover any thing in it distinctly.

Fig. 7.



For further contemplation I have given in Fig. 7, a more schemal section of the Graafian vesicle of the sheep, represented in *Fig.* 1, and which in *Fig.* 7 is seen lying in the ovary. *a* is the germ couch, (stroma,) of the ovary, *b* the serous peritoneal covering. The Graafian vesicle presents a double membrane, and a granulous content; the ovulum itself is surrounded by the pellucid border, then next inclosed

by the chorion, and shows a dotted yolk; within lies the germinal vesicle, with the germinal spot. For observance of the germinal vesicle and germinal spot of the Mammalia, I recommend powerful enlargements of 300 to 500 diameters.

I wish that these remarks and inquiries may induce naturalists to make observations in the ensuing spring.

Supplement.

Since the end of last year (1834) I have unremittingly inquired into, and already prepared forty tables of drawings of, the ovum in the different classes of animals. It is thence shown:

1. That the primitive parts of the ovum are the germinal vesicle and the germinal spot, as is most satisfactorily demonstrable in insects; the yolk is added at a later period.

2. The germ is, at its first appearance, that which I have named germinal spot. It is a layer or granulous mass, which appears sometimes single as a spot (Mammalia, snails, insects, &c.)—sometimes forms several scattered globules, (Crafish, Fishes, Batrachia,) which at an earlier period I erroneously considered as drops of fat. It is fixed to the internal surface of the germinal vesicle, where it is immersed in the albuminous fluid of the same.

3. I have distinctly observed the origin of the germinal layer out of the germinal spot. This gradual metamorphosis from the minutest germinal vesicle, measuring at times less than $\frac{1}{100}$th of a line, to the mature ovum, the relation to the germinal vesicle, &c. is of great interest.

The number of animal species examined is very considerable, and my micrometric observations may be not far short of a thousand. I wish only yet to extend my researches among marine animals.*

* Note by the Editor, (Müller,) The supplement is taken from a letter of the Author's. The treatise was sent to the "Archiv" last year. (1834.)

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