On the Structure of the Ovary and the Ovarian Ovum of Loris lydekkerianus, Cabr.

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With Plates 8 and 9 and 2 Text-figures.

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1. INTRODUCTION.

The species of lemur from South India whose ovarian structure and ovum have been investigated was formerly described (1) under the name of Loris gracilis (Geoffr.). It has been discovered recently that this prosimian form really includes two distinct species, distinguished as L. lydekkerianus (Cabr.), peculiar to Mysore (2), and L. malabaricus (Thos. and Wrough.), common in the other parts of South India. A very large number of both sexes of the Mysore species has been kept under observation for several months.

2. THE STRUCTURE OF THE OVARY AND THE OVARIAN OVUM.

In Loris the ovaries are solid-looking rounded bodies, the surface being uneven owing to the graafian follicles of various sizes. They lie in the mesovarian pouch formed by the reflected broad ligament which supports the greatly convoluted oviduct. The fimbriated mouth of the fallopian tube is closely applied to the ovary, whose average measurement across the
greatest width is 3·5 mm. The ovarian ligament passes obliquely from the ovary to the sides of the anterior ventral margin of the uterus, and the round ligament, which extends to the groin, commences at about the middle of the fallopian tube and projects from the broad ligament. The surface of the ovary, besides being uneven owing to the vesicles of large sizes, bears numerous orifices which lead into tubular invaginations. In addition to these ingrowths, as is evidenced by the preparations, the cortical region in certain portions of the ovary presents a ramifying system of canals which, judged from the histological character of the lining membrane, must have been produced by the secondary growths of the invagination of the surface epithelium. The structure of the mammalian ovum has been described by several investigators, and my own observations are in accord with their results. The ova of Loris in the later phases of growth present the following measurements. They are more or less oval in cross-section, and the numbers given are the averages in each case of twelve ova measured. The fully grown eggs contained in cumulus proligerus measure 0·109 × 0·099 mm., the nucleus 0·025 mm., and the nucleolus 0·016 mm. The fat-bodies range from 0·008 mm. to 0·016 mm. Young ova which are surrounded by follicle cells are 0·085 × 0·076 mm., and their nuclei are quite as large as those of the fully grown ones, while the fat-bodies are excessively large, being nearly one and a half times the size of those occurring in the larger ova. The tubal eggs are both spherical and oval in sections; the latter are 0·034 × 0·028 mm., the former 0·032 mm.

The fully grown ovum of the lemur bears the usual cytoplasmic inclusions of which the fat-globules are the most conspicuous in all osmic preparations. These deutoplasmic bodies are of very variable sizes, and usually the largest ones occur in the younger ova, and therefore only a few in number; while the smaller and medium-sized ones are met with in the larger ova quite arbitrarily.

The mode of occurrence of the various cytoplasmic inclusions in the eggs at different periods of growth presents certain
interesting features. In the tubal eggs the nuclei are large, practically occupying the entire area of the cell-body with only a few fat-globules in the form of dark dots which occur in the periphery. There is a definite polarity in the ovarian ova as regards the distribution of these fat-bodies in the younger as well as the fully grown examples. The central portion of the spherical ovum is almost entirely plastic, and on one border of it the nucleus lies. The fat-globules occupy the opposite pole in profusion so as to constitute a deutoplasmic cap from which they extend to the opposite pole in one or two layers along the periphery. In the fully grown types of ova the fat-bodies at the accumulated pole as a rule are smaller than those which occur in the marginal regions and at the opposite pole. The nucleus lies nearer to this pole. In some few instances the plastic region is also invaded by the fat-globules of the larger and smaller varieties, as can be seen in fig. 1, Pl. 8. Fig. 2, Pl. 8, which represents a section passing across the ovum between the deutoplasmic and the opposite poles, shows peripheral distribution of the fat-bodies with a clear plastic area which is occupied by the yolk-spherules. The size attained by some of these fat-globules is remarkable, as is seen in fig. 3, Pl. 8, which is a section of a young ovum in which, however, the deutoplasmic pole is occupied by the smaller variety of fat-globules. It has not been possible for me to distinguish two types of ova based on the size or the distribution of these deutoplasmic inclusions, for I find that in all my preparations the eggs, when they become fully surrounded by the follicle cells, present a condition in which one of the poles is definitely occupied by fat-globules of uniformly small size (fig. 4, Pl. 8), while the peripheral regions and the opposite nuclear pole are occupied by the smaller and the larger varieties of fat-spherules. As I have already stated, the younger ova almost as a rule possess in the marginal regions about the equitorial plate yolk-spherules of exceptionally large size, some of which are nearly three times as large as those occurring in the fully grown ova in the same parts. In my preparations it is possible to study the formation of new fat-spherules around the periphery
immediately under the investing membrane and the divisions of the old larger ones by fission (fig. 4, Pl. 8). These two processes must account both for the smaller size and the increased number of fat-globules in the fully grown ova, though it is not quite clear why one of the poles should be almost exclusively occupied by the fat-bodies of one size, while in the rest of the ovum, in the positions already specified, there should occur both the large and small varieties. It is clearly impossible to recognize two types of ova in the prosimian studied by me, and while it is easy to distinguish a definite polarity as regards the distribution of fat-globules, we must note that of the two sets of fat-bodies the smaller kind is confined to the deutoplasmic pole, while the smaller and larger ones occur together all round the margin and at the opposite pole. It is not possible, therefore, to divide the eggs into two groups designed by structural devices to produce males and females, as R. Van der Stricht (3) appears to have made out in the case of the rabbit.

Dr. Ludford, in his contributions (4) on the morphology and physiology of the nucleolus of Limnaea, has given a summary of the previous work on the subject, and in his other paper (5), dealing with the oogenesis of Patella, has elucidated the behaviour of the nucleolus. In the nerve-cells of mammals Page May and Walker (6) have observed that the nucleoli after fission and undergoing other staining reactions are extruded from the body of cells to be absorbed by the leucocytes or capsular cells. It would be beyond the scope of this paper to enter into any discussion about the theories of the nucleolar function, but as my preparations show nucleolar extrusions into the cytoplasm of the oocytes of different degrees of growth, I have thought fit to describe the phenomenon as illustrated by my slides. The appearance of the nucleolus in the nucleus, and the subsequent extrusion of parts of it into the general cytoplasm, are associated with the phenomena of oogenesis and vitellogenesis. In the tubal eggs the presence of a nucleolus is not indicated, and indeed its appearance is correlated with a certain size of the ovum and its being surrounded by follicle cells,
and the breaking up and redistribution of the chromatin threads of the nucleus itself. I shall refer to the latter part of the subject in the subsequent paragraphs. In all the preparations fixed in Levi fluid and stained with safranin and acid fuchsin even the youngest ova show the occurrence of yolk- and fat-globules; the latter, however, are not present in those ova which are just differentiating from the germinal epithelium. If the nucleolus cannot be detected in cell-bodies in which these two types of deutoplasmic inclusions occur, then it becomes somewhat difficult to postulate that the nucleolus exerts a direct influence on their formation, though it may be possible to maintain that it may have an indirect influence on the later phases of their elaboration. Long before the polarity of the fat-globules is established the nucleoli appear in the nucleus, and the oxyphil portion has already extruded particles of its substance. In none of my preparations am I able to discover the oxy- and basiphil portions in an integral state, though in several young ova the occurrence of both as separate entities is demonstrable. I do not express any opinion as regards their mode of formation, whether, for instance, they appear as independent entities, or are only staining differentiations which occur later in the development of the original basiphil or oxyphil nucleolus. As has been already stated, even in these stages of oogenesis the oxyphil substance is met with in the general cytoplasm (fig. 3, Pl. 8) in addition to a fairly large oxyphil nucleolus in the nucleus. As the ovum increases in bulk (fig. 4, Pl. 8), the oxyphil nucleolus passes bodily through the nuclear membrane, and after occupying various points in the protoplasm finally takes up a position near the cell-membrane at the pole opposite to the deutoplasmic cap (fig. 1, Pl. 8). In its movements through the body of the cell it seems to grow in size (fig. 3, Pl. 8), for in its resting phase it is even larger than the largest fat-globule, while at the time of its emission it is about the size of one of the smaller fat-bodies (figs. 1 and 2, Pl. 8). As it is growing in size and is moving through the substance of the ovum, it is seen to be surrounded by small fat-globules which break away, and such minute particles
may be also detected in the central portions of the nucleolus (fig. 5, Pl. 9). Such a phenomenon is not isolated but is universally met with in all ova. In the final stages of the growth of the ovum a second extrusion of the nucleolus takes place (fig. 4, Pl. 8), and it behaves in precisely the same manner as its forerunner, moving like it through the cytoplasm and swelling in size. In these stages of oogenesis it is clear that the oxyphil nucleolus has an independent origin in the nucleolus, and this would warrant the supposition that it arises similarly even in the younger ova. From fig. 2, Pl. 8, it will be seen that the nucleolus first extruded is ultimately eliminated from the ovum into the general mass of follicle cells where it is absorbed, or may be sometimes found in the liquor folliculi. At the time of its elimination the nucleolus is found to have greatly diminished in size. In the second case of nucleolar extrusion from the nucleus, small grains are found both in its general matrix and all over the periphery of its substance, and indeed a general streaming outwards of such grains seems to take place from the centre of this oxyphil substance. This is of most common occurrence in all my preparations, and the formation of fat from out of the nucleolus is obvious (figs. 3 and 4, Pl. 8). The fact that no part of the nucleolus is expended in such formation, but that it acts as its focus, is proof that the oxyphil nucleolus is of the nature of an enzyme which initiates by its presence the production of fat-bodies. My observations on the origin of the nucleolus are in conformity with the views expressed by Nakahara (7) that the nucleoli represent substances going through the nucleus in metabolism. According to this hypothesis nucleoli may be formed directly of a material taken up by the nucleus or may be produced from some substances within the nucleus in the course of the metabolic processes. Further, the fact that the appearance of nucleoli synchronizes with the ovum being surrounded by the follicle cells cannot be entirely devoid of interest or significance. Though it may not be possible to establish a direct connexion between the formation of the nucleoli and the ovum being enveloped by the follicle cells, still the influence of the latter
on the metabolic process of the nucleus and the cytoplasm of the egg is an undisputed matter. It may be held, therefore, that in the case of oocytes the substances out of which the nucleoli are constructed are in the first instance derived from the follicle cells, and are later elaborated by the metabolic activity of the nucleus itself. It is difficult to say whether the migrating nucleus carries from the nucleus any secretory or excretory products, but at all events its substance seems capable of elaborating fat-globules from the general undifferentiated cytoplasm of the ovum in *Loris*. There is one other point about the two nucleoli in the young oocytes to which a brief reference may be made. The basiphil nucleolus is variable in its staining reactions. Haematoxylin and methylene blue affect it deeply. In some of my Mann-Kopsch preparations, without counter-stains, osmium tetroxide has affected the substance equally deeply, giving a very sharp image of the nucleolus (fig. 7, Pl. 9). Again, in silver-nitrate preparations the basiphil nucleolus is black and the oxyphil part is pale yellow. The argentophil character of this nucleolus has been referred to by previous authors, and of these two classes of nucleoli, both the basiphil and oxyphil types seem capable of executing amoeboid movements (fig. 4, Pl. 8). These pseudopodial processes, if they are really pseudopodial (fig. 4, Pl. 8), occur very rarely and only in a few nucleoli. In some of my preparations I could discover tiny little vacuoles in these outgrowths, and they would appear to be more of the nature of vacuoles formed on the periphery than protrusions of the nucleolar substance. The basiphil part remains intact throughout the growth of the ovum, and in some ova in which more than one oxyphil nucleolus occurs it is possible that the segments may have been due to the division of the extruded part, though I could not discover any in the actual state of fission. In several ova, chiefly those which have not attained complete growth, the elimination of these fragments (fig. 4, Pl. 8) from the cell membrane into the follicle cells is observable, and possibly they are absorbed after disintegration. This is in accord with the observations of Page May and Walker on the behaviour of the nucleolus of the cells
of cerebrospinal and gasserian ganglia of certain mammals to which I have already referred.

In his paper on the relationship between the formation of yolk and the mitochondria and Golgi apparatus during oogenesis, Professor Gatenby (8) has put forth the suggestion that the filamentous nature of the Golgi apparatus described by Del Rio Hortega in the ovum of the rabbit may be found upon further work to be formed of small curved plates. In the germinal cells of the lemur ovary fixed by the Mann-Kopsch technique I can easily make out a Golgi apparatus; and also a few granular bodies occur, some of which presumably represent this apparatus while others are mitochondria. There is no means by which the last two can be distinguished, though the juxta-nuclear position of some may be regarded as indicating their Golgi character. Fig. 7, Pl. 9, which is a photograph of a fully grown ovum, shows both mitochondria and Golgi apparatus in their characteristic positions. The latter in the untreated sections forms a compact black cap over the nucleus, and the separate elements are in the form of rods which surround the archoplasm. The mitochondrial elements are granular and form a dense layer in the peripheral parts of the ovum. As the process of oogenesis takes place the Golgi mass becomes resolved into separate units which now begin to move away from the nucleus and spread throughout the general cytoplasm (fig. 8, Pl. 9). In doing so, they divide (fig. 7, Pl. 9), and at this stage the rods assume the characteristic banana-shape fringing the margin of the archoplasm globule. The multiplication of the Golgi batonettes occurs pari passu with the distribution and rearrangement of the mitochondria. Three layers of these bodies can be made out (fig. 8, Pl. 9). The outermost layer which lies immediately below the cell membrane, the middle and the inner layers, the latter in close proximity to the nucleus. Long before these processes are initiated the plasmosome nucleolus has entered the cytoplasm, with the result that the deutoplasmic formations are now in active progress. I have already drawn attention to the fact that the extruded nucleolus forms the centre of the
formation of fat-globules, and in the course of its movements in the cell body must ensure the polarity to which reference has already been made in the earlier part of the paper. At this stage the fat-bodies, the mitochondria, and Golgi batonettes are promiscuously mixed up (fig. 8, Pl. 9), and only prolonged treatment of the sections with turpentine or oxalic acid will help to differentiate the latter two elements (fig. 9, Pl. 9). In my preparations fixed by Levi's fluid followed by Altmann's acid fuchsin and picric acid the fat-globules and yolk-disks can be studied, and the latter, which are comparatively smaller, are of uniform size and are evenly distributed throughout the cell body. The mode of formation of yolk-spheres has been studied in other forms by various investigators, and the results I have obtained are in accord with their general conclusions. I have to observe that the fat-content of the yolk-disks is comparatively poor in the lemur, and hence in the untreated sections they appear pale and are readily stained by acid fuchsin. Both Golgi apparatus and mitochondria take part in their formation (figs. 8 and 9, Pl. 9), but it is difficult to adjudge their relative share. It must be borne in mind that the division of mitochondria usually results in the formation of meta- and micromitochondria. In the peripheral regions of the egg-cell the dense mitochondrial matting is composed of both these elements. The middle layer is of only the smaller variety, while both kinds occur in the neighbourhood of the nucleus. It is noticed that in the region of micromitochondria (fig. 9, Pl. 9) vacuoles arise, and for some time these granules are formed to repose on their periphery and disappear later. These vacuoles when filled with lipoid substances, produced from the general cytoplasm, probably incited by the one or the other kind of mitochondria, are converted into yolk-spheres. Throughout oogenesis the micromitochondria and yolk-disks continue to be formed, and therefore the yolk-spheres also continue to make their appearance. The micromitochondria are comparatively few in number and are practically absent from the fully grown eggs, a fact which lends support to the view that the micromitochondria having given rise to the yolk-spheres, however
scanty, virtually disappear, giving place to the larger type of mitochondria. The formation of yolk is uniform throughout the general cell substance in accordance with the even distribution of the smaller variety of mitochondria. It is impossible from my preparations to trace the ultimate fate of the micro-mitochondria; but on the other hand, from their close relation with the yolk-vacuoles until their disappearance, it is probable that they may take part in the elaboration of lipoid substance. Whether the disintegrated products of mitochondria do or do not become converted into the fat of the yolk-disks is a subject on which I can express no opinion. Interspersed between the fat-globules and mitochondria are the Golgi apparatus in the growing oocytes. Each apparatus comprises (fig. 7, Pl. 9) a batonette stuck on the periphery of the archoplasm sphere. The latter is twice the size of the metamitochondrial grains. The Golgi bodies are certainly far fewer than the mitochondria, and the part played by them in the formation of yolk can be easily followed. The archoplasm spheres undergo little or no change in chemical reactions so long as the associated batonettes retain their original form and size. The shrinkage in the size of the Golgi rods appears to herald the process of yolk-formation, which no doubt arises in the centre of the archoplasm mass. While there is no doubt that the lipoid substances in this sort must be due to the direct influence of the reposing Golgi rods, it is impossible to be sure whether it is the archoplasm itself or the surrounding cytoplasm which ultimately becomes converted into these fat-bodies. Except perhaps in size, the yolk-disks formed by the mitochondrial and Golgi agencies can hardly be distinguished, but the main fact is that both are concerned in their formation. The diminished Golgi rods having contributed to the elaboration of deutoplasmic inclusions, now go back to the nuclear region where they form a dark ring round the nuclear membrane, while others which have not taken any part in yolk-formation continue to remain scattered in the egg-cell. Such Golgi rings round the nucleus are demonstrable in every fully grown ovum, but absent from those which have not completed the process of oogenesis. I am at present unable
to assign any specific function to the metamitochondria, though these may be also concerned in the initiating of yolk-formation. The relations of the protoplasmic and deutoplasmic inclusions, so far as they relate to the prosimian ova, may be graphically represented thus:

<table>
<thead>
<tr>
<th>Protoplasmic Inclusions</th>
<th>Deutoplasmic Inclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasmosome (oxyphil nucleolus)</td>
<td>Fat-globules</td>
</tr>
<tr>
<td>Micromitochondria</td>
<td>Yolk-spheres</td>
</tr>
<tr>
<td>Metamitochondria</td>
<td>Yolk-spheres</td>
</tr>
<tr>
<td>Golgi apparatus</td>
<td>Yolk-spheres</td>
</tr>
</tbody>
</table>

I have already noticed that the plasmosomes are extruded from the cell after discharging their function, and the effete Golgi rods go back to the nucleus round whose membrane they form a fairly thick ring. This marks the period of the full growth of the ovum when nucleolar extrusions no longer take place. In the follicle cells the Golgi apparatus, consisting of a few bent rods, forms a cap on the nucleus, and the mitochondria are few comparatively and lie scattered in the cytoplasm and are unaffected during oogenesis.

I have examined the sections of the ovaries of the immature, mature, and pregnant lemurs with a view to following the development of interstitial cells into ova, a subject on which Miss Lane-Claypon (9) has written an excellent paper. Her conclusions are that after the transformation of the germinal cells some become ova, some follicle cells, and others interstitial cells. These latter, when they receive an appropriate stimulus in the form of pregnancy, are capable of being converted into ova. Consequently she assumes that for the purpose of the renewed formation of ova the ovary need not return to invaginations of the germinal epithelium. The main question is, does or does not the ovary during pregnancy form invaginations, and if so what is the significance of such periodical return to the tubular formation? Most observers have pointed out that fresh ova are formed during the lifetime of the animal, and their source must be traced either to the interstitial cells or the undifferentiated germ-cells of the invaginations. The results
of my own observations tend to establish that fresh ova arise from both these sources, and during pregnancy the ovary acquires such a powerful impetus that almost every part of it responds. In the section on the structure of the ovary of Loris I have alluded to the occurrence of deep invaginations and their secondary ramifications in the subjacent tissues. In the ovaries of the non-pregnant prosimians, on the other hand, such invaginations are rare or are absent, and the ramifying canals do not occur at all. It is easy to follow the sequence

TEXT-FIG. 1.

Camera lucida tracing. × 220. A section of pregnant ovary showing the fresh invagination formed at the commencement of pregnancy. 

FC, follicle cells; GE, germinal epithelium; INT, interstitial cells in different stages of growth; INV, fresh invagination; IO, primitive ovum derived from the interstitial cell; LEPT, leptotenic phase; OG, ovum derived from the germinal cell; PROT, protobroque cell; YO, young ovum.

of nuclear transformations in the case of the undifferentiated germinal and interstitial cells by which the maturity of the ova is reached. Text-figs. 1 and 2 show chromatin transformations in the case of the germinal cells, and Text-fig. 2 those of interstitial cells more prominently. The cells from the germinal epithelium which divide mitotically give rise to the follicle epithelium of the ova or may pass into the interior of the ovary as interstitial cells. It is a matter of common histological
knowledge that in the non-pregnant animals generally there is a clearly marked off boundary between the primordial ova and the peripheral tissues and the germinal layer, and in the

TEXT-FIG. 2.

Camera lucida tracing. × 136. A section of pregnant ovary in the peripheral region showing the branched system of sub-germinal spaces produced by the invagination whose incipient stage is shown in Text-fig. 1. The great activity in nuclear transformations of young ova derived from the germinal cells at the invaginated points and from the interstitial cells is clearly shown. B.V, blood capillary; C.C, connective-tissue cells; C.F.I.B, connective-tissue fibres; D.E.U.T, deutobroque cells; D.I.C, dictyate phase; D.I.P, diplotenic phase; I.N.T, interstitial cells; G.E.P.L, germinal epithelial layer; L.E.P.T, leptotenic phase; P.A.C.H, pachytenic phase; P.R.O.T, protobroque cells; S.Y.N, synaptic phase.

case of pregnant forms the same cells are beginning to be isolated either by connective-tissue fibres or by follicle cells. Those which are surrounded by the connective-tissue sheath
remain as interstitial cells (Text-fig. 2) which possess the potency of developing into ova at a later period. On the other hand, the primordial ova which are surrounded by the follicle epithelium receive the necessary metabolic impulses for reaching maturity. In this process the chromatin substance traces (Text-fig. 2) practically all the transformations which precede mitotic division, which in their turn incite the cell-inclusions to activity. It is not only difference in size which distinguishes the interstitial cells from the growing ova, but their cell organs and their cytoplasmic contents also become differentiated soon after their histological separation. Not until the advanced stages of pregnancy are reached do the interstitial cells migrate to the periphery of the ovary, where they start on a series of nuclear transformations analogous to those of the primordial ova and the characteristic cell-inclusions manifest. The first change which occurs in the interstitial cell is the enlargement of the nucleus (Text-fig. 2), and the spreading out over the increased area of the chromatin filaments into a loose meshwork with chromatin nodules stuck upon them. This is usually regarded as representing the leptotenic stage of nuclear division. By this time it is noticed that a few follicle cells have aggregated already round this incipient ovum, and with further changes in the nuclear substance of the growing oocyte the follicular epithelium becomes multilayered. The subsequent changes in the nucleus of the metamorphosing interstitial cell in the pregnant ovary of Loris are in accord with those described by V. Winiwarter (10) and Claypon (9). The synaptic condition of the nucleus is indicated by the fact that the filaments have now massed together into a lump on one of the sides of the nucleus, and a fairly large number of nuclei are detectable in this state. These characteristic phases are shown in Text-fig. 2. In the pachytenic stage the synaptic lump is resolved into coarser and more bulky filaments which alone would distinguish them from the leptotenic filaments. Either the diplotenic phase of nuclear transformation, both in the growing interstitial cell and the primordial ovum, is fugitive or does not occur, for in the material at my disposal it is not possible to make out clearly
the dual arrangement of the filaments, though certain stages of chromatin transformations are suggestive of this phase. The appearance of a nucleolus marks practically the conclusion of the nuclear transformations, and in the case of *Loris* the final or dictyate stage is speeded up. In the young ovum derived from whatever source, the nucleolus is very definite, and the nuclear filaments are in the nature of thick strands occupying the entire nuclear area with fine chromatin granules stuck upon them. I have not studied the ovogenetic phenomena in the ovaries of lemur embryos, and am not therefore in a position to compare them with those occurring in the adult ovaries. From the studies of the ovaries of the adults and embryos of rabbits, Miss Claypon, as has been pointed out already, concludes that for the formations of first ova the germinal epithelium need not form invaginations which most of the previous investigators like Pfluger considered necessary for the purpose. At least in the case of *Loris* the fresh formation of invaginations of the germinal epithelium of the pregnant ovaries is demonstrable, and it is equally clear that primordial ova, follicle, and interstitial cells are formed. Text-figs. 1 and 2 show this. To me it appears that the proliferating germinal cells at the base of these secondary invaginations represent the clear cells near the marginal zones in cats and rabbits noticed by Schron, and to which Miss Claypon alludes. The changes involved in the production of ova from these undifferentiated germinal cells, which arise in solid columns from the base of the hollow ingrowths of the germinal layer, have been fully described by Von Winiwarter (10) in the case of the rabbit, and they accord with my own observations. The only difference is perhaps that which relates to the formation of a diplotenic stage of the nuclear transformation of the growing oocyte, a stage which would appear to be less clearly marked in the prosimian. It is unnecessary to enter into the details which have been already described and of which an excellent summary is given by Marshall in his 'Physiology of Reproduction'. 
3. SUMMARY.

There is a definite polarity in the ovarian ova as regards the distribution of the fat-bodies in the younger as well as the fully grown examples. It has not been possible to distinguish two types of ova based on the size or distribution of these deutoplasmic inclusions. The deutoplasmic pole is occupied by fat-bodies of uniformly small size, while the periphery and the plastic or nuclear pole are distinguished by the occurrence of small and large varieties of fat-spherules. Nuclear emission takes place very early in the growth of the ovum and initiates the formation of fat-bodies, and in doing so the nucleolus itself increases in size, while in the final stages of its catalytic activities it diminishes before final expulsion into the follicle cells where it is absorbed. The formation of yolk-disks is attributable to the agency of micrometachondria whose general distribution accords with the appearance of yolk and with which they are in intimate relation. Having given rise to the yolk-disks, they disappear from the fully grown ova. The Golgi bodies also initiate the formation of yolk which appears in the archoplasm, and in this process the Golgi rods are noticed to undergo appreciable diminution in size. Later in the development of the ovum the Golgi rods form a close cap on the nuclear membrane, and those which have not participated in the formation of yolk lie scattered in the general cytoplasm. Deep invaginations and their secondary ramifications occur in the ovary throughout the life of the lemur, and fresh ova arise from the germinal layers of these invaginations as well as the interstitial cells. The nuclear changes involved in the production of fresh ova are in accord with the observations already published by the other authors who have studied these changes in the rabbit, and the only point worth recording is that the diplotenic stage is less clearly marked and the dictyate stage is speeded up in the lemur.
4. List of References.

5. —— "The Behaviour of the Nucleolus during Oogenesis with Special Reference to the Mollusc Patella", ibid., 1921, March, part i; and 1921, June, part ii.

EXPLANATION OF PLATES 8 AND 9.

LETTERING.

AN, abnormal fat-body giving rise to smaller globules; BN, basiphil nucleolus; EN, extruded nucleolus; EN', degenerate oxyphil nucleolus; F, fat-globules treated with oxalic acid; FB, fat-body in the act of dividing; G, golgi batonette enclosing archoplasm; G', Golgi body in a state of division; GE, clumps of Golgi apparatus; M, micromitochondria; ME, metamitochondria; N, nucleus; NE, basi- and oxyphil nucleoli; ON, oxyphil nucleolus giving rise to fat spherules; ON', oxyphil nucleolus extricating pseudopodia; ONx, oxyphil nucleolus which has attained maximum growth and which still is forming fat-bodies; Y, yolk-spheres.

PLATE 8.

Fig. 1.—Nearly a mature ovum, shows the occurrence of the two varieties of fat-globules even in the plastic region.
Fig. 2.—Represents a section across the ovum between the deutoplasmic and plastic poles. The fat-bodies are confined to the periphery, leaving a clear central area occupied by yolk. Nucleoli extruded among the follicle cells.

Fig. 3.—A young ovum showing the abnormal consolidation of the fat-globules. The nucleolus is seen giving rise to the small fat-bodies which are found stuck on its surface, and one which is still being formed is seen inside it.

Fig. 4 and Fig. 4 b.—Shows two young ova in which the division of fat-bodies is taking place. Oxyphil nucleolus (ON) in one is exhibiting pseudopodia. Similar local protrusions may also be seen in the basophil nucleolus in the same ovum.

Plate 9.

Fig. 5.—Section of the ovum passing through the deutoplasmic pole in which the oxyphil nucleolus is actively forming fat-spheres which are found inside it and on its surface. The micromitochondria are best seen actively inciting the formation of yolk-spherules.

Fig. 6.—Two ova showing the outer and middle layers of metamitochondria and the Golgi bodies forming a close cap for the nucleus. The yolk-layer is distinctly marked. The oxyphil nucleolus is escaping from the nuclear membrane in one of the ova.

Fig. 7.—A mature ovum showing the sparse distribution of the Golgi bodies, one of which shows division. The micro- and metamitochondrial and yolk-layers are shown in their characteristic position.

Fig. 8.—Represents an earlier stage in which clumps of Golgi rods and a greater diffusion of both kinds of mitochondria occur. The formation of yolk can be detected in various positions and may be seen to be formed both from the Golgi apparatus and mitochondria.

Fig. 9.—Section of a mature ovum across the deutoplasmic pole in which the Golgi bodies, the two kinds of mitochondria, fat- and yolk-spherules, are found in their appropriate positions. The division of metamitochondria and actual derivation of yolk from the micromitochondria are clearly made out.

Figs. 1, 2, and 3.—Material fixed in Levi's fluid and stained with acid fuchsin.

Figs. 4–9.—Mann-Kopsch technique. Figs. 7 and 8 treated with turpentine, and figs. 6 and 9 with oxalic acid.