XIII.—The Formation, Rupture, and Closure of Ovarian Follicles in Ferrets and Ferret-Polecat Hybrids, and some Associated Phenomena. By Professor Arthur Robinson, University of Edinburgh. (With Ten Plates.)

(Read July 9, 1917. MS. received April 26, 1918. Issued separately September 18, 1918.)

INTRODUCTION.

A few words of explanation are necessary at the outset in connection with the terms used in association with the animals upon which these investigations were made.

Dealers in ferrets supply two types of animals—one with yellowish-white fur and pink eyes, which they call “ferrets,” and a second type in which the yellowish fur is intermingled with a varying admixture of brownish or brown-black hairs; the second type they call “polecats.” The polecats of the ferret-dealers are not, however, true polecats, for Miss FRANCES PITT, who has bred ferrets and polecats and ferret-polecat hybrids in a scientific manner, and to whom I am indebted for the greater and best part of my information on this subject, points out that the so-called polecat of the dealers is never so dark and handsome in colour as the true polecat. Moreover, as Miss PITT states, in the true polecat the light marks in front of the ears do not usually join across the forehead, whereas in the polecat of the dealers they form a band across the face; further, when viewed from in front and above, the head of the true polecat has the form of a fairly equilateral triangle, whilst in ferrets and the so-called polecats of the dealers the head, on the whole, has the form of an isosceles triangle.

The polecat is classified as a sub-genus of the *Mustelinæ*, and is termed *M. putorius*; and the ordinary ferret is generally looked upon as a white variety of the same sub-genus. Doubt has been cast upon this assumption by MILLER (26), who states that, on account of some cranial features, the common ferret is more closely allied with the Siberian *M. evermanni* than it is with *M. putorius*. The features to which MILLER draws attention cannot be denied, but Miss PITT says that reddish specimens of the polecat are not uncommon in the Aberystwith district, and the red colouring is also met with in the common ferret; this fact appears to point to a reversion of both forms to an ancestral type, though it in no sense substantiates the view that the ferret is a white variety of the polecat. Though the zoological position is of interest, it is not of great importance from the point of view of this investigation, for whatever the zoological affinities of the ferret and the polecat may be, it is certain, from the results of Miss PITT's observations, which are confirmed by my own experience, that ferrets and polecats breed freely together, and their progeny are fertile among themselves, with ferrets

and with polecats; moreover, the structure of the ovaries is the same in all, therefore, for the purpose in hand, they may be looked upon as one group; but for convenience of description, and to indicate clearly in the following account whether a ferret in the ordinary sense or a so-called "polecat," which I believe to be a hybrid, is being described I have termed the so-called "polecat" in all cases a ferret-polecat hybrid.

In the course of the investigation 266 animals were used, but in many cases the ovaries of the animals were in functional stages, which have only indirect bearing on the points to be considered now, or they offered evidence only on subsidiary points, therefore I have selected 118 animals from which 232 ovaries, obtained in satisfactory condition, were cut into continuous sections. Details with regard to these animals are given in the accompanying tables; at the same time it is to be understood that one or both the ovaries of all the 266 animals have been cut into continuous sections and have been examined, and that the statements to be made with regard to conditions which are found at different periods are based upon the whole group.

Some of the animals were obtained from a dealer in Norfolk, others from a dealer in Kent. Some of the animals were reserved for me at the end of one breeding season, were kept separate from the male, and were sent to me either before signs of œstrus appeared or immediately thereafter; these animals were inseminated by healthy, vigorous males in my own laboratory, and under my own observation. Other animals were inseminated under the dealers' observation, and were sent to me immediately thereafter or some days later, care being taken to prevent access to the male after the insemination. Both dealers thoroughly understood what was required of them, and as the results obtained from the animals inseminated under their observation correspond with the results obtained from the animals inseminated in my laboratory, there can be no doubt that they carried out the instructions given to them effectively.

The ferret possesses certain advantages for the purposes of investigations dealing with the phenomena of early development in mammals, for it is one of the few highly specialised carnivora which are obtainable in considerable numbers, and which are small and easily dealt with. It is also one of the group of animals which possess an almost completely closed ovarian capsule of the type present in the racoon and the badger, to which I have previously directed attention (32), (figs. 1, 2, Pl. I), and in which, therefore, it might be hoped that all the ova shed at an ovulation would almost certainly be found in the genital passages; this hope has, for the main part, been fulfilled; though, as will be seen later, it is possible for an ovum to escape through the opening in the peritoneal capsule into the peritoneum. The presence of the peritoneal capsule is also an advantage, inasmuch as it protects the surface of the ovary from injury during the manipulations which are necessary in association with the fixation, hardening, and embedding

of the ovaries preparatory to cutting; and although the ovaries, oviducts, and uterine cornua are not so small as in some other mammals, yet they are so small that the cutting of them into serial sections does not entail an excessive expenditure of labour or time. Further, the ferret is an animal in which ovulation only occurs after insemination.* Therefore it was hoped that it would be possible to establish precisely the time at which ovulation and fertilisation occurred. This hope has not been entirely fulfilled for reasons which will be explained later.

METHODS.

Food and Condition.

I made no stipulations with the dealers as to the feeding of the animals, and I understand that whilst they were in their hands they were fed on milk, bread, and scraps of rabbits, rats, mice, and birds. Whilst they were in my laboratory they were fed on bread and milk only, and they were all healthy and in good condition at the time of death, except one which suffered from rupture of the uterus during parturition and died twelve hours afterwards.

All the animals were killed by chloroform narcosis. They were placed in a jar full of chloroform vapour; in it they showed no fear and very little excitement; in a few seconds they were unconscious, and they were dead within ten minutes. The method was chosen because one of the points to be determined was whether or not there was effusion of blood into the cavity of the ovarian follicles at the time of rupture, and it was essential, therefore, to have as little as possible of excitement and struggling at the time of death.

Fixation.

Immediately after death the abdomen was opened; each uterine cornu was cut through close to the body of the uterus, which is very short in the ferret; the cut end of the cornu was held in the forceps, the broad ligament was divided with scissors to a point cranial to the attachment of the ovary, and the uterine cornu, with the ovary and the oviduct, were placed in the fixation fluid, care being taken to avoid any contact of the ovarian capsule with anything outside the body of the animal except the fixing fluid. In some cases the fixing fluid was heated to body temperature, and in other cases it was at the temperature of the laboratory; the results obtained by the two methods were not essentially different.

The fixing fluids were: Zenker; Maximow; strong Flemming, with from 2 to 3 per cent. of acetic acid; Mann's picro-corrosive sublimate, without and with formol; Perenyi; picro-nitric acid solution, with 5 per cent. formol; Lenhossek's fluid.

* MARSHALL made the same statement in 1904 (21); but in 1910 (22, p. 136) he seems to have modified his opinion, for he writes: "In the ferret ovulation occurs during œstrus, but postponement of coition may bring about the degeneration of the ripe follicles, since they do not always discharge spontaneously."

The ovaries of opposite sides were, as a rule, placed in different fluids, and the fluid used in the case of each ovary is stated in the appended tables.

The post-fixation processes were those in ordinary use in association with the fixatives used, and in all cases in which the fixative fluid contained mercuric perchloride the mercury salt was removed by iodine in 75 per cent. alcohol.

Embedding and Staining.

All the ovaries were embedded in paraffin after being passed through alcohol in increasing strength, into alcohol and xylol, xylol, xylol and paraffin, and finally pure paraffin melting at 55·5° C.

Some of the ovaries were stained in bulk in Meyer's hæmalum before being embedded. This method cannot be recommended, in spite of the fact that it gives beautiful differentiation, because it is apt to shrink and harden the fibrous stroma of the ovary to too great an extent.

The majority of the ovaries, which were not stained in bulk with hæmalum, were faintly stained with eosin, placed in the various alcohols through which they were passed. This facilitates the selection of the sections, which are to be treated by various staining methods, before the paraffin is removed from them. The stain is, in most cases, completely washed out in the subsequent processes.

The majority of the sections were cut 10 μ thick, some were 7 μ , still fewer 5 μ , for I found it practically impossible to get a satisfactory series of sections of 5 μ .

The sections were fixed to the slides with egg albumen.

Most of the sections of the various ovaries were stained by Heidenhain's iron-hæmatoxylin method, sometimes in the ordinary way, but more frequently, and with better results, with the modification suggested by RUBASCHKIN (33)—that is, the sections were placed for one minute in a 25 per cent. solution of potassium permanganate, washed in water, placed for one minute in a solution containing 5 per cent. of potassium sulphite and 5 per cent. of oxalic acid, and then washed for one hour in running water before they were mordanted in iron alum.

After the iron-hæmatoxylin process was completed some of the sections were mounted without further treatment; others were counter-stained with anilin blue, with orange green, or with a mixture of the two; with eosin, or with light green, or with erythrosin and light green.

Other sections, not treated by the iron-hæmatoxylin process, were stained with erythrosin and light green, with Mallory's connective-tissue stain, with safranin and light green.

Special sections were selected for treatment with the various elastic-tissue stains, and others, for the demonstration of mitochondria, by Meves' and Benda's methods.

DESCRIPTION.

In the course of the observations upon the growth of the ovarian follicles of the ferret and other phenomena associated with the development of the ova of ferrets certain points have been noted which have little or no direct bearing upon the question at present under consideration; they are perhaps not of sufficient importance to justify a separate communication, but they have a certain amount of morphological or histological interest, and to these points attention will be directed, incidentally, in the course of the description.

THE OVARIES.

The ovaries of ferrets are of irregular ovoid form, the cranio-caudal length always exceeding the dorso-ventral and the side-to-side measurements, and, as a rule, but not always, the dorso-ventral diameter exceeds the side-to-side measurement.

The size of the ovary naturally varies at different periods; it is smallest in the anæstrus period, and largest about the middle of pregnancy; the average size, measured upon 366 ovaries taken from 183 animals killed between the early part of November and the middle of July, measured, after fixation and hardening, and stated in cubic millimetres, was $30.095996866 \text{ mm.}^3$, the smallest ovary of the anæstrus period being 9 mm.^3 , and the largest 44 mm.^3 . There is some relationship between the weight of the animal and the size of the ovary, but it is by no means constant, and the smallest ovary, 9 mm.^3 , was obtained from an animal which weighed 19 ounces, whilst ovaries of double that size were obtained from animals weighing only 16 ounces.

The average size of twenty ovaries, taken from ten anæstrus ferrets, killed in November, December, and January, was 20.238 mm.^3 , and the size of the largest ovary taken from a pregnant animal was 66.87 mm.^3 ; it may be assumed, therefore, that the ovary may increase to at least three times its average anæstrus size during pregnancy.

The ovaries of the left side are as a whole larger than those of the right side, the average size of the ovaries of the 183 animals before mentioned being 28.626 mm.^3 , the average size of the left ovaries was 31.565 mm.^3 . The point is of no particular importance, but it is noticeable in association with the disappearance of the right ovary in birds, the greater size of the left ovary of monotremes, and the tendency, which is so constant in mammals, for the persistence of the left of any two organs which are formed bilaterally during embryonic life, and of which one disappears during development, the ventral rudiments of the pancreas being an exception. It must be noted, however, that in ferrets, in a proportion of cases which constitute somewhat less than a third of the whole, the right ovary is larger than the left. The difference is not due to the fixative and hardening processes, for though,

in the majority of the cases, the ovaries of opposite sides were fixed in different fluids, the proportion of right and left ovaries fixed in similar fluids was about the same.

Structure.

The cortex and the medulla of the ovary of the ferret are very sharply defined (fig. 61, Pl. X). The medulla is reticular in character, and it is continuous with the extra-peritoneal connective tissue at the hilum of the ovary. Through it pass numerous blood and lymph vessels, and in it lie cords of interstitial cells which are connected with the interstitial substance of the cortex, and two sets of tubules. The tubules of one group, which are irregular in number and size, are similar to the occasional tubules which are met with in the cortex (fig. 63, Pl. X). The other set, consisting of tubules which are of smaller size, lie near the hilum, and are continuous, through it, with the tubules of the epovarium, which lies in the mesentery of the uterine cornu. The latter are similar, in all essential respects, to the tubules described by WINIWARTER (43) in the cat.

The cortex is surrounded by the so-called germinal epithelium, internal to which is a definite tunica albuginea. The tunica albuginea consists of spindle-shaped cells, and of fibrils which run, for the most part, parallel with the surface of the ovary, but which bend inwards, at intervals, to become continuous with strands of spindle-shaped cells which pass through the cortex from the tunica albuginea to the medulla, with both of which they are continuous. Most of the primitive ovarian follicles lie in the spindle-cell strands of the cortex, which are particularly numerous near the hilum of the ovary, but some are found also in the tunica albuginea (fig. 3, Pl. I).

The main mass of the cortex consists of interstitial cells, which are divided into columns and nests by lamellæ of spindle cells (figs. 61, 63, Pl. X).

The interstitial cells vary considerably in size, but they all possess the typical polygonal body and the large round nucleus.

The blood and lymph vessels of the cortex lie either in the tunica albuginea or in the spindle-cell strands, into which they penetrate after passing through the medulla of the ovary.

THE OVARIAN FOLLICLES.

When the primitive ovarian follicles are first recognisable, as such, in the adult ovary, each follicle consists of an ovum, surrounded by a single layer of flattened cells, which constitute the primitive capsule, and which are the progenitors of the follicular epithelium.

The ovum is spherical or ovoid; its nucleus is large, round, and excentric; it always contains one large spherical nucleolus; and sometimes, though rarely, two nucleoli are present. In the portion of the ovum not occupied by the nucleus there are numerous granules of varying shape, size, and chemical constitution (figs. 4, 4A, 5, Pl. I). The granules are especially numerous at the pole opposite to the nucleus,

where they form the vitellogenous crescent of VAN DER STRICHT (40), in which a centrosome is not uncommonly visible (fig. 4, Pl. I). I propose to deal with the structure of the ova in another communication, and therefore content myself with the remark that so far as the ova of the primitive follicles are concerned they correspond, generally, with the primitive ova of the cat, as described by VAN DER STRICHT (39A).

The cells of the capsule are flattened plates, and they are not distinguishable from the cells of the stroma amidst which they lie, except by their position, their arrangement, and by the fact that they stain less vigorously.

As the follicles grow the follicle cells increase in number, and they gradually attain first a cubical and then a columnar form, whilst their nuclei become fairly spherical. At this period, when the follicle cells are seen in surface view, or in sections at right angles to their long axes, the cell bodies are polygonal, and neither in surface views nor in sections, which are either longitudinal or transverse, is there any definite indication of the presence of limiting membranes round the cell bodies; indeed, in many cases the cell bodies appear to be fused to a greater or less extent into a nucleated syncytium.

It is difficult to say whether the increase of the number of the follicle cells, in the early stages, is due to mitotic or to amitotic division, and, as a matter of fact, although I have examined many thousands of primitive follicles, I have never seen any clear indications of mitotic division of the young follicle cells, although mitotic divisions were numerous in larger follicles of the same ovary. Neither, on the other hand, have I been able to convince myself that the increase is due to amitosis, though such indications as are present are more in favour of amitosis than of mitosis.

The primitive follicles, as already stated, lie occasionally in the tunica albuginea, but the majority are in the spindle strands which intervene between the columns and nests of interstitial cells, and neither the older nor the younger follicles are always the more superficially placed, for not uncommonly a follicle, in which the follicular cells have attained a columnar form, lies quite close to the tunica albuginea, whilst follicles which are still quite primitive are situated much more deeply. In some places and at certain times the primitive follicles are so numerous that they form definite nests, and this is most commonly the case in the neighbourhood of the hilum. In such nests two adjacent ova may be separated by only a single layer of follicle cells (fig. 4, Pl. I), but as a rule each ovum has its own capsule of flattened cells.

When the follicles have attained a size of 0.009 mm.^3 the nuclei of the follicular epithelium begin to arrange themselves in two layers—an internal, adjacent to the oolemma of the ovum, and an external, next the external limiting membrane; and whenever the cell territories, associated with each nucleus, can be distinguished, at this stage, they extend from the oolemma to the external limiting membrane. At this period the majority of the follicles are distinctly ovoid in form, and the multiplication of the nuclei is most rapid at the poles of the follicles (figs. 9, 10, 11,

Pl. II). This condition persists until some time after the follicles become vesicular, then, as the follicles are distended by the accumulation of the liquor folliculi in their cavities, they become more spherical, but are never completely spherical. As the antrum folliculi grows the rapidity of the multiplication of the nuclei of the follicular epithelium increases, and it is most rapid in the region of the ovular cumulus; simultaneously the outlines of the follicle cells become more distinctly defined, and the nucleus of the ovum migrates to a peripheral position (fig. 16, Pl. III; figs. 40, 41, 42, Pl. VII).

ANTRUM FOLLICULI AND PRIMARY LIQUOR FOLLICULI.

The majority of the follicles begin to become vesicular as soon as the nuclei of the follicular epithelium are arranged in three layers in the greater part of the area of the follicle, and, as a rule, the first indications of cavity formation take place at the poles of the follicles (figs. 10, 11, 12, Pl. II).

The first indications of the formation of the cavity of a follicle are the appearance of numerous small independent spaces at one or other, or both, poles of the follicle. Presumably the spaces are formed by the accumulation of a more fluid substance between the cell territories; at all events the spaces are separated from one another by strands of protoplasm which are continuous with the protoplasmic substance around the adjacent nuclei. As the fluid-filled spaces distend the protoplasmic strands between them become reduced to extreme tenuity; but, even when the follicle has attained the full growth of which it is capable before insemination, and its cavity is fully distended, it is obvious, when the fixation and staining have been successful, that the so-called liquor folliculi is in reality a fluid-filled meshwork (fig. 13, Pl. II; fig. 14, Pl. III). The extremely fine strands of the reticulum anastomose freely with one another, and they are connected on the one hand with the cells of the ovular cumulus, and on the other with the follicle cells which form, together with the cumulus cells, the peripheral wall of the cavity of the follicle. As the term liquor folliculi is established, and as the fluid part of the content of the cavity is undoubtedly preponderant, I propose to call this first formed, fluid-filled, meshwork the *primary liquor folliculi*, for, as I shall show later, a secondary and a tertiary content of the cavity can be distinguished, each of which has its distinctive characteristics.

The ovarian cumulus, as is well known, is the mass of cells in which the ovum is embedded. The greater part of it projects into the cavity of the follicle, and the remainder, which forms the base of the cumulus, is directly continuous, either over a broad area or by means of a relatively narrow stalk, with the lining follicular cells.

In ferrets and ferret-polcat hybrids the ovular cumulus is generally situated in the deeper part of the follicle, that is, the part furthest away from the surface of the ovary, but in some cases it lies at the most superficial part of the follicle.

As the cavity of the follicle attains its full growth a membrane, which may be

called the *membrana limitans interna*, is formed on the inner surface of the follicular epithelium and on the projecting part of the cumulus. It consists, mainly, of a condensation of the stroma of the primary liquor folliculi, and in it are incorporated the remnants of degenerated follicle cells (fig. 17, Pl. III; figs. 52, 55, 57, Pl. IX).

In the earlier stages of its formation the *membrana interna* is continuous, towards the interior of the cavity, with the stroma of the primary liquor folliculi, and, externally, it is connected with protoplasmic processes of the more internal follicle and cumulus cells.

As the *membrana limitans interna* forms, the stroma of the more central part of the primary liquor folliculi is broken up into a granular detritus, and, under the influence of some of the fixative fluids, especially Zenker's fluid, the remnants of the stroma and the fluid in which it lies tend to form a granular coagulum. In some cases the more solid part of the coagulum separates from the more fluid part without any disturbance of the connection of the *membrana interna* with the follicle and cumulus cells, but in other cases, as the coagulum shrinks the *membrana interna* is torn away from its peripheral attachments, and always more from the follicle than from the cumulus cells. It is probable that the shrinkage of the coagulum and the attendant displacement of the *membrana interna* are not normal processes but are due entirely to the reagents used, but I can offer no direct proof in support of this supposition.

At an early stage in the growth of the follicle an external limiting membrane, the "basal membrane" of many investigators, appears at the outer periphery of the follicular epithelium; it is quite distinct when the follicular epithelium consists of a single layer of more or less well-defined cubical cells, and it persists until shortly before the rupture of the follicle, when it is broken up by the penetration of blood-vessels into the follicular epithelium (figs. 49, 50, Pl. VIII).

As the follicle reaches the full growth which it is capable of attaining, independently of insemination, a growth which may, for convenience, be termed the *pre-inseminal growth*, the outlines of the follicle cells, which were more or less indefinite in the early stages, become more distinctly defined. At this stage the outermost cells of the general epithelial lining and the cells adjacent to the oolemma in the cumulus are columnar, conical, or spindle shaped (figs. 52, 54, 55, 56, 57, Pl. IX; figs. 58, 60, Pl. X; fig. 53, Pl. IX; fig. 16, Pl. III). The outer ends of the follicular epithelium cells, which are always the more distinctly defined, are attached to the external limiting membrane, and the inner ends blend with processes of the more internal cells, which assume stellate and irregular outlines, to form a cellular reticulum. It is to the inner portion of this cellular reticulum that the internal limiting membrane is attached.

The only further change of importance which takes place, in the follicular epithelium, during the *pre-inseminal growth* of the follicle, and which occurs as the growth is completed, is the separation of the cumulus cells into an ovular layer next

the oolemma, and a more external layer next the cavity of the follicle and the base of the cumulus, by the appearance of fluid-filled spaces between the two groups of the cumulus cells (fig. 16, Pl. III; fig. 53, Pl. IX). The appearance produced in the cumulus by these changes is not dissimilar to that seen during the formation of the primary liquor folliculi, but there are differences of importance. During the formation of the primary liquor folliculi the spaces which appear amidst the follicular cells are separated from one another, from the first, by thin strands of protoplasmic substance, which become finer and finer as the cavity of the follicle enlarges. The spaces which appear in the midst of the cumulus cells, and which contain the fluid part of a new fluid, the *secondary liquor folliculi*, have at first a very similar appearance to those associated with the formation of the primary liquor folliculi, and they are similarly separated by fine strands of protoplasmic substance, but the protoplasmic strands are more granular and less filamentous than those of the primary liquor folliculi; moreover, as the cells of the basal part of the cumulus are pushed apart by the increasing fluid, masses of granular substance are formed which are not seen during the formation of the primary liquor. These masses are devoid of nuclei, they are surrounded by groups of fluid-filled spaces, and they are connected with the protoplasm of the adjacent cells by granular protoplasmic strands (fig. 40, Pl. VII; fig. 48, Pl. VIII). The mode of formation of the protoplasmic masses is uncertain; they must be evolved from the protoplasm of the cumulus cells, but there is no evidence of the breaking down of cells, and no evidence of the migration of nuclei from the masses to adjacent parts. Eventually, after insemination, the protoplasmic masses break down and disappear. Another difference between the primary and the secondary liquor folliculi is, that the secondary liquor does not coagulate and shrink under the influence of certain fixatives as the primary liquor does in the later stages of the growth of the follicle.

THE SHEATHS OF THE FOLLICLES.

It is customary to state that each fully developed ovarian follicle is surrounded by two sheaths, the theca interna and the theca externa. The theca interna, which lies immediately outside the external limiting membrane, is said to consist of a somewhat loose cellular stroma interspersed with blood-vessels and with plasma cells, which, apparently, is the name applied by some authors to what are undoubtedly interstitial cells. The theca externa is described as being denser, more fibrillated, and less vascular than the theca interna, and as containing few or no interstitial cells.

In the ferret the stroma surrounding follicles, which have attained their full pre-inseminal growth, is sometimes arranged in the so-called typical manner; more commonly, however, the circumfollicular stroma is not clearly separated into an inner and an outer theca. It is a fibro-cellular layer of very varying thickness,

in which the cells and fibrils run parallel with the external surface of the follicular epithelium, and in which are embedded small clumps of interstitial cells (fig. 49, Pl. VIII). It differs from the other parts of the cortex only because the fibrillar tissue is more marked, the interstitial cells are less numerous, and as the follicle attains its full pre-inseminal size the small blood-vessels in the immediate neighbourhood of the external limiting membrane of the follicle become so numerous that they constitute a definite vascular layer (figs. 19, 20, Pl. III; fig. 24, Pl. IV; fig. 48, Pl. VIII; figs. 54, 57, Pl. IX; figs. 59, 60, Pl. X).

THE SIZES OF FULL-GROWN FOLLICLES OF THE PRE-INSEMINAL STAGES.

The sizes of the follicles in the pre-inseminal stages are of interest in connection with the changes which occur after insemination. They have been estimated by taking the largest follicles in each ovary of the various groups. In the accompanying tables the sizes of the follicles are given, and the number of the follicles of the largest size are stated. In that number are included follicles which were slightly smaller than the largest, but the smaller follicles of the group differed only by a few microns from the larger in one or more of the three diameters. The condition of the largest follicles, whether normal or degenerate, is noted in the tables.

It will be seen that the follicles differ considerably in size in different ovaries, and that the difference is independent of the size of the animal, as judged by its weight.

The average size of the largest follicles in 35 ovaries taken from 16 animals in the anæstrus period (Table I) is $\cdot 0404 \text{ mm.}^3$, the smallest follicle being $\cdot 0025 \text{ mm.}^3$, and the largest $\cdot 1561 \text{ mm.}^3$. If the anæstrus series of largest follicles is broken up into two groups, one consisting of the largest follicles in the ovaries of animals killed between 11th November and 9th December of the following year, and a second group consisting of the largest follicles in animals killed between 5th February and 6th May, it is found that the average size of the largest follicles of the first group is $\cdot 0049 \text{ mm.}^3$, and the average size of the largest follicles of the second group is $\cdot 0598 \text{ mm.}^3$.

The average size of the largest follicles in the ovaries in animals in heat, and in which no attempt at insemination was made (Table III), is $\cdot 3215 \text{ mm.}^3$, and if to this group are added the follicles of two animals which were in heat after parturition (Table IV), the average size of the œstrus follicles is increased to $\cdot 3627 \text{ mm.}^3$.

The average size of the largest follicles in the ovaries taken from 13 animals in full œstrus in which insemination was attempted, but unsuccessfully (Table V), is $\cdot 9567 \text{ mm.}^3$; and the average in the group of ovaries taken from animals in the post-partum or post-abortion condition, and which were not in heat, is $\cdot 2830 \text{ mm.}^3$.

The most important changes in the constituents of the follicles during the pre-inseminal period are increase in size of the ovum and alterations in its constitu-

tion, especially associated with the accumulation of lipoid substances; increase of the thickness of the oolemma; and the migration of the nucleus to the periphery of the ovum, where it lies in close apposition with the oolemma.

It has already been noticed that during the same period the outlines of the follicle cells become gradually more distinct; other changes which occur in the follicle cells, including changes of structure and alterations in the positions of the nuclei, will be dealt with more fully in a subsequent section.

THE POST-INSEMINAL GROWTH AND THE RUPTURE OF THE FOLLICLES.

After insemination the most obvious changes occur in the region of the ovarian cumulus. So far as the ovum is concerned the essential changes are the formation of the first maturation spindle, followed by the formation of the first polar body and the second maturation spindle. These changes only occur, normally, after insemination; they may occur, however, in ova in the follicles of non-inseminated animals, but only occasionally, and then always accompanied by other phenomena which indicate abnormal conditions.

The most striking changes, independently of the maturation phenomena in the ovum, are those which take place in and amidst the cumulus epithelium.

About eighteen hours after insemination, or later, the secondary liquor folliculi, which had already appeared in small amount in the later period of pre-inseminal growth, increases rapidly. As the secondary liquor folliculi is augmented the peripheral cells of the projecting part of the cumulus and the more internal cells of the basal portion are dispersed in all directions (figs. 17, 18, 19, 20, Pl. III; figs. 21, 22, 23, 24, Pl. IV). The nuclei of the dispersed cells show indications of degeneration, the protoplasmic processes by which the cells were connected are destroyed, and many of the cells break down and disappear. At the same time the periovular cells of the cumulus are transformed into a very beautiful corona radiata. As the corona radiata is developed all the periovular cells become club-shaped. The thin ovular ends of the cells remain connected with the oolemma, and the nuclei migrate to the enlarged peripheral ends of the cells (figs. 41, 42, 43, 44, Pl. VII; fig. 45, Pl. VIII).

By the continued increase of the secondary liquor folliculi the membrana interna is separated from the follicular cells. Sometimes this separation is complete, but in the majority of cases it is, probably, only partial. When the cumulus is situated at the superficial part of the follicle the membrana interna, as it is stripped from the follicular epithelium, is simply pushed towards the deeper part of the follicle (fig. 22, Pl. IV), but when the cumulus lies in the deeper part of the follicle, the secondary liquor folliculi pushes its way between the separated membrana interna and the follicular epithelium till it reaches the superficial part of the follicle (figs. 18, 19, 20, Pl. III; figs. 21, 23, 24, 25, Pl. IV). In the meantime the superficial part of the

wall of the follicle becomes thinner and thinner as the distension of the follicle proceeds, and ultimately it ruptures at the most projecting point.

The time which intervenes between insemination and rupture of the follicles varies considerably; the shortest time in my series of animals was $30\frac{1}{2}$ hours, and in one, an animal killed $93\frac{1}{2}$ hours after insemination, rupture had not yet occurred (9 and 10, Table IX).

When rupture takes place the ovum with its corona, the secondary liquor folliculi with the remnants of the dispersed cumulus epithelium, and the primary liquor folliculi with the greater part of the membrana interna, are evacuated, and they are carried, apparently at once, into the cranial part of the middle third of the oviduct. I have found four extruded ova in the space between the ovarian capsule and the ovary, and one escaping through the opening from the interior of the capsule into the peritoneum (fig. 2, Pl. I; fig. 46, Pl. VIII), but all the others, which were still unfertilised, or which were in the earliest stages after fertilisation, were in the cranial part of the middle third of the oviduct, where fertilisation usually occurs. None of the ova which were in the cavity of the ovarian capsule were fertilised, and I have never found spermatozoa beyond the cranial part of the middle third of the oviduct.

Not uncommonly, as in the case of the ovum shown escaping into the peritoneal cavity (fig. 2, Pl. I; figs. 46, 47, Pl. VIII), the extruded ovum and its corona become enveloped by portions of the liquor folliculi, which, judging from its reactions to stains, and from the fact that parts of the membrana interna are associated with it, is the primary liquor; but quite as frequently the ovum and its corona are accompanied and surrounded by numerous cells, which are, apparently, those which were adjacent to it in the cumulus. In other cases the ovum and its corona lie quite free in the fluid in the oviduct. The differences appear to be due to the amount and the character of the dispersion of the cumulus cells which takes place after insemination. In all cases some of the cumulus cells remain attached for a time to the corona cells by fine protoplasmic filaments. In many cases the membrana limitans interna is entirely displaced from the cumulus cells, but in others parts of the membrana interna remain attached to the cumulus cells, which are themselves connected with the corona cells.

When rupture occurs and the cavity of the follicle is evacuated the walls of the follicle contract and fold (fig. 26, Pl. IV; figs. 27, 28, 30, Pl. V), but, as a rule, a considerable part of the cavity of the follicle remains, and only occasionally is it almost entirely obliterated, as in the follicle shown in fig. 29, Pl. V. The differences appear to be associated with the extent to which the membrana limitans interna is detached from the follicular epithelium by the secondary liquor folliculi. If the separation is complete, as in the specimen shown in fig. 24, Pl. IV, all the contents are evacuated and the cavity almost entirely disappears; but if part of the membrana interna retains its connection with the follicular epithelium until the time

of rupture—and this is usually the case—then when the rupture takes place this still attached portion of the membrana interna is forced from its anchorage, and, as it is extruded, it carries with it long filamentous processes of the follicular cells, which frequently drag with them some of the more internal follicular cells; these processes and cells, together with a rapidly exuded fluid which forms a granular coagulum under the action of the fixative reagents, and with which white blood corpuscles are intermingled, constitutes a *tertiary liquor folliculi* (figs. 26, 26A, Pl. IV; figs. 27, 27B, 27C, Pl. V).

For some time after its formation the tertiary liquor folliculi forms an adhesive tenacious coagulum which fills that part of the cavity of the follicle which remains after the rupture has taken place; it also plugs the aperture of rupture, and extends beyond it into the cavity of the ovarian capsule, its terminal portion always inclining towards the orifice of the oviduct (figs. 27, 27A, Pl. V; figs. 31, 33, Pl. VI).

Immediately after the rupture the orifice of the follicle is comparatively large, but as the plug which occupies it shrinks, the opening gradually becomes smaller until it closes. The closure commences externally and terminates internally (see figs. 26, 26A, Pl. IV; figs. 27, 27A, 28, 30, Pl. V; figs. 31–33, 34–37, Pl. VI).

As the orifice in the wall of the follicle closes, the cavity in its anterior usually enlarges (figs. 32, 34, 35, Pl. VI), though exceptions are met with, as in the specimen shown in fig. 29, Pl. V. As the re-enlargement of the cavity proceeds the filamentous coagulum of the tertiary liquor folliculi breaks down into a granular detritus, in which the granules, which are at first relatively coarse, become finer as the fluid content of the redistending follicle increases (figs. 36, 37, 38, Pl. VI).

It has already been noted that vascularisation of the follicular epithelium commences before the rupture of the follicle occurs (figs. 49, 50, Pl. VIII). After the rupture has taken place the blood-vessels amidst the follicular epithelium cells increase in number, and they penetrate further towards the interior of the follicle, until in some cases they approach close to the inner surface of the follicular epithelium (fig. 28, Pl. V; figs. 32, 33, 33A, Pl. VI).

Bleeding into the cavity of the follicle does not occur at the time of rupture, and, in the majority of cases, no blood enters the cavity of the follicle at any period, but hæmorrhage occasionally takes place into the cavity of the follicle after the redistension is completed.

The redistended follicle, which is the rudiment of the corpus luteum, contains a cavity as large as that which was present before rupture. The cavity is filled with a fluid containing granules, which are the remnants of the filaments of the tertiary liquor folliculi, and amidst the granules there are, not uncommonly, a few white blood corpuscles and a few isolated follicle cells in a state of degeneration.

THE POST-INSEMINAL GROWTH OF THE FOLLICLES.

It has been pointed out that the average size of the ovarian follicles of animals in full heat, in which no attempt at insemination was made, the first œstrus of the season, is $\cdot 3215$ mm.³, and that the average size of the largest follicles in animals in which insemination had been unsuccessfully attempted is $\cdot 9567$ mm.³

After insemination, on account of the rapid formation of the secondary liquor folliculi, the average size of the largest follicles increases to $1\cdot 7815$ mm.³, as estimated from the largest follicle of each of twenty ovaries (Tables VI-IX), the ova in the follicles being either in the first maturation spindle stage or in the first polar body stage of development; therefore in a period varying from 19 to 41 hours after insemination the follicles increase to over five times their original size.

After rupture, and before redistension, the average size of the largest follicles falls to $\cdot 7800$ mm.³, as measured in 14 ovaries in which rupture of the follicles had occurred, and in which it was noted that redistension had not recommenced (Tables VII-XII). Measurements made upon the largest follicles of 35 ovaries in which the follicles had ruptured, closed, and redistended give the average size of the redistended follicles as $1\cdot 9478$ mm.³—that is, somewhat larger than the average size of the ripe unruptured follicles.

The redistension of the ruptured follicles may commence 41 hours after insemination, but it may not have commenced 10 hours later. The redistension may be completed at any time between 61 and 120 hours after insemination.

CHANGES IN THE FOLLICULAR EPITHELIUM DURING THE MATURATION AND THE DISTENSION OF THE FOLLICLES.

At all periods of the growth of the follicles the protoplasm of the follicle cells contains a considerable amount of substance which assumes a grey, or greyish-black, or bluish-black appearance when treated by iron-hæmatoxylin methods, and which stains a more or less definite violet under the influence of Benda's alizarine stain; presumably, therefore, it is of mitochondrial nature. This substance may be either in the form of granules or filaments, and the filaments may form a more or less definite reticulum.

In the primitive follicles, in which the follicular epithelium has the form of flattened curved plates, the mitochondrial substance is granular, the nuclei of the cells are ovoid: their chromatic substance is distributed throughout the bodies of the nuclei; it has the form of spheroids of varying size, of which one is usually somewhat larger than the others. The spheroids are scattered irregularly in the interior of the nuclei, but it is not possible to say that any definite nucleoli are present (figs. 4, 5, Pl. I).

When the follicle cells become cubical or columnar the granules of the cell

protoplasm become collected into the form of granular filaments, and although the position of the filaments varies, they tend on the whole to lie parallel with the long axes of the cells (fig. 6, Pl. I). The nuclei of the cubical or columnar cells are spherical or slightly oval, and whilst the cells form only a single layer, the nuclei lie close to the external limiting membrane. When the nuclei form two rows, those of the inner row lie close to the oolemma, and those of the outer row close to the external limiting membrane (fig. 7, Pl. I; figs. 8, 10, 11, 12, Pl. II). The chromatin of the nuclei, as in the previous stage, is still in the form of spheroids, and it is not possible, except occasionally, to distinguish nucleoli. The tendency for the chromatic substance of the nuclei to form spheroidal masses of varying size continues throughout the whole period of the growth, rupture, and closure of the follicles in the nuclei which are in the resting condition, and, at any given moment, they form the majority of the nuclei. After the nuclei have increased considerably in number and are arranged in several layers it is possible to find here and there a nucleus which contains a definite nucleolus, but the appearance of a definite nucleolus in a follicle cell is uncommon, and in that respect the follicle nuclei differ markedly from the nuclei of the ova. The rarity of nucleoli in the nuclei of the follicle cells is as marked as the rarity of mitotic figures in any given section, and it is possible that the formation of a nucleolus is precedent to the commencement of mitosis, when the spheroidal masses of chromatin are transformed into short rods.

As the follicles increase in size the chondriosomes in all the cells, including those which have become stellate or irregular in shape, assume the form of granular rods or filaments (fig. 6, Pl. I; fig. 10, Pl. II; figs. 54, 57, Pl. IX; figs. 58, 59, 60, Pl. X), which appear as granules when cut at right angles to their long axes, and this condition is maintained until the follicle cells begin to assume luteal characters, a condition which may occur before, but which more usually does not take place until after the rupture and closure of the follicle. As the luteal condition is assumed, nucleoli become more and more a feature of the nuclei of the follicle cells.

During the whole period of the pre-inseminal growth of the follicle a layer of nuclei lies close to the external limiting membrane, and a similar layer lies close to the oolemma of the ovum (figs. 48, 49, Pl. VIII; fig. 40, Pl. VII; fig. 57, Pl. IX; fig. 16, Pl. III; fig. 53, Pl. IX); but as the pre-inseminal maturity of the follicle is attained, the number of nuclei which lie close to the external limiting membrane is gradually reduced, for the majority of the nuclei migrate towards the interior of the cavity (fig. 58, 60, Pl. X), though the external ends of the cells to which they belong still maintain their association with the external limiting membrane (figs. 58, 59, 60, Pl. X), and as the pre-inseminal maturity of the follicle approaches, granules of osmic-blackening fat appear in the bodies of the cells (fig. 51, Pl. VIII).

The appearance of spherules of fat in the follicle cells during the pre-inseminal

maturation of the follicles is a constant and normal phenomenon, but the amount of fat which is deposited varies considerably in different follicles. The deposition of fat spherules in the follicle cells is also a constant phenomenon of the commencing degeneration of follicle cells; but when the deposition of fat takes place in commencing degeneration the spherules are always of larger size, more numerous in proportion to the size of the cell in which they are deposited, and they tend to fuse together to form globules of relatively large size, and under low magnification of osmic preparations the dense, black, degenerate follicular epithelium is easily distinguished from normal epithelium (compare the left and right follicles, fig. 39, Pl. VII).

After insemination no very definite changes beyond the nuclear migration occur in the general follicular cells, except in the region of the cumulus. There the dispersion of the follicle cell by the secondary liquor folliculi is a marked phenomenon, and the migration of the nuclei, which lay close to the oolemma, commences and proceeds regularly till the corona radiata is fully developed, when all the nuclei of the corona lie in the peripheral ends of the cells to which they belong (figs. 41, 42, 43, 44, Pl. VII). At the same time the corona cells become greatly, but unequally, elongated, with the result that the surface of the corona appears to be formed by a number of projecting spokes of different lengths, a condition which probably facilitates the effect of the rush of fluid which sweeps the ovum through the cavity of the ovarian capsule into the oviduct.

The chondriosomes of the corona epithelium are similar to those of the general follicle cells, that is, they are rods and filaments of varying size which lie parallel with the long axes of the cells, and, where the inner ends of the corona cells blend with the outer part of the oolemma, the chondriosomes appear to pass into the substance of the oolemma (fig. 43, Pl. VII; fig. 45, Pl. VIII).

DISCUSSION.

Membrana limitans externa.

Unlike the *membrana limitans interna*, the external limiting membrane (fig. 52, Pl. IX; fig. 59, Pl. X) has received a large amount of attention. It seems to be universally present, for although BENCKISER (3), SCHOTTLÄNDER (36), and SANDES (35) say that it is absent in the pig, MONTEROSSO (27) figures and describes ovarian follicles of that animal, and says that "*Tra la membrana basilare o propria folliculi e la theca interna è interposto uno strato quasi continuo di cellule grandi*," a statement which indicates that interstitial cells are present in the pig, and which is not in accord with FRANKEL's account of the ovaries of the pig.

Whilst the presence of the external limiting membrane is well known, there is difference of opinion regarding its constitution. WAGENER (41), SCHOTTLÄNDER (36), and LIMON (18) look upon it as a connective tissue structure, though they

differ in details as to the mode of its formation; whilst WALDEYER (42) and NAGEL (28) believe that it is formed by the follicle cells, and NAGEL says that it is structureless, non-nucleated, and is similar at first to the oolemma.

In the ferret its reaction to stains is not the same as the reaction of the oolemma, and when the follicular epithelium is detached from the internal theca by the action of the fixative reagents, the membrana externa separates into two layers (figs. 58, 60, Pl. X). The inner of the two layers is connected with the outer ends of the follicle cells, and is possibly formed by them, in the same way that the external limiting membrane of the central nervous system is formed by the outer ends of the neuroglial cells. The outer layer is connected with the innermost flattened cells of the internal theca, and it reacts like other connective-tissue structures to connective-tissue stains.

The external limiting membrane is present at a very early stage of the life-history of the follicle, being formed when the follicular epithelium is a single layer of cubical cells. Its function is unknown, but its constant presence indicates utility, and it possibly regulates the passage of different materials in opposite directions to and from the follicle.

Membrana limitans interna.

So far as I am aware, the only observers who have noted the presence of an internal limiting membrane in ovarian follicles are BOUIN and ANCEL (4), who describe it as occurring in the ovarian follicles of the bitch. One of LONGLEY's figures of part of an ovarian follicle of a cat (20) suggests that it is present in that animal also, and one of RUSSO's photographs (34) indicates that it may be present in the mature follicles of the rabbit.

According to BOUIN and ANCEL's account of the internal limiting membrane in the bitch, it is formed, in that animal, by the flattening out of the internal cells of the granulosa, which are transformed into a series of closely applied lamellæ. They also state that when it is definitely established it reacts to stains in the same manner as the external limiting membrane, and they conclude, therefore, that some external membranes may also be of epithelial origin. They do not discuss the function of the internal membrane, but they say that as the corpus luteum is formed the internal membrane becomes delaminated, and its various laminæ constitute a more or less dense feltwork in the interior of the cavity of the corpus luteum, "*tout à fait semblable à des fibres conjonctives enlacées.*" If the membrane which BOUIN and ANCEL describe in the bitch is formed and reacts to stains as they say, and if it takes part in the fibrillar network which afterwards appears in the interior of the corpus luteum, it is quite a different structure from that which I have noted in ferrets. In the latter animals the membrana interna does not react to stains in the same way as the membrana externa, and it never presents the vitreous appearance which is so distinctive of the external membrane; moreover, it takes no part in the formation of the reticulum which appears in the interior of the corpus luteum; on the

contrary, it is ejected from the follicle at the time of rupture. Before it is ejected the greater part is separated from its connections with the follicular epithelium by the formation and extension of the secondary liquor folliculi, and when the part which is not so displaced is forced out at the rupture of the follicle, it carries with it filamentous processes of the bodies of the follicle cells, and sometimes also strands of displaced cells, which take part in the formation of the tertiary liquor folliculi which fills the remnant of the cavity of the ruptured follicle.

As to the function of the membrane little can be said, because there is no definite evidence, but it is possible that it may serve to regulate the constituents of the substances which pass into the antrum to form the fluid portion of the primary liquor folliculi.

Antrum folliculi and Primary liquor folliculi.

There has been considerable discussion as to the mode of formation of the antrum and the primary liquor folliculi, and there is a fairly general agreement that part of the fluid which appears is derived, either by osmosis or by secretion, through the follicle cells from the contents of the blood-vessels of the internal theca, but as to whether the fluid which appears, and by its appearance produces the beginnings of the antrum, is at first inter- or intracellular there is difference of opinion, and there is also difference of opinion as to whether or not the dissolution of the follicle cells plays a considerable part in the formation of the fluid. Amongst those who hold that the breaking down of the follicle cells plays an important part in the formation of the fluid are ALEXANDO (1), JANOSIK (14), SCHOTTLÄNDER (36), NAGEL (28), VAN DER STRICHT (40), and SANDES (35), whilst HONORÉ (13) holds that it is an intercellular secretion, and he shows that the so-called bodies of CALL and EXNER are not, as JANOSIK thought, vacuoles in cells but, in reality, intercellular spaces. My own observations entirely support HONORÉ's point of view, and I believe, moreover, that the central parts of the bodies are merely isolated portions of the general antrum. The point is one upon which it is difficult to form a positive opinion, and indeed it can scarcely be definitely settled until some improved methods of differential staining are evolved, for the photographs given by VAN DER STRICHT of the bats' ovaries, and those which SANDES gives of the ovaries of *Dasyurus viverrinus*, which are supposed to demonstrate the breaking down of follicle cells, can be equally well used to support an opposite opinion. The phenomena met with in the ferret, under the methods of preparation which I have adopted, indicate an inter- rather than an intracellular origin of the fluid portion of the primary liquor. The matter is of importance in association with the real nature of the primary liquor; for if it is formed by the dissolution of the follicle cells, it is primarily a fluid in which may be found here and there the remnants of destroyed cells; but if, as appears to be the case in the ferret, it is formed by an intercellular secretion which forces apart the bodies of the cells and extends their substance into long intercommunicating filamentous processes, then the primary liquor folliculi is primarily a reticulum filled with fluid secreted by

the cells, and it bears, therefore, a close structural resemblance to the primitive vitreous body of the eyeball. That such a reticulum is formed in the ferret is obvious, and I am inclined to think, judging from the photographs of VAN DER STRICHT (40) and SANDES (35), that it may be found in bats and *Dasyurus*; but my specimens of ovaries of dogs, cats, rabbits, guinea-pigs, mice, and rats, though prepared in the same manner as those of ferrets' ovaries, do not show the reticulum in the same clear manner, and I am inclined to believe, therefore, that modifications of the process found in ferrets may be present in other animals.

Secondary liquor folliculi.

So far as I am aware, no one has drawn attention to the formation of the secondary liquor folliculi in ovarian follicles. There is no doubt in the case of the ferret that it is present, that it is formed more rapidly, and that it is of more fluid consistence than the primary liquor, and that it takes part in the final distension of the follicle which precedes the rupture. But although the formation of the secondary liquor appears to have escaped the attention of observers who have paid special attention to the development of ovarian follicles, some of the figures they have given to illustrate other points of follicular development indicate that the secondary liquor is formed in the ovarian follicles of other animals besides the ferret. Thus the figure which LONGLEY (20) gives to illustrate the conditions of the cumulus region of a normal follicle of the cat, just before rupture, depicts essentially the same details as are shown in follicles of the ferret at the same stage of development, and which are represented in the photographs which constitute figs. 18 and 20, Pl. III. Further, Russo's photograph (fig. 6, pl. xxxiv) suggests that something of the same kind takes place at all events in some ovarian follicles of rabbits. Indeed, unless the process is one of fairly common occurrence it is difficult to account for the extrusion of the ovum and its corona from follicles, such as those of the human female, the sheep, the bat, and *Dasyurus viverrinus*, in which the cumulus oophorus is merely a more or less prominent rounded elevation of the general follicular epithelium; for there seems to be no reason why the evacuation of the primary liquor, which does not disturb anything more than the superficial part of the stratum granulosum, should break up and displace the somewhat dense mass of cells which forms the primitive cumulus, though it might readily break down the *retinaculæ* which maintain the cumulus in position in some of the follicles of rabbits and some other rodents.

The Growth of Ovarian Follicles.

For many years after PFLUGER's descriptions of the tubes and nests of cells, which are present in the ovaries of the female embryos of all mammals, became generally known, it was presumed that the ova and the follicle cells which sur-

rounded them were the cells of the tubes and nests, gradually isolated into follicles by the interposition of stroma cells. Further, it was asserted, and generally believed, that all the ova which come to maturity were formed in the ovary during the embryonic period; elaborate calculations of their numbers were made, and the results are still at times quoted.

After "germ cells" were discovered, and their migrations from their seats of origin to the ovary were traced, the assumption previously adopted was modified, and it became usual to accept the "germ cells" as the progenitors of the ova, whilst the follicle cells were considered to be the descendants of the germinal epithelium which covers the surface of the ovary. Definite proof that ova are derived from "germ cells" in mammals has never been produced, but the suggestion was enticing, and it received ready acceptance, although it was unaccompanied by any explanation of the reason why of all the ova and follicles, formed at approximately the same time, some proceeded to further growth and development at relatively long periods, in some cases years, before the others, whilst all were presumably subjected to the same influences at all periods.

In 1905 Miss LANE-CLAYPON (16) made a series of observations, on the ovaries of rabbits, which led her to propound the conclusion that the ova, the follicle cells, and the interstitial cells of the ovary are all formed by the germinal epithelium, and that the interstitial cells are potential ova. Her general conclusions have not been confirmed by other observers, but it has become increasingly evident from the researches of WINIWARTER and SAINMONT on the cat (43), RUBASCHKIN on the guinea-pig (33), and KINGERY (15) on the white mouse, that the ova formed by the early embryonic proliferation, whether they are descendants of the germinal epithelium cells or of special germ cells, are not those which attain to maturity and become the rudiments of a new generation of animals, for they all die before they have attained any advanced stage of development, and many of them before they become enclosed in follicles.

According to RUBASCHKIN (33), the ova which attain to maturity are formed by a proliferation of the cells of the germinal epithelium which takes place before birth, but which is, at all events, a third and not a first generation; whilst WINIWARTER and SAINMONT (43) found, in the cat, that the ova which reach maturity are formed by a proliferation of cells, starting from the germinal epithelium and taking place from three and a half to four months after birth. If this is the case, explanation is still wanting as to why certain numbers of the follicles and their contained ova mature for each ovulation period; for all being formed at the same time are of the same age, are situated in practically similar situations, and are subjected to the same influences which bring about the maturation of only a small number at any given ovulation period.

It seems improbable that of a large number of ova and follicles formed at the same time only a few shall attain maturity at an early epoch, whilst the majority

remain quiescent for relatively long periods, in some animals for years, when, throughout the whole period, all are under the influence of exactly similar conditions.

In the course of my investigations into the history of the follicles in the ferret I have noted a number of facts, which I hope to publish as soon as photographs of the specimens can be made, which are entirely opposed to the idea that the ova and follicles which become mature at different periods are all formed at one period of proliferation of the germinal epithelium; and, although the work is not yet completed, I may state here that the results so far obtained not only confirm in all essential respects those arrived at by KINGERY during his investigations on the development of ova in the white mouse, *i.e.* "that the new formation of germ cells from the germinal epithelium is prolonged and extends from birth or shortly afterwards to approximately sexual maturity," but that they lead me to the conclusion that new groups of ova and follicle cells are formed throughout the whole period of the functional life of the ovary.

My observations do not extend over the period from the beginning of August to the end of October; but during the remaining period of the year, that is, from the early part of November to the end of July, it may be said, speaking generally, that in ferrets and ferret-polecat hybrids the growth and death of groups of ovarian follicles proceeds continuously, and that it is not interfered with by pregnancy, but the statement, though it is true in its broad outlines, requires qualifications.

In the first place, if the corpora lutea are numerous and large they may occupy practically the whole of the cortex; stroma, interstitial tissue, and follicles being reduced to a minimum. In these cases the follicles which are present, normal and degenerate, are either quite primitive or but slightly advanced beyond that condition, and it is probable that it is in cases of this kind that the animal has no second œstrus period during the breeding season; this, however, is merely a supposition, and it is not supported by the material at my disposal, for five post-partum animals bearing upon the point of which I have definite notes give the following results:—

F.D. X/16 (Table II). 11 days post-partum. Cast 7 young on 29th May. All young dead on 1st June. Killed 10th June, when showing slight signs of pro-œstrum. Corpora lutea corresponding with last pregnancy, 10 in one ovary and 6 in the other ovary. Both ovaries contained follicles of full pre-inseminal growth.

P.D.A. 40/15 (Table IV). Cast 8 young on 8th May. In full heat 27th May. Killed 1st June. Corpora lutea corresponding with last pregnancy, 8 in one and 4 in the other ovary. Both ovaries contained follicles of full pre-inseminal growth.

F.D. Z²/16 (Table II). Cast 7 young on 6th May, and ate them all the same day. Was not in heat when killed on 2nd July. Corpora lutea corresponding with previous pregnancy, 8 in one and 4 in the other ovary. No follicles of full growth in either ovary.

D.A. 42/15 (Table II). Cast 11 young on 11th May, and was not in heat when killed on 8th June. Corpora lutea corresponding with last pregnancy, 3 in one and 5 in the other ovary. Both ovaries contained follicles of full pre-inseminal growth, and the animal would probably have shown signs of the pro-œstrum in a few days.

F.D.A. 45/15 (Table IV). Cast 8 young on 21st May, which were all dead the next day. In full heat on 7th June. Killed 2nd July. Corpora lutea corresponding with the previous pregnancy, 10 in one and 8 in the other ovary. Both ovaries contained follicles of full pre-inseminal growth.

The ovaries of all five animals contained a considerable amount of cortical tissue not encroached upon by the degenerating corpora lutea.

In spite of these apparently adverse facts a survey of the ovaries of all the animals at my disposal shows that the sizes of the corpora lutea vary greatly both in the same and in different animals. They also show that although the space occupied by the corpora lutea is relatively large, a considerable portion of the cortical tissue remains in most cases as in the above mentioned for animals, and that it frequently contains follicles of considerable size, whilst in a certain number of cases, as already stated, the corpora lutea practically usurp the whole of the cortical area, and only a few very rudimentary follicles can be found. In these latter cases it seems impossible to believe that the cortex can be reconstituted and follicles developed in time for a second œstrus.

There are other factors, with which this inquiry is not concerned, which interfere with the occurrence of a second œstrus in one season, but the point already noted raises the question of the amount of time occupied by the follicle in passing from its initiation to its full pre-inseminal growth. The data at disposal cannot, of course, give a positive answer to the question, for it is not possible to follow the life-history of any given follicle, but they offer interesting suggestions.

Table I shows that the size of the largest follicles in the ovaries of anœstrus animals gradually rises from the middle of November to the early part of April, the breaks in the series being due in all probability to the fact that some of the animals were young adults born late in the previous season. It shows further that of the follicles of largest size, or about largest size, a considerable proportion are in a state of degeneration, and that that proportion is relatively the same throughout the whole period. Under these circumstances it seems scarcely possible to assume that the largest normal follicles of the earlier part of the period persist and become the largest normal follicles of the later part of the period; on the contrary, it seems more reasonable to suppose that all the largest follicles of the earlier part of the period die and are replaced by other follicles, which, as the œstrus period approaches, are able to attain a more advanced stage of development, until, finally, some attain to full pre-inseminal growth, but not to full pre-inseminal development. This supposition is

supported by the specimen F.D.A. 45/15 (Table IV), which was killed on the thirtieth day of her second œstrus, for in her ovaries were not only follicles of full pre-inseminal growth-size, both normal and degenerate, but also follicles which had evidently attained that stage and had then undergone atrophy as well as other follicles of comparatively large size, apparently approaching to full growth.

After insemination and the rupture of the mature follicles, follicles of full post-inseminal and pre-ruptural growth-size are found in a certain number of ovaries; but such follicles always show definite signs of abnormal conditions, and though they may become luteal, they do not rupture (fig. 38, Pl. VI).

Follicles of full pre-inseminal growth-size are present in the ovaries of pregnant animals up to the twentieth day of pregnancy. From the twentieth to the thirtieth day no follicles of that size were found. They are present again at the thirty-sixth day, and in increasing numbers to the forty-second day, which is the termination of the full period. Among the largest follicles present at any given day of pregnancy, some are always normal and some degenerate. It appears, therefore, that throughout the whole period of pregnancy, growth and death of groups of follicles continues with a diminution of the largest size attainable during the middle of the period. But whilst the size of the largest follicles during the middle of the period of pregnancy is less than the size of the largest follicles in the early and late parts of that period, it is never so small as the size of the largest follicles of the early part of the anœstrus period. It is obvious, therefore, that the largest follicles present at the beginning of pregnancy all disappear by the middle of pregnancy, and that they are replaced by younger follicles; but there is no evidence to show which of the younger follicles, the primitive or those more advanced of the early period, become the largest follicles of the later period. The facts as they stand, however, lend basis to the assumption that a follicle takes at least half the time of the period of pregnancy, that is, twenty-one days, to pass from its primitive condition to the condition of full pre-inseminal growth.

The conditions met with in the ovaries of ferrets during the gestation period are similar in all essential respects to those described by LOEB (19, 19A) in guinea-pigs, and it is obvious that in both groups of animals corpora lutea, as such, have no detrimental effect on the growth of the follicles; but whilst they do not prevent the growth, they do, in the guinea-pig, prevent the ripening; for LOEB finds that when the corpora lutea are totally extirpated in that animal, in a certain number of cases ovulation may occur during pregnancy. But whilst under ordinary circumstances the corpora lutea do not prevent the growth of follicles, there are cases in the ferret where the number and sizes of the corpora lutea are so great that the remaining part of the cortex of the ovary is reduced to a minimum; in those cases the growth of the follicles is interfered with, but that is due to the circumstance that there is neither room nor, probably, is there pabulum sufficient for the growth which is more usually met with at the corresponding periods of gestation.

In other animals, such as rats, mice, and rabbits, in which ovulation does, or can, take place immediately after parturition, it is very probable that the growth of the follicles occurs during pregnancy, much in the same way as in guinea-pigs and ferrets, the only difference between the various animals being that, in those in which ovulation is not dependent on insemination, some follicles reach full maturity during gestation, whilst in the ferret they only attain to full or almost full pre-inseminal growth, a point which will be referred to again in the consideration of the causation of œstrus.

Whether the conditions met with in the ovaries of ferrets, during the gestation which intervenes between two œstrus periods, occur also in the ovaries of polyœstrus animals is doubtful, and, so far as the human subject is concerned, the statements made by different observers are extremely contradictory. Unfortunately, most of the observers who have dealt with human material have been chiefly concerned in inquiring as to whether or not ovulation occurs during pregnancy, and on that point they are practically all agreed; it either does not occur or is very exceptional; neither does it occur in any other animal, being prevented, according to LOEB's observations, by the corpora lutea; but ovulation is only the termination of completed follicle growth, and there is considerable difference of opinion as to what extent follicle growth takes place in the human ovary during pregnancy.

SEITZ (37), who examined the ovaries of thirty-six pregnant women, was unable to find ripe or nearly ripe follicles in any of them, and he throws doubt on a case of CONSENTINO's, which he quotes, in which a recently ruptured follicle was found in the ovary of a woman in the sixth month of gestation. The more recent researches of LEOPOLD and RAVENO (17) and those of RAVENO (31), which were carried out on a large number of cases, do not support SEITZ.

RAVENO, as the result of his observation of a series of sixty cases, writes: "In allen Eierstocken fanden sich Graafsche Follikel auf dem Wege der Reife; ei einige schon reif und im Begriff zu platzen, aber ein frisch angebrochener Follikel wurde niemals beobachtet" (31).

HILL and O'DONOGHUE (12) state that the rupture of a group of follicles in *Dasyurus viverrinus*, which is monœstrus, and which ovulates spontaneously, is not followed by the growth of a fresh batch of follicles, whether the animal becomes pregnant or not; but they do not state that follicle growth completely ceases either after ovulation without pregnancy or during pregnancy, and it appears, from what is known with regard to other animals, that follicle growth proceeds throughout the whole or the greater part of extrauterine life—even in the human female, after the menopause, according to LEOPOLD and RAVENO (17). But whilst this must be admitted in view of the evidence which is available, it must be noted that the state of development to which the follicles can attain varies considerably at different periods of life.

In association with these facts three questions at least arise: 1. What is the

cause of the growth of the follicles? 2. Why do many follicles die before attaining maturity? 3. What is the cause of the rupture of the follicles? To these questions the conditions met with in the ovaries of ferrets suggest certain answers, but they furnish no absolutely conclusive proofs that those answers are correct. Such absolute proof can only be obtained by experiments, which will be very difficult to carry out on account of the intimate relations of the parts of the ovary which are involved.

The cause of the growth of the follicles is either intraovarian, extraovarian, or partly one and partly the other.

It is possible to suppose that the cause of the growth of the follicles is extraovarian, and that it is due to some supposititious substance, such as the "gonadin" invoked by HEAPE as the cause of the general phenomena of the pro-œstrum and œstrus; but if that supposition is admitted, it is necessary to account for the fact that the majority of the follicles formed fail to become mature; for whilst it may be granted that some of the follicles die because their positions in the ovary are unfavourable to complete development, as both HEAPE (11) and LOEB (19) suggest, that explanation does not account for the fact that, both in the guinea-pig and the ferret, many generations of follicles, which appear in the ovaries at certain periods, die before attaining to maturity, unless it is assumed that the substance formed outside the ovary and carried to it by the blood-vessels is first formed in small quantity sufficient to produce a moderate amount of development and then fails, later in larger but still insufficient amount and again the supply fails, until finally an amount sufficient to carry the follicles to their maturity is provided; and that these conditions recur again and again in regular sequence. This is a supposition difficult to entertain, and although extraovarian influence has not been excluded, no series of observations or experiments hitherto made has provided it with any appreciable basis of support. If, therefore, we leave aside the possibility of extraovarian influence and turn to the ovary for an explanation of the growth of its follicles, there are three parts of the organ which at once suggest possibilities: (1) the interstitial tissue, (2) the corpora lutea, and (3) the follicles themselves. It is generally admitted that both the interstitial tissue and the corpora lutea do produce secretions which pass into the blood and influence the activities of other organs, but it is not so generally admitted that the follicles are also endocrine organs. Nevertheless it is possible, as I will attempt to show, that the follicles, once formed, are the cause of their own further evolution.

A certain number of primitive follicles of any given group or generation are capable of obtaining from the surrounding blood and lymph vessels sufficient nutriment to enable them to grow until they become follicles with a single layer of cubicular or columnar follicle cells. As the follicle cells assume their cubical or columnar shape they acquire also all the characteristic features of secreting cells (figs. 6 and 7, Pl. I). It may be argued, and it is frequently assumed, that

any secretive capabilities which the follicle cells possess at this stage are utilised for transmitting to the ovum the material which is necessary for its growth and development. It cannot be doubted that the secreting power of the follicular epithelium is used for this purpose, but there is no evidence that it is not utilised also for the transmission to the exterior of the follicle of substances formed in the follicular cells; indeed there are indications, long before the pro-œstrum appears, that this is the case.

When a follicle becomes vesicular, on the appearance of its antrum, the follicle cells separate into two groups—the peripheral group, which forms the boundary wall of the antrum, and the cumulus group, which projects from the peripheral group into the antrum. One of the functions of the cells of both groups is to form the liquor folliculi. The function of some of the cells of the cumulus group is to transmit nutritive material to the ovum, for there is no other way than by and through the cumulus cells that the ovum can obtain the nutriment necessary for its growth and development. The protoplasm of the innermost cells of the cumulus blends with the outermost layer of the oolemma (figs. 41 and 43, Pl. VII; fig. 45, Pl. VIII), and the nuclei of many of the cumulus cells lie in close contact with the oolemma until after insemination has taken place, then they all rapidly move away to the peripheral ends of the cells (figs. 41, 42, 43, Pl. VII; figs. 45, 47, Pl. VIII). The peripheral cells of the general follicular epithelium exhibit the same peculiarities, but the positions of the cells are reversed, that is, the peripheral ends of the cells are in contact and fused with the external limiting membrane (figs. 58, 59, 60, Pl. X), and the nuclei of many of the peripheral cells lie in close apposition with the external limiting membrane until the development of the follicle is completed (figs. 48, 49, Pl. VIII; figs. 54, 57, Pl. IX).

It is certain that the inner cells of the cumulus are transmitting material to the ovum, and it is not unfair to assume therefore that the cells which bear the same relationship to the external limiting membrane that the innermost cumulus cells do to the ovum may be transmitting material to the exterior of the follicle.

The material transmitted to the exterior of the follicles in the period shortly before the rupture plays a part, and probably the chief part, in the production of the phenomena of the pro-œstrum and the œstrus, and it is to be presumed that the material transmitted to the exterior of the follicle in the earlier stages of follicular development also has some function; that function is, I believe, to facilitate the growth of the follicles themselves. The secretion produced by an earlier generation of follicles enables that generation to grow to a certain stage, but it is not sufficient, when the demand comes to carry it on to the next stage; therefore the generation dies, but part of the secretion remains, and that remainder, together with the supply produced by itself, enables the next generation to attain a further stage of development; again the supply is not sufficient for the demand at a certain period, and the generation dies, but the amount of secretion left is

greater than it was at the preceding stage, and so the process proceeds until the amount of secretion present is sufficient to enable the next or some succeeding generation to attain to maturity.

In other words, the earlier generations of follicles are the pioneers which blaze out the pathway along which the succeeding generations advance to the promised land of maturity.

In some animals, such as *Dasyurus viverrinus*, the secretion produced by groups of follicles which have died is so exhausted by the production of the maturity of what may be called a terminal group, that, whether pregnancy occurs or not, a long ancestrus period is necessary during which numerous groups of follicles may grow and die before sufficient secretion is accumulated to induce the maturation of another terminal group.

In the guinea-pig the regular production of groups of follicles, which grow to a certain extent and then die, continues throughout the period of pregnancy, and although it is interfered with by the corpora lutea, as BEARD (2) suggested it was in all mammals, and as LOEB (19) has proved it to be in guinea-pigs, still it occurs to an extent necessary to bring a terminal group of follicles to maturity at or about the period of parturition, and it is practically certain that the same conditions occur in rats and mice.

It appears probable, therefore, that in all mammals groups of follicles are produced and grow and die throughout the whole period of sexual life, and that the majority of the groups have no possibility of attaining maturity; nevertheless they have a definite function, which is to form the secretion which is necessary for the maturation of a terminal group of follicles. A time comes, however, at all events in the case of the human female, when the production of groups of follicle, or their growth, or their capability to form the necessary secretion, is so reduced that ovulation first becomes irregular and then ceases, and the menopause occurs.

The suggestion is not invalidated by the fact that ovulation occurs after the menopause in a certain number of cases, for the occurrence is rare, and it is probable that the follicles which rupture them are not normal, inasmuch as the ova they extrude are rarely, if ever, capable of fertilisation.

The Relation of the Follicles to the Pro-œstrum and Œstrus.

In some of the preceding pages I have shown the necessity for the repeated production of groups of ovarian follicles, and have attempted to show that the attainment of maturity by special groups depends upon the life-work of the groups of follicles which preceded them and failed to reach maturity; but in addition to their work of preparing the means for their own development, the follicles at a certain period of their history appear to take on the function of providing the secretion which is responsible for the phenomena of the pro-œstrum and the œstrus. This

function, considered in the light of the evidence furnished by the ferret, may now be considered.

The contention that it is a secretion produced by the ovarian follicles which is responsible for the phenomena of the pro-œstrum and the œstrus does not receive universal acceptance.

HEAPE (11), as the result of extensive observations on rabbits, arrived at the conclusion that "it does not seem possible to accept the view that the stimulus which induces pro-œstrum and œstrus has its origin in the ovary," and he believes that the phenomena are due to a substance of extraneous origin ("gonadin"), "due to a change in the condition of the blood brought about by climatic influences and food."

HEAPE (9, 10, 11) has shown that in monkeys ovulation may occur without menstruation, and that menstruation may occur without, in some cases, a precedent, and in others any subsequent, ovulation. LEOPOLD (17) has demonstrated the same facts in the case of the human female. It seems to be mainly on these two groups of circumstances that HEAPE bases his belief that the ovary cannot possibly play a part in the production of the phenomena of heat; but whilst he is convinced of the impossibility of looking upon the ovaries as causative agents in the production of the phenomena of the pro-œstrum and the œstrus, he makes no attempt to show how it is that the phenomena cease in sexually mature females after the ovaries are removed.

MARSHALL (23) acknowledges the influence of the ovaries, but denies that the follicles are the responsible agents. He bases his objection to the follicles on the results of two experiments made on bitches, in which he pricked the protruding follicles of the ovaries, in one case from one to three weeks before the expected period, and in the other two months before the period was due. In both cases œstrus appeared at about the expected time. The first animal was killed a week after the appearance of œstrus, and it was found that "the ruptured follicles were very abnormal, since they contained large cavities surrounded by tissue resembling degenerate luteal tissue." "The probable conclusion is that heat is not brought about by the ripening follicles, but that the process of maturation and the phenomena of the pro-œstrum and œstrus are both the results of some further factor which is probably to be sought for in the ovarian interstitial cells."

To this conclusion O'DONOGHUE (29) rightly objects that interstitial tissue is not present in many mammals which ovulate regularly; and although it may be doubted if interstitial tissue, or at all events cells which play the part of interstitial cells, are absent as frequently as is supposed, they are undoubtedly not present in many mammals in the typical glandular form met with in the rabbit, cat, and ferret. It is stated that they are absent in the bitch—that is, in the animal on which MARSHALL experimented—but in some bitch ovaries in my possession interstitial cells are undoubtedly present in considerable numbers in the form of strands of cells and

scattered cells, but they do not form so prominent a feature of the ovarian structure as in the cat and ferret.

MOREOVER, MARSHALL'S experiment, though it is apparently accepted by PATON (30) as conclusive, is not adequate to support the contention based upon it. It provides no proof that the capabilities of the cells of the ruptured follicles were interfered with, and there is every reason to suppose they were not. The intra-follicular pressure was temporarily reduced, but it was, obviously, soon re-established, for MARSHALL notes what he takes to be the abnormal size of the follicles in the first animal when it was killed, a week after œstrus had commenced and three and a half weeks after the operation. Such considerable redistension of the normally ruptured follicles is not unusual in ferrets, and is only one of the phases met with in the formation of the corpora lutea.

In all young animals group after group of follicles grows and dies, but no signs of heat appear, because none of the groups have attained to the phase of growth during which they form the heat-producing secretion. Again, in sexually mature and adult guinea-pigs and ferrets group after group of follicles grows and dies without attaining the stage at which the heat-producing secretion is formed; but once a group of follicles has attained to that stage which is shown in the ferret (fig. 13, Pl. II; figs. 15, 16, Pl. III), when the cumulus epithelium begins to show signs of separation into an outer and an inner group of cells, the phenomena of the pro-œstrum followed by those of the œstrus appear. It was probably just before this stage was attained that MARSHALL punctured the follicles, but it is obvious that the puncture did not prevent the subsequent growth and the transformation of the follicle cells into luteal cells, which MARSHALL describes, and thinks, were of abnormal character. Even if that was the case, it is clear that the follicle cells had passed successfully through the phases which precede their transition into luteal cells, and it is in those phases that they produce the secretion which gives rise to the phenomena of heat.

The preceding statement is not merely the expression of a supposition, for the ferret furnishes practically conclusive information with regard to the point at issue.

I have shown, and a reference to the accompanying tables of notes will confirm the statement, that the ferret does not ovulate unless it is properly inseminated, and by proper insemination I mean unless spermatozoa enter the caudal third of the oviduct, for the excitement of the act of copulation may occur without subsequent ovulation (see Table V), although the follicles in the ovaries are at the stage of growth at which rupture would occur if insemination were successful. After insemination has been unsuccessfully attempted the phenomena of heat continue, and if the female is placed with another male, successful insemination can be attained. If insemination is successful, the phenomena of heat disappear as the follicles pass to their later phases of development; but if the female in heat is kept separate from the male, the phenomena of heat continue. In one of MARSHALL'S specimens it lasted for a period of five weeks (21) and then terminated; in another it was still present

at the end of six weeks, when the animal was killed (21). In one of my specimens it had lasted thirty-two days when the animal had to be killed, in the summer of 1914, and I have not since then had an opportunity to carry the investigation further. It is, therefore, uncertain how long heat may continue in the case of the ferret. The time is obviously variable, and is no doubt associated with the fact that some ferrets produce one brood, others two, and a few three in the sexual season; which probably means that the substance necessary for the maturation is present in the first case only in sufficient amount to bring one group of follicles to pre-inseminal maturation, and is then so used up that there is not time, during the succeeding forty-two days of pregnancy, for the necessary recuperation to an extent sufficient for the production of the maturation of another group of follicles during the season; or that the groups of follicles which grow and die during the gestation are not sufficient to produce the necessary amount of material, whilst in the second and third group of cases the conditions are more favourable.

MARSHALL gives no account of the ovaries of his two ferret specimens referred to which were kept separate from the male. In my specimen, which was killed in the thirty-second day of œstrus, the ovaries contained fourteen large follicles, of which five were in a state of degeneration; the remainder were in the stage of development always found associated with the condition of heat (fig. 39, Pl. VII).

In ferrets, therefore, œstrus only occurs when the ovaries contain follicles in a certain stage of development, and such follicles are present as long as œstrus continues (see Tables III, IV, V). Under these circumstances it can scarcely be doubted that the phenomena of heat are due to something produced by the follicles, and MARSHALL's experiments prove not that the follicles take no part in the production of the phenomena of the pro-œstrum and the œstrus, but that puncture of follicles of considerable size, which have not yet attained the proper stage, does not prevent the follicular epithelium reaching the necessary stage and performing the functions associated with it.

This part of the subject cannot be dismissed without some reference to the events which occur in the bats, for they have been used as an argument against the possibility that the follicles can play any part in the production of the phenomena of heat. It is known from the researches of VAN BENEDEN (38) and VAN DER STRICHT (39) that the majority if not all the sexually mature females are inseminated in autumn, and that the spermatozoa lie dormant till the following spring; then some of the ovarian follicles ripen, ovulation occurs, and fertilisation follows. This evidence, so far as it goes, tells against the position I have taken; but, unfortunately, we have no clear knowledge of the condition of the ovaries of bats in autumn, when it must be assumed that heat occurs, and until that is furnished, the evidence offered by bats has no great weight either one way or the other. There are also other possible explanations of the phenomena which occur in bats to which it will be necessary to refer in connection with the next section of this discussion; but before passing to

that, it should be noted that the suggestion that the follicles produce the substance which facilitates their own growth, and also that on which the phenomena of heat depend, is not in disaccord with HEAPE'S contention that the phenomena of the œstrus period are dependent on climatic and food conditions, for it is obvious that the necessary pabulum must be provided for both purposes, and, under ordinary conditions of life, it is probable that the proper pabulum is only attainable at certain seasons, whilst in the cases of domesticated animals it is provided all the year round; thus by the artificial alteration of external conditions it is possible that a normally monœstrus animal might be converted into a polyœstrus animal.

The Cause of the Rupture of the Follicles in Ferret and Ferret-Polecat Hybrids.

In ferrets and ferret-polecat hybrids no ovarian follicles rupture unless spermatozoa are present in the caudal third of the oviduct; moreover, the rupture does not take place at the same time after copulation in all animals. It may occur about thirty hours after copulation, and it may be delayed for over ninety hours (see Tables VII, IX).

In the specimens in which ovulation was delayed, follicles of normal size and structure were present in the ovaries, but the ova in some had not passed into the stage of the first maturation division, and in others were only attaining that stage at a later period.

It is well known that animals will not permit sexual congress unless they are in heat, and heat is always associated with follicles which contain ova which are in the first maturation division phase, or which are ready to pass into that phase as soon as the necessary stimulus is provided. Therefore the animals in which spermatozoa were found in the oviducts must have been in œstrus; their ovaries all contained follicles in the stage of pre-inseminal maturity. The only difference which could be detected between those in which ovulation followed insemination after a relatively short period and those in which ovulation was delayed was the number of spermatozoa in the caudal thirds of the oviducts.

In those cases in which the spermatozoa were numerous ovulation occurred relatively soon, and in those in which the spermatozoa were few in number ovulation was delayed.

In those animals in which the spermatozoa in the oviducts are numerous the dispersion of the cumulus epithelium, the formation and extension of the secondary liquor folliculi, the phenomena of the first maturation division of the ovum, and the rupture of the follicles take place relatively quickly, whilst in those in which few spermatozoa are present all the phenomena are retarded.

It appears, therefore, that, in the case of the ferret, the final phenomena of the maturation of the follicles and their rupture are due either to the spermatozoa or to the seminal fluid.

It is possible, however, that other factors may be at work, for I find that in the cases of females inseminated by the same male ovulation may occur in all, but fertilisation may fail in one or more. Thus if it is possible for the seminal fluid to produce ovulation in two females and fertilisation in only one of the two, it is also possible that the seminal fluid of a given male, independently of the number of spermatozoa, may be less potent in producing ovulation in one female than in another. The evidence at present available on this matter is quite insufficient to justify a positive statement, and the point must be left open.

A question which naturally arises in association with the points which have already been noted is, is there any significant structural difference between the ovaries of the animals which ovulate spontaneously and the ovaries of animals which only ovulate after coitus? It may be admitted at once that the evidence available does not justify a definite answer, but it suggests assumptions and indicates paths along which further investigations might be made, and on that account it deserves consideration.

In the cat and ferret, which ovulate only after successful insemination, the interstitial tissue forms a preponderant part of the cortex of the ovary. In the human female, on the other hand, and in monkeys, mares, asses, pigs, and in *Dasyurus viverrinus*, all of which ovulate spontaneously, the interstitial tissue is either absent or it is present in only small amount, and not in the typical glandular form in which it occurs in the animals first mentioned; but although there are two widely different types of ovaries so far as the presence of interstitial tissue is concerned, that tissue cannot be responsible for the different modes of ovulation, for it is present in the typical form and in large amount in guinea-pigs, which ovulate spontaneously, and in the rabbit, which sometimes, though rarely, ovulates spontaneously (25A), and in the bitch, which regularly ovulates spontaneously; for although FRANKEL denies its presence in that animal, it is present in considerable amount in some of my specimens. The bats give, at present, as little help in the solution of the question of the relation of ovarian structure to ovulation as they do to the question of the relation of follicular growth to follicular development. Their ovaries contain a very large amount of interstitial tissue, and we know that the majority, if not all, of the sexually mature females are inseminated in autumn and do not ovulate till the following spring; but we also know that some females are inseminated in spring, and with regard to them there is no evidence as to whether they ovulate spontaneously or not. Moreover, it must not be forgotten that the arrangements in bats may be a case of special adaptation developed to assure the majority of the females being inseminated, in autumn, by vigorous, well-fed males rather than by males which have recently passed through a long period of hibernation.

That such special adaptations do occur is evidenced by conditions met with in birds. In the case of the ordinary fowl the male takes no part in the incubation

of the eggs, and ovulation occurs independently of the presence of the male. In pigeons, the male pigeon takes his fair share in the process of incubation. It would obviously be a disadvantage, therefore, if the female began to lay before pairing; and CRAIG (6) has shown that if pairing is prevented, ovulation is delayed for a very considerable period. In this particular case the influence of the male appears to be purely of psychic character, and it is certainly unassociated with coition.

The present knowledge which we possess of marsupials also helps very little towards the solution of the question at issue, for though O'DONOGHUE (29) has pointed out that interstitial tissue is absent from the ovaries of the polyprotodonts, and is present in the ovaries of the diprotodonts, and HILL and O'DONOGHUE (12) have found that in the polyprotodont *Dasyurus viverrinus* ovulation is spontaneous, we do not yet know whether it is spontaneous or not in other marsupials.

There is still another structural difference between the ovaries of polyœstrus spontaneously ovulating animals and the ovaries of the animals which only ovulate after copulation, that is, the presence in the former group of periodic corpora lutea, which develop after ovulations which are not followed by pregnancy. Periodic corpora lutea are structurally similar to the corpora lutea of gestation, but they persist for a much shorter time. In 1909 BOVIN and ANCEL (5) formulated the opinion that the interstitial gland is not present in spontaneously ovulating animals, and that its place is taken by the periodic corpora lutea, both structures presiding over the development of the secondary female sexual characters. The opinion cannot be sustained, since the base on which it rests is unsound; for the guinea-pig, which ovulates spontaneously, and therefore can form periodic corpora lutea, also possesses a very large amount of interstitial gland tissue, and many other spontaneously ovulating animals have a considerable amount of interstitial tissue in their ovaries.

So far as the evidence available goes, it seems to exclude interstitial tissue as an active agent in the control of ovulation, and we are driven towards the tentative conclusion that in animals that ovulate spontaneously something is present or something is absent as contrasted with animals which ovulate only after coition.

If something is present in the first group which favours spontaneous ovulation, it must be absent in the animals which ovulate only after coition, and must be provided by coition; and if something is present in animals which ovulate only after coition, which interferes with ovulation, it must be neutralised by coition, and it must be absent in animals which ovulate spontaneously. If either inference is correct, the question arises, How is the substance provided by coition, and is the end attained by chemical means, or by psychic means, as in the case of pigeons?

The evidence afforded by ferrets is opposed to the idea of psychic influence, for, in their case, sterile coition is not followed by ovulation, and it is difficult to believe

that an alteration of the nervous system produced by sexual congress can produce results in some animals of a species in about thirty hours, when in other animals, of the same species, placed under similar conditions, the result may be delayed for more than ninety hours, whilst if the coition is sterile, the result aimed at is not attained.

If the influence is a nervous phenomenon, which acts by producing vascular engorgement of the generative glands, and so provides an increase of pabulum for the developing follicles, it might be expected to be fairly regular in its effects, as it seems to be in rabbits, which usually ovulate about ten hours after coition, whether the coition is sterile or not. This possibility cannot at present be definitely excluded, and it must be noted in association with it that, in my series of thirteen ferrets, in which coition was attempted, and was apparently successful, but in which ovulation did not follow (Table V), the average size of the largest follicles is .9567 mm.³, that is, somewhat less than three times as large as the average size of the largest follicles in animals in full heat but in which no attempt at insemination was made, a fact which points to the conclusion that although the coition was sterile and was not followed by ovulation, it had nevertheless a definite influence on the growth of the follicles.

If the influence produced by coition is a chemical influence, then it must be due either to the spermatozoa or to other constituents of the seminal fluid.

In bats, coition produces no results, with which we are acquainted, until several months after its occurrence, and it is difficult to imagine that the fluid portion of the seminal fluid can lie in the uterus for so long a period without diffusing into the lymph or blood-vessels and then be suddenly absorbed in the early months of spring, whilst it is less difficult to realise that the spermatozoa might lie dormant.

The influence of spermatozoa is more or less excluded, however, by the conditions met with in rabbits. Some, but very few, of those animals ovulate, on rare occasions, spontaneously (25A). The majority ovulate about ten hours after coition, but ovulation may occur when coition has been rendered sterile by a previous operation, either on the male or on the female, the result, judging from the data furnished by MARSHALL (25A), being much less certain in the cases of sexually mature virgins than in parous animals. This point may prove to be of importance, for it suggests that previous fertile coition facilitates sterile coition at a later period, and, if this is so, it may be an indication of the lasting effects of spermatozoal action. The evidence is not sufficient to justify a conclusion, and, so far as the data available go, it must be supposed, for the present, that the ovulation in the rabbit is due to coition, and is brought about either by some nervous influence or by the constituents of the spermatid fluid other than the spermatozoa. It is obvious, bearing in mind the size of the protometra, that such constituents may be fairly abundant.

A survey of facts which fails to secure a definite conclusion is always unsatisfactory, but it must be admitted that the data at present at our disposal are not

sufficient to justify a positive statement; whilst, at the same time, they seem to point towards the conclusion that, in animals which ovulate only after coition, something is present which prevents ovulation until it is neutralised by coition, and that it is not present in spontaneously ovulating animals; or conversely, that in spontaneously ovulating animals something is present which favours ovulation, it is absent in animals which only ovulate after coition, and that it is provided by coition; but, in either case, there is no evidence to show what the substance is, or how or where it is formed.

SUMMARY.

In ferrets and ferret-polecat hybrids successive generations of ovarian follicles are formed throughout the whole period of life.

In the interval between two ovulations, whether the period be long or short, successive groups of follicles grow and die, at successively advanced stages, until a group attains to full maturity.

It seems probable that the follicles of one group produce material which favours its own growth and facilitates the further advance of succeeding groups.

The phenomena of the pro-œstrum and the œstrus only appear when a group of follicles has attained a stage of development which may be called pre-inseminal maturity, and the phenomena are due to some secretion produced by the follicles in that phase of their development.

The follicles only become fully mature and only rupture after spermatozoa have entered the caudal third of the oviduct.

The rupture of the follicles is due to the formation of the secondary liquor folliculi which follows successful insemination.

There is no bleeding when rupture occurs, either into the follicles or at the margins of the apertures in their walls, and bleeding only occurs occasionally during the redistension of the follicles.

The greater part of the follicular epithelium remains in the follicles after the rupture and the extrusion of the ovum and the cumulus cells.

After the rupture the follicles redistend, and the redistension is associated with the transformation of the follicle cells into lutein cells.

LIST OF LITERATURE.

This list only contains the communications directly referred to; very complete lists of associated articles will be found in the papers quoted, and especially in No. 40.

- (1) ALEXANDO, N., "Contribution à l'histologie normale et pathologique des ovaires de la femme," *Ann. de Gynécologie*, 1891.
- (2) BEARD, J., *The Span of Gestation*, Jena, 1897.
- (3) BENCKISER, A., "Zur Entwicklungsgeschichte des Corpus luteum," *Archiv für Gynäkologie*, Bd. xxiii.
- (4) BOUIN, P., et ANCEL, P., "Sur la différenciation d'une membrane propre d'origine épithéliale pendant le développement du corps jaune chez le chien," *C. R. de la Soc. Biol.*, t. lxxv, 1908.
- (5) BOUIN, P., et ANCEL, P., "Sur les homologues et la signification des glandes à sécrétion interne de l'ovaire," *C.R. Soc. Biol. Paris*, t. lxxvii, 1909.
- (6) CRAIG, W., "Oviposition induced by the Male in Pigeons," *Journ. of Morph.*, vol. xxii, 1901.
- (7) FRANKEL, L., "Vergleichend histologische Untersuchungen über des Vorkommen drüsiger Formationen im interstitiellen Eierstocks gewebe," *Archiv für Gynäkologie*, Bd. lxxv, 1905.
- (8) HEAPE, W., "The Menstruation of *Semnopithecus entellus*," *Phil. Trans. Roy. Soc.*, vol. B, 1894.
- (9) HEAPE, W., "The Menstruation and Ovulation of *Macacus rhesus*," *Phil. Trans. Roy. Soc.*, vol. B 188, 1897.
- (10) HEAPE, W., "The Menstruation and Ovulation of Monkeys and the Human Female," *Obstetrics Trans.*, vol. xi, 1898.
- (11) HEAPE, W., "Ovulation and Degeneration of Ova in the Rabbit," *Proc. of Roy. Soc.*, vol. B 76, 1905.
- (12) HILL, J. P., and O'DONOGHUE, C. H., "The Reproductive Cycle in the Marsupial *Dasyurus viverrinus*," *Q.J.M.S.*, vol. lix, 1914.
- (13) HONORÉ, C., "Recherches sur l'ovaire du Lapin," *Archiv de Biol.*, t. xvi, 1899-1900.
- (14) JANOSIK, J., "Zur Histologie des Ovariums," *Sitz. d. Kais. Akad. d. Wiss.: Mathem. Naturw. Kl.*, 95-96 Bd., 1887.
- (15) KINGERY, H. M., "Oogenesis in the White Mouse," *Journ. of Morph.*, vol. xxx, No. 1, 1917.
- (16) LANE-CLAYTON, J. E., "On Ovogenesis and the Formation of the Interstitial Cells of the Ovary," *Journ. of Obstetrics and Gynaecology*, vol. xi, 1907.
- (17) LEOPOLD, L. U., and RAVEN, A., "Neuer Beitrag zur Lehre von der Menstruation und Ovulation," *Archiv für Gynäk.*, Bd. lxxxiii, 1907.
- (18) LIMON, M., "Sur l'évolution de la membrane propre des ovisacs au cours de leur atrophie," *Bibl. Anat. Paris, Nancy*, t. xiii, 1904.
- (19) LOEB, L., "Der normale und pathologische Zyklus im Ovarium des Säugetier," *Virchow's Archiv*, Bd. xx, 1911.
- (19A) LOEB, L., "The Cyclic Changes in the Ovary of Guinea-pig," *Journ. of Morph.*, vol. xxii, 1911.
- (20) LONGLEY, W. H., "The Maturation of the Egg and Ovulation in the Domestic Cat," *American Journ. Anat.*, vol. xii, 1911-12.
- (21) MARSHALL, F. H. A., "The Estrus Cycle in the Common Ferret," *Q.J.M.S.*, vol. xlviii, 1904.
- (22) MARSHALL, F. H. A., *The Physiology of Reproduction*, London, 1910.
- (23) MARSHALL, F. H. A., "On the Ovarian Factor concerned in the Recurrence of Estrus," *Proc. of the Phy. Soc. Jour. of Phys.*, vol. xliii, 1911-12.
- (24) MARSHALL, F. H. A., "The Estrus Cycle and the Formation of the Corpus luteum of the Sheep," *Phil. Trans. Roy. Soc.*, vol. B 196, 1904.
- (25) MARSHALL, F. H. A., and JOLLY, W. A., "The Estrus Cycle in the Dog," *Phil. Trans. Roy. Soc.*, vol. B 198, 1906.
- (25A) MARSHALL, F. H. A., "The Functional Correlation between the Ovaries, Uterus, and Mammary Glands in the Rabbit; with Observations on the Estrus Cycle," *Proc. Roy. Soc.*, vol. B 87, 1914.
- (26) MILLER, G. S., "Catalogue of Mammals of Western Europe," p. 423, London, 1913.
- (27) MONTEROSSO, B., "Sur la struttura e la funzione della cellule parietali della granulosa nel follicolo ovarico del Maiale," *Atti della Accad. Gioenia di Sc. Nat. Catania*, vol. v, 1912.

- (28) NAGEL, W., "Das Menschlich Ei," *Archiv f. mikr. Anat.*, Bd. xxxi, 1888.
- (29) O'DONOGHUE, C. H., "On the Corpora lutea, and the Interstitial Tissue of the Ovary in Marsupialia," *Q.J.M.S.*, vol. lxi, 1916.
- (30) PATON, D. NOËL, *Regulation of Metabolism*, London, 1913.
- (31) RAVENO, A., "Ueber die Frage nach der Thätigkeit des Eierstocks in der Schwangerschaft," *Arch. f. Gynäk.*, Bd. lxxxiii, 1907.
- (32) ROBINSON, ARTHUR, "The Position and Peritoneal Relations of the Mammalian Ovary," *Jour. of Anat. and Phys.*, vol. xxi, 1887.
- (33) RUBASCHKIN, W., "Zum Lehre von der Keimbahn bei Säugetieren," *Anat. Hefte*, Bd. xlvi, 1912.
- (34) RUSSO, A., "Sulla cromolisi delle cellule della granulosa durante il digiuno e sul suo significato nella differenziazione sessuale delle ova dei mammiferi," *Atti della Accad. Gioenia di Sc. Nat. in Catania*, vol. ii, 1909.
- (35) SANDES, F. P., "The Corpus luteum of *Dasyurus viverrinus*; with Observations on the Growth and Atrophy of Graafian Follicles," *Proc. of the Linnean Soc. of New South Wales*, 1903.
- (36) SCHOTTLÄNDER, J., "Ueber den Graaf'schen Follikel seine Entstehung beim Menschen und seine Schicksale bei Menschen und Säugethieren," *Arch. f. mikr. Anat.*, Bd. xli, 1893.
- (37) SEITZ, L., "Die Follikelatresie während der Schwangerschaft," *Arch. f. Gynäk.*, Bd. lxxvii, 1905-06.
- (38) VAN BENEDEN, E., "Contribution à la connaissance de l'ovaire des mammifères," *Arch. de Biol.*, t. i, 1880.
- (39) VAN DER STRICHT, O., "La ponte ovarique et l'histogénèse du corps jaune," *Bull. de l'Acad. Roy. de Belgique*, 1901.
- (39A) VAN DER STRICHT, O., "Sur le processus de l'excrétion des glandes endocrines. Le corps jaune et la glande interstitielle de l'ovaire," *Arch. de Biol.*, t. xxvii, 1912.
- (40) VAN DER STRICHT, R., "Vitellogénèse dans l'ovule de Chatte," *Arch. de Biol.*, t. xxvii, 1912.
- (41) WAGENER, G., "Bemerkungen über den Eierstock und des gelben Körper," *Arch. f. Anat. u. Physiol.*, 1879.
- (42) WALDEYER, *Eierstock und Ei*, Leipzig, 1870.
- (43) WINIWARTER, H. VON, et SAINMONT, G., *Nouvelles recherches sur l'ovogénèse de l'ovaire des mammifères, (chat)*, Liège, 1912.

EXPLANATION OF THE LETTERS IN THE TABLES INDICATING THE
METHODS OF FIXATION.

Fl. Strong Flemming's fluid with 2-3 per cent. acetic acid.	Mx. Maximow's fluid.
Len. Lenhossek's fluid.	Per. Perenyi's fluid.
Mann. Mann's fluid.	P.N.F. Picro-nitric fluid with 5 per cent. formol.
M.F. Mann's fluid with 5 per cent. formol.	PO. Perenyi's fluid with osmic acid.
	Z. Zenker's fluid.

EXPLANATION OF THE LETTERS INDICATING THE STAINS USED IN THE
SECTIONS SHOWN IN THE FIGURES.

E. Eosin.	Mallory. Mallory's connective-tissue stain.
H.E. Hæmatoxylin and eosin.	O.G. Orange green.
I.H. Iron-hæmatoxylin.	

TABLE I.—FERRETS AND FERRET-POLECAT HYBRIDS IN THE ANESTRUS PERIOD.

Specimen.	Weight in Ounces.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	No. of Follicles of largest size, Normal and Degenerate.
1. F.Z.R.A. 4/14 }	?	18/11/14	18.666 320 000	.036 780 480	13 (4 deg.)
2. F.Fl.L.A. 4/14 }	"	"	22.482 360 000	"	7 (1 aeg.)
3. F.Z.R.A. 1/14 }	20	"	19.584 400 000	.008 506 080	9 (3 deg.)
4. F.Fl.L.A. 1/14 }	"	"	27.800 960 000	.002 520 400	7 (3 deg.)
5. F.Z.R.A. 2/14 }	14½	19/11/14	17.264 855 600	.007 983 360	10 (5 deg.)
6. F.Fl.L.A. 2/14 }	"	"	15.256 512 000	.005 987 520	3 (2 deg.)
7. F.Z.R.A. 3/14 }	19	21/11/14	9.000 375 000	.025 920 000	9 (5 deg.)
8. F.Fl.L.A. 3/14 }	"	"	9.002 487 500	"	7 (4 deg.)
9. F.Z.R.A. 5/14 }	16½	10/12/14	16.905 920 000	.004 608 000	7 (6 deg.)
10. F.Fl.L.A. 5/14 }	"	"	20.841 435 000	"	6 (4 deg.)
11. F.Z.R.A. 6/14 }	"	"	12.327 900 000	.009 000 000	10 (5 deg.)
12. F.Fl.L.A. 6/14 }	"	"	18.274 291 200	.016 848 000	7 (2 deg.)
13. F.Z.R.A. 7/14 }	"	17/12/14	16.086 470 400	.042 768 000	10 (3 deg.)
14. F.Fl.L.A. 7/14 }	"	"	22.522 752 000	"	12 (4 deg.)
15. P.Z.R.A. 8/14 }	"	"	23.598 800 000	.051 166 080	13 (6 deg.)
16. P.Fl.L.A. 8/14 }	"	"	17.998 848 000	.030 948 000	13 (4 deg.)
17. F.Z.R. B/14 .	?	?/1/14	15.517 756 800	.027 279 360	9 (5 deg.)
18. F.Z.R. C/14 .	"	"	11.859 187 500	.036 936 000	6 (1 deg.)
19. F.Mx.R.A. 9/15 }	19	9/1/15	15.993 288 000	.035 251 200	14 (4 deg.)
20. F.Fl.L.A. 9/15 }	"	"	29.298 456 000	.052 941 600	18 (6 deg.)
21. F.Z.R.A. 10/15 }	26	"	27.864 000 000	.037 402 560	9 (1 deg.)
22. F.Fl.L.A. 10/15 }	"	"	44.010 000 000	.040 068 000	11 all normal
23. P.Z.R.A. 11/15 }	24	5/2/15	18.159 336 000	.054 550 080	7 (4 deg.)
24. P.Fl.L.A. 11/15 }	"	"	25.122 636 000	.030 355 200	9 (5 deg.)
25. P.P.O.R.A. 12/15 }	18	"	27.607 172 000	.005 348 880	3 (1 deg.)
26. P.Z.L.A. 12/15 }	"	"	25.588 440 000	.021 772 800	5 (2 deg.)
27. P.Fl.R.A. 13/15 }	15½	19/2/15	15.780 992 000	.036 288 000	12 (5 deg.)
28. P.Z.L.A. 13/15 }	"	"	14.826 240 000	.059 940 000	6 (1 deg.)
29. P.Fl.R. 14/15 }	18½	"	19.542 124 800	.029 030 400	2 both deg.
30. P.P.O.L. 14/15 }	"	"	25.256 448 000	.040 824 000	6 (3 deg.)
31. P.P.O.R. A/15 .	22	18/3/15	21.528 000 000	.156 103 200	7 (3 deg.)
32. P.P.O.R. A/16 }	21	"	28.392 120 000	.096 782 400	9 (3 deg.)
33. P.Z.L. A/16 }	"	"	18.658 727 600	.101 178 000	12 (3 deg.)
34. F.G.A. 19/15 R.Per. }	12¾	5/5/15	34.673 328 000	.125 439 600	6 all normal
35. F.G.A. 19/15 L.Fl. }	"	"	24.713 640 000	.075 790 080	8 (5 deg.)

Note.—All the measurements used in the calculations of the cubic size of the ovaries, follicles, and ova were made in thousandths of a millimetre, and the full number obtained in the calculations is stated, in the tables, in each case, but the figures after the fourth significant figure have no practical value.

TABLE II.—FERRETS, POST-PARTUM OR POST-ABORTION, NOT IN HEAT.

Specimen.	Weight in Ounces.	Number of Days after attempted Insemination.	Number of Days Post-partum.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. F.G.A. 17/15 R.Fl. } 2. " " L.Mx. }	15½ "	36 "		22/6/15 "	16.391 280 000 21.555 072 000	.363 242 880 .375 210 000	6 (3 deg.) 7 (3 deg.)	{ Not in heat, but uterine cornua larger than in an ordinary an- estrus ferret. No corpora lutea in right ovary, but one corresponding with date of insemination in left ovary. 4 corpora lutea corresponding with date of insemination. 3 old corpora lutea which must have belonged to pregnancy of previous season. 3 corpora lutea corresponding with date of insemination. 3 old corpora lutea which must have belonged to pregnancy of previous season.
3. F.G.A. 16 A/15 R.Fl. } 4. " " L.Mx. }	18½ "	.. "		21/6/15 "	42.620 256 000 24.761 547 200	.047 090 160 .045 481 600	8 (6 deg.) 2 normal	
5. F.D. Y/16 R.Per. } 6. " " L.M.F. }	11½ "	.. "	1 "	6/6/16 "	34.936 488 000 28.317 600 000	.138 520 800 .834 960 000	5 (4 deg.) 7 (3 deg.)	
7. F.D. Z ¹ /16 R.Per. } 8. " " L.Fl. }	13 "	.. "	2 "	7/6/16 "	17.781 120 000 13.592 448 000	.076 626 000 .043 908 480	6 (4 deg.) 8 (4 deg.)	
9. F.D. V/16 R.Fl. } 10. " " L.Z. }	17½ "	.. "	6 "	26/5/16 "	40.723 200 000 18.387 111 600	.174 919 080 .275 868 000	5 all normal 10 (2 deg.)	8 3
11. F.D. X/16 R.Per. } 12. " " L.Fl. }	19 "	.. "	12 "	6/6/16 "	31.022 160 000 54.577 152 000	.731 289 600 1.165 233 600	5 (1 deg.) 7 all normal	10 6
13. F.D. Z ² /16 R.Fl. } 14. " " L.Per. }	17½ "	.. "	26 "	2/6/16 "	34.776 000 000 44.906 400 000	.054 432 000 .051 324 000	5 (1 deg.) 9 (4 deg.)	8 5
15. D.A. 42/15 R.Mx. } 16. " " L.Fl. }	17 "	.. "	28 "	8/6/15 "	33.103 980 000 28.827 452 500	.111 600 000 .109 058 400	10 (1 deg.) 9 (5 deg.)	3 5

TABLE III.—FERRETS AND FERRET-POLECAT HYBRIDS IN ŒSTRUS, NOT INSEMINATED, AND INSEMINATION NOT ATTEMPTED.

Specimen.	Weight in Ounces.	Length of Œstrus.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. P.G.B. 1/15 R.Fl. } 2. " " L.Mx. }	18 "	{ Pro-œstrum just com- mencing. }	21/4/15 "	40.197 854 700 35.797 500 000	.185 241 600 .198 900 000	9 (2 deg.) 8 all normal	
3. G.A./16 R.M.F. } 4. " " L.Per. }	15 "		28/4/16 "	39.522 600 000 32.418 000 000	.163 244 130 .149 572 800	6 6	
5. F.Z.R.A./17 } 6. F.Fl.L.A./17 }	16½ "	{ Œstrus No. of days ? }	17/5/15 "	37.830 672 000 28.813 750 000	.199 267 200 .324 124 416	8 (5 deg.) 11 (6 deg.)	
7. G.A. 18/15 R.Fl. } 8. " " L.Mx. }	17½ "		3/7/15 "	17.572 464 000 22.353 408 000	.569 963 520 .782 127 360	4 (1 deg.) 10 (4 deg.)	

OVARIAN FOLLICLES IN FERRETS AND FERRET-POLECAT HYBRIDS. 343

TABLE IV.—FERRET AND FERRET-POLECAT HYBRIDS, POST-PARTUM AND IN ŒSTRUS.

Specimen.	Weight in Ounces.	Number of Days post-partum.	Number of Days of 2nd Œstrus.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. P.D.A. 40/15 R.Fl. } 2. " " L.Z. }	19 "	23 "	? "	1/6/15 "	23.597 568 000 33.412 392 000	.513 520 000 .524 422 800	6 all normal 5 "	{ Young were cast on May 8, and the animal was in full heat when killed on June 1 { Young were cast May 21, and the animal was in full heat on June 7, and, judging by the state of the vulva, it must have been in heat for at least four days. It was quite healthy when killed on July 3
3. F.D.A. 45/15 R.Mx. } 4. " " L.Fl. }	16 "	43 { " "	At least 30 "	3/7/15 "	18.501 768 000 25.185 560 000	.309 236 400 .266 760 000	8 all deg. 5 (4 deg.)	

TABLE V.—FERRETS AND FERRET-POLECAT HYBRIDS IN ŒSTRUS. INSEMINATION ATTEMPTED BUT UNSUCCESSFUL, ALL IN FULL HEAT.

Specimen.	Weight in Ounces.	Number of Days after attempted Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicles in mm. ³	Number of Follicles of largest size.	Notes.
1. F.Z.R. 1/14 } 2. F.Fl.L. 1/14 }	10½ "	1 "	20/5/14 "	10.222 380 000 12.398 226 750	.891 692 928 .502 842 060	12 (4 deg.) 10 (5 deg.)	{ Ovary enlarged, and greater part of it converted into myomatous tumour.
3. F.Mx.R. 1-1/14 } 4. F.Mann.L. 1-1/14 }	9 "	" "	" "	7.858 900 000 13.106 537 500	.410 743 872 .409 600 800	" 10 (5 deg.)	
5. P.D. L/16 R.M.F. } 6. " " L.Per. }	15½ "	2 "	10/5/16 "	26.707 968 000 22.149 072 000	1.241 612 800 1.165 847 360	6 all normal 1 "	
7. F.Z.R. 1-2/14 } 8. F.Fl.L. 1/14 }	? "	3 "	14/4/14 "	34.095 698 840 48.906 250 000	.162 938 880 .095 800 320	8 (2 deg.) 10 (5 deg.)	
9. F.Z.R. 1-1/14 } 10. F.Fl.L. 1-1/14 }	" "	" "	" "	? 37.419 932 500	.751 559 040 1.373 760 000	6 (2 deg.) 4 all normal	
11. G.6. Mann. . 12. F.Z.R. 1/14 }	" "	4 "	5/4/04 12/4/14	16.288 207 380 13.834 800 000	.638 820 000 1.086 618 240	5 (2 deg.) 3 (2 deg.)	
13. F.Fl.L. 1/14 } 14. F.Mann.R. 1-2/14 }	" "	" "	" "	25.644 609 375 25.414 565 880	1.319 760 000 .933 660 000	6 all normal 6 (2 deg.)	
15. F.Len.L. 1-2/14 } 16. F.Mx.R. 1-1/14 }	" "	" "	" "	24.329 440 000 24.465 210 000	.758 939 520 2.173 500 000	5 (2 deg.) 8 all normal	
17. F.Per.L. 1-1/14 } 18. F.Z.R. 1/14 }	" 24	" 6	" 1/5/14	28.350 000 000 20.233 651 200	3.353 853 600 .835 380 880	7 5 (3 deg.)	
19. F.Fl.L. 1/14 } 20. F.D.A. 10/15 R.Fl. }	" 23½	" 13	" 24/4/15	36.661 248 800 18.906 739 200	.639 133 200 .890 265 600	12 (2 deg.) 4 (2 deg.)	
21. " " L.Mx. } 22. P.D.A. 37/15 R.Mx. }	" 8½	" 14	" 10/5/15	23.425 920 000 17.107 200 000	.849 139 000 .616 896 000	10 (4 deg.) 5 (4 deg.)	
23. " " L.Fl. } 24. P.D.A. 1/15 R.Z. }	" 21½	" 15	" 7/4/15	21.735 000 000 22.208 472 000	1.273 050 000 1.206 975 600	7 (2 deg.) 7 normal	
25. " " L.Fl. }	"	"	"	28.230 094 000	1.044 505 440	4 normal	

TABLE VI.—FERRETS AND FERRET-POLECAT HYBRIDS INSEMINATED AT FIRST ŒSTRUS OF SEASON.
TIME OF DEATH AFTER INSEMINATION NOT MORE THAN 24 HOURS.

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. F. 3-5/08 Z. } 2. F. 1-2/08 Mann. }	? "	19½ "	31/5/08 "	37-582 000 000 20-657 000 000	2-328 422 400 1-840 302 000	7 all normal 3 "	{ The side to which each ovary belonged is uncertain. First polar body stage.
3. F.D.A. 41/15 R.Fl. } 4. " " L.Z. }	11½ "	21 "	2/6/15 "	15-886 293 600 18-389 376 000	·832 032 000 1-236 452 400	8 (2 deg.) 5 (3 deg.)	
5. P.D.B. 1/16 R.Mx. } 6. " " L.M.F. }	24 { " "	Under 24 "	28/4/16 "	25-991 500 000 33-205 450 000	·533 360 800 1-007 760 240	6 all normal 8 "	{ The animal was dispatched from the trader in the same box with a male, but in a separate compartment. The compartment was broken in transit, and the female was killed 23 hours after it left the breeder's premises. Nucleus present. First maturation spindle not formed.
7. F.Fl.R. 1-1/14 } 8. F.Per.L. 1-1/14 }	? "	" "	26/5/14 "	31-835 546 875 27-799 065 000	1-471 335 936 ·725 760 000	2 both normal 6 all normal	
9. F.Z.R. 1/14 } 10. F.Fl.L. 1/14 }	21 "	" "	" "	29-180 937 500 38-322 308 740	1-412 775 000 2-162 073 600	6 all normal 5 "	{ Between 21 and 24 hours after insemination, but exact time uncertain. Some ova with first maturation spindle, some with first polar body.
							{ Between 21 and 24 hours after insemination, but exact time uncertain. First maturation spindle stage.

TABLE VII.—FERRETS INSEMINATED AT FIRST ŒSTRUS OF SEASON. TIME OF DEATH AFTER INSEMINATION OVER 24 AND UNDER 49 HOURS.

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. F.D.A. 43/15 R.Mx. } 2. " " L.Fl. }	21 "	26¼ "	9/6/15 "	41-343 120 000 39-127 762 800	1-253 070 000 1-581 465 600	5 all normal 9 "	{ In first polar body stage in ovary. In the right ovary there were two and in the left ovary three degenerate follicles slightly smaller than the normal follicles.
3. F.G.B. 3/15 R.Fl. } 4. " " L.Z. }	16½ "	27½ "	23/4/15 "	34-215 640 625 40-381 035 968	1-353 081 600 1-433 700 000	5 6 "	
5. F.G.A. 1/15 R.Z. } 6. " " L.Fl. }	22 "	" "	" "	38-598 906 250 21-081 098 750	1-380 744 000 1-089 262 080	7 1 normal	{ First maturation spindle not yet formed. Nuclei of ova peripheral, but still with distinct nuclear membranes and no signs of mitosis.
7. F.D. D/16 R.Per. } 8. " " L.P.N.F. }	? "	30½ "	5/5/16 "	45-622 050 000 58-201 200 000	3-595 536 000 2-967 674 400	4 all normal 7 "	

TABLE VII.—*continued.*

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
9. P.D. C/16 R.M.F. } 10. " " L.Per. }	17½ "	31½ "	5/5/16 "	40-523 000 000 38-848 300 000	-947 700 000 1-045 816 200	4 all normal 2 both normal	{ Ova in middle third of uterine tube (oviduct) in pronuclear stage. Ruptured follicles plugged but not distended. In right ovary there were two unruptured degenerate follicles of .251 856 000 mm. ³ , and in the left ovary two unruptured normal follicles of .634 752 000 mm. ³
11. P.D.B. 1/15 R.Z. } 12. " " L.FI. }	20 "	40½ "	29/4/15 "	27-446 265 000 41-136 861 600	3-736 789 200 1-620 259 200	3 all normal 5 "	{ In first maturation spindle stage in ovary.
13. P.D.B. 2/15 R.FI. } 14. " " L.Z. }	24 "	" "	29/4/15 "	23-522 238 000 43-275 085 600	1-444 752 000 1-086 750 000	3 " 8 "	{ In first maturation spindle stage in ovary.
15. F.D. F/16 R.Per. } 16. " " L.Mx. }	19 "	40¾ "	7/5/16 "	41-908 536 000 41-105 232 000	-515 782 300 -725 760 000	5 " 5 "	{ Ova in middle third of the oviduct in pronuclear stage. Ruptured follicles plugged but not distended. In right ovary five unruptured follicles of .182 019 000 mm. ³ , of which four were degenerate. In left ovary four unruptured follicles of .099 792 000 mm. ³ , all degenerate.
17. F.D. I/16 R.Per. } 18. " " L.M.F. }	20 "	41 "	8/5/16 "	35-358 848 000 49-956 480 000	-826 096 000 1-370 880 000	3 " 7 "	{ Ova in middle third of the oviduct, some in pronuclear stage, some just fertilised with second spindle and first polar body. In right ovary four unruptured degenerated follicles of .310 515 840 mm. ³ In left ovary one unruptured degenerate follicle of .324 161 520 mm. ³
19. F.D. J/16 R.M.F. } 20. " " L.Per. }	15¾ "	41½ "	" "	31-408 128 000 30-873 600 000	-887 040 000 2-304 000 000	7 " 2 both normal	{ Ova in middle third of the oviduct in pronuclear stage. In right ovary four unruptured follicles of .124 416 000 mm. ³ In left ovary one unruptured follicle of .140 808 240 mm. ³ The ruptured follicles in the left ovary beginning to redistend.
21. F.G.A. 2/15 R.FI. } 22. " " L.Z. }	16½ "	41½ "	25/4/15 "	36-281 250 000 56-306 250 000	1-940 389 600 2-490 912 000	12 all normal 8 "	{ In the right ovary some of the ova in the large follicles were in the first maturation spindle stage, others had not reached that stage. In the left ovary the ova of the large follicles were in the first maturation spindle stage or the first polar body stage.
23. F.G.B. 4/15 R.Per. } 24. " " L.FI. }	13 "	41½ "	" "	35-985 600 000 26-939 808 000	-772 761 600 -510 801 200	4 " 5 "	{ Ova in middle third of the oviduct in pronuclear stage. In right ovary four unruptured follicles of .586 872 000 mm. ³ , all degenerate. In left ovary one unruptured follicle of 1-271 061 000 mm. ³ , with ovum with first maturation spindle and a second follicle slightly smaller and degenerate.
25. F.D. G/16 R.M.F. } 26. " " L.Per. }	13½ "	" "	7/5/16 "	27-212 050 000 35-417 088 000	-538 783 200 -524 880 000	3 " 5 "	{ Ova in middle third of the oviduct in pronuclear stage. In right ovary four unruptured follicles of .142 128 000 mm. ³ , of which two were degenerate. In left ovary three unruptured follicles of .167 961 000 mm. ³ , of which one was degenerate. The ruptured follicles had not commenced to distend.

TABLE VII.—*continued.*

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
27. F.Mx.R. 1-1 ² /14 } 28. F.Per.L. 1-1 ² /14 }	?	44 ¹ / ₂	8/4/14	20-950 200 000 26-986 500 000	.465 585 120 .456 805 400	3 all normal 5 "	The first maturation spindle had not yet formed. The spermatozoa in the oviduct and uterus were very few. The ova were in the middle third of the oviduct in the pronuclear stage. The ruptured follicles were contracted and plugged. In the right ovary there were seven unruptured follicles of .085 708 800 mm. ³ , of which one was degenerate. In the left ovary there were six unruptured follicles of .083 721 600 mm. ³ , of which one was degenerate.
29. F.D. K/16 R.Per. } 30. " " L.M.F. }	16	44 ³ / ₈	10/5/16	51-004 800 000 44-248 780 000	.938 936 400 .912 192 000	3 " 6 "	
31. F.Z.R. 1 ² /14 } 32. F.Fl.L. 1 ² /14 }	?	45 ¹ / ₂	"	25-519 500 000 24-777 500 000	.877 784 400 .534 518 640	4 " 4 "	The first maturation spindle had not yet formed. The spermatozoa in the uterus and oviduct were very few.
33. F.Mann.R. 1-2 ² /14 } 34. F.Len.L. 1-2 ² /14 }	"	"	"	25-624 350 000 37-691 250 000	.276 236 120 .779 188 420	2 both normal 7 all normal	
35. P.G.A. 3/15 R.Fl. } 36. " " L.Z. }	19 ¹ / ₂	47 ¹ / ₂	26/4/15	37-311 750 000 45-941 210 000	.880 308 800 .799 200 000	3 " 5 "	The first maturation spindle had not yet formed. The spermatozoa in the uterus and oviduct were very few. The ova were in the middle third of the oviduct. One ovum on the right side was in the 2-cell stage, the other two were in the pronuclear stage. The ova on the left side were in the first polar body stage or the pronuclear stage. The ruptured follicles were beginning to distend. In the right ovary there were two unruptured follicles of .232 696 800 mm. ³ , both degenerate. In the left ovary there was one unruptured follicle of 1-741 344 000 mm. ³ , with the ovum in the first maturation spindle stage, and four unruptured follicles of .160 923 840 mm. ³ , all degenerate.
37. F.G.B. 5/15 R.Z. } 38. " " L.Fl. }	17 ¹ / ₂	"	"	43-273 350 000 35-593 750 000	.679 680 000 .612 320 000	7 " 4 "	
39. F.D.A. 33/15 R.Fl. } 40. " " L.Z. }	16 ¹ / ₂	"	12/5/15	17-769 375 000 26-462 592 000	.760 838 400 1-143 072 000	2 both normal 4 all normal	The ova were in the middle third of the oviduct in the pronuclear stage. In the right ovary there were two unruptured follicles of .118 117 400 mm. ³ , both degenerate. In the left ovary there were three unruptured follicles of .734 976 000 mm. ³ , all degenerate. The ruptured follicles in the left ovary were beginning to distend.

TABLE VIII.—FERRETS AND FERRET-POLECAT HYBRIDS INSEMINATED AT FIRST ŒSTRUS OF SEASON.
 TIME OF DEATH AFTER INSEMINATION OVER 48 AND UNDER 73 HOURS.

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. F.D.A. 38/15 R.Fl. } 2. " " L.Z. }	14 "	51½ "	29/5/15 "	16.798 377 500 17.392 976 250	.410 400 000 .704 418 400	3 all normal 2 both normal	The ova were in the middle third of the oviduct, in the pronuclear stage. In the right ovary there was one unruptured follicle of .471 744 000 mm. ³ degenerate. In the left ovary there were two unruptured follicles of .340 982 000 mm. ³ degenerate. The ruptured follicles had not begun to distend.
3. P.D.A. 31/15 R.Z. } 4. " " L.Fl. }	21 "	53½ "	7/5/15 "	41.103 036 900 36.956 160 000	1.945 944 000 .508 034 000	7 all normal 7 "	The ova were in the lower part of the middle third of the oviduct, some in 1-, some in the 2-cell stage. In the right ovary there were three unruptured follicles of .544 056 000 mm. ³ , all degenerate. In the left ovary there were seven unruptured follicles of .516 096 000 mm. ³ , all degenerate. The ruptured follicles of the right ovary were partially distended.
5. F.G.A. 4/15 R.Fl. } 6. " " L.Z. }	16½ "	64 "	28/4/15 "	49.723 380 000 49.286 250 000	.836 352 000 .816 480 000	7 " 5 "	The ova were in the lower part of the middle half of the oviduct, some in the 4-, some in the 8-cell stage. In the right ovary there were three unruptured follicles of .241 488 000 mm. ³ , all degenerate. In the left ovary there were seven unruptured follicles of .254 826 000 mm. ³ , all degenerate. Distension was commencing in the ruptured follicles.
7. P.G.B. 7/15 R.Z. } 8. " " L.Fl. }	12 "	" "	29/4/15 "	23.589 843 750 21.936 093 750	2.225 462 400 1.080 241 920	2 both normal 3 all normal	The ova were in the middle third of the oviduct in the 2-cell stage. In the right ovary there were four unruptured follicles of .117 661 780 mm. ³ degenerate. In the left ovary there were four unruptured follicles of .210 375 000 mm. ³ degenerate. The ruptured follicles were definitely distended.
9. F.G.A. 5/15 R.Fl. } 10. " " L.Z. }	16½ "	64½ "	" "	18.207 000 000 29.347 683 750	1.189 881 000 1.950 342 880	3 " 6 "	The ova were in the lower part of the middle third of the oviduct, some in the 4-, some in the 8-cell stage. In the right ovary there was one unruptured follicle of 1.766 044 800 mm. ³ degenerate. In the right ovary there were five unruptured follicles of .187 246 080 mm. ³ degenerate. In the left ovary there were four unruptured follicles of .249 687 795 mm. ³ degenerate. Distension of the ruptured follicles was definite.

TABLE VIII.—*continued.*

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
11. F.G.B. 6/15 R.Z. } 12. " " L.Fl. }	12 "	65 "	28/4/15 "	26-212 725 200 26-068 037 980	2-187 360 000 -574 560 000	3 all normal 4 "	The ova were in the lower part of the middle third of the oviduct in the 4-cell stage. In the right ovary there were five unruptured follicles of .491 803 200 mm. ³ degenerate. In the left ovary there were six unruptured follicles of .703 800 000 mm. ³ degenerate. The ruptured follicles in the right ovary were definitely distended.
13. P.G.B. 8/15 R.Z. } 14. " " L.Fl. }	17 "	67 "	1/5/15 "	33-468 750 000 33-500 000 000	2-358 720 000 1-506 600 000	3 " 7 "	The ova were in the middle third of the oviduct in the 4-cell stage. In the right ovary there were five unruptured follicles of .491 803 200 mm. ³ , all degenerate. In the left ovary there were six unruptured follicles of .703 800 000 mm. ³ , all degenerate. Some of the ruptured follicles were almost completely distended.
15. F.G.A. 6/15 R.Fl. } 16. " " L.Z. }	18 "	68 "	" "	31-706 375 000 30-345 000 000	1-390 802 400 1-642 291 200	3 " 5 "	On the right side two ova were in the middle third of the oviduct, one in the 4-cell and one in the 2-cell stage. One ovum was in the ovarian pouch in the first polar body stage. On the left side the ova were in the middle third of the oviduct, one still undivided, and four in the 4-cell stage. In the right ovary one unruptured normal follicle and five unruptured degenerate follicles of .774 040 000 mm. ³ In the left ovary three unruptured follicles of 1-890 029 800 mm. ³ , with ova in first spindle stages. The ruptured follicles were partly distended.
17. F. 22-23/08 Mann. .	?	69½	..	17-770 462 500	1-151 073 000	3 "	The first maturation spindles had not yet formed. There were very few sperms in the lower part of the oviduct. Side to which ovary belonged not known.
18. F. 12-14/08 Z. } 19. G. 25-26/08 Mann. }	" "	" "	5/4/08 "	61-992 000 000 43-761 000 000	1-416 600 000 -721 201 400	6 " 6 "	The ova were not yet in the first spindle stage. The sperms in the lower part of the oviduct were not numerous. Side to which each ovary belonged not recorded.
20. F. 15-17/08 Mann. } 21. F. 24-27/08 Z. }	" "	" "	" "	19-068 750 000 25-110 000 000	-856 517 760 1-058 400 000	5 " 6 "	The ova were not yet in the first spindle stage. The sperms in the lower part of the oviduct were few. The side to which each ovary belonged not recorded.
22. F.D.A. 21/15 R.Z. } 23. " " L.Fl. }	21 "	69½ "	29/4/15 "	23-931 093 750 27-287 195 040	1-628 640 000 1-140 480 000	3 " 5 "	The ova were in the lower part of the middle third of the oviduct, some in the 4-cell, some in the 8-cell stage. The ruptured follicles were closed and almost fully distended. In the right ovary there were three follicles of .190 969 920 mm. ³ , of which two were degenerate. In the left ovary there were numerous follicles of .024 235 200 mm. ³ , both normal and degenerate.

TABLE VIII.—*continued.*

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
24. F.D.A. 22/15 R.Fl. } 25. " " L.Z. }	17 "	70 "	29/4/15 "	22·796 425 000 22·545 056 250	1·968 320 000 1·221 158 400	4 all normal 6 "	<p>The ova were in the lower part of the middle third of the oviduct, some in the 8-, some in the 10-cell stage. The ruptured follicles were moderately distended.</p> <p>In the right ovary there were seven unruptured follicles of ·072 331 840 mm.³, of which three were degenerate.</p> <p>In the left ovary there were two unruptured follicles of ·127 872 000 mm.³, both degenerate.</p>
26. F.D.A. 23/15 R.Z. } 27. " " L.Fl. }	18½ "	" "	" "	29·772 343 750 29·949 306 250	1·544 212 800 1·118 476 800	3 " 6 "	
28. F.G.A. 10/15 R.Fl. } 29. " " L.Z. }	12½ "	72 "	31/5/15 "	16·731 750 000 44·261 100 000	1·837 404 000 2·539 641 600	1 normal 7 all normal	<p>The ova were in the middle third of the oviduct, some in the 4-, some in the 8-cell stage. The ruptured follicles were distended, especially on the left side.</p> <p>In the right ovary were three degenerate unruptured follicles of ·115 394 400 mm.³</p> <p>In the left ovary were two degenerate unruptured follicles of ·346 959 360 mm.³</p>
30. F.G.B. 9/15 R.Fl. } 31. " " L.Z. }	14½ "	" "	4/5/15 "	18·791 797 000 31·104 000 000	·623 920 000 ·844 240 000	2 both normal 3 all normal	

TABLE IX.—FERRETS AND FERRET-POLECAT HYBRIDS INSEMINATED AT THE FIRST ESTRUS OF THE SEASON.
TIME OF DEATH AFTER INSEMINATION OVER 72 AND UNDER 97 HOURS.

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. F.D.A. 44/15 R.Fl. } 2. " " L.Mx. }	13½ "	74 "	19/6/15 "	33-239 808 000 20-528 640 000	2-078 600 000 1-980 576 000	3 all normal 4 "	The ova were in the middle third of the oviduct, some in the 3-, some in the 4-cell stage. The ruptured follicles were distended. In the right ovary were four degenerate follicles of .315 872 000 mm. ³ In the left ovary was one follicle of degenerate epithelium, and with an ovum in the first polar body stage. The follicle measured .886 356 000 mm. ³
3. F.G.A. 7/15 R.Z. } 4. " " L.Fl. }	15 "	76 "	4/5/15 "	30-840 328 800 39-180 625 000	3-036 217 400 3-045 168 000	8 8 "	The ova were in the uterus, some in the 1-, some in the 2-, and one in the 4-cell stage, and all were degenerate. In the right ovary were three unruptured degenerate follicles of .173 880 000 mm. ³ In the left ovary were four unruptured degenerate follicles of .090 248 000 mm. ³ The ruptured follicles were distended.
5. P.D.A. 5/15 R.Per. } 6. " " L.Fl. }	20½ "	76½ "	22/4/15 "	21-356 055 000 29-804 709 375	.607 500 000 .665 280 000	3 7 "	The ova were in the middle third of the oviduct in the stage of fusing pronuclei. The ruptured follicles were not distended. In the right ovary was one unruptured degenerate follicle of .186 263 600 mm. ³ In the left ovary were four unruptured degenerate follicles of .077 760 000 mm. ³
7. F. 1 27-28/08 Z. } 8. F. 1-1 29-30/08 Mann. }	? "	93½ "	5/4/08 "	29-204 331 250 16-334 156 250	1-451 980 800 1-136 851 200	3 5 "	The ova were in the lower part of the middle third of the oviduct, some in the 7-, some in the 8-, and some in the 9-cell stage. The ruptured follicles were distended, and there were signs of lutein formation. In the right ovary were four normal unruptured follicles of .269 892 000 mm. ³ In the left ovary were three normal unruptured follicles of .140 616 000 mm. ³ The sides to which the ovaries belonged is uncertain.
9. F. 1-2 31-34/08 Mann. } 10. F. 1-3 35-37/08 Z. }	" "	" "	" "	48-129 900 000 56-772 000 000	1-932 096 000 2-938 328 000	8 normal 3 degenerate 3 all normal	The follicles were unruptured, and contained ova either in the first spindle stage or the first polar body stage. In addition ovary 31-34 contained three degenerate follicles of .184 680 000 mm. ³ , and the ovary 35-37 contained twelve degenerate follicles of .200 250 000 mm. ³ The sides to which the ovaries belonged is uncertain.

TABLE IX.—*continued.*

Specimen.	Weight in Ounces.	Number of Hours after Insinuation.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
11. F. 1-4 G. 1-2/08 M. } 12. F. 1-5 G. 3-5/08 Z. }	? "	94½ "	16/4/08 "	25-699 850 000 56-594 375 000	.839 056 000 1-995 022 000	3 all normal 7 "	The ova were in the middle third of the oviduct, some in the pronuclear stage, and some in the stage of the first division. The ruptured follicles were partially or completely distended. In the ovary G 1-2 there were five degenerate follicles of .154 242 720 mm. ³ In the ovary G 3-5 there were five degenerate follicles of .180 633 600 mm. ³ The sides to which the ovaries belonged is uncertain.
13. P.D. M/16 R.M.F. } 14. " " L.Per. }	14½ "	" "	13/5/16 "	33-125 760 000 56-842 560 000	1-933 282 880 1-640 380 080	{ 3 abnormal 2 normal 5 abnormal 7 normal	Most of the ova were in the lower third of the oviduct in the morula stage, with not less than 14 cells. One ovum on the right side was in the ovarian pouch, and was degenerated. One ovum on the left side was in the lower third of the oviduct in the 1-cell stage, and was abnormal. In the right ovary were six unruptured follicles of .071 064 000 mm. ³ , of which one was degenerate. In the left ovary were three normal unruptured follicles of .200 970 000 mm. ³ The ruptured follicles were distended.
15. F.D. W/16 R.Per. } 16. " " L.Mx. }	17½ "	95 "	21/5/16 "	40-166 784 000 35-834 400 000	1-651 104 000 1-553 378 000	6 all normal 3 "	The ova were in the lower third of the oviduct in the morula stage (about 12 cells). The ruptured follicles were distended. In the right ovary were four unruptured degenerate follicles of .764 640 000 mm. ³ In the left ovary was one unruptured degenerate follicle of 2-000 700 000 mm. ³
17. F.Mx.R. 1-1 4d/14 } 18. F.Per. L. 1-1 4d/14 }	? "	95½ "	12/4/14 "	36-978 913 125 27-221 250 000	1-862 784 000 .973 477 440	{ 1 abnormal 5 normal 1 abnormal 1 normal	The ova were in the lower third of the oviduct in the morula stage, some of about 12, others of about 20 cells. The ruptured follicles were distended. In the right ovary were two normal unruptured follicles of .128 520 000 mm. ³ In the left ovary were three normal unruptured follicles of .086,788,800 mm. ³ , and one unruptured degenerate follicle of same size.

[TABLE X.

TABLE X.—FERRETS AND FERRET-POLECAT HYBRIDS INSEMINATED AT THE FIRST OESTRUS OF THE SEASON.
TIME OF DEATH AFTER INSEMINATION OVER 96 AND UNDER 121 HOURS.

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. F. 1-1/4 G 8 Mann. } 2. F. 1-2/4 G 10 Z. }	?	116½	7/5/04	27-677 672 400 33-409 950 000	1-355 270 400 2-193 408 000	4 all normal 4 "	The ova were in the middle third of the oviduct in the pronuclear stage. The ruptured follicles were distended. In ovary G 8 there was one unruptured degenerate follicle of 1-336 500 000 mm. ³ which contained an ovum in the first spindle stage. In the ovary G 10 there were two unruptured degenerate follicles of 1-111 825 000 mm. ³ The side to which each ovary belonged is uncertain.
3. F. 1-3/4 G 12 Mann. } 4. F. 1-4/4 G 14 Z. }	"	"	"	20-235 807 190 30-706 250 000	3-171 571 200 4-177 958 400	4 " 6 "	The ova were in the cranial part of the lower third of the oviduct, some in the 8- and some in the 12-cell stage. The ruptured follicles were distended. In ovary G 12 there were three unruptured degenerate follicles of 1-115 153 920 mm. ³ In ovary G 14 there was one unruptured degenerate follicle of 1-321 235 200 mm. ³ The side to which each ovary belonged is uncertain.
5. F. 1-5/4 G 17 Mann. } 6. F. 1-6/4 G 19 Z. }	"	117½	23/4/04	43-499 531 250 34-420 156 250	2-195 726 400 1-862 784 000	4 " 5 "	The ova were in the caudal third of the oviduct in the morula stage of about 20 cells. The ruptured follicles were distended. In ovary G 17 there were two unruptured degenerate follicles of 1-619 718 400 mm. ³ In ovary G 19 there was one unruptured degenerate follicle of 1-486 512 000 mm. ³ containing a degenerate ovary, and with the follicle wall becoming luteal. The side to which each ovary belonged is uncertain.
7. F. 1-7/4 G 21 Mann. } 8. F. 1-8/4 G 23 Z. }	"	"	"	23-326 875 000 28-411 175 000	2-406 487 200 1-693 094 400	4 " 6 "	The ova were in the caudal third of the oviduct in the morula stage with many cells. The ruptured follicles were redistended. In the right ovary was one unruptured degenerate follicle of 1-376 992 000 mm. ³ In the left ovary were six unruptured degenerate follicles of 1-049 920 000 mm. ³ The side to which each ovary belonged is uncertain.
9. P.Z.R. 1/14 } 10. P.Fl.L. 1/14 }	"	119½	26/4/14	30-188 276 250 43-157 625 000	1-675 696 000 2-462 140 800	5 " 5 "	The ova were in the caudal third of the oviduct in the morula stage of about 20 cells. The ruptured follicles were redistended. In the right ovary were four unruptured abnormal follicles of 1-053 360 000 mm. ³ , with ova in the first spindle or first polar body stage. In the left ovary were five abnormal unruptured follicles of 1-591 200 000 mm. ³
11. P.Mann.R. 1-2/14 } 12. P.Len.L. 1-2/14 }	"	120	"	21-745 899 000 27-522 450 000	1-656 064 000 1-907 200 000	8 " 3 "	The ova were in the caudal third of the oviduct in the morula or commencing blastula stage. The ruptured follicles were redistended. In the right ovary were two unruptured degenerate follicles of 1-056 200 000 mm. ³ In the left ovary were five unruptured degenerate follicles of 1-076 608 000 mm. ³

TABLE XI.—FERRET AND FERRET-POLECAT HYBRIDS INSEMINATED AT THE FIRST ŒSTRUS OF THE SEASON.
TIME OF DEATH AFTER INSEMINATION OVER 120 AND UNDER 145 HOURS.

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. P.D. N/16 R.Per. } 2. " " L.Fl. }	14½ "	120½ "	17/5/16 "	47.076 019 200 48.553 344 000	2.057 745 600 1.373 888 160	{ 5 normal 5 abnormal 6 normal 7 abnormal	The ova were in the caudal third of the oviduct in the morula stage of about 12 cells. The ruptured follicles were redistended. In the right ovary were two unruptured follicles .185 724 000 mm. ³ , one becoming luteal. In the left ovary were four unruptured follicles .205 128 000 mm. ³ , all luteal and three degenerate.
3. P.G.A. 16 B/15 R.Mx. } 4. P.G.A. 16 B/15 L.Fl. }	17 "	122½ "	22/6/15 "	37.739 520 000 26.578 175 000	1.417 950 000 1.004 400 000	8 all normal 6 "	The ova were in the middle third of the oviduct, some in the 1-cell and others in the 4-cell stage. Some of the ova in the 1-cell stage were abnormal. The ruptured follicles were redistended. In the right ovary were six unruptured follicles .271 209 600 mm. ³ , of which three were degenerate, and one of the three was luteal. In the left ovary were eight unruptured follicles .534 600 000 mm. ³ , of which five were degenerate, and of these three were luteal.
5. F.D. T/16 R.Per. } 6. " " L.M.F. }	16½ "	123½ "	20/5/16 "	24.155 820 000 42.021 504 000	1.945 866 240 1.453 140 000	1 normal 5 normal 1 abnormal	The ova were in the caudal third of the oviduct, some in the 8- and some in the 10-cell stage. The ruptured follicles were redistended. In the right ovary were eight unruptured follicles .157 172 400 mm. ³ , of which three were degenerate. In the left ovary were five unruptured follicles .099 290 800 mm. ³ , of which one was degenerate.
7. F. 1.5 H. 8/08 R.Z. } 8. F. 1.6 H. 6/08 L.Z. }	? "	139¼ "	7/5/08 "	48.785 156 250 26.146 601 250	1.766 793 600 1.422 230 400	9 all normal 7 "	The ova were in the uterus in the blastula stage. The ruptured follicles were redistended. In No. 7 were seven unruptured follicles .159 224 000 mm. ³ , of which three were degenerate. In No. 8 were nine unruptured follicles .245 674 080 mm. ³ , of which six were degenerate, and one of these was luteal.
9. F. 1.9 H. 10/08 R.Mann. } 10. F. 1.10 H. 1/08 L.Z. }	" "	140¼ "	2/5/08 "	21.535 552 500 15.184 800 000	1.560 971 520 1.543 050 000	5 " 2 both normal	The ova were in the uterus in the blastula stage. The ruptured follicles were redistended. In No. 9 were three unruptured follicles .101 361 200 mm. ³ , of which one was degenerate. In No. 10 were three unruptured follicles .086 860 800 mm. ³ , all normal.
11. F. 1.11 H. 3/08 R.Mann. } 12. F. 1.8 G. 37/08 L.Z. }	" "	140½ "	7/5/08 "	32.701 016 250 15.497 133 750	1.551 420 000 .817 080 000	2 " 2 "	One ovum was in the caudal end of the oviduct in the morula stage. The others were in the cranial part of the uterus in the blastula stage. The ruptured follicles were redistended and luteal. In No. 11 were seven unruptured follicles .128 493 420 mm. ³ , of which four were degenerate. In No. 12 were three unruptured follicles .195 854 400 mm. ³ , all normal.

TABLE XI.—*continued.*

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
13. F. 1-3 G. 35/08 Mann. } 14. F. 1-4 G. 31/08 Z. }	? "	140½ "	30/4/08 "	32-922 540 000 39-503 750 000	1-289 389 200 2-287 000 000	4 all normal 5 "	{ The ova were in the caudal part of the oviduct in the morula stage. The ruptured follicles were redistended and luteal. The side to which each ovary belonged is uncertain. In No. 13 were four unruptured follicles .045 158 400 mm. ³ , of which three were degenerate. In No. 14 were five unruptured follicles .110 376 000 mm. ³ , all normal.
15. P.Mx.R. 1-1½/14 } 16. P.Per.L. 1-1½/14 }	19 "	144 "	1/5/14 "	28-306 026 000 25-909 632 000	3-122 841 600 1-086 750 000	{ 1 abnormal 9 normal 7 all normal	{ Some of the ova were in the caudal part of the oviduct in the morula stage, others were in the cranial part of the uterus, some in the morula stage and some in the early blastula stage. The ruptured follicles were redistended and luteal. In the right ovary were three unruptured follicles of .103 774 608 mm. ³ , of which one was degenerate. In the left ovary were four unruptured follicles of .031 303 920 mm. ³ , of which one was degenerate.
17. F.D.A. 28/15 R.Z. } 18. " " L.Fl. }	" "	143 "	2/5/15 "	43-223 687 500 43-160 386 880	1-875 200 000 1-632 960 000	5 5 "	{ The ova were in the caudal third of the oviduct in the morula stage. The ruptured follicles were all closed, redistended, and luteal. In the right ovary were twelve unruptured follicles (of which three were degenerate) of .171 417 600 mm. ³ In the left ovary were three normal unruptured follicles of .157 132 800 mm. ³
19. F.Mann.R. 1-2½/15 } 20. F.Len.L. 1-2½/15 }	17 "	144½ "	1/5/14 "	22-297 680 000 17-694 720 000	1-412 460 000 1-176 940 000	4 4 "	{ Some of the ova were in the caudal part of the uterine tube in the morula stage, others were in the cranial part of the uterus in the early blastula stage. The ruptured follicles were redistended and luteal. In the right ovary were two normal unruptured follicles of .216 940 800 mm. ³ In the left ovary were two normal unruptured follicles of .032 125 520 mm. ³
21. F. 1 G. 27/08 Z. } 22. F. 1-1 G. 33/08 Mann. }	? "	144 "	23/4/08 "	46-786 162-500 28-622 896 250	2-467 584 000 1-617 408 000	6 4 "	{ The ova were in the cranial part of the uterus in the blastula stage. The ruptured follicles were redistended and luteal. The side to which each ovary belonged is uncertain.

TABLE XII.—FERRETS INSEMINATED AT SECOND ESTRUS.

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Number of Days Post-partum or Post-abortion.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
1. F.D.A. 39/15 R.Z. } 2. " " L.Fl. }	16 "	24 "	22 "	30/4/15 "	21-441 024 000 36-824 470 000	2-105 064 000 1-819 584 000	3 all normal 6 "	{ Ova of second pregnancy in first polar body stage. Young of first pregnancy were cast on May 8, 1915. The animal was in full heat on May 29, 1915, and was killed after insemination on May 30, 1915. The side to which the ovaries belong is uncertain. The ova in both cases were in the middle third of the oviduct in the first polar body stage. Some were fertilised, others were not fertilised. In ovary 3 there were seven old corpora lutea. In ovary 4 there were two old corpora lutea. The ova were in the lower part of the middle third of the oviduct, some in the 7- and others in the 9-cell stage. In the right ovary there were two large unruptured follicles, one of .894 240 000 mm. ³ , one of 1-272 290 000 mm. ³ , both with ova in the first polar body stage. In the left ovary there was one follicle of 1-089 849 600 mm. ³ with ovum in first spindle stage, and one follicle of .406 378 000 mm. ³ with unripe ovum. The ruptured follicles were closed and distended. Four corpora lutea of previous pregnancy were present in each ovary. The ova were in the middle third of the oviduct; two of those on the right side were in the 4-cell stage and one in the 3-cell stage. On the left side three were in the 4-cell stage and one in the 2-cell stage. In the right ovary there were four unruptured follicles of .087 768 000 mm. ³ , of which three were degenerate. In the left ovary there were five unruptured follicles of .251 164 800 mm. ³ , of which four were degenerate. The ruptured follicles were partially distended. In the right ovary four corpora lutea of the previous pregnancy. In the left ovary seven corpora lutea of the previous pregnancy.
3. F. 6-9/08 Z. } 4. F. 10-11/08 Mann. }	? "	43½ "	? "	23/5/08 "	24-178 500 000 17-227 000 000	.720 824 000 .628 560 000	4 8	
5. F. 18-19/08 R.Mann. } 6. 20-21/08 L.Z. }	" "	65½ "	" "	" "	35-709 375 000 25-100 000 000	2-046 179 200 1-645 712 640	5 4	
7. F.G.A. 11/15 R.Z. } 8. " " L.Fl. }	13½ "	69 "	" "	31/5/15 "	27-845 141 060 34-166 643 600	1-550 016 000 1-144 044 000	3 4	

TABLE XII.—*continued.*

Specimen.	Weight in Ounces.	Number of Hours after Insemination.	Number of Days Post-partum or Post-abortion.	Date of Death.	Size of Ovary in mm. ³	Size of largest Follicle in mm. ³	Number of Follicles of largest size.	Notes.
9. F.D. Z ³ /16 R.Per. }	17	17	?	3/7/16	18-576 000 000	-875 427 840	3 all normal	<p>The ova from the ruptured follicles of the second œstrus were in the caudal third of the oviduct in the morula stage of many cells, except one which was degenerate and unfertilised.</p> <p>The ruptured follicles were definitely luteal.</p> <p>In the left ovary there was a large unruptured follicle of 2-574 400 000 mm.³, with walls becoming luteal, and three degenerate unruptured follicles of -152 182 800 mm.³</p> <p>In the right ovary were three degenerate unruptured follicles of -062 640 000 mm.³</p>
10. " " L.Fl. }	"	"	"	"	38-074 176 000	-920 160 000	6 "	

EXPLANATION OF FIGURES IN THE PLATES.

A. Artery.	L.f.t. Tertiary liquor folliculi.
A.f. Cavity of ovarian follicle.	L.v. Lymph vessel.
A.p.f. Aperture of ruptured follicle.	M.e. Membrana externa.
B.o.c. Base of ovarian cumulus.	M.i. " interna.
B.v. Blood-vessel. B.vs. Blood-vessels.	Minl. Nucleus in mitosis.
C. Centrosome.	M.o. Medula ovarii.
C.o. Ovarian cumulus.	M.s.p. 1. First maturation spindle.
C.p.o. " capsule.	M.s.p. 2. Second " "
C.r. Corona radiata.	N. Needle in opening of ovarian capsule.
C.r.e. " " epithelium.	Nl. Nucleus.
C.t.c. Connective-tissue cell.	Nll. Nucleolus.
C.t.o. Cortex ovarii.	O. Ovum.
C.t.t. Tubule of cortex.	O.c. Opening of ovarian capsule.
D.f. Degenerate follicle.	Od. Oviduct.
D.fs. " follicles.	Ol. Oolemma.
E.f. Follicular epithelium.	Pl. Plug in aperture of ruptured follicle.
E.o. Escaping ovum.	Pv.s. Perivitelline space.
F.a. Atresic ovarian follicle.	R.f. Ruptured follicle.
F.g. Fat granules.	S.c. Stroma cell. S.cs. Stroma cells.
Fl.o. Ovarian follicle.	Sp.c.st. Spindle-cell stroma.
Fl.os. Ovarian follicles.	St.l.f.p. Stroma of the primary liquor folliculi.
F.o. Surface of ovary.	St.l.f.t. " " tertiary " "
F.s. Fibrous stroma.	St.v.f. Vascular layer of wall of follicle.
I.c. Interstitial cell.	T.a. Tunica albuginea.
I.cs. " cells.	U.c. Uterine cornu.
L.f. Liquor folliculi.	V. Vein.
L.f.p. Primary liquor folliculi.	V.c. Vitellogenous crescent.
L.f.s. Secondary " "	W.b.c. White blood corpuscles.

PLATE I.

Fig. 1. Surface view of the ovarian capsule and the cranial end of the uterine cornu of a ferret. $\times 1.8$. A needle is placed in the opening through which the cavity of the capsule communicates with the peritoneal cavity. The corresponding aperture is seen in section in fig. 2, together with an ovum which has just escaped through the aperture into the peritoneal cavity.

Fig. 2. Section of the ovary, ovarian capsule, and the cranial end of the uterine cornu of a ferret-polecat hybrid: $\times 11$. The section traverses the opening through which the interior of the ovarian capsule communicates with the peritoneal cavity, and a recently extruded ovum is seen escaping into the peritoneal cavity between the uterine cornu and the apex of one of the fimbriae of the cranial end of the oviduct. (Specimen P.D. C/16. L.Per. $31\frac{1}{2}$ hours after insemination.) I.H. O.G.

Fig. 3. Section through the cortex of the ovary of a ferret, showing ovarian follicles of various sizes, some normal and some degenerate. Some of the follicles are situated superficially and others deeply in the cortex. $\times 65$. (Specimen F.D. T/16. L.M.F. $123\frac{1}{2}$ hours after insemination.) I.H. O.G.

Fig. 4. Section of several primitive ovarian follicles of a ferret. $\times 800$. (Specimen F.G.A. 18/15. L.Mx. 32 days' oestrus.) I.H.

Fig. 5. Section of young ovarian follicles of a ferret. $\times 540$. One of the follicles shows a surface view of the follicular epithelium. The other follicle has been cut obliquely, so that on one side a single layer of cubical epithelium is seen, and on the other side an oblique section through the cubical follicular cells is shown. (Specimen F.D. G/16. L.Per. $41\frac{1}{2}$ hours after insemination.) I.H. O.G.

Fig. 6. Longitudinal section through an ovarian follicle of a ferret, showing the ovoid form of the follicle. $\times 800$. The follicular epithelium is entering on the two-layered stage at one end of the follicle. (Specimen F.D.A. 42/15. R. 28 days post-partum and not in heat.)

Fig. 7. Section through an ovarian follicle of a ferret-polecat hybrid. $\times 540$. The follicular epithelium is in the early part of the two-layered stage. (Specimen P.D. C/16. R.M.F. $31\frac{1}{2}$ hours after insemination.) I.H. O.G.

PLATE II.

Fig. 8. Longitudinal section of an ovarian follicle of a ferret. $\times 350$. Follicle and ovum are both ovoid. The follicular epithelium is in the early part of the three-layered stage. (Specimen F.Z.R.A. 10/15, anestrus period.) I.H.

Fig. 9. Longitudinal section through an ovarian follicle of a ferret, showing the more rapid increase of the follicular cells at the poles of the follicle. $\times 540$. (Specimen F.D. F/16. L.Mx. $40\frac{3}{4}$ hours after insemination.) I.H.

Fig. 10. Oblique section through an ovarian follicle of a ferret, showing the commencement of the cavity (antrum folliculi) of the follicle at one pole of the follicle. $\times 540$. (Specimen F.D. G/16. R.M.F. $41\frac{1}{2}$ hours after insemination.) I.H. O.G.

Fig. 11. Longitudinal section through an ovarian follicle of a ferret, showing a more advanced stage in the formation of the cavity of the follicle. $\times 540$. (Specimen F.D. G/16. R.M.F. $41\frac{1}{2}$ hours after insemination.) I.H. O.G.

Fig. 12. Section through an ovarian follicle of a ferret, showing changes in the follicle cells as the cavity of the follicle increases. $\times 549$. (Specimen F.D. G/16. L.Per. $41\frac{1}{2}$ hours after insemination.) I.H. O.G.

Fig. 13. Section through a part of a full-grown ovarian follicle of a ferret which was not inseminated though insemination was attempted, showing the strands of primary stroma which permeate the primary liquor folliculi and which are connected with the follicular epithelium. $\times 65$. (Specimen F.Z.R. 1/14. 6d.) I.H.

PLATE III.

Fig. 14. Section through part of the ovarian follicle depicted in fig. 13. $\times 310$. Showing the relation of the strands of the stroma of the primary liquor folliculi to the follicular epithelium and to the epithelium of ovarian cumulus.

Fig. 15. Section of an ovarian follicle of a ferret almost ready for ripening, showing the stalk of the

ovarian cumulus, and the separation of the cumulus cells into an outer group which will be dispersed, and an inner group which will form the corona radiata. The reticular character of the primary liquor folliculi is also shown. $\times 65$. (Specimen P.D. C/16. 31 hours after insemination.) I.H. O.G.

Fig. 16. The ovarian cumulus and part of the wall of the follicle shown in fig. 15. $\times 310$. Showing more definitely the separation of the cumulus cells into two groups, and the relationship of the reticulum of the primary liquor folliculi to the follicular cells and to the cells of the cumulus.

Fig. 17. Section through an ovarian follicle of a ferret $27\frac{1}{2}$ hours after insemination, showing the commencing dispersion of the more external cumulus cells. $\times 55$. The membrana interna is quite distinct on the inner surface of the follicular epithelium and on the outer surface of the cumulus. (Specimen F.G.A. 1/15. R.Z. $27\frac{1}{2}$ hours.) I.H.

Fig. 18. Section through an ovarian follicle of a ferret $19\frac{3}{4}$ hours after insemination. $\times 30$. The ovum is in the first maturation spindle stage, but the section does not pass through the spindle. The membrana interna surrounds the primary liquor folliculi. The secondary liquor folliculi is dispersing the outer cells of the ovarian cumulus, and is also beginning to force its way between the membrana interna and the inner surface of the follicular epithelium. (Specimen F. 3-5. Z. 1904.) H.E.

Fig. 19. Section through the ovarian follicle of a ferret $30\frac{1}{2}$ hours after insemination. $\times 30$. Part of the primary liquor folliculi has been coagulated and shrunk by the fixing fluid. The membrana interna has been separated from the follicular epithelium to a greater extent than in the specimen shown in fig. 18, and part of it has been dragged into folds by the contraction of the coagulated primary liquor folliculi. (Specimen F.D. D/16. L.P.N.F. $30\frac{1}{2}$ hours.) I.H. O.G.

Fig. 20. Section through an ovarian follicle of a ferret $26\frac{1}{4}$ hours after insemination. $\times 30$. The ovum was in the first polar body stage, but the polar body and the second spindle are not in the plane of the section. Although the amount of secondary liquor folliculi in the region of the cumulus is not greater than in the follicle shown in fig. 19, the membrana interna is separated from the follicular epithelium to a greater extent—that is, along the whole of one side and at the superficial part of the follicle. (Specimen F.D.A. 43/15. L.Fl. $26\frac{1}{4}$ hours.) E.

PLATE IV.

Fig. 21. Section through an ovarian follicle of a ferret 24 hours after insemination. $\times 30$. The ovum was in the first polar body stage, and the polar body is seen as a black dot in the upper and left part of the ovum, close to the oolemma. The dispersion of the cumulus epithelium has proceeded to a greater extent than in the specimens shown in the previous figures; there is also a greater amount of secondary liquor folliculi, and a greater extent of separation of the membrana interna from the follicular epithelium. (Specimen F.D.A. 39/15. R.Z. 24 hours.) I.H.

Fig. 22. Section through an ovarian follicle of a ferret $19\frac{3}{4}$ hours after insemination. $\times 30$. In this follicle the ovum was situated near the surface of the ovary, and was in the first maturation spindle stage, but the section does not pass through the plane of the spindle. There is greater dispersion of the cumulus epithelium than in the follicles shown in the preceding figures, and the membrana interna is separated from the follicular epithelium over more than a third of the superficial part of the wall of the follicle. (Specimen F. 3-5. Z. 1904. $19\frac{3}{4}$ hours.) H.E.

Fig. 23. Section through an ovarian follicle of a ferret 21 hours after insemination. $\times 30$. The ovum was in the first maturation spindle stage, but the section does not pass through the plane of the spindle. The follicle is of smaller size than those shown in the preceding figures, and the dispersion of the cumulus epithelium is less advanced than in the follicle depicted in fig. 22, but the separation of the membrana interna from the follicular epithelium is more advanced. (Specimen F.D.A. 41/15. R.Fl. 21 hours.) I.H.

Fig. 24. Section through an ovarian follicle of a ferret $26\frac{1}{4}$ hours after insemination. $\times 30$. The ovum was in the first polar body stage, but the section does not pass through the plane of the polar body. In the plane through which the section passes the membrana interna has been completely separated from the follicular epithelium by the secondary liquor folliculi. (Specimen F.D.A. 43/15. R.M. $26\frac{1}{4}$ hours.) I.H.

Fig. 25. Section through an ovarian follicle of a ferret $41\frac{1}{2}$ hours after insemination. $\times 30$. The

ovum was in the first polar body stage, but the polar body does not lie in the plane of the section. In the plane of section the membrana interna is separated from the follicular epithelium for some distance on each side of the cumulus, and the secondary liquor folliculi, extending more rapidly in a plane at right angles to the plane of the section, has reached the superficial part of the follicle, and in its progress, along a relatively narrow pathway, it has invaginated the membrana interna towards the centre of the follicle. (Specimen F.G.A. 2/15. R.Fl. 41½ hours.) E.

Fig. 26. Section through a recently ruptured ovarian follicle of a ferret 41½ hours after insemination. $\times 30$. The ovum from the follicle is in the middle third of the oviduct in the pronuclear stage. A portion of the membrana interna is still adherent to the follicular epithelium on the lower part of the right-hand wall of the follicle, but the membrana interna has disappeared from the greater part of the area, and the cavity of the follicle is filled with liquor folliculi tertia, which plugs the orifice in the follicle wall. The liquor folliculi tertia consists of fluid interspersed with strands of fibrils which are connected with the follicle cells. (Specimen F.D. G/16. L.Per. 41½ hours.) I.H. O.G.

Fig. 26A. A portion of the lower and left part of the follicle shown in fig. 26. $\times 260$. Showing the relation of the stroma of the tertiary liquor to the follicle cells. The plane of section is 20μ from that shown in fig. 26.

Fig. 26B. A portion of the floor of the follicle shown in fig. 26, in the same plane as the section shown in fig. 26B. $\times 260$. Showing the characters of the follicular cells and the relation of the cells to the tertiary liquor.

PLATE V.

Fig. 27. Section through a ruptured ovarian follicle of a ferret 41 hours after insemination. $\times 30$. The ovum from the follicle is in the middle third of the oviduct in the stage of fusing pronuclei. As contrasted with the follicle shown in fig. 26, the orifice of rupture is smaller, the wall is more folded, and the blood-vessels round the external periphery of the follicular epithelium are more numerous. (Specimen F.D. I/16. R.Per. 41 hours.) I.H. O.G.

Fig. 27A. Section through the orifice of a follicle in the same stage as that shown in fig. 27. $\times 260$. Showing (a) the relation of the plug to the left-hand margin of the orifice, (b) white blood corpuscles in the liquor folliculi, (c) the relation of the strands of the tertiary liquor and the relation of the blood-vessels to the follicular epithelium. (Specimen F.D. I/16. R.Per. 41 hours.) I.H. O.G.

Fig. 27B. Section through a part of the floor of the same follicle as that represented in fig. 27A. $\times 260$. Showing white blood corpuscles and follicle cells in the tertiary liquor.

Fig. 27C. Section through a portion of a follicle in the same stage as that shown in fig. 27, and from the same ovary. $\times 260$. Showing the relation of the follicle cells in the tertiary liquor to the strands of the stroma.

Fig. 28. Section through two adjacent ruptured ovarian follicles of a ferret 44½ hours after insemination. $\times 30$. Showing different stages of contraction of ruptured follicles. In the right-hand follicle the orifice is widely open, and few remnants of the liquor folliculi are left in the cavity. In the case of the left-hand follicle the orifice is firmly plugged and a considerable amount of liquor is present in the superficial part of the follicle. (Specimen F.D. K/16. L.M.F. 44½ hours.) I.H. O.G.

Fig. 29. Section through a ruptured ovarian follicle of a ferret 70 hours after insemination. $\times 30$. The orifice of the follicle is contracted and plugged, but redistension of the cavity has not commenced. The blood-vessels around the periphery of the follicular epithelium are relatively few, but there are numerous small blood-vessels amidst the cells of the follicular epithelium. (F.D.A. 22/15. L.Z.) I.H. Mallory.

Fig. 30. Section through a ruptured ovarian follicle of a ferret 64½ hours after insemination. $\times 30$. The orifice of the follicle is contracted and firmly plugged. There are remnants of the tertiary liquor folliculi and its stroma in the remains of the cavity of the follicle. There are few blood-vessels around the periphery of the follicular epithelium and amidst the follicle cells, and redistension of the follicle has not commenced. The folding of the follicular epithelium layer and the adjacent connective-tissue stroma of the wall of the follicle is very marked. The ova from the specimen ovary from which the section is taken are in the middle third of the oviduct, one in the 2-cell and others in the 4-cell stage. (Specimen F.G.A. 5/15. L.Z. 64½ hours.) I.H.

PLATE VI.

Fig. 31. Section through the ruptured ovarian follicle of a ferret-polecat hybrid 53½ hours after insemination. The orifice is contracted and firmly plugged, blood-vessels are fairly numerous around the periphery of the follicular epithelium, and the redistension of the cavity of the follicle with tertiary follicular fluid has taken place to a slight extent. $\times 30$. (Specimen P.D.A. 31/15. L.Fl. 53½ hours.) The ova are in the middle of the oviduct in the 2-cell stage. I.H.

Fig. 32. Section through the ruptured ovarian follicle of a ferret 64 hours after insemination. The orifice of the follicle is more contracted than in the specimen represented in fig. 33, and the redistension of the follicle is more advanced. Blood-vessels are numerous in the follicular epithelium. $\times 30$. The ova are in the middle third of the oviduct, some in the 4-cell and some in the 8-cell stage. (Specimen G.A. 4/15. L.Z. 64 hours.) I.H.

Fig. 33. Section through the ruptured ovarian follicle of a ferret 64 hours after insemination. The orifice of the follicle is a little more contracted than in the follicle shown in fig. 34. Blood-vessels are numerous in the follicular epithelium and around its periphery, and the redistension of the follicle has taken place to a slight extent. $\times 30$. The ova are in the middle third of the oviduct, some in the 4- and some in 8-cell stage. (Specimen G.A. 4/15. L.Z. 64 hours.) I.H.

Fig. 33A. Section through a portion of the wall of the follicle represented in fig. 33. $\times 540$. Showing the relation of the blood-vessels to the follicular epithelium.

Fig. 34. Section through the ruptured ovarian follicle of a ferret-polecat hybrid 53½ hours after insemination. The orifice of the follicle is very much reduced, and the cavity of the follicle is considerably redistended. The ova are in the middle third of the oviduct in the 2-cell stage. (Specimen P.D.A. 31/15. L.Fl. 53½ hours.) I.H.

Fig. 35. Section through the ruptured ovarian follicle of a ferret 70 hours after insemination. The orifice of the follicle is closed externally, and the redistension of the cavity is well advanced. (Specimen. The ova are in the middle third of the oviduct in the 8-cell stage. (Specimen F.D.A. 23/15. L.Fl. 70 hours.) E.

Fig. 36. Section through the ruptured ovarian follicle of a ferret 69¾ hours after insemination. The orifice of the follicle is completely closed, and the redistension of the cavity is well advanced. The ova are in the middle third of the oviduct, some in the 6- and some in the 8-cell stage. $\times 30$. (Specimen F.D.A. 21/15. R.Z. 69¾ hours.) I.H.

Fig. 37. Section through the ruptured ovarian follicle of a ferret 74 hours after insemination. The orifice is completely closed, and the redistension of the cavity is practically complete. $\times 30$. The ova are in the middle third of the oviduct, some in the 6- and some in the 8-cell stage. (Specimen F.D.A. 44/15. R.Fl. 74 hours.) E.

Fig. 38. Section through the ovary of a ferret 69¾ hours after insemination, showing a ruptured, closed, and redistended follicle and an unruptured follicle with a ripening ovum. $\times 30$. The ova from the ruptured follicles of the ovary are in the middle third of the oviduct, some in the 6- and some in the 8-cell stage. (Specimen F.D.A. 21/15. R.Z. 69¾ hours.) I.H.

PLATE VII.

Fig. 39. Section through part of the ovary of a ferret in the thirty-third day of œstrus, showing part of the wall of a large normal follicle and several degenerate follicles. $\times 40$. The animal was not inseminated, and insemination was not attempted. (Specimen F.G.A. 18/15. R.F. 32 days' œstrus.) E.

Fig. 40. Section through a portion of the ovum and the ovarian cumulus in the ovarian follicle of a ferret-polecat hybrid in the pro-œstrum. The nucleus of the ovum is placed peripherally, close against the oolemma; mitosis is taking place in two of the cells, which would have formed cells of the corona radiata, and the more peripheral cells of the cumulus are beginning to be separated from the more centrally placed cells by fluid-filled spaces. $\times 470$. (Specimen P.G.B. 1/15. L.Mx. Early pro-œstrum, not inseminated.) I.H.

Fig. 41. Section through a part of the ovum, the nucleus, and part of the corona radiata of the follicle ovum of a ferret 19¾ hours after insemination. $\times 1000$. The nuclear membrane is still quite distinct, and chromosomes have not yet formed. The nuclei of most of the corona radiata cells have begun to migrate

peripherally. Mitochondria are visible in the bodies of the cells of the corona radiata. (Specimen F. 1-2/08. 19 $\frac{3}{4}$ hours.) H.E.

Fig. 42. Section through the cumulus of an unruptured ovarian follicle of a ferret 27 $\frac{1}{2}$ hours after insemination. $\times 240$. Showing the peripheral migration of the nuclei of the cells of the corona radiata and the commencing dispersion of the more peripherally situated cumulus cells. The membrana interna is seen on the periphery of the cumulus. (Specimen F.G.A. 1/15. R.Z. 27 $\frac{1}{2}$ hours.) I.H.

Fig. 43. Section through part of the follicular ovum and the corona radiata of a ferret 41 $\frac{1}{2}$ hours after insemination. $\times 1000$. The peripheral extension of the cells of the corona radiata and the peripheral migration of their nuclei is practically completed. Mitochondria are visible in the cell bodies of the corona radiata cells. The nuclear membrane has almost entirely disappeared, and chromosomes have definitely formed. (Specimen F.G.A. 2/15. L.Z. 41 $\frac{1}{2}$ hours.) I.H.

Fig. 44. Section through the follicle ovum and the corona radiata of a ferret 30 $\frac{1}{2}$ hours after insemination. $\times 310$. The ovum is in the latter part of the anaphase of mitosis, and the typical arrangement of the cells of the corona radiata and their nuclei is well shown. (Specimen F.D. D/16. L.P.N.F. 30 $\frac{1}{2}$ hours.) I.H. O.G.

PLATE VIII.

Fig. 45. A portion of the ovum represented in fig. 47. $\times 1000$. Showing the structure of the corona radiata cells and some of the features of the protoplasm of the ovum.

Fig. 46. Section through the cranial end of the uterine cornu and a terminal fimbria of the oviduct of a ferret-polecat hybrid 31 $\frac{1}{2}$ hours after insemination, showing an ovum surrounded by its corona and a portion of the contents of the ovarian follicle escaping into the peritoneal cavity. $\times 19$. (Specimen P.D. C/16. L.Per. 31 $\frac{1}{2}$ hours.) I.H. O.G.

Fig. 47. The ovum shown in fig. 49. $\times 310$. Showing the second maturation spindle in the upper and left part of the body of the ovum and the arrangement of the cells, and nuclei of the corona radiata.

Fig. 48. Section of a portion of the wall of the ovarian follicle of a ferret-polecat hybrid at the commencement of the early pro-œstrum. $\times 300$. The portion of the wall shown in the figure is in the region of the ovarian cumulus. It demonstrates the arrangement of the follicle cells and their commencing dissemination, and shows the relationship of the blood-vessels to the external limiting membrane of the follicle. (Specimen P.G.B. 1/15. L.Mx.) I.H.

Fig. 49. Section of a portion of the wall of a ripe unruptured ovarian follicle of a ferret-polecat hybrid 31 $\frac{1}{2}$ hours after insemination. $\times 310$. The part of the wall seen in the figure is on the opposite side to the ovarian cumulus. The relation of the follicular cells to the blood-vessels and to the interstitial cells of the sheath of the follicle is seen. (Specimen P.D. C/16. L.Per. 31 $\frac{1}{2}$ hours.) I.H. O.G.

Fig. 50. Section through a portion of the wall of the unruptured follicle of a ferret 41 $\frac{1}{2}$ hours after insemination. $\times 300$. The ovum in the follicle was ripening. The section shows a stage of the invasion of the follicular epithelium by the blood-vessels. (Specimen F.G.A. 2/15. L.Z. 41 $\frac{1}{2}$ hours.) I.H.

Fig. 51. Section through a portion of the wall of a full-grown normal ovarian follicle of a ferret. $\times 800$. Showing the positions of the fat granules in the follicular cells and in some of the interstitial cells. (Specimen F.G.A. 18/15. R.Fl. 32 days' œstrus.)

PLATE IX.

Fig. 52. Section through a portion of the wall of a fully-grown ovarian follicle of a ferret. The animal was in full heat, and was killed six days after insemination had been unsuccessfully attempted. $\times 310$. The section shows an early stage in the formation of the internal limiting membrane, its connection with the follicle cells and with the reticulum of the primary liquor folliculi. It also shows the external limiting membrane and the relation of the latter to the blood-vessels. (Specimens F.Z.R. 1/14. Insemination unsuccessfully attempted.) I.H.

Fig. 53. Section through the ovarian cumulus of a fully-grown ovarian follicle of a ferret in full heat and not inseminated. $\times 310$. Showing the commencing formation of the internal limiting membrane on the surface of the cumulus. (Specimen F.D.A. 40/15. L.Z. 23 days post-partum in full heat.) I.H.

Fig. 54. Section through a portion of the wall of a fully-grown ovarian follicle. $\times 1000$. Showing

the expanded external ends of some of the follicle cells, the positions of the nuclei, and the structure of the cells. (Specimen F.D.A. 40/15. L.Z. 23 days post-partum in full heat.) I.H.

Fig. 55. Section through a portion of the wall of the ovarian follicle which contained the cumulus shown in fig. 53. $\times 310$. The section shows a more advanced stage in the formation of the internal limiting membrane on the wall of the follicle than that seen on the cumulus, and a distinctly more advanced stage than that depicted in fig. 54. (Specimen F.D.A. 40/15. L.Z. 23 days post-partum in full heat.) I.H.

Fig. 56. Section of a portion of the wall of a ripening ovarian follicle of a ferret killed $27\frac{1}{2}$ hours after insemination. $\times 310$. The section shows the arrangement of the follicle cells in the immediate neighbourhood of the ovarian cumulus, and the relationship of the very definite internal limiting membrane to the follicle cells. (Specimen F.G.A. 1/15. R.Z. $27\frac{1}{2}$ hours.) I.H.

Fig. 57. Section of a portion of the wall of a fully-grown ovarian follicle of a ferret. $\times 1000$. Showing the inclusion of degenerating follicular cells in the forming internal limiting membrane. (Specimen F.D.A. 40/15. L.Z. 23 days post-partum in full heat.) I.H.

PLATE X.

Fig. 58. Section through a portion of the wall of a fully-grown normal ovarian follicle of a ferret. $\times 1000$. Showing the structure of the cells and the relation of the external limiting membrane to the follicle cells and to the extra-follicular connective tissue. (Specimen F.Z.R. 1/14. Six days after unsuccessfully attempted insemination in full heat.) I.H.

Fig. 59. Section through a portion of the wall of a fully-grown normal ovarian follicle of a ferret. $\times 1000$. Showing strands of granules (mitochondria?) in the cells, the relation of the external ends of the cells to the external limiting membrane, and the relation of the external limiting membrane to the wall of a blood-vessel. (Specimen F.D.A. 40/15. L.Z. 23 days post-partum in full heat.) I.H.

Fig. 60. Section through a portion of the wall of a fully-grown normal ovarian follicle of a ferret. $\times 1000$. Showing the relation of the external limiting membrane to the outer ends of the follicle cells, to the extra-follicular connective-tissue cells, and to the wall of a blood-vessel. (Specimen F.D.A. 40/15. L.Z. 23 days post-partum and in full heat.) I.H.

Fig. 61. Section through the ovary of an anæstrus ferret. $\times 24$. Showing the relation of the cortex to the medulla, the spindle strands of the cortex, and the ovarian follicles. (Specimen F.Z.R.A. 5/14.) I.H.

Fig. 62. Section through a portion of the cortex of the ovary shown in fig. 61. $\times 340$. Showing the superficial epithelium, the tunica albuginea, a young follicle, spindle-cell strands, and interstitial cells. (Specimen F.2, R.A. 5/14.)

Fig. 63. Section of a portion of the cortex of the ovary of a ferret. $\times 340$. Showing spindle-cell strands of the cortex, young follicles, and interstitial cells. Compare with fig. 3, which is a section of an adjacent portion of the same ovary. (Specimen F.D. T/16. L.M.F. $123\frac{1}{2}$ hours.) I.H. O.G.

N O T E.

I AM indebted to the Carnegie Trust for a grant covering the cost of the plates accompanying this communication, and to the Moray Fund for grants for the purchase of some of the animals and materials used in the research.

A. R.

FIG. 5.

FIG. 1.

FIG. 4.

FIG. 2.

FIG. 3.

FIG. 4A.

FIG. 6.

FIG. 7.

Professor ARTHUR ROBINSON: "The Formation, Rupture, and Closure of Ovarian Follicles in Ferrets and Ferret-Polecat Hybrids, and some Associated Phenomena."—PLATE II.

FIG. 8.

FIG. 11.

FIG. 9.

FIG. 12.

FIG. 10.

FIG. 13.

Professor ARTHUR ROBINSON: "The Formation, Rupture, and Closure of Ovarian Follicles in Ferrets and Ferret-Polecat Hybrids, and some Associated Phenomena."—PLATE III.

FIG. 14.

FIG. 17.

FIG. 15.

FIG. 18.

FIG. 20.

FIG. 16.

FIG. 19.

Professor ARTHUR ROBINSON: "The Formation, Rupture, and Closure of Ovarian Follicles in Ferrets and Ferret-Polecat Hybrids, and some Associated Phenomena."—PLATE IV.

FIG. 26A.

FIG. 26B.

Professor ARTHUR ROBINSON: "The Formation, Rupture, and Closure of Ovarian Follicles in Ferrets and Ferret-Polecat Hybrids, and some Associated Phenomena."—PLATE V.

FIG. 27.

FIG. 27A.

FIG. 27B.

FIG. 27C.

FIG. 28.

FIG. 29.

FIG. 30.

Professor ARTHUR ROBINSON: "The Formation, Rupture, and Closure of Ovarian Follicles in Ferrets and Ferret-Polecat Hybrids, and some Associated Phenomena."—PLATE VI.

FIG. 40.

FIG. 39.

FIG. 41.

FIG. 43.

FIG. 42.

FIG. 44.

Professor ARTHUR ROBINSON: "The Formation, Rupture, and Closure of Ovarian Follicles in Ferrets and Ferret-Polecat Hybrids, and some Associated Phenomena."—PLATE VIII.

FIG. 45.

FIG. 49.

FIG. 46.

FIG. 47.

FIG. 51.

FIG. 48.

FIG. 50.

FIG. 52.

FIG. 55.

FIG. 53.

FIG. 56.

FIG. 54.

FIG. 57.

FIG. 58.

FIG. 60.

FIG. 59.

FIG. 62.

FIG. 61.

FIG. 63.