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HISTOLOGICAL STUDIES ON THE OVARIES OF SOWS I.
HISTOLOGICAL OBSERVATIONS ON THE FIVE GROUPS
OF STRUCTURES FOUND ON OVARIAN SURFACES
WITH SPECIAL REFERENCE TO
HEMATOXYLIN-EOSIN SECTION-PREPARATIONS

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INTRODUCTION

The writer has already reported the results of macroscopical observations on the various structures which were found on the ovarian surfaces in sows.

In the previous report these structures were classified into five groups, namely "turbid follicle", "white spot", "yellow spot", "normal follicle" and "corpus luteum". The turbid follicles were also divided into white and dark-red ones by the colors of the turbid areas. The former seemed to correspond to the features of the early stage of cystic atretic follicles, and the latter to those of atretic follicles with hemorrhage in the cavity. The majority of white spots, which were generally much smaller than other structures, were considered to have originated from atretic follicles, some of them from corpora lutea. The majority of yellow spots seemed to be derived from corpora lutea of non-pregnancy, and only a few of them from atretic follicles. On the other hand, the reddish-yellow spots were considered to be derived from corpora lutea of past pregnancy.

However, these results should be confirmed by histological investigations. In this paper the results of the histological investigations of the structures of the above-mentioned five groups with special reference to H.-E. section preparations are described.

MATERIALS AND METHODS

Materials for this research were collected from sows, which were not actually in any conditions of pregnancy, at the slaughter-house in Sapporo, Japan. Accordingly, the age, the number of repetitions of parturition and so on were not known exactly.

The five different groups of structures found on the surfaces of fresh organs were divided again respectively into many subgroups according to the findings of the macroscopical observations. The fresh materials were left in 10% formalin for about one week. After fixing, their previously marked structures were cut off respectively or in the small groups with some surrounding tissues. As a routine matter, the specimens were embedded

in paraffin, sectioned 5 to 8 μ in thickness, and stained with hematoxylin-eosin.

The total number of the objects observed in each group of the structures mentioned above is indicated in table 1.

TABLE 1. *Total Numbers of Five Groups of Structures Used in These Observations*

STRUCTURE	TOTAL
Follicle	182
Turbid follicle	77
White spot	64
Corpus luteum	124
Yellow spot	76

FINDINGS

I. Cellular Elements Found in Follicle Cavities

There were various cellular elements in the cavities of ovarian follicles and various structures originated from the follicles. The present writer classified them into two main groups, the large and the small cells.

The large cells, of about 14 to 24 μ diameter, were round, ellipsoid-, bean- or irregular-shaped with an eccentric, spherical nucleus each. Their cytoplasm was finely granulated. Their nucleus was deeply stained, but the chromatin content was few.

The group of large cells was subdivided into two subgroups. Ones with a relatively normal nucleus were called "large, normal epitheloid cells" (E.Z.), and others with various sorts of degenerated nucleus (pynosis, karyolysis, karyorrhesis and so on) "large, degenerated epitheloid cells" (D.E.Z.).

Each subgroup of cells was divided into 4 types according to the findings on their cytoplasm: the "finely granulated cells" (E.Z. I and D.E.Z. I), the "cells with vacuoles" (E.Z. II and D.E.Z. II), the "phagocytic cells" (E.Z. III and D.E.Z. III) and the "phagocytic cells with vacuoles" (E.Z. IV and D.E.Z. IV).

The group of small cells was subdivided into two subgroups; ones with various sorts of degenerated nucleus were called "small degenerated epitheloid cells" (L.Z.), and others originated probably from the blood cells "hematocytic cells" (H.Z.). Moreover, the former was further divided into two types: the cells with a degenerated nucleus in finely granulated cytoplasm (L.Z. I) and those with a pynotic nucleus, without any cytoplasm (L.Z. II). The cells of type H.Z. were likewise divided into two types: (a) cells possessing the nature of neutrophilic leucocytes containing a segmented nucleus and slight eosinophilic granules in cytoplasm (H.Z. I) and (b) cells with the nature of eosinophilic leucocytes containing an eccentric, elliptic nucleus and eosinophilic granules in the cytoplasm (H.Z. II).

II. Findings on the Ovarian Follicles

By the histological observations of the so-called "ovarian follicles" which were considered

as normal macroscopically, they were divided into two groups. Namely, one group had various cellular elements in their cavity and the other group had no cellular elements in their cavity. The present writer called the latter "follicles of group 1" (F.), and former "follicles of group 2" (Fa.).

1) Follicles of group 1 (F.)

For convenience, the 90 follicles of this group were classified into 6 types by the various structures of their walls.

Type F. I: The 23 follicles of this type were about 1.0 to 1.9 mm in diameter, with a large follicular cavity which was filled by liquor folliculi stained slightly with eosin. In the granulosa layer of about 70 to 100 μ in thickness the cells were arranged in 6 to 9 layers. The cells of the granulosa layer were 5 to 7 \times 8 to 12 μ in size. Their cytoplasm with a round, dark nucleus was finely granulated. Mitoses were frequently found in this layer. The two layers of theca folliculi (the theca interna and the theca externa) could be differentiated clearly. The theca interna was composed of compact, 6 to 8 cell layers. They were about 4 to 6 \times 7 to 11 μ in size, ellipsoid in shape, with finely granulated cytoplasm, and their nucleus was round or ellipsoid in shape, with relatively poor chromatin. Many mitotic figures were found in the cells of this layer. Although the blood capillaries were developed fully in this layer, no sign of vascular dilatation was found there. The theca externa was composed of somewhat compact, concentric spindle-shaped connective tissue cells, which were scarcely distinguishable from the surrounding stroma cells. A few arterioles and venules were found in this layer.

Type F. II: The follicles were 17 in number, and about 1.4 to 3.9 mm in diameter. The appearance of the granulosa layer was similar to that of the next preceding type, but the theca interna of about 50 to 80 μ thickness was somewhat thicker. The irregularly round or polygonal cells of the theca interna were about 6 to 10 \times 8 to 13 μ in size, containing a few fine vacuoles in the cytoplasm. The theca interna with many, somewhat dilated blood capillaries containing a large amount of red blood corpuscles showed a slight hyperemic condition.

Type F. III: The 16 follicles of this type were about 2.3 to 5.5 mm in diameter. The granulosa layer was similar to that of type F. I. The theca interna of about 40 to 70 μ thickness was slightly thinner than that of type F. II. The cells of the theca interna were similar to those of the type F. II, but cell layers were 4 to 6 being somewhat fewer. Mitotic figures were few in both the granulosa layer and the theca interna. There were found somewhat distinct dilatation and hyperemia in capillaries of the theca interna, especially in those found under the granulosa layer.

Type F. IV: These 6 follicles were 3.9 to 6.8 mm in diameter. A few cells in the superficial layers of the granulosa were desquamated from the follicle walls, but these cells were seen situated at the periphery of the follicle cavity. The theca interna were 30 to 50 μ in thickness, being thinner than in type F. III. In this theca the cells were arranged in 3 to 5 layers. The theca interna cells, of 9 to 11 \times 9 to 15 μ in size, presented very conspicuous appearance. In many cells there were seen one or two coarse vacuoles in the cytoplasm. The capillaries at the boundary between the theca interna and the granulosa layer dilated remarkably with cavities full of blood.

Type F. V: These 24 follicles were 4.1 to 7.4 mm in diameter. The striking features of these follicles were the appearance of partial small plica-like folds of the theca interna accompanied with wavings of the surfaces of the granulosa layer. Although the granulosa layers at the parts in contact with the folds of the theca interna were arranged closely, the layers at other parts were loose in arrangement. The theca interna which was 20 to 40 μ in thickness and consisted of 2 to 4 cell layers, diminished in thickness and number of cell layers compared with type F. IV. However the cells of the theca interna were very large, 10 to 15 \times 15 to 20 μ in size, and became the predominant components on the walls of these follicles. Further, in many cells of the theca interna of this type there were found several large vacuoles in the cytoplasm. Mitoses were seldom seen in either the theca interna or the granulosa. The remarkably distended capillaries between the theca interna and the granulosa were full of blood. Such findings especially conspicuous at the folds of the theca interna.

Type F. VI: The follicles were only 4 in number, and 6.1 to 12.0 mm in diameter. The plica-like folds of the theca interna were extremely conspicuous in the follicles of this type. Therefore the surfaces of the granulosa layer showed strong wavings, and the numerous cells of the granulosa were desquamated from the follicle walls into the cavity. The granulosa cells were 7 to 9 \times 9 to 14 μ in size, and were larger than those of type F. V. Mitoses in the cells of the granulosa were not seen. Although the features of the theca interna were similar to those of type F. V, the extremely distended capillaries of this theca seemed like the sinusoid capillary. These hyperemic capillaries were especially remarkable at the boundary to the granulosa layer. Mitoses in the theca interna were rare.

2) Follicles of group 2 (Fa.)

The 92 follicles were subdivided into 6 types.

Type Fa. I: The follicles were 46 in number, and 1.0 to 5.8 mm in diameter. The structures were similar to those of types F. I to IV of group 1. But in the follicles of this type, a few L.Z. I and II cells appeared at the periphery of the cavity or even among the granulosa cells.

Type Fa. II: The 8 follicles were 1.1 to 7.7 mm in diameter. In some follicles many L.Z. I and II cells appeared in the periphery of the follicle cavity, and a few similar cells appeared in the granulosa layer; in other follicles many similar cells appeared in the granulosa layer, while a few similar cells appeared in the periphery of the cavity. In the granulosa layer the cells were arranged in 4 to 7 layers, which were thinner than those of type Fa. I. Although the theca interna was similar to that of types F. I to III of group 1, the dilatation and hyperemia of the capillaries in this theca were slighter than those of group 1.

Type Fa. III: The follicles were 34 in number and 1.0 to 6.3 mm in diameter. In some follicles many L.Z. I and II cells were seen in a few large masses at the periphery of the follicle cavity; in others the normal cells of the granulosa remained in 1 to 5 layers, containing numerous L.Z. I and II cells among them, but H.Z. I cells were found only in small number among them.

Type Fa. IV: The follicle of this type was only one; it was 3.1 mm in diameter.

These were no normal cells in the granulosa layer of this follicle. L.Z. cells took the places of granulosa cells. The features of the theca interna were similar to those of type F. IV of group 1. But dilatation and hyperemia of capillaries were not observed there.

Type Fa. V: There was also only one; it was 1.5 mm in diameter. The normal granulosa cells disappeared entirely. In addition to the numerous L.Z. and H.Z. cells, there were many I and II cells of E.Z. and D.E.Z. types and a few III and IV cells of E.Z. and D.E.Z. types appeared in the follicle cavity. The structures of the follicle walls also differed much from those of type Fa. IV. There were appearances of three different structures in layers which the writer has provisionally named the "yellow body-like tissue", the "hyaline layer" and the "radial layer". The "yellow body-like tissue" appeared as the thin layer composed of loose and irregularly arranged 2 to 3 cell layers, partially along the inner wall. The cells of this layer were spindle- or stellate-shaped with long processes. They were connected together by their processes, forming large networks. In the meshes of these networks there were seen large round cells. The features of these large cells were similar to those of E.Z. I or II cells. Capillaries were not observed in this layer. The thin "hyaline layer" staining pale red with eosin was immediately adjacent to the inner "yellow body-like tissue", enveloping the follicle cavity completely. The "radial layer" was thicker and adherent outside to the "hyaline layer" in the part where the "yellow body-like tissue" was observed. This layer was composed mainly of spindle-shaped cells which were arranged radially around the follicle wall. There was no distinct demarcation between this layer and the ordinary ovarian stroma. Therefore in such part showing such regression it was difficult to distinguish the theca interna from the theca externa. However, in the parts lacking the "yellow body-like tissue" it was still easy to distinguish the two layers in the theca. But the theca interna of this type differed from that of type Fa. IV; that is to say, the theca interna cells decreased in number, on the other hand the spindle-shaped cells increased. These spindle-shaped cells were closely packed together and their long diameter ran parallel to the follicle wall.

Type Fa. VI: The follicles of this type were only two in number; they were 1.0 and 1.2 mm in diameter. In these follicles a few cells of E.D., D.E.Z., L.Z. and H.Z. types scattered in the small follicle cavity. The I and II cells of the E.Z. and the D.E.Z. types were predominant, while the III and IV cells were very few. The "yellow body-like tissue" was thicker than that of type Fa. V, composed of 6 to 8 layers of large round cells; such tissue was observed on the entire wall of these two follicles. A few capillaries were found in this tissue. The "hyaline layer" was also thicker than in type Fa. V, and contained a few cells with a various degenerated nucleus and nuclear fragments. The "radial layer" was also thicker, and surrounded the follicle wall.

It was apparent that conspicuous differences were found between type Fa. IV and type Fa. V follicles. In the follicles of the types Fa. I to IV only small epitheloid cells appeared in the follicle cavity, but in the types Fa. V and VI large epitheloid cells appeared in addition to the small epitheloid ones. At the same time, in the follicles of types Fa. V and VI, the three layers of the "yellow body-like tissue", the "hyaline layer" and the "radial layer" appeared in the follicle wall.

3) The comparisons between the macroscopical findings and the histological types of follicles are set out in table 2.

TABLE 2. *Comparison between Macroscopical Findings and Histological Typing of Follicles*

COLOR	BLOOD VESSEL	TOTAL	TYPES OF FOLLICLES OF GROUP 1 (F.)						TYPES OF FOLLICLES OF GROUP 2 (Fa.)					
			I	II	III	IV	V	VI	I	II	III	IV	V	VI
Grayish- white	--	25	4	2		1			4	1	9	1	1	2
	+	8				3		1		4				
Light- grayish- yellow	--	50	19	12					14	1	4			
	+	61		3	6	5	8		25	2	12			
	++	22			8		7		1	1	5			
Light-red	++	16			2		6	4	1	3				
Total		182	23	17	16	6	24	4	46	8	34	1	1	2

In the follicles of group 1 the majority of the grayish-white and the light-grayish-yellow follicles without blood vessels on their surfaces in macroscopical observations were included in type F. I or II, excepting a few. All of the grayish-white, light-grayish-yellow and light-red follicles, each of which showed + or ++ degree of development of blood vessels of the follicle surfaces, fell into types F. II to VI. It is noteworthy that the majority of the light-red follicles comprised in type F. V or VI.

Among the follicles of group 2 the greatest part of grayish-white, grayish-yellow and light-red follicles, in spite of the varied development of the blood vessels of their surfaces, were comprised in types Fa. I to III. It is noteworthy that the grayish-white follicles of group 2 were more numerous than those of group 1. All of the follicles of types Fa. IV to VI were grayish-white, and had no blood vessels on their surfaces.

III. Findings on the So-called "Turbid Follicles"

1) White turbid follicles (Ft.)

The white turbid follicles were subdivided into 6 types according to the structures of their walls, as follows.

Type Ft. I: These follicles numbered 14, 1.5 to 5.1 mm in diameter, and were similar to the follicles of type Fa. III of group 2.

Type Ft. II: The 6 follicles were 1.8 to 4.5 mm in diameter, and similar to the follicles of type Fa. IV of group 2.

Type Ft. III: The 25 follicles were 1.4 to 5.0 mm in diameter. The cavities of these follicles were full of the various cells of L.Z., H.Z., E.Z. and D.E.Z. types. The L.Z. and the H.Z. cells were in the majority. The majority of the E.Z. cells were type I. The D.E.Z. cells were very few. All large epitheloid cells were seen at the periphery of the cavity. The features of the theca interna were almost like those of type Ft. II. But in this type a few small arterioles were seen to penetrate from the theca externa into the theca interna.

Type Ft. IV: The 8 follicles were 2.2 to 3.2 mm in diameter. Various cellular elements were seen within the cavity of this type. Small degenerated epitheloid cells (L.Z. and H.Z.) were fewer than in type Ft. III. On the other hand large epitheloid cells (E.Z. and D.E.Z.) were more numerous throughout the cavity. A few E.Z. I or II cells were found to protrude from the walls into the cavity just like a rosary. All cells of the theca interna were hypertrophic, and similar appearance to E.Z. I or II cells found at the periphery of the cavity. Mitoses were rare in the theca interna.

Type Ft. V: The 15 follicles were 1.4 to 3.5 mm in diameter and similar to the follicles of type Fa. V of group 2.

Type Ft. VI: The 3 follicles were 1.0 to 2.1 mm in diameter and similar to the follicles of type Fa. VI of group 2.

To briefly summarize, it is remarkable that E.Z. and D.E.Z. cells appear in the follicle cavity of types Ft. III to VI. Also it is especially noteworthy that all the three layers of the "yellow body-like tissue", the "hyaline layer" and the "radial layer" are not found in the follicle walls of types Ft. III and IV. According to these facts the present writer concluded that the follicles of types Ft. III and IV should be situated between types Ft. II and Ft. V in the series of atresia.

2) Comparisons between the macroscopical findings and the histological types of white turbid follicles are set out in table 3.

TABLE 3. *Comparison between Macroscopical Findings and Histological Typing of White Turbid Follicles*

FORM OF TURBID AREA	COLOR OF FOLLICLE	TOTAL	TYPES (Ft.)					
			I	II	III	IV	V	VI
Spotted	Grayish-white	28	4		10	7	7	
	Light-grayish-yellow	19	9	1	7		2	
Circular	Grayish-white	4			2		2	
	Light-grayish-yellow	2			1		1	
Diffuse	Grayish-white	18	1	5	5	1	3	3
Total		71	14	6	25	8	15	3

No clear correlations were found between the two.

3) Dark-red turbid follicles (Fst.)

The turbid follicles of this group were only 6; they were subdivided into 3 types, as follows.

Type Fst. I: There was only one follicle of this type; it was 1.9 mm in diameter. In this follicle in addition to a few L.Z. cells scattered at the periphery of the cavity, numerous erythrocytes were found throughout the cavity. The granulosa layer, which

was 6 to 9 layers of cells, was similar to that of type Fa. I of the group 2 follicles. Among the normal cells of the granulosa in this type the L.Z. cells were more numerous than those in type Fa. I. The theca interna also resembled that of type Fa. I. But the dilatation and the hyperemia of capillaries in the theca interna were especially conspicuous in this one Fst. I follicle. Moreover extravascular erythrocytes were seen in the theca interna.

Type Fst. II: The follicles of this type numbered only two; they were respectively 3.3 and 4.5 mm in diameter. The most striking feature was that the follicle cavity was full of erythrocytes. Moreover a few L.Z., H.Z. and E.Z. cells were seen among the erythrocytes. The granulosa layer had disappeared completely. The theca interna was similar to that of type Ft. III of white turbid follicles, but the dilatation and the hyperemia of capillaries were more conspicuous than those of that type. Remarkable extravascular erythrocytes were seen throughout the theca interna.

Type Fst. III: The follicles were 3 in number, 2.2 to 2.6 mm in diameter. In this type the erythrocytes were found in the follicle cavity as in type Fst. II. Among them, in addition to many L.Z., H.Z. and E.Z., a few D.E.Z. cells were found. The "yellow body-like tissue" and the "hyaline layer" were developed at a part of the follicle wall. Such findings resembled those of type Ft. V of the white turbid follicles.

To summarize, the dark-red turbid follicles resembled the white turbid follicles, except for the large amount of blood cells in the follicle cavity.

4) The comparison between the macroscopical findings and the histological types of the dark-red turbid follicles is set out in table 4.

TABLE 4. *Comparison between Macroscopical Findings and Histological Typing of Dark-red Turbid Follicles*

FORM OF TURBID AREA	COLOR OF FOLLICLE	TOTAL	TYPES (Fst.)		
			I	II	III
Spotted	Grayish-white	0			
	Light-grayish-yellow	1	1		
Diffuse	Dark-red	5		2	3
Total		6	1	2	3

The light-grayish-yellow follicle which had spotted dark-red turbid areas was placed in type Fst. I, and the others which had a diffuse, dark-red turbid area throughout the cavity were placed type Fst. II or III.

IV. Findings on the So-called "White Spots" (W.)

1) White spots were subdivided into 5 types, as follows.

Type W. I: The 12 white spots of this type were 0.4 to 2.4 mm in diameter, and were similar to type Ft. IV of white turbid follicles.

Type W. II: This type numbered only two, and their diameter were 1.0 and 1.2 mm.

Although they resembled type Ft. V of the white turbid follicles, the III and IV cells of E.Z. and D.E.Z. in these cavity were more numerous than those of type Ft. V. The "yellow body-like tissue" was composed of 5 to 6 cell layers. The "hyaline layer" was thicker. The "radial layer" occupied a half of the wall.

Type W. III: The 24 spots were 0.2 to 1.5 mm in diameter. They had a small and irregular-shaped space in the center. A few L.Z. I, L.Z. II, E.Z. I and D.E.Z. I cells were found in the space. Markedly developed "yellow body-like tissue", which was penetrated by capillaries, was observed. The thicker "hyaline layer" and the "radial layer" were seen outside the "yellow body-like tissue".

Type W. IV: The 20 spots were 0.5 to 1.8 mm in diameter. Instead of the central space there was seen "yellow body-like tissue". The large epitheloid cells of this tissue were less numerous than those of type W. III; cells with a various degenerated nucleus were predominant. The capillaries were not found in this tissue. The particularly thick "hyaline layer" did not show clear-cut boundary with the "radial layer". The "radial layer" of this type was rather thinner than that of type W. III.

Type W. V: The 6 spots were 0.4 to 1.2 mm in diameter. This type resembled the next preceding type. But the large epitheloid cells were fewer in the "yellow body-like tissue". The irregularly arranged spindle-shaped cells were rather predominant.

To summarize, the types W. I and II resemble the white turbid follicles, on the other hand types W. III to V were scar-like tissues.

2) The comparisons between the macroscopical findings and the histological types of white spots are set out in table 5.

TABLE 5. *Comparison between Macroscopical Findings and Histological Typing of White Spots*

APPEARANCE	DEMARICATION	TOTAL	TYPES (W.)				
			I	II	III	IV	V
Granular	{ Certain	16	12	1	3		
	{ Uncertain	15		1	7	4	3
Diffuse	{ Certain	4				4	
	{ Uncertain	29			14	12	3
Total		64	12	2	24	20	6

The majority of the white spots which showed granular appearances and the clear-cut demarcations from the surrounding tissues were comprised in types W. I or II, and many white spots which showed granular or diffuse appearances without clear-cut demarcations to the surrounding tissues were comprised in types W. III to V.

V. Findings of Corpora Lutea

The 124 specimens of the corpora lutea were classified into two groups histologically; the one group those with a small, well organized central cavity (110/124) and the other

group those with an extremely large central cavity full of a great amount of fluid (14/124). The present writer designated the former as the "corpora lutea of group 1" (L.) and the latter as the "corpora lutea of group 2" (L.).

1) Corpora lutea of group 1 (L.)

The corpora lutea specimens of this group were subdivided into 8 types according to the various features of the lutein cell layers, as follows.

Type L. I: The corpora of this type were 6 in number, and 3.3 to 7.3 mm in diameter. Two kinds of the lutein cell layers, inner (inner layer) and outer (outer layer), were distinguished clearly. In this type the narrow outer layer situated in contact with the capsule; at several parts it swelled up to make plica-like folds. The thicker inner layer covered over the plica-like folds of the outer layer. The demarcation between these two layers was clear. The rounded or irregular polygonal cells (outer cells) of the outer layer were 16 to 20×24 to 40 μ in size, and showed a clear outline of cell bodies. Their cytoplasm was pale-stained, and contained vacuoles of various sizes in the peripheral portions. The typical large, elliptic or round nucleus with coarser chromatin nets was about 8 μ in diameter, being about one-third of the cell volume. Moreover many spindle-shaped connective-tissue cells were found around the outer cells in this layer. In the inner layer, on the other hand, the cells (inner cells) were rod, elliptical or irregularly polygonal in shape, 16 to 20×16 to 24 μ in size, and smaller than the outer cells. They had abundant, weakly stained basophilic cytoplasm. Some cells had a large vacuole in the periphery of the cytoplasm. The nuclei had a diameter of 6 to 8 μ , were spindle, elliptical or spherical in shape, densely stained, and contained coarse chromatin nets. Between the inner and the outer layers, a few spindle-shaped connective-tissue cells were found. Moreover a few connective-tissue cells extended to near the inner surfaces of the folded inner layer. Many of the capillaries, markedly dilated and full of erythrocytes, were found in the outer layer. Such conditions were especially conspicuous at the demarcation between the outer and the inner layers. On the other hand, the penetrating pictures of the capillaries into the inner layer were very inconspicuous.

Type L. II: The 11 corpora of this type were 4.1 to 7.9 mm in diameter. In these corpora the two lutein cell layers could be still distinguished clearly, but the demarcation between them was indistinct. The folds of the outer layer were higher but thinner than those of the preceding type. At the base of the folds there were often found triangular masses composed purely of the outer cells. These outer cells were similar to those of the preceding type, being a little smaller, 16 to 24×24 to 32 μ in size. On the other hand, the inner cells were 16 to 24×16 to 32 μ in size, being larger than those of the preceding type. Many of the inner cells contained large vacuoles in their cytoplasm. There were many connective-tissue cells intermixed in the inner layer. The dilatation and the hyperemia of capillaries were extremely conspicuous in the outer layer. Remarkable, extravascular erythrocytes were seen at the demarcation between the two lutein cell layers. Many capillaries invaded the deeper layers of the inner layer. In this type a few arterioles appeared at the base of the folds.

Type L. III: The 10 corpora of this type had a diameter of 6.4 to 10.1 mm. In the deeper layers of the wall it was difficult to differentiate the outer layer from the inner.

But at the bases of the folds the outer cells were found to group into triangular masses. The outer cells were smaller than those of type L. II. One could find these small outer cells with vacuoles of various sizes in the cytoplasm mixed among the large inner cells severally or in groups. The inner cells were 24 to 32×28 to 40μ in size. Many of them had large vacuoles, a few of which contained one or two spherical, light red staining hyaline substances nearly equal in size to an erythrocyte. The connective-tissue cells became increasingly numerous in the inner layer. The capillaries developed well, but the dilatation and hyperemia were slighter than those of type L. II. A few arterioles were found in the deep layer of the wall of these corpora.

Type L. IV: These 15 corpora were 3.5 to 8.4 mm in diameter. The outer cells in small masses were found adjacent to the small blood vessels under the capsule. Also it was difficult to find them since they were scattered among the large inner cells in the deeper layers. They were nearly equal in size to those of type L. III, but only a few cells contained large vacuoles. On the other hand the large inner cells were also nearly equal in size to those of type L. III. Their nuclei had a diameter of about 10μ , and was lighter in staining. Their cytoplasm was poor, being finely granular and dense deep in staining. The majority of the inner cells contained a very large vacuole, which included one or more hyaline substances. Capillaries developed remarkably throughout the wall, surrounding each lutein cell. Also arterioles were found near the central cavity.

Type L. V: The 16 corpora in this type had a diameter of 6.3 to 9.9 mm. They showed relatively clear lobular structures. The outer layers composed of a few outer cells under the capsule, or the outer cells seen severally in superficial layer were few, and it were exceedingly difficult to find the outer cells in the deep layers. The majority of the inner cells were nearly equal in size to those of type L. IV, but the number of cells with various sized vacuoles containing hyaline substances was much decreased. In this (L. V) type there were found a few shrunken cells with nuclei in various phases of degeneration scattered throughout the wall. The dilatation of the capillaries around the inner cells decreased greatly in comparison with type L. IV.

Type L. VI: The 4 corpora were 6.5 to 8.0 mm in diameter. The lobular structures were more clear on account of the existence of more developed interstitial connective tissue. In this type the outer cells were rare. The inner cells showed 20 to 28×28 to 40μ in size and were smaller than those of type L. V. They had exceedingly clear-cut cellular outlines. Their cytoplasm was rich, containing a few small, peripheral vacuoles. Also many cells with pycnotic or degenerated nuclei appeared crowding around the inner cells. In addition, a few leucocytes were seen, severally or in small masses.

Type L. VII: The 35 corpora of this type showed 4.1 to 3.9 mm in diameter. In this type the lobular structures were inconspicuous. Also the outer cells could not distinguish from the inner cells. A few normal lutein cells were 16 to 24×20 to 32μ in size, smaller than those of type L. VI. In the numerous lutein cells with nuclei in various phases of degeneration, there were found large globular spaces similar to fat globules. Also there was an increased number of connective-tissue cells around the degenerated lutein cells. A few capillaries appeared to be collapsed.

Type L. VIII: These 13 corpora were 1.8 to 4.7 mm in diameter. The few normal

lutein cells were 12 to 20×16 to 28 μ in size. The corpora of this type had a uniform homogeneous appearance due to hyaline changes of the connective tissue. A few degenerated lutein cells had large vacuoles which filled up the cytoplasm areas almost entirely. Many capillaries were collapsed. In the deep layers, the walls of the small arterioles showed the same hyaline changes as the surrounding connective tissue. On the other hand, the relatively large arterioles under the capsule showed no degenerative changes.

To summarize, there were two kinds of lutein cell layers in the corpora of types L. I to V of group 1. In the corpora of type L. VI only a few outer lutein cells were seen severally throughout the entire organ. It was very difficult to find outer lutein cells in the corpora of type L. VII. In the corpora of types L. V to VIII degenerated lutein cells were observed. Moreover in the corpora of type L. VI, leucocytes were clearly distinguished. In the type L. VIII the hyaline changes of the interstitial connective tissue and the walls of the small arterioles in deep layers were distinctly proved.

2) Corpora lutea of group 2 (l.)

The corpora lutea of this group numbered only 14. They contained markedly large, non-organized central cavity, which occupied more than one-third of the entire bulk of each corpus luteum, and were full of blood or serous fluids. However the structures of the wall in the corpora of this group resembled the structures of corpora lutea of group 1.

The corpora of this group were subdivided into 6 types from type l. I to VI. The

TABLE 6. *Comparison between Macroscopical Findings and Histological Typing of Corpora Lutea*

COLOR	RUPTURE WOUND	TOTAL	TYPES OF CORPORA LUTEA OF GROUP 1 (L.)								TYPES OF CORPORA LUTEA OF GROUP 2 (l.)					
			I	II	III	IV	V	VI	VII	VIII	I	II	III	IV	V	VI
Dark-red	{ ++	0														
	{ ++	0														
Black-red	{ ++	2										2				
	{ ++	7		7												
	{ +	5		4										1		
Light-red	{ ++	3	3													
	{ ++	5	3								2					
Yellowish- red	{ ++	5				2							3			
	{ +	5			1				2				1		1	
	{ -	55			9	13	16	4	11				1	1		
Light-yellow	{ +	3							3							
	{ -	24							18	6						
Dark-yellow	{ +	1							1							
	{ -	9								7						2
Total		124	6	11	10	15	16	4	35	13	2	2	6	1	1	2

pictures of the corpora lutea of group 2 corresponded to these of corpora lutea of group 1 as follows: l. I to L. I, l. II to L. II, l. III to L. III, l. IV to L. V, l. V to L. VII and l. VI to L. VIII. In the corpora of types l. IV, V and VI, there was found loose fibrous tissue along the wall of the central cavity.

3) Comparisons between macroscopical findings and histological types of corpora lutea are set out in table 6.

In the corpora lutea of group 1, the reddish-toned corpora with distinct rupture wounds showing the latest ovulation belonged to types L. I and II. On the other hand, the yellowish-toned corpora were properly comprised in types L. VII and VIII. Many yellowish-red-toned corpora showed intermediate states, and were comprised in types L. III to VI.

VI. Findings on the So-called "Yellow Spots"

The present writer differentiated the yellow spots into three groups on the basis of histological findings. One group of the yellow spots had a few, strongly degenerated blood vessels, whilst the other group had numerous blood vessels with a slight degeneration. The writer designated the former as "yellow spots of group 1" (G.), and the latter as "yellow spots of group 2" (g.). Further, only one yellow spot was found to be similar to the white spots. The writer designated it as "yellow spot of group 3" (B.).

1) Yellow spots of group 1 (G.)

The yellow spots of this group were subdivided into 4 types, as follows.

Type G. I: Three yellow spots were 2.8 to 5.6 mm in diameter. These were similar to those of type L. VII in the corpora lutea of group 1.

Type G. II: Twelve spots were 3.0 to 5.6 mm in diameter. There were similar to those of type L. VIII.

Type G. III: Nineteen spots were 1.7 to 5.6 mm in diameter. Hyaline degeneration was predominant in this type. The much of the connective tissues between the capsule and the central fibrous core were affected. No intact lutein cells remained. There were numerous small fork-like spaces or slits. All the capillaries were collapsed. A few small arterioles with remarkable hyaline degeneration of walls were seen.

Type G. IV: Twenty-seven spots were 1.0 to 3.9 mm in diameter. The entire spot was a mass of hyaline substances. A few heavily degenerated lutein cells and small fork-like spaces or slits were found throughout this spot. Even the central fibrous core indicated the appearances of greater hyaline degeneration. No normal arterioles remained.

To sum up, the types G. I and II were to be treated in the category of the corpus luteum. The types G. III and IV showed relatively conspicuous hyaline degenerated changes in the interstitial tissue. Therefore the present writer has designated those as "hyaline bodies".

2) Yellow spots of group 2 (g.)

The yellow spots of this group were subdivided into 3 types, as follows.

Type g. I: Five spots were 3.3 to 4.3 mm in diameter. The most striking feature in these spots was the appearance of many, tortuous blood vessels, especially arterioles, throughout the entire organ, many of which were nearly normal and engorged with blood; a few showed various degrees of hyaline changes in the wall. Moreover the interstitial

connective tissues showed almost the same hyaline changes as those of type L. VIII of corpora lutea of group 1. But the cellular elements were more numerous than those of the type L. VIII. Most of them contained a large vacuole in the cytoplasm with degenerated nuclei of various grades.

Type g. II: Seven spots were 1.4 to 3.3 mm in diameter. In this type many relatively normal blood vessels appeared throughout the entire organ like type g. I. However other features were similar to type G. II of yellow spot of group 1.

Type g. III: Only two spots were 1.8 and 2.8 mm in diameter. In this type the entire organ were filled with various sized, tortuous arterioles which seemed to be almost normal. Although a few arterioles were already collapsed, many had narrow cavities engorged moderately with blood. Around these arterioles small amounts of loose fibrous connective tissue had developed. Partially hyaline substances appeared in small masses.

To sum up, it was characteristic that the yellow spots of group 2 contained many, almost normal, convoluted blood vessels as if they were "bodies of the arteriole-complex". For this reason the present writer designated them as the "vascular bodies" against the "hyaline bodies" mentioned above.

3) Yellow spot of group 3 (B.)

Type B. I: The yellow spot was only one; it was 1.7 mm in diameter. This spot was similar to type W. IV of white spots mentioned above. However in this spot there were seen many capillaries and pigment cells, which were not found in the white spots, in the "yellow body-like tissue". The "hyaline layer" around this tissue was rather slight in

TABLE 7. *Comparison between Macroscopical Findings and Histological Typing of Yellow Spots*

COLOR	APPEAR- ANCE	TOTAL	TYPES OF YELLOW SPOTS OF GROUP 1 (G.)				TYPES OF YELLOW SPOTS OF GROUP 2 (g.)			TYPE OF YELLOW SPOT OF GROUP 3 (b.)
			I	II	III	IV	I	II	III	I
Dark-reddish- yellow	{ Granular	0								
	{ Diffuse	12					5	7		
Light-reddish- yellow	{ Granular	0								
	{ Diffuse	0								
Light-yellow	{ Granular	14	2	10		2				
	{ Diffuse	1		1						
Dark-yellow	{ Granular	0								
	{ Diffuse	28	1	1	13	13				
Light-brown	{ Granular	0								
	{ Diffuse	14			4	9				1
Dark-brown	{ Granular	0								
	{ Diffuse	7			2	3			2	
Total		76	3	12	19	27	5	7	2	1

development.

4) Comparisons between the macroscopical findings and the histological types of yellow spots.

In this research, in the yellow spots of group 1 reddish-yellow-toned ones were found. The yellow-toned spots were comprised in types G. I to IV, and the majority of yellow spots with dense deep yellow-toned and all brown-toned spots were comprised in types G. III and IV.

In the yellow spots of group 2, there were no yellow-toned spots. The reddish-yellow-toned spots were placed in type g. I or II, and brown-toned ones type g. III.

The yellow spot of group 3 was light-brown and showed diffuse appearance macroscopically.

DISCUSSION

The present writer undertook to settle still unsolved problems on the various structures of the ovaries of sows. For this purpose his tentatively-named five groups of macroscopical structures were investigated histologically.

Normal follicles: Out of 182 macroscopic normal follicles 90 follicles with no histological abnormality were designated as the "follicles of group 1" (F.), and subdivided into 6 types.

The follicles from the types F. I to IV correspond well with the "growing follicles" described by CLARK.

Up to this time the maturity of follicles has been judged by the ovum formed the first polar body and the spindle for the second. CORNER⁸⁾ stated that the formation of the polar body was not always the basis for accurate judgement on the ripeness of follicles, since they were often found in the initial stages of atretic follicles as FLEMMING had pointed out. If the large follicles remove from the animals during heat contain a normal ovum in process of maturing, they are thought to be normal and mature (CORNER).⁸⁾ The present writer's type F. V resembled nearly the "mature follicles" of CORNER.⁸⁾

On the other hand CLARK and DOERING reported that in mature follicles the cells of granulosa were in found in degenerated state, and occasionally they had disappeared completely. However SOBOTTA pointed out that the mature follicles observed by CLARK were atretic follicles obviously. The present writer found many macroscopically normal large follicles with various degenerative changes of the granulosa layer. Therefore he distinguished them as the "follicles of group 2" differing the "follicles of group 1". By present writer they were thought to be in the process of degeneration, because he found a series of transitional features between them and so-called typical "atretic follicles" such as turbid follicles and white spots.

CORNER⁸⁾ observed that the wall of follicles lying in deep parts of ovaries

folded with small wavy rising toward the follicle cavity. The findings in the present writer's type F. V were presumed to correspond with finding of CORNER. Namely, the theca interna protruded partially toward the granulosa layers, and the capillaries of the theca interna dilated remarkably. Such a finding was most conspicuous in the writer's type F. VI. Accordingly, the follicles of type F. VI were thought to correspond to the "mature follicles just before ovulation" which have been observed in follicles of woman by STIEVE and WATZKA.

The present writer's conception that the grayish-white and the light-grayish-yellow follicles are in process of follicle maturation was confirmed on account of the result of observations in the follicles of group 1 mentioned above. But many grayish-white and light-grayish-yellow follicles accompanied by blood vessels (+ or ++) showed maturity. The reddish follicles were thought to be in mature state just before ovulation.

Atretic follicles: The "follicles of group 2" (Fa.), the "white turbid follicles" (Ft.) and the "white spots," (W.) showed a series of stages in the process of involution in vesicular follicles. The follicles of three groups were brought together in one group, designated as the "atretic follicles" (AF.), and divided newly into 12 types in series. In table 8 is shown the correlation of AF. to Fa., Ft. and W.

TABLE 8. *Correlation between "Atretic Follicles" (AF), and "Follicles of Group 2" (Fa.), "White Turbid Follicles" (Ft.) and "White Spots (W.)"*

		TYPE AF.											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Type	Fa.	I	II	III	IV			V		VI			
	Ft.			I	II	III	IV	V		VI			
	W.						I		II		III	IV	V

Up to this time, there have been many published histological studies in the atretic follicles of various animals, and the conceptions of two types, cystic and obliterated atretic follicles, are accepted widely.

The present writer's so-called small degenerated epitheloid cells (L. Z.) in follicles from the types AF. I to IV, were considered to be derived from degenerated cells of granulosa. The granulosa cells with various degenerative features—pycnosis, karyolysis, karyorrhexis and so on—appeared on the superficial layers of the granulosa; from there the granulosa cells gradually fell into degeneration as far as the basal layers, and finally fell off from the follicle walls

into the cavity. These findings were similar to the descriptions of CORNER⁹⁾ and MORI in sows.

It has been reported by many authors that specific cells appear in the follicle cavity with the destruction of granulosa layers. Such cells were described as wandering connective-tissue cells by RABL in man and mammalia, and as histiocytic cells by IOKA in man. EVANS and TAJIMA pointed out that those showed active phagocytosis, because of containing supravital stainable granules.

In sows also CORNER⁹⁾ mentioned that large cells appeared in the follicle cavity full of degenerated granulosa cells, and with shrunken or no ovum.

In the present writer's observation these large cells corresponded to E.Z. and D.E.Z. cells in atretic follicles. These large epitheloid cells of the writer were presumed to be mesenchymal cells derived from follicle wall or ovarian stroma on account of their morphological characters and phagocytosis.

From among the various changes in the follicle walls, the process of the changes of the theca interna cells have attracted the attention of investigators. In the present writer's investigation in sows the theca interna cells did not alter to fibrocytes as they do in man and in other ungulata, but rather they grew larger to form their masses as seen in rodentia and carnivora. The present writer considered that in sows the theca interna cells migrated into the follicle cavity at the beginning of their hypertrophy, assuming the characteristics of the large epitheloid cells.

The structures of the walls in the follicles from type AF. VII to XII were different from those in the follicles up to type AF. VI. The "hyaline layer" which corresponded with GROHE-SLAVIANSKY's "hyaline membrane" appeared first in the inner layers of the follicle walls of type AF. VII, and became thicker gradually.

At the same time, the writer's "yellow body-like tissue" appeared partially in the inner sides of the "hyaline layer" (AF. VII). The development of this tissue was accompanied by increase of thickness of the "hyaline layer" (AF. VIII and IX), forming the thicker layer around the cavity (AF. X), and finally became filling the original cavity (AF. XI and XII).

The periods of the appearances and the process of the changes of the writer's "yellow body-like tissue" correspond to the accepted conceptions on the course of events in the atretic follicles. Therefore this tissue is thought to be derived from the young mesenchymal tissue of the theca interna.

The "radial layer" which appeared partially outside the "hyaline layer" was thought to be composed of the fibrocytes of the theca externa and of the ovarian stroma which had actively invaded the theca interna. This layer became thicker and thicker and surrounded the whole follicle wall in company with the "yellow body-like tissue" (AF. VIII and IX). However, this layer degenerated gradually

opposite to the thickening of the "hyaline layer" (AF. X), and at last became scarce (AF. XI and XII).

The follicles of type AF. VII were filled with scar-tissue (AF. XI and XII) as the final step in their atresia.

In the atresia of the vesicular follicles in sows one may find 3 stages, the first of which is characterized by the degeneration of the granulosa layer (AF. I to IV), the second by the appearance and thickening of the "hyaline layer" inside the wall, the penetration of the mesenchymal tissues of the theca interna into the cavity, the invasion of the connective tissues of the theca externa and of the ovarian stroma into the theca interna (AF. V to X), and the third by the scar-tissue (AF. XI and XII).

Histological observations showed that the follicles of group 2 were in the first stage of atresia. They were grayish-white, light-grayish-yellow or light-red in color, and their blood vessels were from— to ++ in their degree of development. That is to say, more than a half of macroscopical normal follicles were seen to be in an initial stage of atresia.

Most of white turbid follicles were in the second stage of atresia, and a few in the first stage.

The white spots were proved to be derived from atretic follicles, and the majority of them were in the last stage of atresia.

Atretic follicles with hemorrhage: HIROSE and ADACHI^{1,2)} proved that the growing follicles tended to undergo bleeding in the cavity, brought about in the process of involution or corpus luteum formation.

By the present writer the dark-red turbid follicles were divided into 3 types. These were similar to the white turbid follicles, except the large amount of blood in the cavity, and agreed well with the experimental atretic follicles of rabbits. Therefore they were considered to be cystic atretic follicles with hemorrhage.

Among the light-brown yellow spots, only one was distinguished as the "yellow spot of group 3". This was a scar similar to type XI of the atretic follicles. Many cells with brown pigments were seen. These pigments were proved to contain Fe derived from erythrocytes. Therefore this spot is presumed to be derived from the dark-red turbid follicles.

Both groups of structures—the dark-red turbid follicles (Fat.) and the yellow spot of group 3 (B.)—were placed finally in one group, designated as "atretic follicles with hemorrhage" (aF.), and divided newly into 4 types. Table 9 shows the correlation of aF. to Fst. and B., and the new established stages of their atretic process in comparison with the findings of the preceding "atretic follicles" (AF.).

TABLE 9. *Correlation of "Atretic Follicles with Hemorrhage" (aF.) with "Dark-Red Turbid Follicles" (Fst.) and "Yellow Spot of Group 3" (B.), and Histological Stages of Their Atretic Process*

		TYPE aF.			
		I	II	III	IV
Type	{ Fst.	I	II	III	
	{ B.				I
Stage		First	Second		Last

Corpora lutea of non-pregnancy: All the corpora lutea after the latest ovulation were corpora lutea of non-pregnancy, because there was no embryo or foetus in the uterus in these materials. Between the small corpora lutea and the yellow spots of group 1 on the one hand, and the bloom stage of corpora lutea of non-pregnancy, there were proved a series of transitional features. Accordingly, these two groups of structures were called the "corpora lutea of non-pregnancy" (CL.). They were put together and divided newly into 10 types. Table 10 shows the correlation between corpora lutea of non-pregnancy and previous two classifications (L. I—VIII and G. I—IV).

TABLE 10. *Correlation of "Corpora Lutea of Non-pregnancy" (CL.) with Corpora Lutea of Group 1 (L.) and Yellow Spots of Group 1 (G.)*

		TYPE CL.									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Type	{ L.	I	II	III	IV	V	VI	VII	VIII		
	{ G.							I	II	III	IV

MEYER was the first to distinguish 4 stages in human corpus luteum, (1) proliferation, (2) vascularization, (3) maturity or bloom, (4) regression. Later SCHRÖDER and other some authors gave detailed descriptions of the corpora lutea in each stage based on the use of silver impregnation methods.

On the other hand, the corpus luteum of sows have been described by ZWICKY at first and later by other some authors, and the detailed descriptions on the process of its histological development have been given by CLARK and CORNER^{7,8}. The formation of corpus luteum described by CLARK occurs in the follicles with degenerated granulosa layer. According to the present writer's observations the formation of the corpus luteum started its first step in the mature follicles just

before ovulation. CORNER's opinion was that the processes of formation of the corpus luteum of pregnancy and of non-pregnancy are entirely the same, and fall into the scar-tissue without any difference between them.

CORNER⁸⁾ divided the histological life-history of the corpus luteum into 4 stages, (1) freshly ruptured follicle, (2) invasion of the granulosa, (3) fully formed corpus luteum and (4) retrogression of the corpus luteum.

In comparison with the findings of the present writer in the mature follicles just before ovulation and findings understood by CORNER in the freshly ruptured follicles, the writer's so-called outer lutein cell layer may be recognized to have been derived from the theca interna, and the inner lutein cell layer from the granulosa layer. On account of these items of evidence, type CL. I resembles the freshly ruptured follicles of CORNER. In the follicles of CORNER, capillaries of the theca interna did not yet penetrate into the granulosa layer. But in type CL. I of the present writer a few capillaries were seen to penetrate into the granulosa layer. Therefore the type CL. I are thought to be a more advanced stage of corpus luteum than the freshly ruptured follicles of CORNER.

The early stage and more advanced stage of the invasion of the granulosa in CORNER's cases resemble well the writer's type CL. I and III each. Type CL. II showed the transitional features between types CL. I and III. The round hyaline substances which are found in the inner lutein cells of type CL. III are thought to correspond to the colloidal spherules which were observed by CORNER in the granulosa lutein cells at the early stage of invasion of the granulosa. CORNER believed such an appearance in the granulosa cells to be peculiar to young corpora lutea of pregnancy. However the present writer found them in the corpora lutea of non-pregnancy, in a little later stage than in CORNER's corpora lutea of pregnancy.

The histological features in the maturity of the corpus luteum of pregnancy were given by CORNER^{7,8)}. The cases of the writer's type CL. IV were almost similar to those of CORNER.

On the other hand, the fully formed corpora lutea of non-pregnancy were described by CLARK. He stated that the lutein cells were derived only from the theca interna cells of mature follicles, and he found the appearance of lutein cells which already had undergone fatty degenerative changes before this stage. Although some investigators described the appearances of degenerated lutein cells within the fully formed corpora lutea, many others have thought that the appearance of them is evidence of the regression of the corpora lutea.

With regard to the origin of the lutein cells, VON BAER set forth the connective tissue theory in cats. Twenty years later, BISCHOFF published the epithelial theory in guinea-pig, rabbits and dogs. WALDEYER advocated the dualistic theory in

cattle.

In sows, ZWICKY and KOPSCH supported the epithelial, and CLARK, DOERING and JANKOWSKI the connective tissue theory. The only investigator supporting the dualistic theory was CORNER^{7,8)}. The present writer's opinion may be in conformity with CORNER's theory, because of the finding of young and fully formed corpora lutea of non-pregnancy.

The histological changes in the process of the retrogression of the corpora lutea of non-pregnancy were explained in detail by CLARK. He divided that process into 3 stages. His first stage designated as the corpus fibrosum is characterized by the disappearance of the lutein cells and by the progressive increase of the connective tissue. CORNER⁹⁾ designated the CLARK's corpus fibrosum as the corpus albicans. The present writer's type CL. VII resembles remarkably both the corpus fibrosum of CLARK and the corpus albicans of CORNER⁹⁾. Types CL. V and VI showed transitional features to type CL. VII.

At the second stage of the regression the corpus fibrosum of CLARK shrank until its fiber had a uniform homogeneous appearance due to hyaline change.

The writer's corpora lutea of type CL. VIII, especially types CL. IX and X, were also designated as the "hyaline bodies", and correspond completely to the second stage, "hyaline bodies", of CLARK.

The "hyaline bodies" at the last stage of CLARK finally formed only a fine hyaline, serpentine-like line. The present writer did not find such a very old corpus luteum which corresponded to the last stage of CLARK, because the present researches were based upon the structures found on ovarian surfaces.

The present writer divided the life-history of the corpus luteum of non-pregnancy into 5 stages; vascularization (types CL. I to III), maturity (type CL. IV), the beginning of regression (types CL. V and VI), the middle stage of regression (type CL. VII) and the last stage of regression (types CL. VIII to X).

Corpora lutea of non-pregnancy with a large central cavity (Corpora lutea of group 2): These were subdivided into 6 types.

CORNER⁸⁾ stated that in the follicles just after ovulation there frequently occurred bleeding in the cavity, sometimes even a large amount of bleeding. Therefore fresh corpora lutea often extended so wide as to affect the development of their wall up to the time of formation of the lutein cysts. CORNER believed that the lutein cysts were very common as a sort of physiological phenomena in the pig ovaries.

The writer's corpora lutea of group 2 may correspond to CORNER's lutein cysts. However the writer could not draw a clear-cut line between the physiological and pathological lutein cysts in the scope of this research, except in enormously large cysts.

Vascular bodies (Yellow spots of group 2): A group of yellow spots with many slight degenerated blood vessels were designated as "vascular bodies"; this group was subdivided into 3 types.

In the macroscopical observation the writer differentiated the yellow spots of reddish-tone into two groups of dark-reddish and light-reddish ones. In his present materials there were no light-reddish-toned yellow spots, and all the yellow spots of group 2 were dark-reddish ones. Their histological appearances were sufficiently special as to warrant designation as "vascular body".

Hitherto so far as is known, there are no descriptions of the "vascular body" in literatures.

The present writer could not find any other reasons for the high frequency of vessels in the "vascular body" than the prolonged functional condition of the corpus luteum in the case of gestation. In the ovaries of cows the well known "white bodies" are thought to correspond to the fertilized ova in the past pregnancies, showing high frequency of vessels in their tissue. Recently TIBA et al. have proved that, in the ovaries of the so-called "white heifer disease", in cases of which the uteri were malformed with large mucoid cysts and blind cavities, there occurred many white body-like structures with numerous vessels in their tissue, suggesting the prolonged activities of the yellow bodies. These are actual phenomena indeed! On the basis of these facts, the present writer wishes to deduce that the "vascular bodies" of ovaries of sows are the scar-tissues of old corpora lutea, which correspond to the fertilized ova in the past gestations.

If these writer's deduced conclusion is correct, the opinion of CORNER⁸⁾ upon the fate of the corpus luteum shall be changed, and the unknown careers of gestations in any sows shall be cleared up histologically to some extent. For the confirming of this hypothetic conclusion additional investigations are necessary. Above all it would have direct meaning to investigate the ovaries of the sows which are clear in the careers of gestation; the dates of heat, copulation and insemination, parturition and number of piglets of each litter and so on. If the grade of regression of corpus luteum should correspond to the order of the successive parturitions, and the number of "vascular bodies" of the same grade should agree with the number of piglets of each litter in the respectively corresponding parturition, the present writer would satisfy himself in respect of his conception even though lacking the chances of experimental studies on artificial "vascular bodies" in the ovaries of sows.

SUMMARY

The results of this research may be summarized as follows.

1. Various cellular elements were found in the cavity of follicles and classified

into 12 types.

2. Normal vesicular follicles were differentiated into 6 types according to their ripening process.

The actual maturity of follicles may be decided by the histological appearances of follicle walls: viz., the conspicuous hypertrophy of theca interna cells, the conspicuous dilatation and hyperemia of capillaries, especially between the theca interna and the granulosa layer, the partial, plicated infoldings of the theca interna and so on.

4. Out of macroscopically normal follicles about a half were in the beginning stage of cystic atretic follicles. They were designated as follicles of group 2, and divided into 6 types.

5. The histological features of the first stage of cystic atretic follicles start in the appearances of degenerating granulosa cells in the granulosa layer, and the feature of distinct atresia is the complete necrosis of the granulosa layer.

6. White turbid follicles were divided into 6 types in series by histological findings according to grade of changes.

7. Most of the white turbid follicles corresponded to the second stage of cystic atretic follicle, and a few of them to the first stage.

8. The histological characteristics of the second stage of cystic atretic follicle were the disappearance of granulosa cells, the hypertrophy of theca interna cells and wandering of them into the cavity, the appearances of hyaline membrane in the inner walls, and the invasion of young connective tissues into the follicle cavity.

7. The cells of types E.Z. and D.E.Z. were considered to coincide with the theca lutein cells designated in the dualistic theory from their forms and characteristics.

10. White spots were divided into 5 types.

11. The majority of white spots were in the last stage of cystic atretic follicles, usually showing scar-tissue formation.

12. All types of the follicles of group 2, of white turbid follicles and of white spots, were put together, designated as cystic "atretic follicle" in sows, and classified newly into 12 types.

13. Dark-red turbid follicles were divided into 3 types.

14. The dark-red turbid follicles were similar to the cystic atretic follicles, except for the large amount of blood in the follicle cavity, conspicuous dilatation and hyperemia of the capillaries in the theca interna, and scattering of erythrocytes in the theca interna.

15. Corpora lutea of group 1 were divided into 8 types.

16. On the derivation of cells, the present writer has supported the dualistic

theory of CORNER.

17. Macroscopically reddish-toned corpora lutea showed the features of vascularization stage, yellow-toned ones the features of the last stage of regression, and the yellowish-red ones the intermediate features between the previous 2 groups.

18. Corpora lutea containing a large amount of fluid in the central cavity were designated as "corpora lutea of group 2", and divided into 6 types.

19. The writer could not determine whether the corpora lutea of group 2 were the physiological phenomena or the pathological cysts.

20. The yellow spots which showed the higher hyaline degeneration of connective tissue and of blood vessels were designated as "hyaline bodies".

21. The "hyaline bodies" showed the features of the last stage of regressive corpus luteum of non-pregnancy.

22. The types of corpus luteum of group 1 and yellow spot of group 1 were put together, designated as the "corpora lutea of non-pregnancy" in sows, and newly divided into 10 types.

23. The yellow spots which contained many blood-vessels with relatively slight degeneration were designated as "vascular bodies".

24. The "vascular bodies" were thought to represent an old corpus luteum of pregnancy in sows. Further researches are expected to confirm this conception.

25. Of the brown yellow spots, only one showed the feature of scar-tissue. The writer thought that this was derived from the cystic atretic follicle with hemorrhage.

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REFERENCES

- 1) ADACHI, K. (1923): *Osaka Igk. Z.*, **22**, 939 (in Japanese).
- 2) ADACHI, K. (1930): *Ibid.*, **29**, 2693 (in Japanese).
- 3) VON BAER, K. E. (1827): *De ovi mammalium et hominis genesi*, Leipzig [Cited from CORNER⁸⁾].
- 4) BENCKISER, A. (1884): *Arch. Gynaek.*, **23**, 350.
- 5) BISCHOFF, TH. L. W. (1842): *Entwicklungsgeschichte des Kaninchen-Eies.*, Braunschweig [Cited from CORNER⁸⁾].
- 6) CLARK, J. G. (1899): *Johns Hopk. Hosp. Rep.*, **9**, 594.
- 7) CORNER, G. W. (1915): *Contr. Embryol. Carneg. Inst.*, **5**, 69.
- 8) CORNER, G. W. (1919): *Amer. J. Anat.*, **26**, 117.

- 9) CORNER, G. W. (1921): *Contr. Embryol. Carneg. Inst.*, **13**, 117.
- 10) DOERING, H. (1899): Inaug.-Diss., Königsberg [Cited from CORNER⁸⁾].
- 11) EVANS, H. M. (1916): *Proc. Soc. exp. Biol., N. Y.*, **13**, 80.
- 12) FLEMMING, W. (1885): *Arch. Anat. Physiol.*, Jg. 1885, 221.
- 13) HIROSE, T. (1920): *Tokyo Igk. Z.*, **34**, 71 (in Japanese).
- 14) IOKA, T. (1917): *Kyoto Igk. Z.*, **14**, 273 (in Japanese).
- 15) JANKOWSKI, T. (1904): *Arch. mikr. Anat.*, **64**, 361.
- 16) KOPSCH, F. (1901): *Anat. Anz.*, **19**, 210.
- 17) MEYER, R. (1911): *Arch. Gynaek.*, **93**, 354.
- 18) MORI, Y. (1941): *Kumamoto Igk. Z.*, **17**, 1767 (in Japanese).
- 19) PALADINO, G. (1879): Studio sulla fisiologia dell'ovaja struffura, genegi, et significazione del corpo luteo, Napoli [Cited from CORNER⁸⁾].
- 20) RABL, H. (1898): *Arb. anat. Inst., Wiesbaden*, **11**, 109.
- 21) SCHROEDER, R. (1914): *Arch. Gynaek.*, **101**, 1.
- 22) SOBOTTA, J. (1899): *Arch. mikr. Anat.*, **53**, 546.
- 23) STIEVE, H. (1942): *Zbl. Gynäk.*, **66**, 1456.
- 24) TAJIMA, A. (1936): *Kaibo Z.*, **9**, 491 (in Japanese).
- 25) TIBA, T., T. ISHIKAWA & K. KAWATA (1959): *Jap. J. vet. Res.*, **7**, 139.
- 26) WALDEYER, W. (1870): Eierstock u. Ei, Leipzig [Cited from CORNER⁸⁾].
- 27) WATZKA, W. (1957): Handbuch der mikroskopischen Anatomie des Menschen nach W. v. MÖLLENDORFF; Harn- und Geschlechtsapparat, 3 Teil, Julius Springer, Berlin.
- 28) YAMASHITA, T. (1955): Inaug.-Diss., Sapporo (in Japanese).
- 29) ZWICKY, H. L. (1844): Inaug.-Diss., Zürich [Cited from CORNER⁸⁾].

EXPLANATION OF PLATES

PLATE I.

Follicles of Group 1 (F.), H.-E. stain. × 350.

Fig. 1.	Type F. I.	Fig. 4.	Type F. IV.
Fig. 2.	Type F. II.	Fig. 5.	Type F. V.
Fig. 3.	Type F. III.	Fig. 6.	Type F. VI.

PLATE II.

Follicles of Group 2 (Fa.) and White Turbid Follicles (Ft.), H.-E. stain. × 350.

Fig. 7.	Type Fa. I.	Fig. 11.	Type Fa. V.
Fig. 8.	Type Fa. II.	Fig. 12.	Type Fa. VI.
Fig. 9.	Type Fa. III.	Fig. 13.	Type Ft. III.
Fig. 10.	Type Fa. IV.	Fig. 14.	Type Ft. IV.

PLATE III.

Dark-red Turbid Follicles (Fst.) and White Spots (W.), H.-E. stain.

Fig. 15.	Type Fst. I.	× 70.	Fig. 19.	Type W. III.	× 70.
Fig. 16.	Type Fst. II.	× 70.	Fig. 20.	Type W. IV.	× 70.
Fig. 17.	Type Fst. III.	× 70.	Fig. 21.	Type W. V.	× 70.
Fig. 18.	Type W. II.	× 350.			

PLATE IV.

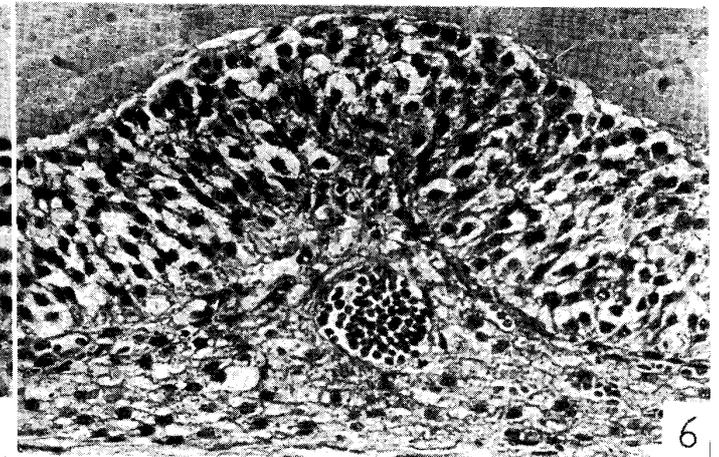
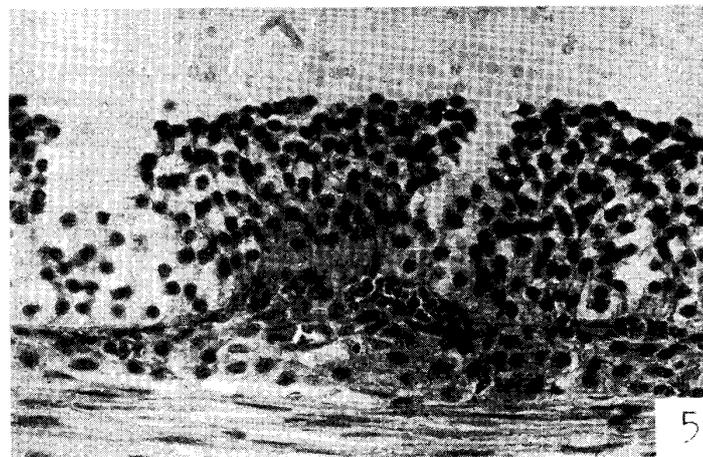
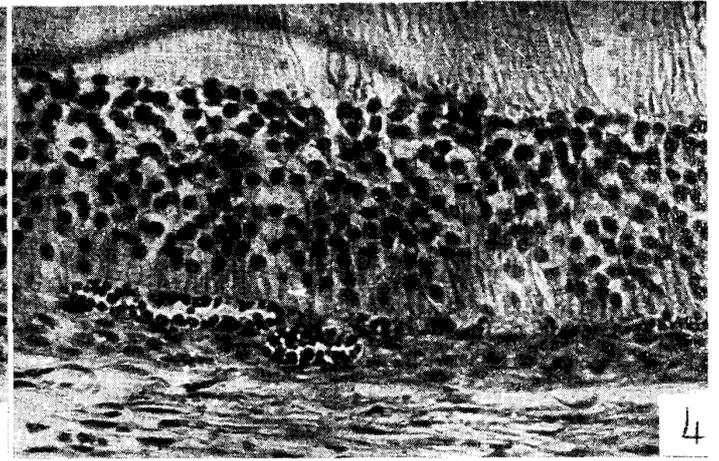
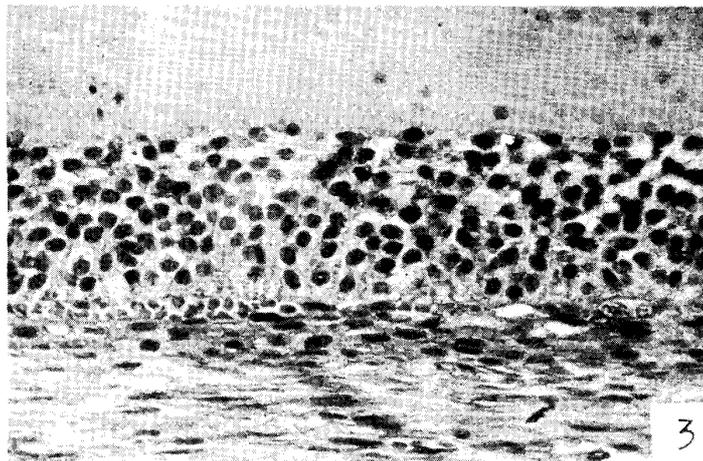
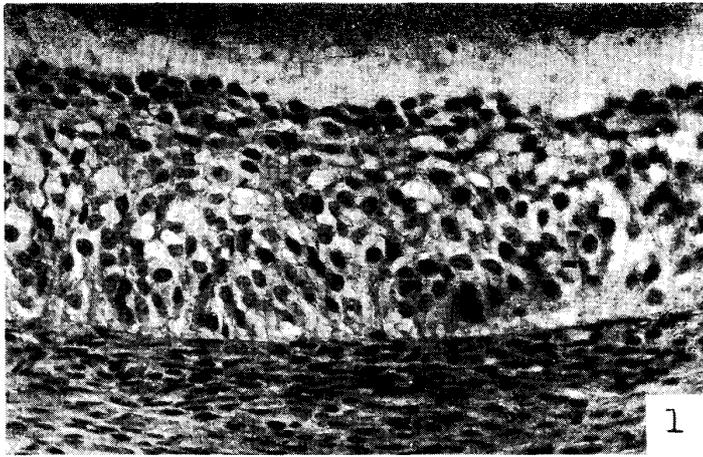
Corpora Lutea of Group 1 (L.), H.-E. stain.

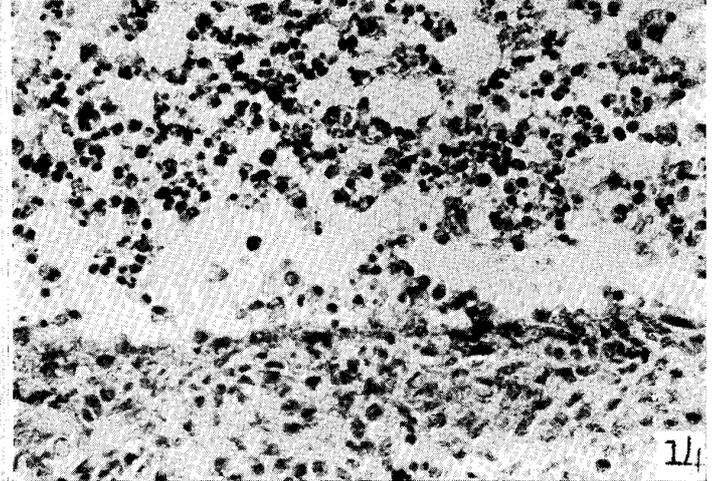
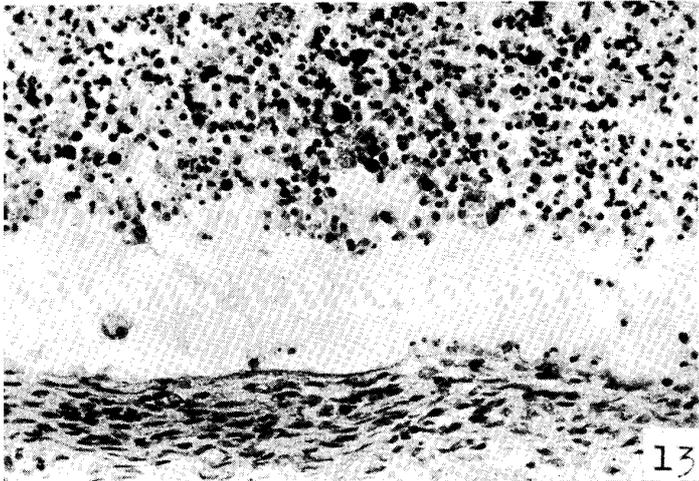
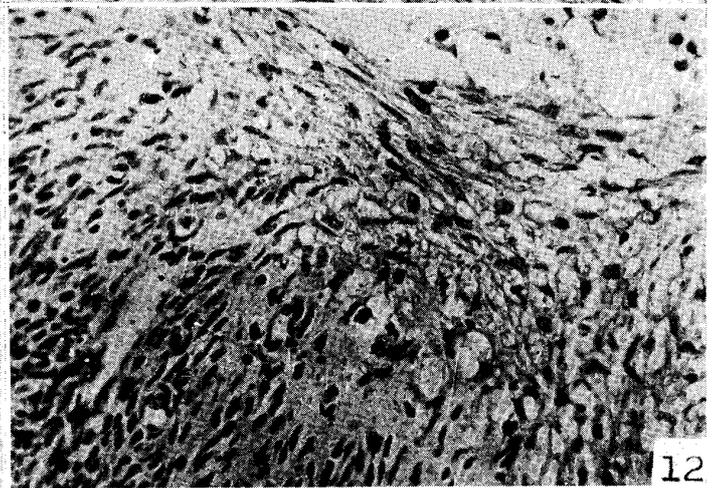
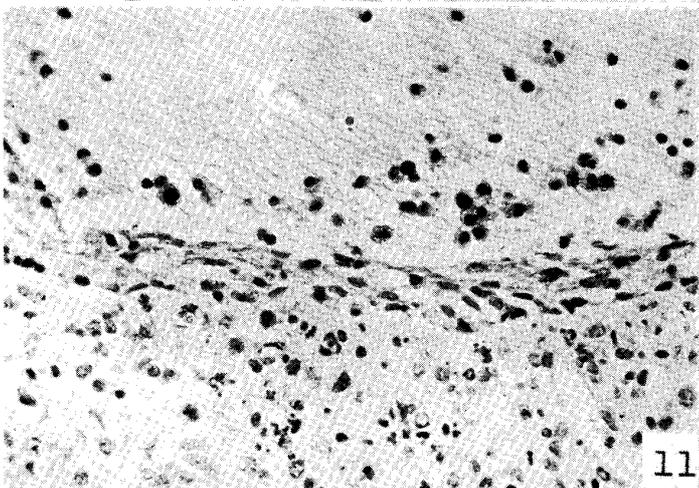
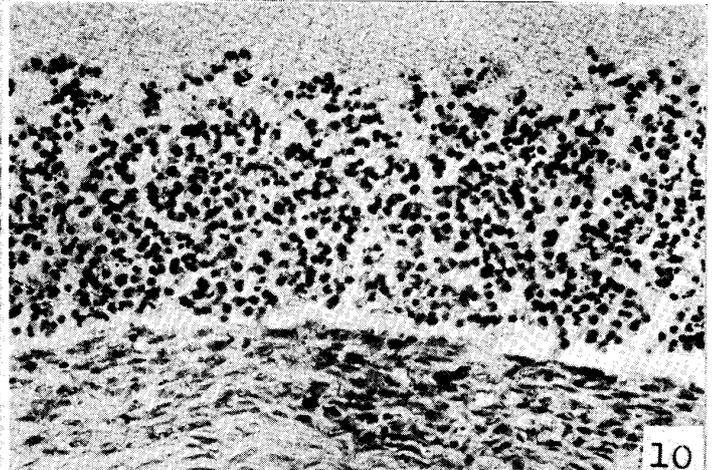
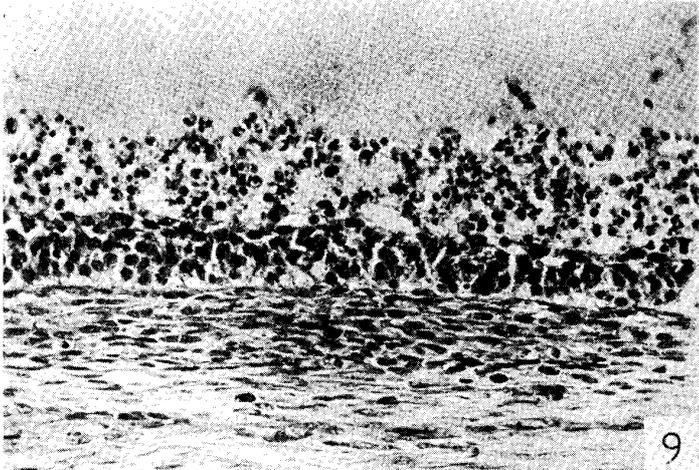
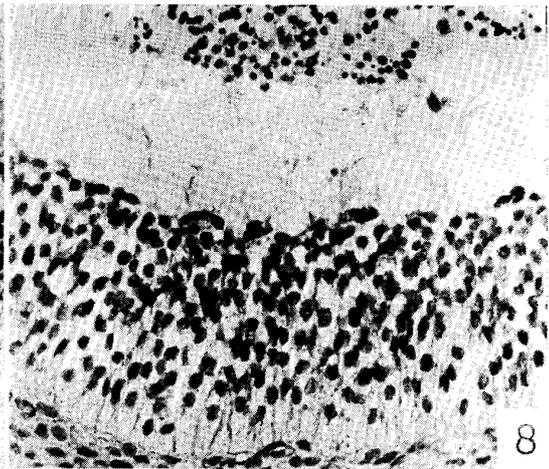
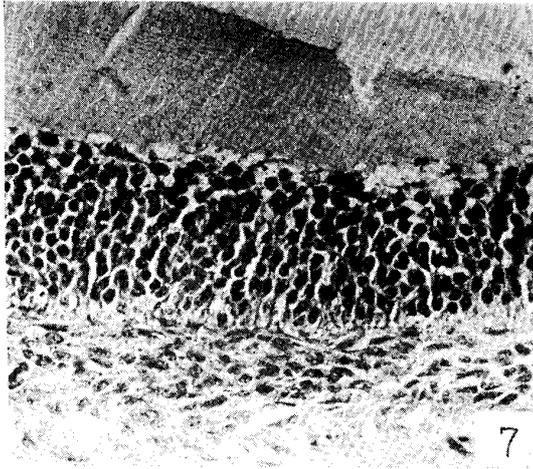
Fig. 22.	Type L. I.	× 70.	Fig. 26.	Type L. V.	× 350.
Fig. 23.	Type L. II.	× 70.	Fig. 27.	Type L. VI.	× 350.
Fig. 24.	Type L. III.	× 70.	Fig. 28.	Type L. VII.	× 350.
Fig. 25.	Type L. IV.	× 350.	Fig. 29.	Type L. VIII.	× 70.

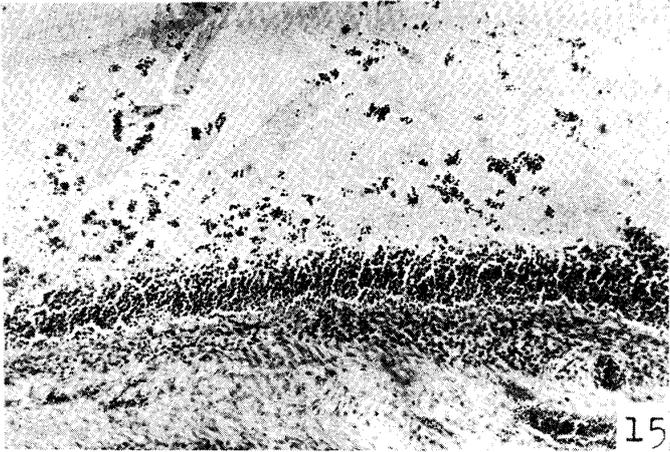
PLATE V.

Corpora Lutea of Group 2 (l.), Yellow Spots of Group 1 (G.), Yellow Spots of Group 2 (g.) and Yellow Spot of Group 3 (B.), H.-E. stain. × 70.

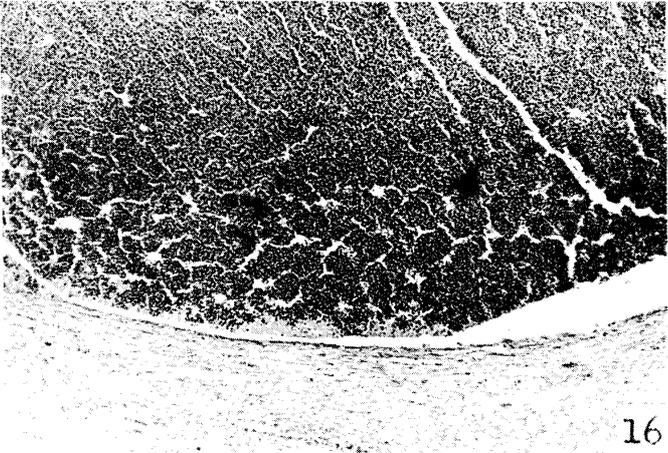
Fig. 30.	Type l. IV.	Fig. 34.	Type g. II.
Fig. 31.	Type G. III.	Fig. 35.	Type g. III.
Fig. 32.	Type G. IV.	Fig. 36.	Type B. I.
Fig. 33.	Type g. I.		







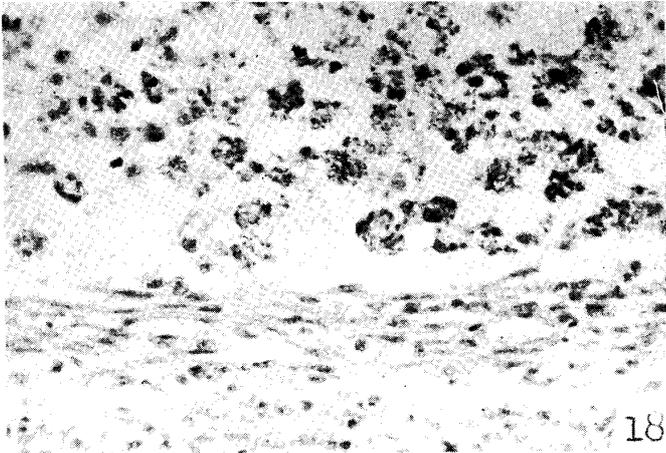
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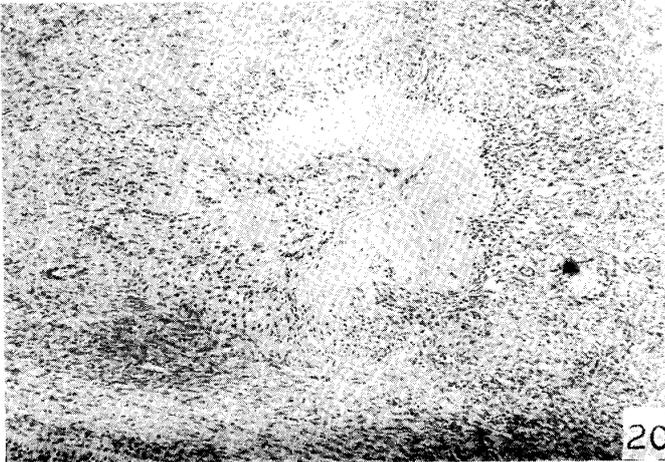
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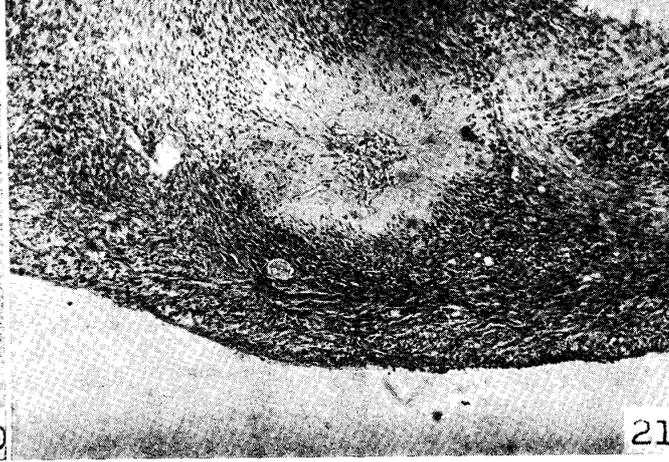
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