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ANATOMICAL AND PATHOLOGICAL STUDIES
ON THE SEX ORGANS FROM
SLAUGHTERED BULLS IN HOKKAIDO
II. SOME OBSERVATIONS ON REMNANTS OF
THE MÜLLERIAN DUCT*

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Remnants to the Müllerian duct in the male have been described by many investigators as uterus masculinus, utriculus prostaticus, uterovagina masculina, vagina masculina or as Müllerian cysts. According to SKODA, these remnants were present in 82 of 115 bulls subjected to examination in Germany. BLOM & CHRISTENSEN²⁾ found remnants often among 2,000 bulls in Denmark and ROLLINSON⁹⁾ reported remnants to be present in 4 cases out of 10 bulls in England. Recently, BLOM & CHRISTENSEN³⁾ demonstrated these cyst formations in 38 per cent and 44 per cent of newborn and fattening calves of Danish Friesian cattle, in 24 per cent of Red Danish Milk breed calves and in about 33 per cent of Jersey calves, respectively. On the other hand, SISSON stated that these Müllerian remnants are present in the horse, pig and dog, but are usually absent in the bull. In Japan, no report concerning Müllerian remnants has been published in any kind of male domestic animals.

The present authors encountered 6 cases of Müllerian remnants in the course of studying sex organs obtained from slaughtered bulls in Hokkaido. This paper deals with the macroscopical and histological findings of the remnants in these cases. In addition, some consideration will be presented concerning hereditary problems.

MATERIALS AND METHODS

The materials for this investigation were sex organs with Müllerian remnants obtained from 5 Holstein-Friesian bulls and one Guernsey bull out of 19 bulls slaughtered at Sapporo,

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from May 1958 to October 1959, including 15 bulls which were reported in the previous report⁶. The ages and clinical data of these 6 cases are outlined in table 1.

TABLE 1. *Materials Used and Clinical Data*

BULL NO.	BREED	AGE	SEMEN PICTURE	FERTILITY	CAUSE OF DISPOSAL	REMARKS
H-15	Holstein	yr. mo. 8.1	—	average % 82.7	Psychic impotence	•
H-30	"	9.4	Good	90.0	Senility	•
H-31	"	—	—	—	—	No response from the owner
H-32	"	5.0	Good	95.0	Lameness	•
H-34	"	2.3	"	—	—	Experimental bull
H-27	Guernsey	8.2	"	60.0	Low fertility, lameness	•

—: Missing data

After the bulls had been slaughtered, the remnants of the Müllerian duct of each animal were photographed, then examined macroscopically and measured carefully. Specimens for histological examination were taken from each remnant, fixed with 10 per cent formol solution, and embedded in paraffin. Sections were stained with hematoxylin-eosin for microscopical examination.

In addition, macroscopical and microscopical examinations of the testis, epididymis and other accessory glands of the 6 bulls were made.

DESCRIPTION

All specimens of remnants of the Müllerian duct were situated on the dorsal surface of the urogenital fold. Most of the cases appeared single, forming a firm oval small cystic vesicle of a rice grain to thumb-head size, lying on the anterior or medial part of the urogenital fold, without connection to the urogenital canal. But, in some cases, the remnants showed considerable variations in size, shape, number and location: Bulls H-31 and H-34 had two remnants. In the latter case, one of the remnants showing a pear-like shape was located at the posterior part of the urogenital fold. Bull H-15 had a tubular construction with the shape of three-connected-balls, having a narrow passway connecting to the urogenital canal beneath the body of the prostate. All these Müllerian remnants were filled with translucent viscid fluid.

The location, size and shape of these remnants are outlined in table 2, and relations to the neighboring sex organs are shown schematically in the chart.

Histologically, all remnants had a narrow central cavity covered with a single layered or stratified epithelium consisting of cuboid, columnar, flattened and ciliated epithelial cells. In one case (H-15), a part of the epithelium showed many folds. In most of the cases, except H-32, many small accessory cavities which resembled female bovine uterine glands, surrounded the central cavity. But, the development of the accessory cavities was varying from case to case. The lumina of the central and accessory cavities contained secretory products. The

TABLE 2. *Macroscopical and Microscopical Findings of Remnants of Müllerian Duct*

BULL NO.	SIZE	SHAPE	THICKNESS OF WALL OF REMNANT	EPITHELIAL CELL TYPE OF CENTRAL CAVITY	DEVELOPMENT OF ACCESSORY CAVITIES
	cm		μ		
H-15	10.2×1.4×1.4	Three-connected-balls	470~4,650	Columnar Flattened Cuboid, Ciliated	+++
H-27	1.3×1.0×0.8	Oval	200~280	Cuboid Ciliated	+
H-30	0.8×0.4×0.5	"	200~300	Columnar Cuboid	++
H-32	2.5×1.8×1.3	"	450~550	Columnar Cuboid	—
H-31	I 0.7×0.55×0.3	"	340~800	Columnar Cuboid	+++
"	II 0.3×0.2×0.1	"	300~680	Columnar Cuboid	++
H-34	I 0.7×0.9×0.5	"	300~400	Columnar Cuboid Ciliated	+++
"	II 1.4×0.4×0.4	Pear	250~600	Flattened Columnar Cuboid	+++

Notes: — No accessory cavity
 + Poor
 ++ Considerably good
 +++ Good

wall of the remnant consisted of connective tissues and several layers of smooth muscles. The thickness of the wall showed considerable variations ranging from 200 μ to 4,650 μ . Thus, the major histological aspects of the Müllerian remnants were similar to those of the immature uterus in the heifer. The thickness of the wall of the central cavity, the type of epithelial cells of central cavity and the degree of development of the accessory cavities are shown in table 2.

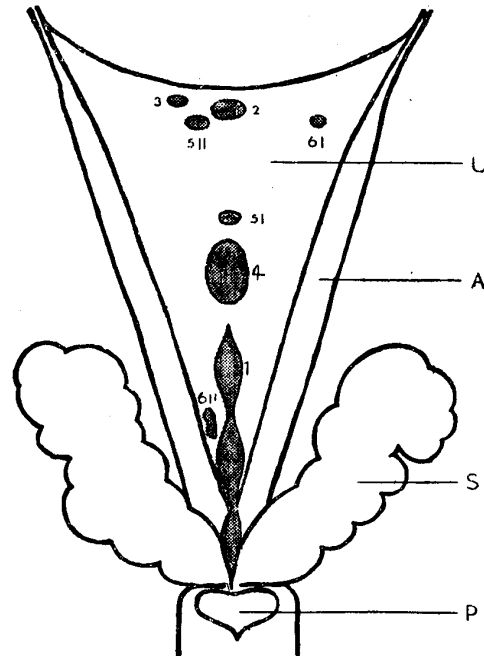
No remarkable variation from normal was observed macroscopically nor microscopically in the testis, epididymis and other accessory glands in all cases examined.

DISCUSSION

The occurrence of the remnants of the Müllerian duct in the male bovine genitalia has been reported in a considerably high incidental rate in foreign countries. In Japan, however, any such occurrence had not been reported until the present report that the Müllerian cyst formation was found in 6 cases of 19 slaughtered mature bulls in Hokkaido.

These Müllerian remnants seemed distinguishable into two types; one is

CHART. *Schema of Location, Size and Shape of Müllerian Remnants in all Cases and Relation to Neighboring Sex Organs*



Notes	1 :	Bull H-15	2 :	Bull H-27
	3 :	Bull H-30	4 :	Bull H-32
	5 I }	Bull H-31	6 I }	Bull H-34
	5 II }		6 II }	
	U :	Urogenital fold	A :	Ampulla ductus deferentis
	S :	Seminal vesicle	P :	Body of prostate

a tubular type which is characterized by a passway connecting with the urogenital canal. This type is accordant with ELLENBERGER & BAUM's description according to which the remnant opens between the ejaculatory orifices. The other is the small vesicular type without connection to the urogenital canal. Most of the cases reported by ROLLINSON⁹⁾ and BLOM & CHRISTENSEN³⁾ seem to belong to the latter type. Histologically, both types of Müllerian remnants are similar to an immature bovine uterus, as has already been reported by BLOM & CHRISTENSEN³⁾. According to ROLLINSON⁹⁾, the epithelium of the central cavity consisted of only ciliated columnar cells. BLOM & CHRISTENSEN³⁾ also described the central cavity as being covered with only cylindrical epithelial cells. In the present authors' cases, however, a different type of epithelial cell was found; cuboid epithelial cells were observed in all cases, and columnar cells were commonly, but ciliated or flattened cells were considerably rare. In addition, the epithelium was generally a single layer of cells, but sometimes showed weak stratification.

The opinion that these small cystic bodies are ontogenical vestiges of the Müllerian duct, is not yet accepted by some investigators. For example, according

to MAXIMOW & BLOOM, some recent observations show that the utriculus prostaticus in human is not a vestigial organ without function, but an accessory gland of the male genital apparatus. However, the histological features of the present investigation strongly suggest that these bodies are of Müllerian origin. This conception is also supported by the fact that the utriculus prostaticus in the bull is, histologically, very similar not only to the immature heifer uterus, but also to the Müllerian remnant observed in the case of "White heifer disease"¹⁰⁾. As concerns the hereditary problem of "White heifer disease", SPRIGGS considered it to be caused by a single, recessive, sex-linked gene with linkage to the gene for white color; also GREGORY et al. believed that the condition was definitely derived from a single, autosomal, recessive gene causing a sex-linked sterility due to inbreeding to a sire homozygous for this gene. But, ASDELL reported that this gene appeared to have no effect upon the development of the genital system in a bull calf. In view of these somewhat divergent opinions, the present authors investigated the color of the hair coat and presence or absence of inbreeding for the 5 bulls examined, except one case (H-32) for which clinical data could not be obtained. However, no clear evidence throwing light upon the occurrence of the condition could be obtained.

ROLLINSON¹⁰⁾ suggested that remnants of the Müllerian duct of the bull may be associated with the "female" type of body conformation, but without any proof of bad influence against semen production. LAGERLÖF has warned that the selection of bulls of a "feminine" type for breeding may cause some sterility involving the interaction of hormone balance and environment. Though in the present cases the secondary sexual characters could not be studied in entirety, most of the animals, except two (H-32 & H-35), were registered as breeding bulls by the Holstein Cattle Association of Japan. Furthermore, in the present authors' cases, the existence of the remnants of the Müllerian duct seemed to exert no untoward influence upon either the semen picture or the fertility rate.

As regards the problems of endocrinology and heredity of the Müllerian remnants in the bull, much remains to be studied.

SUMMARY

In the course of the post-mortem routine investigation of the sex organs of 19 mature bulls, the present authors encountered 6 cases having remnants of the Müllerian duct. These Müllerian remnants were located on the dorsal surface of the urogenital fold. They seemed to be grouped into two types; one is the tubular type which is characterized by a passway connecting with the urogenital canal, while the other is the small vesicular type without connection to the urogenital canal. Most of the cases belonged to the latter type, only one case

belonging to the former type.

Microscopically, both types of Müllerian remnants had a narrow central cavity lined with a single layered or stratified epithelium, consisting of cuboid, columnar, flattened and ciliated epithelial cells. Many smaller accessory cavities surrounding the central cavity resembled the female bovine uterine glands. But, the development of the accessory cavities varied from case to case. The lumina of the central and accessory cavities contained secretory products. The wall of the remnants consisted of connective tissues and several layers of smooth muscles. Thus, the histological features of the Müllerian remnant in the bull were very similar not only to those of the immature heifer uterus, but also to the Müllerian remnant observed in the case of "White heifer disease".

As regards many problems concerning the rate of incidence, heredity or function of the Müllerian remnants in the bull, much remains to be studied.

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EXPLANATION OF PLATES

PLATE I.

- Fig. 1. Bull No. H-15: Tubular type of Müllerian remnant. Dorsal view of remnant (C) lying on urogenital fold with both ampulla ductus deferentis (A & A'). (Scale: cm).
- Fig. 2. General appearance of removed remnant and its cross sections. Remnant is $10.2 \times 1.4 \times 1.4$ cm in size and shaped like three-connected-balls. Specimens for histological examination were taken from four parts of the remnant. (Scale: cm).
- Fig. 3. Microscopic picture of part I of fig. 2 shows a part of central cavity (C) and smaller accessory cavities (A & A'). $\times 180$.
- Fig. 4. Microscopic picture of part II of fig. 2 shows many folds of mucosal epithelium of central cavity and abundant accessory cavities. $\times 75$.
- Fig. 5. Microscopic picture of part III of fig. 2. Fold formation of epithelium of central cavity is remarkable, but accessory cavities decrease in number. $\times 75$.
- Fig. 6. Microscopic picture of part IV of fig. 2 presents marked distension of accessory cavities. $\times 180$.

PLATE II.

- Fig. 7. Bull No. H-27: Dorsal view of vesicular type of remnant of Müllerian duct (arrow) on anterior part of urogenital fold.
UB: Urinary bladder
A & A': Ampulla ductus deferentis
SV: Seminal vesicle
UC: Urogenital canal
- Fig. 8. Microscopic picture of remnant in fig. 7. $\times 180$.
C: Central cavity
F & F': Flattened small accessory cavities
W: Wall of remnant
- Fig. 9. Bull No. H-30: A vesicular type of small remnant located on anterior part of urogenital fold (arrow).
- Fig. 10. Microscopic picture of remnant in fig. 9. $\times 180$.

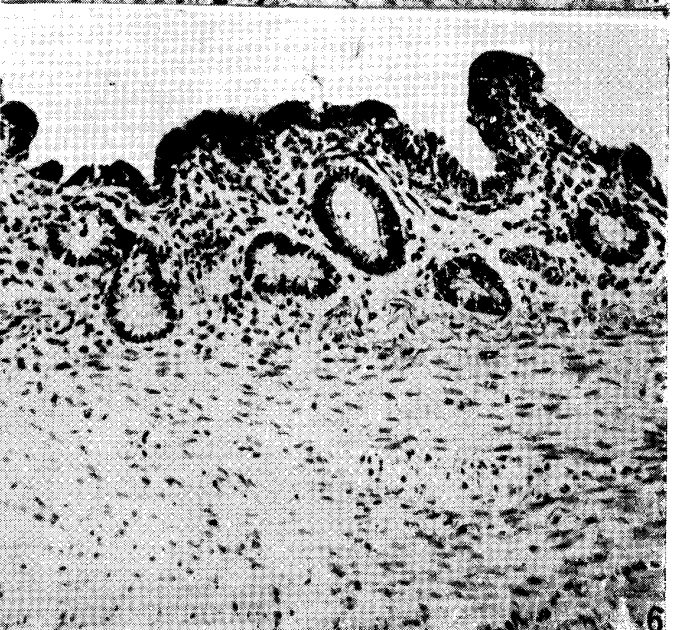
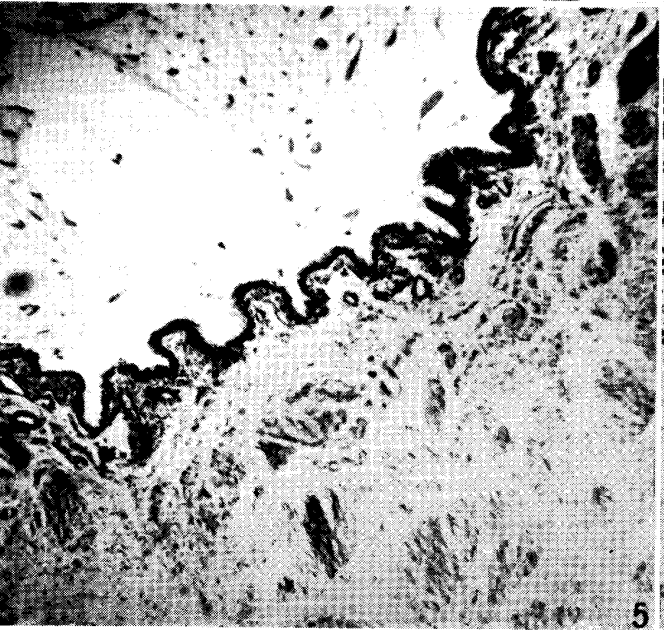
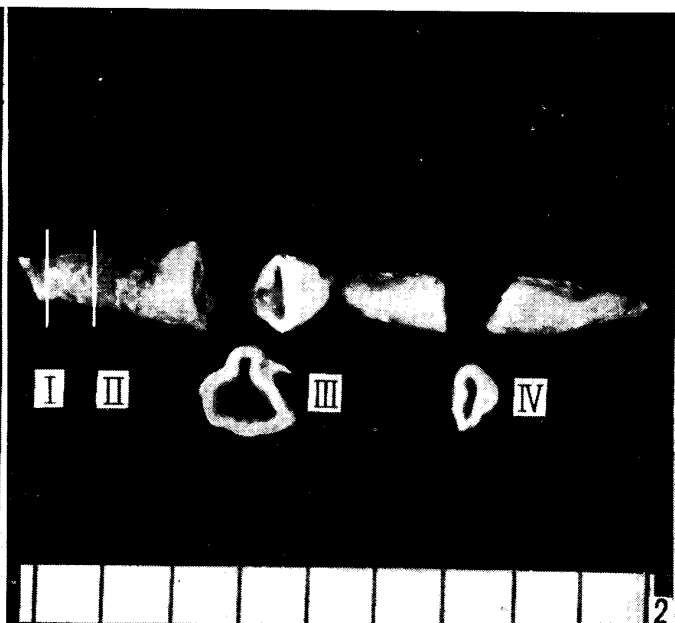
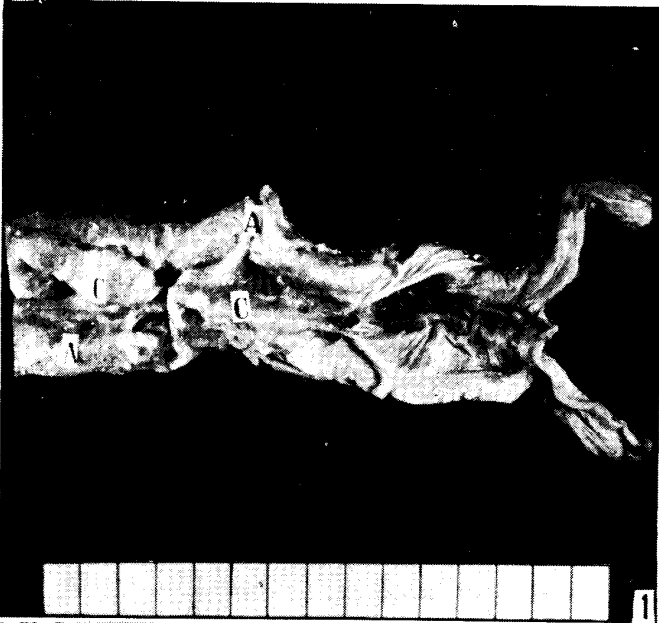
PLATE III.

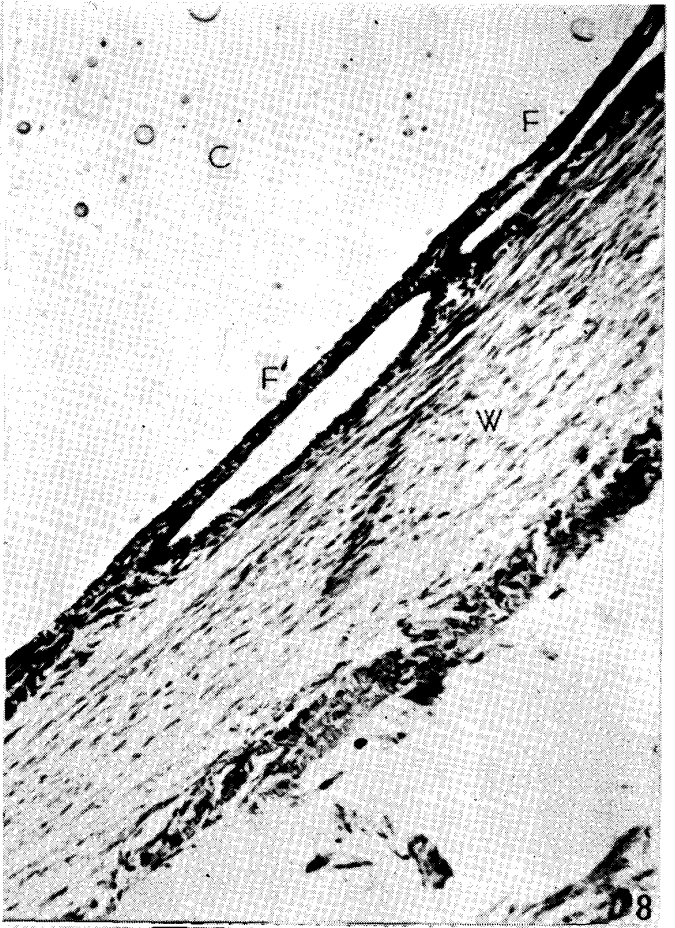
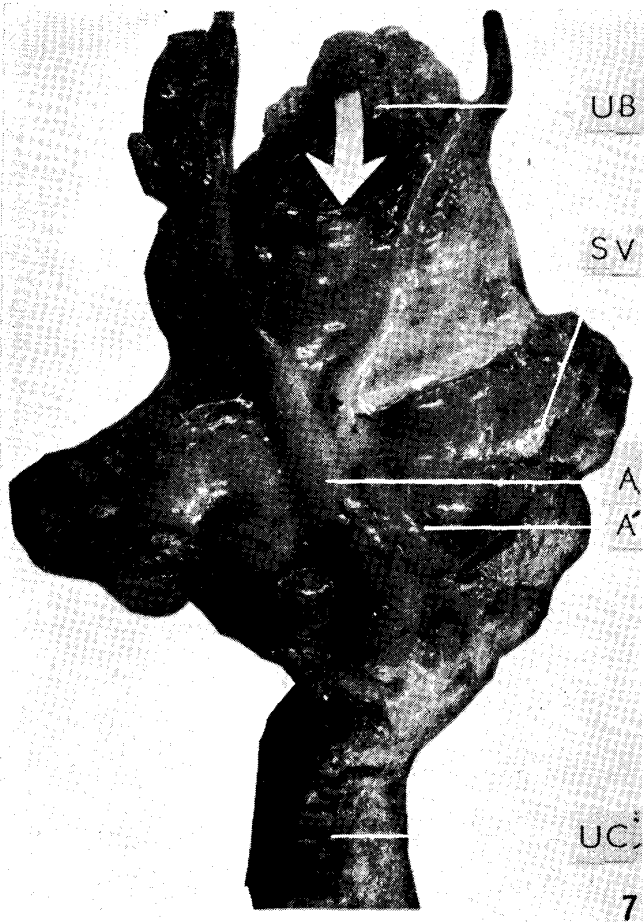
- Fig. 11. Bull No. H-31: Two small remnants of vesicular type are shown on anterior and medial parts of urogenital fold (arrows).
- Fig. 12. Microscopic picture of remnant on anterior part in fig. 11. A central cavity and many small accessory cavities surrounding it resemble the histological figure of immature heifer uterus. $\times 180$.
- Fig. 13. Bull No. H-32: Dorsal view of vesicular type of remnant shown in medial part of urogenital fold (arrow).

- Fig. 14. Microscopic picture of remnant in fig. 13 presents thick wall without accessory cavities. $\times 180$.

PLATE IV.

- Fig. 15. Bull No. H-34: Microscopic picture of remnant on anterior part of urogenital fold. Central cavity contains large quantity of secretory products. Accessory cavities show good development; some of them are markedly distended. $\times 180$.
- Fig. 16. Microscopic picture of remnant on posterior part of urogenital fold. $\times 180$.



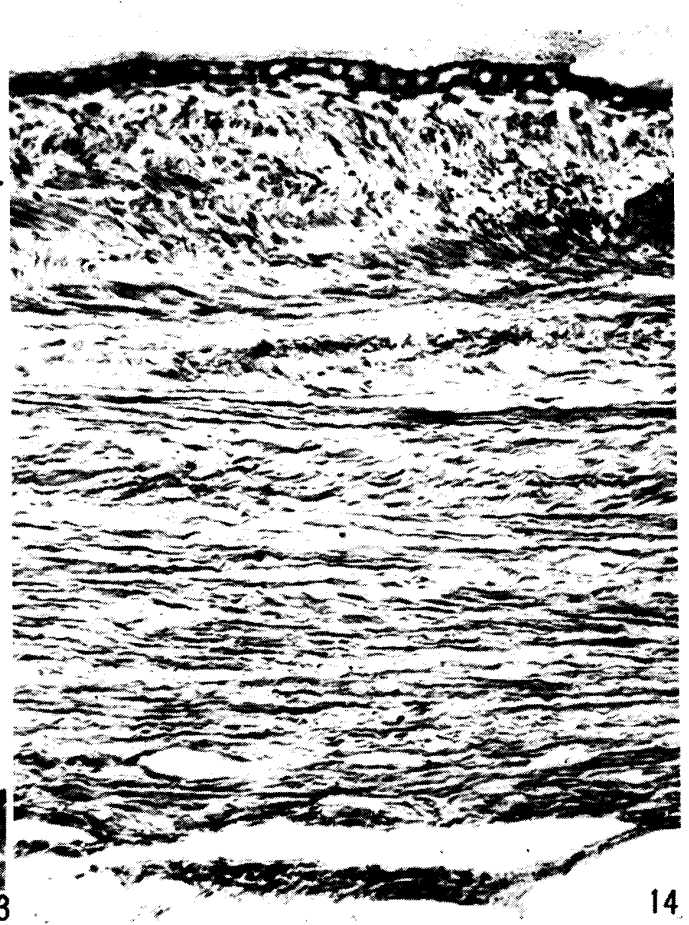




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