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# ANATOMICAL AND PATHOLOGICAL STUDIES ON THE SEX ORGANS FROM SLAUGHTERED BULLS IN HOKKAIDO*

## I. ANATOMICAL FINDINGS

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### INTRODUCTION

Recent progress in the technique of artificial insemination in the cattle and its rapidly widespread use in Japan, have brought about a considerable decrease in number of breeding bulls. At the same time, the tendency has appeared that only bulls of excellent quality are used most frequently for breeding. Thus, their reproductive capacity and hereditary factors offer very important problems in connection with bovine reproduction.

Since RICHTER reported in 1919 on the sterility of the he-goat, WILLIAMS & SAVAGE studied first the morphology of the bull sperm and discussed its reproductive capacity. Recently, in Sweden, LAGERLÖF and his co-workers have widely investigated the pathological and hereditary problems of bovine male reproduction[1,4,8]. In England, HAQ and HAQ & ROLLINSON studied abnormal epithelial cells lining the genital tract of the bull. While, in Denmark, BLOM & CHRISTENSEN made ontogenical and anatomical studies on the sex organs of the bull, many workers reported sterility problems of the bull in the United States. However, in Japan, male sterility of the cattle has not been reckoned with until recent years, while female sterility problems have been studied by many researchers.

In an attempt to clarify the present status of bovine male infertility in Hokkaido, the present author has studied the sex organs of slaughtered bulls from the anatomical and histo-pathological view-points. At the same time, in order to make easy the analysis of some relationships between the pre-mortem conditions and the post-mortem observations, efforts were made to gather as perfect clinical

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TABLE 1. *Materials Used and Clinical Data*

| BULL NO. | BREED | AGE (yr. mo.) | CAUSE OF DISPOSAL | SEMEN PICTURE | FERTILITY (average %) | USE FOR BREEDING | TRANSPORTATION AFTER PUBERTY | REMARKS |
|---|---|---|---|---|---|---|---|---|
| H-15 | Holstein | 8.1 | Impotence | Unknown | 82.7 | NS | – | |
| H-16 | " | 8.1 | Untamable temperament | " | 47.8 | AI→NS | + | |
| H-18 | " | 6.3 | Selection | Good | Good | NS→AI | + | |
| H-20 | " | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No response |
| H-21 | " | 10.10 | Bad semen character | Increase of abnormal sperm, oligozoospermia | Poor | AI | + | |
| H-22 | " | 5.7 | Prolonged gestation factor | Good | 84.0 | AI | – | |
| H-23 | " | 7.10 | Lameness | " | 68.5 | AI→NS | – | |
| H-26 | " | 3.0 | Use for meat | Unknown | ... | ... | – | Not yet used for breeding |
| H-28 | " | 4.8 | Selection | Good | Good | NS | – | |
| H-29 | " | 4.8 | " | " | 84.0 | NS | – | |
| H-30 | " | 9.4 | Senility | " | 90.0 | NS→AI | – | |
| H-31 | " | Unknown | Unknown | Unknown | Unknown | Unknown | Unknown | No response |
| H-32 | " | 5.0 | Lameness | Good | 95.0 | NS | – | |
| H-33 | " | 6.2 | Low fertility | Oligozoospermia | 60.1 | NS→AI→NS | – | |
| H-27 | Guernsey | 8.2 | Low fertility, lameness | Go od | 60.0 | NS | + | |

Notes: NS Natural service
AI Artificial insemination

histories and causes for disposal of the experimental bulls as possible. The present paper deals only with certain limited macroscopic findings; the remainder of the results obtained will be described later in this Journal.

## Materials and Methods

The materials used in this investigation were sex organs taken from 15 bulls slaughtered at Sapporo and Tsukisappu Abattoirs from April 1958 to July 1959. They consisted of 14 Holstein and one Guernsey bull; they ranged from 3 to 11 years of age. Their clinical data which were informed from the owners are outlined in table 1, including 2 cases without response. Immediately after the animals were slaughtered, these sex organs removed were examined macroscopically and measured in detail.

## Findings

1. In 11 cases, fibrous adhesions were observed macroscopically among the testis, epididymis and tunica vaginalis, as shown in table 2 and in the photographs. The adhesions were mostly bilateral, not only in old bulls but also in young ones.

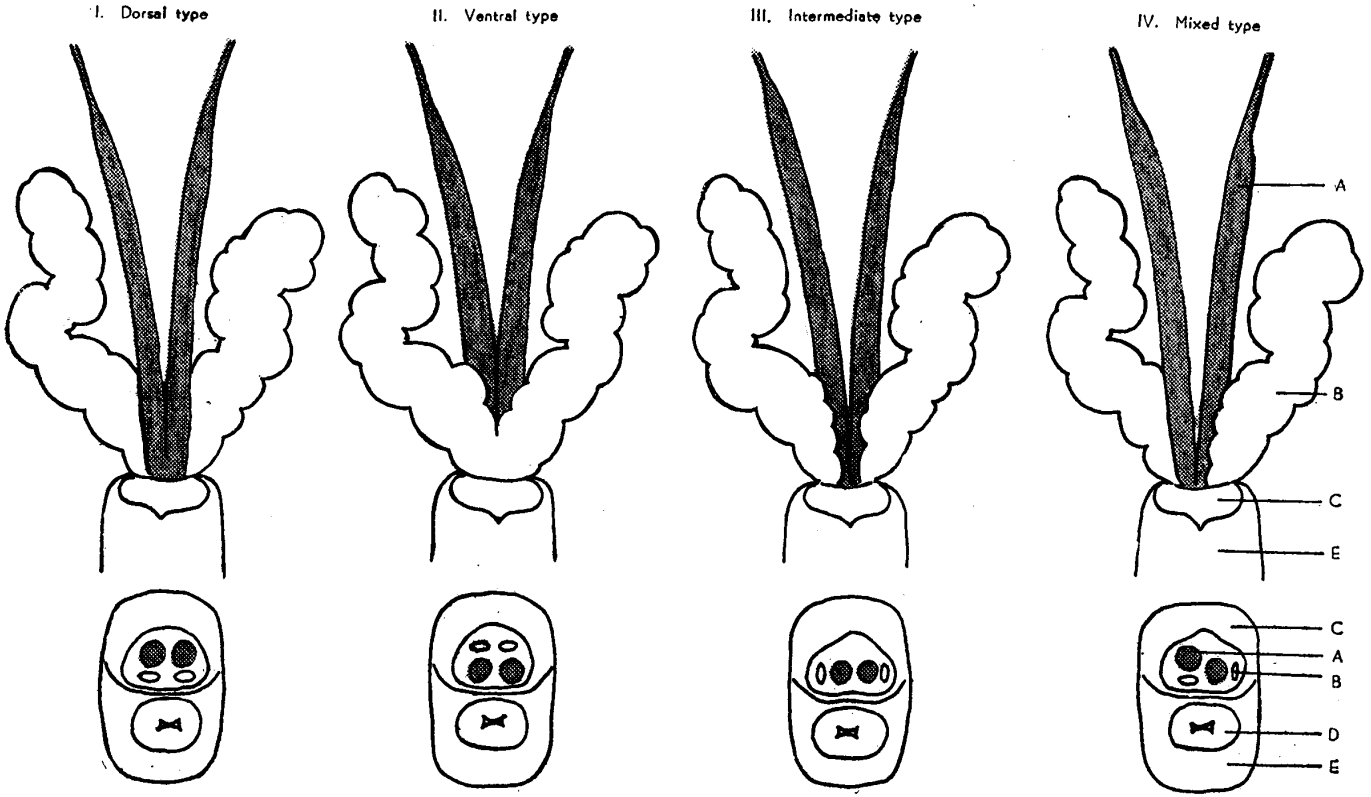
2. The four following types were categorized according to the differences in the anatomical positions in which the ampulla ductus deferentis attached to the seminal vesicle;

Table 2. *Adhesions in the Testis* and the Epididymis***

| Bull No. | Age (yr. mo.) | Testis | | Epididymis | |
|---|---|---|---|---|---|
| | | Right | Left | Right | Left |
| H 26 | 3.0 | − | − | − | − |
| H 28 | 4.8 | + | + | + | + |
| H 29 | 4.8 | + | + | + | + |
| H 32 | 5.0 | − | − | − | − |
| H 22 | 5.7 | + | + | + | + |
| H 33 | 6.2 | + | + | − | − |
| H 18 | 6.3 | + | + | + | + |
| H 23 | 7.10 | − | + | + | + |
| H 15 | 8.1 | − | − | + | − |
| H 16 | 8.1 | − | − | − | − |
| H 27 | 8.2 | + | + | − | − |
| H 30 | 9.4 | − | − | − | − |
| H 21 | 10.10 | − | + | + | + |
| H 20 | Unknown | + | + | + | + |
| H 31 | 〃 | + | + | − | − |

Notes: + Adhesion positive − No adhesion
* Adhesions between testis and epididymis or tunica vaginalis
** Adhesions between epididymis and testis or tunica vaginalis

CHART 1. *Schemata of Four Types of Attachment of the Ampullae to the Seminal Vesicles*




Notes: Schema of each type shows a dorsal view (upper) and a cross section through the body of prostate (below).

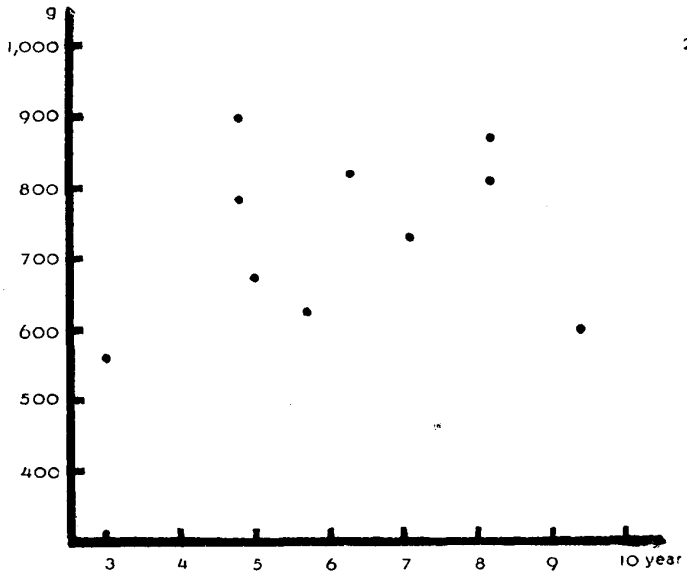
A. Ampulla ductus deferentis
B. Seminal vesicle
C. Body of prostate
D. Neck of bladder
E. Urethral muscle

TABLE 3. *Measurements of the Sex Organs*

| BULL NO | AGE | | TESTIS Sizes[*1] | TESTIS Weight | WEIGHT OF EPIDIDYMIS | AMPULLA D. D. Length | AMPULLA D. D. Diameter | SEMINAL VESICLE Sizes[*1] | SEMINAL VESICLE Weight | PROSTATE Size[*1] of Body | PROSTATE Length of P. D.[*2] | BULBO-URETHRAL GL. Sizes[*1] | BULBO-URETHRAL GL. Weight | LENGTH OF PENIS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | yr. mo. | | cm | g | g | cm | cm | cm | g | cm | cm | cm | g | cm |
| H-27[*3] | 8.2 | R[*4] | 13.4×8.2×7.7 | 490 | 38.0 | 9.0 | 1.4 | 11.3×5.5×3.1 | 96 | 3.8×1.4×1.6 | 10.2 | 2.9×1.7×1.5 | — | 111.7 |
| | | L[*5] | 13.5×8.2×7.8 | 515 | 41.5 | 8.6 | 1.3 | 10.5×5.0×3.0 | 87 | | | 3.0×1.9×1.7 | — | |
| H-26 | 3.0 | R | 10.9×6.2×7.1 | 286 | 36.0 | 10.3 | 0.9 | 9.0×4.3×1.8 | 48 | 2.3×1.6×1.0 | 8.3 | 2.8×1.5×1.5 | 4.3 | 113.0 |
| | | L | 10.6×7.1×6.9 | 276 | 38.0 | 10.5 | 0.9 | 9.7×4.0×2.4 | 48 | | | 2.5×1.6×1.2 | 4.7 | |
| H-28 | 4.8 | R | 12.4×7.7×7.7 | 408 | 48.5 | 13.7 | 1.4 | 11.0×2.8×4.3 | 59 | 3.3×1.2×2.8 | 12.4 | 2.0×1.7×1.5 | — | 110.0 |
| | | L | 11.8×7.7×7.8 | 389 | 46.5 | 13.7 | 1.3 | 12.0×2.7×4.6 | 59 | | | 3.4×1.5×1.7 | — | |
| H-29 | 4.8 | R | 13.9×7.5×7.7 | 458 | 59.0 | 13.0 | 1.2 | 10.2×4.4×2.7 | 58.5 | 3.6×1.4×1.8 | 15.6 | 4.1×2.5×2.0 | 11.5 | 121.0 |
| | | L | 13.4×8.0×7.8 | 445 | 64.0 | 12.1 | 1.3 | 10.4×4.9×2.6 | 50.0 | | | 4.0×2.8×2.0 | 8.5 | |
| H-32 | 5.0 | R | 12.0×7.0×7.0 | 340 | 55.0 | 13.5 | 1.5 | 10.2×5.5×3.5 | 75 | 2.0×1.5×2.0 | 14.5 | 3.9×1.5×2.0 | 7.2 | 108.5 |
| | | L | 12.6×6.2×7.1 | 335 | 55.0 | 13.5 | 1.4 | 9.6×4.4×4.0 | 80 | | | 3.9×1.5×2.0 | 6.5 | |
| H-22 | 5.7 | R | 13.0×7.3×7.7 | 350 | 58.0 | 10.2 | 1.1 | 12.0×4.8×3.3 | 88 | 3.0×1.2 — | 13.2 | 3.9×2.4×1.8 | 9.3 | 125.0 |
| | | L | 12.8×6.9×7.2 | 300 | 46.0 | 10.2 | 1.0 | 10.4×6.6×2.6 | 80 | | | 3.9×2.3×1.7 | 9.5 | |
| H-33[*6] | 6.2 | R | 13.0×6.1×6.0 | 240 | 40.0 | 15.0 | 1.2 | 11.3×5.2×2.7 | 80 | 2.5×2.1×1.3 | 14.6 | 4.5×2.3×1.9 | 10.0 | 109.6 |
| | | L | 12.9×6.5×6.4 | 260 | 40.0 | 14.4 | 1.3 | 10.8×3.7×2.7 | 75 | | | 4.0×2.6×1.8 | 9.8 | |
| H-18 | 6.3 | R | 12.7×8.5×5.7 | 362 | 108.0 | 11.0 | 1.3 | 10.3×4.6×2.8 | 96 | 4.1×2.0×1.8 | 11.8 | 2.5×2.0×1.8 | 5.0 | 123.0 |
| | | L | 13.6×8.5×6.2 | 462 | 103.0 | 10.6 | 1.4 | 10.9×5.7×3.4 | 74 | | | 1.8×1.9×1.7 | 6.5 | |
| H-23 | 7.10 | R | 12.7×7.6×7.2 | 370 | 50.0 | 15.5 | 1.3 | 15.1×4.6×2.8 | 135 | 2.8×1.9×1.5 | 10.9 | 3.7×2.2×1.5 | 6.3 | 120.0 |
| | | L | 12.6×7.5×7.4 | 368 | 60.0 | 15.5 | 1.2 | 14.3×6.4×3.2 | 132 | | | 3.7×2.2×1.5 | 6.7 | |
| H-15 | 8.1 | R | 13.6×8.4×7.0 | 400 | 90.0 | — | 0.9 | 8.5×5.0×1.7 | 53 | 3.4×1.8×0.9 | 10.5 | 3.0×1.9×1.0 | 5.6 | 130.0 |
| | | L | 13.8×8.0×6.6 | 410 | 80.0 | — | 1.2 | 9.1×4.0×1.3 | 49 | | | 2.9×2.0×0.8 | 6.1 | |
| H-16 | 8.1 | R | 16.3×7.5×7.3 | 475 | 85.0 | — | — | 10.9×4.2×2.8 | 99.5 | 3.4×1.6×1.8 | 10.0 | 2.6×2.4×2.0 | 10.0 | 125.0 |
| | | L | 15.0×7.8×7.0 | 400 | 100.0 | — | — | 11.4×4.3×2.8 | 99.5 | | | 3.2×2.2×1.5 | 8.0 | |
| H-30 | 9.4 | R | 10.7×7.1×6.9 | 320 | 40.0 | 15.8 | 1.6 | 12.4×5.8×2.5 | 90 | — | 12.5 | 3.0×2.6×2.2 | 10.0 | 104.0 |
| | | L | 10.8×6.8×6.8 | 280 | 30.0 | 15.0 | 1.4 | 13.6×3.5×3.2 | 75 | | | 3.5×2.6×2.0 | 8.0 | |
| H-21 | 10.10 | R | 11.1×8.2×6.9 | 380 | 62.0 | 15.4 | 1.3 | 14.2×6.7×3.8 | 128 | 1.7×1.6×1.2 | 11.0 | 3.1×1.5×1.4 | 5.7 | 132.0 |
| | | L | 13.8×7.0×7.3 | — | | 15.1 | 1.7 | 13.9×5.8×3.4 | 122 | | | 3.1×1.7×1.6 | 5.8 | |
| H-20 | Unknown | R | 12.4×7.1×6.6 | 312 | 84.0 | 13.1 | 1.2 | 12.6×5.5×2.9 | 120 | 2.4×1.3×2.3 | 10.6 | 3.2×2.2×1.6 | 17.0 | 111.0 |
| | | L | 11.7×7.3×6.4 | 325 | 108.0 | 12.7 | 1.2 | 13.0×4.2×3.1 | 110 | | | 3.0×2.1×1.5 | 15.0 | |
| H-31 | Unknown | R | 12.7×8.0×7.9 | 440 | 60.0 | 15.0 | 1.4 | 12.3×3.3×2.5 | 60 | 2.0×1.5×1.7 | 10.7 | 2.0×1.6×3.8 | 6.8 | 109.0 |
| | | L | 12.0×7.8×7.9 | 425 | 60.0 | 15.5 | 1.4 | 10.4×4.3×3.2 | 60 | | | 2.5×1.7×3.8 | 7.0 | |

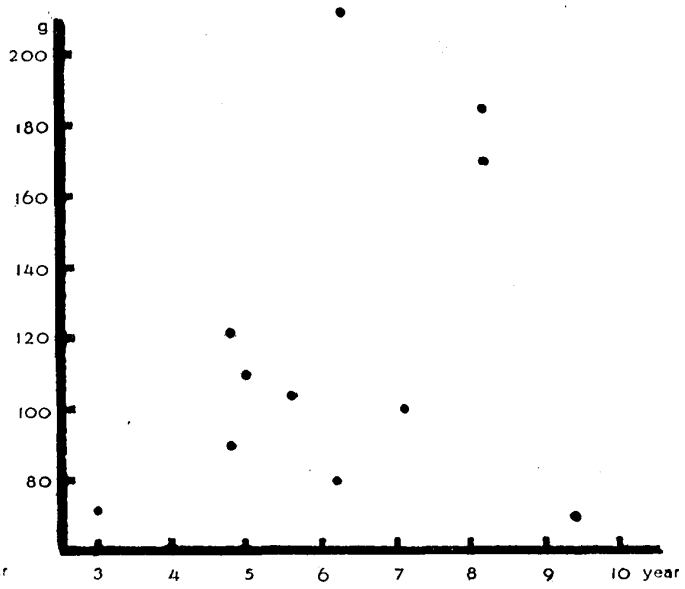
Notes: [*1] Length × width × thickness
[*2] Pars disseminata
[*3] Guernsey
— Missing data
[*4] Right
[*5] Left
[*6] Both testes showing marked atrophy due to chronic orchitis

CHART 2. *Correlation between Age and both Testes Weight*



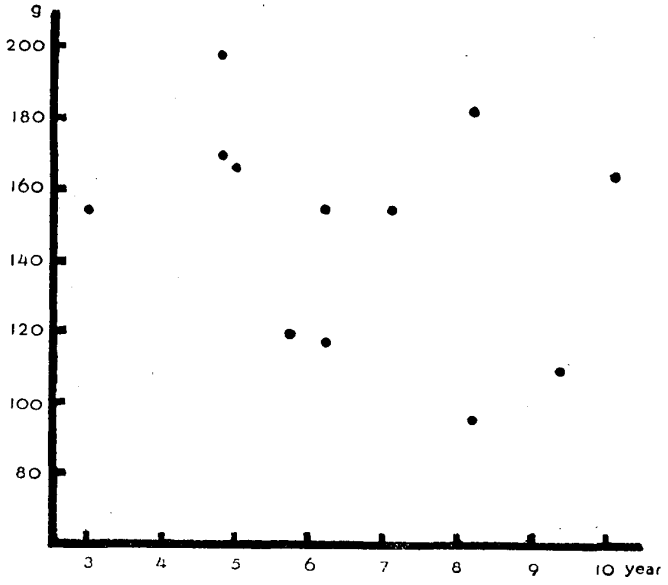

Note: Except H–20, 21, 27, 31 and 33

CHART 3. *Correlation between Age and both Epididymides Weight*



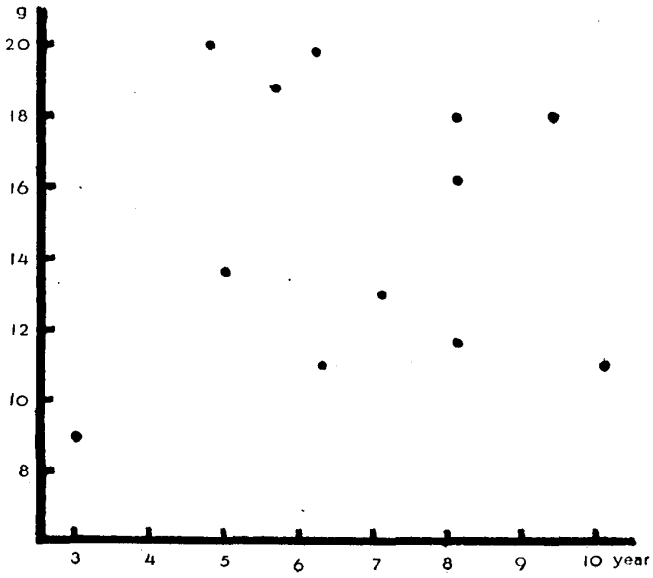

Note: Except H–20, 21, 27 and 31

CHART 4. *Correlation between Age and both Seminal Vesicles Weight*




Note: Except H–20, 27 and 31

CHART 5. *Correlation between Age and both Bulbo-Urethral Glands Weight*




Note: Except H–20, 27, 28 and 31

(1) Dorsal type—dorsal attachment of the ampullae to the seminal vesicles. Seven cases were included in this type.
(2) Ventral type—ventral attachment of the ampullae to the seminal vesicles. Only one case fell into this type.
(3) Intermediate type—intermediate attachment of the ampullae to the seminal vesicles. Five cases were included in this type.
(4) Mixed type—dorsal attachment of the right ampulla and intermediate attachment of the left ampulla to each seminal vesicle. Two cases belonged to this type.

Schemata of these four different types are presented in chart 1.

3. The measurements of the sex organs are shown in detail in table 3. The reciprocal differences between the sizes of the right side of the testis, epididymis, seminal vesicle and bulbo-urethral gland on the one hand and those of the left side on the other were analyzed statistically, without, however, any significant difference being discovered for the organs. Similarly, in the Holstein bulls in which clinical and measurement data were available, no correlation was found between the weights of each sex organ and ages of the animals (Charts 2, 3, 4 & 5).

## Discussion

The clinical significance of the fine fibrous adhesions among the testis, epididymis and tunica vaginalis is not yet entirely clear but the clinical data, macroscopical observations as well as microscopical findings, which will be described later in this journal, will show that these adhesions have not much to do with the function of the testis and epididymis, since the semen picture and fertile activity thereof have revealed little abnormality. These adhesions may be due to various factors including traumatic or mechanical injuries. The testes seem to be easily affected by these various factors, because they are located in the scrotum and hang beneath the abdomen of the animal.

As for the anatomical variations in the attachment of the ampulla ductus deferentis to the seminal vesicle, Blom & Christensen reported that the dorsal, ventral and intermediate types were found in 40, 38.2 and 21.8 per cent, respectively, of their examined 55 adult Danish bulls. In the present author's observation, however, only one case of the ventral type was found, but the total number of cases examined was not sufficient. In addition, in 2 cases a new type was detected in which the right ampulla was in an intermediate position, while the left was in a dorsal position. These anatomical variations in the attachment of the ampulla to the seminal vesicle may be ontogenical without any effect on the function of these organs. Furthermore, no correlation was observed between these four types and the ages of the animals.

The results of the measurement of each sex organ were almost in accordance with those described by many authors, such as Blom & Christensen, Derivaux

et al., KEHL and LAGERLÖF. The reciprocal differences between the sizes of the right testis, epididymis, seminal vesicle and bulbo-urethral gland on the one hand and those of the corresponding organs of the left on the other were similar to the values reported by DERIVAUX et al. As for the comparison in weight of each testis, however, KUGIMOTO examined 36 Japanese Holstein-Friesian bulls, and reported that in 83.3 per cent the right testis was heavier than the left one. Unfortunately, at present, the number of the cases examined is too small for gathering adequate data to be subjected to statistical analysis.

## SUMMARY

Anatomical investigations were made on the sex organs obtained from 15 bulls.

The findings obtained were as follows:

1. Among the testis, epididymis and tunica vaginalis, fine fibrous adhesions were observed in 11 cases; most of the adhesions were bilateral.

2. The differences in the anatomical positions of attachment of the ampulla to the seminal vesicle were classified into four types: dorsal (5 cases), ventral (1), intermediate (7) and mixed types (2).

3. The reciprocal differences between sizes of the right testis, epididymis, seminal vesicle and bulbo-urethral gland on the one hand and those of the left on the other were statistically insignificant, respectively. Likewise there was no correlation between the ages of the animals and weights of these organs.

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## EXPLANATION OF PLATE

Fig. 1.

Cases No. H-18: Lateral outside view of left testis with epididymis and a part of tunica vaginalis. A string-like fibrous adhesion between testis and tunica vaginalis (arrow) and many fine fibrous adhesions between testis and epididymis are observed. (Scale: cm).

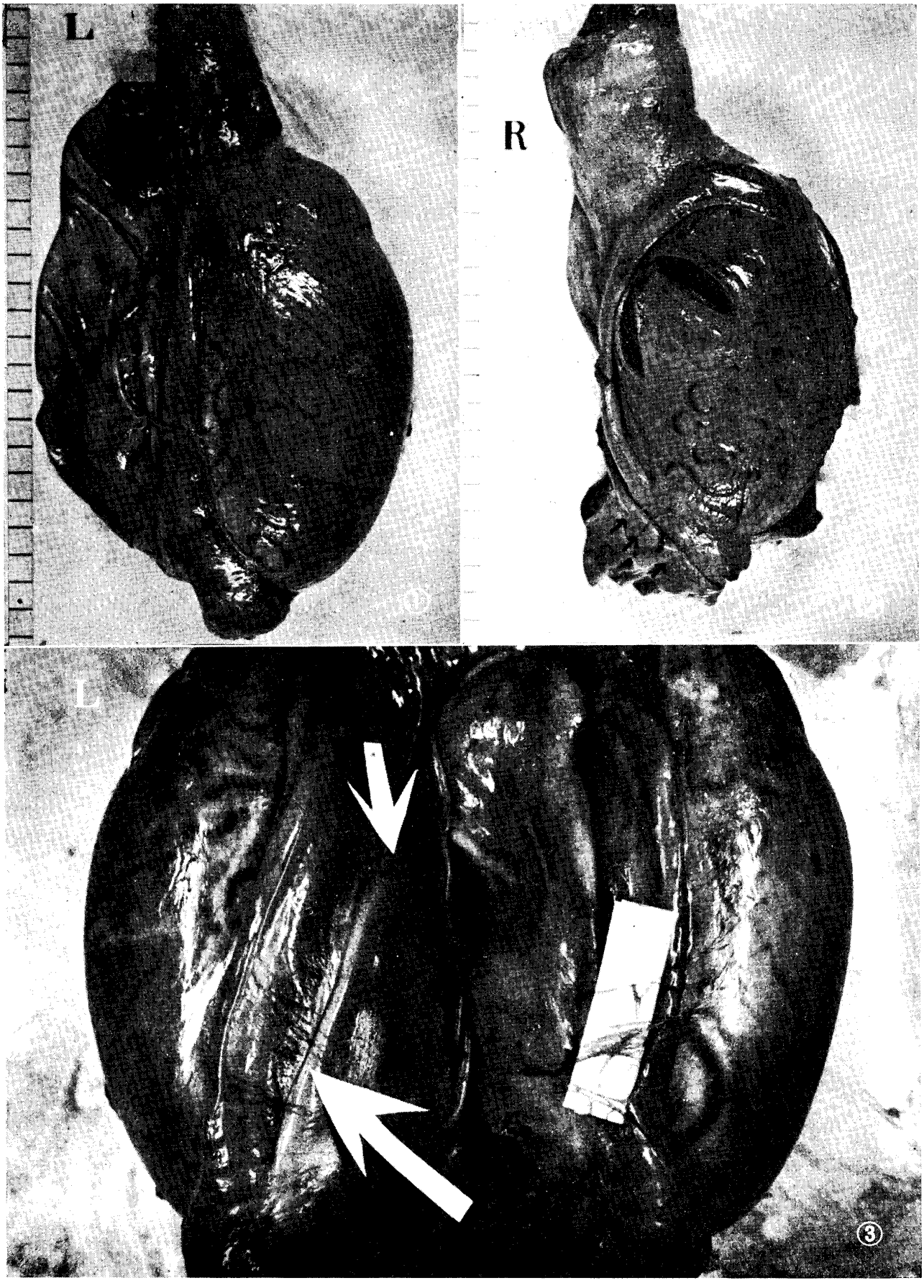
Fig. 2.

Case No. H-18: Lateral outside view of right testis with epididymis and a part of tunica vaginalis. Several fine fibrous adhesions between testis and tunica vaginalis are seen (arrows). (Scale: cm).

Fig. 3.

Case No. H-28: Lateral outside views of right (R) and left (L) testes. Among each testis, epididymis and tunica vaginalis, many fine adhesions are shown in both sides.

Fine fibrous adhesions of the other cases resemble those of this case in most respects.


L
R
L
③