A HISTOLOGICAL STUDY OF SENSORY NERVES IN THE EPIDIDYMIS, SPERMATIC CORD AND PROSTATE GLAND

by

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I. INTRODUCTION

The existence of sensitivity in the male sexual organs has been physiologically proved by LANGLEY, EDGEWORTH, ASAI, KUBO, KAWAKAMI and others.

CH. KIMURA and Y. YOSHIIKE of our laboratory have also proved, from the experiments in human beings, dogs and cats, the existence of sensitivity in the male sexual organs by stimulating them with direct stimuli, electric faradization or by injecting acetylcholine into them. The histological studies of the nerves in the male sexual organs have been reported by LELZTERICH, RETIUS, SCLAVUNOS, TIMOFEEW, KUNZ, PINES, MAIMAN, OKKELS and SAND etc.

SETO and YAMASHITA have done histological studies and reported the existence of sensory nerve endings in the connective tissues of the testis, ampullar portion of the spermatic cord and in the prostate gland, but they have not described about them in the epididymis or the spermatic cord (except the ampullar portion), nor traced the roots.

Pursuing the secondary degeneration in the organs of peripheral innervation after section of the dorsal spinal roots and the vagal nerve trunks, KIMURA and OTSU have studied the distribution of the visceral sensory nerves and the sites of their roots in the spinal cord, which were described in their paper "Systematic Observation of the Visceral Sensory Nerves".

Moreover, OTSU, TANAKA, INOUE, MAKINO, IN and others of our clinic have found sensory nerves in all the digestive organs and in the biliary tract and as

for the urogenital organs, SATO, OTSUJI and YOSHIDA have studied histologically the sensory nerves in the ovary, the testis, the kidney, the ureter and in the urinary bladder together with sites of their roots.

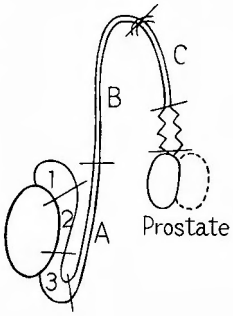
KIMURA and YOSHIIKE have proved physiologically that the spermatic cord from the epididymis to the inguinal region is innervated principally by the thoracolumbar sympathetic sensory nerves and that from the inguinal region to the prostate gland it is mainly innervated by the sacral sensory nerves. But there is no literature reporting histological demonstrations of this problem.

The author's study was carried out to determine sensory innervation in the epididymis, the spermatic cord and in the prostate gland.

II. MATERIALS AND METHODS

The materials used in this study were the male genital organs of human beings and adult dogs. The author used only fresh specimens taken from the epididymis, the spermatic cord and the prostate gland which had been resected operatively. After dividing them into such portions as shown in TABLE 1, the author fixed them in 10% neutral formol solution for 3~4 weeks. The specimens

TABLE 1



Epididymis	1.	Caput epididymis
	2.	Corpus epididymis
	3.	Cauda epididymis.
Spermatic cord	4. A	--- Pars epididymica
	5. B	--- between pars epididymica and the external ring
	6. C	--- between the external ring and the ampulla portion
Prostate gland	8.	Right lobe
	9.	Left lobe

were frozen, sliced in thickness of 35~40μ, fixed again in 10% neutral formol solution for more than 2~4 months, and then stained. The axis-cylinder was stained with SETO's or SUZUKI's modification of BIELSCHOWSKY's silver impregnating method, while the myelin sheath was stained with EHRLICH's acid hematoxyline method. Then in order to determine the sites of roots of the sensory nerves in the epididymis, spermatic cord and prostate gland, the dorsal roots of the spinal cord, the sacral nerves and the vagal nerves were cut.

LEHMAN, OKINAKA and NITTA have proved by their physiological studies that the afferent nerves pass through the ventral spinal roots. For the purpose of

confirming their opinion histologically, the author sectioned the ventral spinal roots and studied the secondary degeneration in these organs.

According to the results of many experiments performed by investigators of our clinic, peripheral nerves demonstrate secondary degeneration 5～6 days after section of the roots of the spinal cord. Therefore, the male genital organs of dogs were extirpated 5～6 days after rhizotomy. But in the case of the vagal nerves the author made most preparations of specimens 7～8 days after vagotomy, because our previous experiments showed that the optimal conditions for studying secondary degeneration are 7～8 days after vagotomy.

Operations were carried out under general anesthesia with the injection of isomytalsodium, and thoracotomy was performed under positive pressure breathing. The animals were sacrificed under general anesthesia by being bled to death by cutting the femoral artery. Specimens were taken immediately.

Operations were performed as follows:

Ist Group

(1) Section of the dorsal roots on the right side (Th.10…Th. 13)
(2) Section of the ventral and dorsal roots on the right side (Th. 10…L. 4)
(3) Section of the ventral roots on the right side (Th. 10…L. 4)
(4) Section of the ventral and dorsal roots on the right side (L. 1…L. 4)
(5) Section of the dorsal roots on the right side (L. 1…L. 4)
(6) Section of the ventral and dorsal roots on the right side (L. 5…L. 7)
(7) Section of the dorsal roots on the right side (L. 5…L. 7)

IInd Group

(1) Section of the ventral and dorsal roots on the right side (S. 1…Co. 5)
(2) Section of the ventral and dorsal roots on the right side (S. 1…S. 3)
(3) Section of the dorsal roots on the right side (S. 1…S. 3)
(4) Section of the ventral roots on the right side (S. 1…S. 3)

IIIrd Group

(1) Cervical vagotomy on the right side at a point distal to the ganglion nodosum
(2) Cervical vagotomy on the left side at a point distal to the ganglion nodosum
(3) Bilateral vagotomy in the thorax

III. MICROSCOPIC OBSERVATION IN THE EPIDIDYMIS, SPERMATIC CORD AND PROSTATE GLAND

(1) Intrinsic nerves of the epididymis (human beings and adult dogs)

By staining with BIELSCHOWSKY-SETO's silver method and BIELSCHOWSKY-SUZUKI's silver method, the author found many nerve bundles (which had been recognized by YAMASHITA) in the connective tissues around the tunica vaginalis propria and in the submucous layer of the epididymis (Fig. 1, 2). After branching several times the fibers of the nerve bundles became finer and finer and penetrated the connective tissues of the epididymis, where they formed a network

structure, i. e., the vegetative terminal networks or nervous syncytia (Fig. 3, 4).

The author found, on the other hand, special nerves having much thicker diameter and varicosities which suggested a sensory nature. Especially abundant nerve fibers were found in the connective tissues around the tunica vaginalis propria including afferentes as well as vegetative nerves (Fig. 5).

YAMASHITA did not find sensory nerve fibers in the epididymis, but the author, both in human beings and dogs, recognized nerves which were quite different from the autonomic fine nerves (Fig. 6, 7), and they never showed complicated endings but seemed to end freely or in arborizations.

Nerve cells were never found in the epididymis.

Using EHRLICH's acid hematoxyline method the author found many myelinated fibers, forming nerve bundles together with nonmyelinated fibers in the connective tissues around the tunica vaginalis propria and the submucous layer of the epididymis. They might be afferent nerves (Fig. 8, 9).

(2) Intrinsic nerves of the spermatic cord (human beings and adult dogs)

In the specimens stained by EHRLICH's method many myelinated fibers were found in the connective tissues of the tunica vaginalis propria. But the author could not find them in the muscular layers of the spermatic cord in the specimens from human beings and dogs.

In specimens stained by silver impregnation many autonomic nerve fibers were found in the muscular layer and the submucous layer. They formed vegetative terminal networks.

As for the sensory nerves, the author confirmed the existence of sensory nerves running simply and freely in the muscular layer and the submucous layer not only in the ampullar portion but also in the middle portion of the spermatic cord (Fig. 10, 11). A greater number of them were found in the ampullar portion, but very few in other portions (Fig. 12, 13, 14).

A group of nerve cells was recognized in the connective tissue of the ampullar portion of the spermatic cord, but none in other portions.

(3) Intrinsic nerves of the prostate gland (human beings and adult dogs)

The existence of sensory nerves in the prostate gland was reported by SETO. The author found them entering into the submucous layer, and terminating in free endings or in terminal arborizations (Fig. 15, 16, 17, 18).

Nerve cells were found mainly in the connective tissue of the prostate gland (Fig. 19, 20, 21, 22).

(Supplement): Nerves in the hypertrophic prostate gland

Normal sensory nerve fibers were found in some parts of the submucous layer, but there were fewer than in normal specimes (Fig. 23).

On the other hand, some sensory nerve fibers were broken and others howed abnormal thick varicosities which suggested the early state of granular change (Fig. 24, 25, 26).

IV. DEGENERATION EXPERIMENTS OF THE SENSORY NERVES IN THE EPIDIDYMIS, SPERMATIC CORD AND PROSTATE

GLAND

Using adult dogs as experimental animals, operations were performed as follows:

Laminectomy was performed under general anesthesia with sodium isomytal. The spinal canal was opened, and the dorsal and ventral roots were separated carefully from each other and only the ventral or the dorsal roots were cut at a point distal to their ganglia. The male sexual organs were mostly resected 5～6 days after rhizotomy.

Vagus nerves were cut on one side in the neck distal to the ganglion nodosum or on both sides in the thorax under positive pressure breathing. Specimens were taken out more than 6～7 days after vagotomy, and stained with EERLICH'S hematoxyline method.

Ist Group

(1) Section of the dorsal roots on the right side (Th. 10…Th. 13)

A very few degenerated nerve fibers were found in the connective tissue of the epididymis only on the right side (Fig. 27), but no degeneration was found in other portions : in the epididymis on the left side, the spermatic cord on either side and in the prostate gland.

(2) Section of the ventral and dorsal roots on the right side (Th. 10…L. 4)

In the epididymis and in the connective tissue around the tunica vaginalis of the spermatic cord A and B (see TABLE 1) on the right side, numerous degenerated nerve fibers were recognized. In some, all of the myelinated fibers of nerve bundles had degenerated. In the spermatic cord C and the ampullar portion on the right side and in the right lobe of the prostate gland, a few degenerated nerve fibers were found (Fig. 28, 29, 30). But no degenerated nerve fibers were found in the epididymis on the left side, the spermatic cord on the left side and in the left lobe of the prostate gland.

(3) Section of the ventral roots on the right side (Th. 10…L. 4)

No degenerated fibers were found in the epididymis, the spermatic cord, or in the lobe of the prostate gland on either side.

(4) Section of the ventral and dorsal roots on the right side (L. 1…L. 4)

(5) Section of the dorsal roots on the right side (L. 1…L. 4)

Both cases showed the same results as (2): in the epididymis and in the connective tissue around the tunica vaginalis propria of the spermatic cord A, B on the right side, many degenerated nerve fibers were found, and in some all the myelinated fibers of the nerve bundles had degenerated (Fig. 31, 32, 33, 34).

A few degenerated fibers were found in the spermatic cord C and ampullar portion on the right side and in the right lobe of the prostate gland.

On the other hand, no degenerated nerve fibers were found in the epididymis, the spermatic cord, or in the lobe of the prostate gland on the left side.

(6) Section of the ventral and dorsal roots on the right side (L. 5…L. 7)

(7) Section of the dorsal roots on the right side (L. 5…L. 7)

In both cases no degenerated nerve fibers were found in the epididymis,

spermatic cord, or prostate gland.

IInd Group

(1) Section of the ventral and dorsal roots on the right side (S. 1…Co. 5)

(2) Section of the ventral and dorsal roots on the right side (S. 1…S. 3)

(3) Section of the dorsal roots on the right side (S. 1…S. 3)

In cases (1), (2) and (3), a considerable number of degenerated myelinated nerve fibers in the right lobe of the prostate gland were recognized, and in some nerve bundles all of the myelinated nerve fibers were destroyed (Fig. 35, 36, 37, 38).

A considerable number of degenerated myelinated fibers were observed in the connective tissue of the spermatic cord C and the ampullar portion on the right side (Fig. 39). But no degenerated myelinated fibers were found in other portions: the epididymis on both sides, the spermatic cord A and B on the right side, or the spermatic cord on the left side.

As for the prostate gland, in the connective tissue of the median portion of the left lobe a few degenerated myelinated fibers were found, but none in other portions of the left lobe (Fig. 40, 41).

(4) Section of the ventral roots on the right side (S. 1…S. 3)

A very few degenerated myelinated fibers were found only in the right lobe of the prostate gland (Fig. 42), but none in any other portions.

IIIrd Group

(1) Cervical vagotomy on the right side at a point distal to the ganglion nodosum

(2) Cervical vagotomy on the left side at a point distal to the ganglion nodosum

(3) Bilateral vagotomy in the thorax

In none of the cases was there any secondary degeneration of the nerves in the epididymis, spermatic cord or prostate gland.

V. DISCUSSION

In regard to the peripheral structure of the autonomic nerves, many investigators have described a fine network. Stoehr named it "Terminalreticulum" and Jaeonero "Nervoese Synztium" and they maintain that the autonomic nerve fibers never show free endings in the network.

Prof. H. Seto (Tohoku University) distinguished special nerve fibers in viscera which are much thicker than the autonomic nerve fibers and terminate in free endings. He designated these nerves as visceral sensory nerves and described the existence of sensory nerve endings in the male sexual organs : in the testis, the connective tissues around the tunica vaginalis propria, ampullar portion of the spermatic cord and in the prostate gland.

Edgeworth, Langley, Fulton and Kunz have physiologically or histologically proved that the visceral afferent nerves pass through the dorsal spinal roots. Moreover Langley insisted that the visceral afferent nerves have their cells in the

dorsal spinal root ganglia and reach the effector organs without intermittent neurons on the way.

The existence of visceral afferent fibers in the pelvic nerves was histologically as well as physiologically confirmed by LANGLEY, ANDERSON, KUNZ, WHITE, NITTA, KUBO, YOSHIIKE and others.

NEUMANN, FULTON, WHITE, KUBO, ASAI, and others described visceral afferent nerves in the vagus, and RANSON, CLARKET and others reported that visceral afferents of the vagus have their cell-stations in the ganglion nodosum.

Considering the above points, KIMURA and OTSU have made the following important conclusions: (1) The visceral sensory nerve is myelinated in the periphery even near the ending. (2) The visceral sensory nerves have their cell-stations in the dorsal root ganglia, or in the ganglion nodosum of the vagus and reach the effector organs with single neurons. Therefore, the nerve roots were cut distal to these ganglia, and several days after the section visceral sensory nerves showed secondary degeneration in such peripheral tissue as the mucous membrane of the alimentary cannal or the parenchymatous tissues in the ovary. In such peripheral tissues, the autonomic fibers must be postganglionic fibers after changing neurons. KIMURA and OTSU found degenerated nerve fibers in these peripheral portions as well as non-degenerated fibers. The former were detected as afferents. Therefore, the visceral afferent nerves are generally demonstrable as degenerated nerve fibers in the viscera at the portions distal to the intramural nerve cells after posterior rhizotomy or vagotomy.

Using this method histological studies of sensory nerves in various viscera have been reported by many investigators of our clinic ; i. e., TANAKA in the esophagus, OTSU in the stomach, INOUE in the biliary tract, MAKINO in the small intestine, IN in the colon, WANG in the sigmoid and rectum, SATO in the ovary, OTSUJI in the testis and YOSHIDA in the urinary organs.

By the systematic observation of sensory nerves in the male sexual organs, KIMURA and YOSHIIKE have proved physiologically that the testis, epididymis and spermatic cord from the epididymis to the external ring (spermatic cord A, B) are predominantly innervated by the thoracolumbar sensory nerve and the portion between the external ring (spermatic cord C and ampullar portion) and the prostate gland are mainly innervated by the sacral sensory nerves.

Considering the histological and physiological studies above mentioned, the author investigated the normal structure and innervation of the sensory nerves in the epididymis, the spermatic cord and in the prostate gland.

(1) The normal afferent nerve

The author believes in the existence of sensory nerves in the submucous layer of the epididymis, spermatic cord and prostate gland of human beings and adult dogs. SETO and YAMASHITA described sensory nerve endings in the connective tissue around the tunica vaginalis propria testis of the epididymis, the ampullar portion of the spermatic cord and in the prostate gland.

In addition to these portions, the author demonstrated a few sensory nerves

in the connective tissue and the submucous layer of the epididymis and in the muscular and submucous layer of the spermatic cord. These sensory nerve endings never show a complicated apparatus but they seem to terminate in free endings. However, TSEI of our clinic studied the afferent nerves in the liver and maintains that some visceral sensory nerves, though they apparently seem to terminate in free endings, sometimes change into fine fibrils forming networks like the autonomic nerves, terminal expansions or special end apparati. Therefore, the author considers that the free endings of the visceral sensory nerves must be more closely examined.

In the hypertrophic prostate gland, some thick nerve fibers are broken and swollen, and some others have many granular varicosities. From these facts, the neurohistological appearance of the hypertrophic prostate gland is coincidental with that of chronic inflammations or precancerous tissues: showing some stimulated and other degenerated nerve fibers in the same specimen.

(2) The thoraco-lumbar afferent innervation

After section of the ventral and dorsal roots (Th. 10…L. 4), the ventral and dorsal roots (L. 1…L. 4) and the dorsal roots (L. 1…L. 4) on the right side, the secondary degenerated myelinated nerve fibers showed similar results: a majority of them were found in the epididymis, spermatic cord A and B (see TAELE 1) on the right side and a few in the spermatic cord C and the ampullar portion and in the lobe of the prostate gland on the right side, but no change in the myelinated nerve fibers was found on the left side.

After section of the ventral and dorsal roots (L. 5…L. 7) on the right side, no secondary degeneration was found throughout the epididymis, the spermatic cord and the lobe of the prostate gland on either side.

The results of these experiments indicate that a majority of the myelinated fibers in the epididymis and the spermatic cord between the epididymis and the inguinal ring pass through the thoracolumbar afferent nerves from Th. 10 to L. 4, mainly from L. 1 to L. 4, and a minority of the myelinated nerve fibers in the spermatic cord from the inguinal ring to the prostate gland and in the prostate gland pass through the thoraco-lumbar afferent nerves, and they have homolateral innervation.

The results of these experiments coincide with those of the physiological experiments by YOSHIIKE.

(3) The sacral afferent innervation

Antero-postero rhizotomy at S. 1…Co. 5, S. 1…S. 3 on the right side and posterior rhizotomy at S. 1…S. 3 on the right side, caused the same degeneration of the myelinated nerve fibers: there were many degenerated myelinated nerve fibers in the right lobe of the prostate gland, the right ampullar portion of the spermatic cord, and in the connective tissue around the tunica vaginalis propria in the right spermatic cord C, and only a very few degenerated fibers in the left lobe of the prostate gland. But no degeneration was found in any other sportion: i. e., in the epididymis on either side, in the spermatic cord A and B on either

side, in the spermatic cord C or the ampullar portion on the left side.

After anterior rhizotomy at S. 1···S. 3 on the right side, a few degenerated myelinated nerve fibers were found distal to the nerve cells in the right lobe of the prostate gland.

These results indicate that a majority of the myelinated nerve fibers in the spermatic cord between the inguinal ring and the prostate gland, pass through S. 1···S. 3 of the sacral posterior roots on the same side, and that the lobe of the prostate gland is under the same sacral sensory innervation as these regions of the spermatic cord; the only difference between these two is that very few sensory nerve fibers extend to the lobe of the prostate gland on the opposite side. The author's results as to the sacral sensory innervation of these organs also agree with the physiological findings of YOSHIIKE.

OTSUJI's and SATO's histological studies of the afferent innervation in the testis and the ovary of the dog led them to believe that there is sacral afferent innervation, though very slight. Therefore, posterior sacral afferent innervation may be expected in the epididymis and the spermatic cord around it (spermatic cord A, B). So the author looked for sacral afferent innervation in many dogs, but could not find any. Therefore, it is doubtful whether such innervation exists.

(4) Vagal afferent innervation

Using KIMURA and OTSU's experimental method, the author sectioned the vagus distal to the ganglion nodosum in the neck or in the thorax. But no degeneration of the myelinated fibers was found in the epididymis, the spermatic cord, or in the prostate gland. As to vagal sensory innervation in the sexual organs from the physiological point of view, KUBO (in the frog's ovary) and ASAI (in the rabbit's ovary) found it, though very slight. But SATO (in the dog's ovary) and OTSUJI (in the dog's testis) found none in their histological studies. These facts and the author's results suggest that there is probably no vagal sensory innervation of the epididymis, the spermatic cord and the prostate gland.

By studying myelinated afferent innervation, the author has described the spinal segment problem of the visceral sensory innervation in the epididymis, spermatic cord and prostate gland. The author, however, cannot deny other sensory nerve innervation besides these two. Moreover the author has not reported on the non-myelinated visceral sensory nerves or the sensory nerves contained in the "Terminalreticulum" described by STOEHR.

VI. CONCLUSION

Using EHRLICH's acid hematoxyline method, and modified BIELSCHOWSKY's silver method, the author studied the sensory nerves in the epididymis, the spermatic cord and in the prostate gland.

The results are summarized as follows:

(1) Myelinated nerve fibers are found in the epididymis, the connective tissue around the spermatic cord and in the prostate gland. Some of them degenerate after posterior rhizotomy at the periphery near the endings proving the existence

of afferent nerve fibers in these organs.

(2) Sensory nerve endings exist in the connective tissue and the submucous layer of the epididymis, the muscular layer and the submucous layer of the spermatic cord (containing the ampullar portion) and in the connective tissue and the submucous layer of the prostate gland, which show simple free endings or terminal arborization but never specific end apparati.

(3) The afferent nerves which innervate the epididymis of dogs pass mainly through the posterior thoraco-lumbar roots on the same side (Th. 10…L. 4 mainly L. 1…L. 4). Sacral afferent innervation is not found in the epididymis.

(4) In the spermatic cord of the epididymis side to the inguinal ring, the sensory nerves pass mainly through the posterior thoraco-lumbar roots on the same side (Th. 10…L. 4, mainly L. 1…L. 4), and in the spermatic cord of the prostate side to the inguinal ring the sensory nerves pass mainly through the posterior sacral roots on the same side (S. 1…S. 3), but some of them pass through the thoraco-lumbar roots.

(5) In the lobe of the prostate gland the sensory nerves pass mainly through the posterior sacral roots on the same side (S. 1…S. 3), a very few of them pass through the posterior thoracolumbar roots and the anterior sacral roots on the same side.

(6) Afferent vagal innervation in the epididymis, the spermatic cord and in the prostate gland is not proved.

(7) In the specimens of the hypertrophic prostate gland, many abnormal sensory nerves are observed, i. e., some of them are broken and swollen and others show abnormal thick varicosities in the same specimen.

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Seto's Method

The specimens, which have been cut with the freezing method and kept in 10% neutral formal solution, are

1) washed with distilled water for a few minutes,
2) put into 20% silver nitrate solution, being protected from light, for 24-48 hours,
3) washed in distilled water for 20-30 seconds,
4) put into 20% neutral formal solution, This solution must be made by diluting the mother neutral formal only with running water, and placed in 4-5 plates. The specimens are transferred to these plates one by one until the white precipitation disppears,
5) washed with running water for 30-50 seconds,
6) placed on filter paper to blot up the water,
7) put into warm ammoniacal silver solution for about 10 minutes,
8) washed with distilled water twice,
9) placed in 0.05-0.1% gold chloride solution for 3-4 hours,
10) placed in 20% sodium thiosulfate solution until the specimens are colored reddish brown,
11) washed in distilled water,
12) dehydrated and mounted.

Suzuki's Method

The specimens, which have been cut with the freezing method and kept in 10% neutral formal solution, are

1) washed 3 times with distill water, each time for about 10 minutes,
2) put into 20% silver nitrate solution for about 24 hours, in the darkness,
3) washed with distilled water for a few seconds,
4) put into ammoniacal silver solution until the specimens were colored light yellow,
5) placed in 10% sodium-potassium tartrate solution for a few minutes until the specimens were colored gold yellow,
6) washed with distilled water for a few minutes,
7) placed in 0.05-0.1% gold chloride solution for 1-2 hours,
8) washed with distilled water a few minutes,
9) placed in 20% soldium thiosulfate solution,
10) washed in distilled water,
11) dehydrated and mounted.

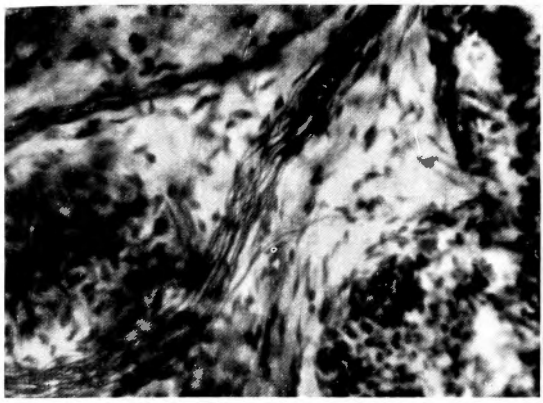

Fig. 1. Large nerve bundles in the connective tissue of the epididymis. (human being) ×280×4/3B.

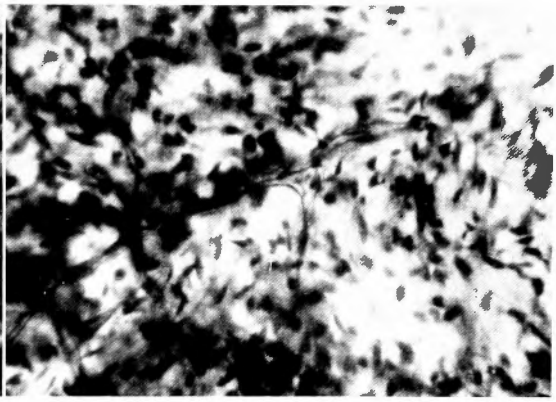

Fig. 2. Nerve bundles in the submucous layer of the epididymis. (human being) ×280×4/3B.

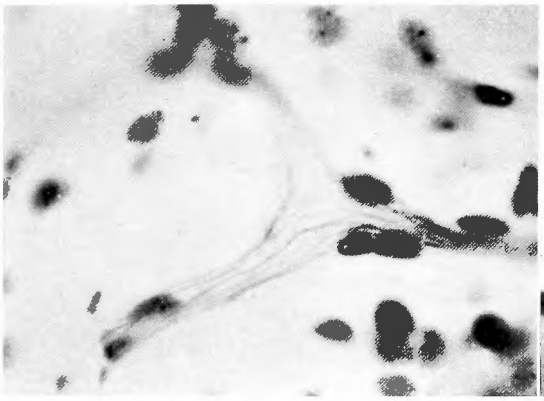

Fig. 3. The "Terminalreticulum" (STÖHR) in the submucous layer of the epididymis. (human being) ×900×4/3B.

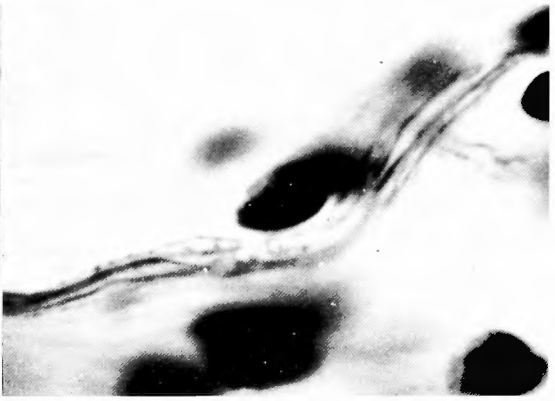

Fig. 4. The autonomic terminal network (nervous syncytia) in the submucous layer of the epididymis. (human being) ×900×4/3B.

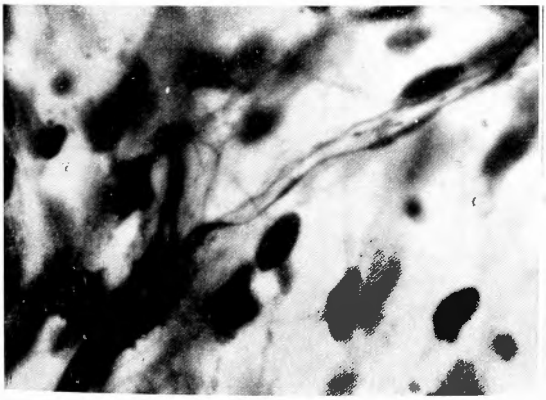

Fig. 5. Sensory nerve fibers and autonomic nerve fibers in the connective tissue around the tunica vaginalis propria testis of the epididymis. (human being) ×400×4/3B.

Fig. 6. A sensory nerve ending in the submucous layer of the epididymis. (human being) ×400B.

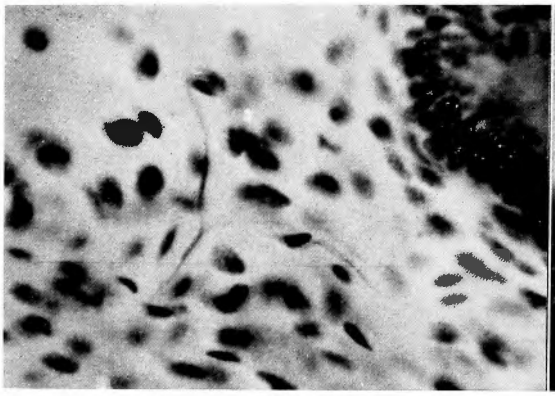

Fig. 7. A sensory nerve ending in the submucous layer of the epididymis. (dog) ×400B.

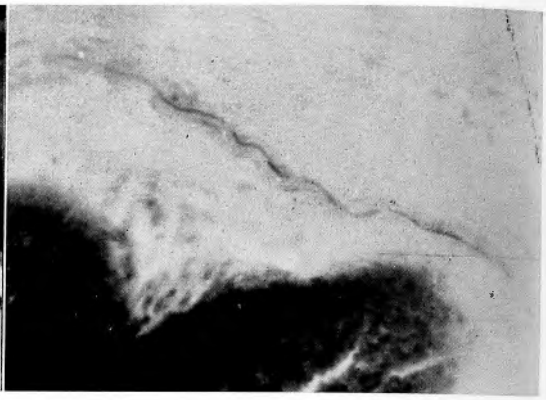

Fig. 8. A myelinated nerve fiber in the submucous layer of the epididymis. (human being) ×280E.

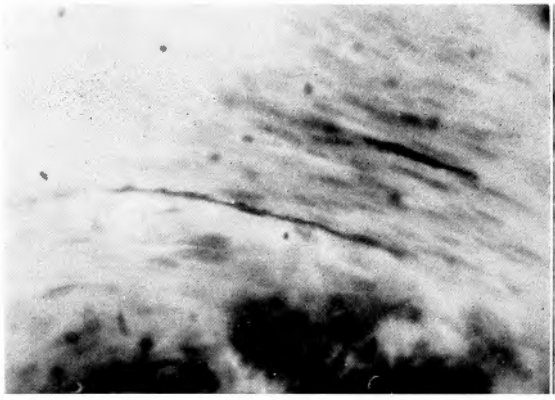

Fig. 9. Myelinated nerve fibers from the connective tissue around the tunica vaginalis propria testis to the submucous layer of the epididymis. (human being) ×280×4/3E.

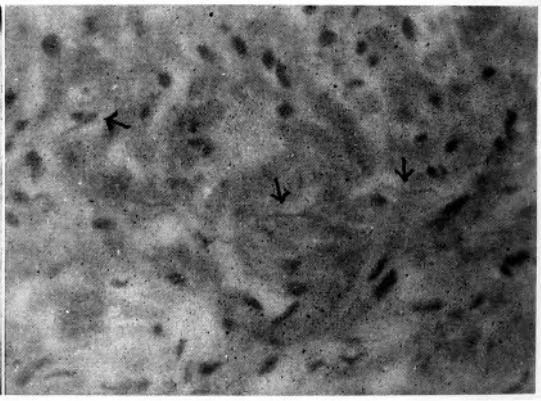

Fig. 10. A sensory nerve ending in the muscular layer of the spermatic cord. (spermatic cord A) (human being) ×400B.

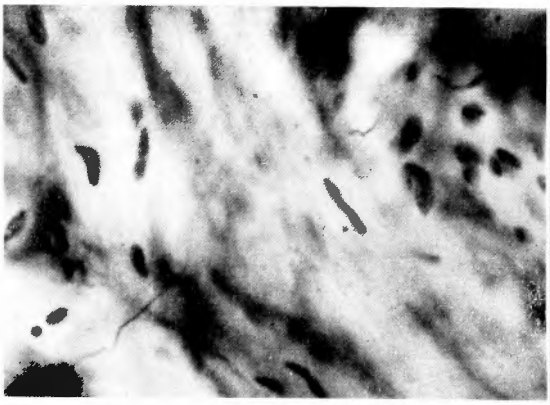

Fig. 11. A sensory nerve ending in the submucous layer of the spermatic cord. (inguinal portion) (human being) ×400×4/3B.

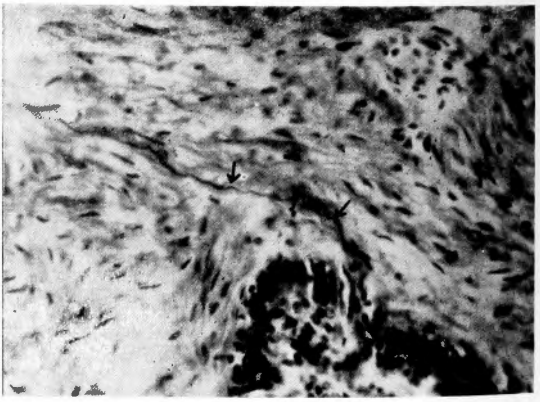

Fig. 12. A sensory nerve ending in the submucous layer of the spermatic cord. (ampullar portion) (human being) ×280×4/3B.

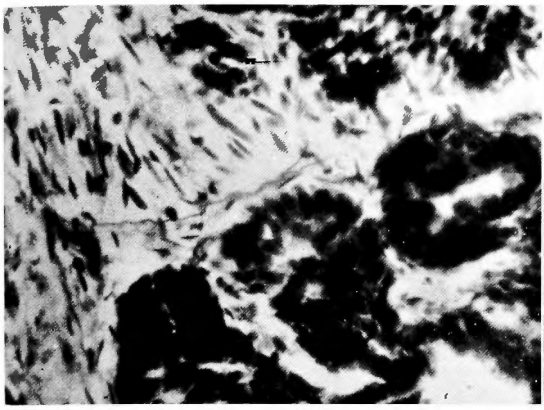

Fig. 13. A sensory nerve ending in the submucous layer of the spermatic cord. (ampullar portion) (human being) ×280×4/3B.

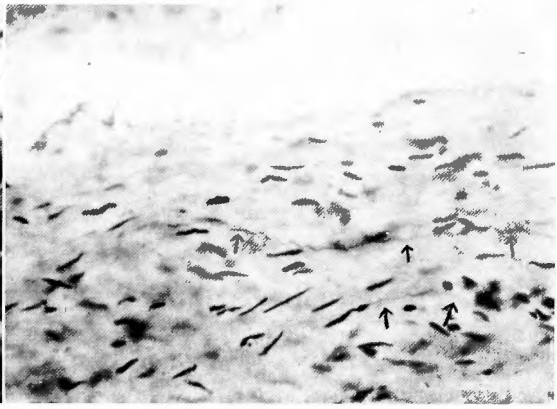

Fig. 14. Sensory nerve endings in the muscular layer of the spermatic cord. (ampullar portion) (human being) ×280×4/3B.

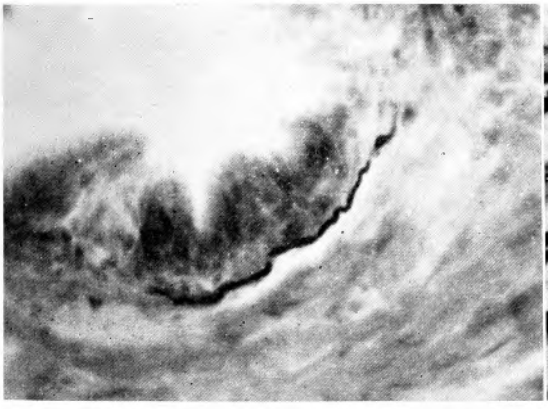

Fig. 15. A myelinated nerve fiber around the mucous layer of the prostate gland. (human being) ×400B.

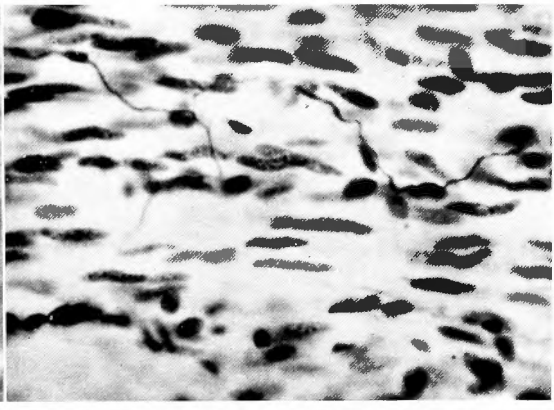

Fig. 16. A sensory nerve ending in the connective tissue of the prostate gland. (dog) ×400B.

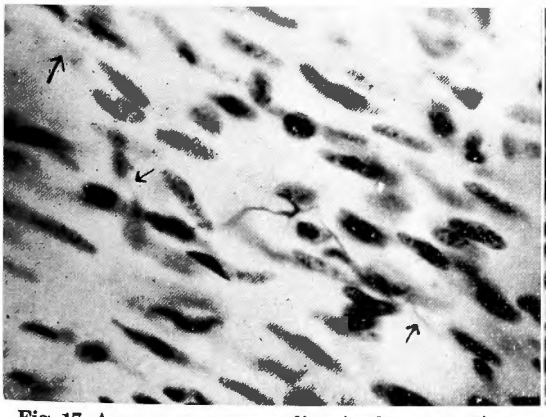

Fig. 17. A sensory nerve ending in the connective tissue of the prostate gland. (dog) ×400B.

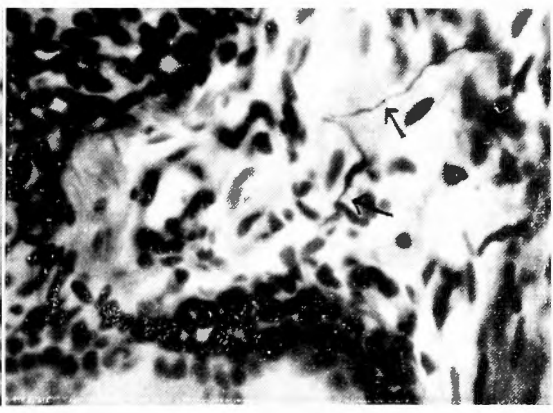

Fig. 18. A sensory nerve ending in the submucous layer of the prostate gland. (human being) ×400B.

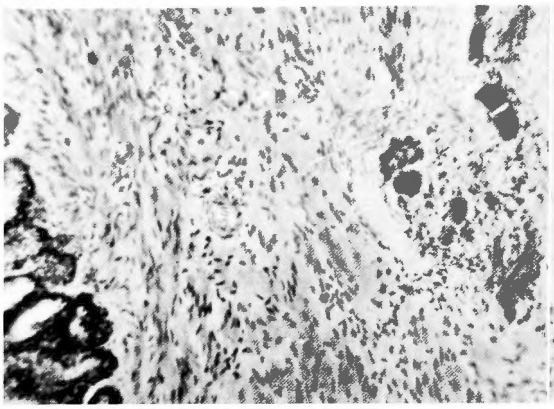

Fig. 19. Nerve cells of the prostate gland. (human being) ×140×4/3B.

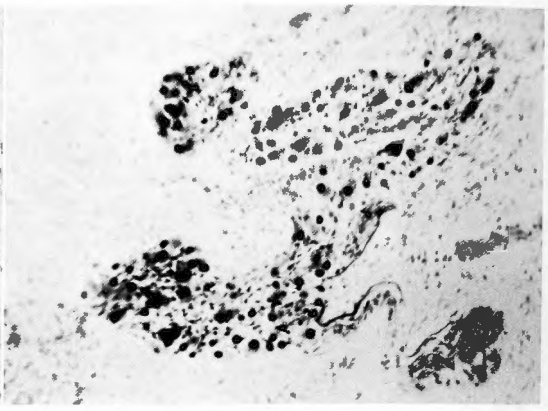

Fig. 20. Nerve cells in the connective tissue of the prostate gland. (human being) ×140×4/3B.

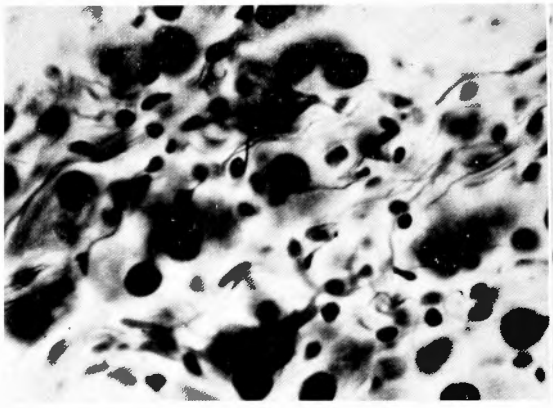

Fig. 21. Nerve cells in the connective tissue of the prostate gland. (human being) ×400B.

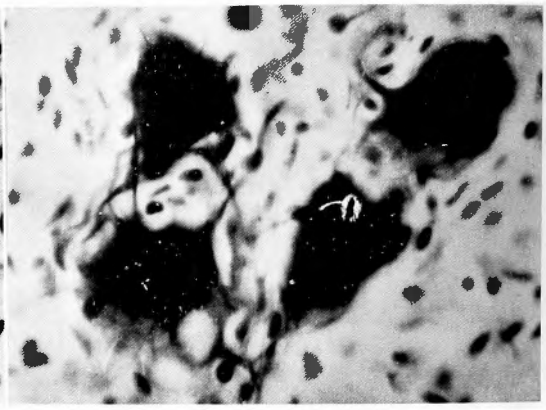

Fig. 22. Nerve cells in the connective tissue of the prostate gland. (human being) ×400B.

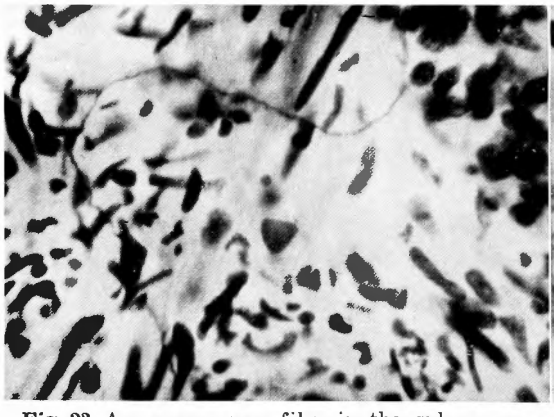

Fig. 23. A sensory nerve fiber in the submucous layer of the hypertrophic prostate gland (human being) ×400B.

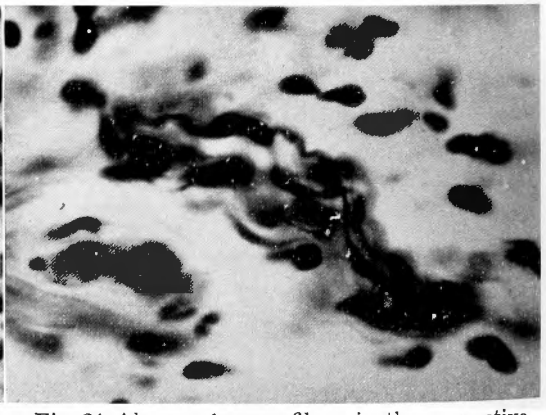

Fig. 24. Abnormal nerve fibers in the connective tissues of the hypertrophic prostate gland. (human being) ×400B.

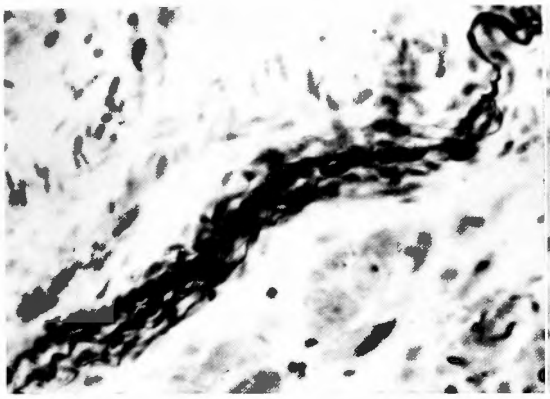

Fig. 25. Abnormal nerve fibers in the connective tissue of the hypertrophic prostate gland. (human being) ×400B.

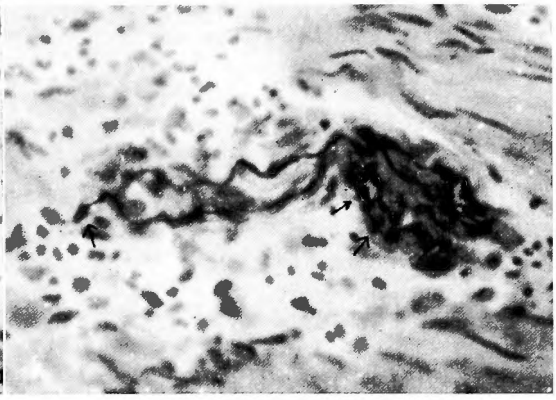

Fig. 26. Abnormal nerve fibers in the connective tissue of the hypertrophic prostate gland (human being) ×280×4/3B.

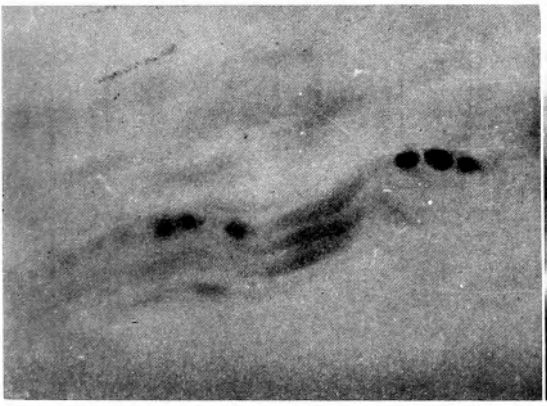

Fig. 27. A degenerated nerve fiber in the connective tissue of a dog's right epididymis after posterior rhizotomy (r-T_{10}···T_{13}) ×400E.

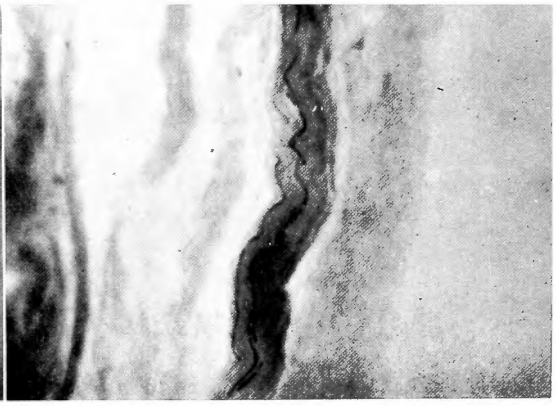

Fig. 28. A degenerated nerve fiber in the connective tissue around the tunica vaginalis propria of a dog's right spermatic cord B after antero-postero rhizotomy (r-T.10 ···L. 4) ×200×4/3E.

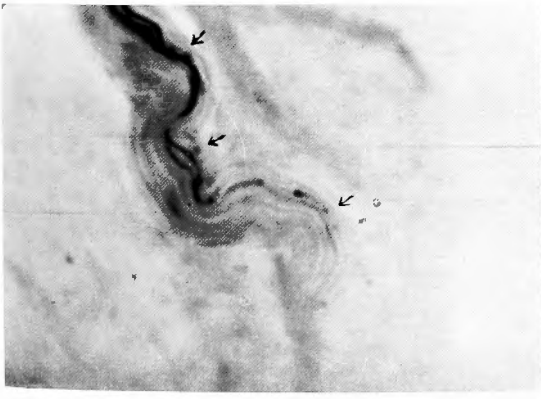

Fig. 29. A degenerated nerve fiber in the connective tissue of a dog's right spermatic cord (ampullar portion) after antero-postero rhizotomy (r-T. 10···L. 4). ×280×4/3E.

Fig. 30. Degenerated nerve fibers in the connective tissue of a dog's right prostate gland after antero-postero rhizotomy (r-T. 10···L. 4) ×400E.

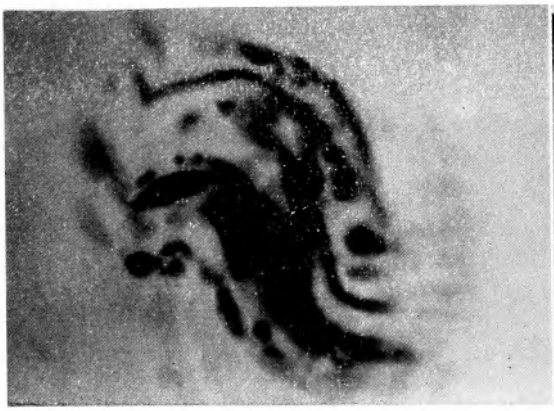

Fig. 31. Many degenerated nerve fibers in the connective tissue of a dog's right epididymis (caput epididymis) after posterior rhizotomy (r-L. 1…L. 4). ×400E.

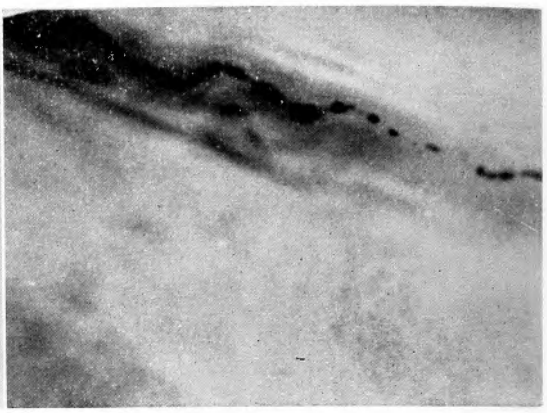

Fig. 32. A degenerated nerve fiber in the submucous layer of a dog's right epididymis (caput epididymis) after posterior rhizotomy (r-L. 1…L. 4) ×280×4/3E.

Fig. 33. Degenerated nerve fibers in the submucous layer of a dog's right epididymis (corpus epididymis) after posterior rhizotomy (r-L. 1…L. 4) ×280×4/3E.

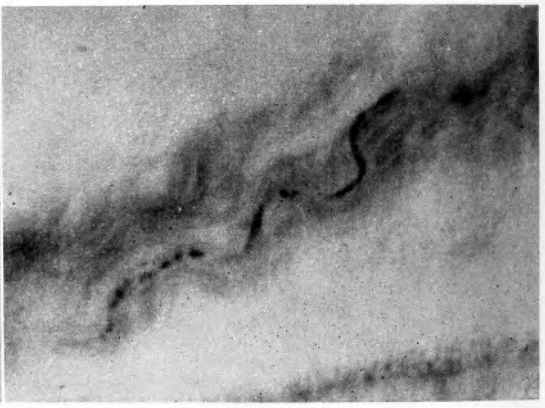

Fig. 34. A degenerated nerve fiber in the connective tissue of a dog's right spermatic cord (spermatic cord A) after posterior rhizotomy (r-L. 1…K. 4). ×280×4/3E.

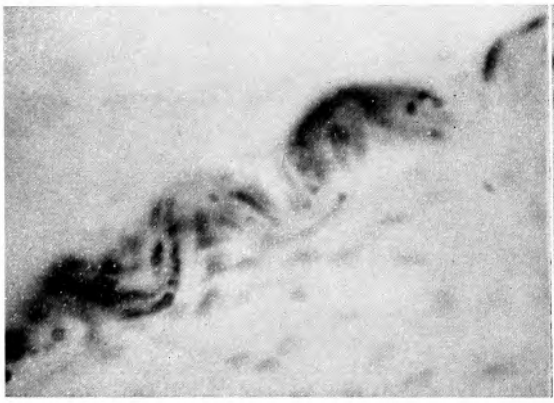

Fig. 35. Many degenerated nerve fibers in the connective tissue of a dog's right prostate gland after posterior rhizotomy (r-S. 1…S. 3) ×280×4/3E.

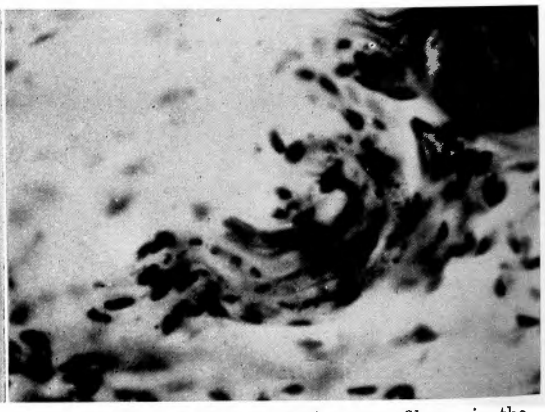

Fig. 36. Many degenerated nerve fibers in the connective tissue of a dog's right prostate gland after posterior rhizotomy (r-S. 1…S. 3). ×280×4/3B

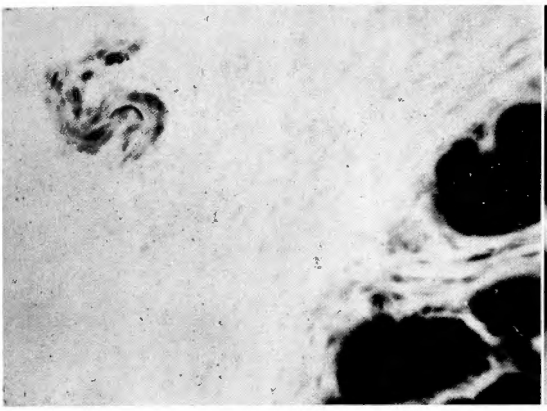

Fig. 37. Degenerated nerve fibers in the connective tissue of a dog's right prostate gland after posterior rhizotomy (r-S. 1…S. 3) ×280×4/3E.

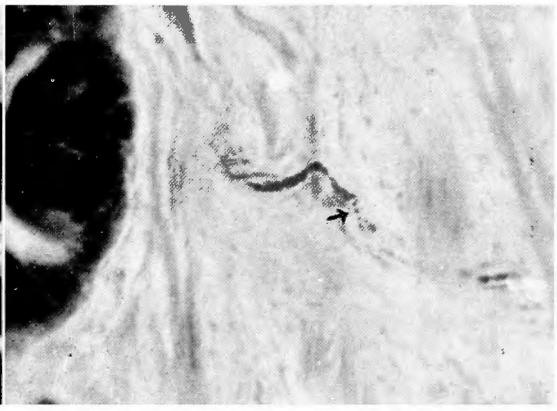

Fig. 38. A degenerated nerve fiber in the right lobe of the prostate gland after posterior rhizotomy (r-S. 1…S. 3) ×280×4/3E.

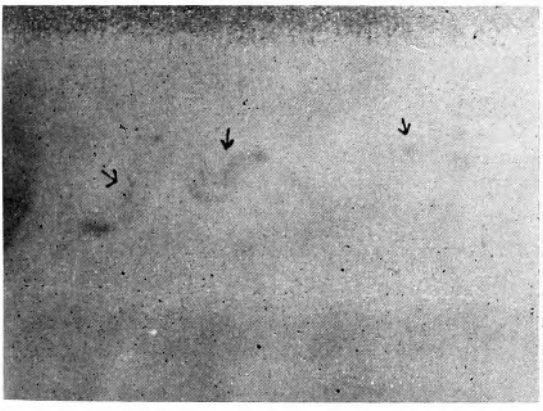

Fig. 39. Degenerated nerve fibers in the connective tissue of a dog's right spermatic cord (ampullar portion) after anterior-posterior rhizotomy (r-S. 1…Co. 5). ×280×4/3E.

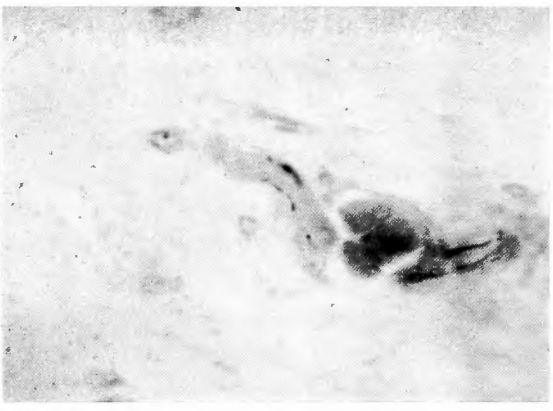

Fig. 40. A degenerated nerve fiber in the connective tissue of a dog's left prostate gland after posterior rhizotomy (r-S. 1…S. 3). ×200×4/3E.

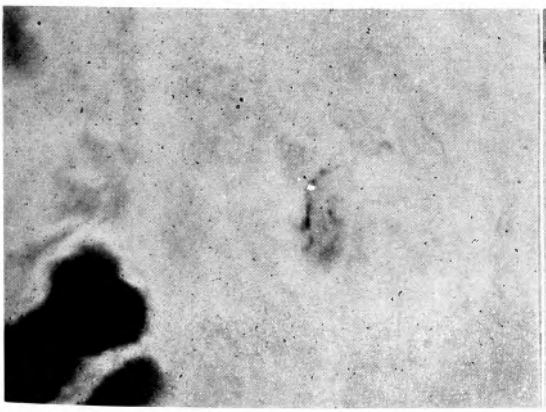

Fig. 41. A degenerated nerve fiber in the connective tissue of a dog's left prostate gland after posterior rhizotomy (r-S. 1…S. 3). ×200×4/3E.

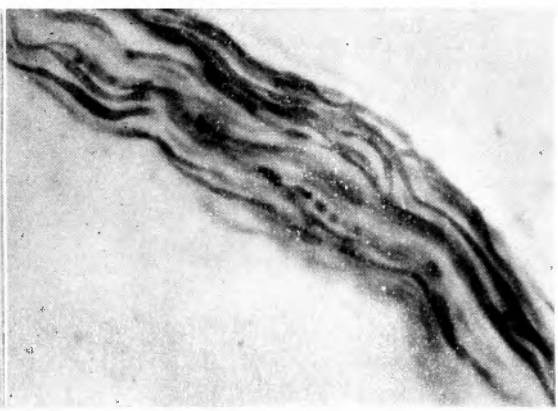

Fig. 42. A degenerated nerve fiber in the connective tissue of a dog's right prostate gland after anterior rhizotomy (r-S. 1…S. 3). ×280×4/3E.

B……BIELSCHOWSKY-SETO's method
E……EHRLICH's method

和　文　抄　録

副睾丸・輸精管及び前立腺の知覚神経の組織学的研究

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人及び犬の新鮮な副睾丸，輸精管並に前立腺の標本を以て，EHRLICH 氏神経髄鞘染色法，BIELSCHOWSKY 氏神経鍍銀染色法の瀬戸氏変法及び鈴木氏変法によつて，組織学的に知覚神経について検討し，更に“内臓に於ける知覚神経の系統的看察法”（木村，大津）と同様の方法によつて，犬の脊髄後根，脊髄前根及び迷走神経の神経幹を切断し，これら臓器内の神経の二次的変性を追求し，その結果から，副睾丸，輸精管，前立腺の知覚神経の支配経路に就て次の結論を得た．

1）　人及び犬の副睾丸，輸精管の鞘膜下結締織内，前立腺には，有髄神経が存在し，更に犬の神経幹切断後にあらわれる二次的変性を検出することによつて，これら臓器には求心性神経の存在することが証明された．

2）　かゝる知覚神経終末は，副睾丸間質結締組織内，副睾丸鞘膜下結締組織内，輸精管筋層内並に粘膜下，前立腺間質内並に粘膜下に存在する．而もその終末形式は，単純な尖鋭な終末か，単純性樹枝状のものである．特殊終末形式のものは見い出されなかつた．

3）　犬の副睾丸を支配する知覚神経は，大部分が同側の胸腰髄後根（Th. 10…L. 4 主として L. 1…L. 4）を通つている．仙髄後根を通るものは証明できなかつた．

4）　輸精管を支配する知覚神経は，胸腰髄後根及び仙髄後根を通つている．即ち鼠蹊輪を境として副睾丸よりの輸精管の知覚神経は，大部分が同側の胸腰髄後根（Th. 10…L. 4 主として L. 1…L. 4）を通り，鼠蹊輪より前立腺よりの輸精管の知覚神経は，主として同側の仙髄後根（S. 1…S. 3）を通るが，一部は胸腰髄後根を通る．

5）　前立腺を支配する知覚神経は，大部分が仙髄後根（S. 1…S. 3）を通るが，一部は胸腰髄後根，仙髄前根を通るものもある．而も同側葉を支配するが，仙髄後根を通るものには，反対側葉を支配するものもある．

6）　迷走神経性知覚神経は，副睾丸，輸精管，前立腺では見い出されなかつた．

7）　前立腺肥大症の標本に於て，異常神経が発見された．この神経繊維には，一部が膨隆したり，断裂したりしたものが認められた．