

Anatomical Studies of the Male Genital Organs of the European Beaver

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The macroscopic structure of the male genital organs in the European beaver (*Castor fiber* Linnaeus, 1758) is described on the basis of anatomical preparation. Studies were made of 10 carcasses of European beavers at different periods in the life of these animals, this number consisting of 4 newborn beavers, 3 males from 6—12 months old and 3 adult males from 3—7 years old. It was found the beaver has no scrotum. The testes together with the epididymis are situated in the vaginal processes and make contact with the abdominal cavity by means of the vaginal annulations. The posterior parts of the soft abdominal membranes pass caudad under the pelvis, forming the subpelvic diverticulum of the abdominal cavity. Ampullae vasa deferentes, the double uterus masculinus, paired trilobal glandulae vesiculares and prostata reach colliculus seminalis. Behind the pelvic symphysis is the postpelvic region, in which paired glandulae bulbo-urethrales with long ductuli deferentes are situated, and the penis with preputium opening, together with paired diverticuli laterale fossae preputialis, glandulae circumanales and anus, into the pseudo-cloaca.

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1. INTRODUCTION

As can be seen from a review of literature on the subject, the male reproductive system in the European beaver has not as yet been described in its entirety. Mention of this subject is to be found in Hinze's monograph (1950) and in the paper by Żurowski (1977). Problems connected with the cyclic nature of spermatogenesis in the beaver have been examined by Ivanova (1961). A more detailed description has been given of the macro- and microscopic structure of the postpelvic region (Nikulin, 1954), where the so-called "preputial glands" producing castoreum, described by Kacnielson & Orlova (1954, 1956), have been distinguished, also termed by Gienc & Doboszyńska (1972) and Doboszyńska (1976, 1978) in females as *diverticula laterales fossae preputialis*, and the *glandulae circumanales* producing the fatty secretion used by the animals to lubricate their fur (Doboszyńska, 1977).

The lack of accurate data on the structure and topography of the organs of the whole reproductive system in male beavers makes breeding work difficult, particular emphasis having been laid on this by Żurow-

ski (1977) in his observations on reproduction of European beavers under farm conditions. The purpose of the present study is to make a detailed examination of the anatomy and topography of the genital organs of the male European beaver at different periods of its life.

II. MATERIAL AND METHODS

The study material consisted of the genital organs of European beavers dying accidentally, *i.e.*, as the result of mechanical injury, lethal biting or food poisoning, on the beaver farm of the Experimental Station of Polish Academy of Sciences at Popielno. Observations were made of 10 animals, 4 of which were newborn beavers, 3 males from 6–12 months old and 3 males from 3–7 years old. The studies consisted in anatomical preparation of fresh material, and also in examination of the carcasses of animals which had either previously been frozen or preserved in formalin.

III. RESULTS

The reproductive system of all the male beavers examined consisted of: paired testes, epididymis, *vasa deferentes*, *uterus masculinus*, paired trilobular vesicular glands, single prostate, urethra (urogenital tubule), paired *glandulae bulbo-urethrales* and the copulatory organ — the penis, the ostium of which is situated in the capacious *cavum pseudo-cloacae*, together with paired *diverticuli laterales fossae preputialis* and the *anus* (Fig. 8, page 340).

It was found that the beavers examined belonged to the group of animals without a *scrotum*, and the loose skin in *regio inguinalis dextra et sinistra* had not even a tendency to form a separate *scrotum*, *i.e.*, a sac composed of *cutis scroti* and *tunica dartos*. The posterior parts of the muscles of the soft abdominal membranes ran under the pelvis towards the rear and were not inserted until they reached the posterior margin of *ossis ischii* and the posterior part of *symphysis pelvina*. The subpelvic part of the abdominal cavity was formed in this way, in the shape of a subpelvic diverticulum of the abdominal cavity (Fig. 3—8 and Fig. 5—3). In both newborn beavers and older individuals well-formed testes (Fig. 1—5, Fig. 2—1, Fig. 3—1, Fig. 4, Plate IV and Fig. 5—5, Plate V) were situated in *processus vaginalis peritonæa* symmetrically: located on both sides at a distance of 2–4 cm from *symphysis pelvina*. Each *processus vaginalis* is almost completely covered by *m. cremaster*, while the interior is lined with *lamina parietalis tunicae vaginalis*. *Processus vaginalis* is sufficiently large for the testis on entry

into it to fill it completely and also always to be able to contact, through its *extremitas capitata*, the abdominal cavity through *annulus vaginalis* in both newborn and older beavers (Fig. 3—5, Fig. 3—6, Fig. 5—5, and Fig. 5—7). The testis together with epididymis is covered by *lamina visceralis tunica vaginalis*. Between these *laminae tunicae vaginalis* there is the fissure-like *cavum vaginalis*, always opened in the place where the testis protrudes into the diverticulum of the abdominal cavity. There is no *cervix processi vaginalis* which would close *cavum vaginalis*. If the testes were situated in the *processi vaginales*, which took place in adult males during the mating season, their presence could be palpated through the abdominal wall. Outside the mating season the testes in adult animals were usually to be found in the abdominal cavity in the region of *annulus vaginalis* (Fig. 5—5 and Fig. 5—7), due to contractions of *m. cremaster*, permitting them easily to emerge from *processus vaginalis*.

The beaver testis is oval (Fig. 4), the size of a walnut in adult individuals, measuring 2.7—3.2 cm in length and 1.8—1.5 cm in breadth, and is sometimes strongly flattened. Topographically the testis together with epididymis is situated diagonally in the posterior part of the subpelvic diverticulum of the abdominal cavity and adheres to it at the level of *corpus ossis ischii* (Fig. 5). *Extremitas capitata* of the right testis is situated at a distance of approx. 8 cm from *extremitas caudalis* of the right kidney, while on the left side this distance is approx. 11 cm. From 3—7 *ductuli efferentes testis* emerging from *rete testis* (Fig. 8—7) on *extremitas capitata testis*, pass into *ductus epididymidis* (Fig. 8—5), forming on *margo epididymis* (Fig. 4—4) a strongly twisted epididymis, consisting of *caput* (Fig. 4—6), *corpus* (Fig. 4—7) and *cauda epididymidis* (Fig. 4—8). *Cauda epididymidis*, attached to *extremitas caudata*, passes into *ductus deferens* (Fig. 4—10).

The absence previously referred to of *cervix processi vaginalis* and the specific situation of the testes in the beaver were the cause of the position, differing from other animals, of *vas deferens* and blood vessels, and also the nerves of the testis, that is, what is termed *funiculus spermaticus*. The neurovascular bundle for the testis, in addition to its own mesentery forms in the beaver a lobular fold hanging loosely in the abdominal cavity (Fig. 5—9). In both newborn and older animals it was larger than the testis and contained abundant fatty tissue, regardless of whether the testes remained in *processi vaginales* or were situated in the diverticulum of the abdominal cavity. Thus in the beaver *funiculus spermaticus* is situated in the abdominal cavity, and not within *processus vaginalis*. *Funiculus spermaticus* is composed of: *ductus deferens* suspended in mesoductus (Fig. 3—3, Fig. 5—6) and *mesorchium* composed of *mesorchium proximale* containing the neuro-vascular bundle

and a large lobe of connective tissue reaching to *caput epididymis*, and *mesorchium distale*, connecting mesepididymis with the testis (Fig. 3—9 and 10 and Fig. 5—8 and 9). It was possible to distinguish *lig. testis proprium* (Fig. 4—5) and the faintly defined *bursa testicularis* in mesepididymis.

Ductus deferens (Fig. 1—6, Fig. 2—2, Fig. 3—3, Fig. 4—10 and Fig. 5—6) takes a slightly undulating course and forms a duct about 15 cm long in adult male beavers. Its terminal part is distinctly broadened and forms *ampulla ductus deferentis* (Fig. 6—7 and Fig. 8—10), ending in *ductus ejaculatorius* entering *urethra masculina* on *colliculus seminalis* (Fig. 2—3, Fig. 6—9 and Fig. 8—13), situated halfway up *symphysis pelvina*.

A fairly large *uterus masculinus* reaches to *colliculus seminalis* (Fig. 8—9). It consists of two separate ducts, the free initial parts of which, 3—4 cm in length (in adult males), are similar to the uterine horns of females (Fig. 6—4) connected by *lig. intercornuale* (Fig. 6—3). Further parts of *uterus masculinus* formed two separate ducts lying close together (Fig. 6—5), connected by a common serous membrane for 5 cm of their length, which was similar to the *uterine corpus* and *cervix* in females. They opened on *colliculus seminalis* near *ductus ejaculatorius*.

On each side of *colliculus seminalis*, immediately behind *ostium vasa deferentes*, are *glandulae vesiculares* (Fig. 6—8 and Fig. 8—12). In newborn beavers these glands are only weakly formed. They were far larger in males 6—12 months old (Fig. 6—8), while in adult animals they were trilobular glands, the anterior lobes being smallest, 1 cm in length, while the central lobes were up to 4 cm in length and 1 cm in breadth, and the posterior lobes up to 1.5 cm in length. The different lobes of each side were covered by a common delicate sac of connective tissue.

At a distance of about 1 cm behind *glandulae vesiculares* there was a single gland — the prostate (Fig. 6—9 and Fig. 8—14), situated on the dorsal surface of the pelvic part of *urethra masculina*. It is oval, 0.5—0.8 cm in length in adult males, and is situated transversely not far from *margo arcus ischiadicus*.

The remaining part of the genital organs in the beaver is included in the postpelvic region (Fig. 5—10 and Fig. 8—C) and forms a part 5—6 cm long in newborn beavers, but in adult males is 11—15 cm long (length measured from the prostate to the ostium of pseudo-cloaca). Paired *glandulae bulbourethrales* run at a distance of 4—7 cm from the prostate to *urethra masculina* (Fig. 2—4, Fig. 6—11 and Fig. 8—15). They consist of the ampullar enlarged glandular part (length 2.0—2.5 cm, breadth 1.0—1.5 cm) and the long *ductus bulbourethralis* about 3 cm in length

(Fig. 8—15 and 16). At the level of the ostium *crus penis* begins on each side, seated together with the thick *m. bulbourethralis* (Fig. 2—5, Fig. 6—12 and Fig. 8—17) on *tuber ischiadicum* of the pelvis.

The penis (Fig. 2—7, Fig. 5—11 and Fig. 8—17, 18 and 19) is similar to a dorso-ventrally flattened cylinder, composed of *corpus penis* 6 cm in length and *glans penis*, which is 3 cm long in adult males. *Glans penis* (Fig. 7—4) as *pars libera penis*, was situated in *cavum preputiale*, formed by the well-developed *plica preputialis* (Fig. 7—3, and contained *os penis* in the interior (Fig. 8—19). *Ostium urethrae externum*, situated on the protruding *bulbus glandis*, was surrounded by three characteristic secondary preputial folds: single — dorsal fold (approx. 0.7 cm in height) and two slightly lower ventral folds (Fig. 8—11).

The final part of *cavum preputiale* widens to produce the characteristic *diverticulum preputiale* (Fig. 7—5), into which the rudiment of *diverticulum laterale fossae preputialis* opens laterally on both sides (Fig. 1—9) in newborn beavers, but which in older animals is a large sac (Fig. 5—12 and Fig. 7—6) producing castoreum, and ends in a wide fissure-like ostium (about 2 cm) closed by numerous folds of mucous membrane (Fig. 2—8, Fig. 7—7, and Fig. 8—25). Immediately behind them are slightly smaller sacs forming *glandulae circumanales*, with openings situated on papillae protruding into the lumen of the pseudo-cloaca (Fig. 1—10, Fig. 2—9, Fig. 5—3, Fig. 7—8 and 9, Fig. 8—26 and 27), producing a greasy, fatty secretion.

The two pairs of characteristic sacs, described above, of the postpelvic region in male beavers opened jointly with the genital tract and anus into the pseudo-cloaca (Fig. 7—10 and Fig. 8—28).

IV. DISCUSSION

It can be seen from the studies made that the male genital organs of the European beaver are similar in structure to the corresponding organs in coypu. Lutnicki (1961), in giving practical instructions for castrating coypu, described the anatomical and topographic relations in the structure of the *processus vaginalis*, *annuli vaginales* and *funiculus spermaticus* and referred to the problems connected with the specific shift of the membranes of the posterior part of the abdominal cavity and the formation in this species of animal of the subpelvic diverticulum of the abdominal cavity. The papers by Lutnicki, in which the author made a number of remarks on the subject of the scrotum and inguinal duct (Lutnicki, 1951), inguinal fissure (Lutnicki, 1956), *tunica vaginalis*

and *funiculus spermaticus* (Lutnicki, 1952) have in many cases been of assistance in ensuring correct elaboration of the component parts of the genital system in beavers. Many of the terms given by Lutnicki, however, are not in accordance with the anatomical nomenclature in current use, and therefore in the description of the beaver organs the nomenclature in accordance with the most recent publication on veterinary anatomical nomenclature (edited by Pilarski, 1978) has been used.

The beaver, like the coypu, is an animal not possessing a scrotum, but even in emaciated animals the testes cannot always be felt through the abdominal integument. As shown by Żurowski (1977), they can be distinguished by palpation during the mating season, for which period they are always situated in *processus vaginalis*. It often happens that these animals have an undescended testis on one side, that is, one testis is permanently situated in *processus vaginalis*, while the other is periodically located in the abdominal cavity (Żurowski, 1977).

A sure way for identifying sex, even in young males, is to feel by palpation *os penis*, although there may be difficulty in applying this method in the case of animals from 5—8 months old, when there is distinct growth of *diverticuli laterales fossae preputialis* (Żurowski, 1977).

All the genital organs are well-formed, even in newborn beavers. At birth these animals have testes in the formed *processus vaginalis*, and have thus passed through the process of descent of the testes during the foetal period. At this time they have the rudiments of all additional male glands, and it is only the dimensions of these glands which increase with age. In the case of *glandulae vesiculares* three distinct lobes are gradually formed and can be observed in males only 6 months old.

Like the coypu, in the beaver also the soft abdominal membranes shift under the pelvis (Lutnicki, 1961) and form the characteristic subpelvic diverticulum of the abdominal cavity. The specific position of the testes and absence of a formed scrotum is due to this.

Some of the male sexual organs, like those described previously in females (Doboszyńska, 1978), are shifted in a posterior direction and are included in the composition of the postpelvic region. In the same way as in females, both the sacs producing castoreum, of similar dimensions and size, and the circumanal glands, are situated in this region. The first of these in females open into the region of the clithoris and are the lateral diverticuli of this region (Gienc & Doboszyńska, 1972), whereas in males they open near the penis and are quite clearly *diverticuli fossae preputialis*.

REFERENCES

1. Doboszyńska T., 1976: Strój bobrowy (Castoreum). *Wszechświat*, 1: 8—10.
2. Doboszyńska T., 1977: Circumanal glands in the European beaver. *Acta theriol.*, 23: 301—305.
3. Doboszyńska T., 1978: Histomorphology of the female reproductive system of the European beaver. *Ib.* 23: 99—125.
4. Gienc J. & Doboszyńska T., 1972: Macromorphological description of the genital organs of the female beaver. *Ib.* 17: 399—406.
5. Hinze G., 1950: *Der Biber*. Akademie Verl.: 1—214. Berlin.
6. Ivanova T. M., 1961: Godovaja cykličnost spermatogeneza rečnogo bobra. *Tr. Voronež. Gos. Zap.*, 12: 117—138.
7. Kacnielson Z. S. & Orlova I. I., 1954: Gistologičeskoe stroenie tak nazyvaemyh prepucialnyh (muskusnyh) želez vzrosłogo bobra. *Ib.* 5: 58—63.
8. Kacnielson Z. S. & Orlova I. I., 1956: Razvitie prepucialnyh „želez” bobra. *Ib.* 6: 67—72.
9. Lutnicki W., 1951: Uwagi na temat moszny i kanału pachwinowego. *Med. Wet.*, 8: 523—527.
10. Lutnicki W., 1952: Zagadnienia moszny, osłony pochwowej i powrózka nasienneo. *Ib.* 10: 467—471.
11. Lutnicki W., 1956: Szczelina pachwinowa i kanał pachwinowy. *Ib.* 10: 605—610.
12. Lutnicki W., 1961: Kastracja nutrii w świetle teorii i praktyki. *Ib.* 8: 479—483.
13. Nikulin W. N., 1954: „Pozaditazovaja oblast” rečnogo bobra. *Tr. Voronež. Gos. Zap.*, 5: 56—59.
14. Pilarski W., 1978: *Weterynaryjne mianownictwo anatomiczne*. Państw. Wyd. Nauk.: 1—605. Warszawa.
15. Żurowski W., 1977: Rozmnażanie się bobrów europejskich w warunkach fermowych. *Polska Akademia Nauk, Inst. Genetyki i Hodowli Zwierząt*: 1—52. Popielno.

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BADANIA ANATOMICZNE NARZĄDÓW ROZRODCZYCH MĘSKICH
BOBRA EUROPEJSKIEGO

Streszczenie

Praca niniejsza zawiera wyniki anatomicznych badań męskich narządów rozrodczych dziesięciu bobrów różnego wieku (od noworodków do 7-letnich), pochodzących z fermy Zakładu Doświadczalnego PAN w Popielnie. Badania wykazały, że wspomniane narządy bobra, w ogólnym obrazie anatomicznym, są podobne do narządów rozrodczych nutrii. Bóbr europejski, tak jak nutria, należy do zwierząt bezmosznowych. Jego jądra wraz z najądrzami znajdują się w wyrostku pochwowym i kontaktują się przez cały czas z jamą brzuszną przez szeroki pierścień pochwowy. Tylne odcinki miękkich powłok brzucha przesunięte są pod miednicę i tworzą charakterystyczny zachyłek podmiedniczny jamy brzusznej. Na wzgórku nasiennym oprócz nasieniowodów uchodzą: dobrze wykształcona macica męska, parzyste, wyraźnie trzyplątowe u samców dorosłych gruczoły pęcherzykowe i pojedynczy gruczoł krokowy. Za gruczołem krokowym kończy się spojenie miedniczne i pozostała część narządów położona jest w okolicy zamiednicznej. Za miednicą do cewki moczowej męskiej uchodzą parzyste, długoprzewodowe gruczoły opuszkowo-cewkowe. Dalej znajduje się prąciowa część cewki moczowej męskiej. Prącie, którego wolna część zaopatrzona jest w kość prąciową, uchodzi wraz z napletkiem, parzystymi zachyłkami bocznymi dołu napletkowego (worki produkujące „strój bobrowy”), gruczołami przyodbytowymi i odbytem do niby-steku.

Plate IV

Fig. 1. Excised male genital organs of a newborn beaver. 1 — *ren*, 2 — *rectum*, 3 — *ureter*, 4 — *vesica urinaria*, 5 — *testis*, 6 — *ductus deferens*, 7 — *pars pelvina: urethra masculina*, 8 — *penis*, 9 — rudiment of *diverticulum lateralis fossae preputialis*, 10 — *glandula circumanalis*.

Fig. 2. Excised genital organs of a 6-month old male beaver. 1 — *testis et epididymis*, 2 — *ductus deferens*, 3 — *colliculus seminalis*, 4 — *glandula bulbourethralis*, 5 — *crus penis*, 6 — *corpus penis*, 7 — *pars libera penis*, 8 — *diverticulum laterale fossae preputialis*, 9 — *glandula circumanalis*, 10 — dissected *cavum pseudocloacae*, 12 — *vesica urinaria*.

Fig. 3. Picture of the genital organs situated in the abdominal cavity and subpelvic diverticulum of the abdominal cavity in a year-old beaver. On the right side—*testis* with *epididymis* removed from *processus vaginalis* (shown against background of sheet of paper), on left side *testis* in *processus vaginalis*. 1 — *testis*, 2 — *caput, corpus et cauda epididymis*, 3 — *ductus deferens* and its *mesoductus*, 4 — *vesica urinaria*, 5 — *annulus vaginalis*, 6 — *testis* together with *epididymis* covered by *lamina visceralis tunicae vaginalis* — situated in *processus vaginalis*, 7 — *rectum*, 8 — dissected wall of *diverticulum subpelvinus* of the abdominal cavity, 9 — *mesorchium proximale*, 10 — *mesorchium distale*, 11 — *tubernaculum testis*.

Fig. 4. Picture of *testis*, *epididymidis* and *ductus deferens* of an adult male beaver. 1 — *facies medialis testis*, 2 — *margo liber*, 3 — *extremitas cepitata*, 4 — *margo epididymalis testis*, 5 — *lig. testis proprium*, 6 — *caput epididymidis*, 7 — *cropus epididymidis*, 8 — *cauda epididymidis*, 9 — lobulated fold of *funiculus spermaticus*, 10 — *ductus deferens et mesoductus*.

Plate V

Fig. 5. Topography of genital organs in adult male beaver. 1 — *vesica urinaria*, 2 — *apertura pelvis cranialis*, 3 — dissected wall of subpelvic diverticulum of abdominal cavity, 4 — *symphysis pelvina*, 5 — *testis* — protruding from *processus vaginalis*, 6 — *ductus deferens et mesoductus*, 7 — *annulus vaginalis*, 8 — neurovascular bundle of *funiculus spermaticus*, 9 — lobulated fold of *funiculus spermaticus*, 10 — postpelvic region, 11 — *penis*, 12 — *diverticulum laterale fossae preputialis*, 13 — *glandula circumanalis*, 14 — *ostium externum pseudocloacae*.

Fig. 6. Part of genital organs of 6-month old beaver showing accessory sex glands. 1 — *vesica urinaria*, 2 — *ureter*, 3 — *lig. intercornuale*, 4 — *cornu uteri masculini*, 5 — *corpus uteri masculini*, 6 — *ductus deferens*, 7 — *ampulla ductus deferentis*, 8 — *glandula vesicularis*, 9 — prostate and region of *colliculus seminalis*, 10 — pelvic part of urogenital duct, 11 — *glandula bulbourethralis*, 12 — *crus penis*, 13 — *corpus penis*.

Fig. 7. Terminal part of genital organs in an adult male beaver — organs opening into pseudo-cloaca. 1 — *rectum*, 2 — part of *corpus penis*, 3 — dissected preputial folds, 4 — *glans penis*, 5 — region of opening of *cavum preputiale* into pseudo-cloaca, 6 — *diverticulum laterale fossae preputialis*, 7 — its opening into pseudo-cloaca, 8 — *glandula circumanalis*, 9 — its opening into pseudo-cloaca.

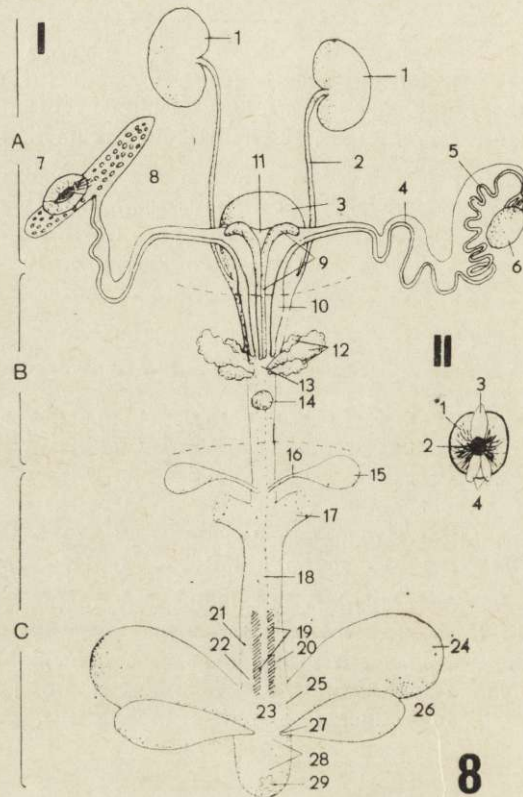
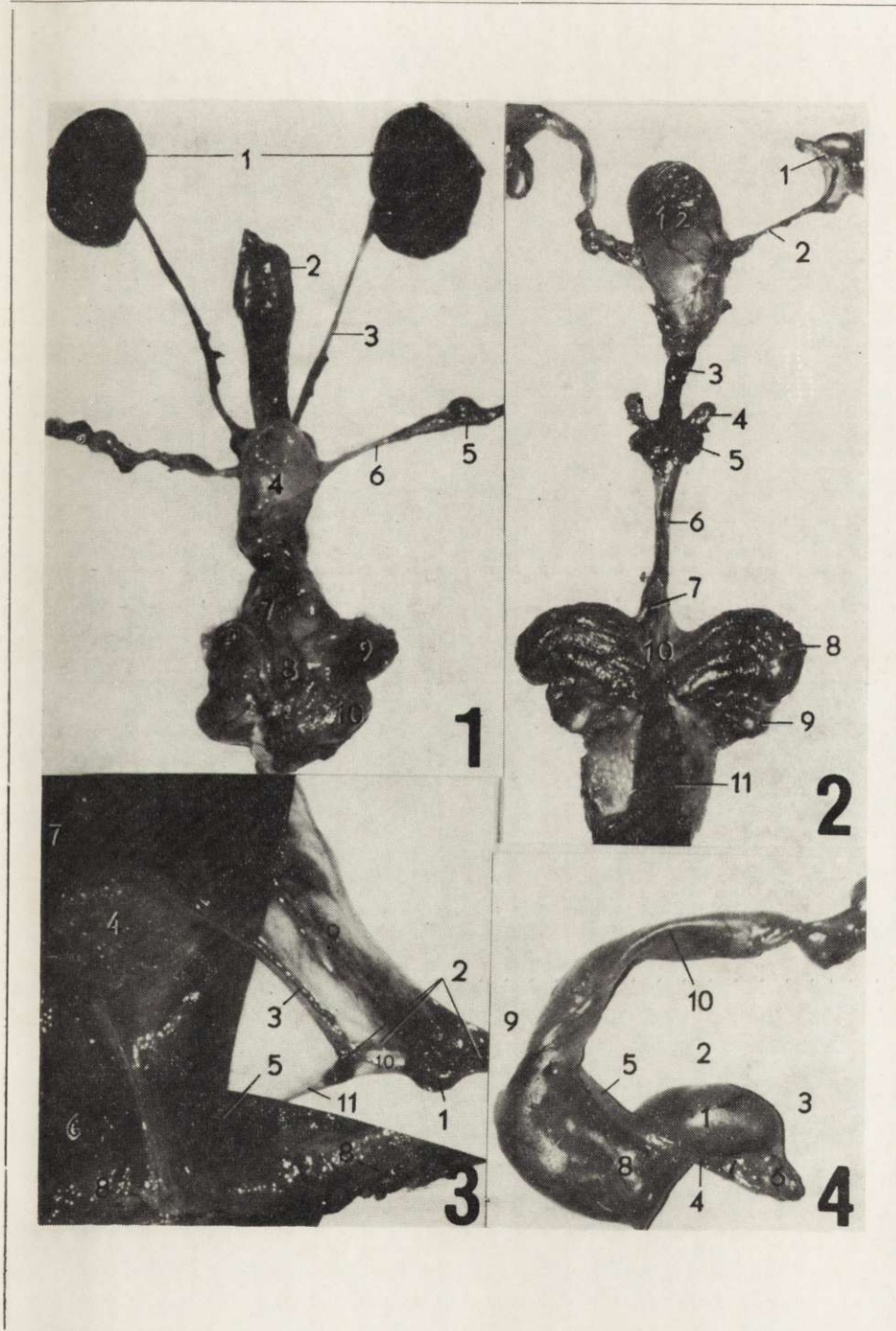


Fig. 8. Diagram representing structure of male genital organs in the European beaver.

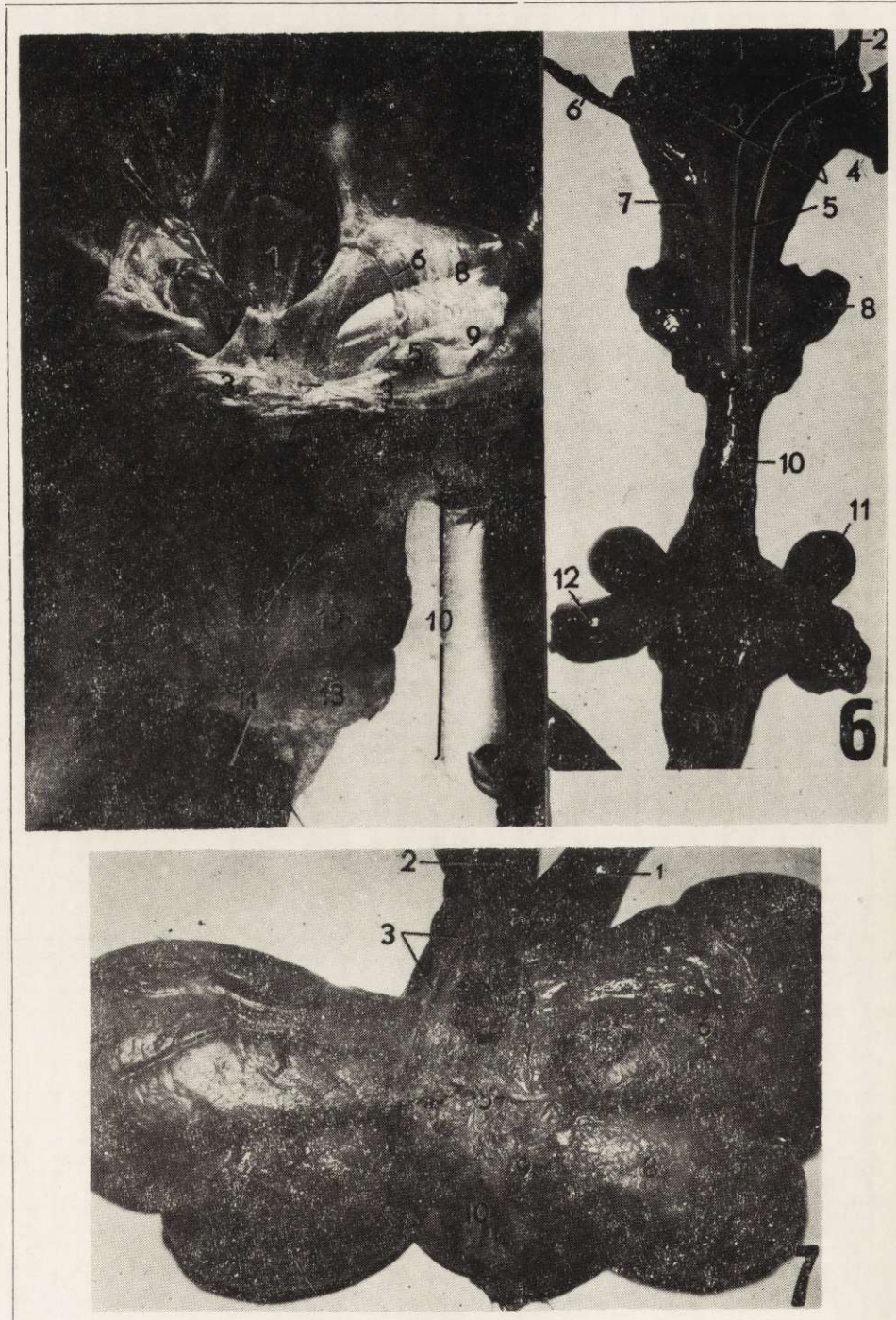
I. A — organs situated in the abdominal cavity, B — organs situated in the pelvis, C — organs of the postpelvic region. 1 — *ren*, 2 — *ureter*, 3 — *vesica urinaria*, 4 — *ductus deferens*, 5 — *ductus epididymidis*, 6 — *testis*, 7 — cross-section of testis showing: *mediastinum testis*, *septula testis* and *ductuli efferentes testis*, 8 — cross-section through component parts of epididymis, 9 — *uterus masculinus*, 10 — *ampulla ductus deferentis*, 11 — *lig. intercornuale*, 12 — *trilobular glandula vesicularis*, 13 — *colliculus seminalis*, 14 — *prostata*, 15 — *glandula bulbourethralis*, 16 — *ductus gl. bulbourethralis*, 17 — *crus penis*, 18 — *corpus penis*, 19 — *pars libera penis* in which *os penis* is located, 20 — *preputium-lamina interna*, 21 — *preputium-lamina externa*, 22 — *cavum preputiale*, 23 — *ostium urethrae externum*, 24 — *diverticulum laterale fossae preputialis*, 25 — its opening into pseudo-cloaca, 26 — *glandula circumanalis*, 27 — its opening into pseudo-cloaca, 28 — *pseudo-cloaca*, and its *ostium externum*, 29 — *anus*.

II. — picture of *glands penis*. 1 — *glans penis*, 2 — *ostium urethrae externum*, 3 — *secondary dorsal preputial fold*, 4 — *secondary ventral preputial folds*.



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A. Penkowski *phot.*



T. Doboszyńska & W. Zurowski

C. Nagiéc *phot.*