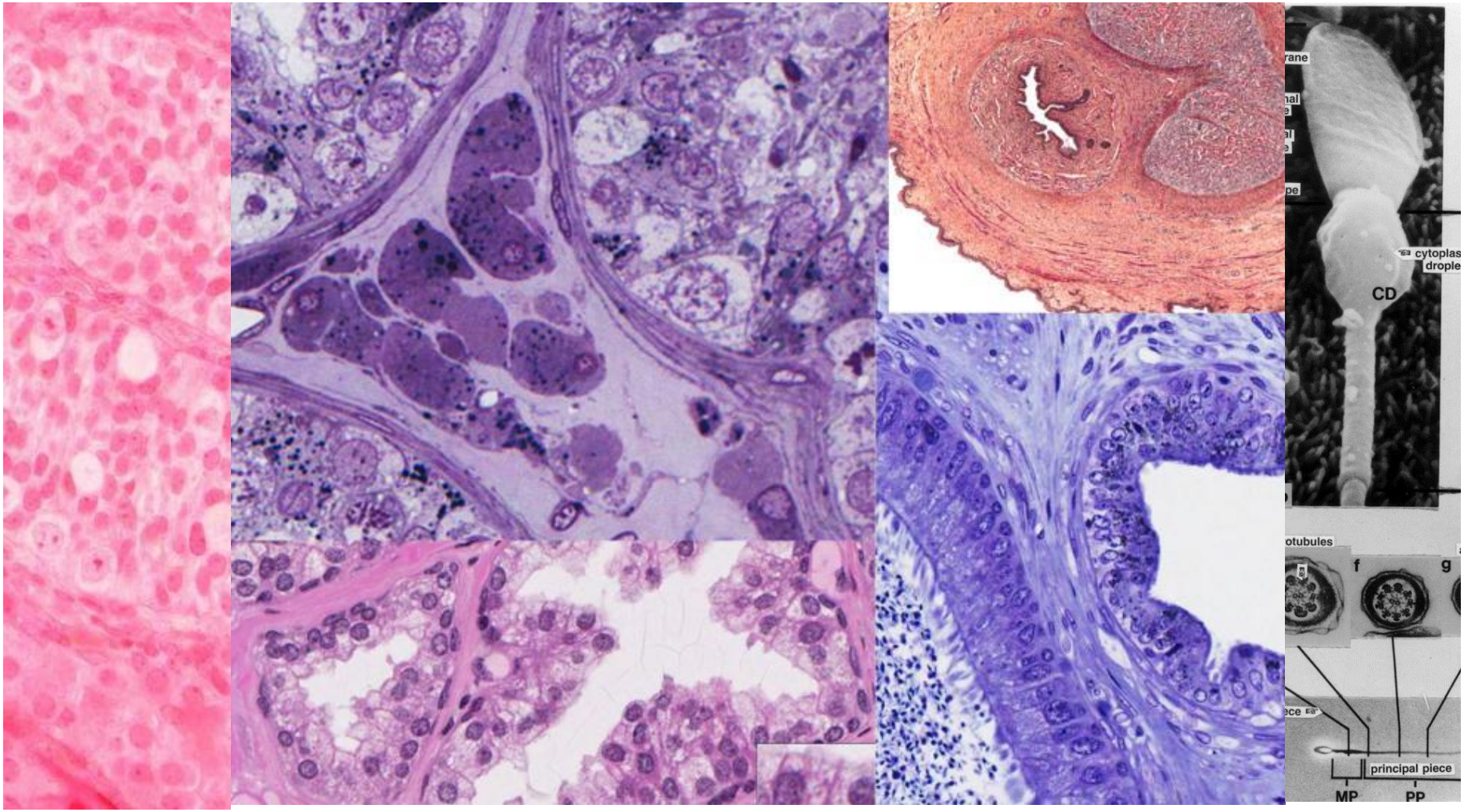
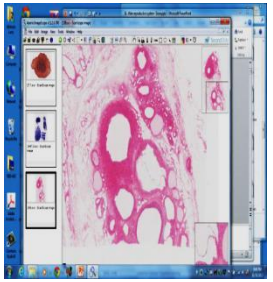
Male reproductive system: Part 1 Spermatogenesis

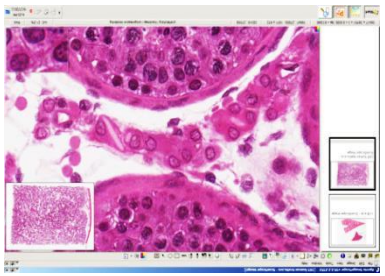


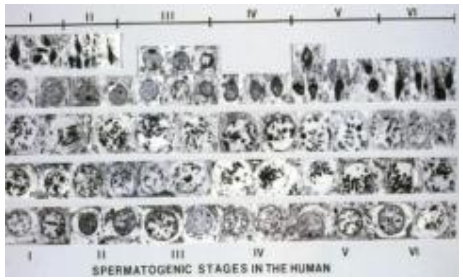
Dr. Larry Johnson Texas A&M University

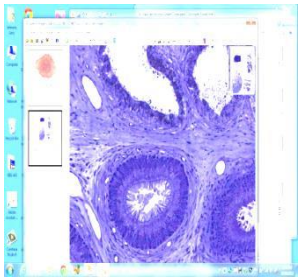
Part 1 Spermatogenesis Objectives

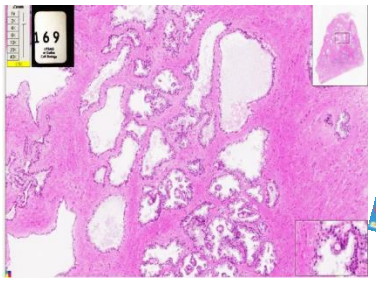


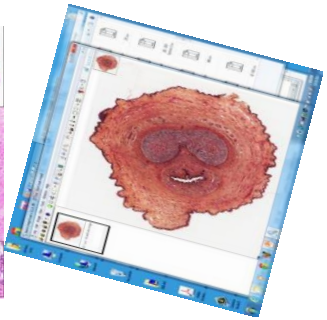
- Identify the endocrine and exocrine subdivisions of the testes?
- Distinguish the cells of the spermatogenic cell lineage.
- Identify and distinguish among epididymis, vas deferens, urethra, seminal vesicles and the prostate gland.
- Describe the structure of the penis and indicate how it becomes tumescent.

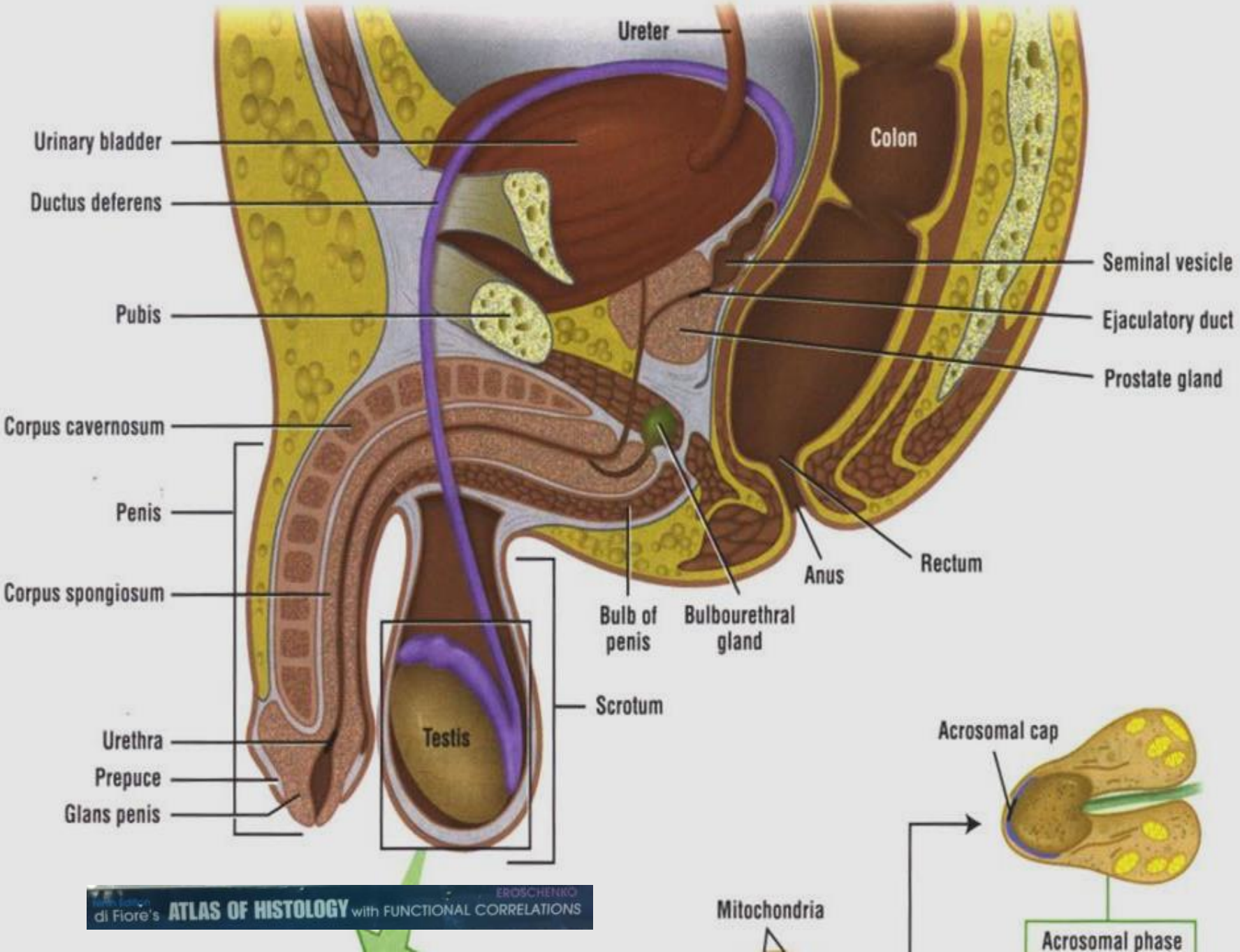


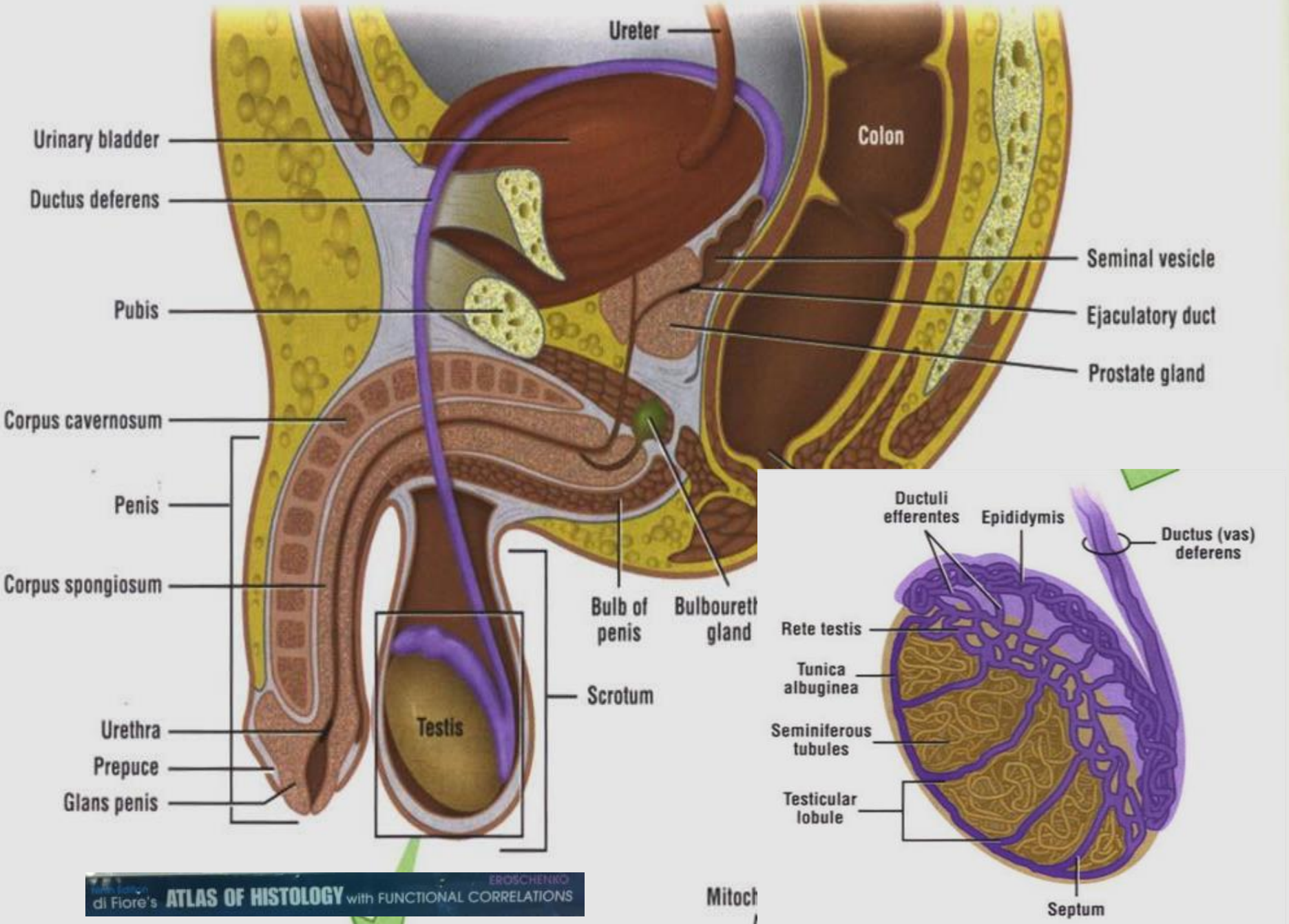


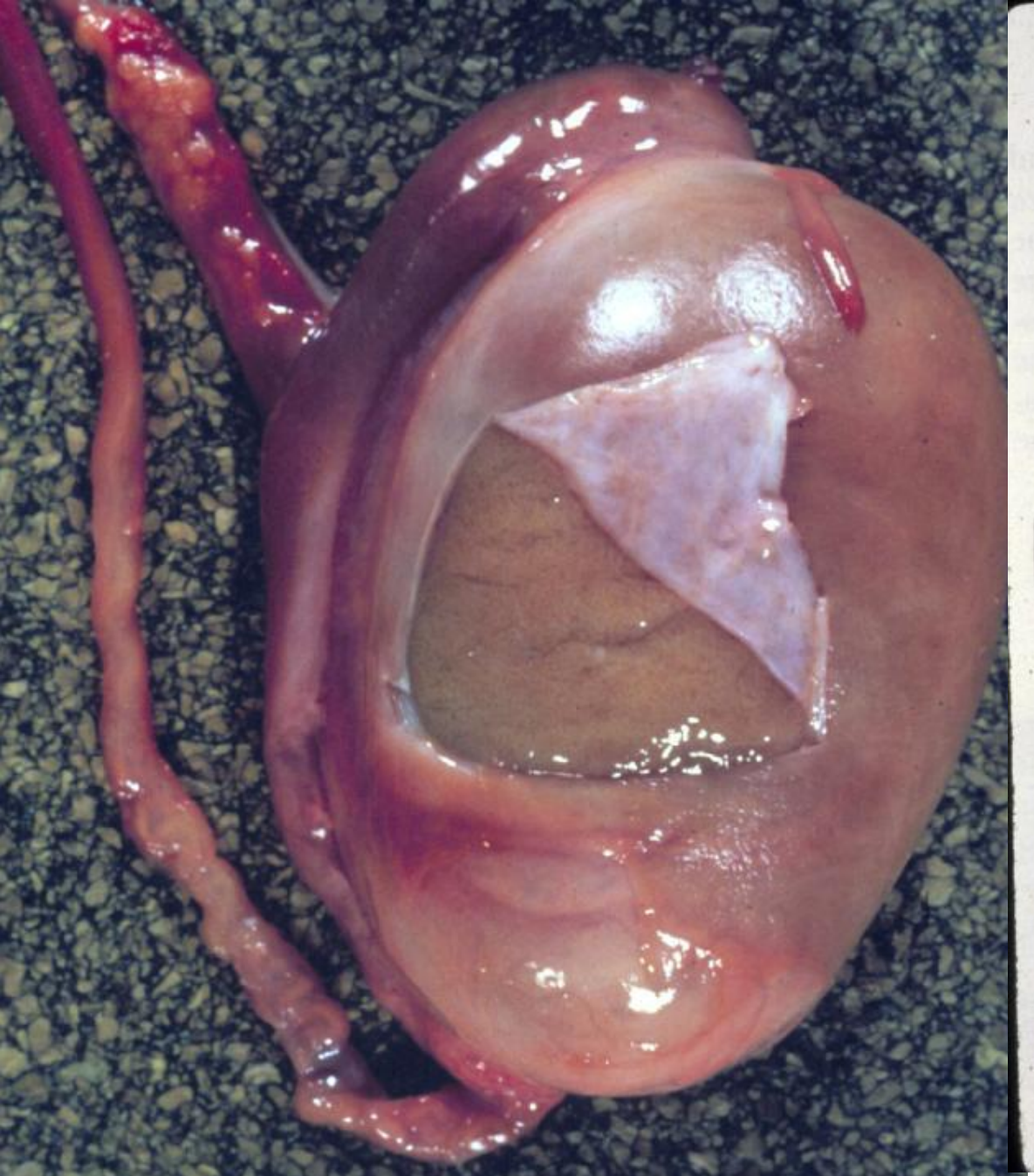


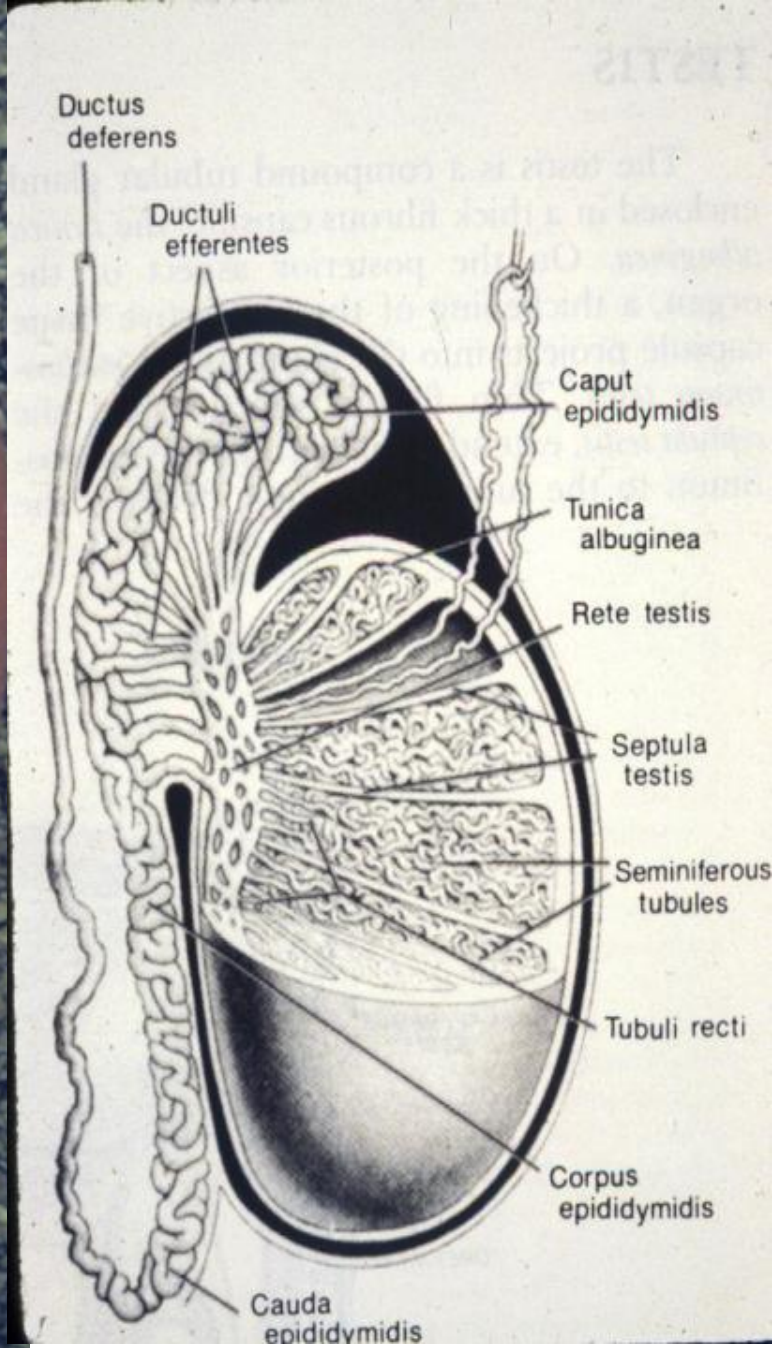






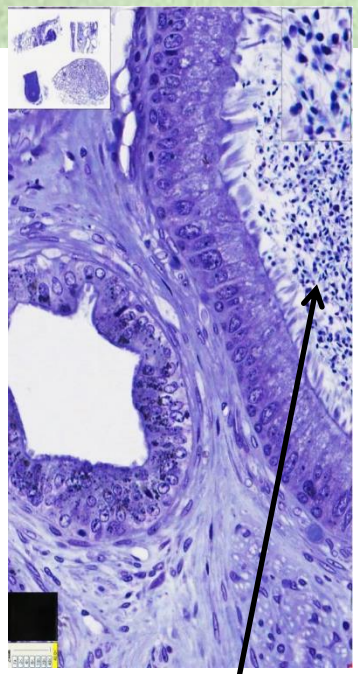





Ductus deferens
Ductuli efferentes
Caput epididymidis
Tunica albuginea
Rete testis
Septula testis
Seminiferous tubules
Tubuli recti
Corpus epididymidis
Cauda epididymidis

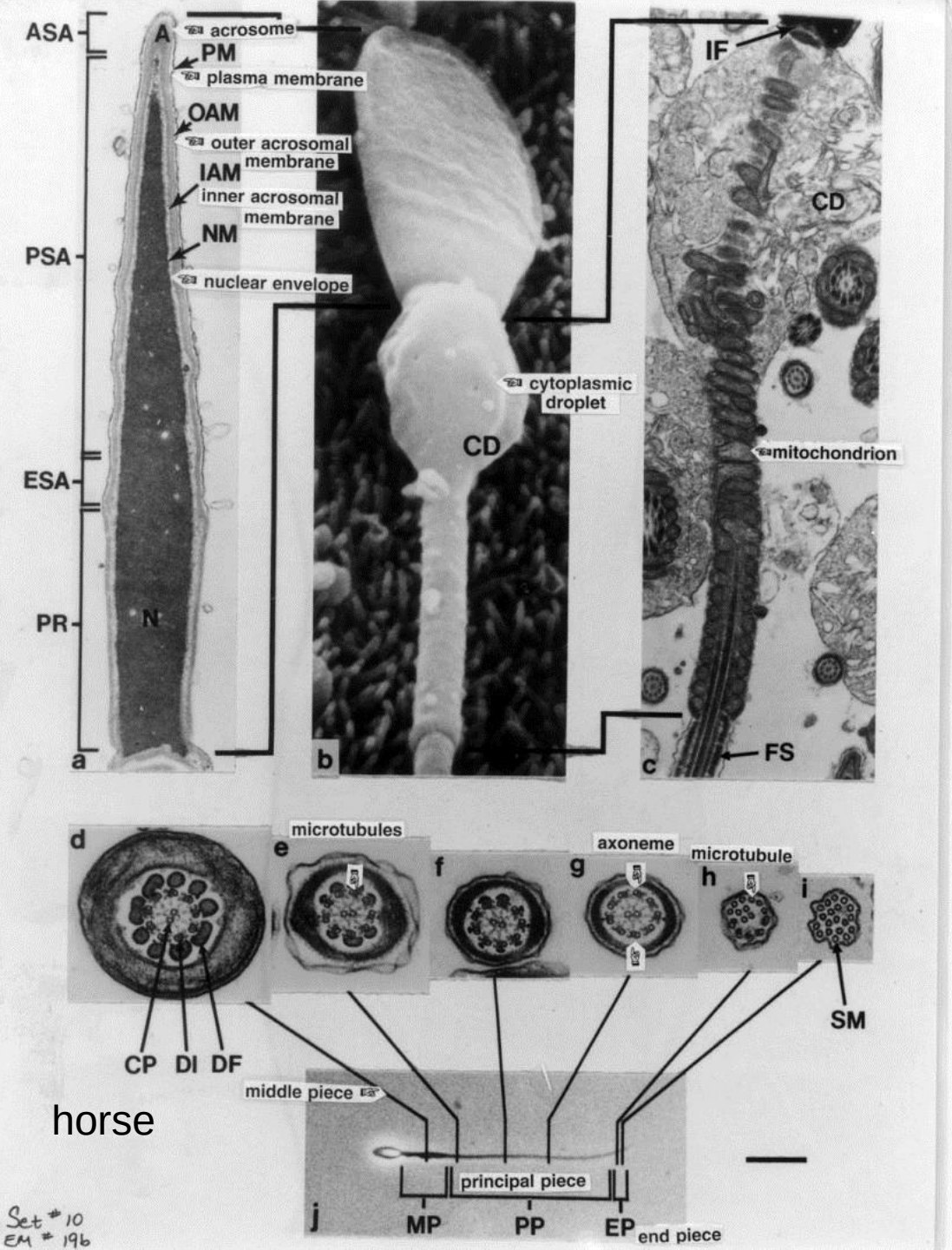
Human sperm in smear

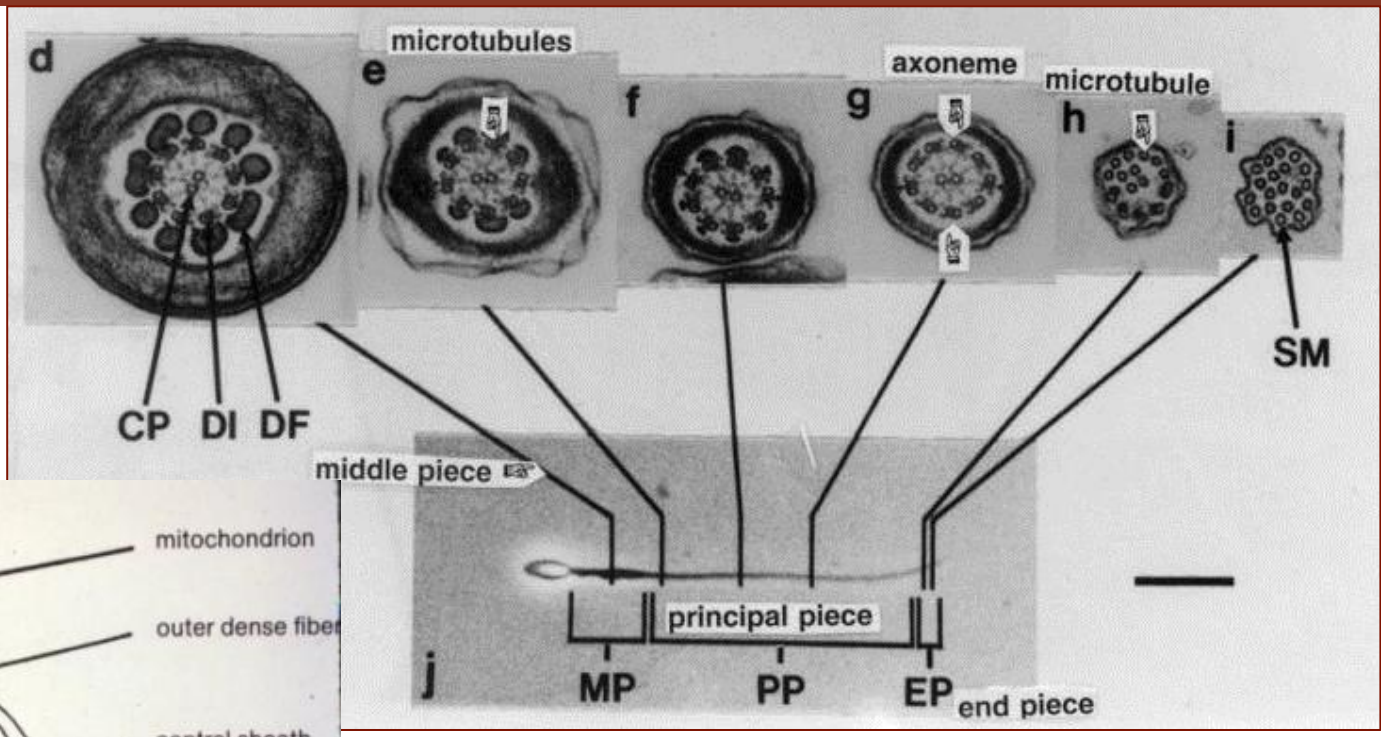
1. Spermatozoon

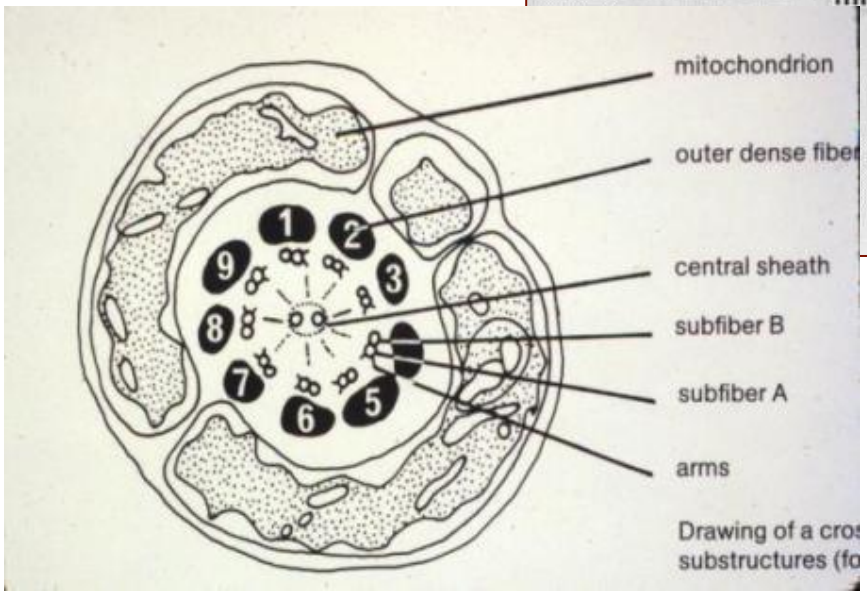


Human epididymal spermatozoa

Human ejaculated spermatozoon





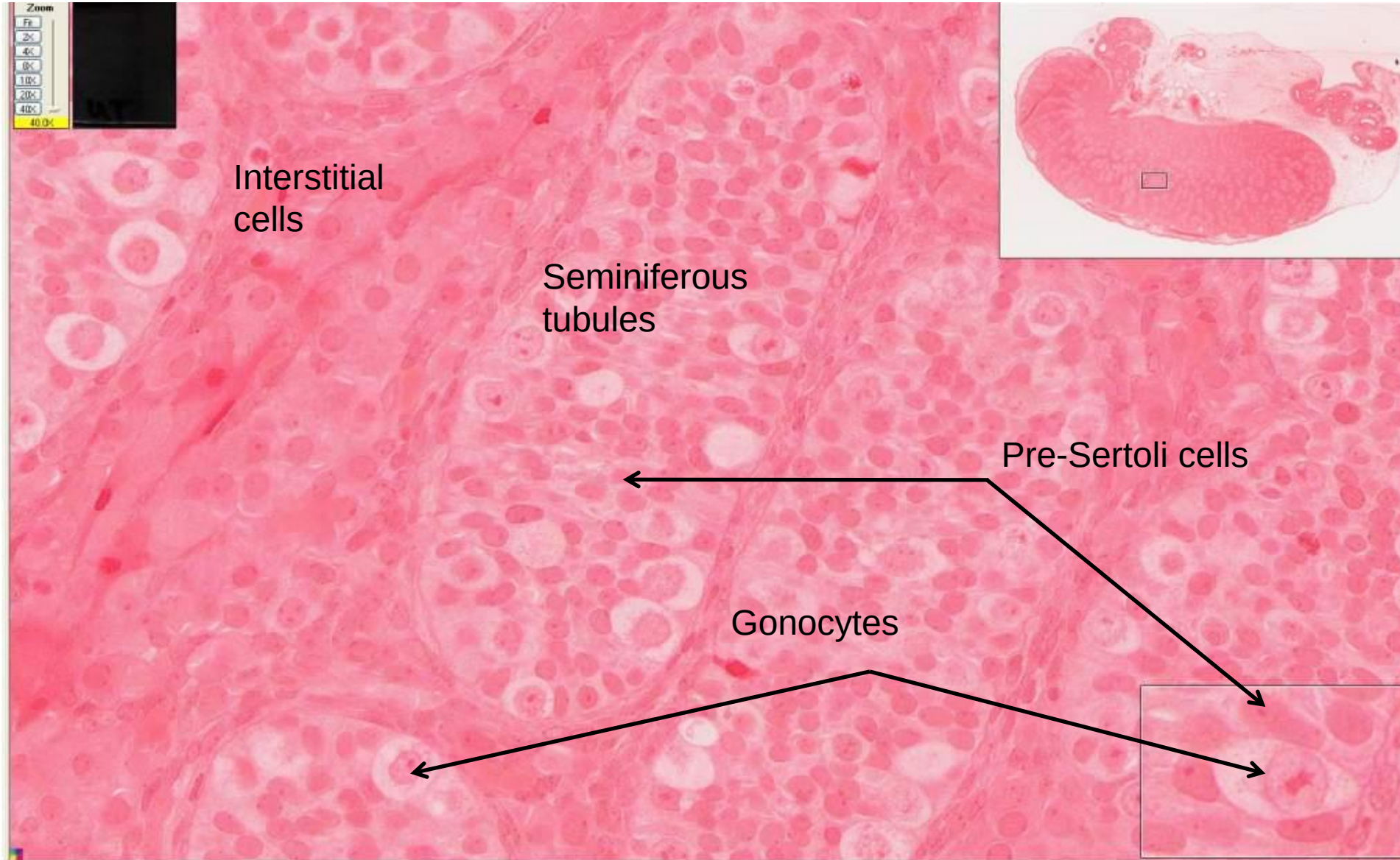


Drawing of a cros
substructures (fo

The microtubular structure of spermatozoan flagellum is composed of microtubule axonemes 9+2 structure: 2 singlet microtubules, surrounded by 9 doublet microtubules with dynein arms. DYNEIN ARMS are a PAIRED LATERAL APPENDAGES
That are PROTEIN with ATPase ACTIVITY FOR CILIARY AND FLAGELLAR MOTILITY.

.

Fetal testis #19760



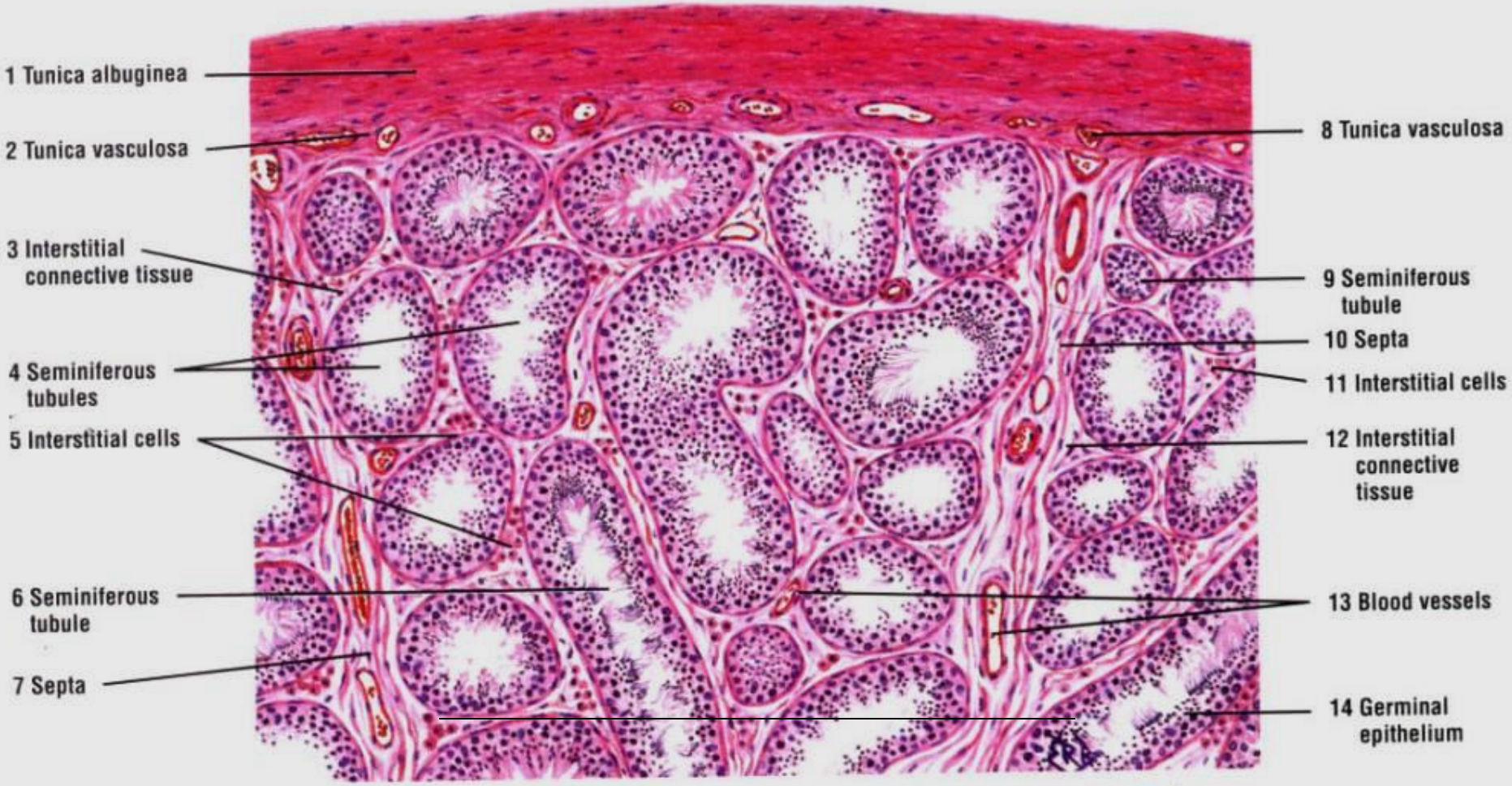
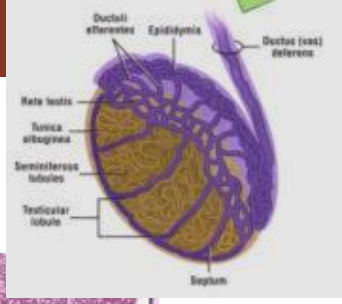


Fig. 17-1 Testis (sectional view). Stain: hematoxylin-eosin. Low magnification.

Slide 165

Human testis capsule and parenchyma



Capsule

Seminiferous tubules

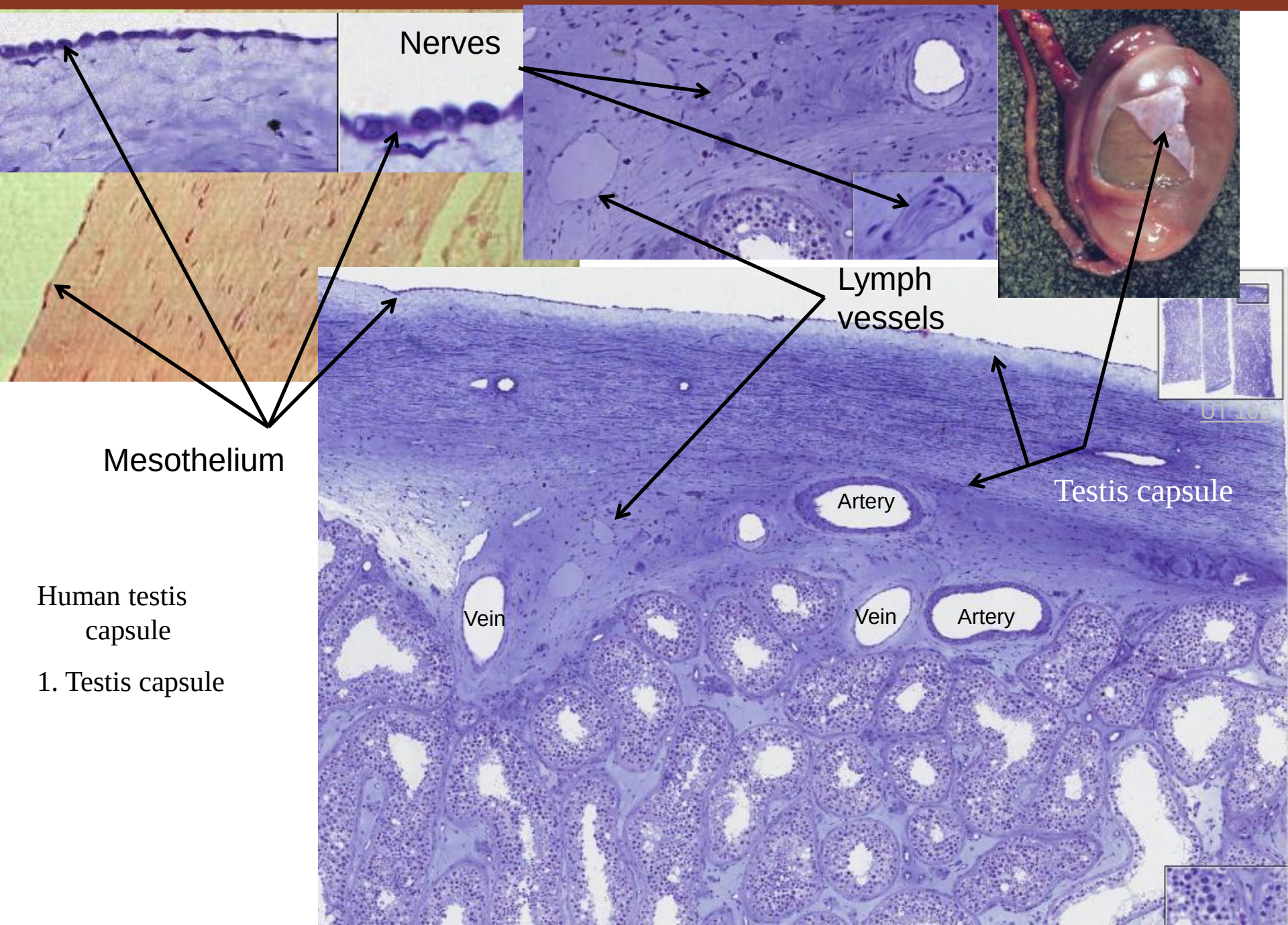
Veins

Leydig cells

Arteries

Lymph vessels

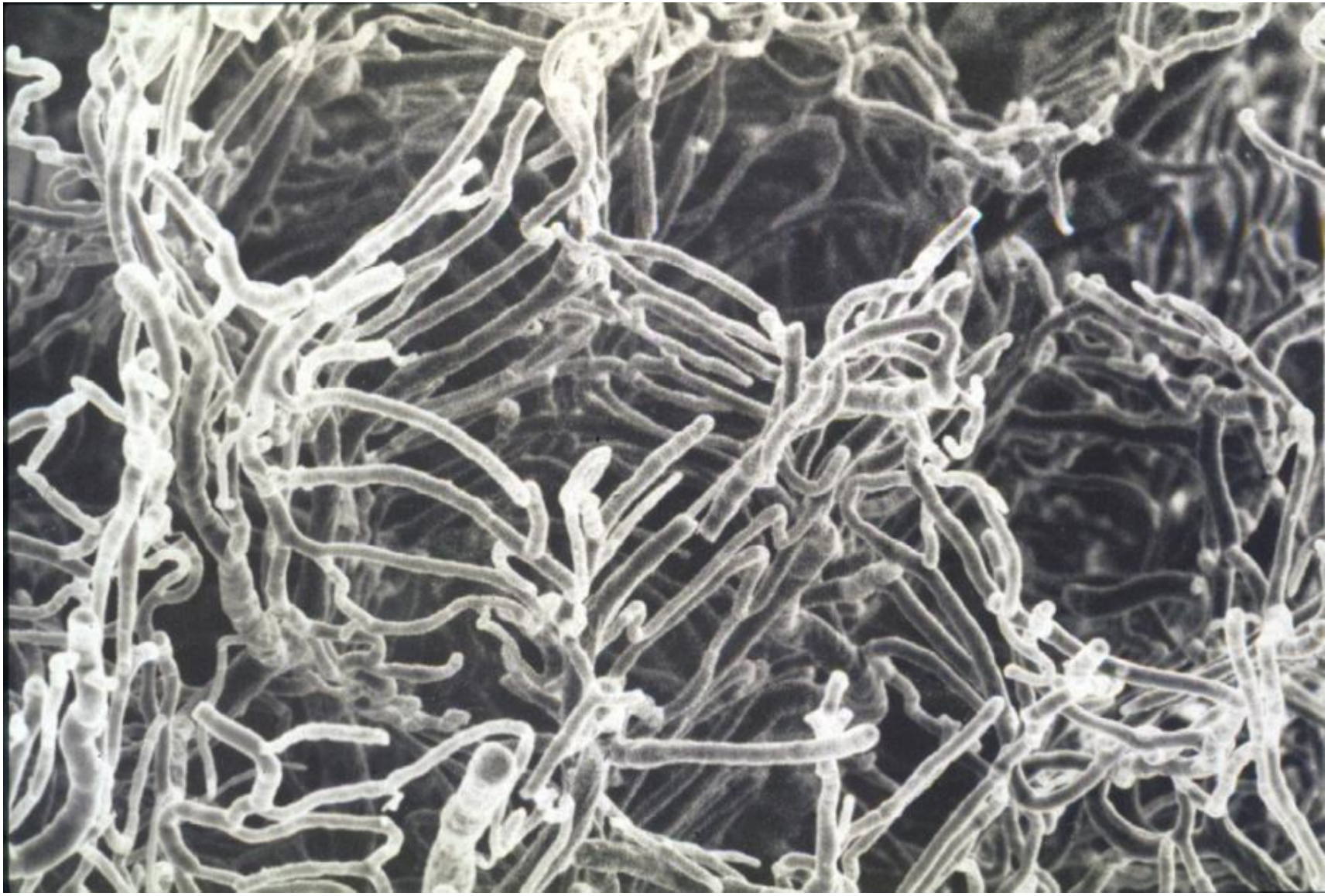
There are major blood vessels within the capsule (tunica albuginea), and these are related to cooling the testis.



Human testis capsule

1. Testis capsule

Blood supply around seminiferous tubules



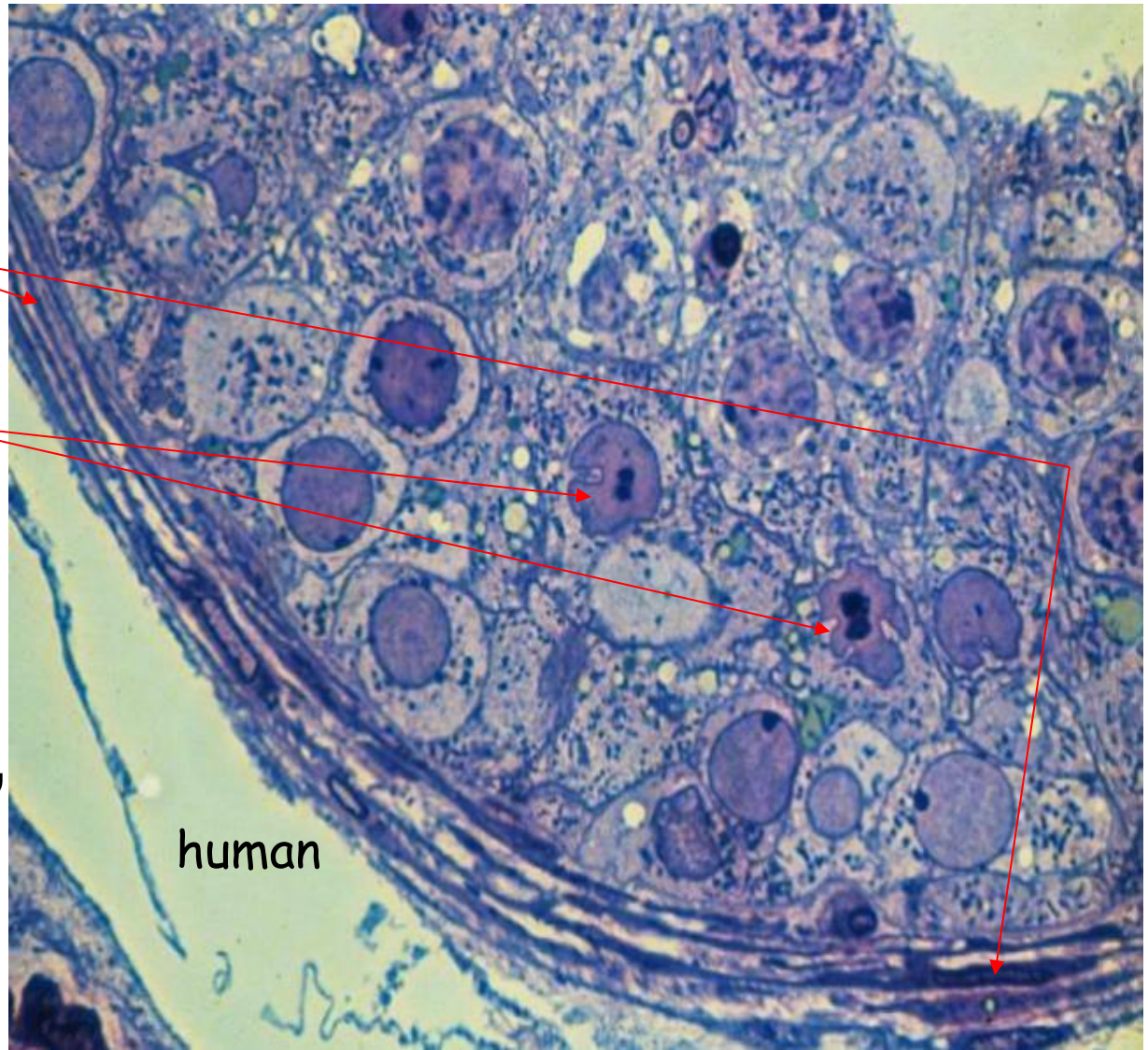
SEMINIFEROUS TUBULES COMPOSED OF:

MYOID CELLS

SERTOLI CELLS

GERM CELLS

- **SPERMATOGONIA,**
- **SPERMATOCYTES,**
- **SPERMATIDS**



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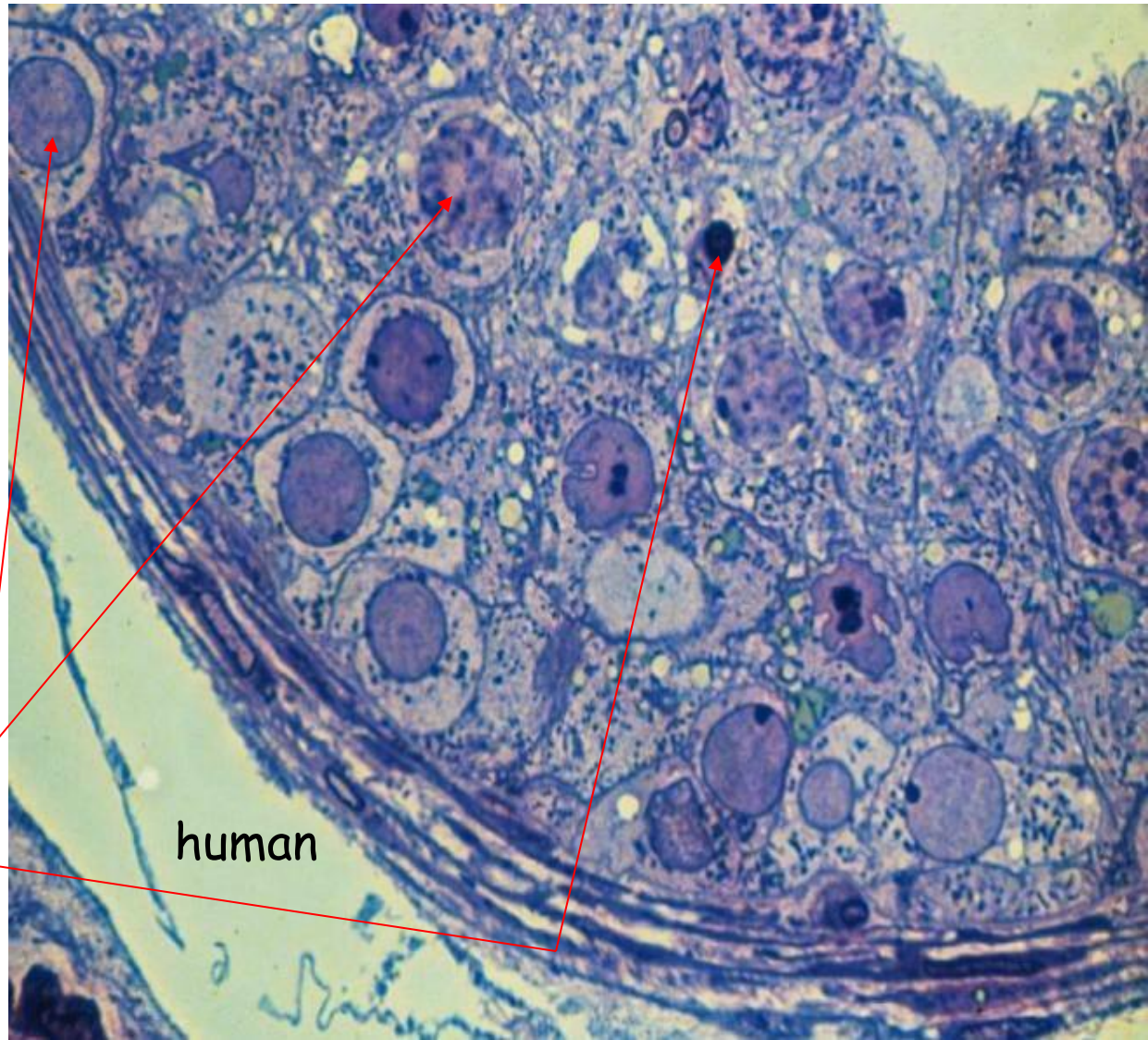


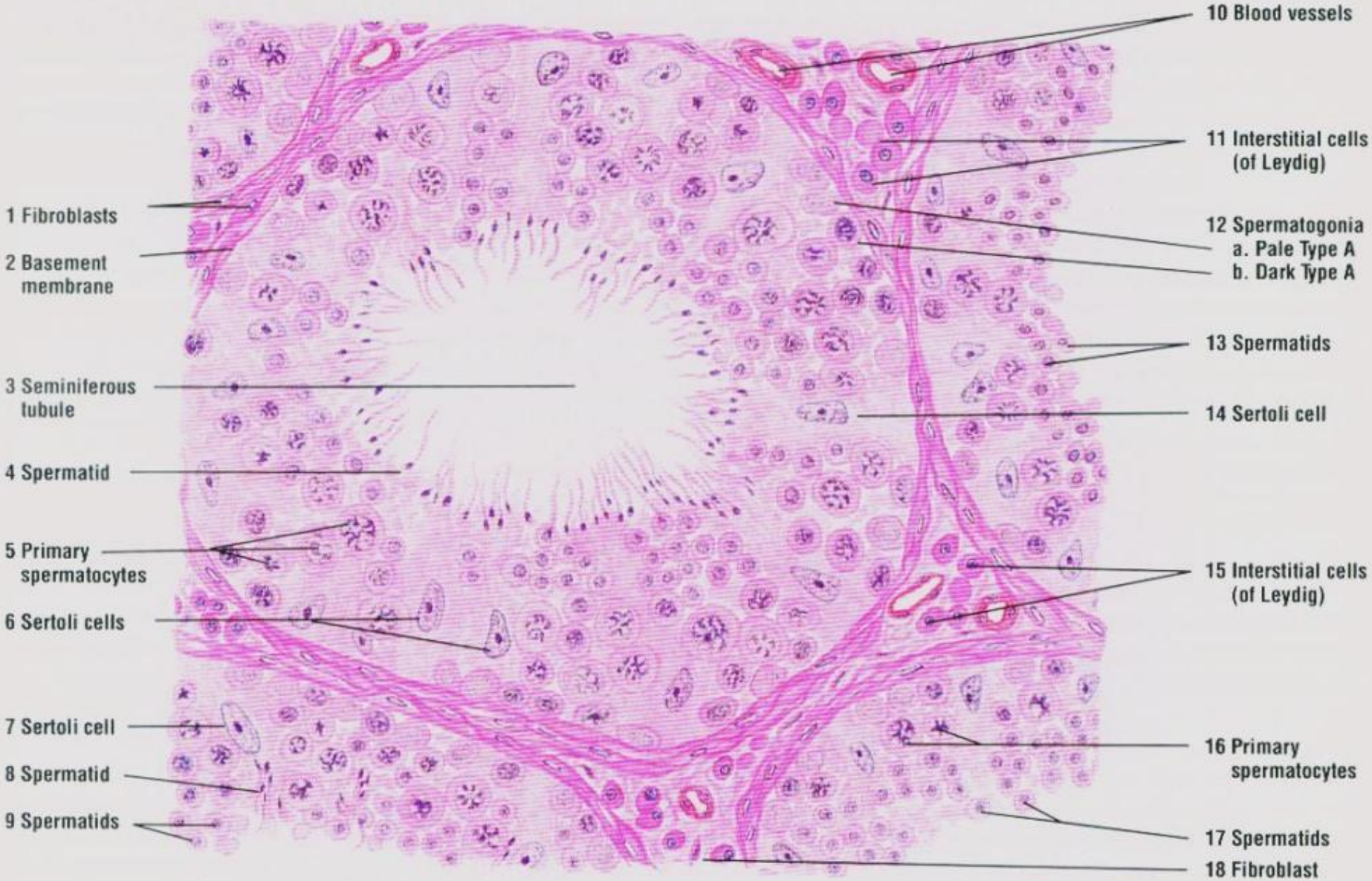
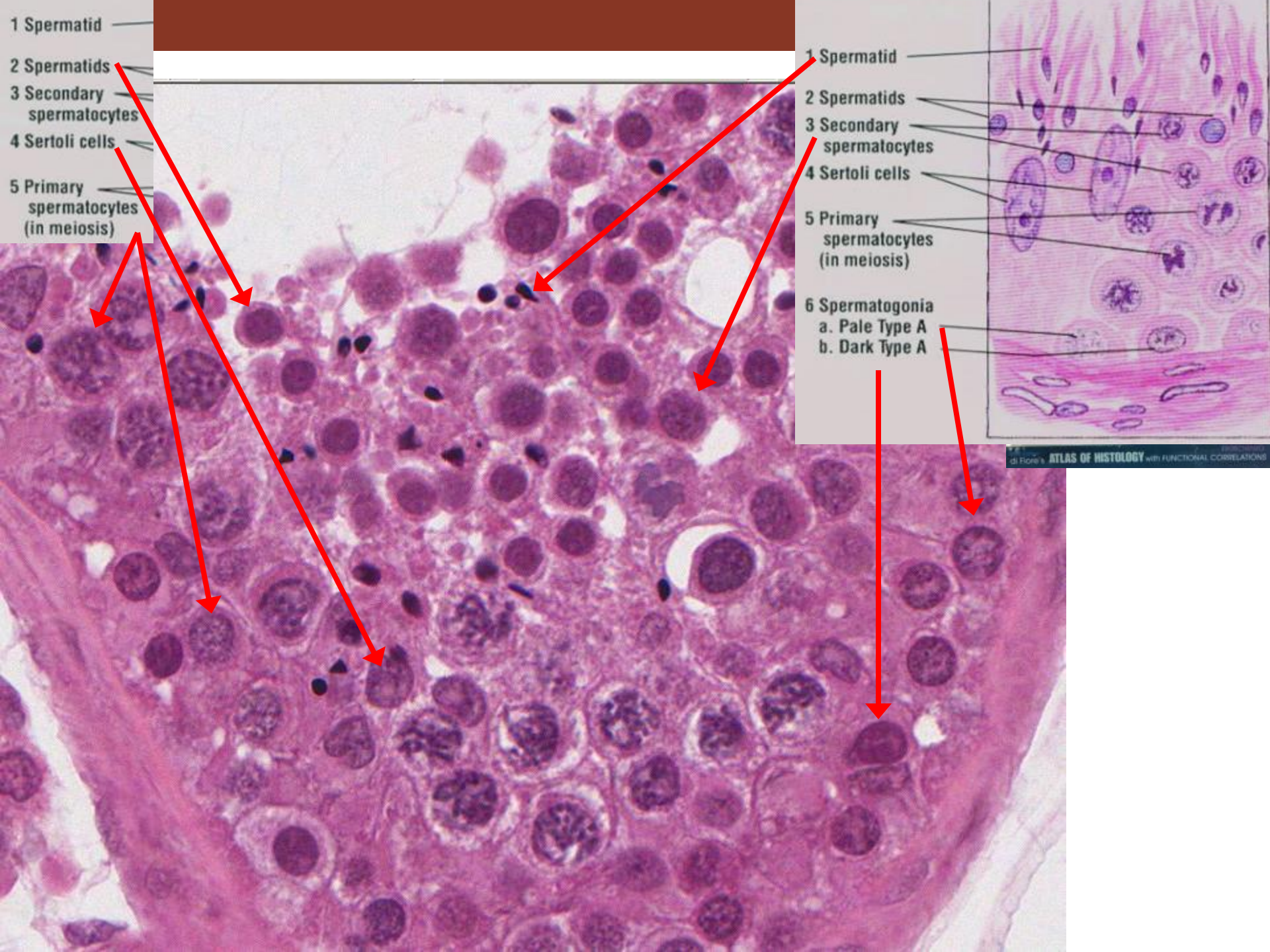
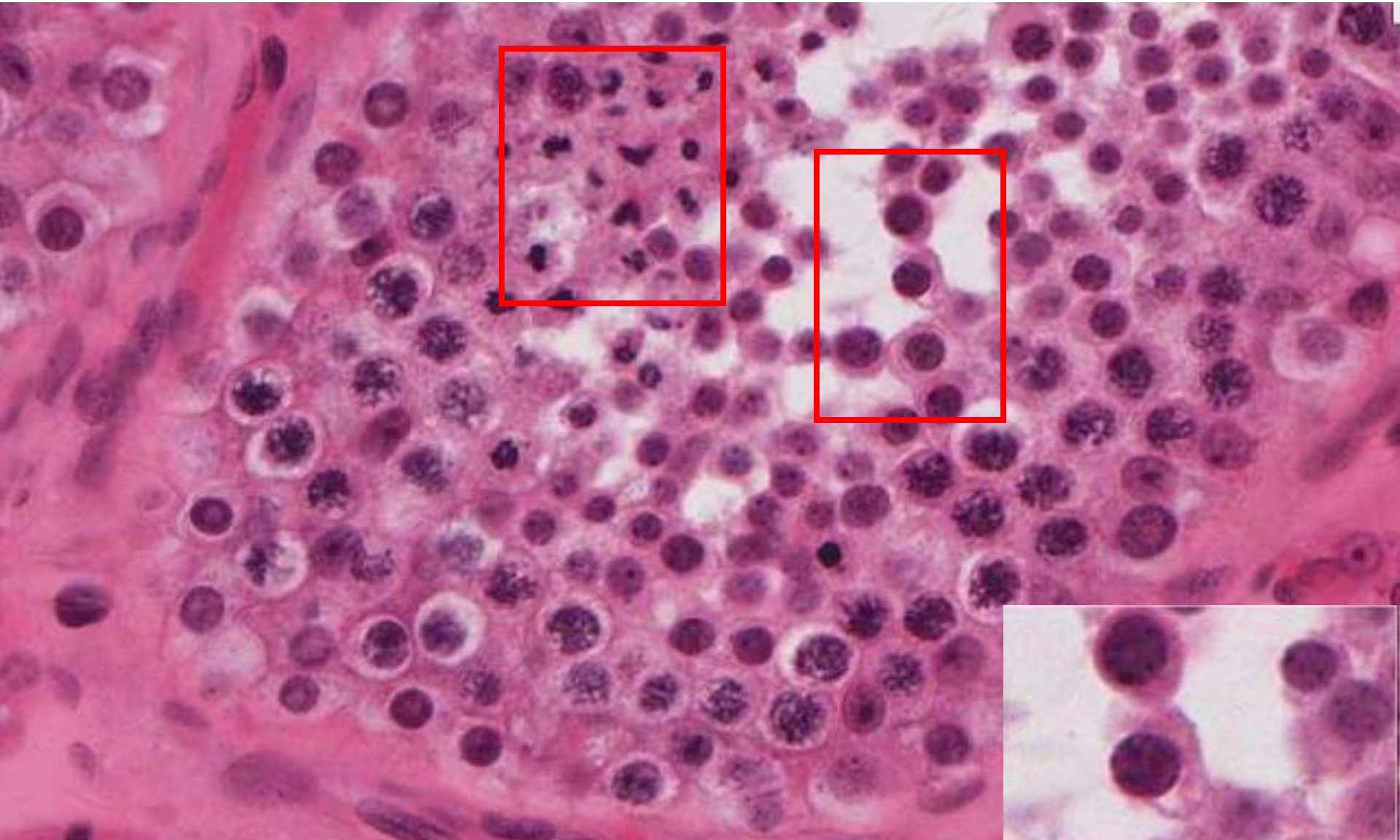


Fig. 17-3 Primate Testis: Spermatogenesis in Seminiferous Tubules (transverse section). Stain: hematoxylin-eosin. Medium magnification.


1 Spermatid
2 Spermatids
3 Secondary spermatocytes
4 Sertoli cells
5 Primary spermatocytes (in meiosis)
6 Spermatogonia
a. Pale Type A
b. Dark Type A
di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS

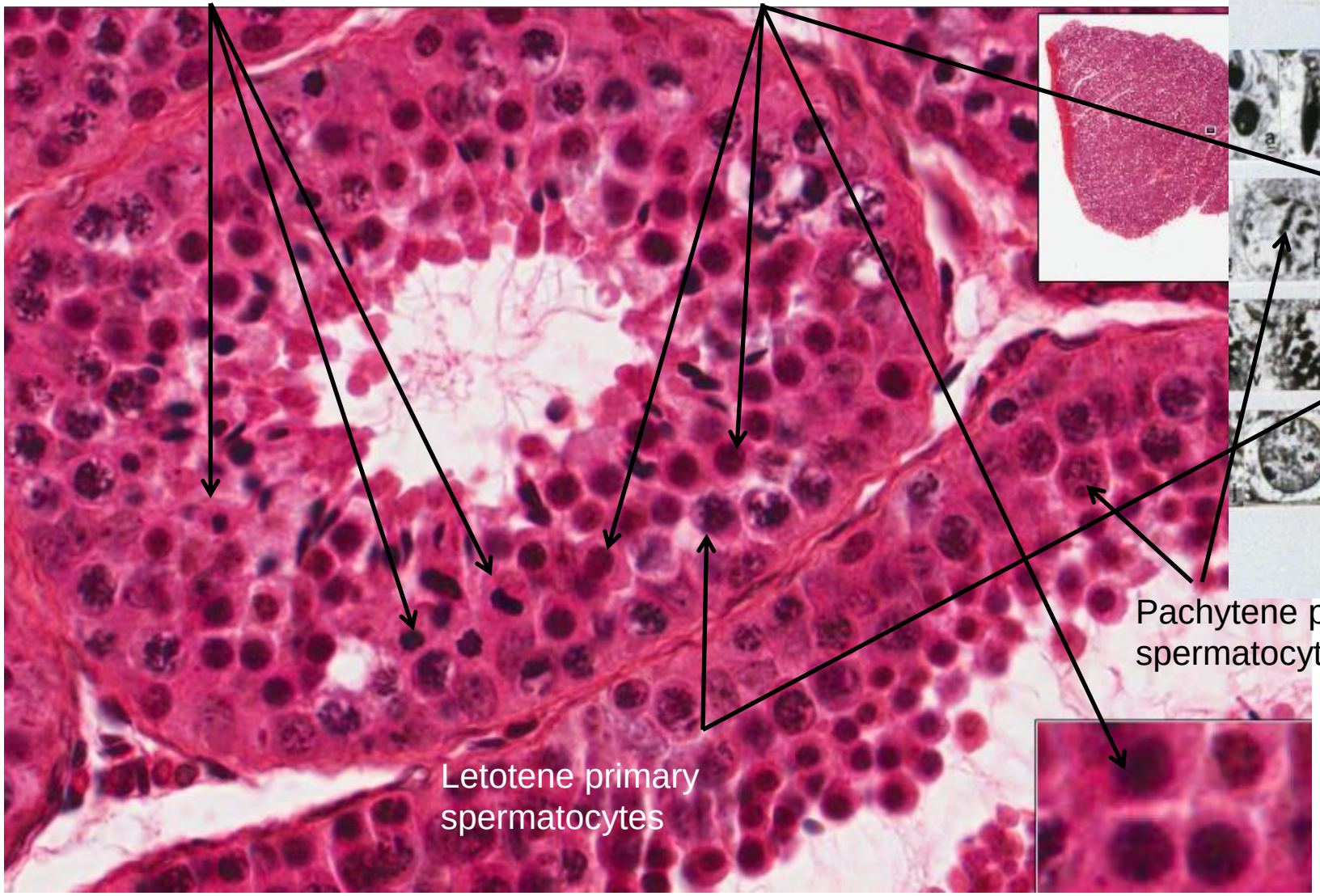
Meiotic activity

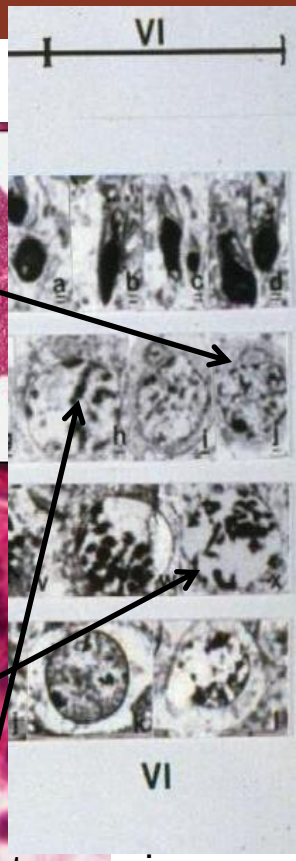
UT165 larger secondary spermatocytes and smaller Golgi phase spermatids human testis



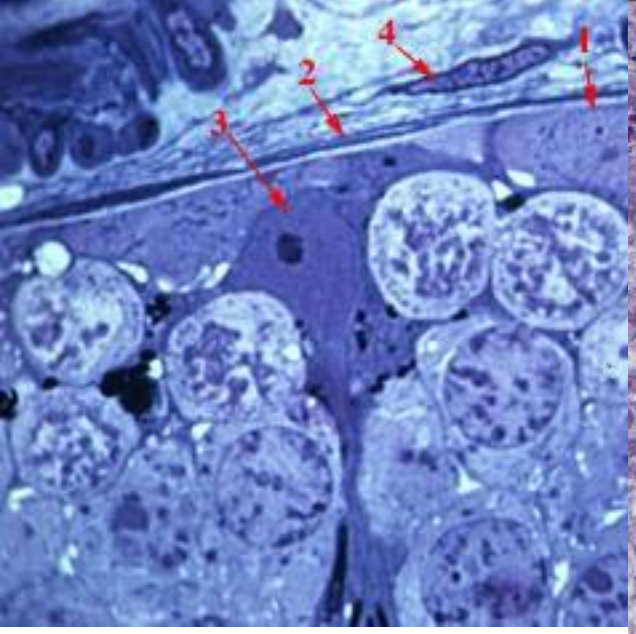
metaphase figures in meiosis

#92 secondary spermatocytes





To find secondary spermatocytes, one needs to find a tubule in stage VI of the spermatogenic cycle with metaphase figures in meiosis and no (almost no) pachytene primary spermatocytes. The pachytene primary spermatocytes are the immediate precursor to secondary spermatocytes.

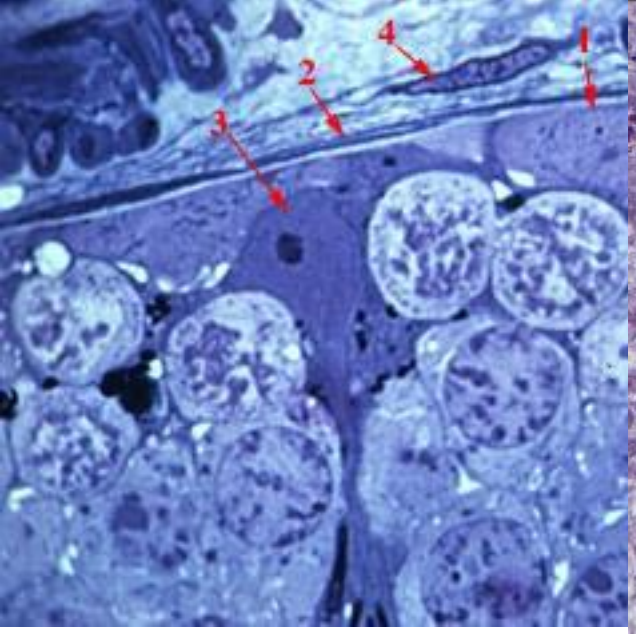


Monkey seminiferous epithelium

1. Spermatogonia
2. Myoid cell
3. Sertoli cell
4. Fibroblast

19680

Leydig cells



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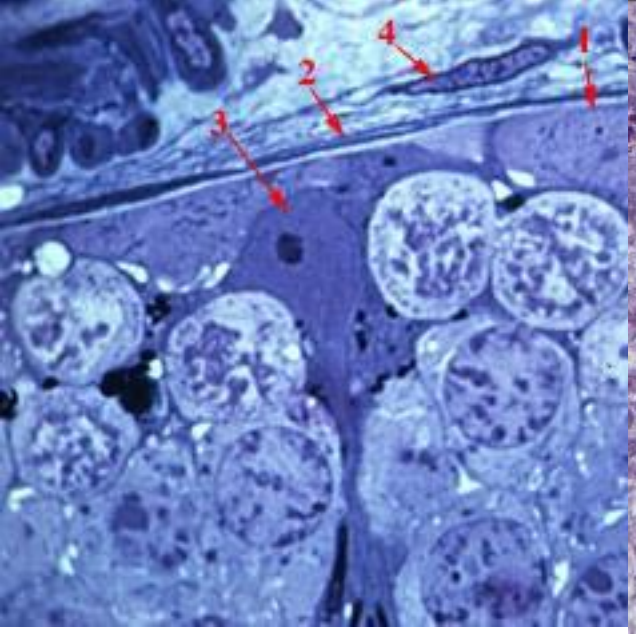
Leydig cells



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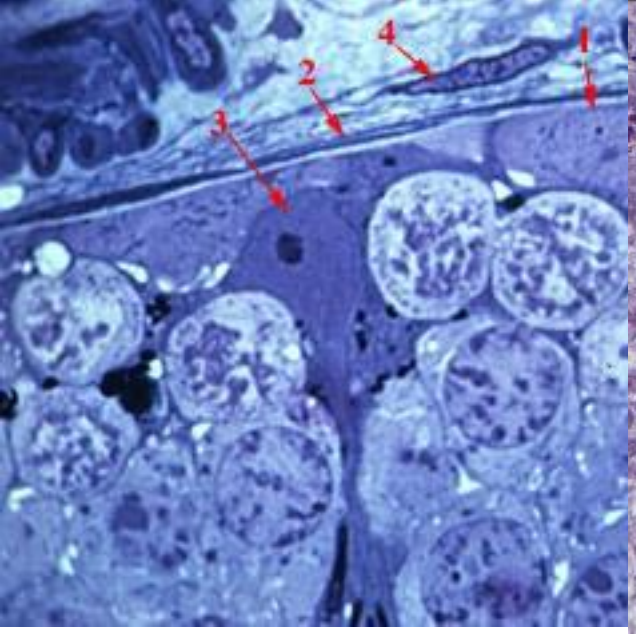
19680



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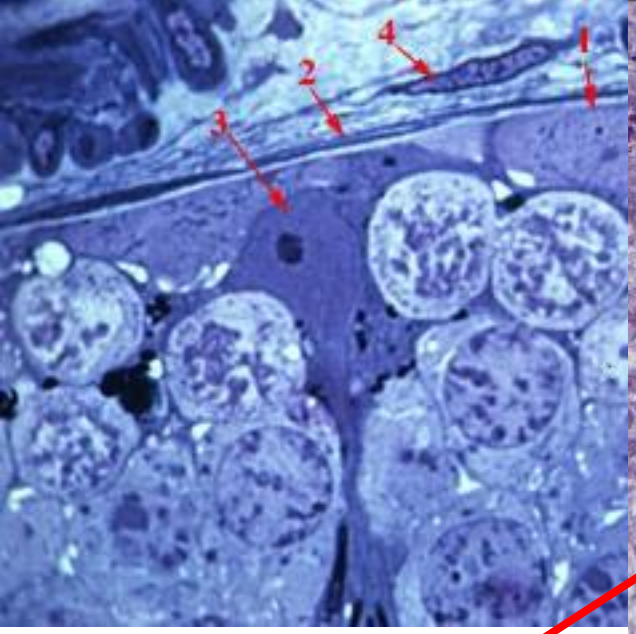
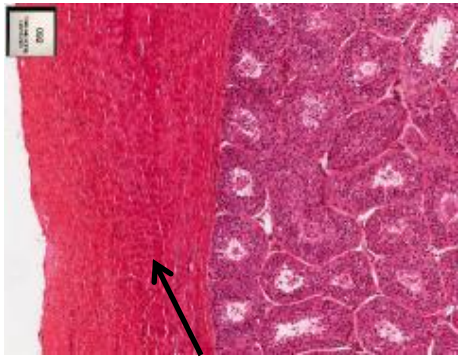


Monkey seminiferous epithelium

1. Spermatogonia
2. Myoid cell
3. Sertoli cell
4. Fibroblast

Leydig cells

Slide 92: Testis



Tunica albuginea

Leydig (interstitial) cells

Residual bodies

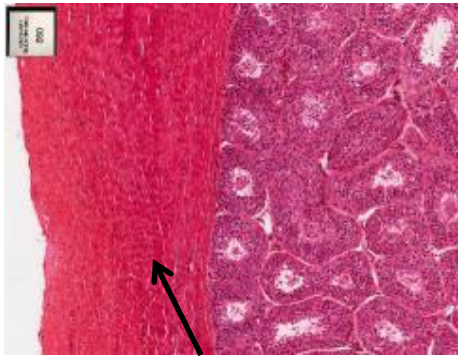
Basement membrane

Myoid cell

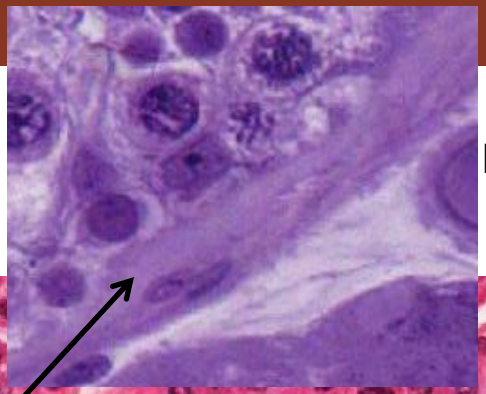
Sertoli cells

Seminiferous tubules

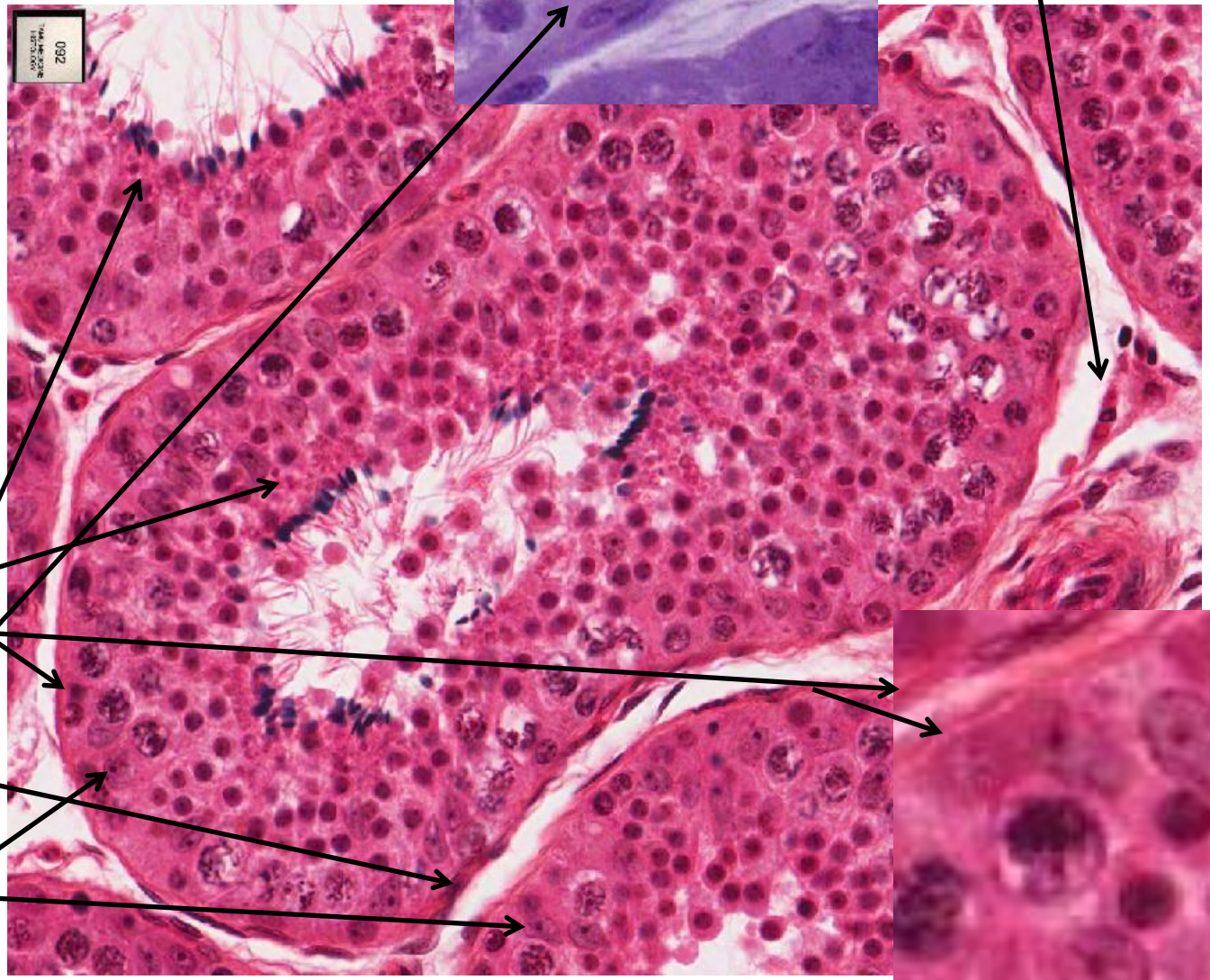
Slide 92: Testis



Tunica albuginea



Leydig (interstitial) cells



Residual bodies

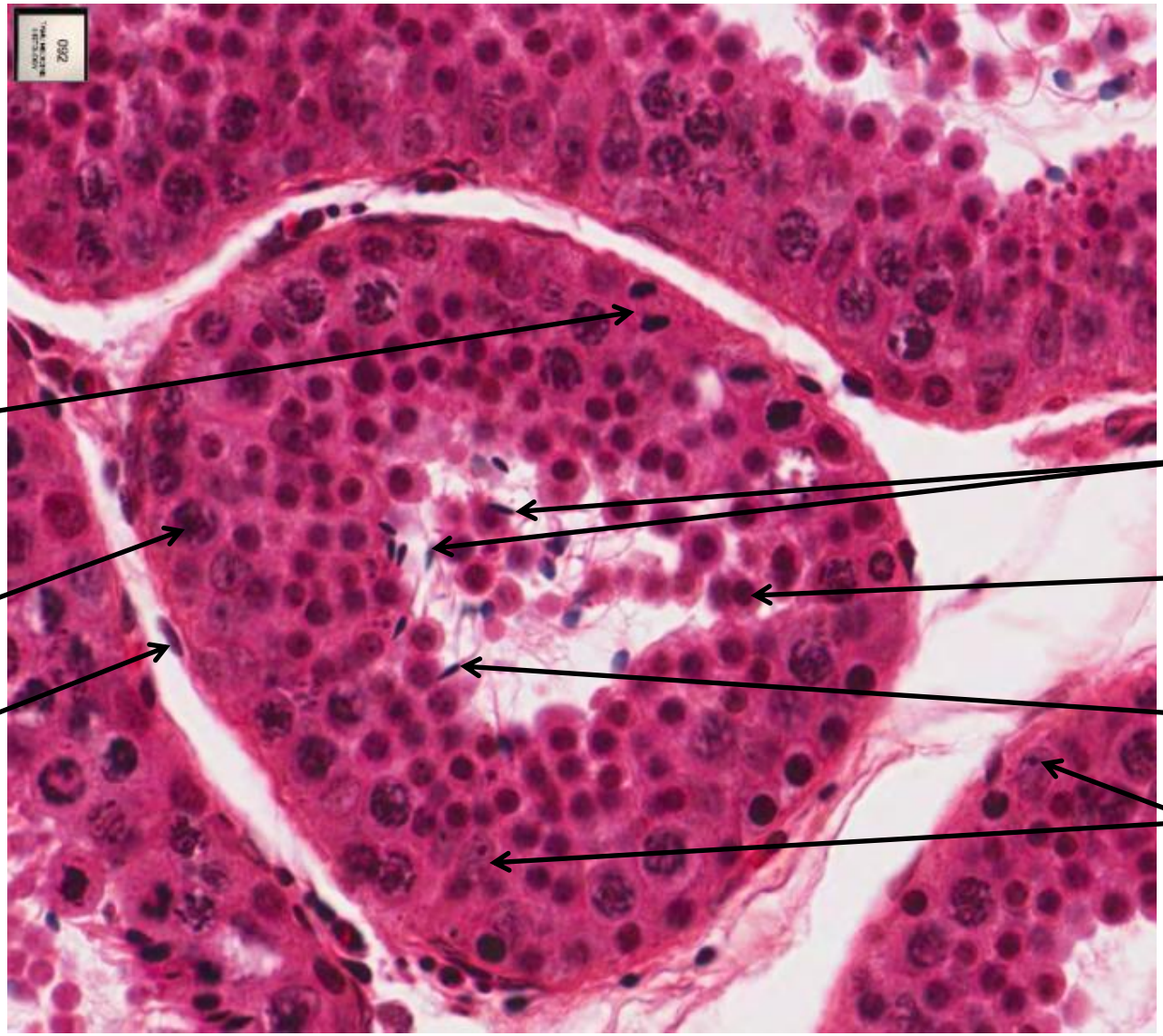
Basement membrane

Myoid cell

Sertoli cells

Seminiferous tubules

Slide 92: Testis



Dividing spermatogonia (mitotic division)

Primary spermatocytes

Myoid cell

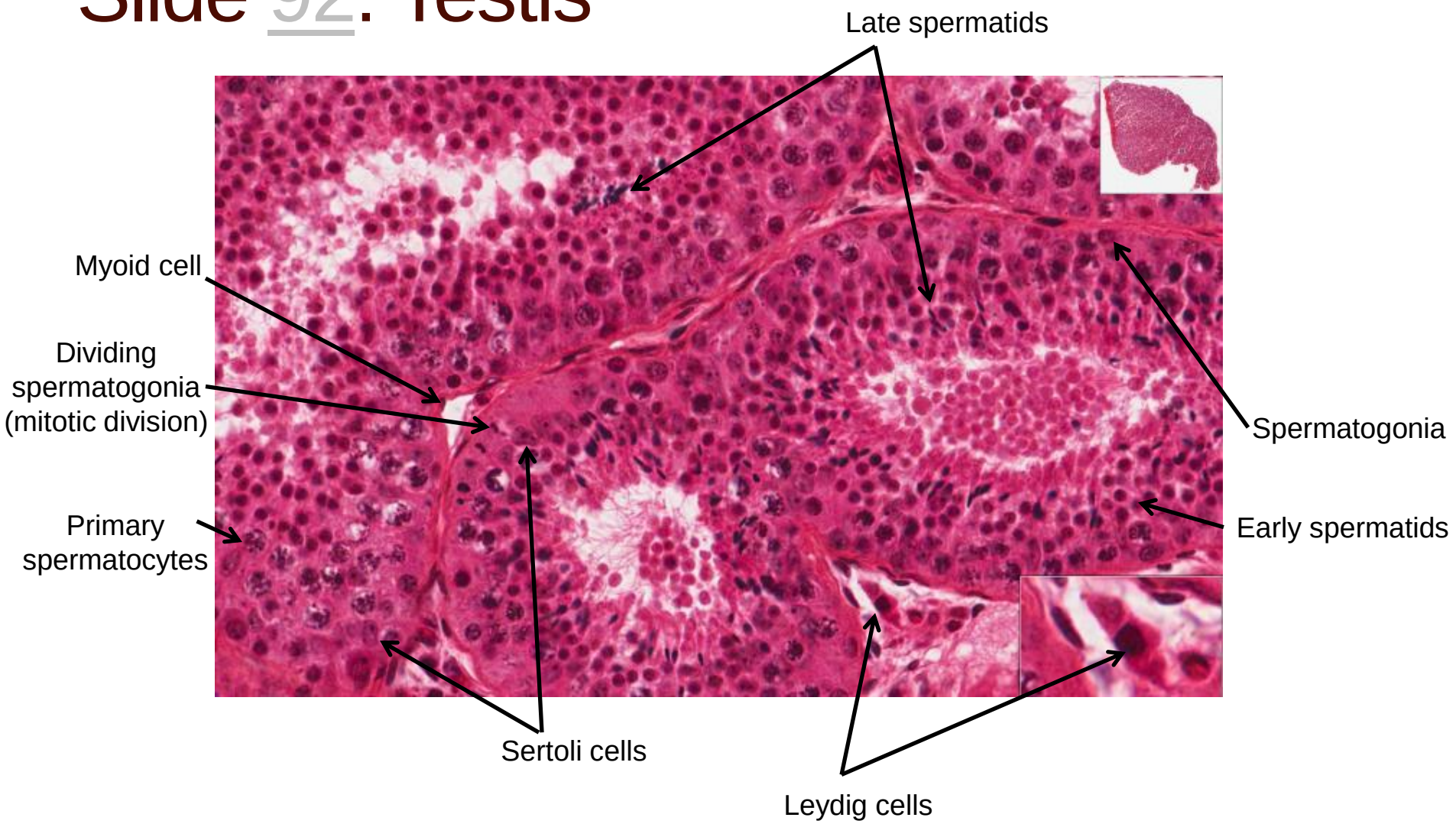
Spermatozoa

Early spermatids

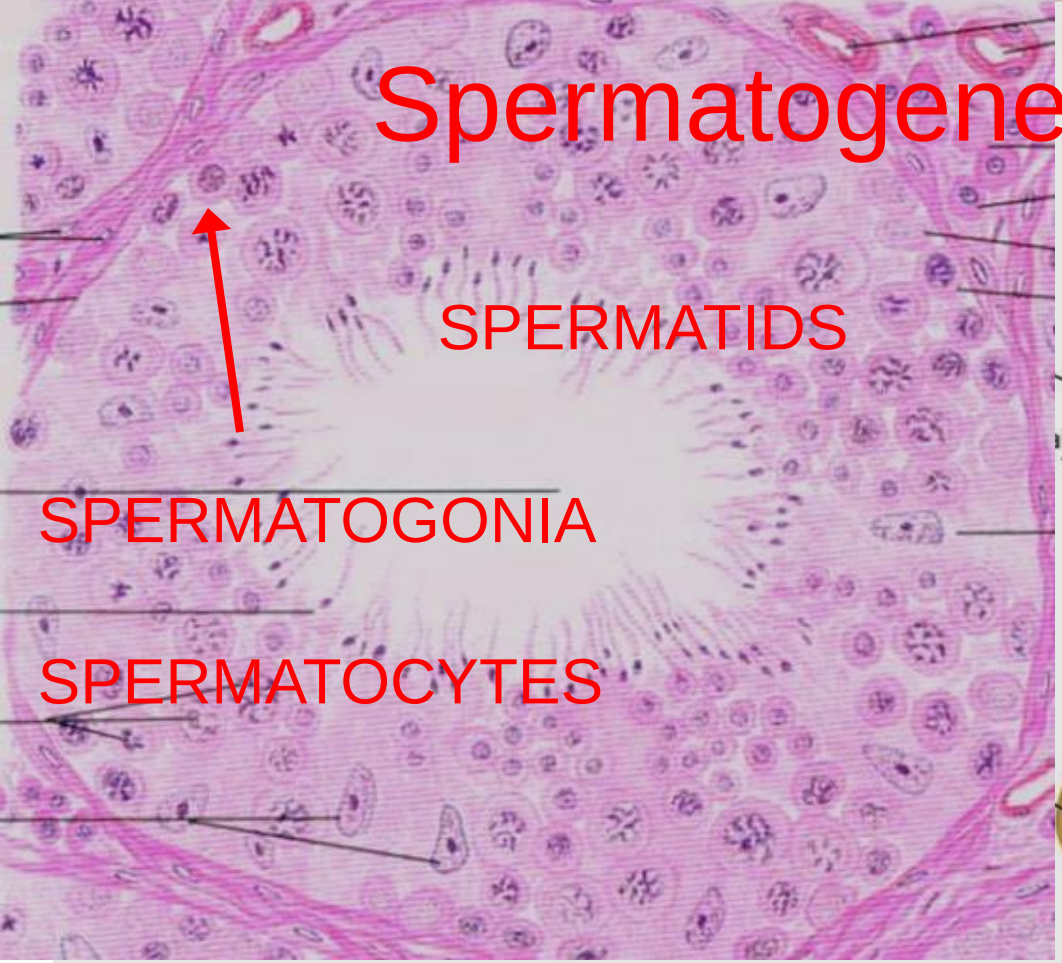
Late spermatids

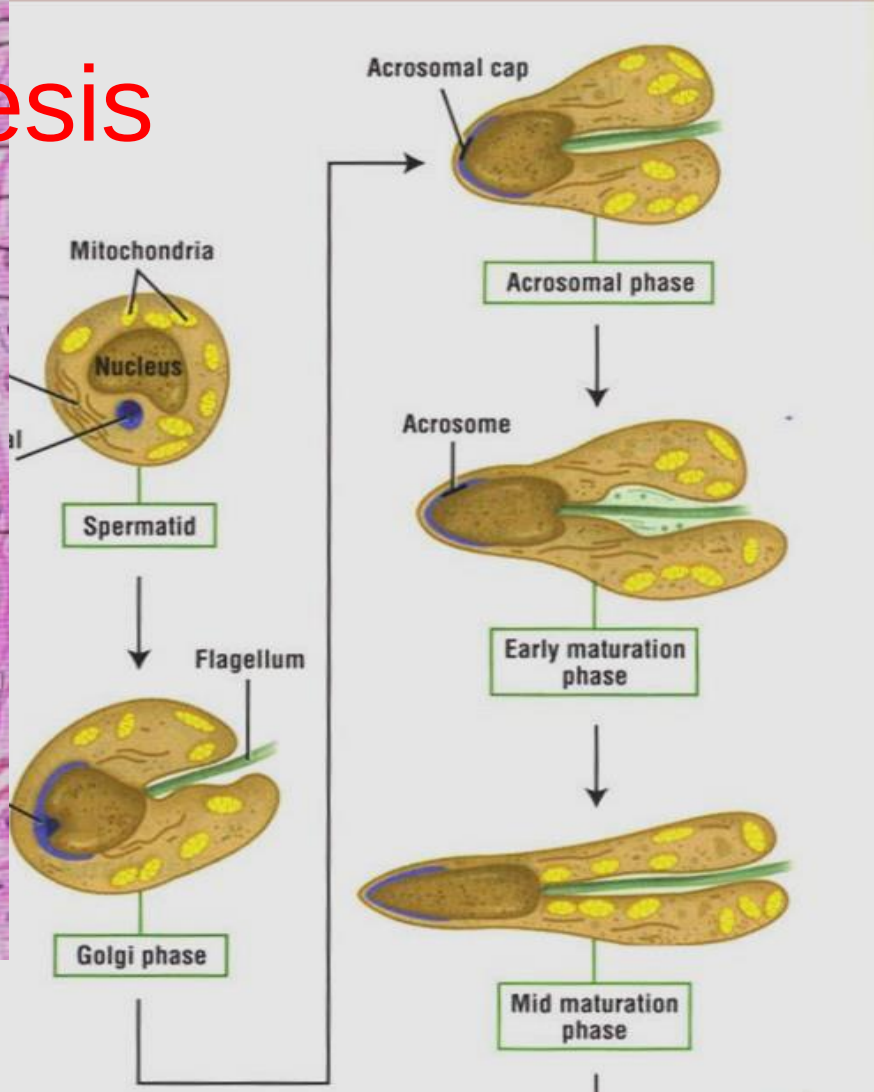
Sertoli cell

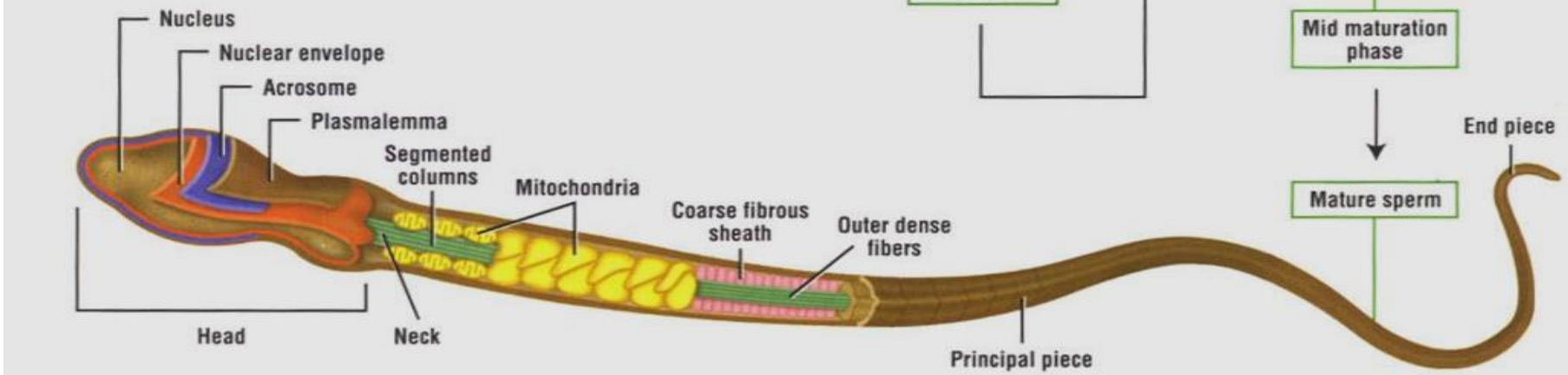
Slide 92: Testis



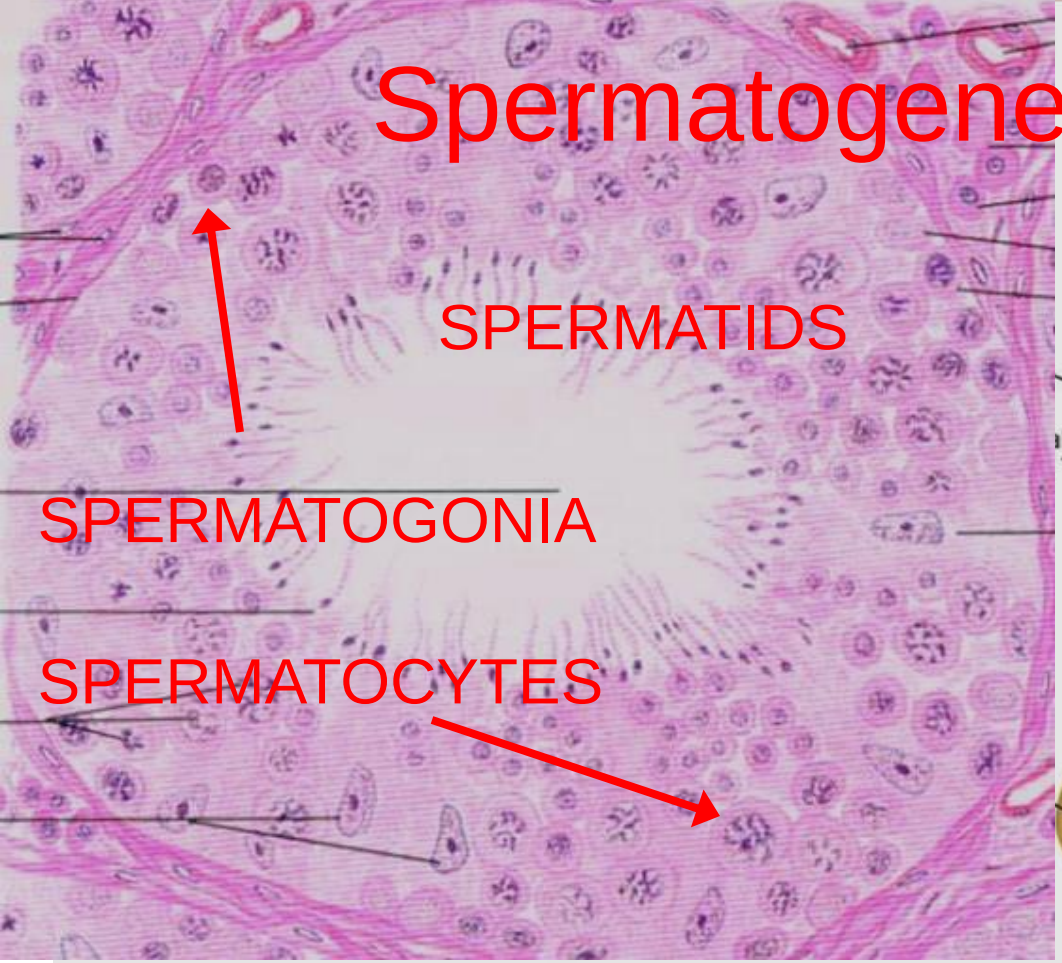
Spermatogenesis

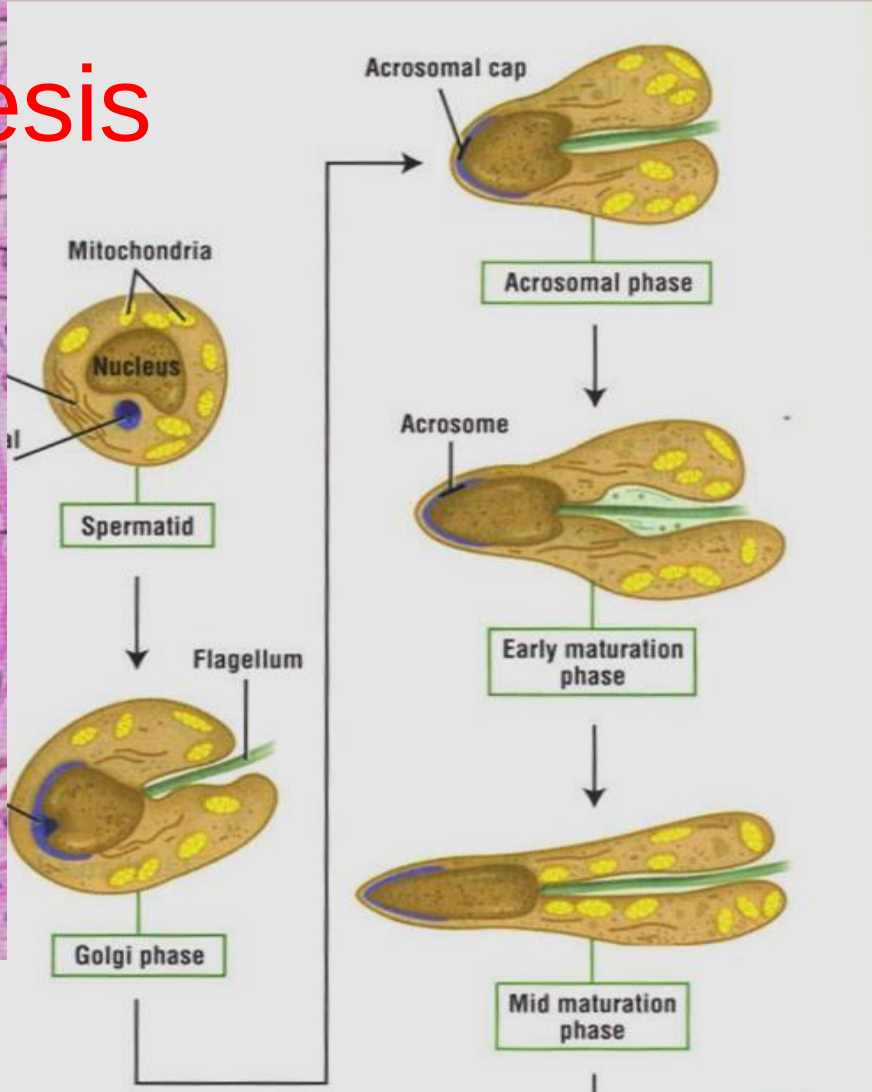


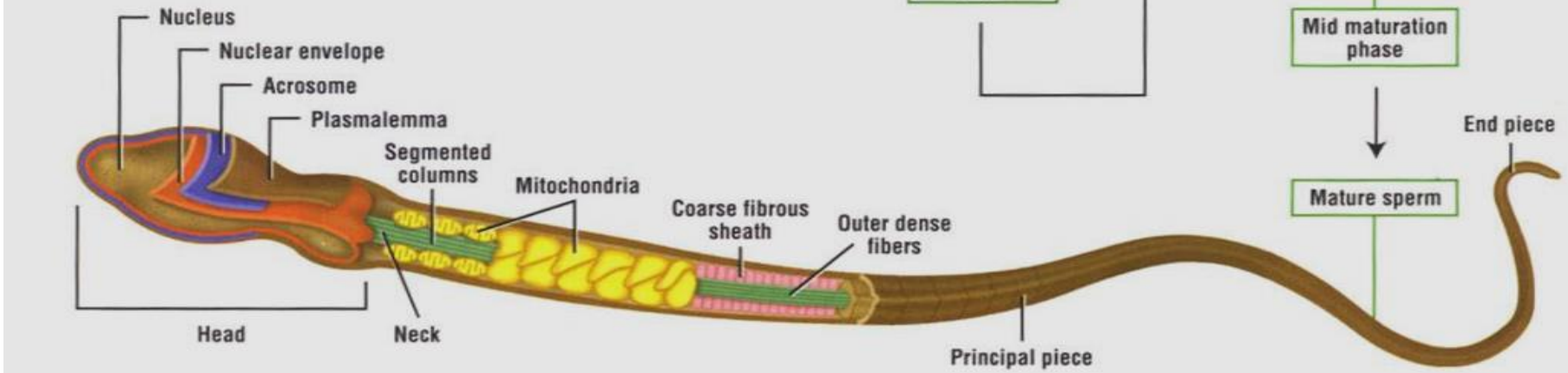




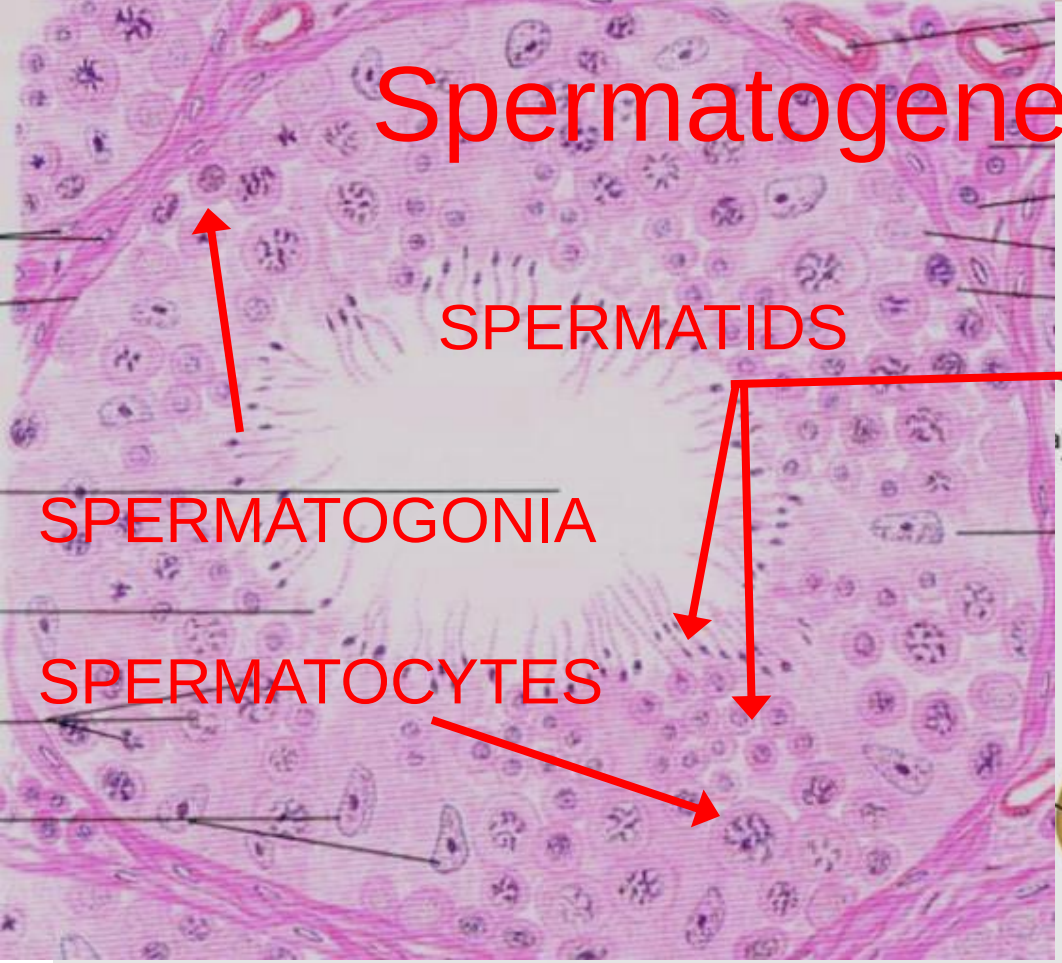
Spermatogenesis

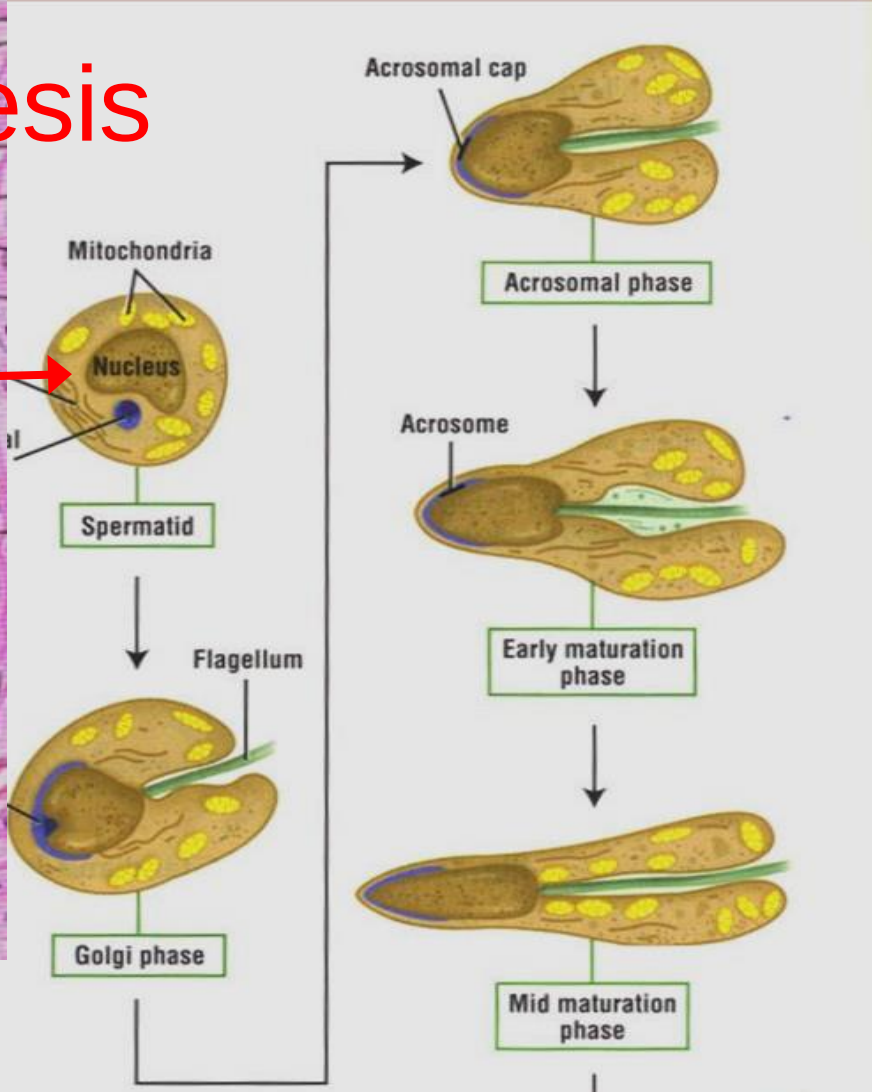


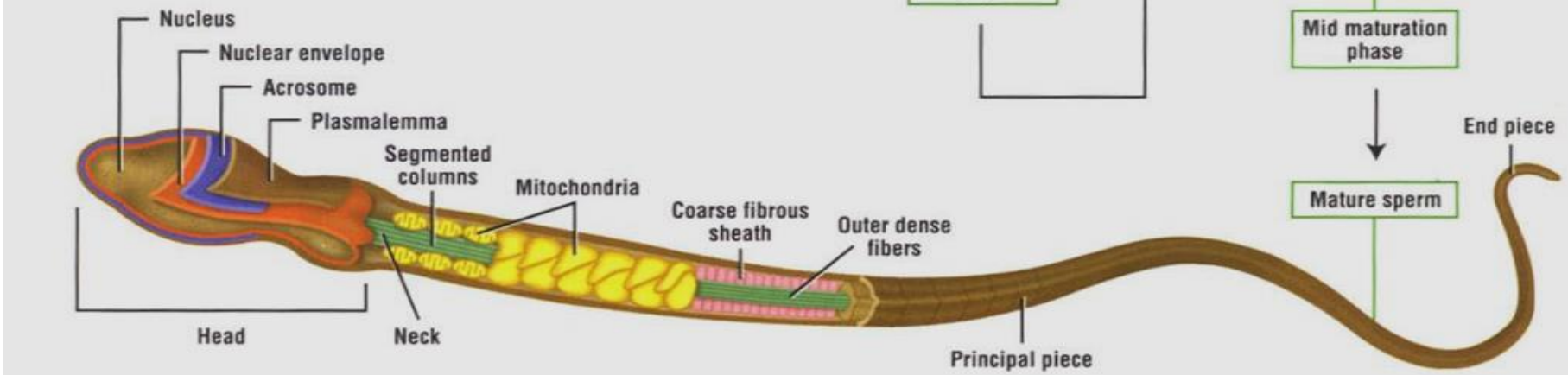




Spermatogenesis







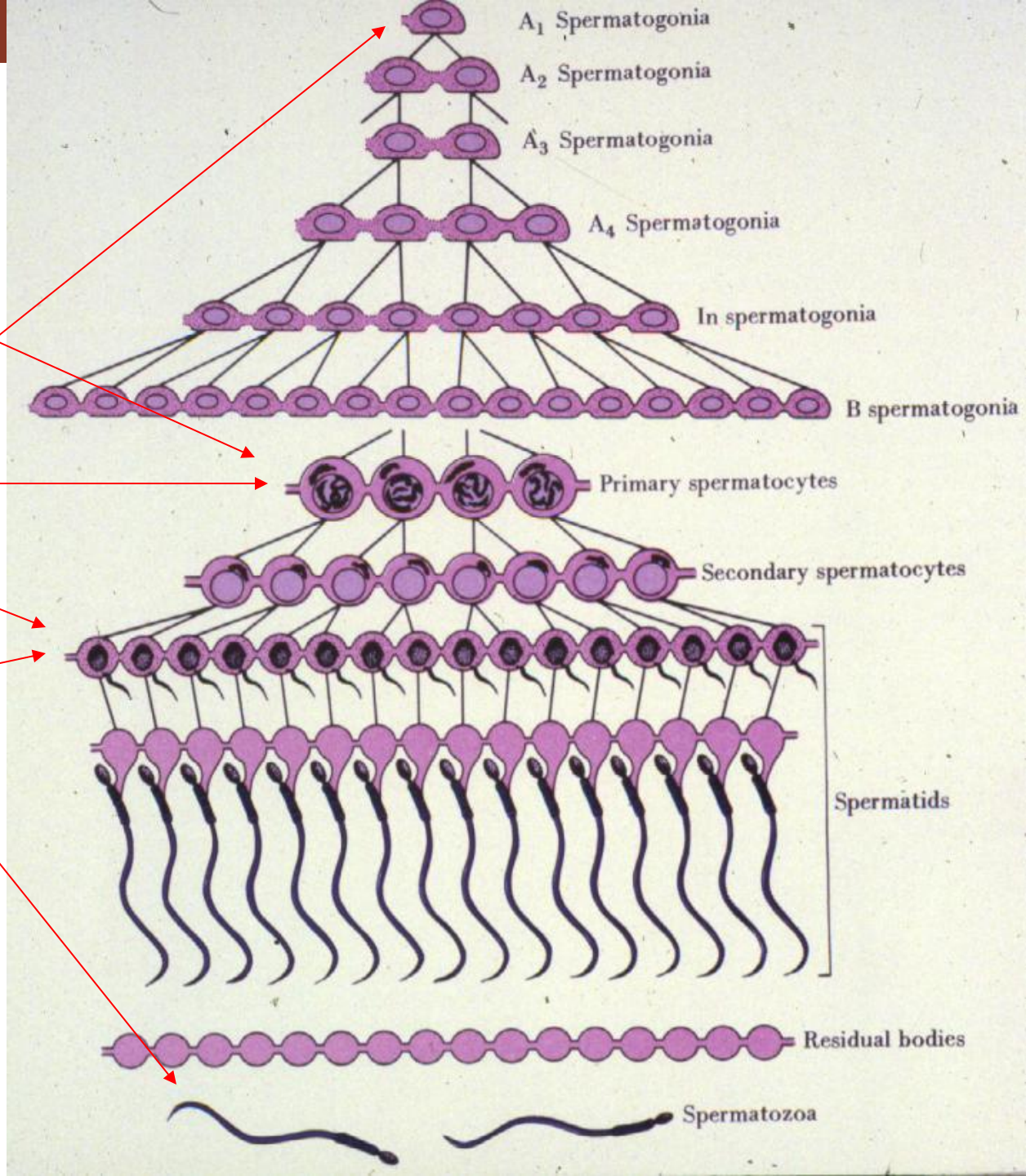
The three germ cell types divide spermatogenesis into three major events

EVENT	CELL TYPE
SPERMATOCYTOGENESIS	SPERMATOGONIA
MEIOSIS	SPERMATOCYTES
SPERMIOGENESIS	SPERMATIDS

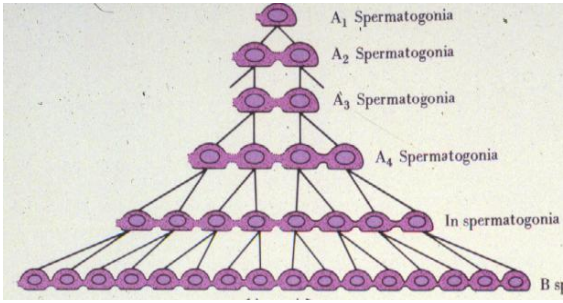
SPERMATOCYTOGENES

MEIOSIS

SPERMIOGENESIS



SPERMATOCYTOGENESIS HAS TWO FUNCTIONS



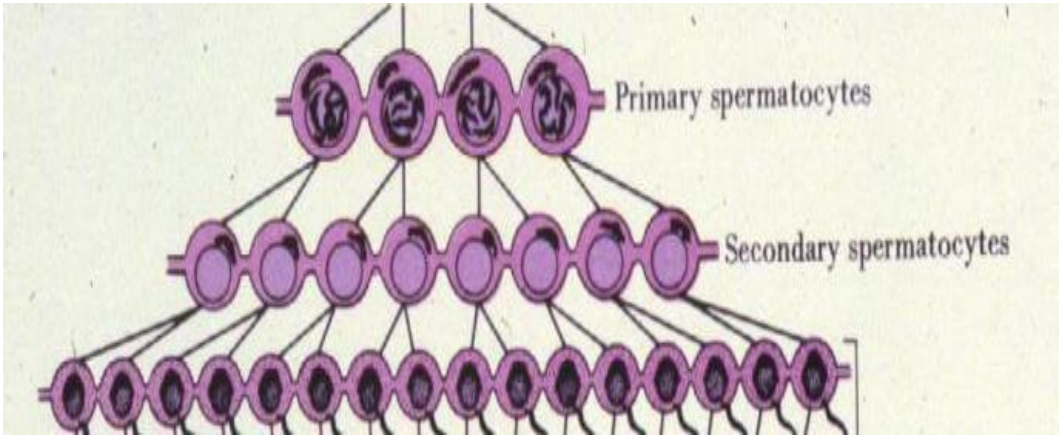
PRODUCES PRIMARY SPERMATOCYTES WHICH RESULT IN THE PRODUCTION OF SPERM 47 DAYS LATER

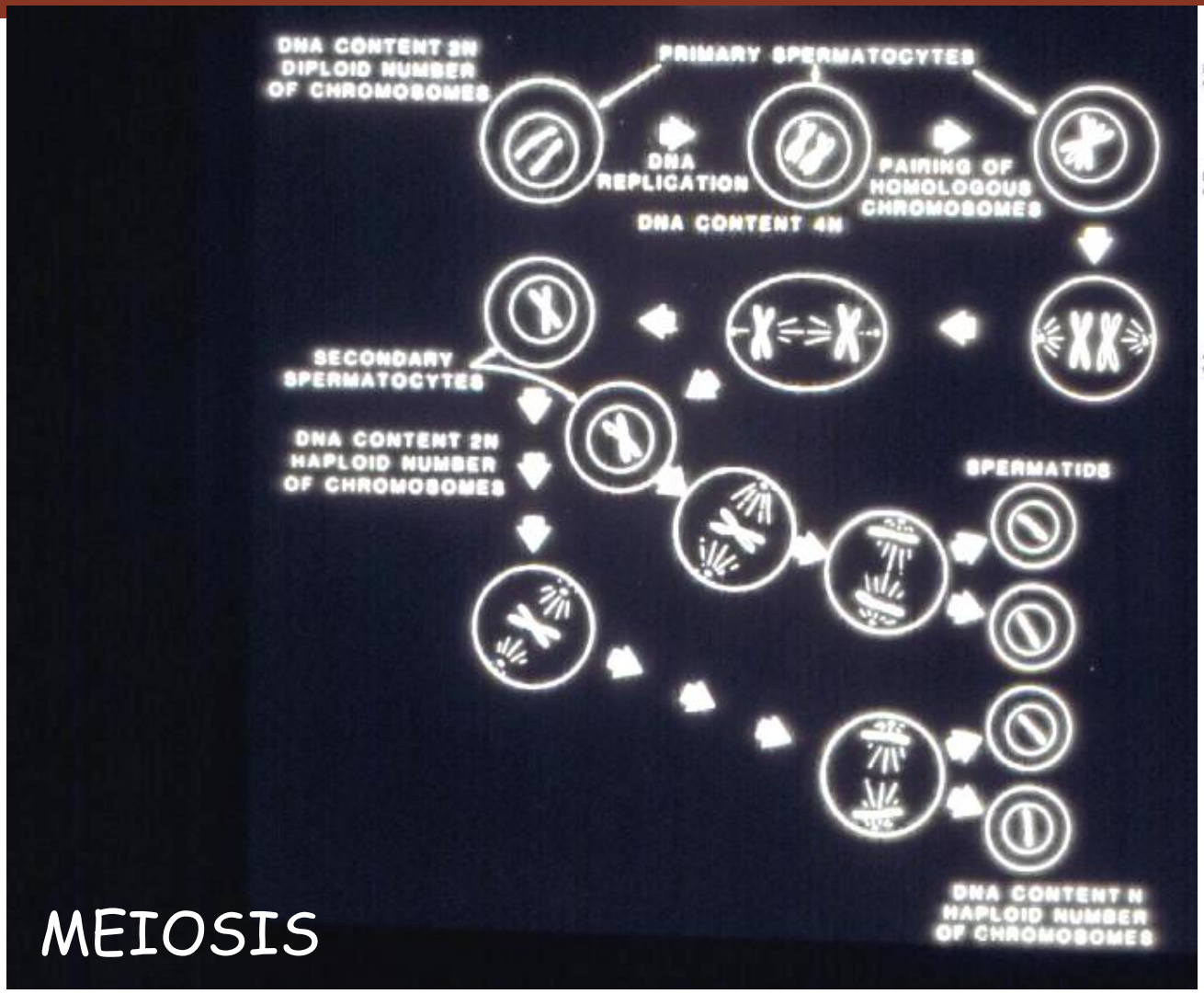
PRODUCES STEM CELLS WHICH INSURE A CONSTANT SUPPLY OF GERM-CELL PRECURSORS THROUGHOUT LIFE

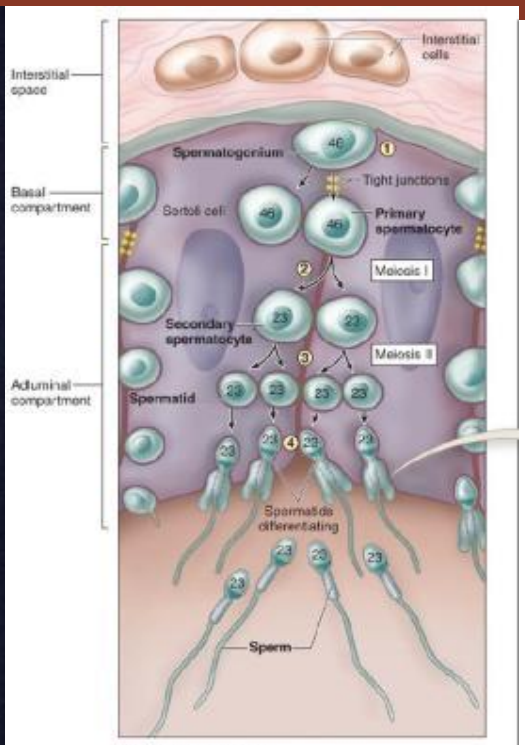
MEIOSIS (ONLY IN SPERMATOGENESIS AND OOGENESIS)

EXCHANGE OF GENETIC MATERIAL IN HOMOLOGOUS CHROMOSOMES (LEPTOTENE, ZYGOTENE, PACHYTENE, AND DIPLOTENE STEPS OF DEVELOPMENT)

PRODUCES HAPLOID CONDITION OF GAMETES



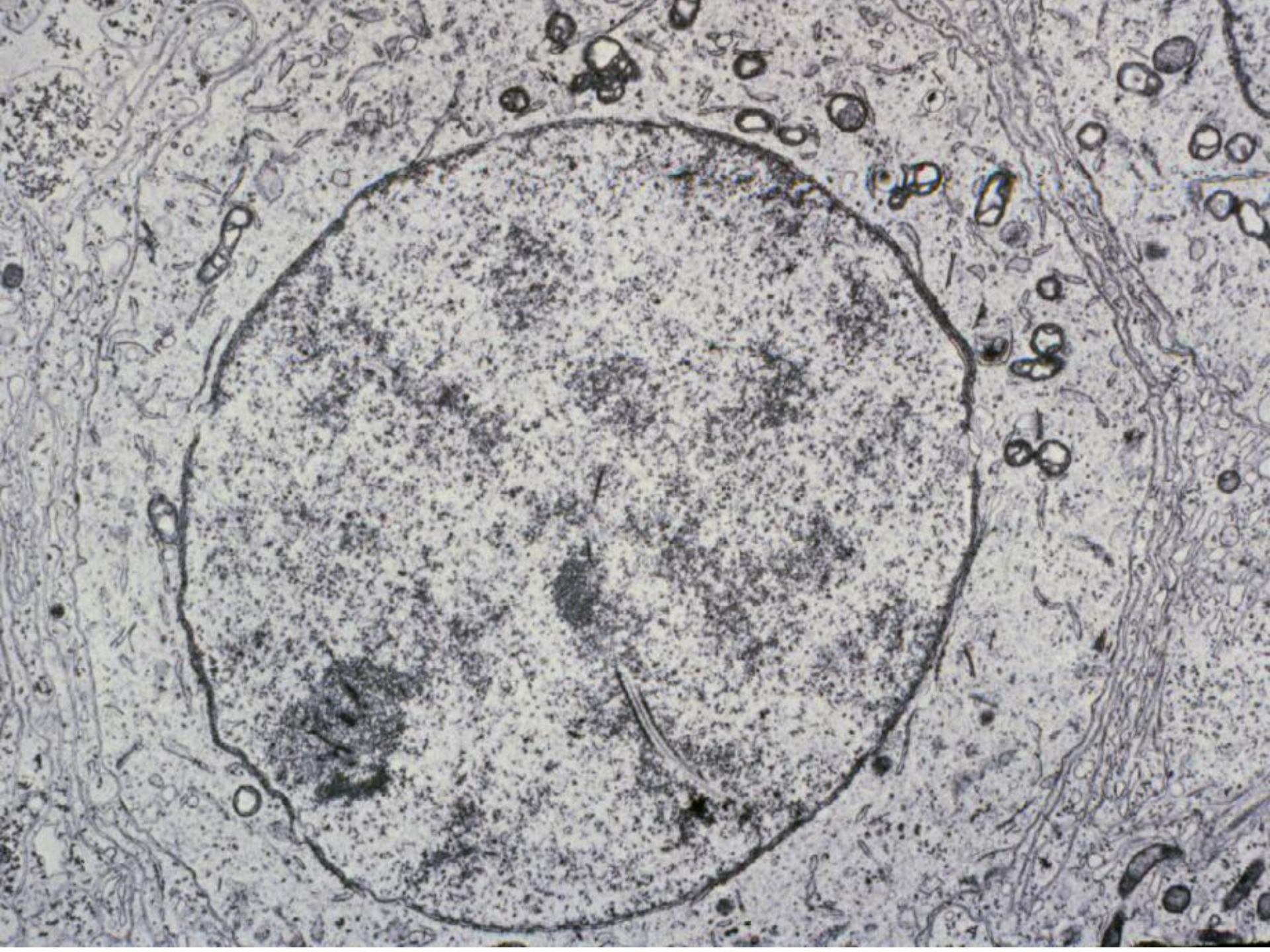




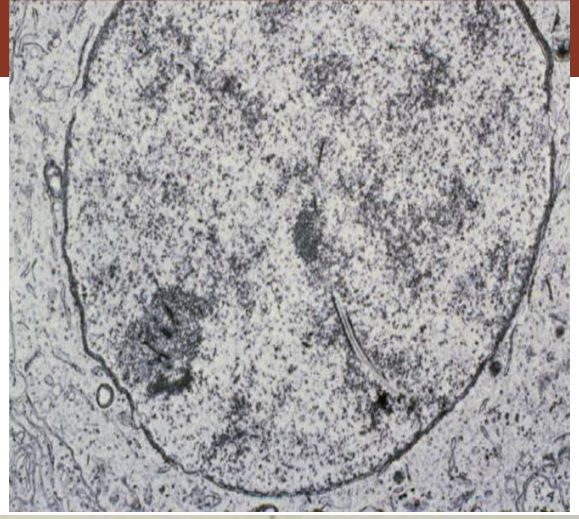
(a) Spermatogenesis

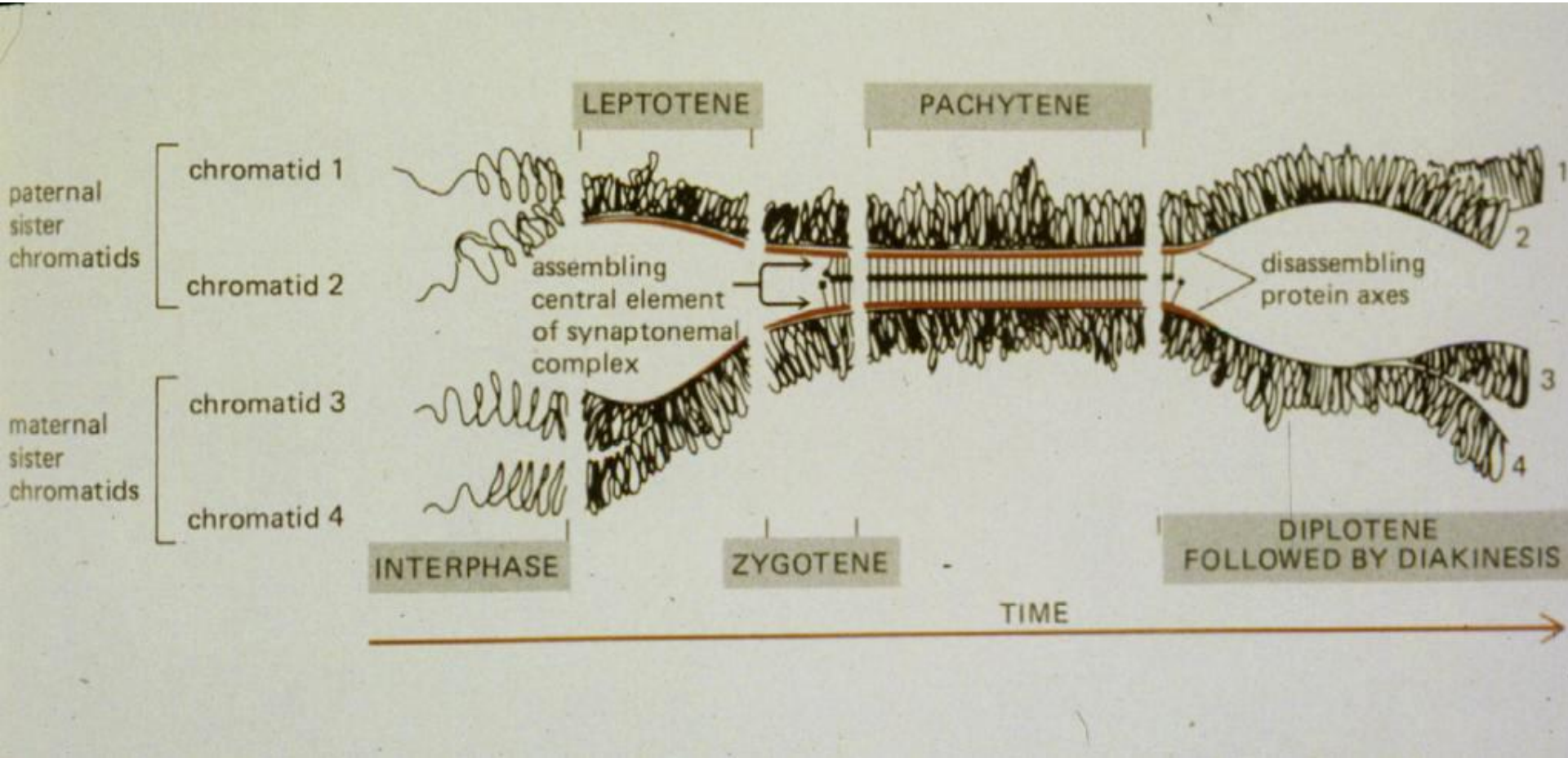
1. The spermatogenic progenitor cells, called spermatogonia, are diploid cells containing 46 chromosomes (23 pairs). Mitotic divisions of these cells each produce a new spermatogonium and a cell called a primary spermatocyte committed to meiosis.
2. Each new primary spermatocyte transiently disassembles the tight junctions of the blood-testis barrier and moves from the tubule's basal compartment to the adluminal compartment. At the same time these cells replicate their DNA, enter meiosis I, and undergo synapsis. The first meiotic division produces two haploid secondary spermatocytes each with 23 chromosomes.
3. Meiosis II is rapid as chromatids in the secondary spermatocyte chromosomes separate into two smaller haploid cells, the spermatids.
4. Near the lumen but still embedded in Sertoli cells, the spermatids differentiate and undergo the morphological changes required to become motile and capable of fertilization.

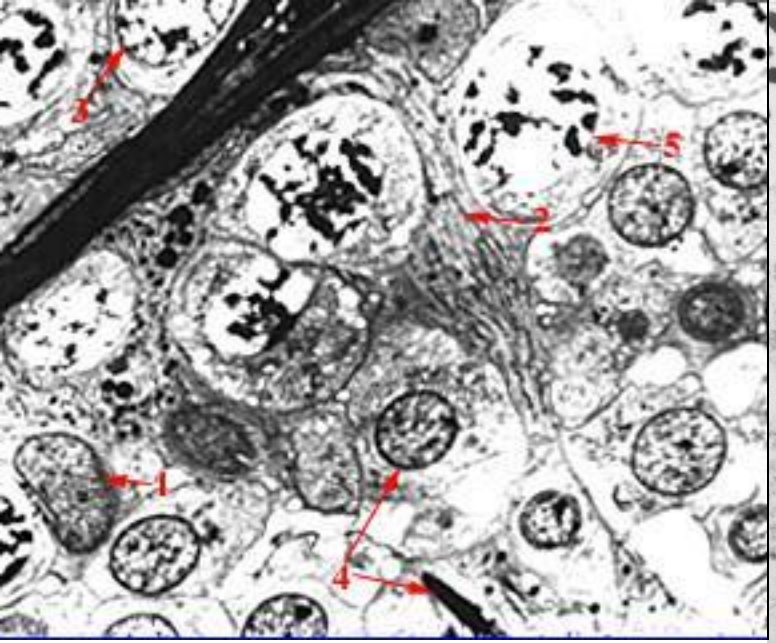
A primary spermatocyte contains 46 chromosomes, the diploid number. However, the secondary spermatocyte contains 23 chromosomes although they are duplicated. A spermatid contains 23 chromosomes, the haploid number.




Primary spermatocytes

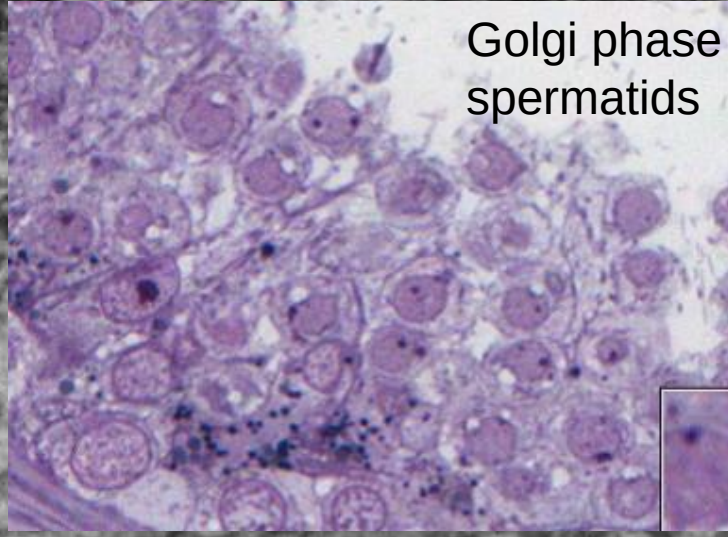



LEPTOTENE
PACHYTENE
paternal sister chromatids
chromatid 1
chromatid 2
assembling central element of synaptonemal complex
disassembling protein axes
maternal sister chromatids
chromatid 3
chromatid 4
INTERPHASE
ZYGOTENE
DIPLOTENE FOLLOWED BY DIAKINESIS
TIME



High voltage EM of horse seminiferous tubules EM 19a

1. Sertoli cell nucleus
2. Mitochondrion
3. Spermatogonium
4. Spermatids
5. Primary spermatocyte



manchette

Golgi forming acrosome

centriole

developing tail

spermatid

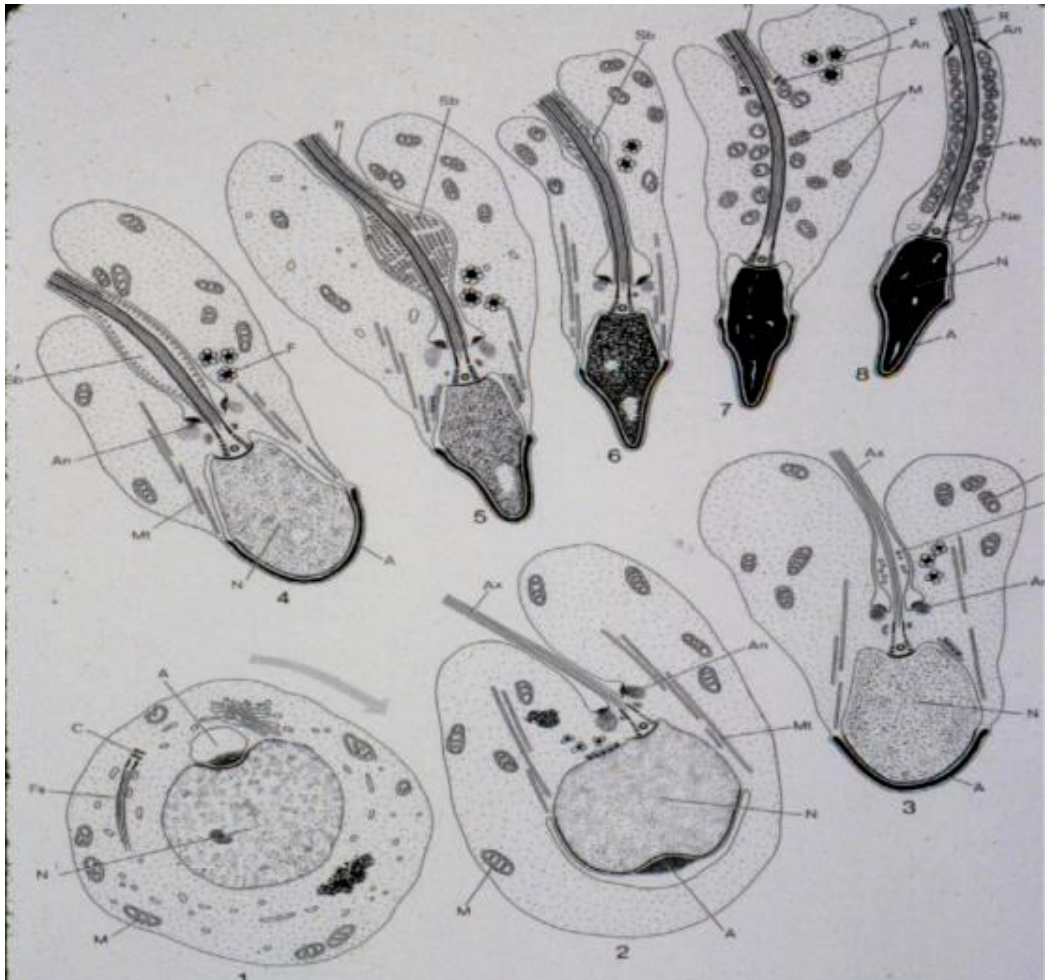
seminiferous epithelium

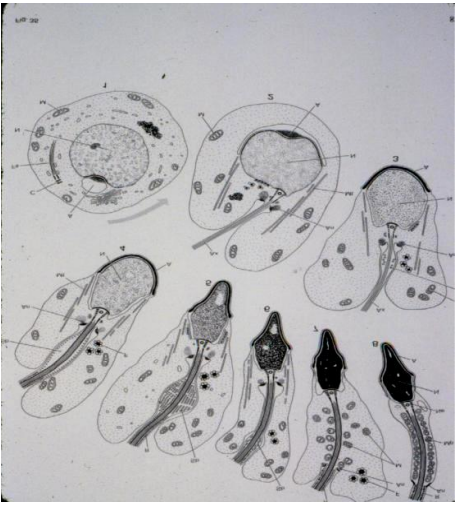
Set #10
EM # Aa

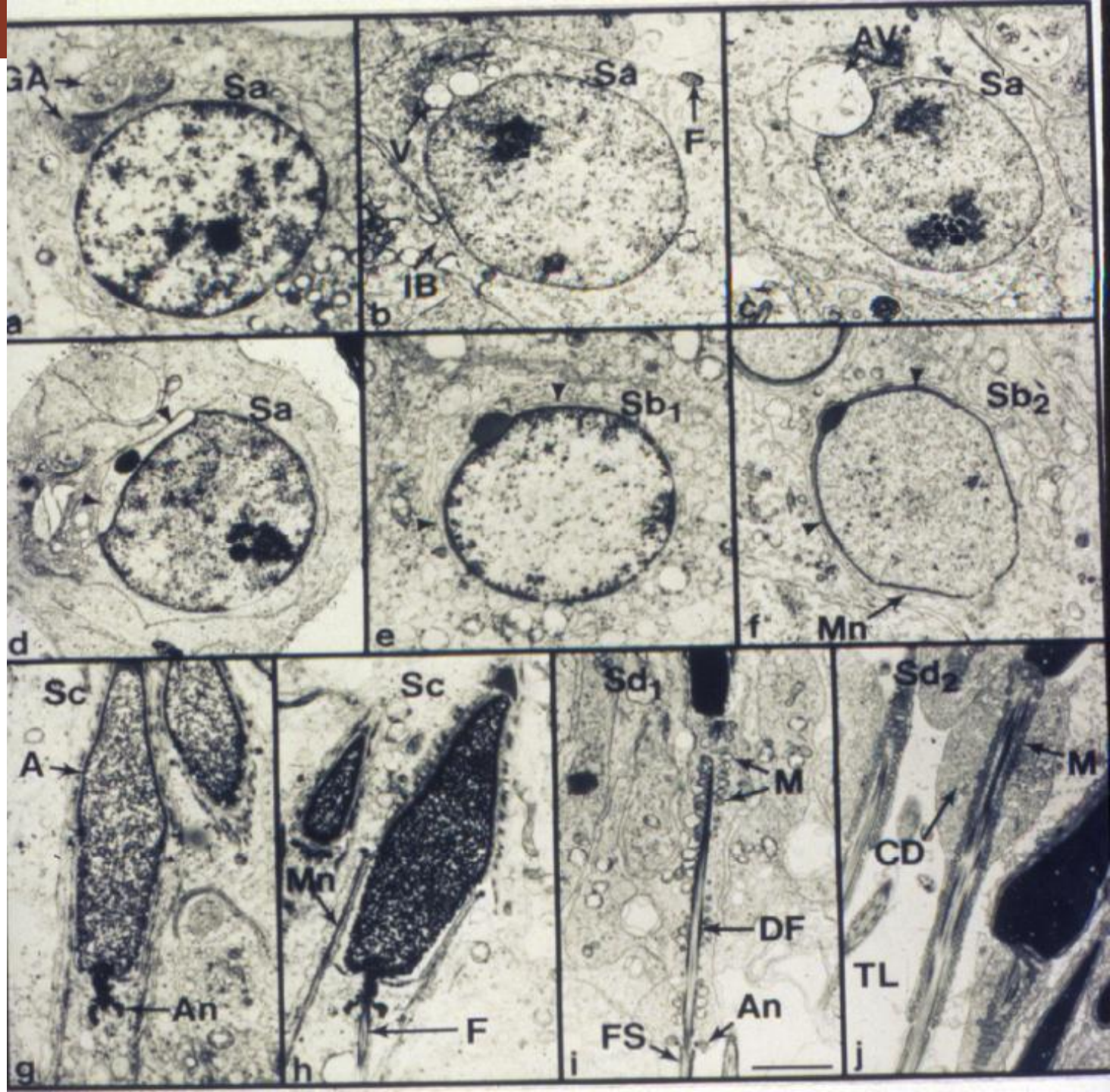
SPERMIOGENESIS

(DIFFERENTIATION OF SPERMATIDS WITH ROUND NUCLEI TO THOSE CHARACTERISTIC OF SPERMATOZOA)

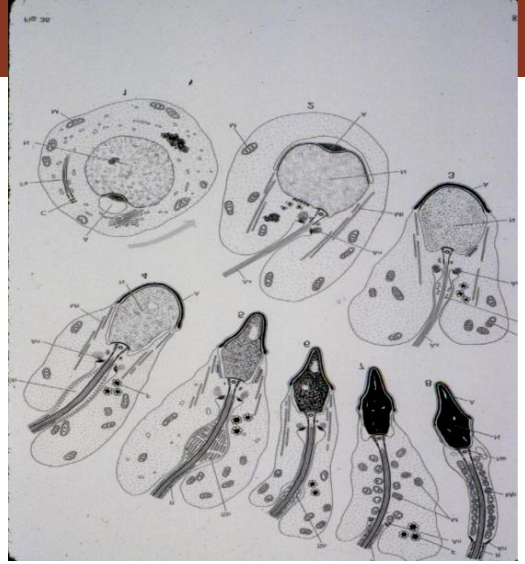
- ACROSOME FROM GOLGI
- NUCLEAR CONDENSATION AND ELONGATION
- FLAGELLUM
- SHEDDING EXCESS CYTOPLASM

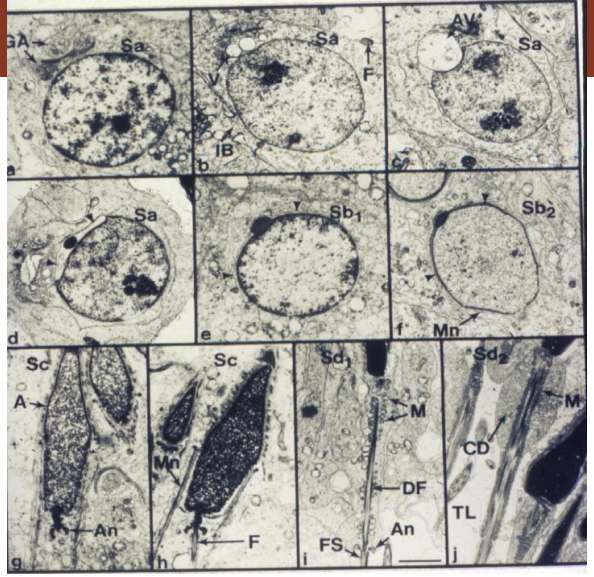






Horse spermatids





Cell-membrane intact and acrosome reacted horse spermatozoa

The formation and function at the acrosome.

1. Golgi phase

   Small proacrosomal vesicles from Golgi coalesce as a single membrane-limited acrosomal cap close to one end of the nucleus.

2. Cap phase

   The acrosomal cap spreads over about half of the condensing nucleus.

3. Acrosome phase

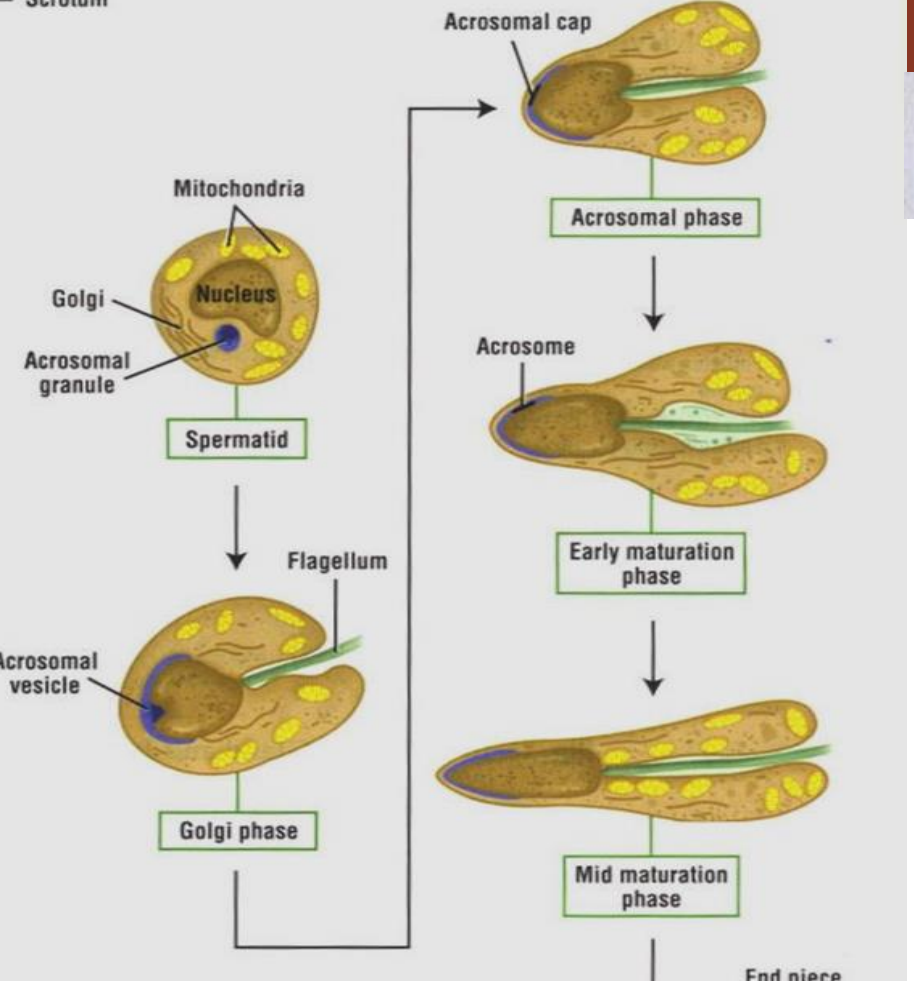
   The head of the developing spermatid, containing the acrosome and the condensing nucleus, remains embedded in the recesses of the Sertoli cell while the flagellum continues to grow.

4. Maturation phase

   Unneeded cytoplasm is shed, and spermatid is released into lumen with acrosome.

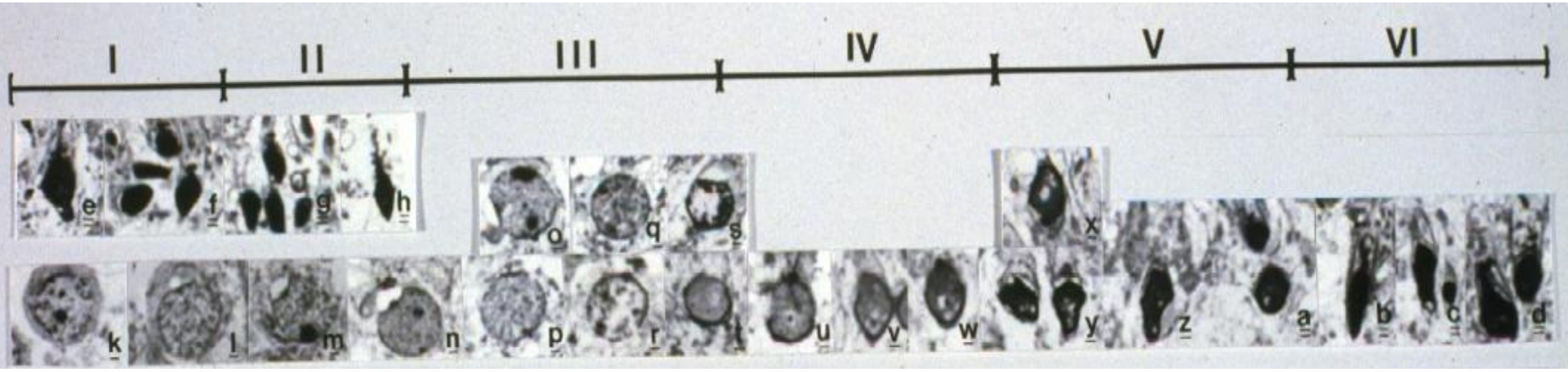
Function

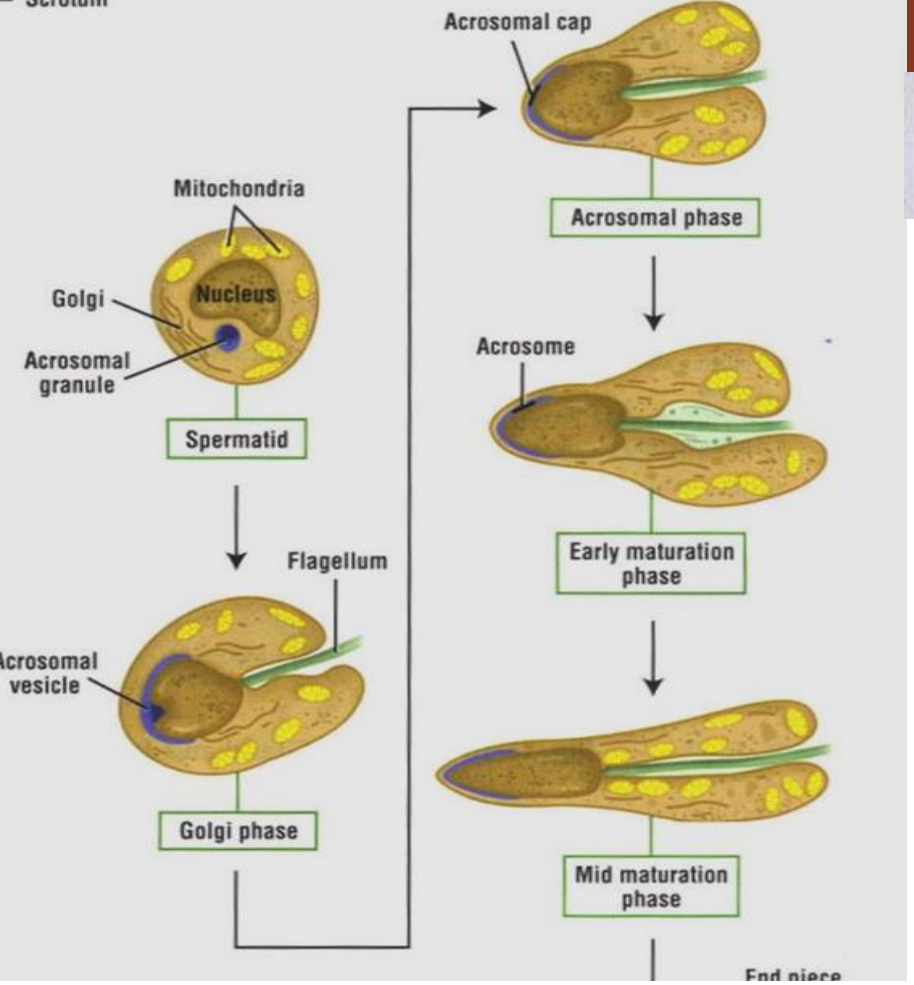
The acrosome is a specialized lysosome containing hydrolytic enzymes (mainly hyaluronidase and acrosin). These enzymes are released when a spermatozoon encounters an oocyte and the acrosomal membrane fuses with the sperm's plasma membrane. This process, the acrosomal reaction, is one of the first steps in fertilization. The enzymes dissociate cells of the corona radiata and digest the zona pellucida, both structures that surround the egg.


Acrosomal cap
Acrosomal phase
Mitochondria
Golgi
Nucleus
Acrosomal granule
Spermatid
Acrosome
Early maturation phase
Flagellum
Acrosomal vesicle
Golgi phase
Mid maturation phase

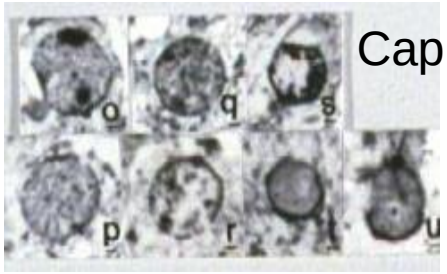

k
l
m
n
p

Golgi phase

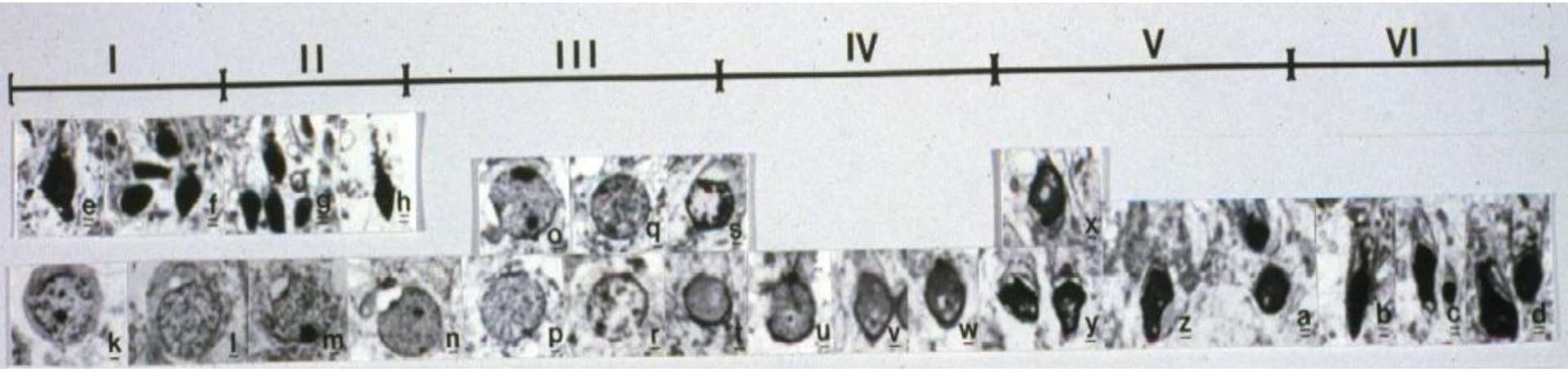

I
II
III
IV
V
VI

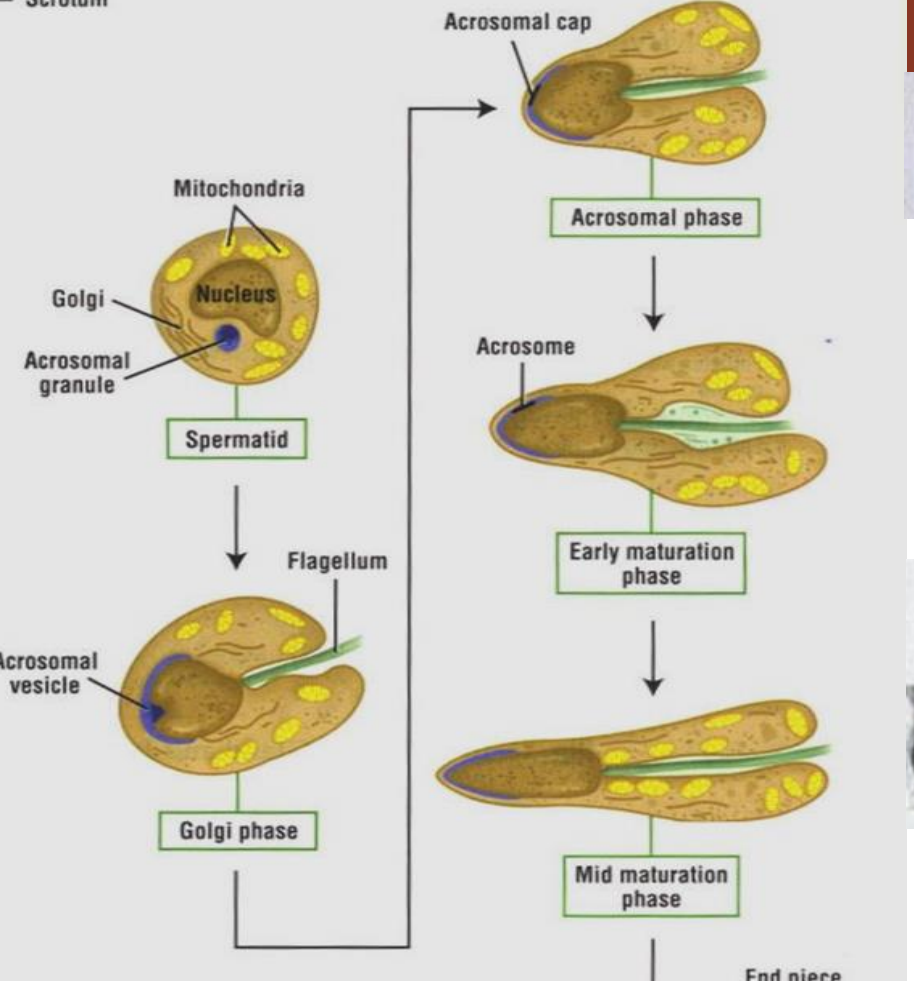


Golgi phase

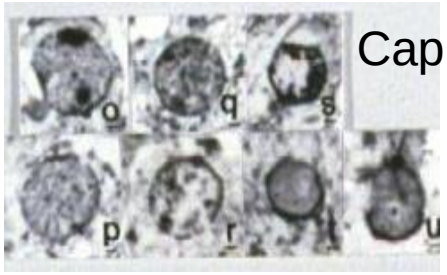


Cap phase

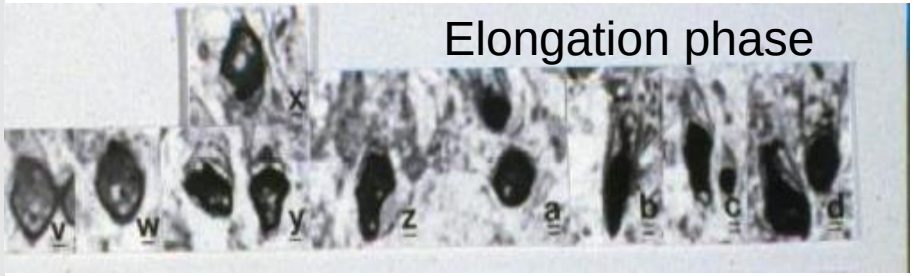




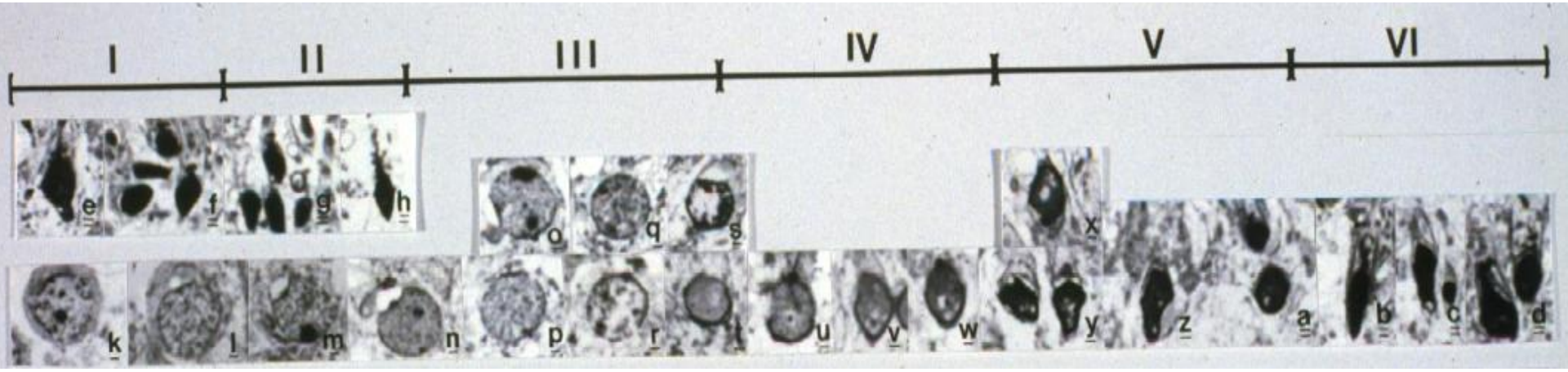
Golgi phase

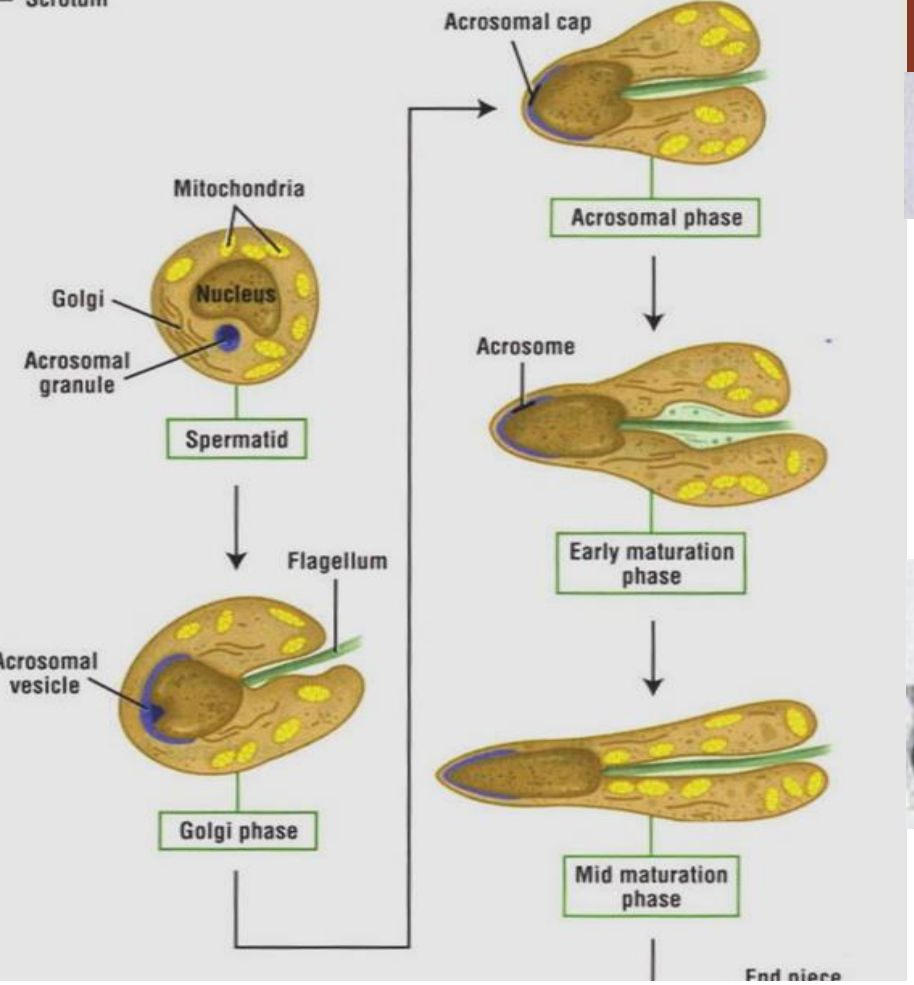


Cap phase

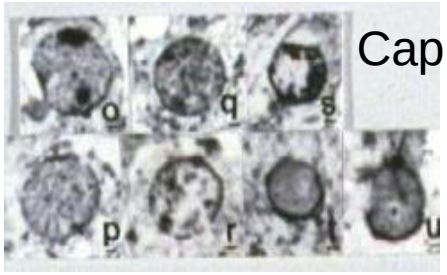


Elongation phase

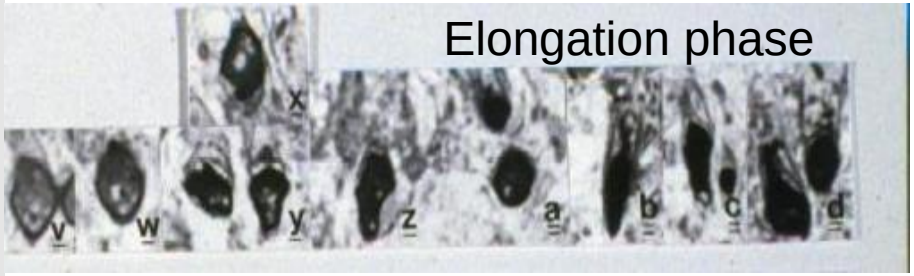




Golgi phase

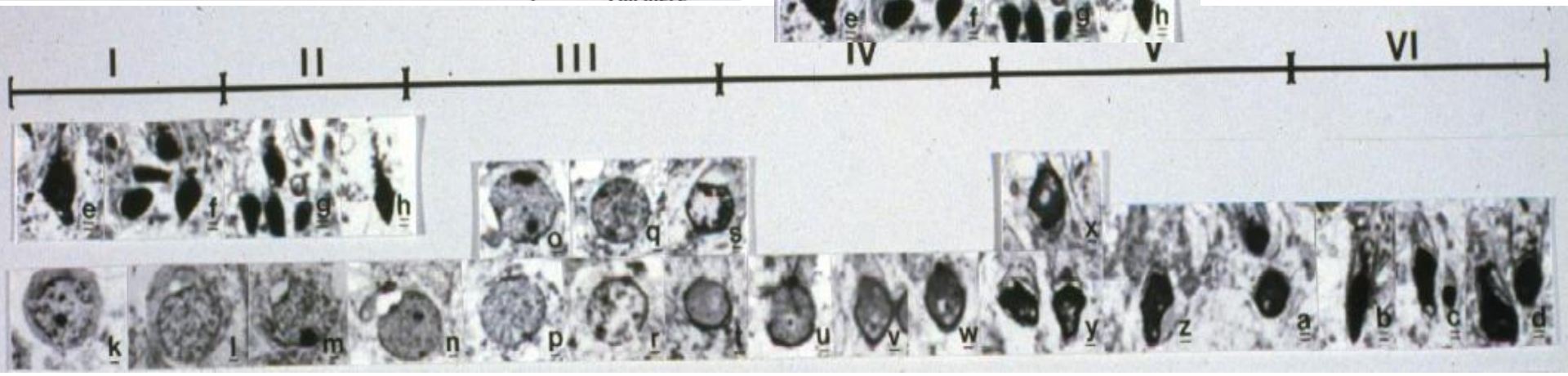


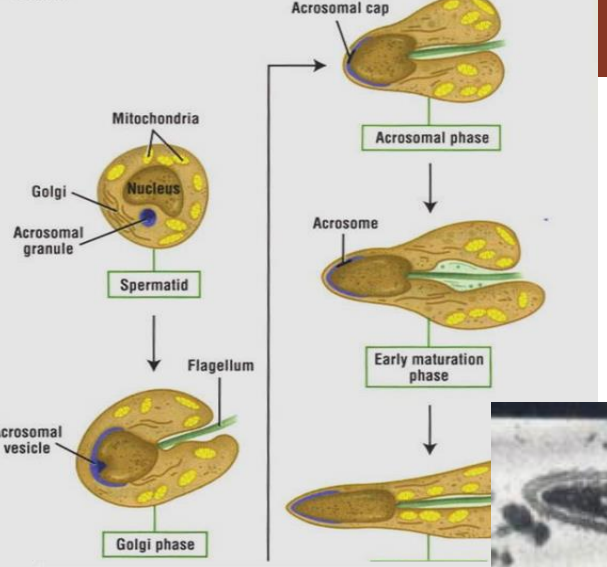
Cap phase



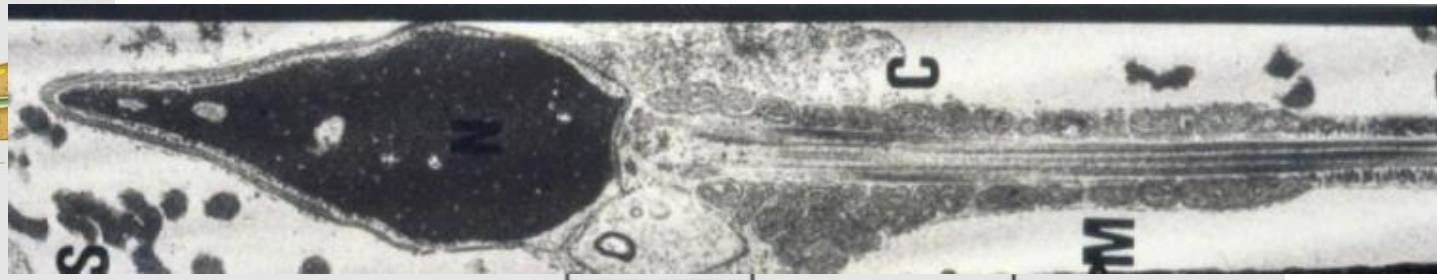
Elongation phase

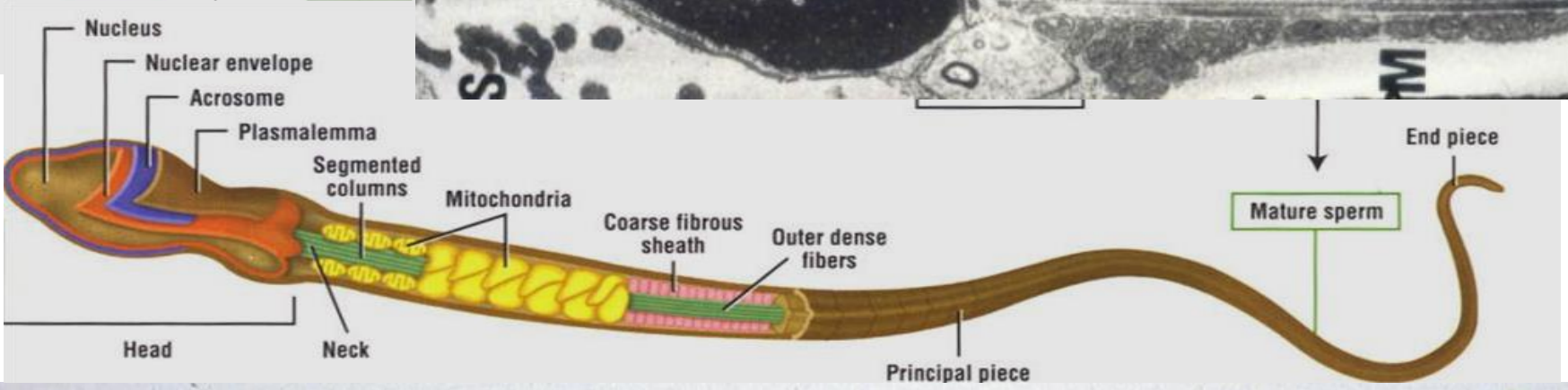
Maturation phase

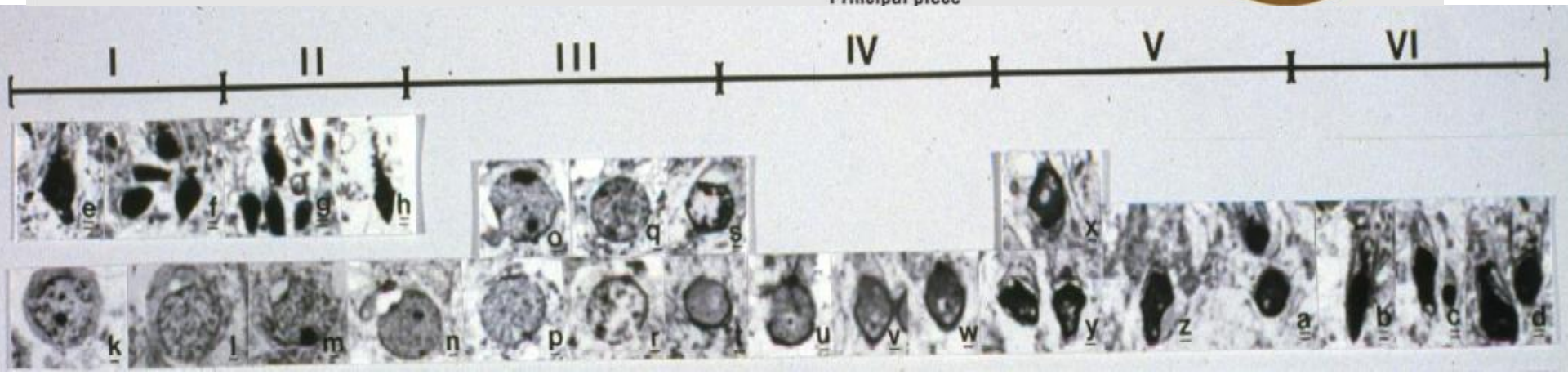




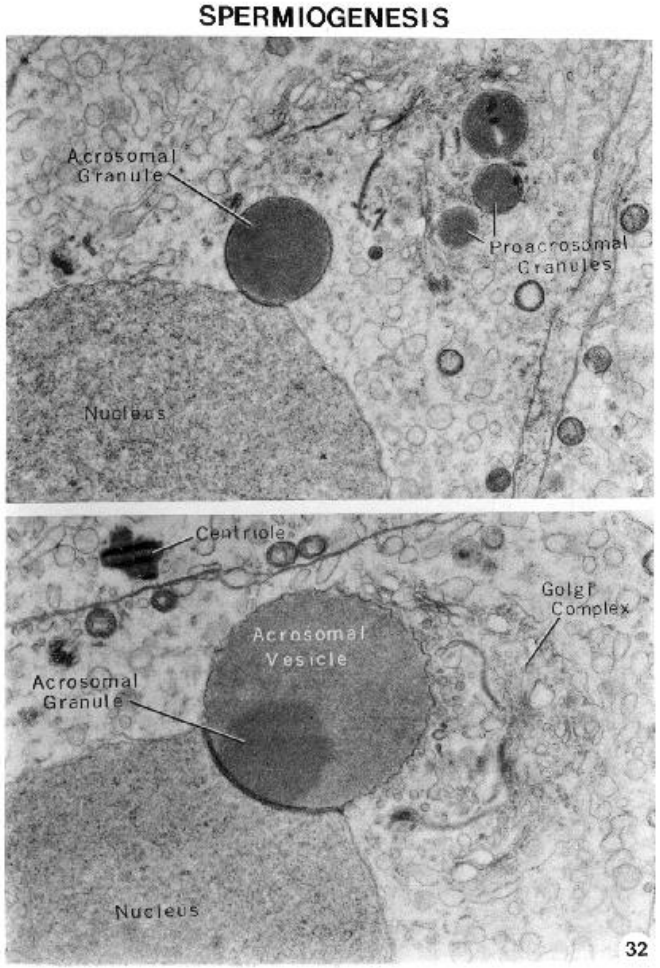
Maturation phase

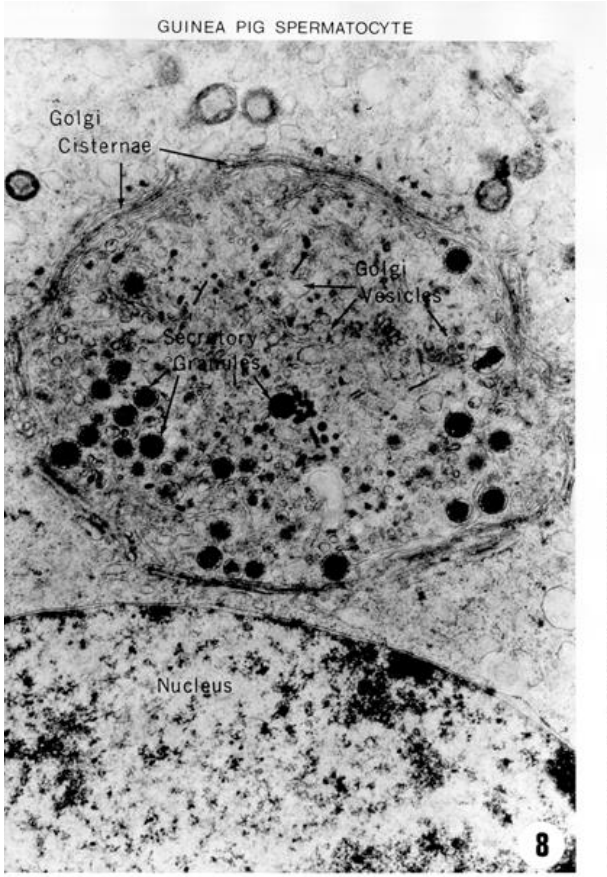


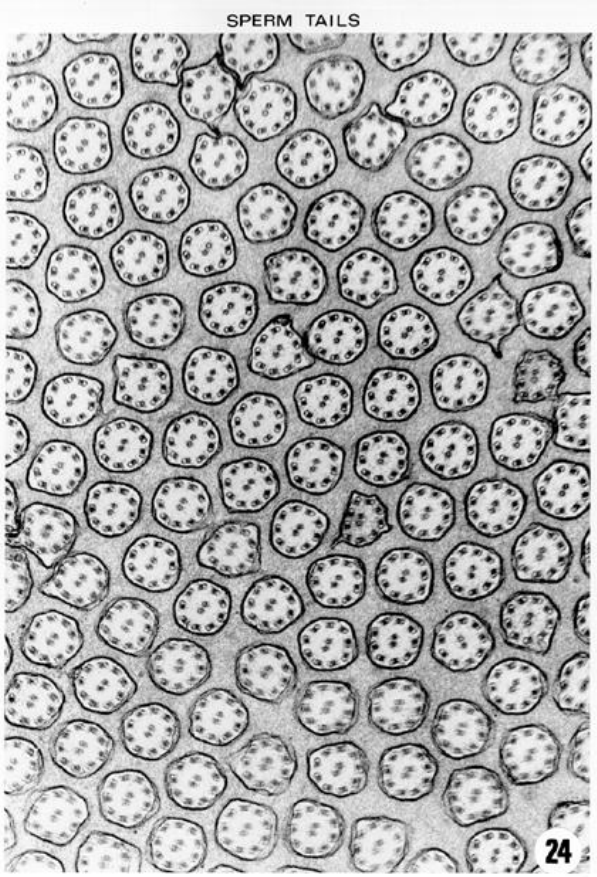


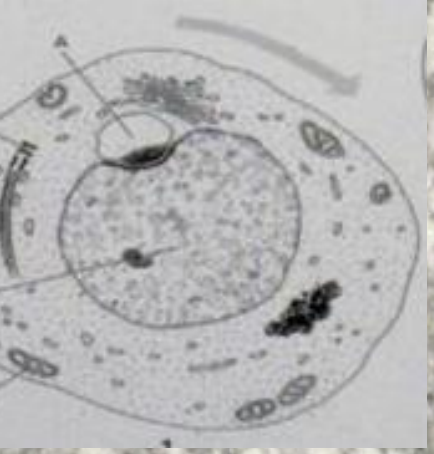


EMs 32, 8, & 24: Developing spermatids





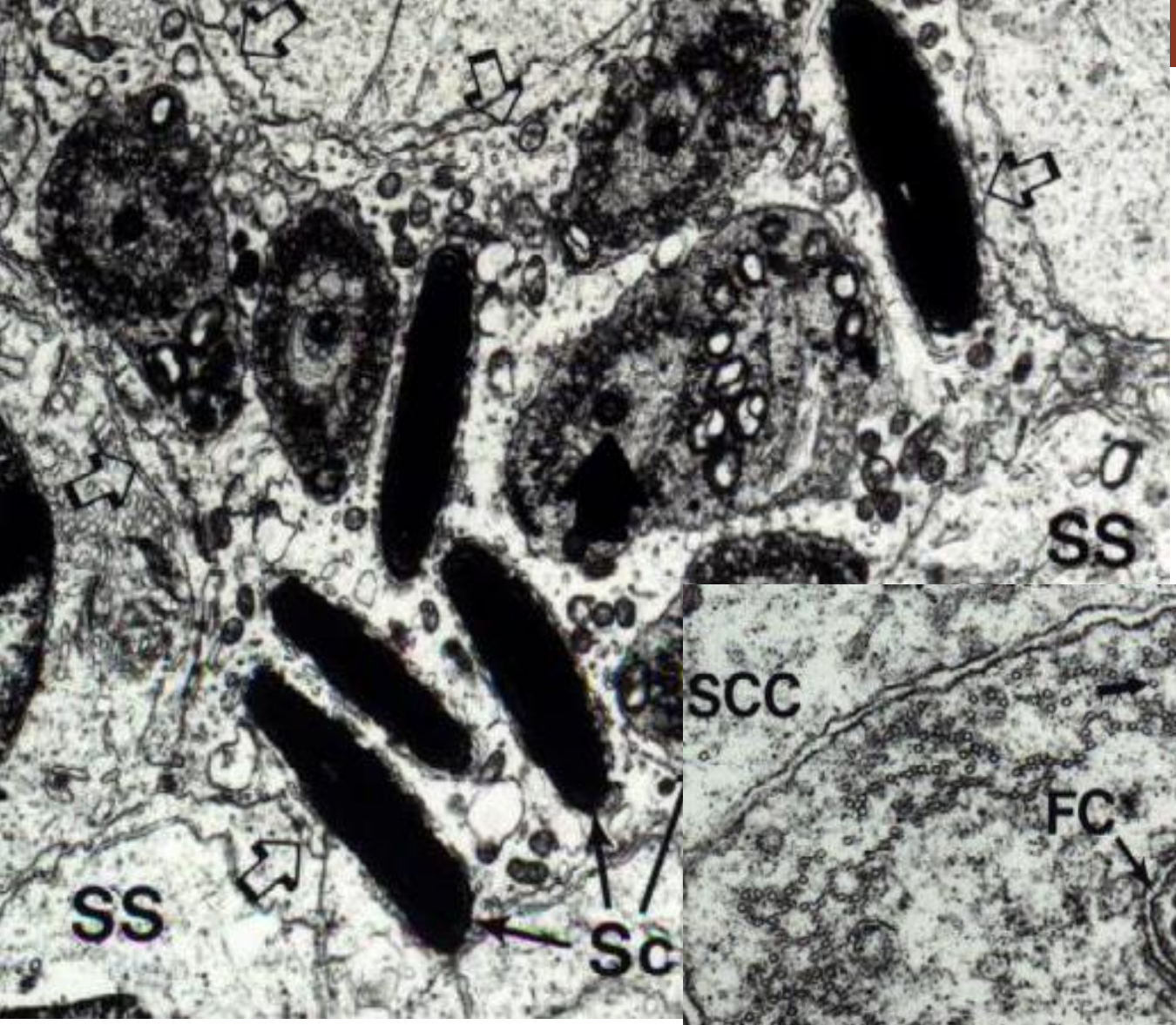


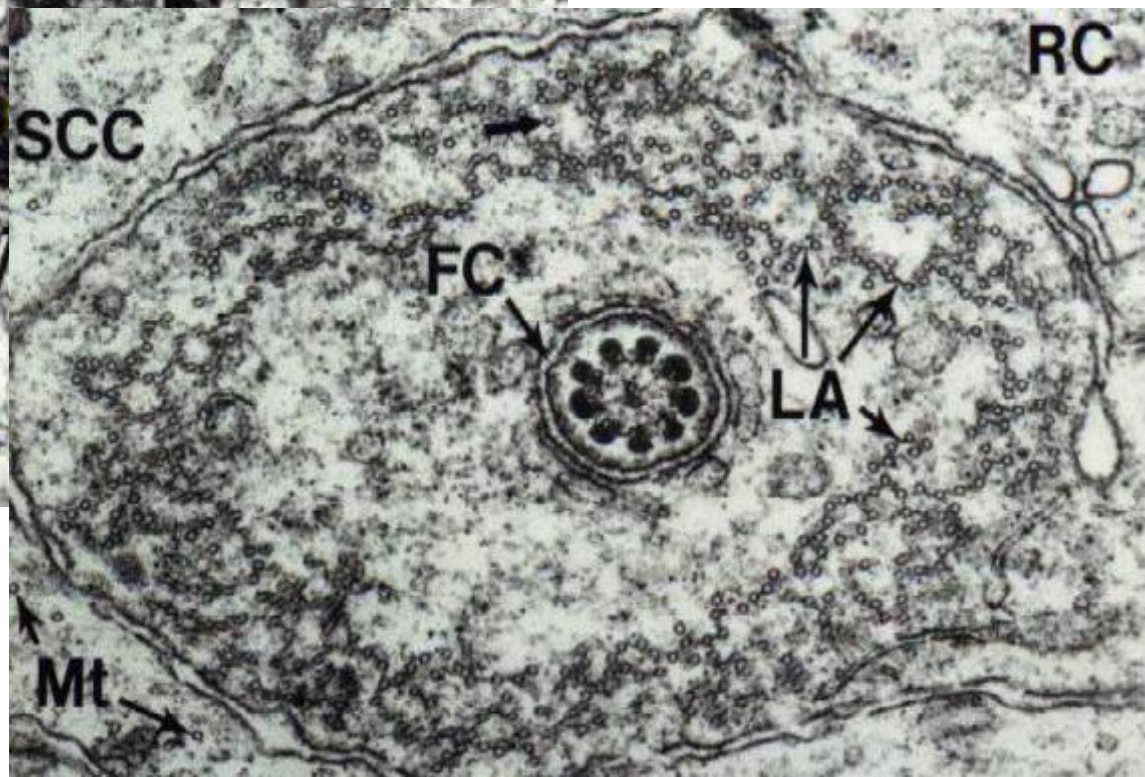


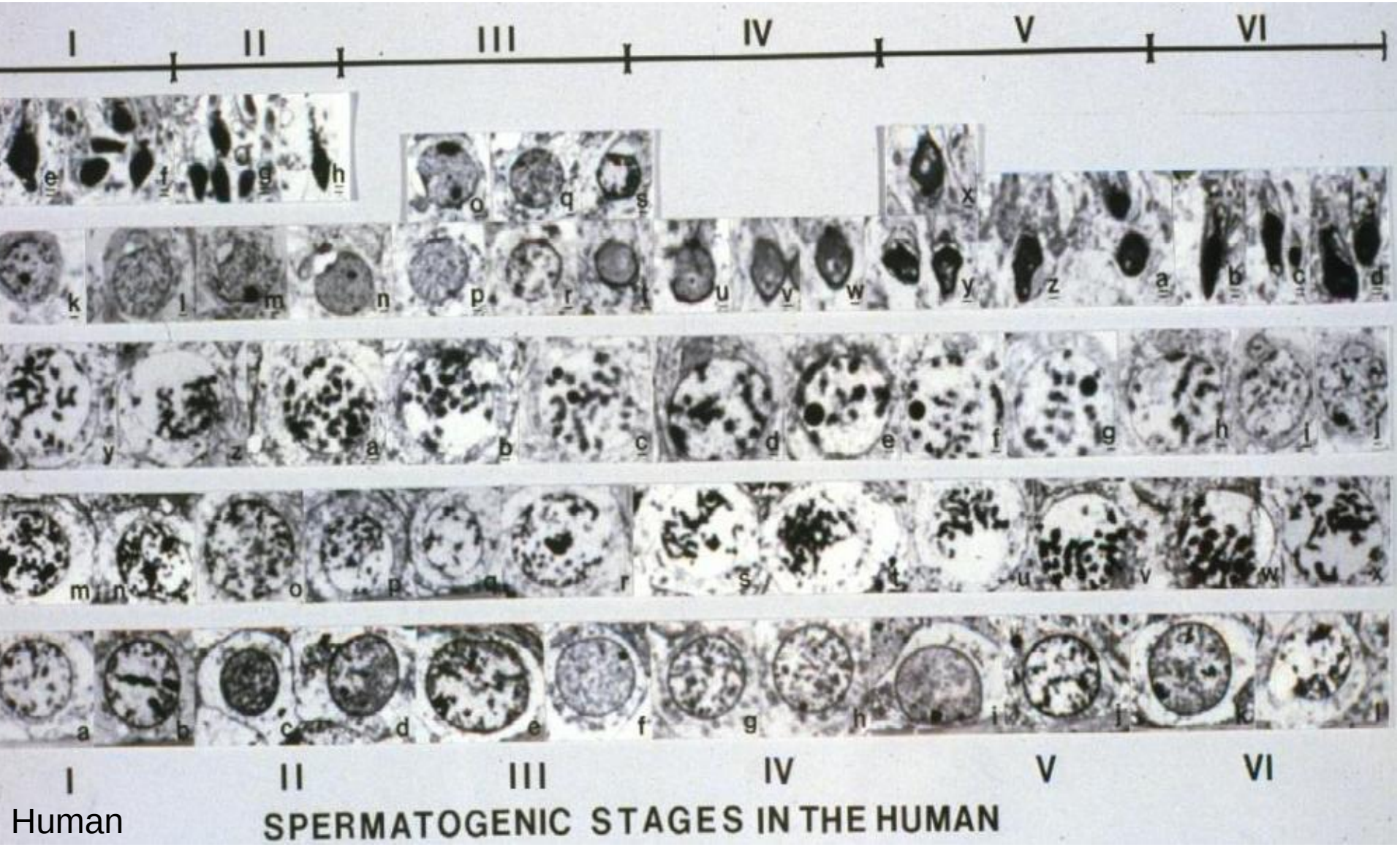
Golgi

Developing acrosome

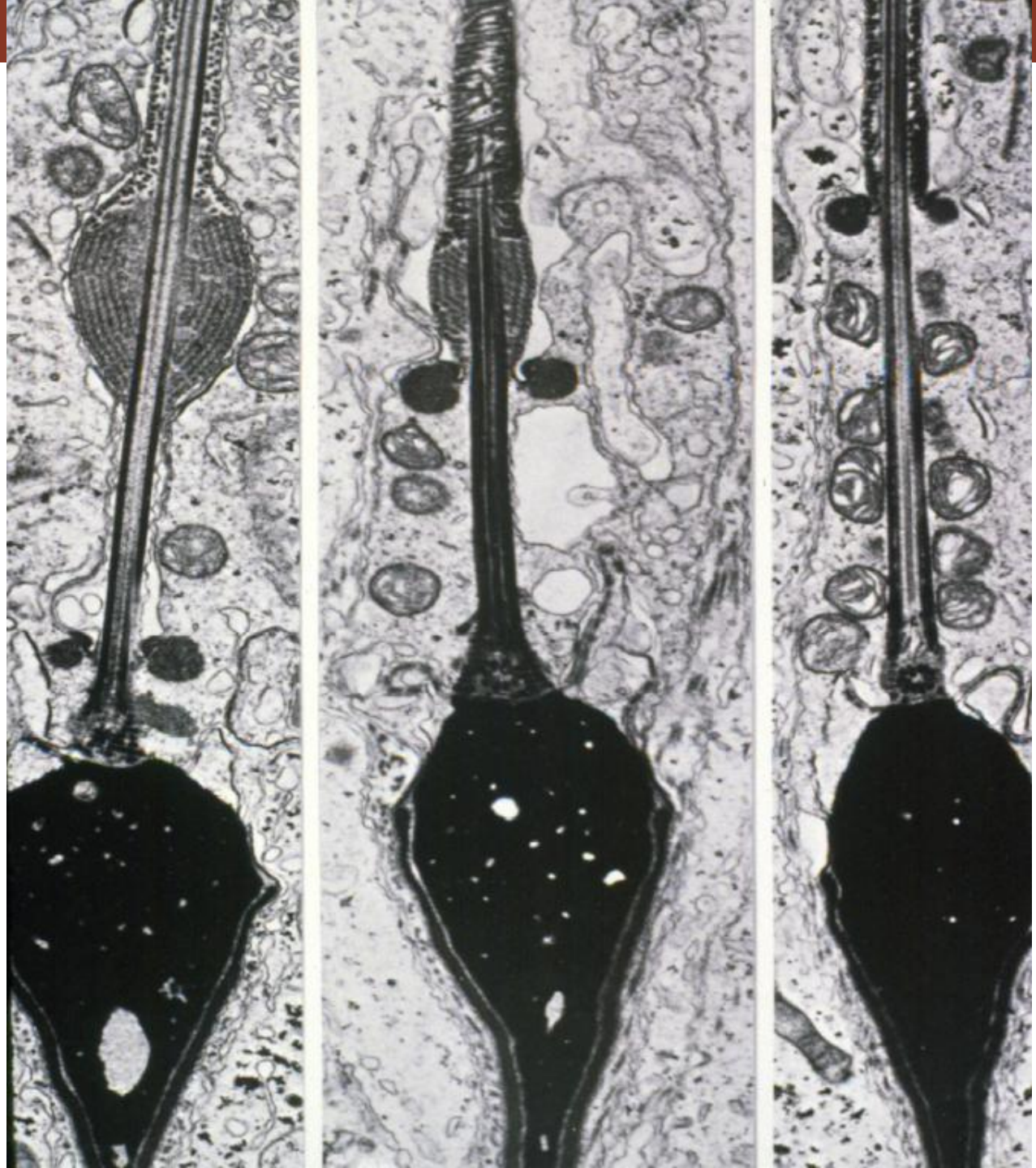
Spermatid nucleus

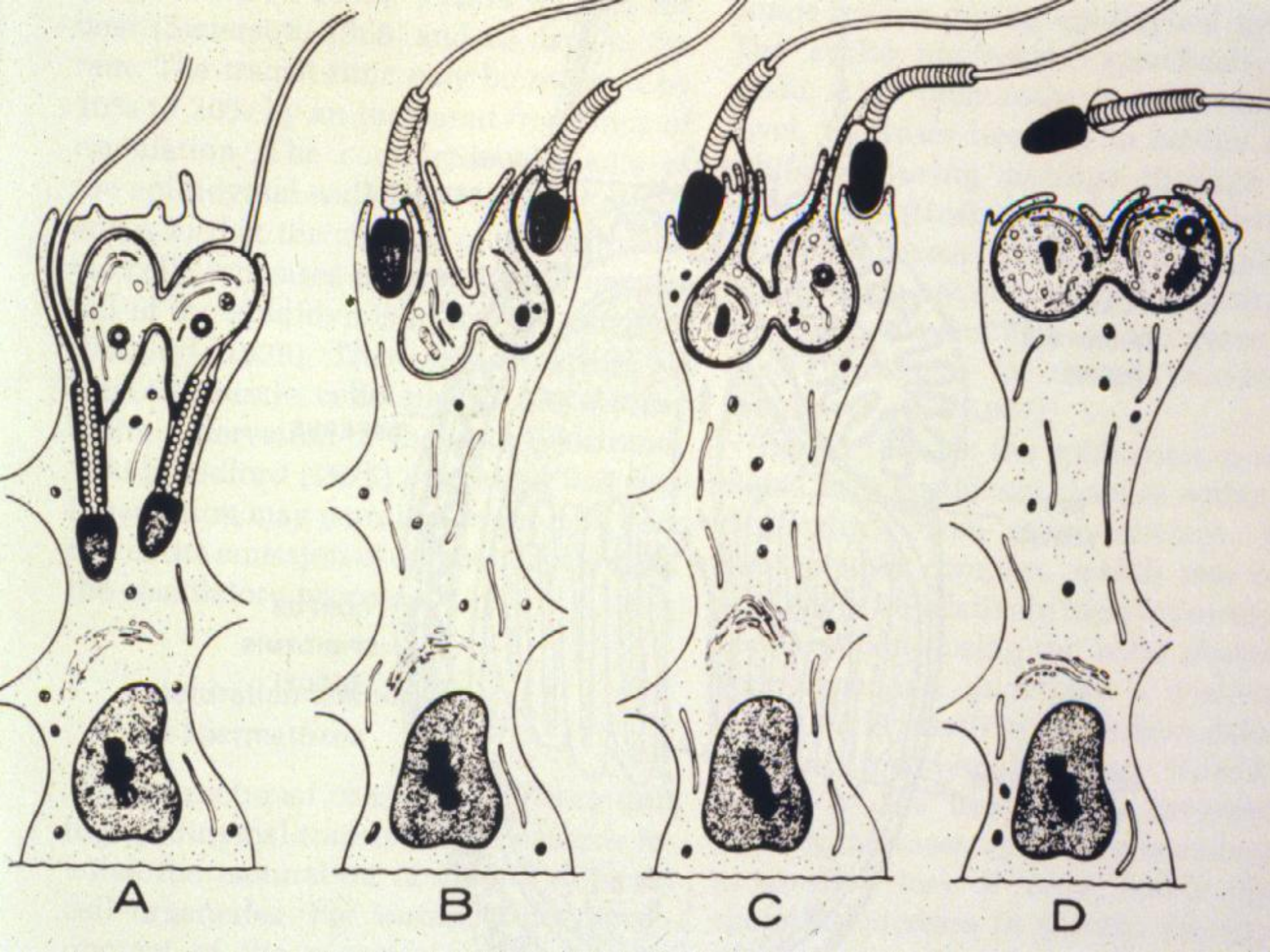

SS
SS
Sc

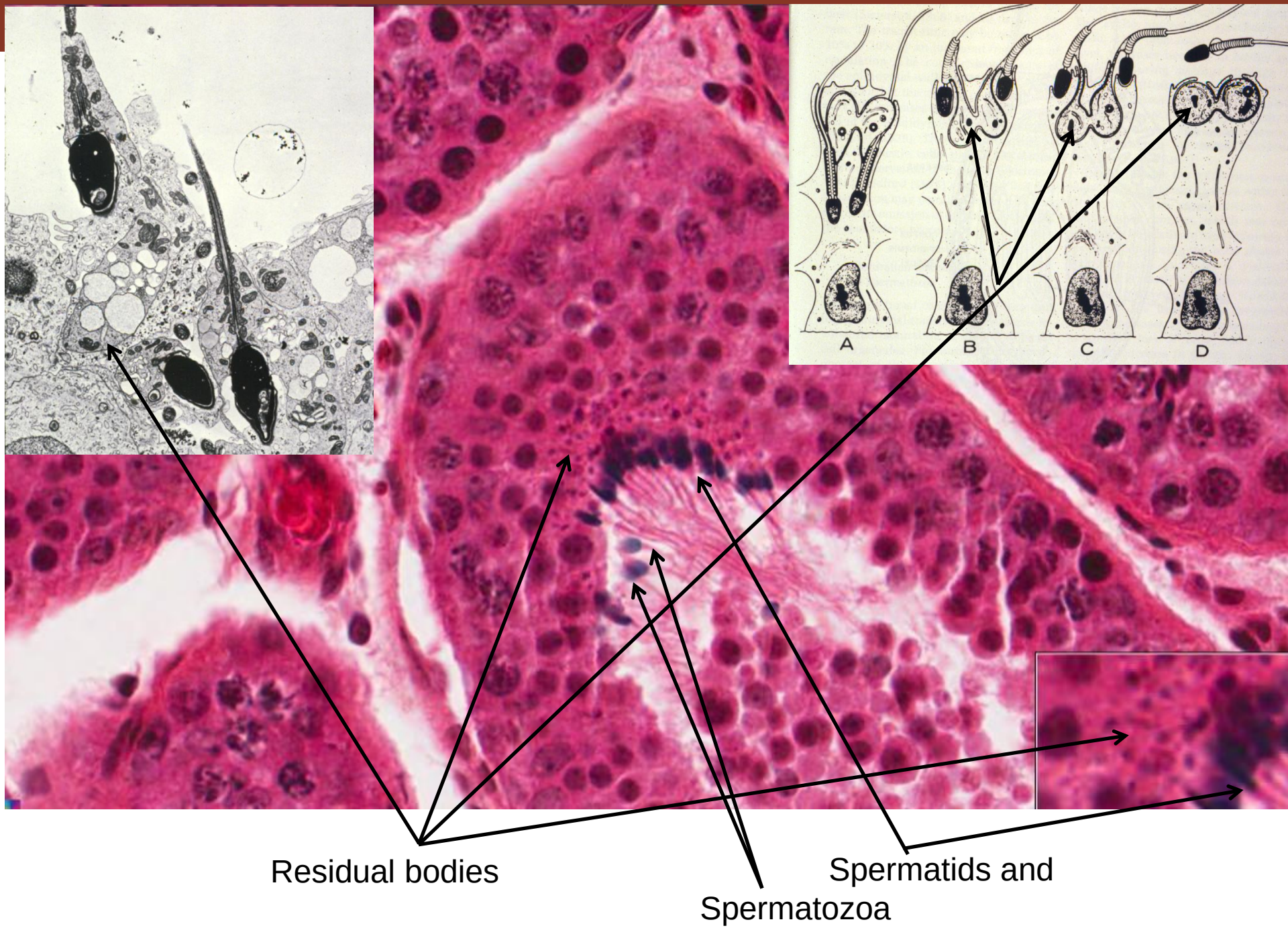

RC
SCC
FC
LA
Mt

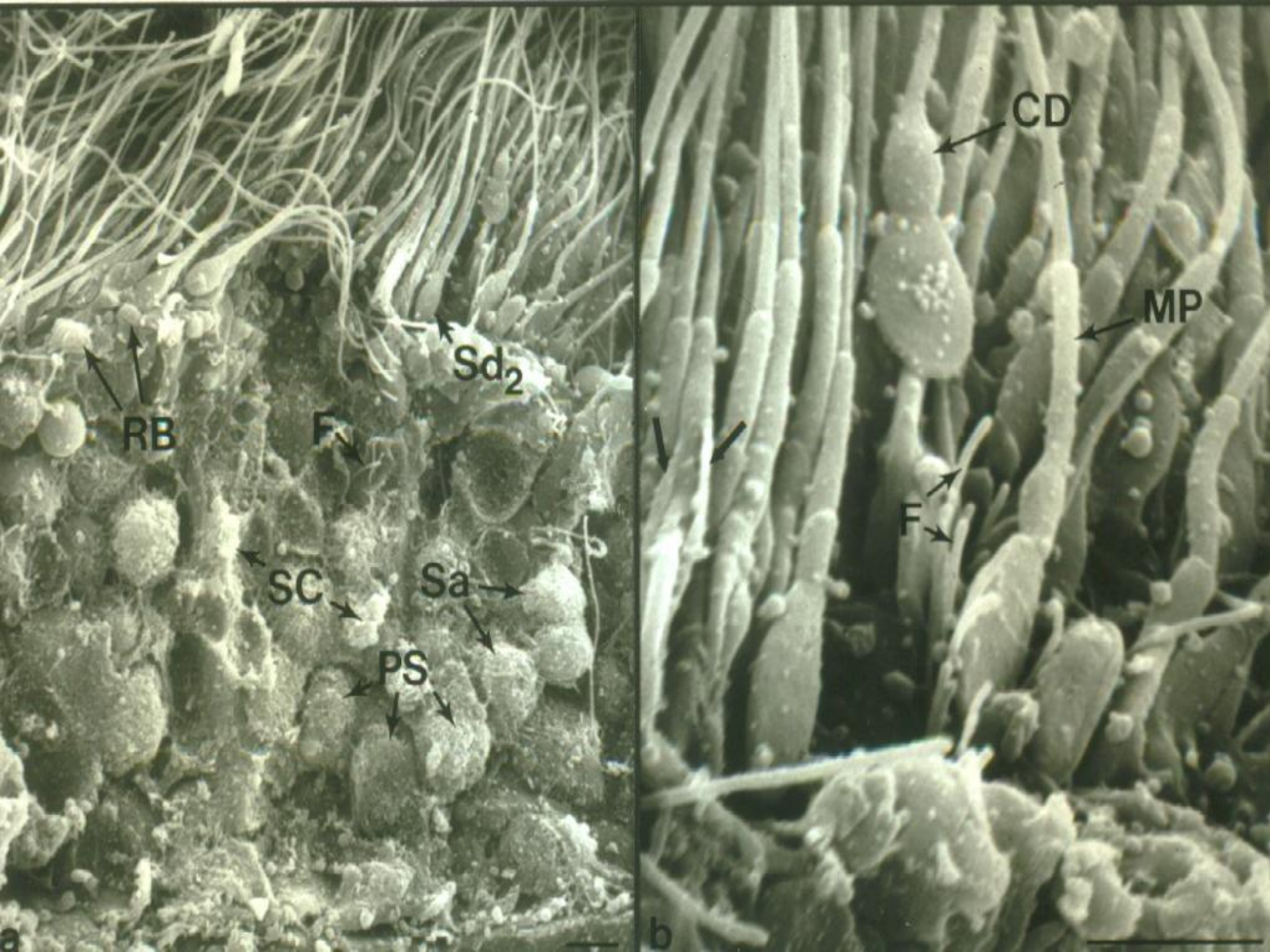


Human

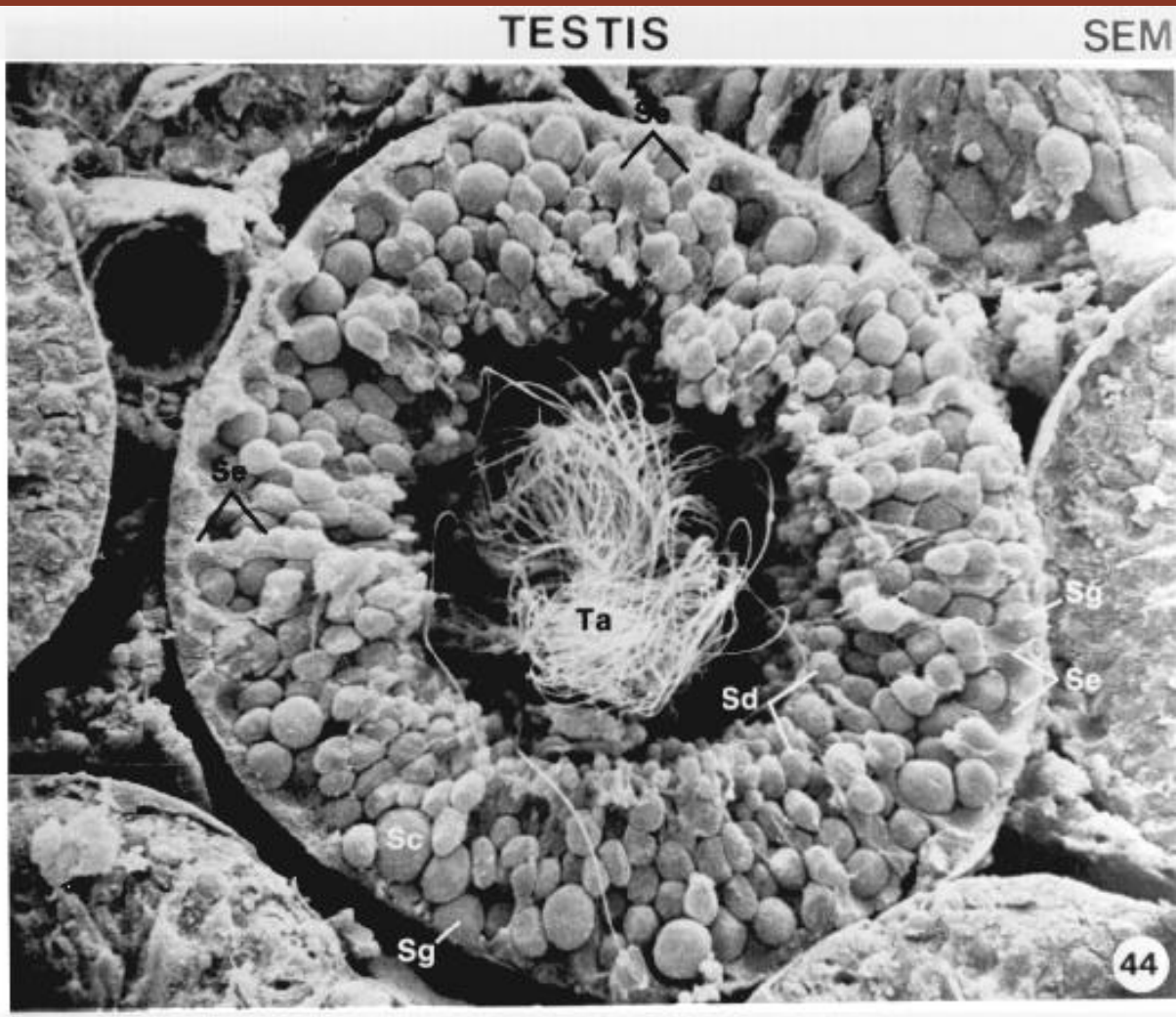



A
B
C
D


A
B
C
D
Residual bodies
Spermatids and
Spermatozoa


RB
F
Sd2
SC
Sa
PS
a
CD
MP
F
b

EM 44: Testes



Sc = Primary Spermatocytes

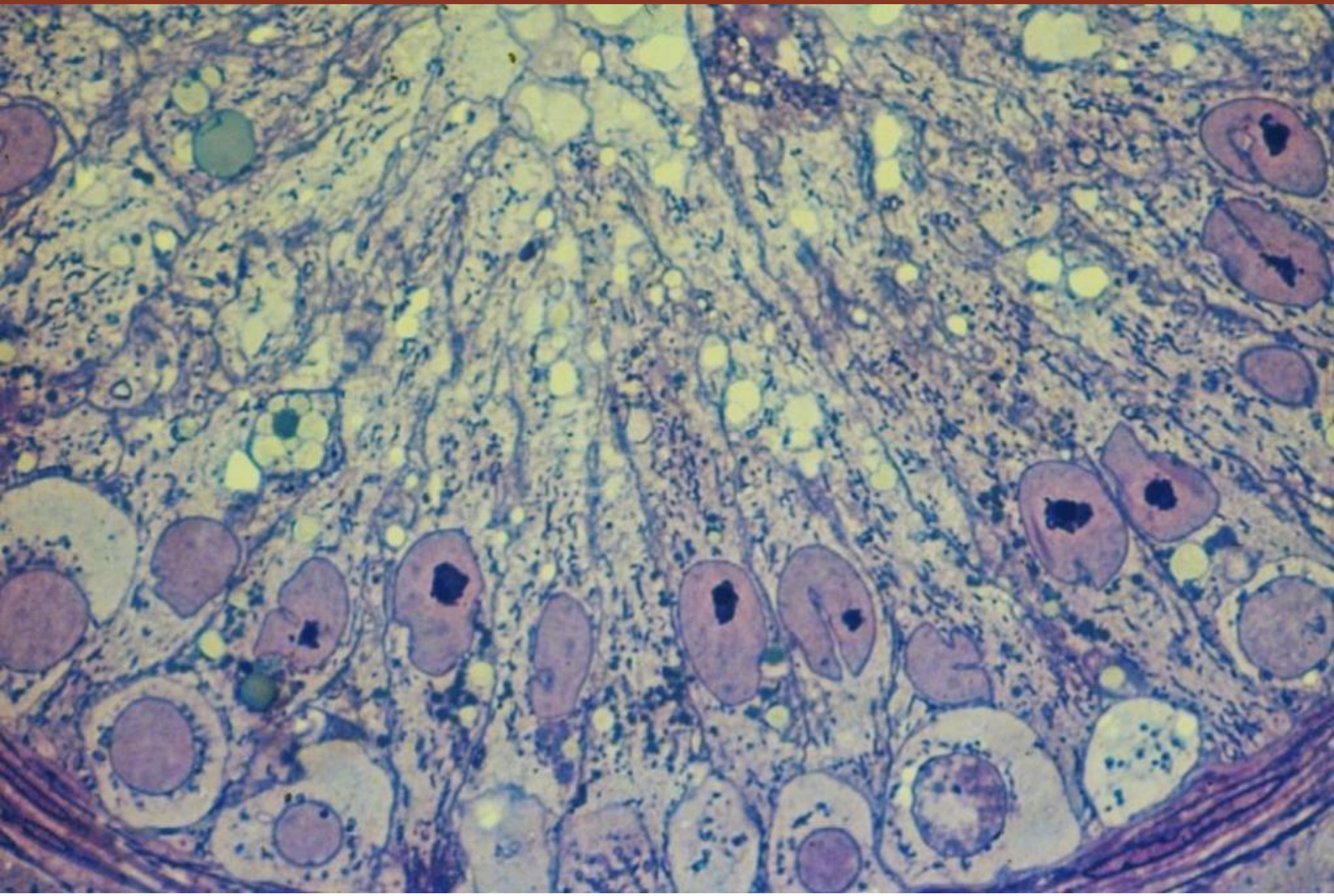
Sd = Spermatids

Se = Sertoli Cells

Sg = Spermatogonia

Ta = Spermatozoa

Human – infertile man



SERTOLI CELLS

PROVIDE SUPPORT AND NUTRITION TO DEVELOPING GERM CELLS

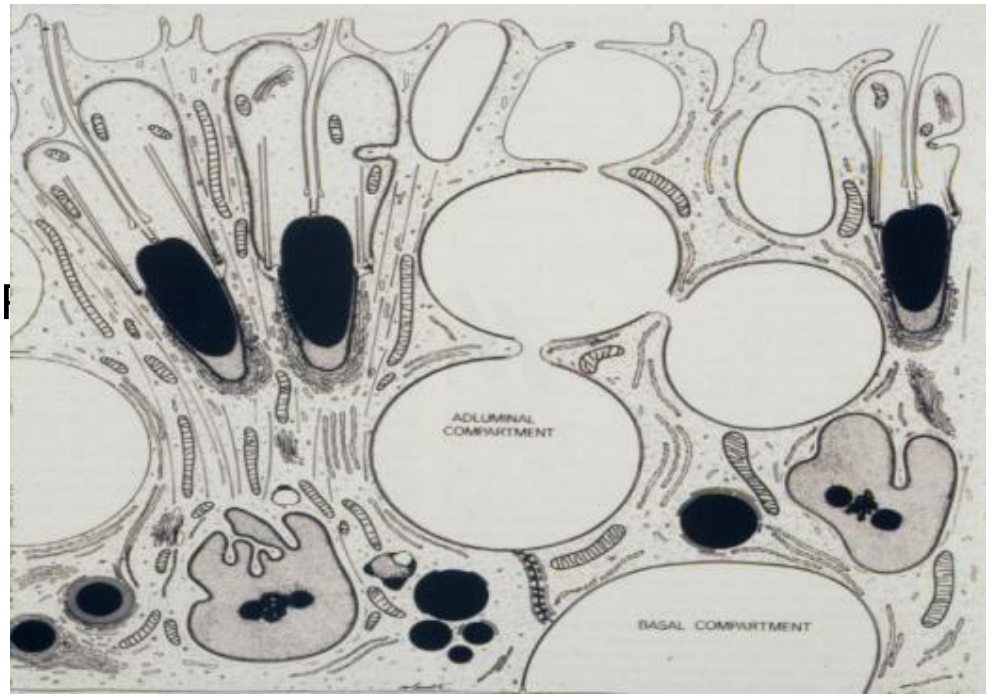
RELEASE SPERMATIDS AS SPERM

PHAGOCYTIZE DEGENERATING GERM CELLS AND RESIDUAL BODIES

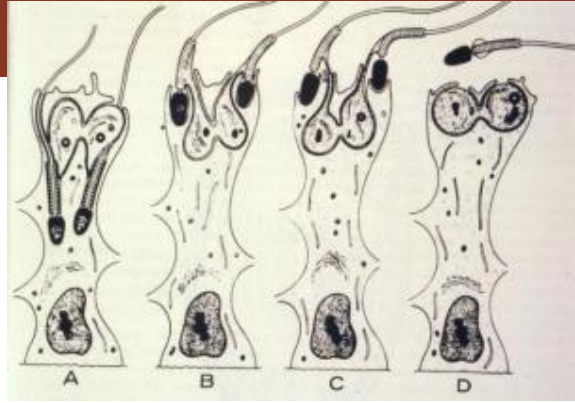
SECRETE:

A. ANDROGEN BINDING PROTEIN
B. CALMODULIN
C. PLASMINOGEN ACTIVATOR
D. INHIBIN

BLOOD TESTIS BARRIER



SERTOLI CELLS



PROVIDE SUPPORT AND NUTRITION TO DEVELOPING GERM CELLS

RELEASE SPERMATIDS AS SPERM

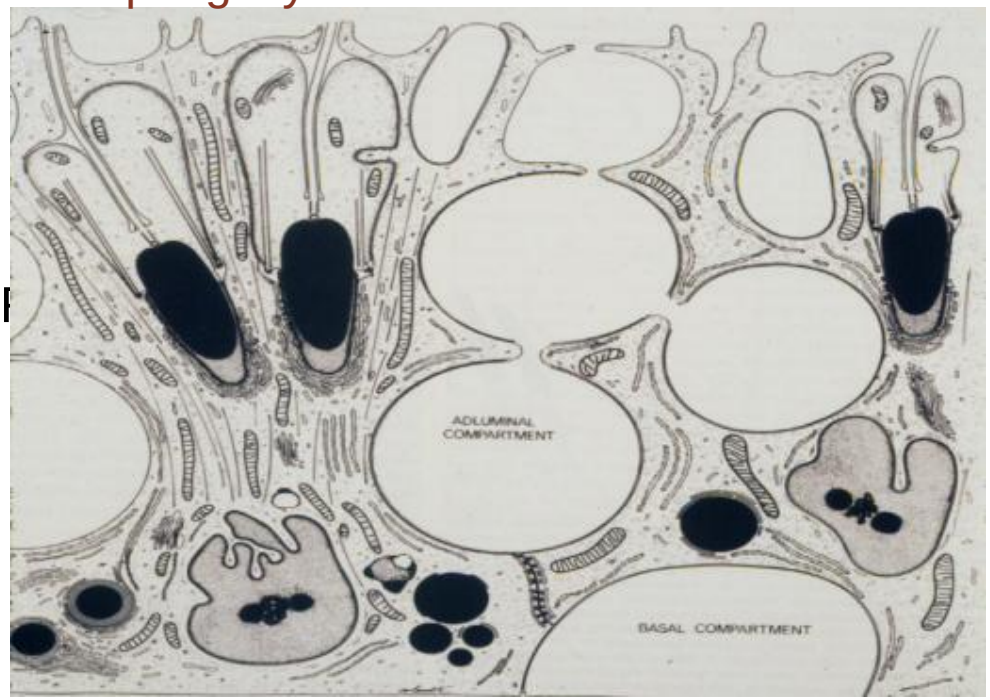
PHAGOCYTIZE DEGENERATING GERM CELLS AND RESIDUAL BODIES

SECRETE:

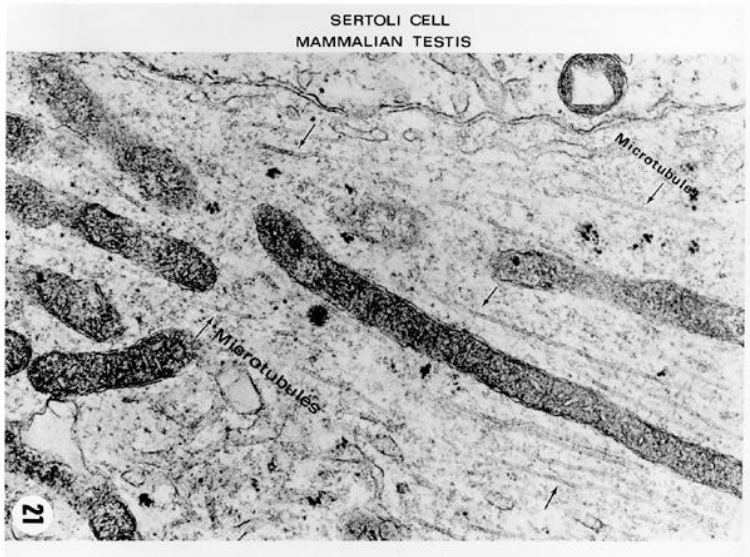
A. ANDROGEN BINDING PROTEIN
B. CALMODULIN
C. PLASMINOGEN ACTIVATOR
D. INHIBIN

BLOOD TESTIS BARRIER

Sertoli cells contribute to spermiogenesis through their nurse-cell function of providing physically and metabolically support to developing germ cells and the specific release of spermatids and phagocytosis of residual bodies.

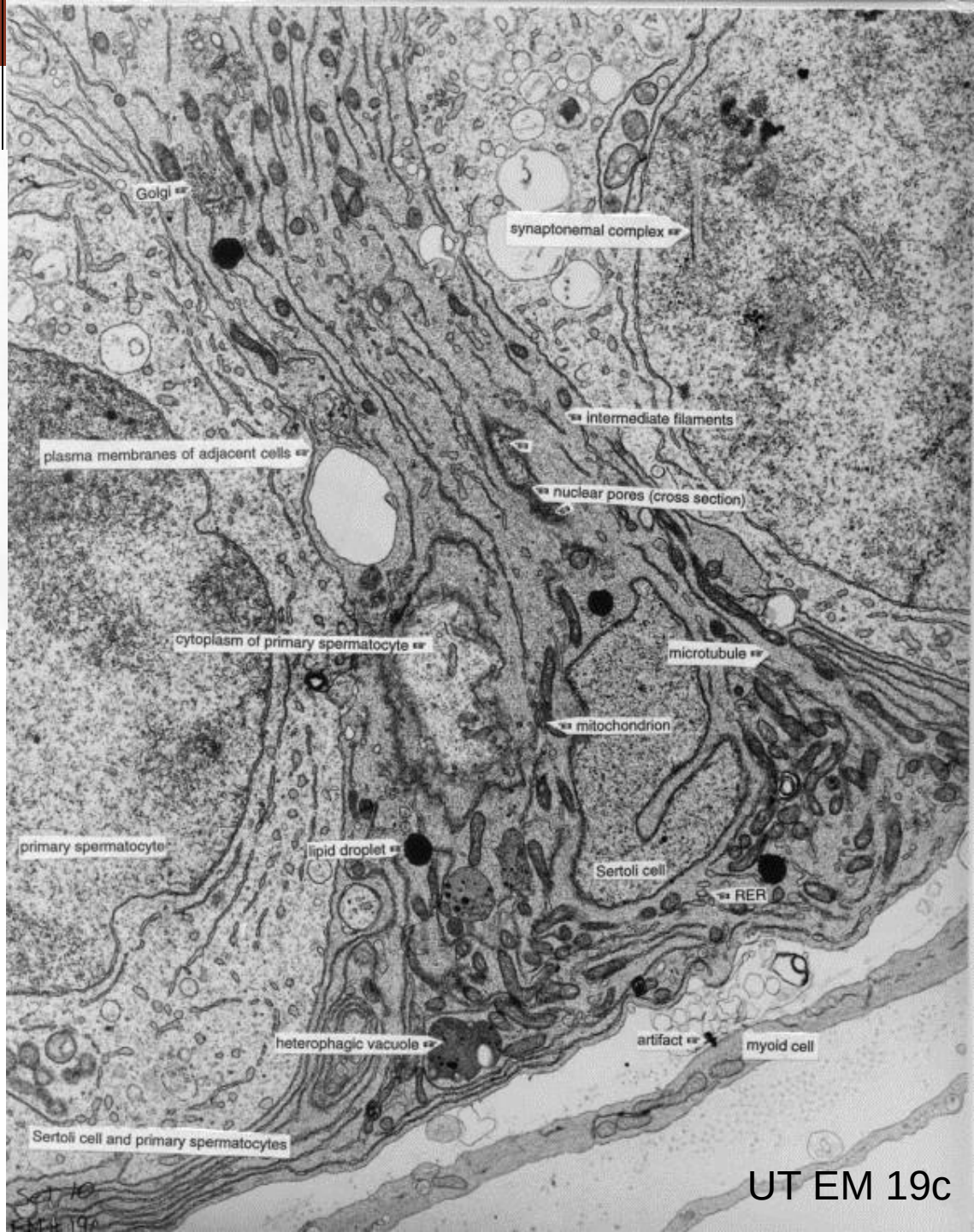


EM 21 Sertoli cell cytoplasm

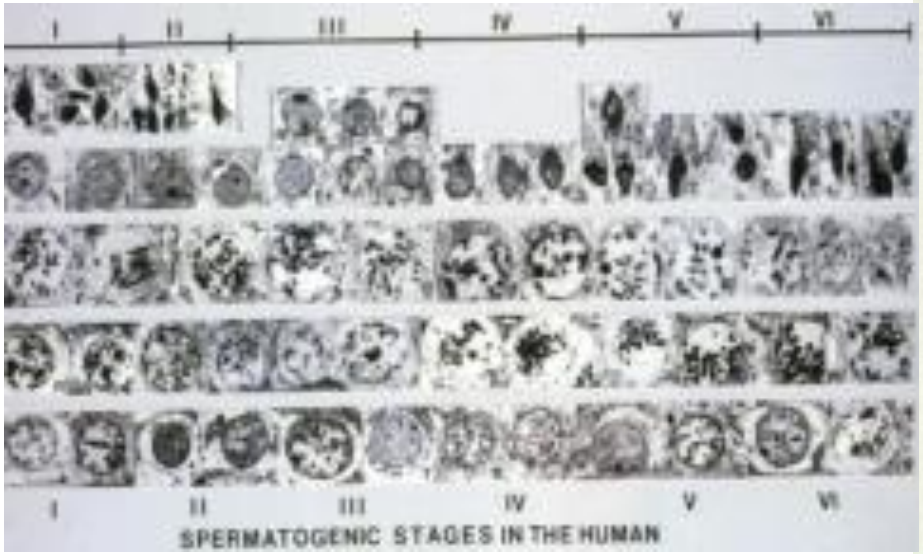


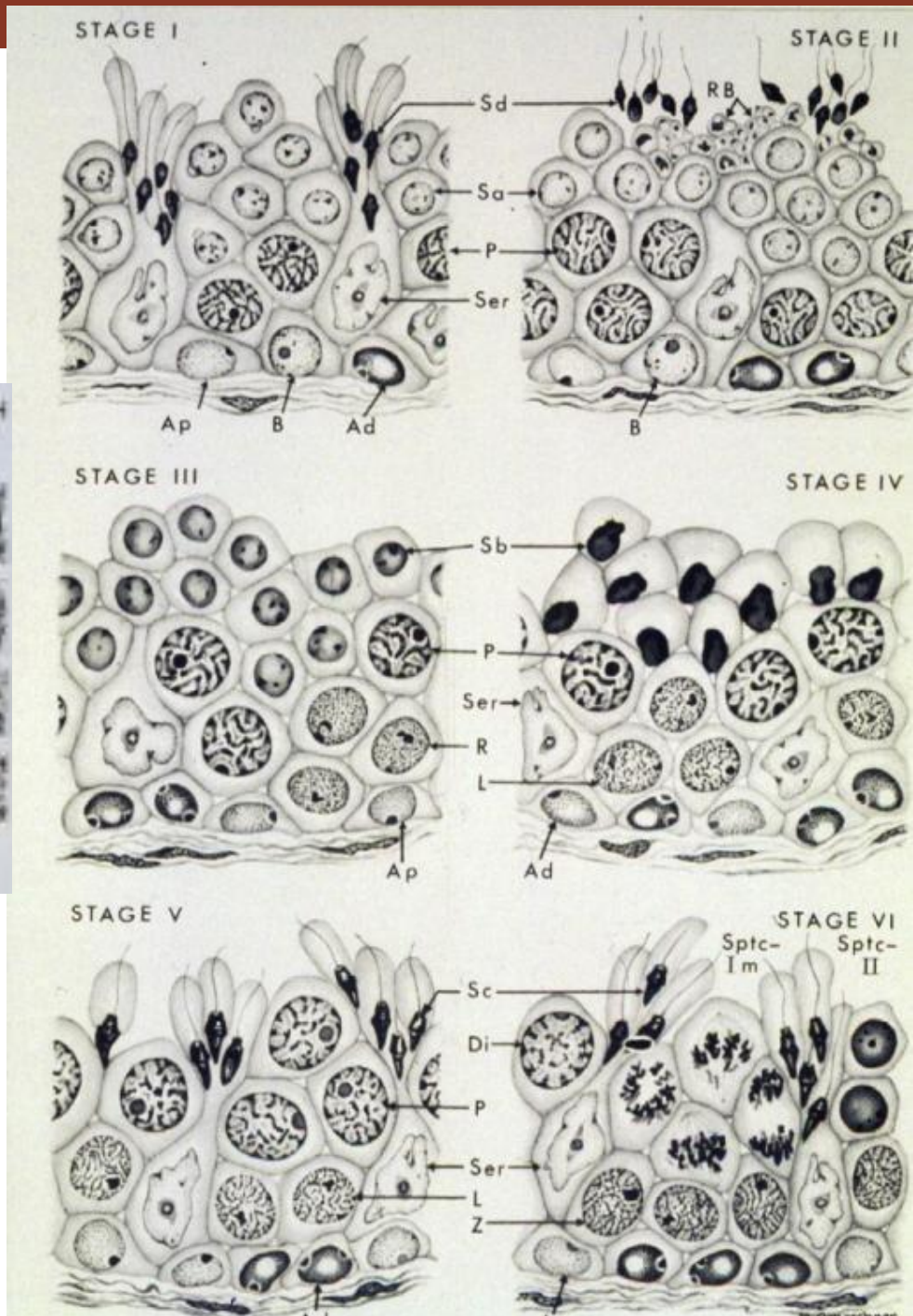
UT EM 19c; Sertoli cell; 13 300x

1. Golgi
2. Heterophagic vacuole
3. Lipid droplet
4. Microtubule
5. Nuclear pores (cross-section)
6. Sertoli cell
7. Synaptoneural complex

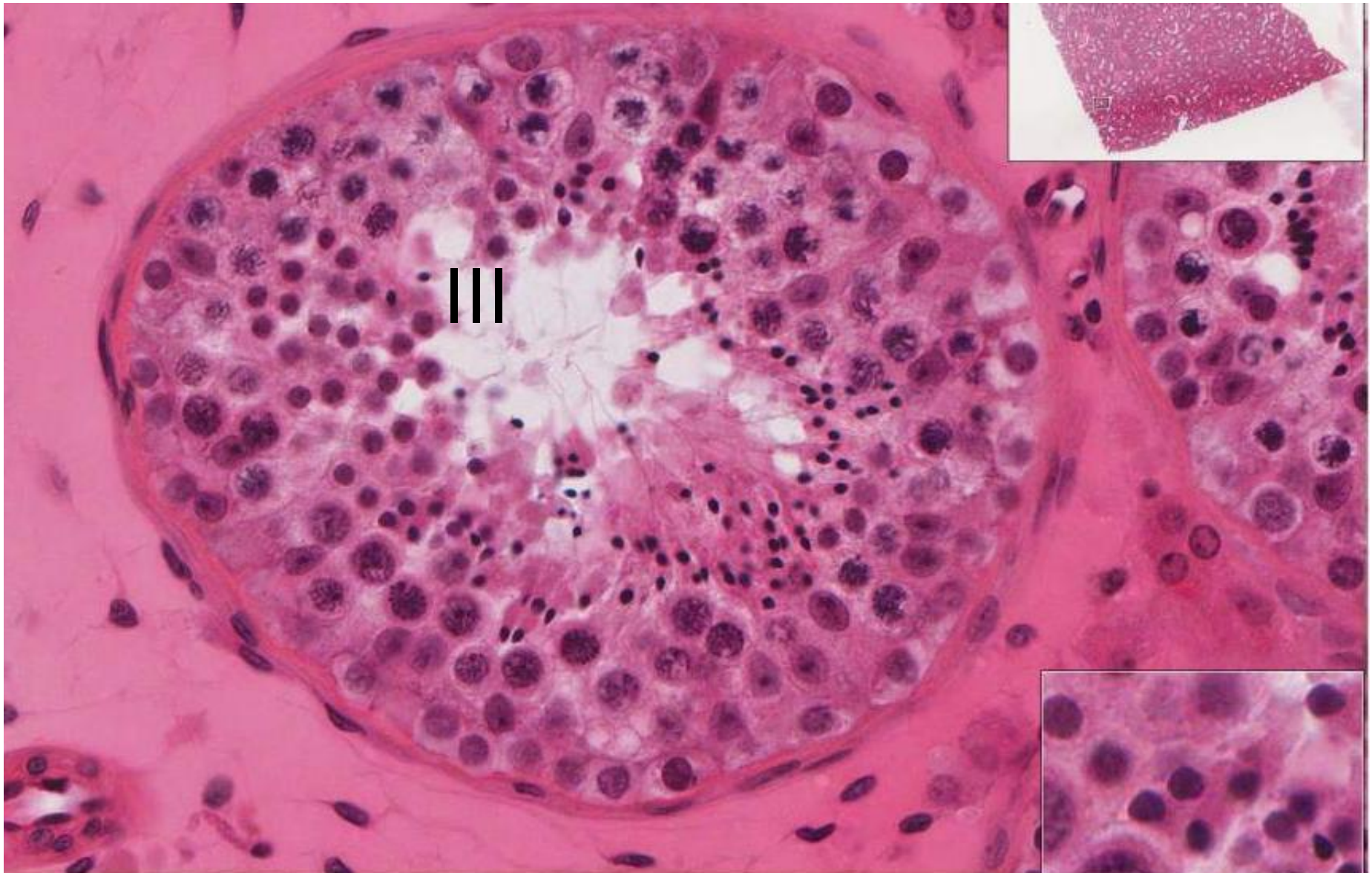


Six stages of the spermatogenic cycle in humans

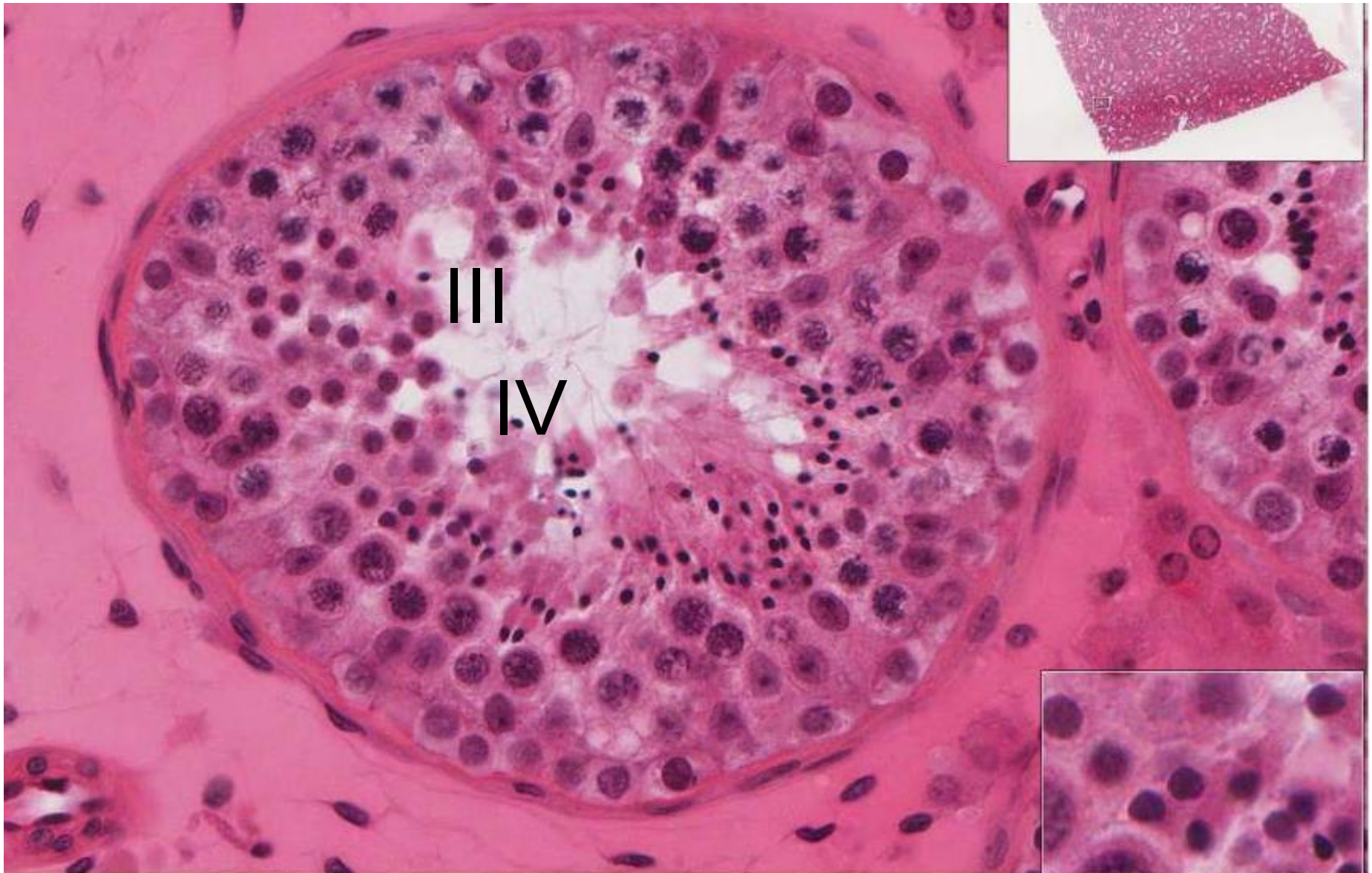




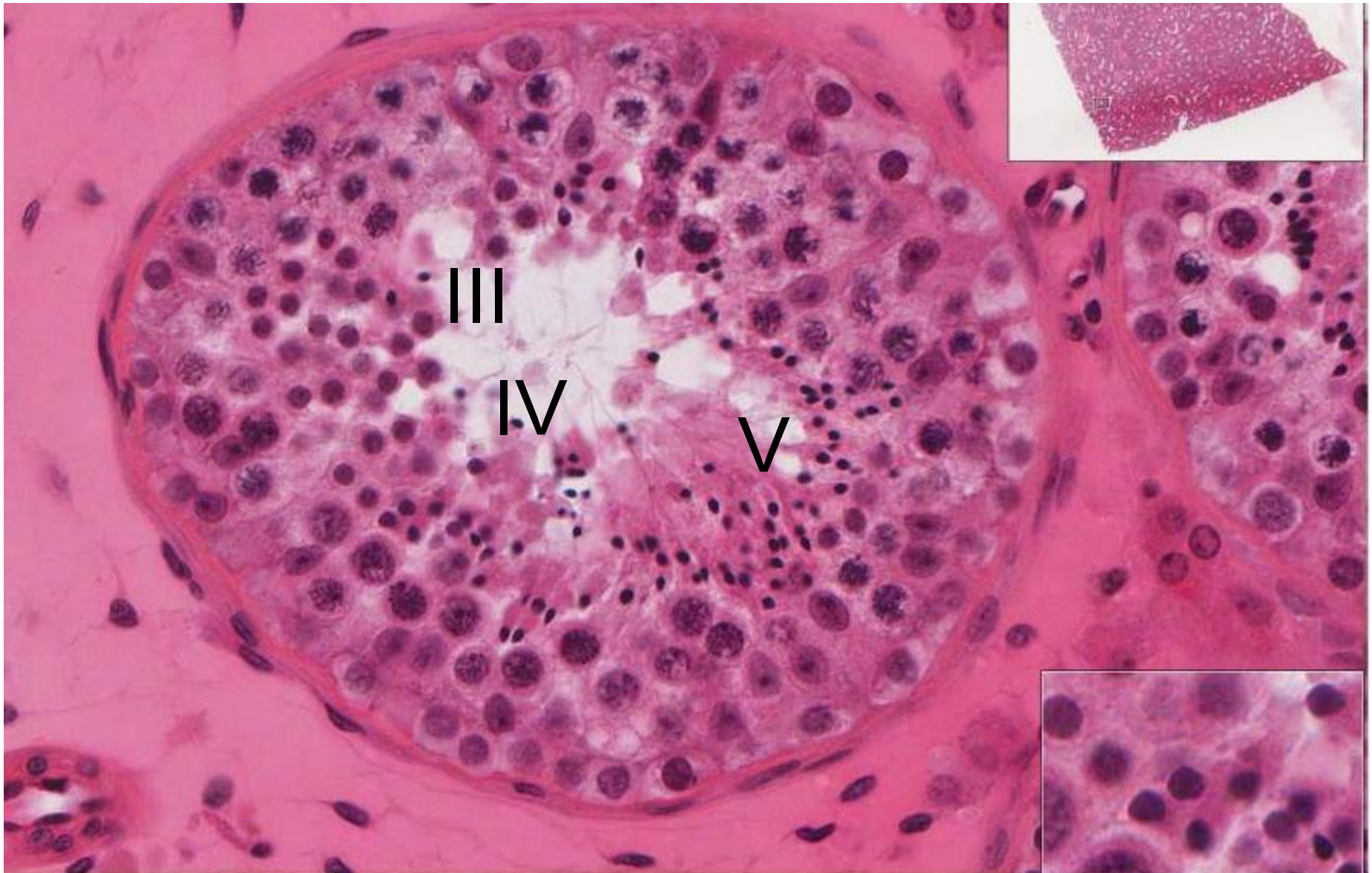
UT 165 human testis spherical, elongating (condensing), and elongated (maturation phase) spermatids



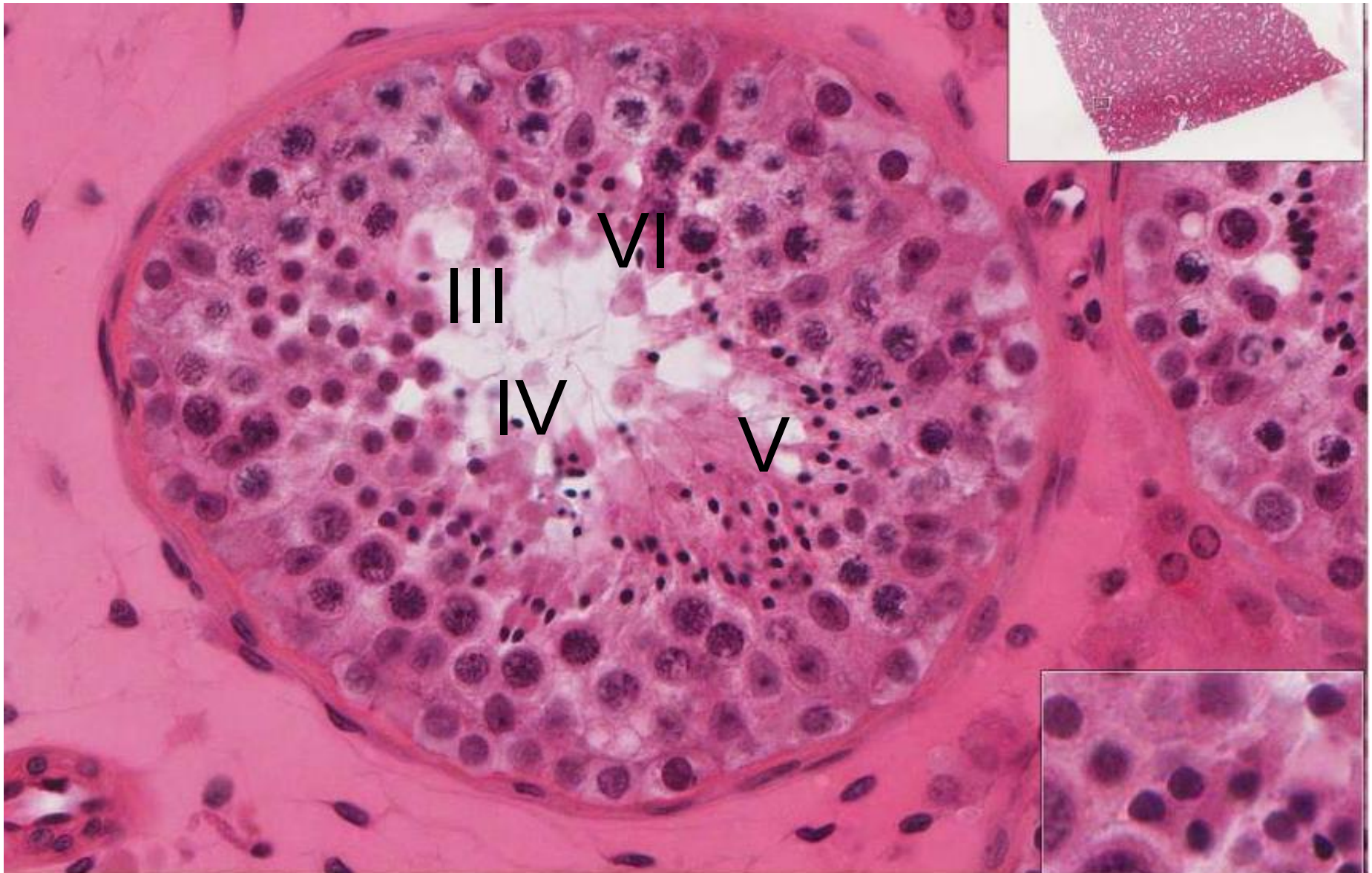
UT 165 human testis spherical, elongating (condensing), and elongated (maturation phase) spermatids



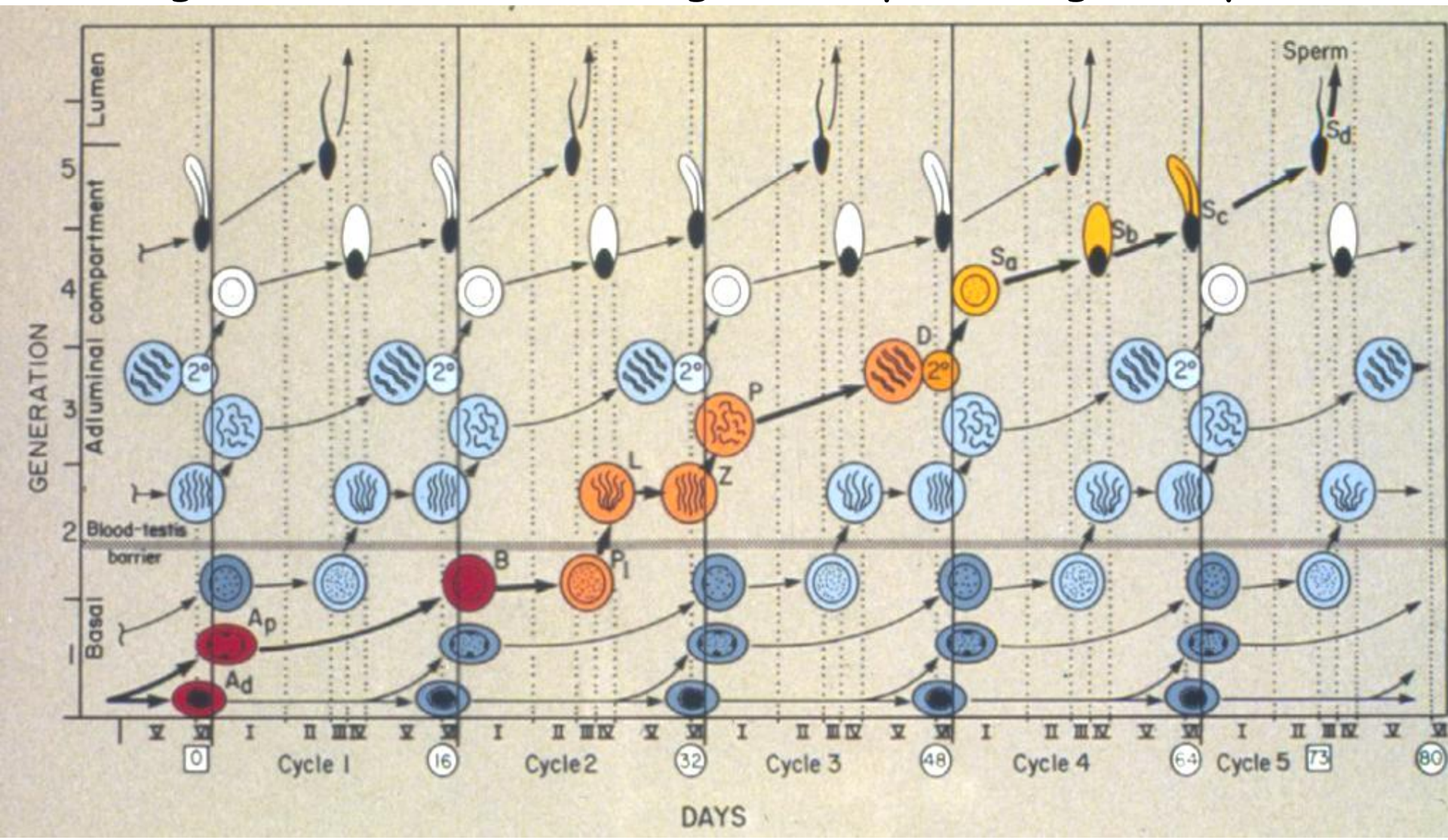
UT 165 human testis spherical, elongating (condensing), and elongated (maturation phase) spermatids

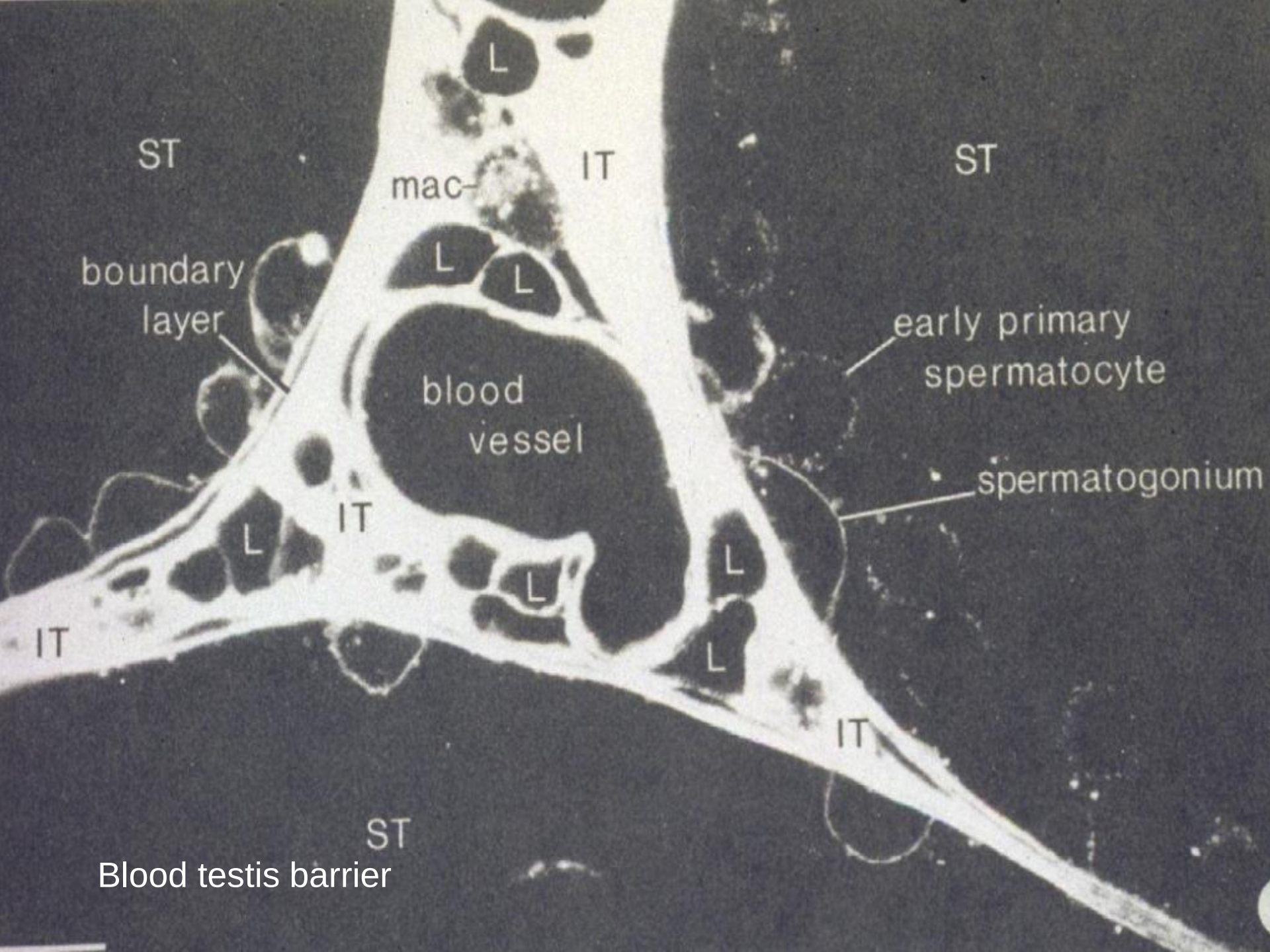


UT 165 human testis spherical, elongating (condensing), and elongated (maturation phase) spermatids

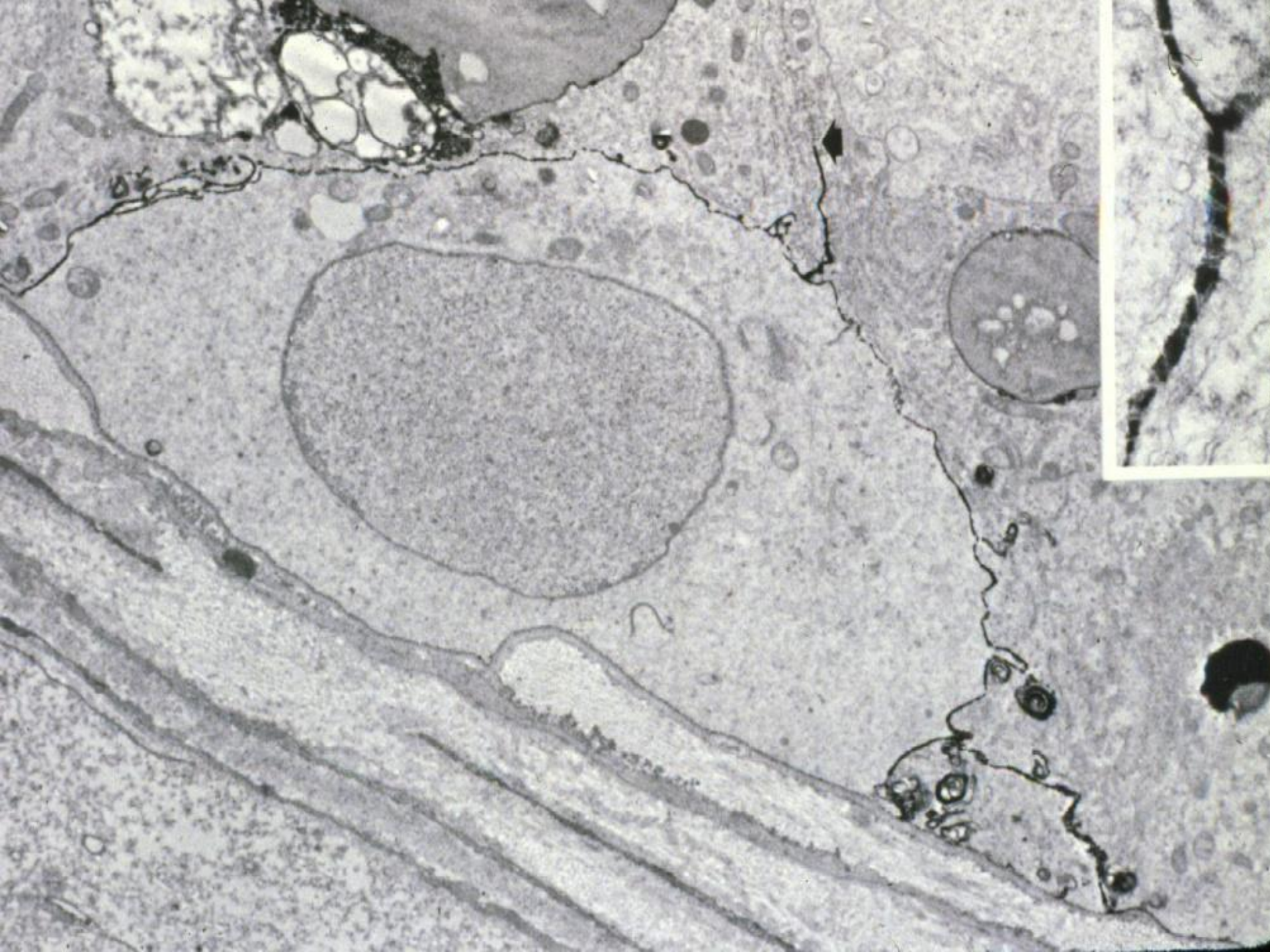


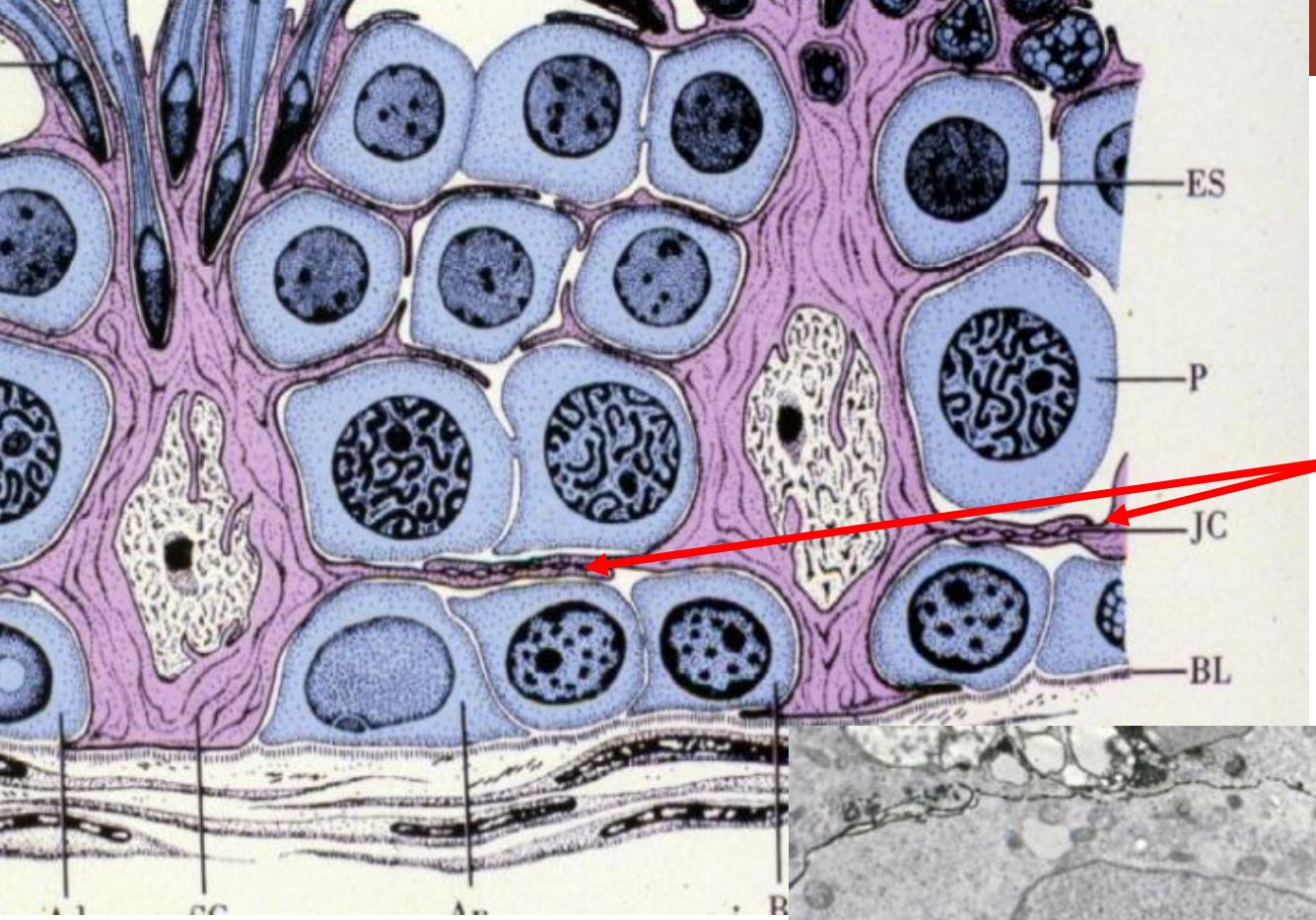
Human spermatogenesis: path followed through spermatocytogenesis, meiosis, and spermiogenesis as a given cell travels through five spermatogenic cycles



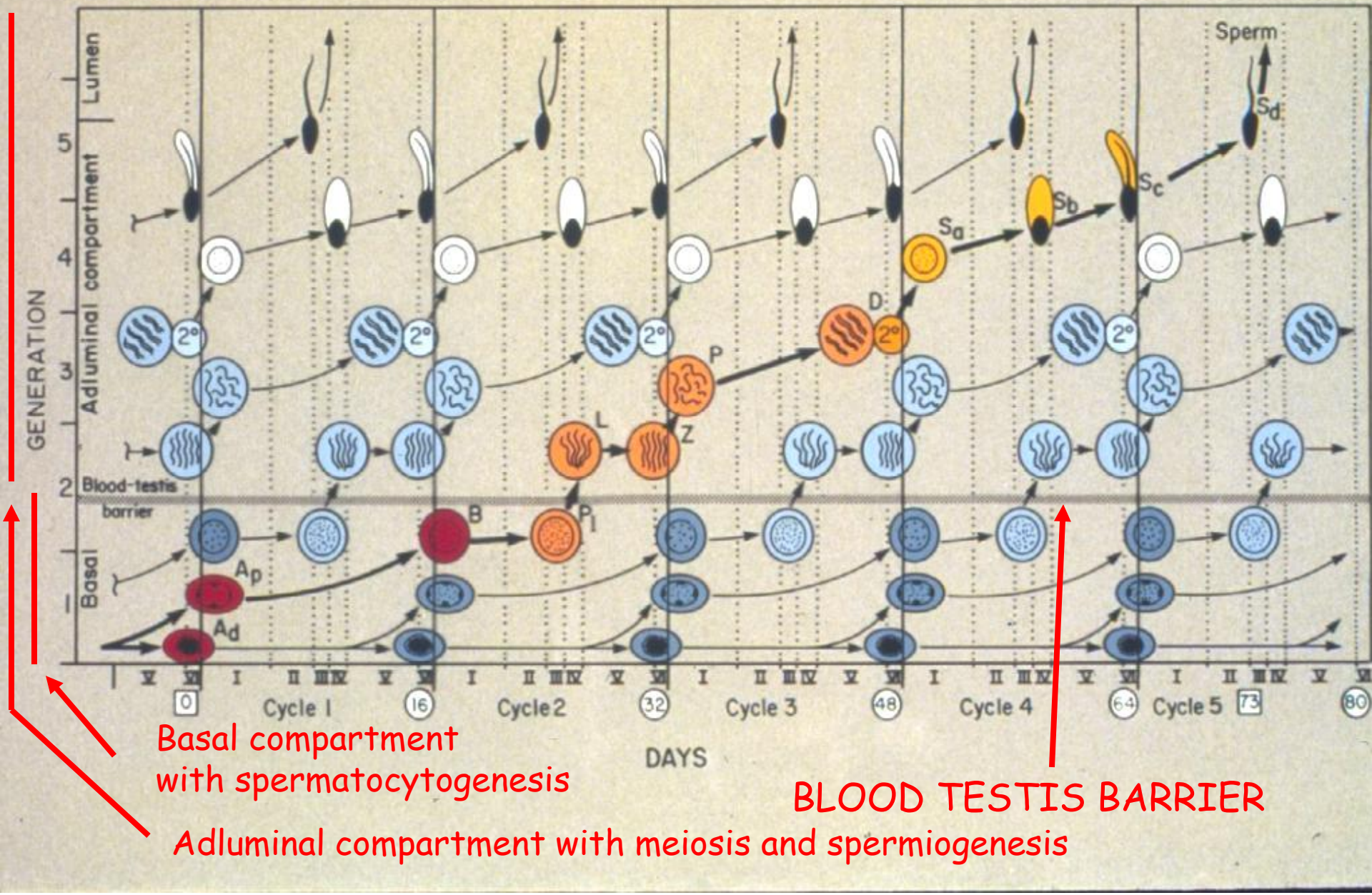


Blood testis barrier

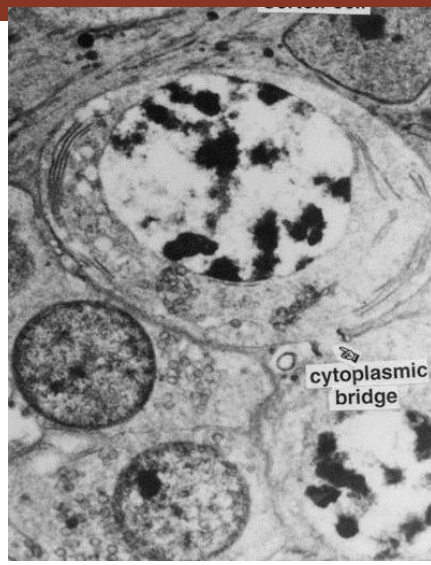



ES
P
JC
BL

Human spermatogenesis: path followed by given cell



INTERCELLULAR BRIDGES



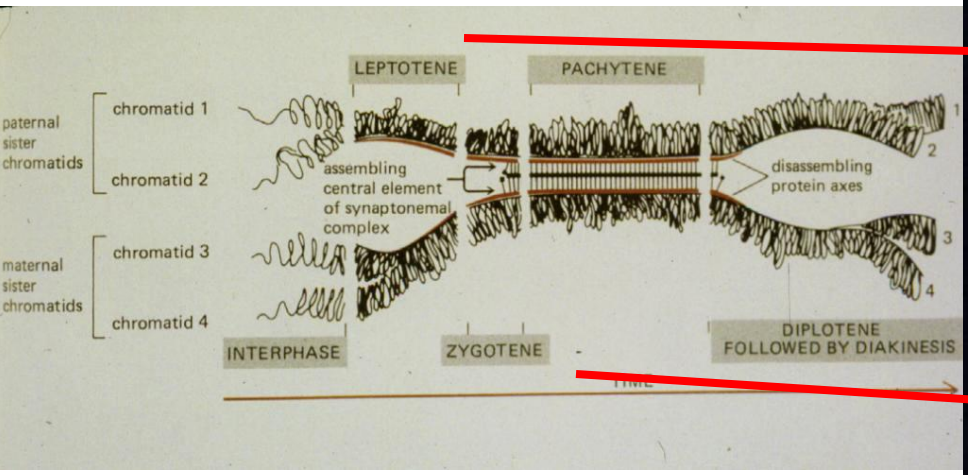
CAUSE - INCOMPLEE CYTOKINESIS

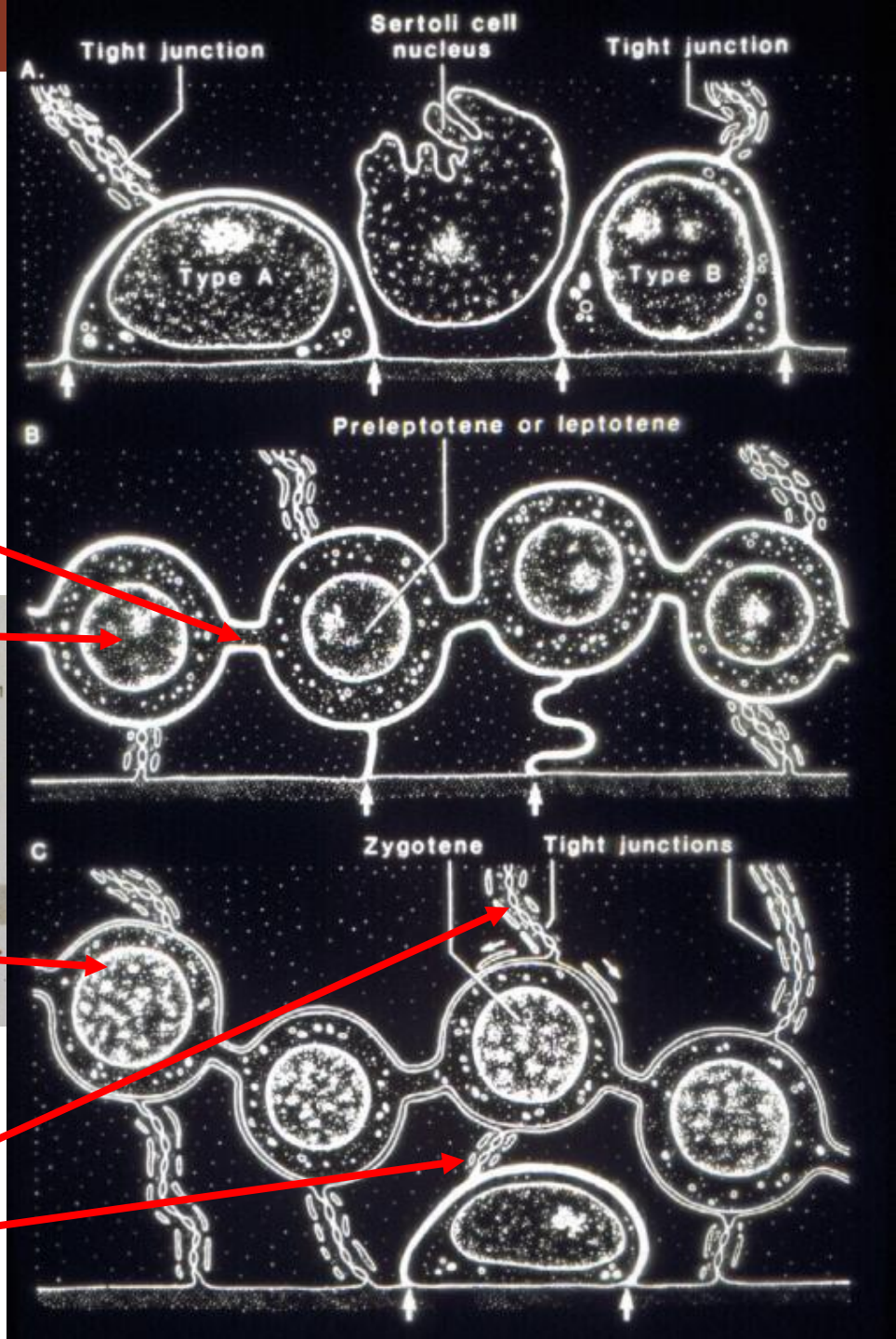
FOUND AMONG CLUSTERS OF SPERMATOGONIA, SPERMATOCYTES, OR SPERMATIDS (never between cells in different steps of development, e.g., never between SPERMATOGONIA and SPERMATOCYTES)

POSSIBLE FUNCTIONS

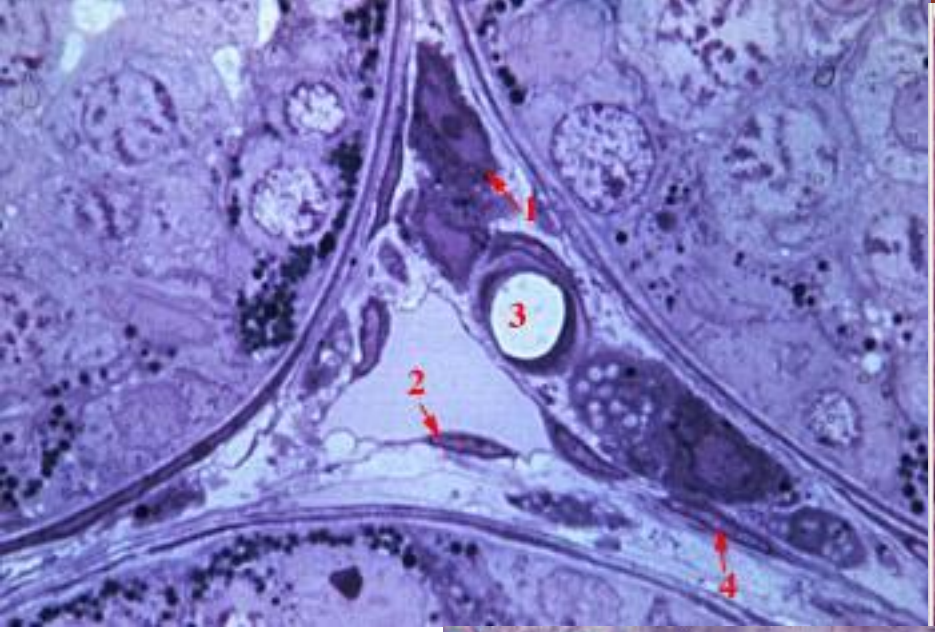
- MEDIATE BOTH DIFFERENTIATION AND DEGENERATION OF SPERMATOGONIA
- MAINTAIN SYNCHRONOUS DEVELOPMENT

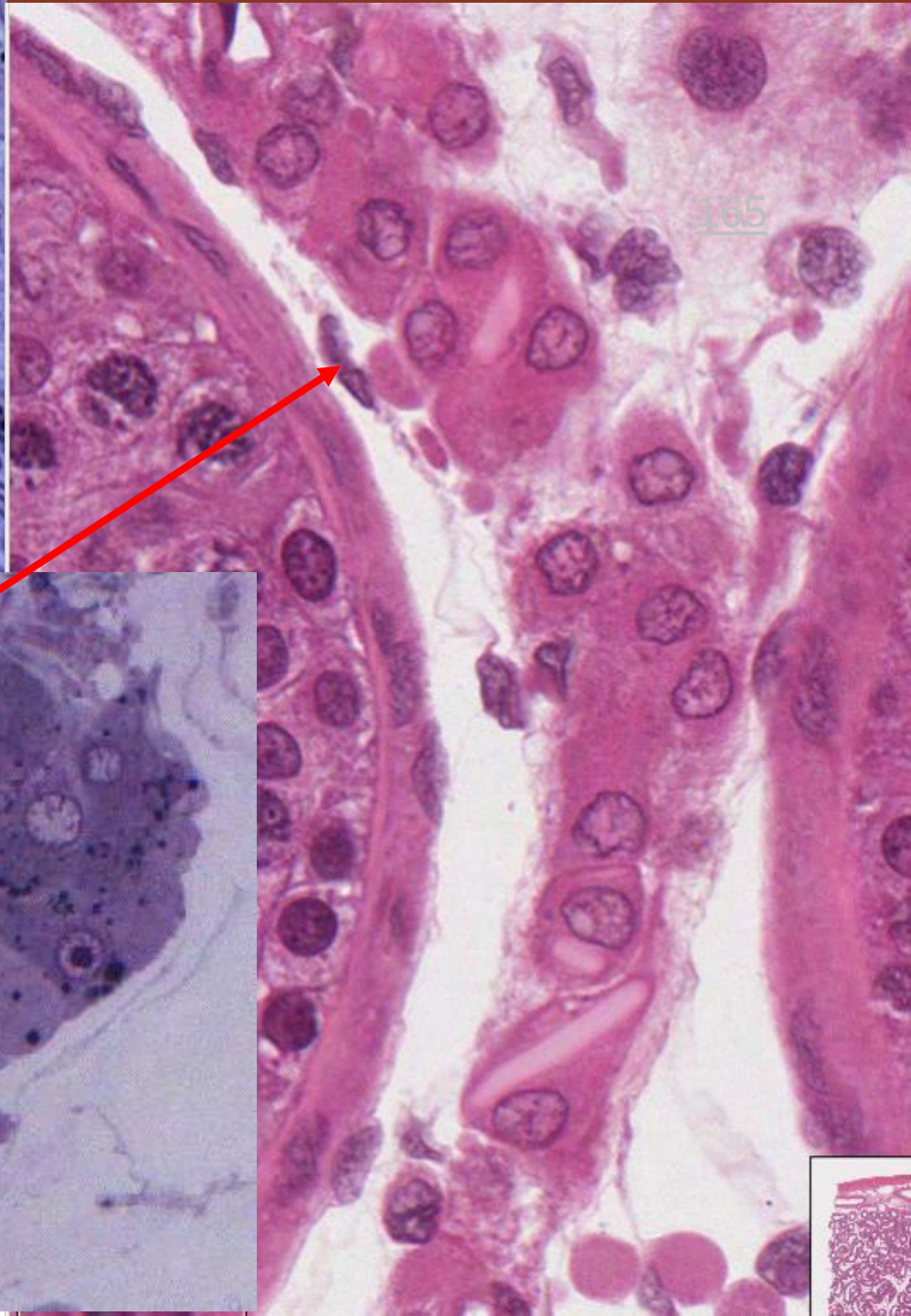
INTERCELLULAR BRIDGES





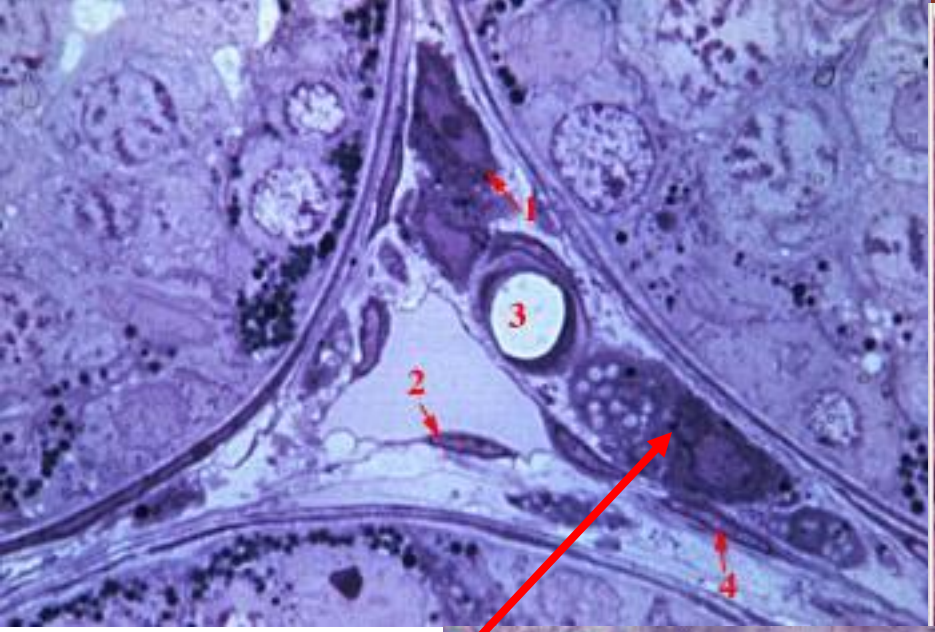
OCCLUDING JUNCTIONS BETWEEN SERTOLI CELLS are still above but now appear below the zygotene spermatocytes

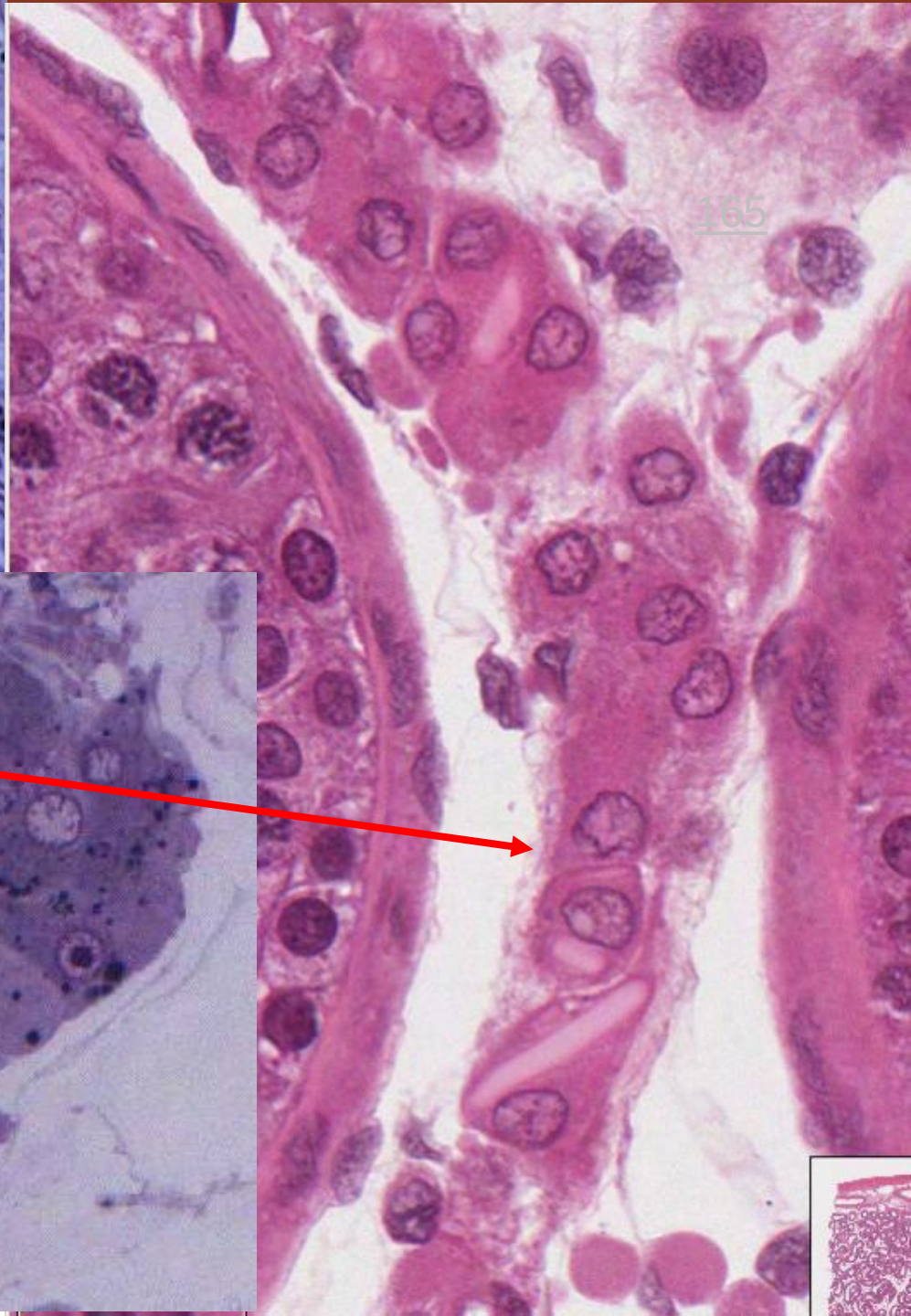




Interstitium (monkey)

1. Leydig cell
2. Endothelial cell of lymph vessel
3. Blood vessel
4. Fibroblast





Interstitium (monkey)

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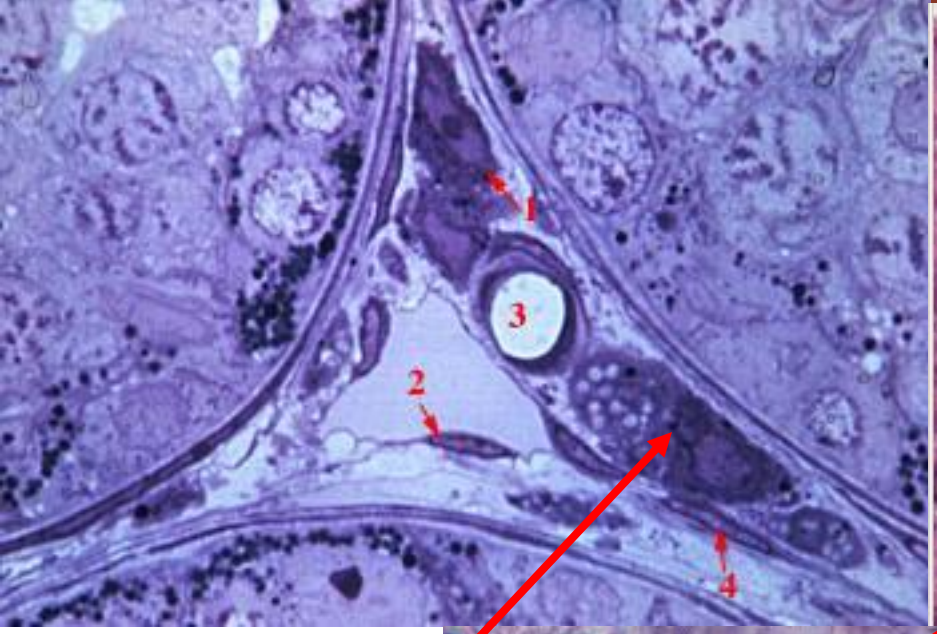
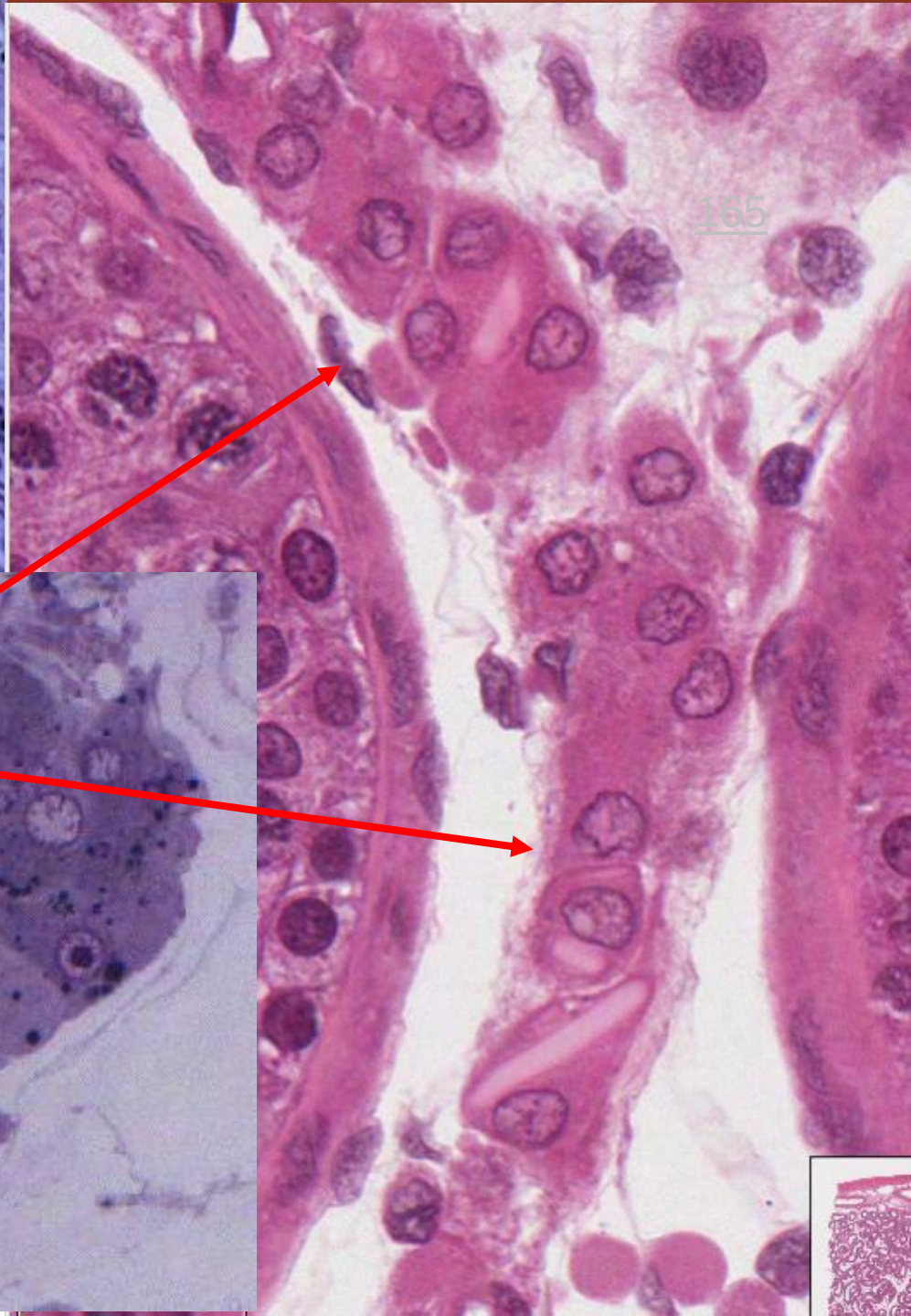
3. Blood vessel
4. Fibroblast





Interstitium (monkey)

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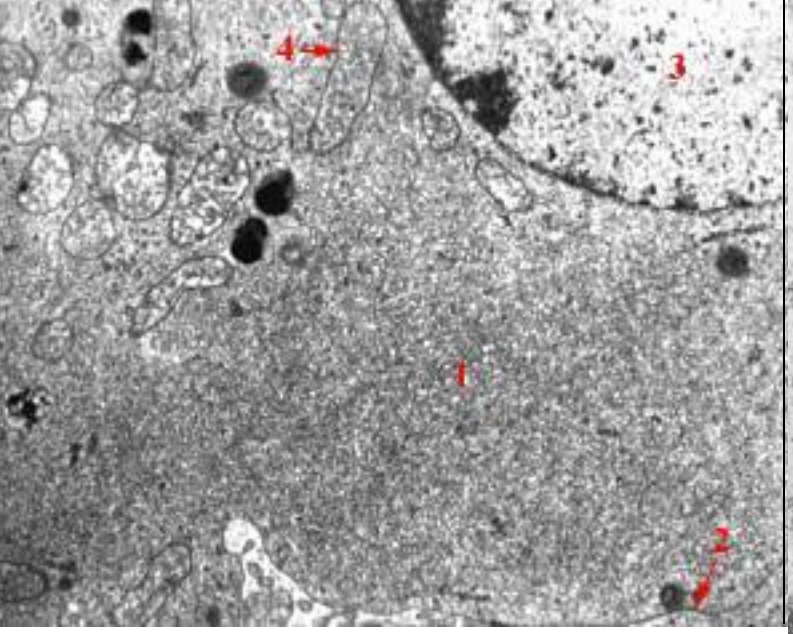
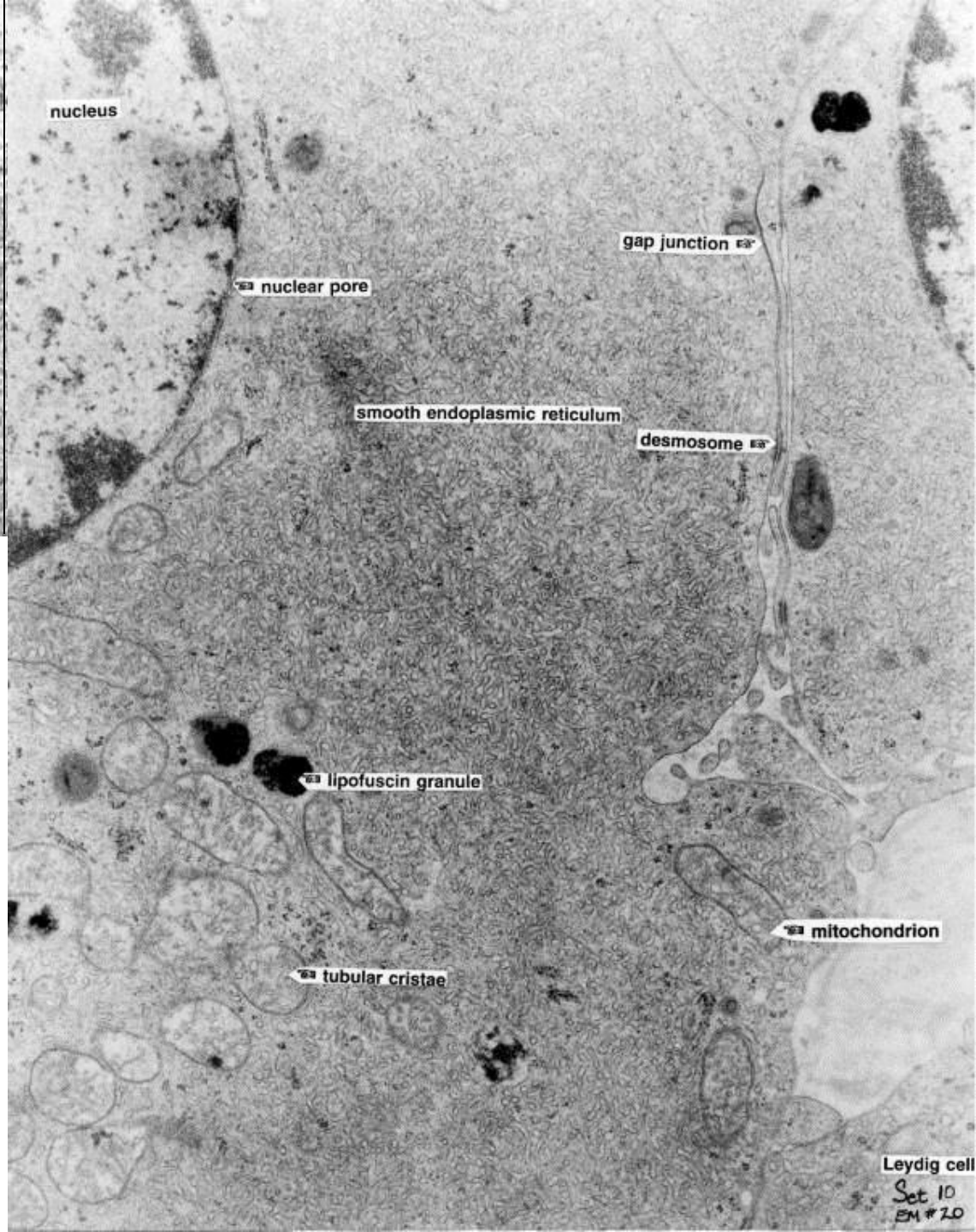
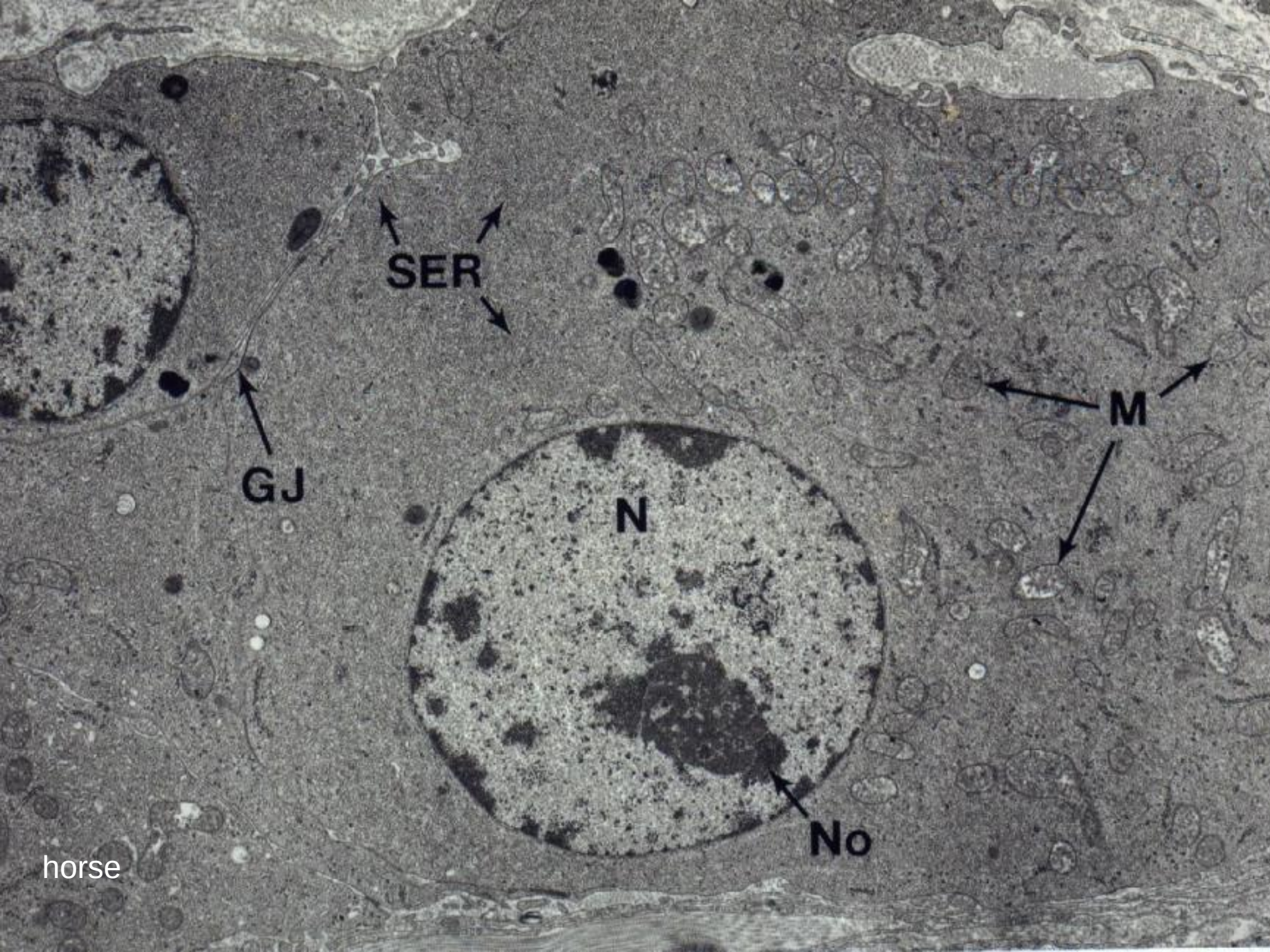




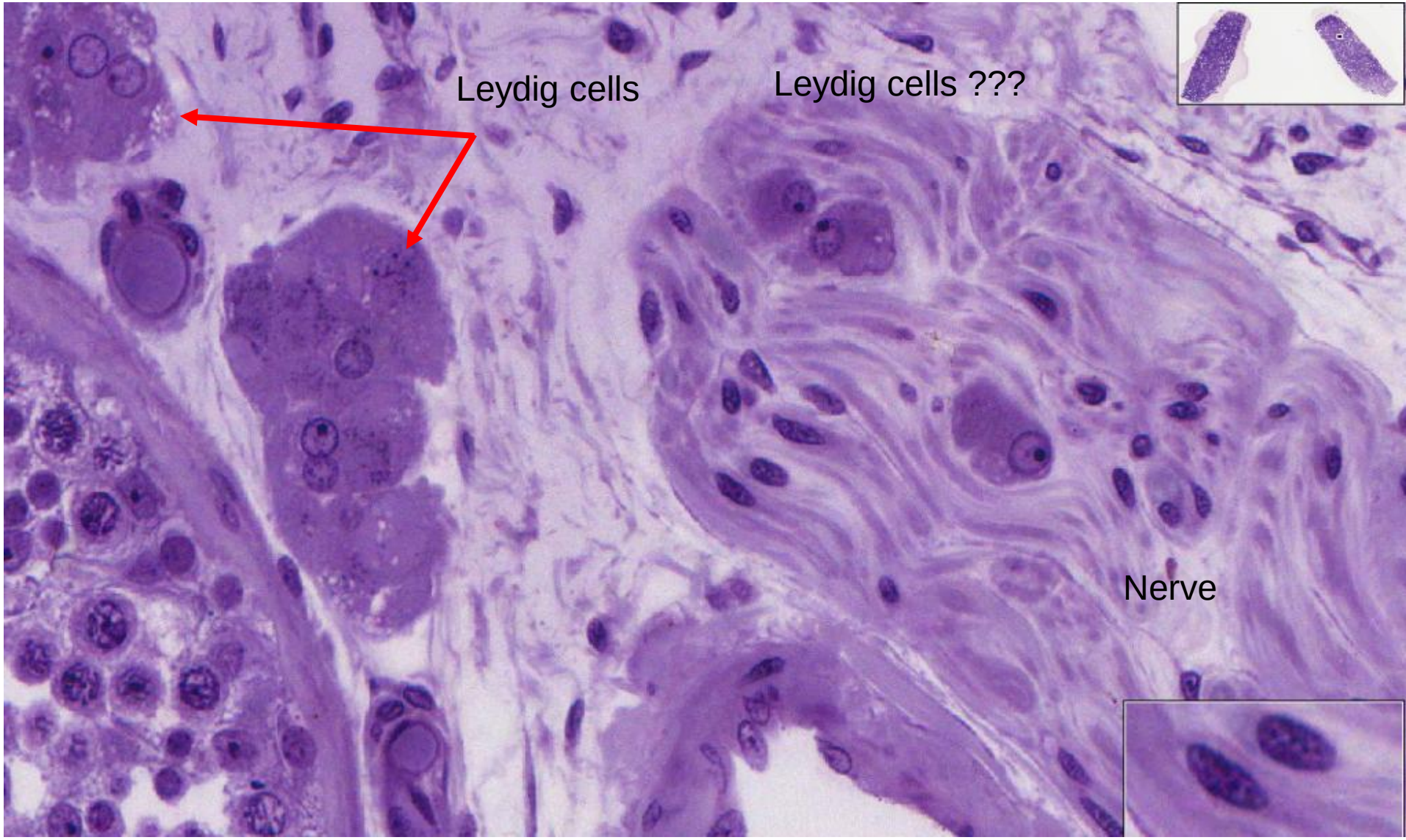
Horse Leydig cells: EM 20

1. Smooth endoplasmic reticulum
2. Gap junction
3. Nucleus of leydig cell
4. Tubular cristae of a mitochondion

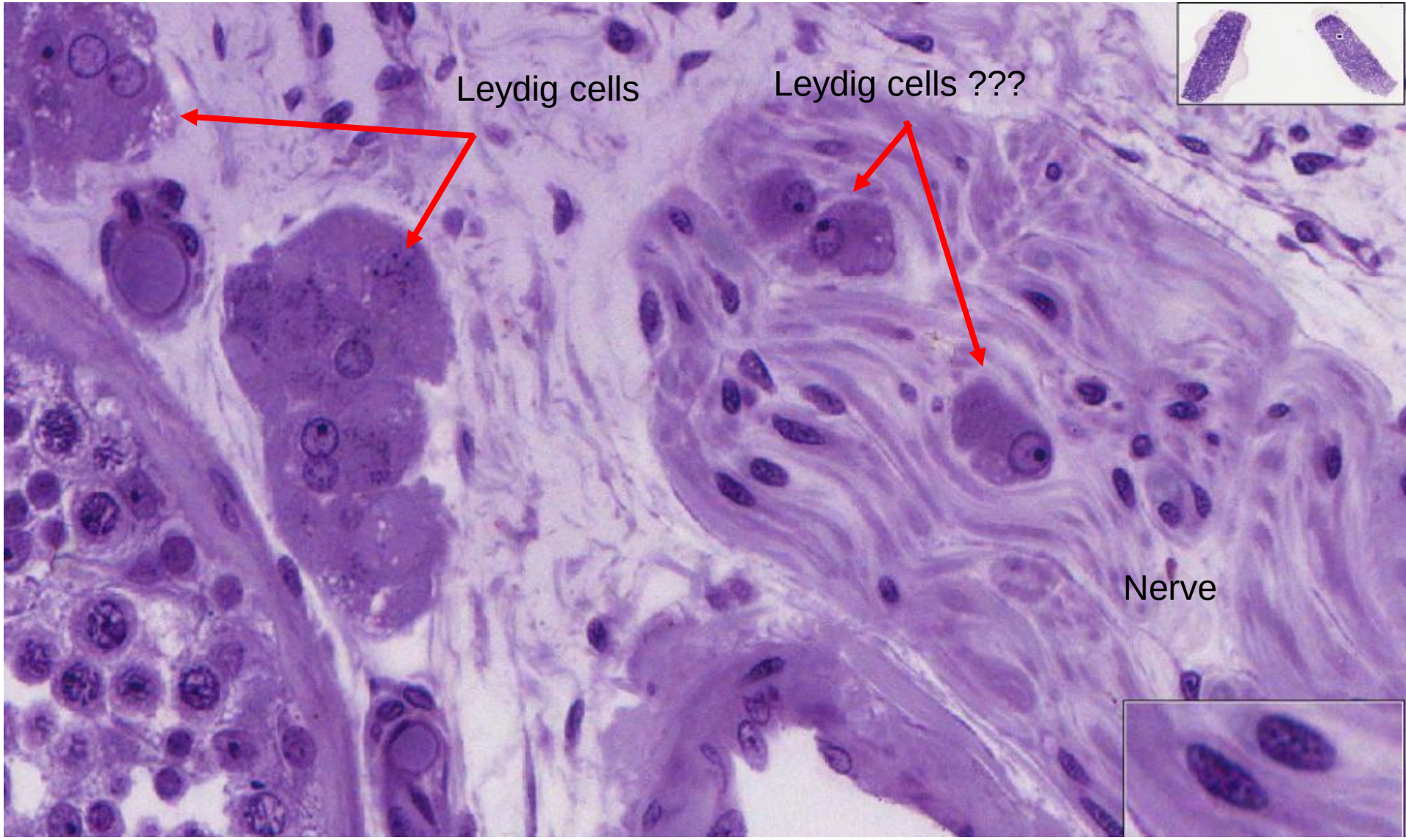

SER
GJ
N
M
No
horse

HORMONAL CONTROL OF SPERMATOGENESIS

HORMONE	CELL STIMULATED	IN SPERMATOGENESIS
FSH	SERTOLI CELLS	SPERMATOCYTOGENESIS SPERMIATION
LH	LEYDIG CELLS (TESTOSTERONE)	MEIOSIS

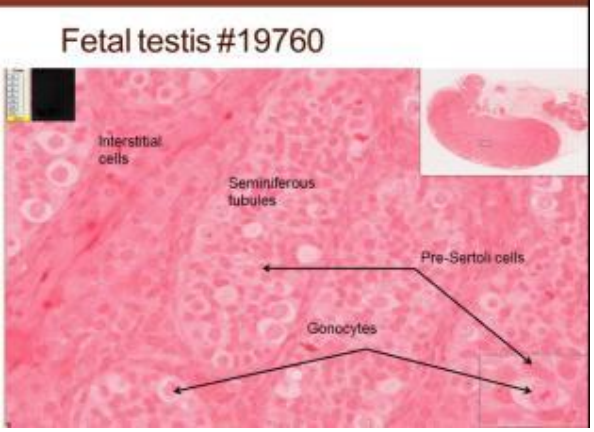


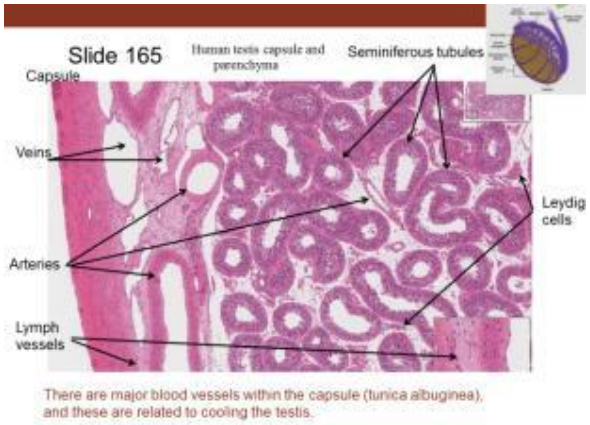
Odd : What appears to be Leydig cells inside the nerve in the human testis.

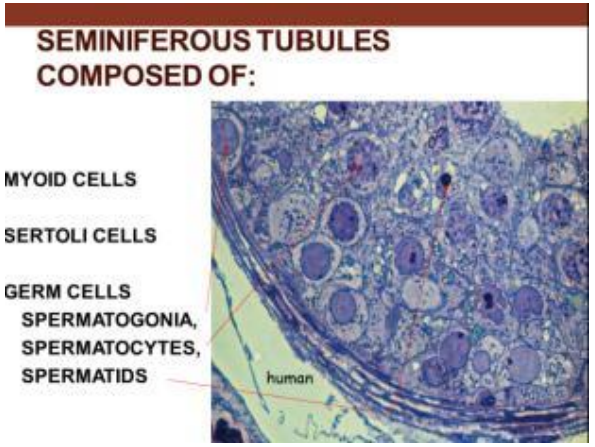


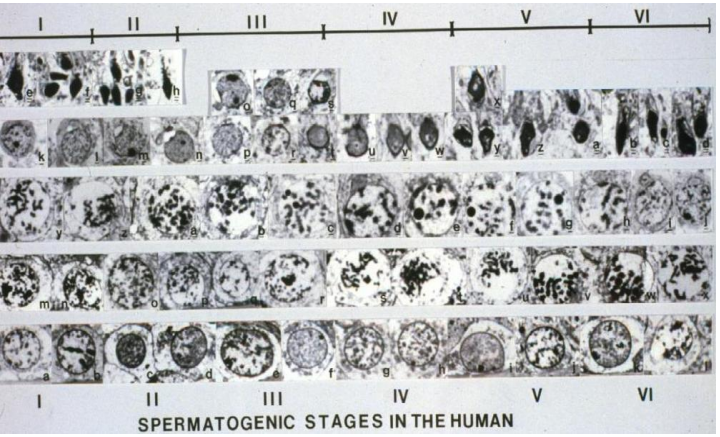
Odd : What appears to be Leydig cells inside the nerve in the human testis.

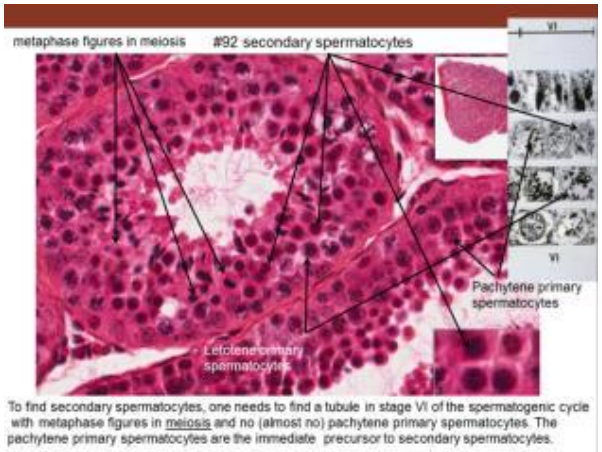
Summary of Male reproductive system: Part 1 Spermatogenesis

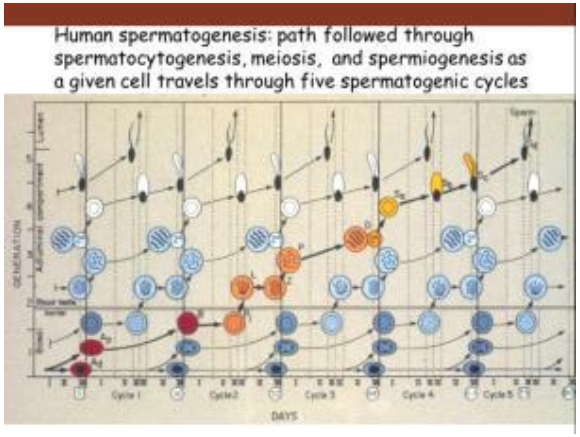


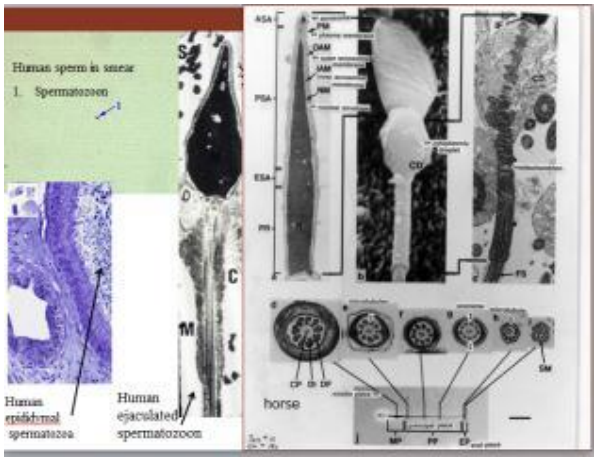


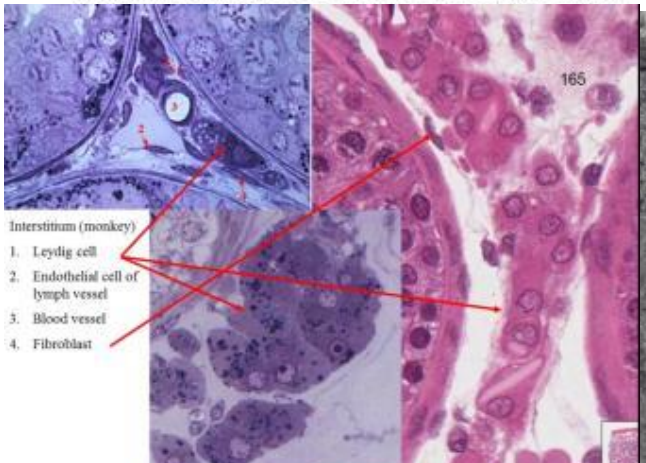


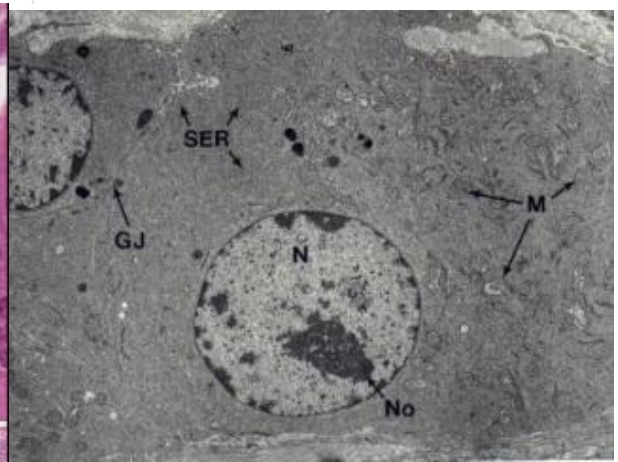












Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

- Bruce Alberts, et al. 1983. Molecular Biology of the Cell. Garland Publishing, Inc., New York, NY.
- Bruce Alberts, et al. 1994. Molecular Biology of the Cell. Garland Publishing, Inc., New York, NY.

- William J. Banks, 1981. Applied Veterinary Histology. Williams and Wilkins, Los Angeles, CA.

- Hans Elias, et al. 1978. Histology and Human Microanatomy. John Wiley and Sons, New York, NY.

- Don W. Fawcett. 1986. Bloom and Fawcett. A textbook of histology. W. B. Saunders Company, Philadelphia, PA.
- Don W. Fawcett. 1994. Bloom and Fawcett. A textbook of histology. Chapman and Hall, New York, NY.

- Arthur W. Ham and David H. Cormack. 1979. Histology. J. S. Lippincott Company, Philadelphia, PA.

- Luis C. Junqueira, et al. 1983. Basic Histology. Lange Medical Publications, Los Altos, CA.
- L. Carlos Junqueira, et al. 1995. Basic Histology. Appleton and Lange, Norwalk, CT.

- L.L. Langley, et al. 1974. Dynamic Anatomy and Physiology. McGraw-Hill Book Company, New York, NY.

- W.W. Tuttle and Byron A. Schottelius. 1969. Textbook of Physiology. The C. V. Mosby Company, St. Louis, MO.

- Leon Weiss. 1977. Histology Cell and Tissue Biology. Elsevier Biomedical, New York, NY.
- Leon Weiss and Roy O. Greep. 1977. Histology. McGraw-Hill Book Company, New York, NY.

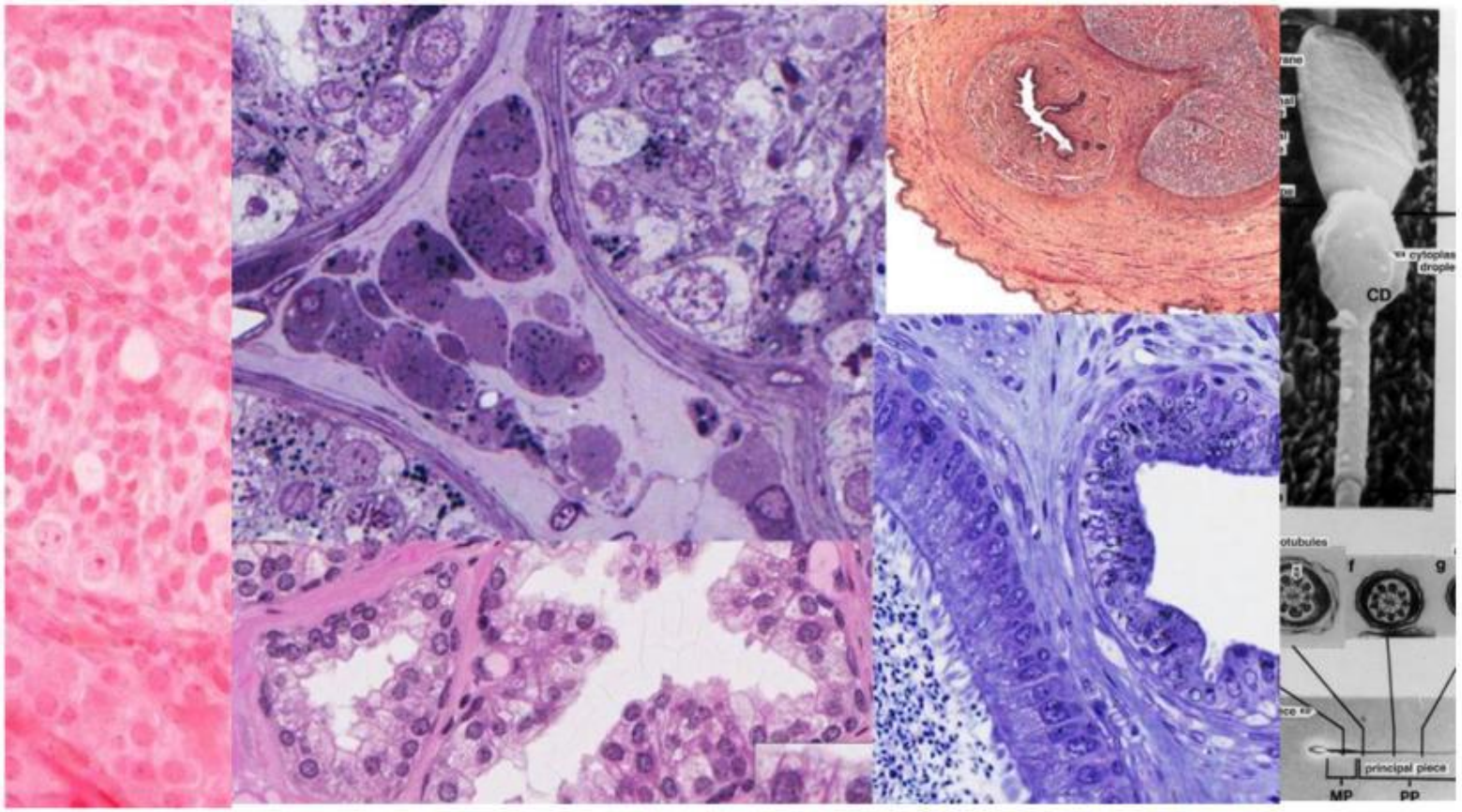
- Nature (http://www.nature.com), Vol. 414:88,2001.
- Arthur C. Guyton,1971.Textbook of Medical Physiology W.B. Saunders company, Philadelphia, PA
- WW Tuttle and BA Schottelius 1969 Textbook of Physiology C.V. Mosby Co.

- A.L. Mescher 2013 Junqueira's Basis Histology text and atlas, 13th ed. McGraw

- Douglas P. Dohrman and TAMHSC Faculty 2012 Structure and Function of Human Organ Systems, Histology Laboratory Manual - Slide selections were largely based on this manual for first year medical students at TAMHSC

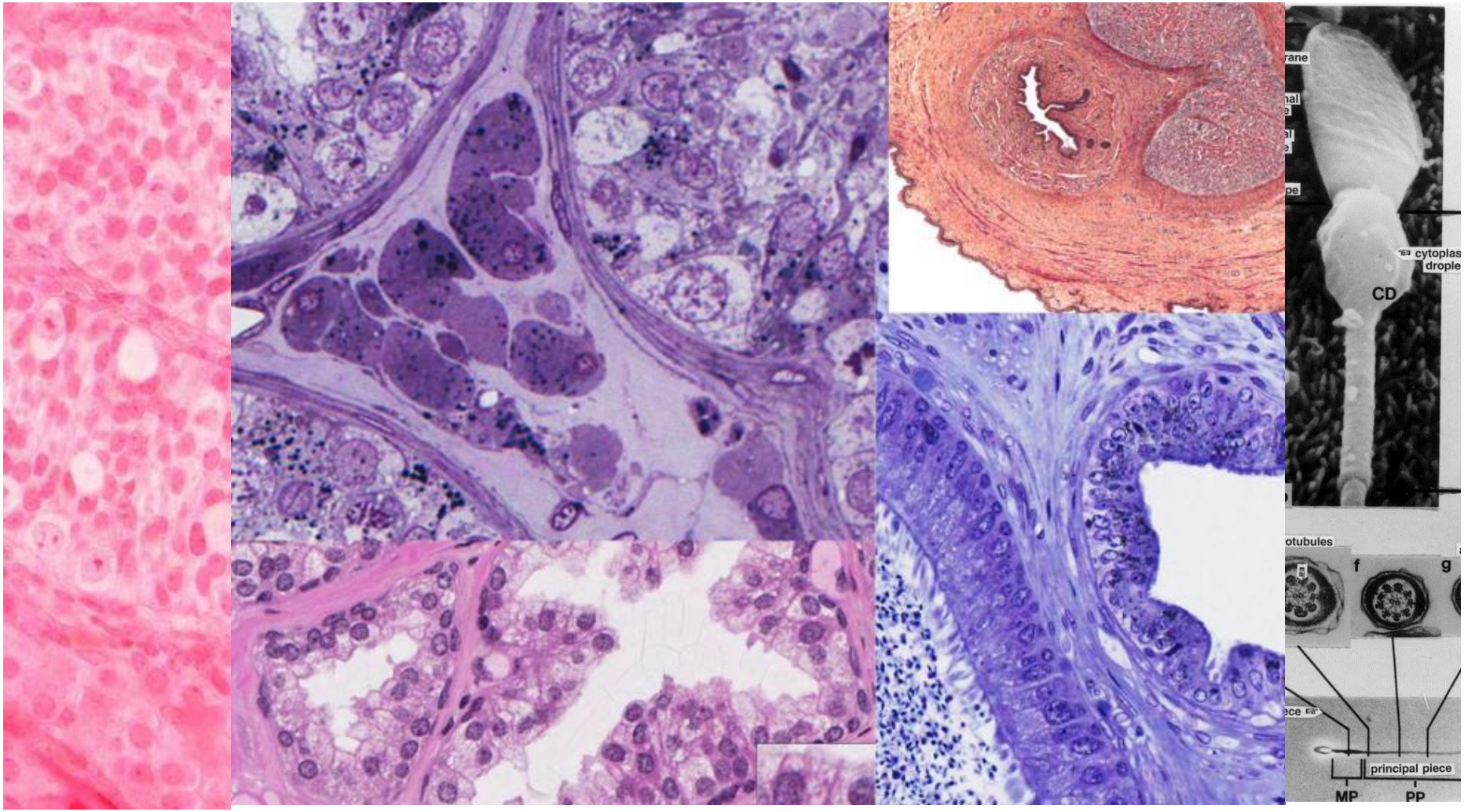
The end of

Male reproductive system: Part 1 Spermatogenesis



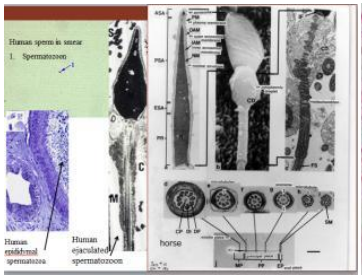
Dr. Larry Johnson Texas A&M University

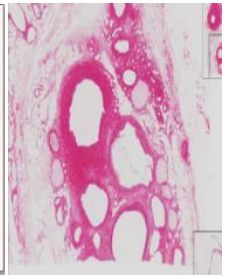
Male reproductive system: Part 2 Excurrent ducts



Dr. Larry Johnson Texas A&M University

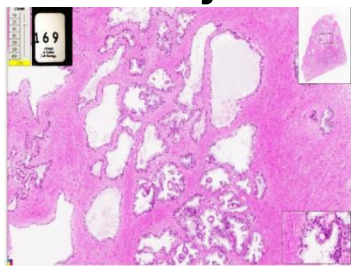
Part 2 Excurrent ducts Objectives

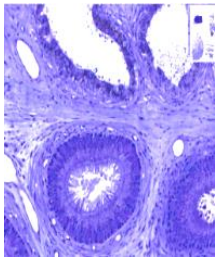


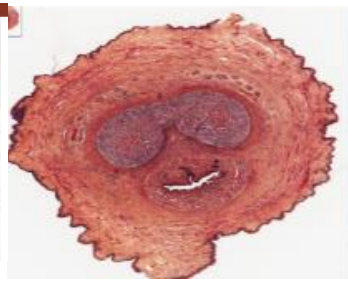


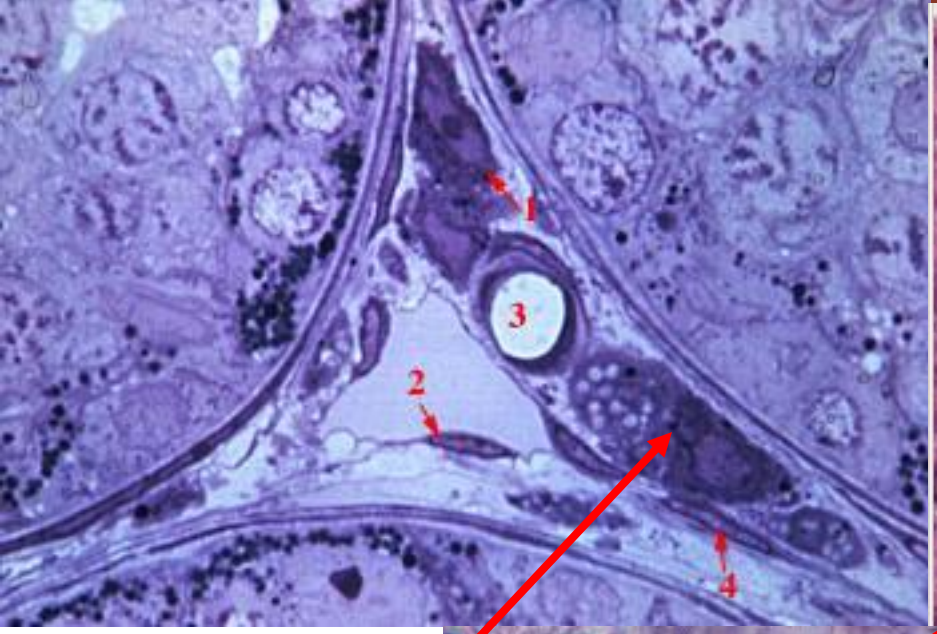
- Identify the endocrine and exocrine subdivisions of the testes?
- Distinguish the cells of the spermatogenic cell lineage.
- Identify and distinguish among epididymis, vas deferens, urethra, seminal vesicles and the prostate gland.
- Describe the structure of the penis and indicate how it becomes tumescent.

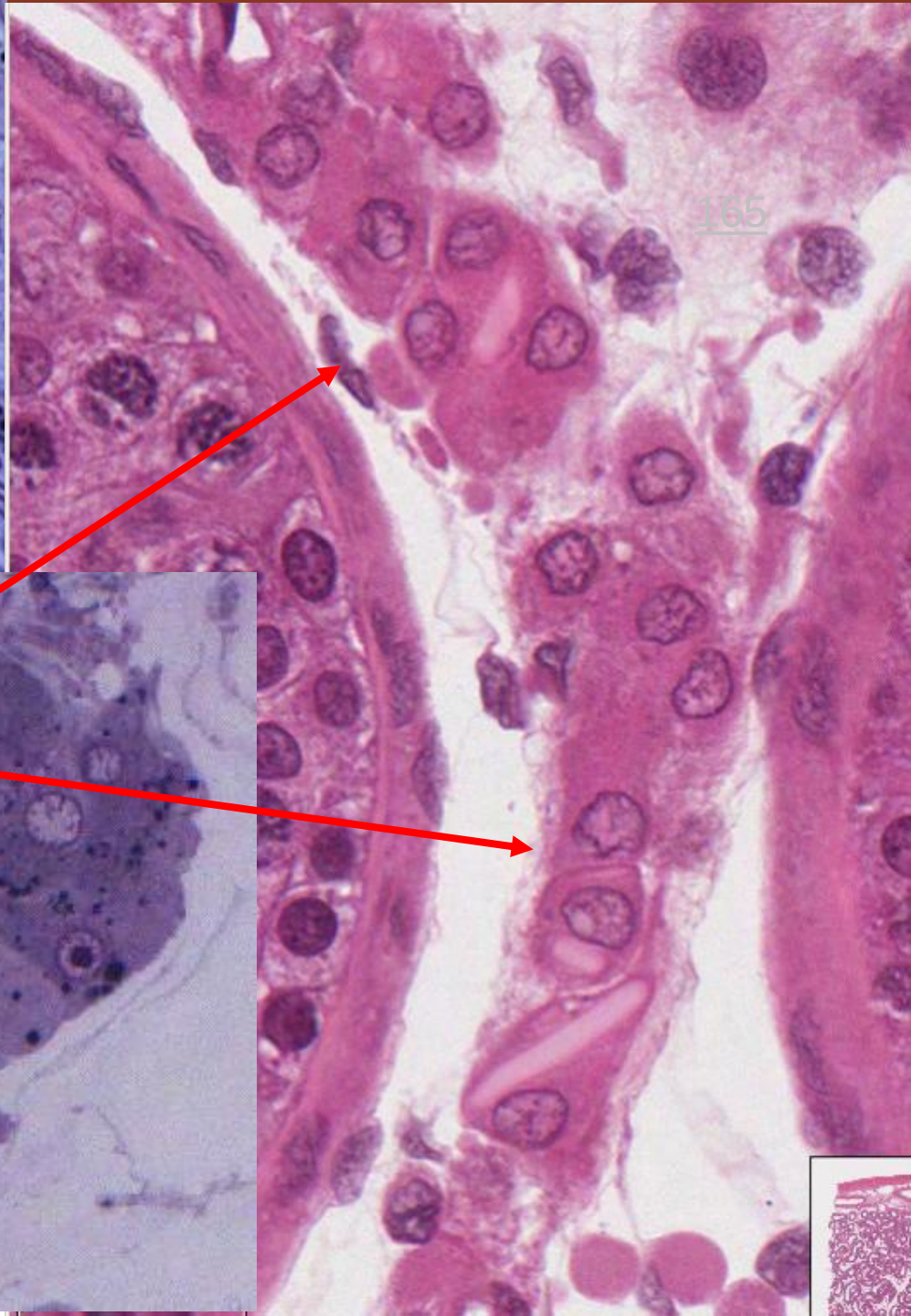
<u>Outline</u> secretions into the excurrent ducts, pathway of the ducts, epididymal maturation of spermatozoa and follow with characteristics of a fertile ejaculate, erection mechanisms, and clinical correlations.











Interstitium (monkey)

1. Leydig cell
2. Endothelial cell of lymph vessel
3. Blood vessel
4. Fibroblast

intact

Hormonal control of height of epithelium seminal vesicles

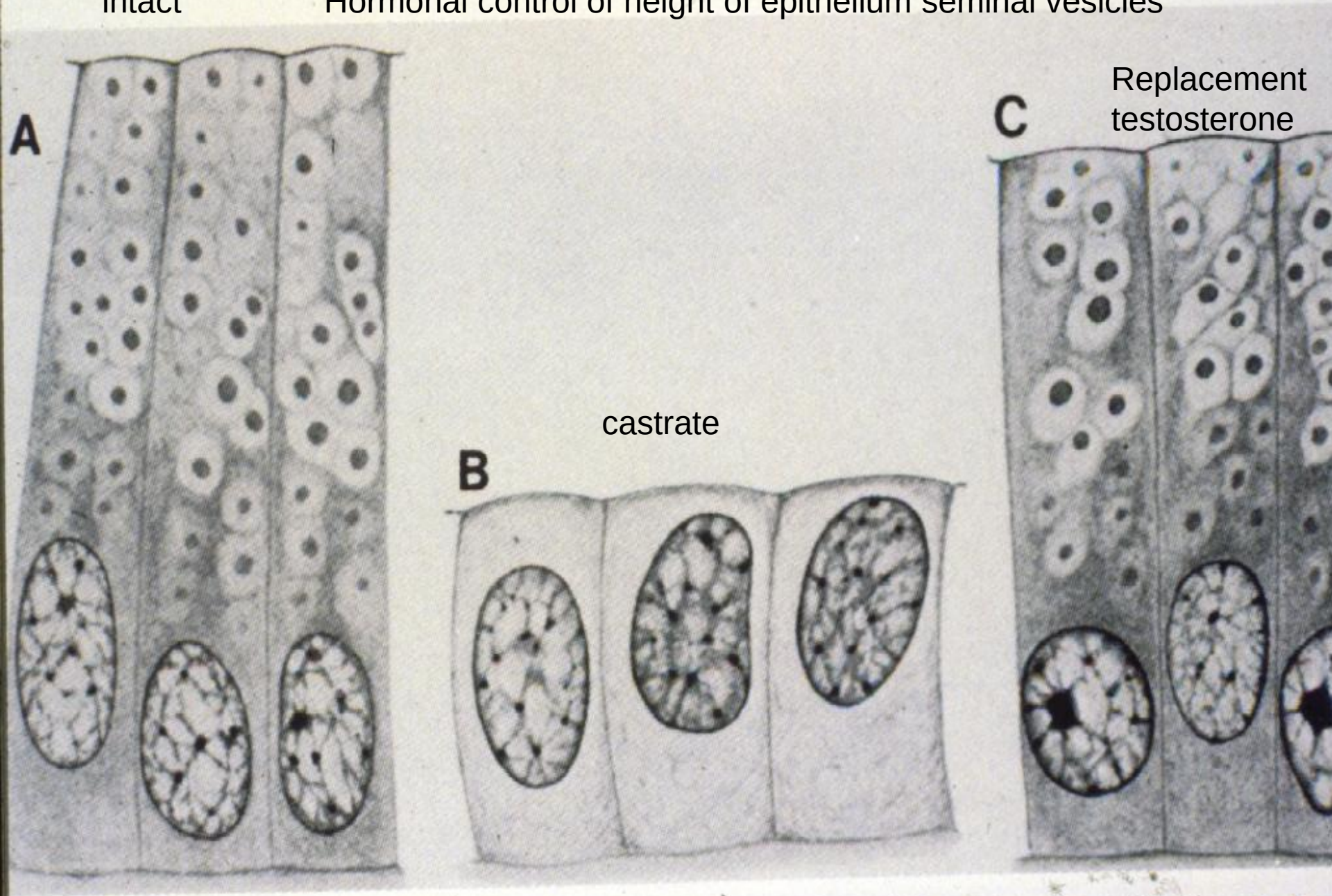
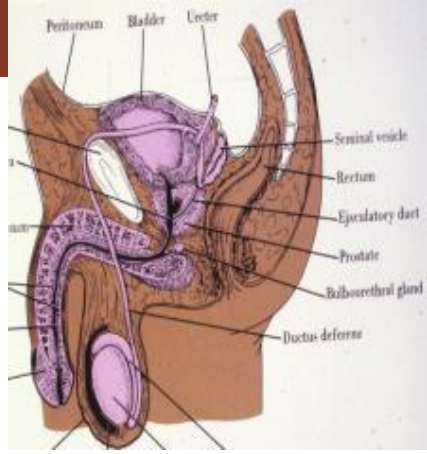


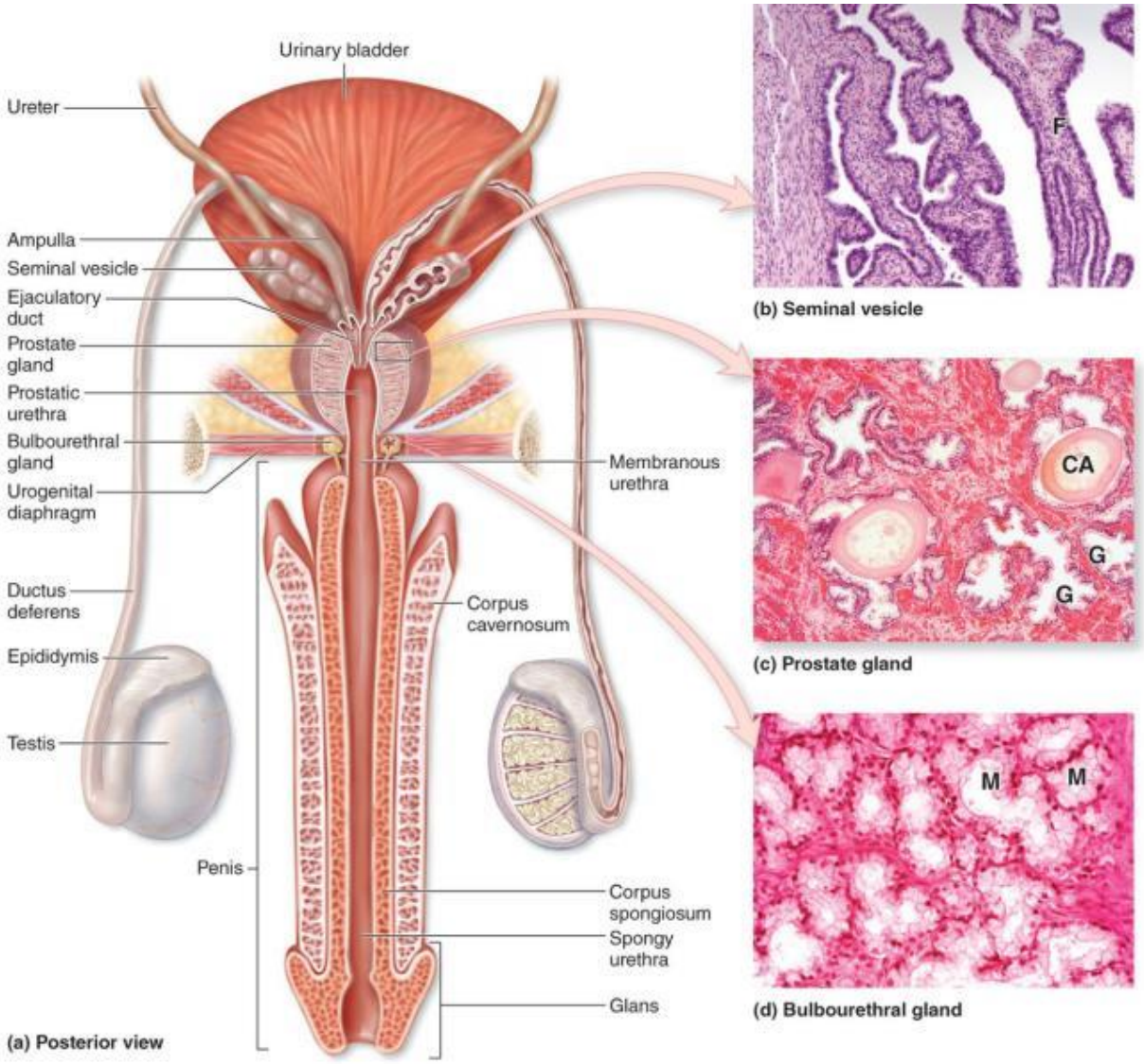
Fig. 27.22 Drawings illustrating the effect of androgen on the lining epithelium of the seminal ve

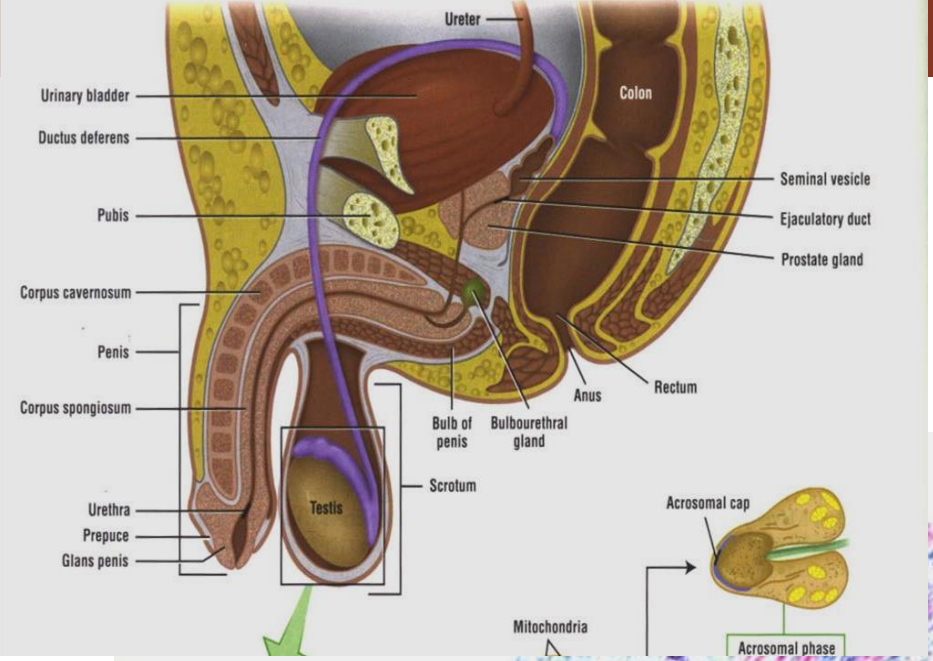
ACCESSORY GLANDS - COMPOSITION AND SECRETION

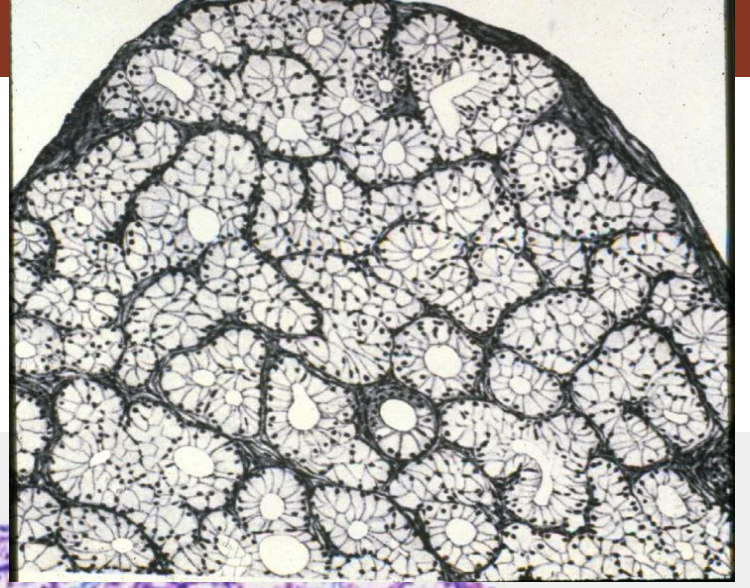


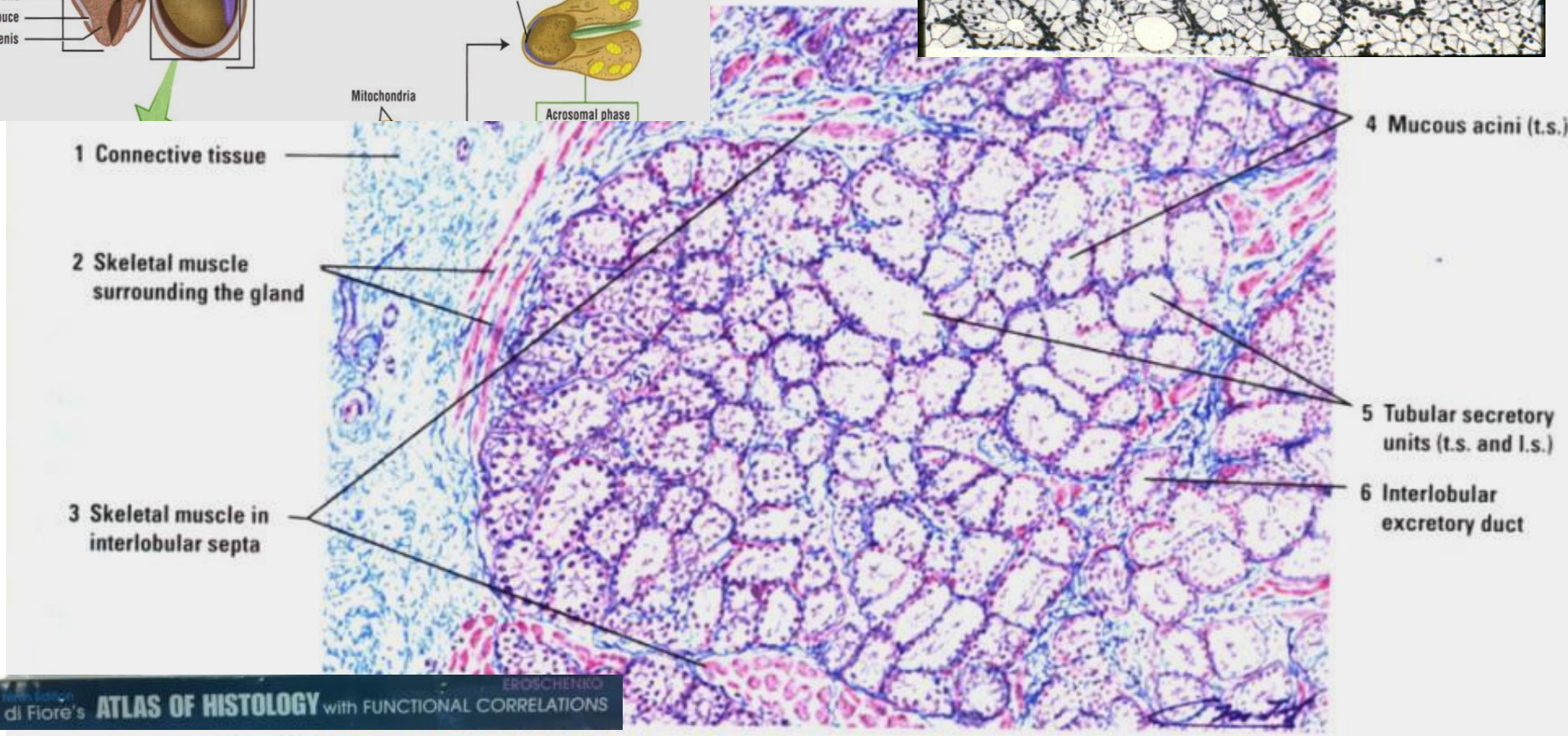
ACCESSORY GLANDS	SECRETION
SEMINAL VESICLES	FRUCTOSE FIBRINOGEN
PROSTATE	CITRATE FIBRINOLYSIN
BULBOURETHRAL GLAND	MUCUS-LIKE LUBRICANT
GLANDS OF LITTRE	MUCUS

Accessory glands



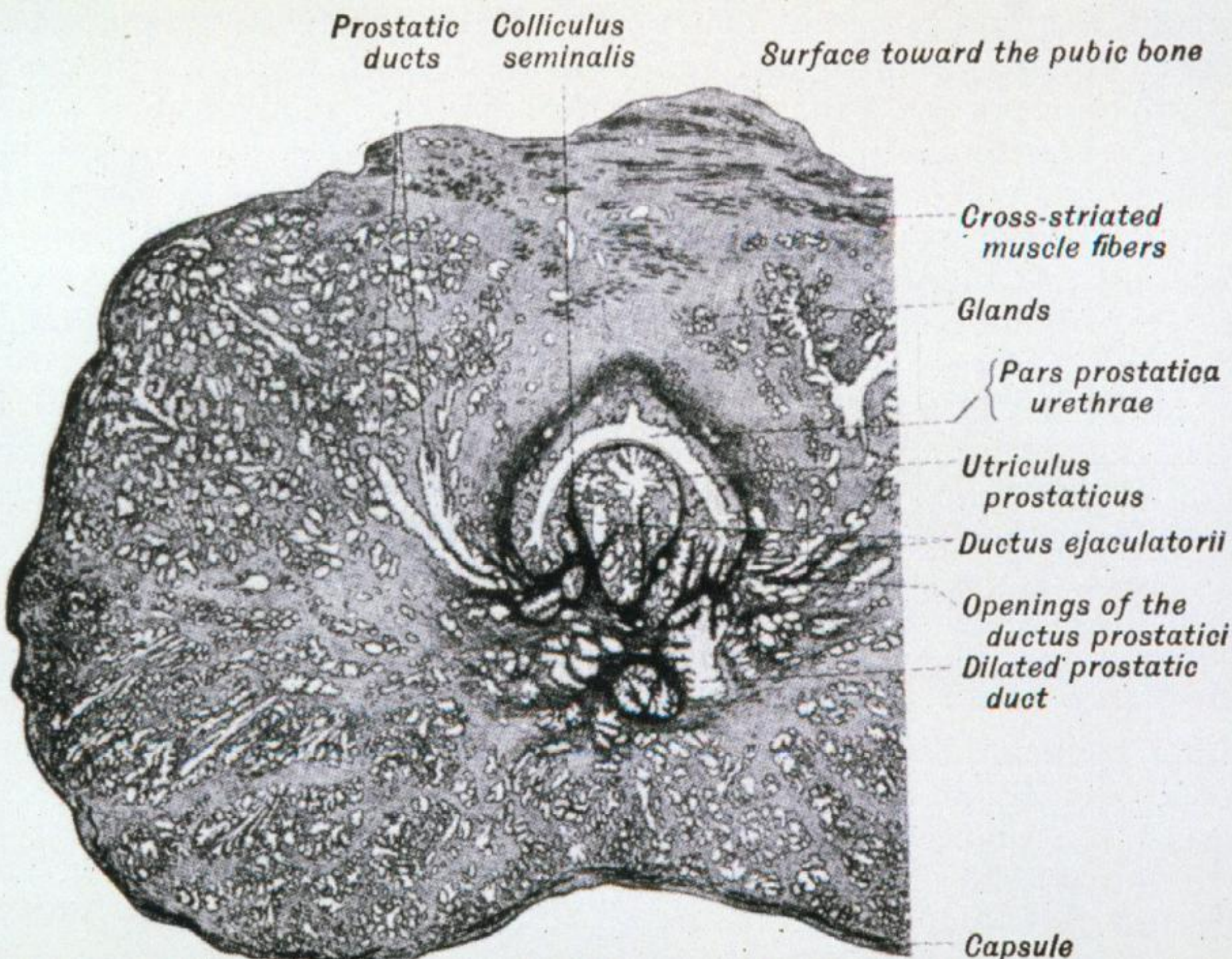


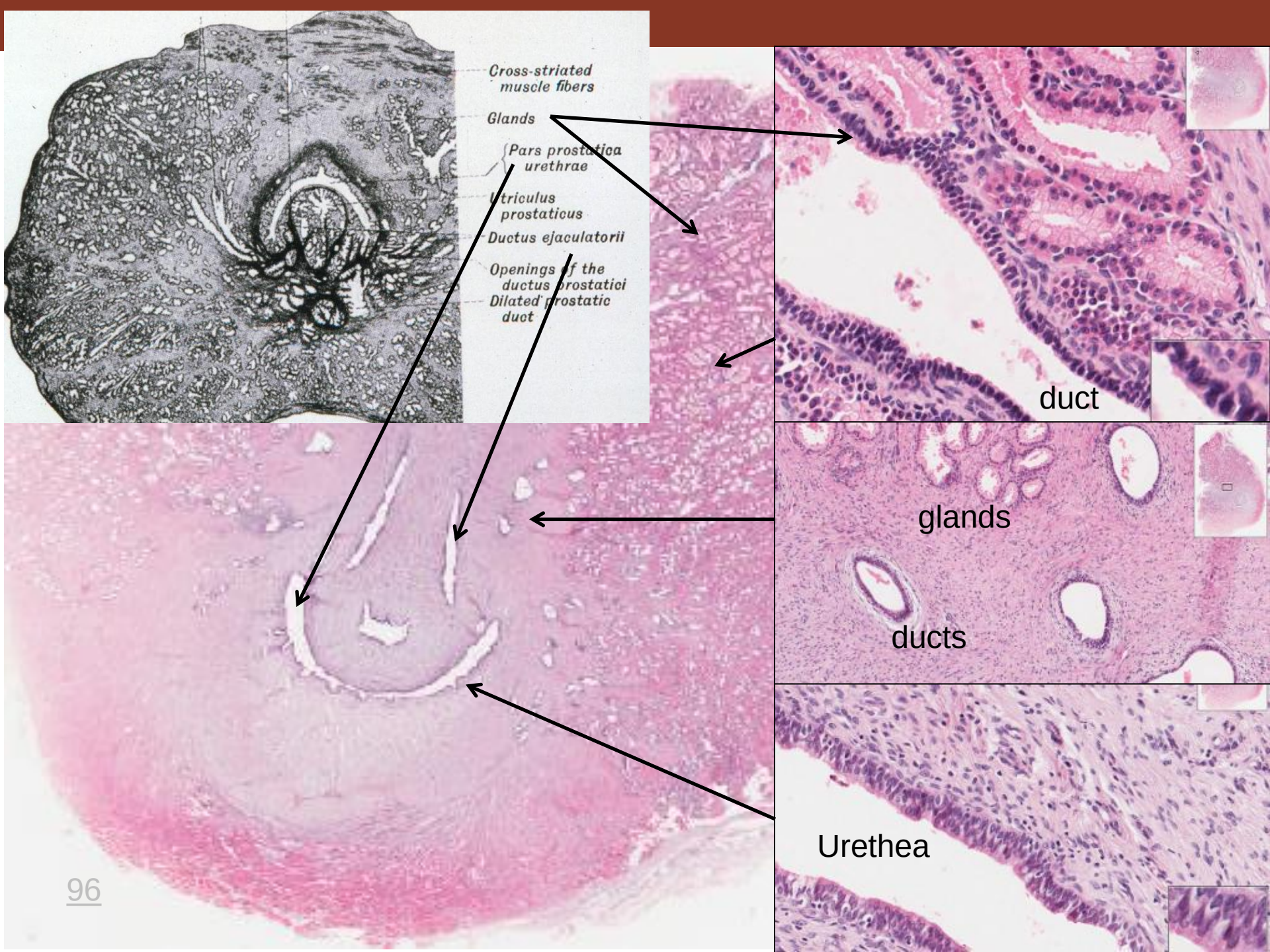




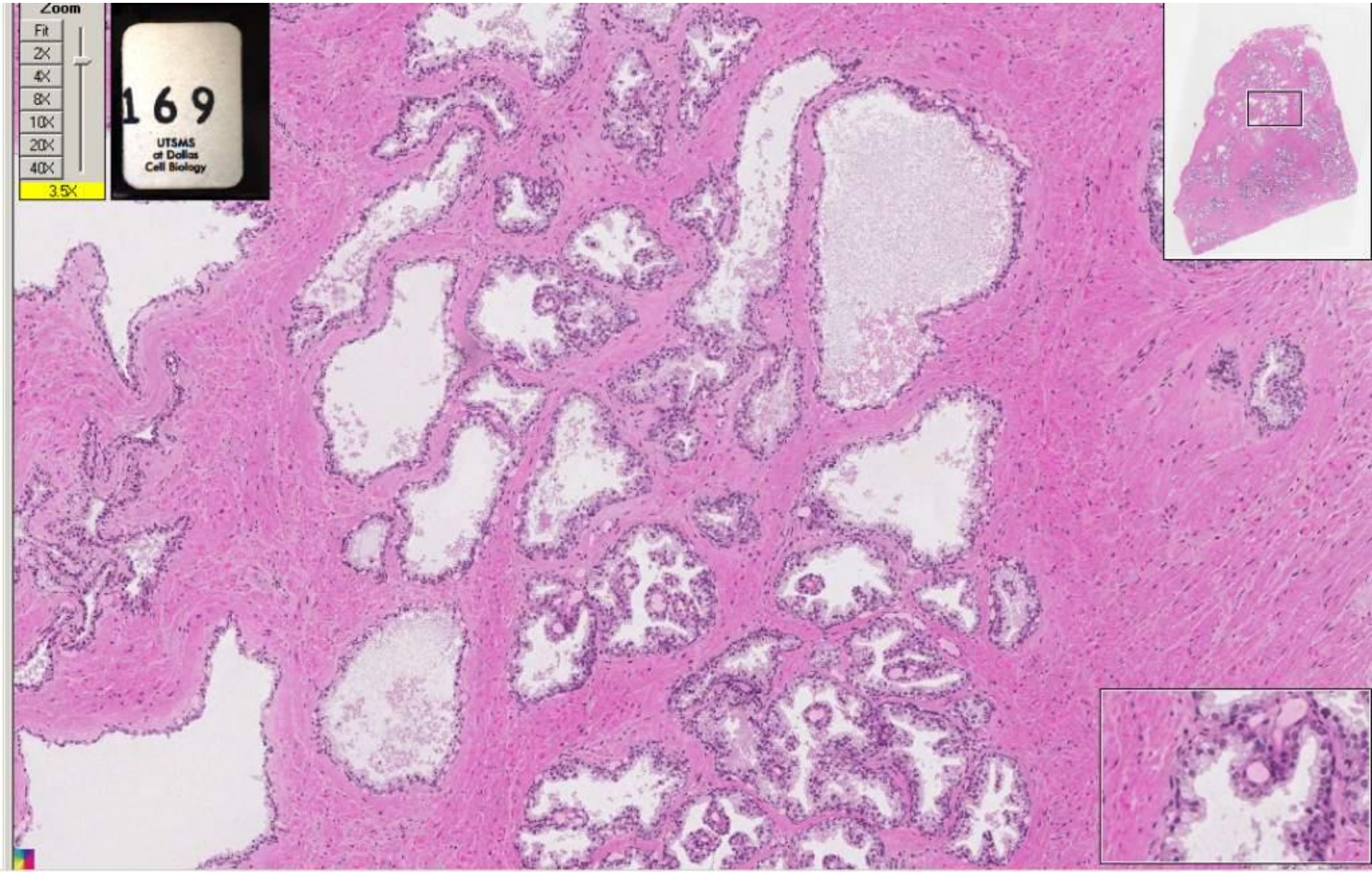
di Fiore's ATLAS OF HISTOLOGY with FUNCTIONAL CORRELATIONS

Fig. 17-12 Bulbourethral Gland (sectional view). Stain: Masson's. High magnification.

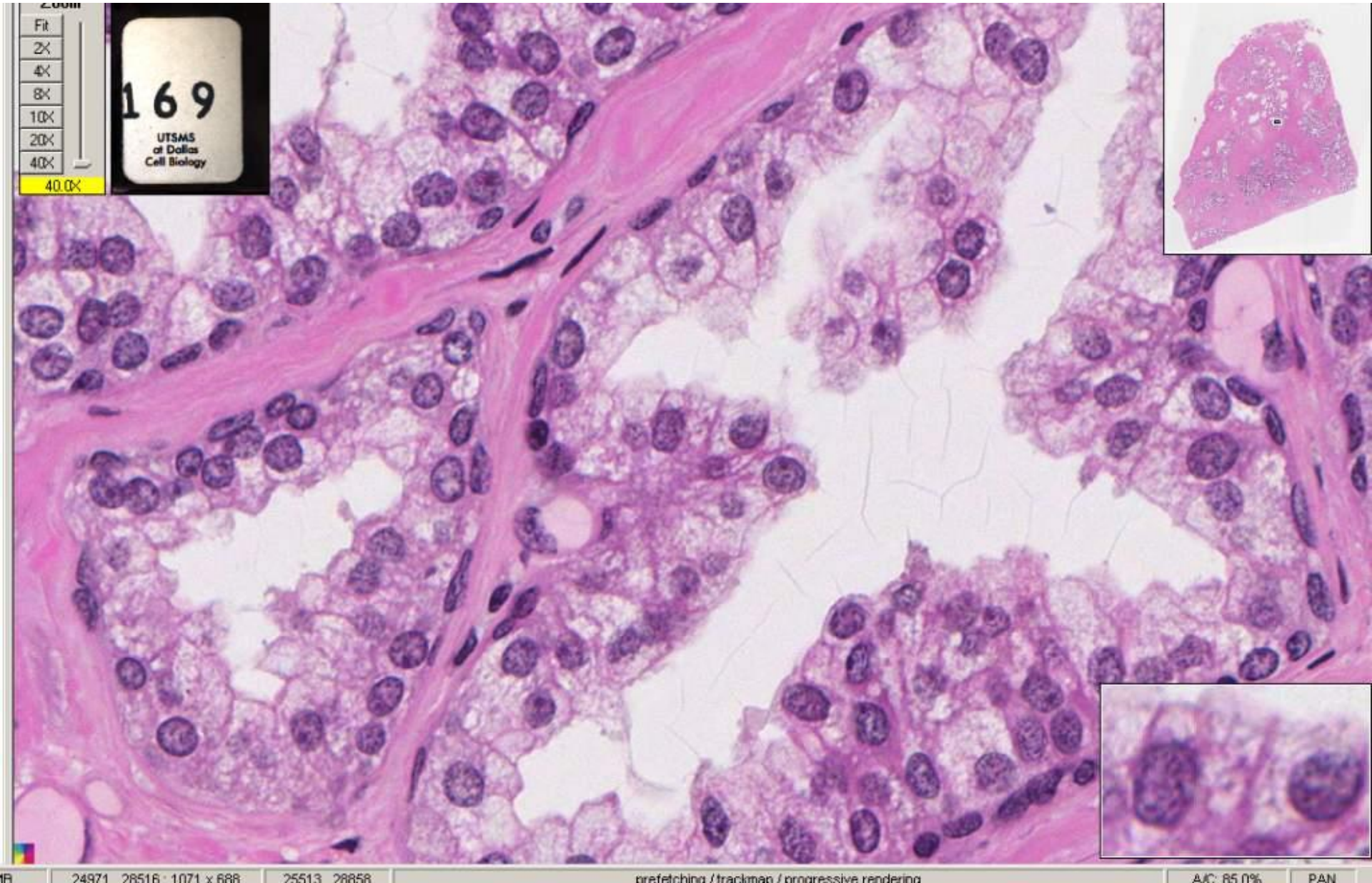

Prostatic ducts
Colliculus seminalis
Surface toward the pubic bone
Cross-striated muscle fibers
Glands
Pars prostatica urethrae
Utriculus prostaticus
Ductus ejaculatorii
Openings of the ductus prostatici
Dilated prostatic duct
Capsule

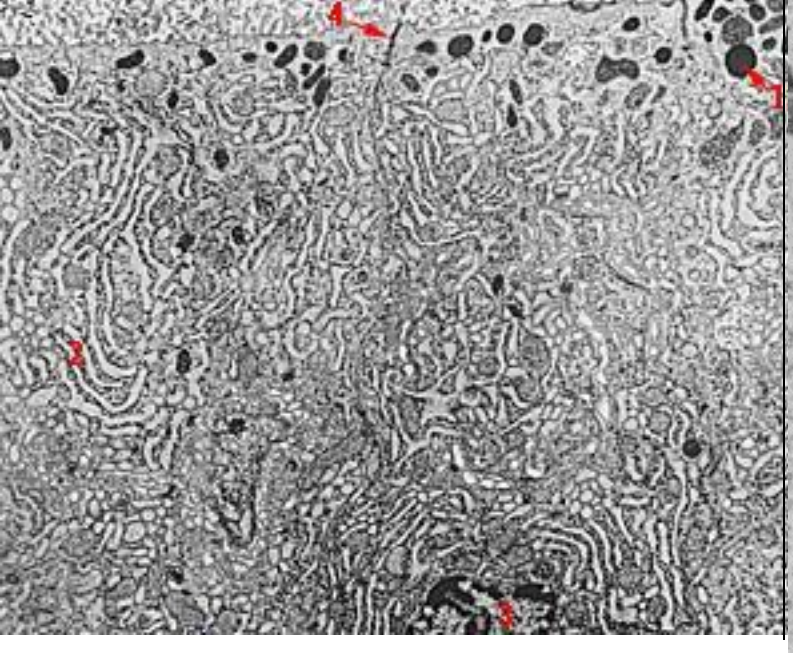

Cross-striated muscle fibers
Glands
Pars prostatica urethrae
Utriculus prostaticus
Ductus ejaculatorii
Openings of the ductus prostatici
Dilated prostatic duct
duct
glands
ducts
Urethea

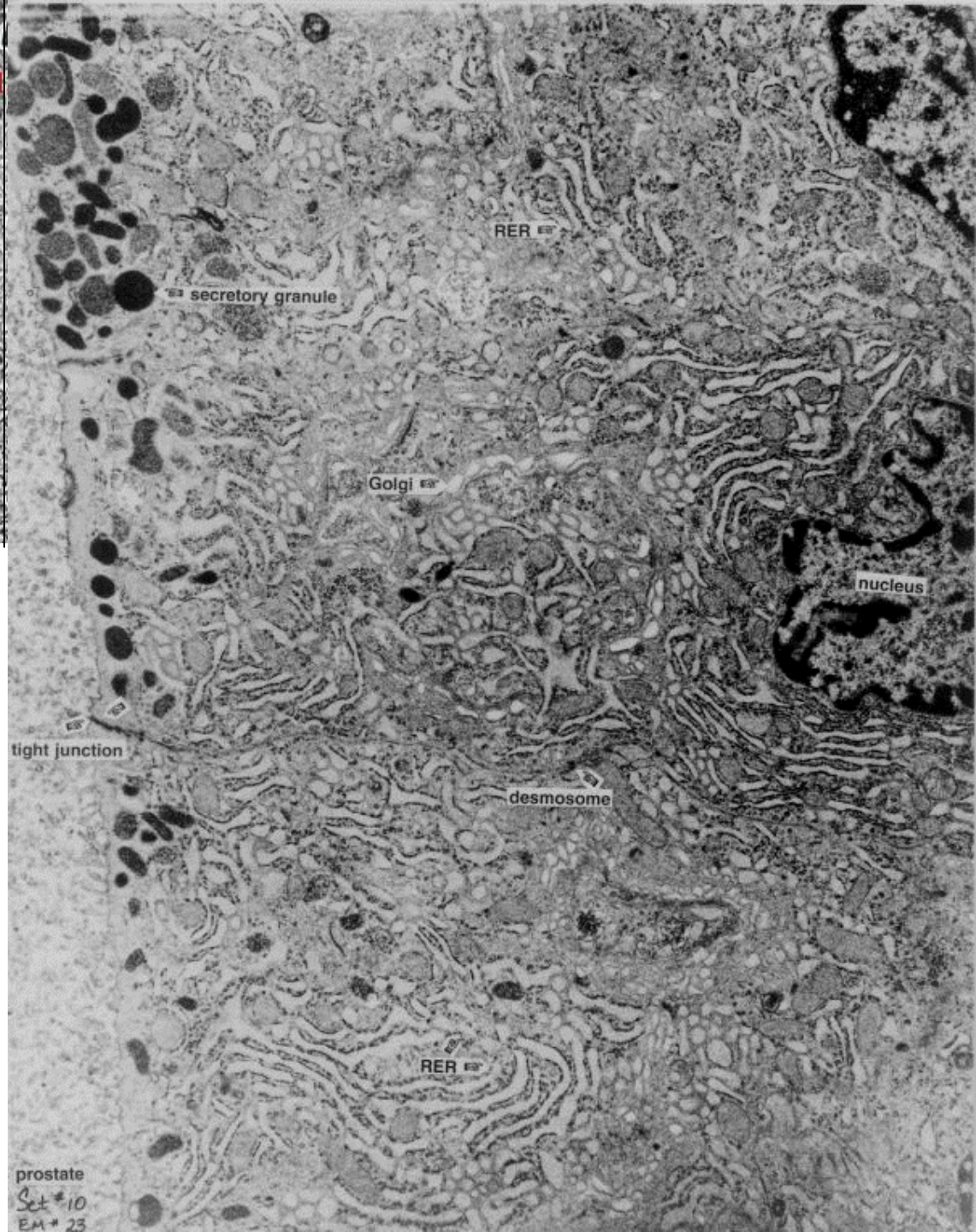
Prostate


Zoom
Fit
2X
4X
8X
10X
20X
40X
3.5X
169
UTSMS
at Dallas
Cell Biology

Prostate



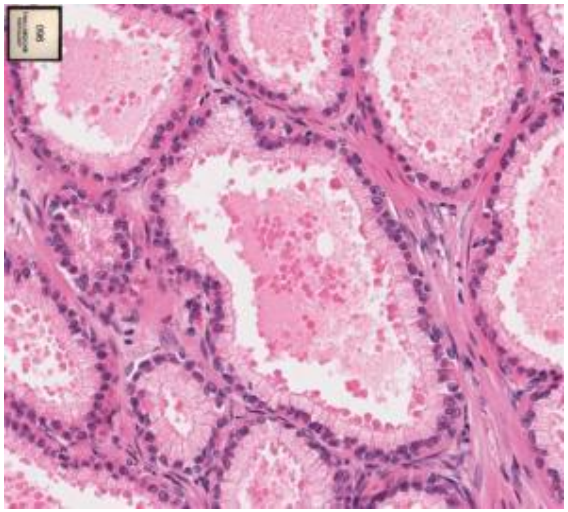




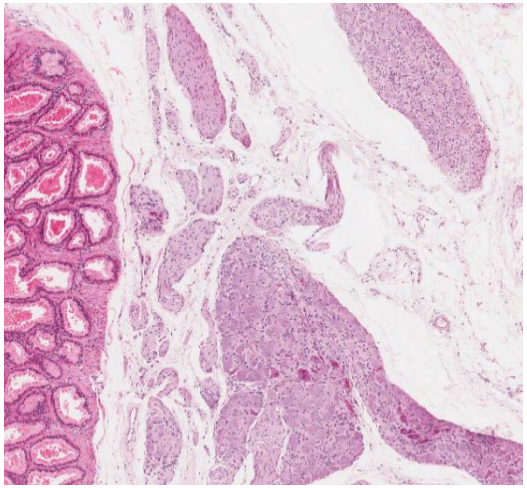
EM 23; prostate; 31 000x

1. Secretory granule
2. RER
3. Nucleus
4. Tight junction

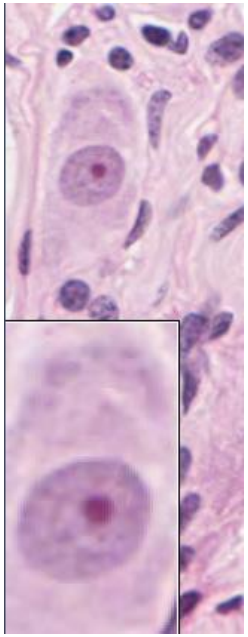
Slide 96: Prostate gland

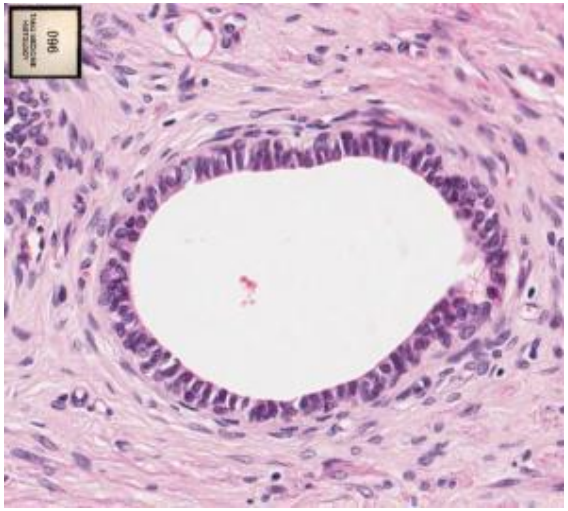


Tubulo-alveolar secretory units
with prostatic secretions

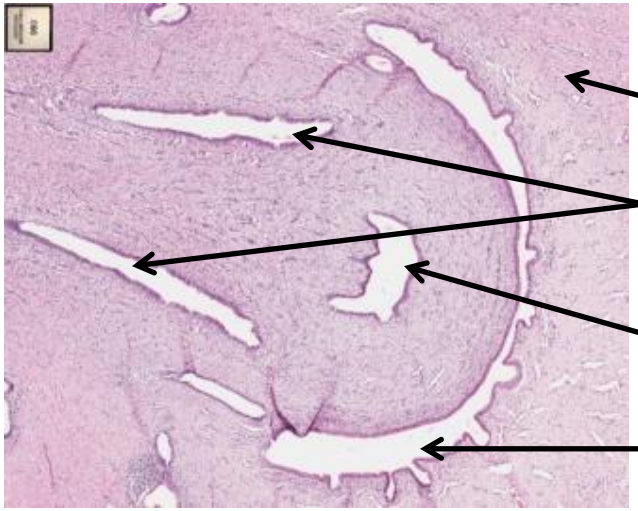


Large nerves and ganglia are
in surrounding CT

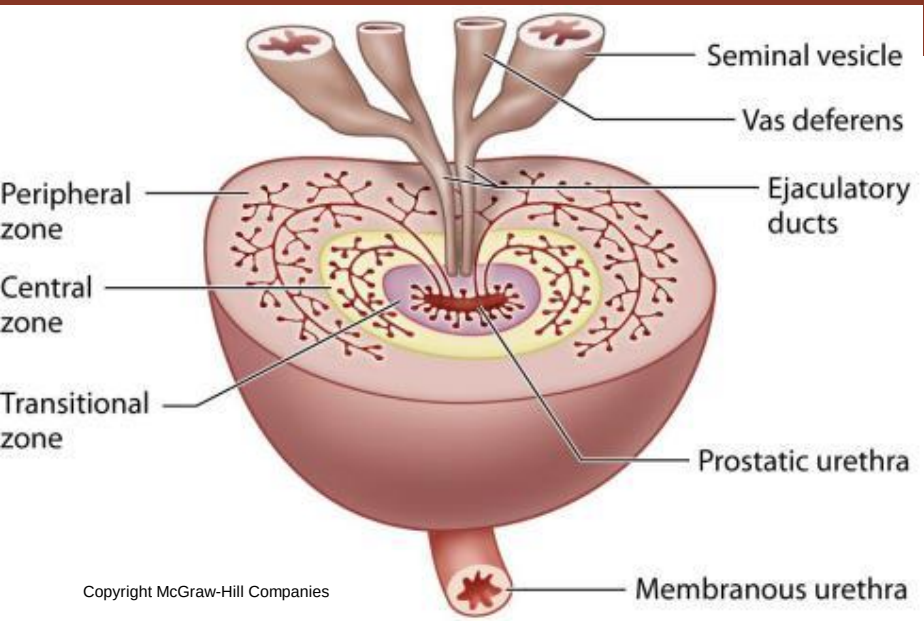


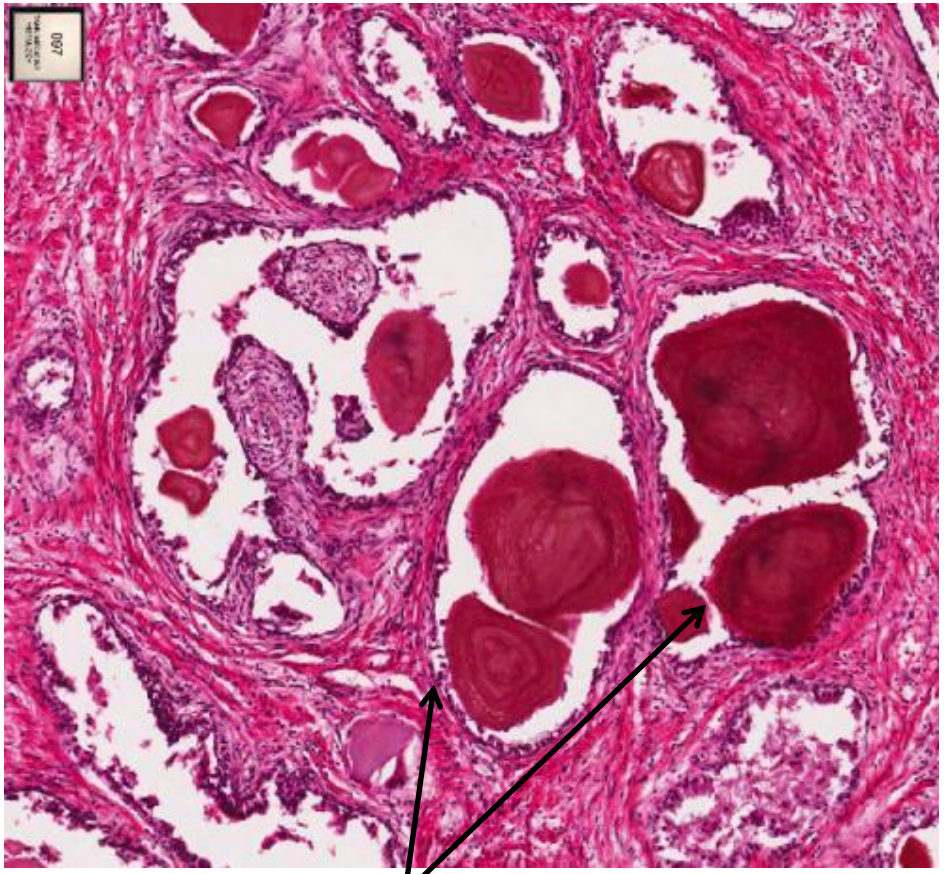


Prostatic gland duct

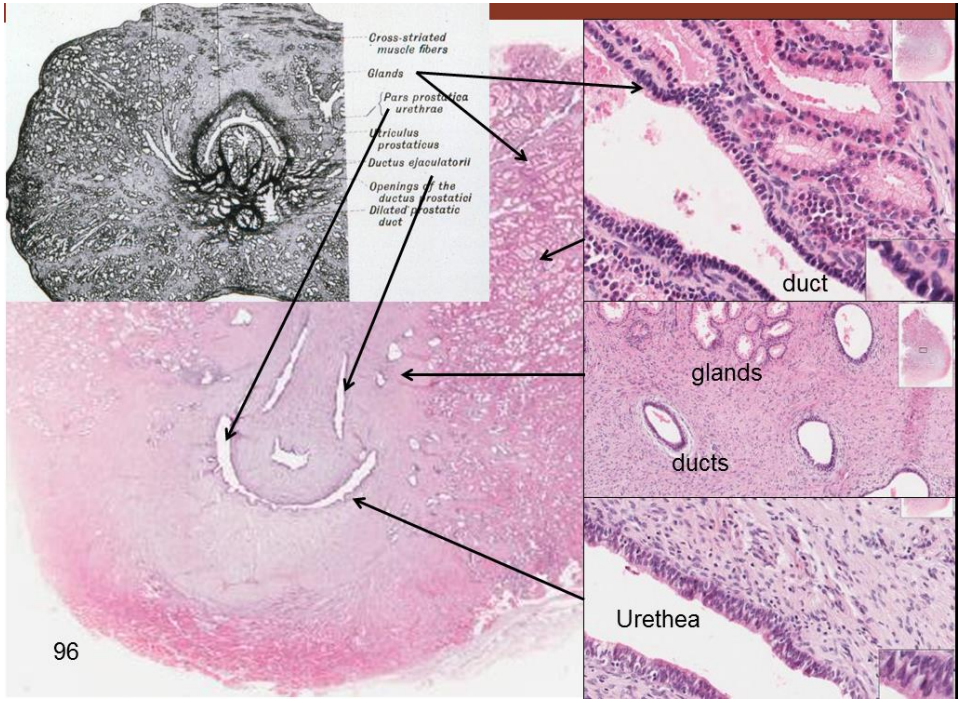


Slide 97: Prostate gland (with concretions)

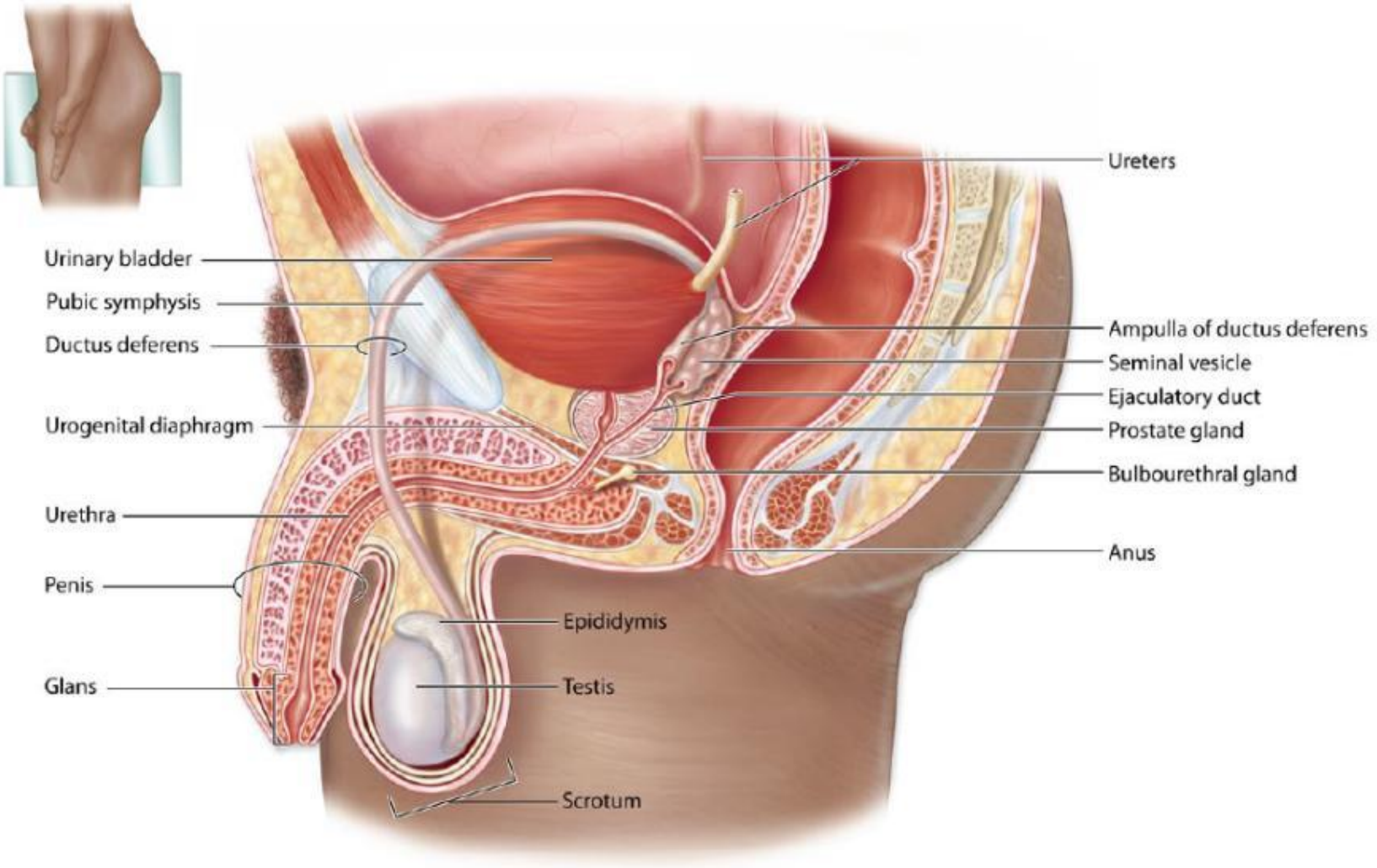


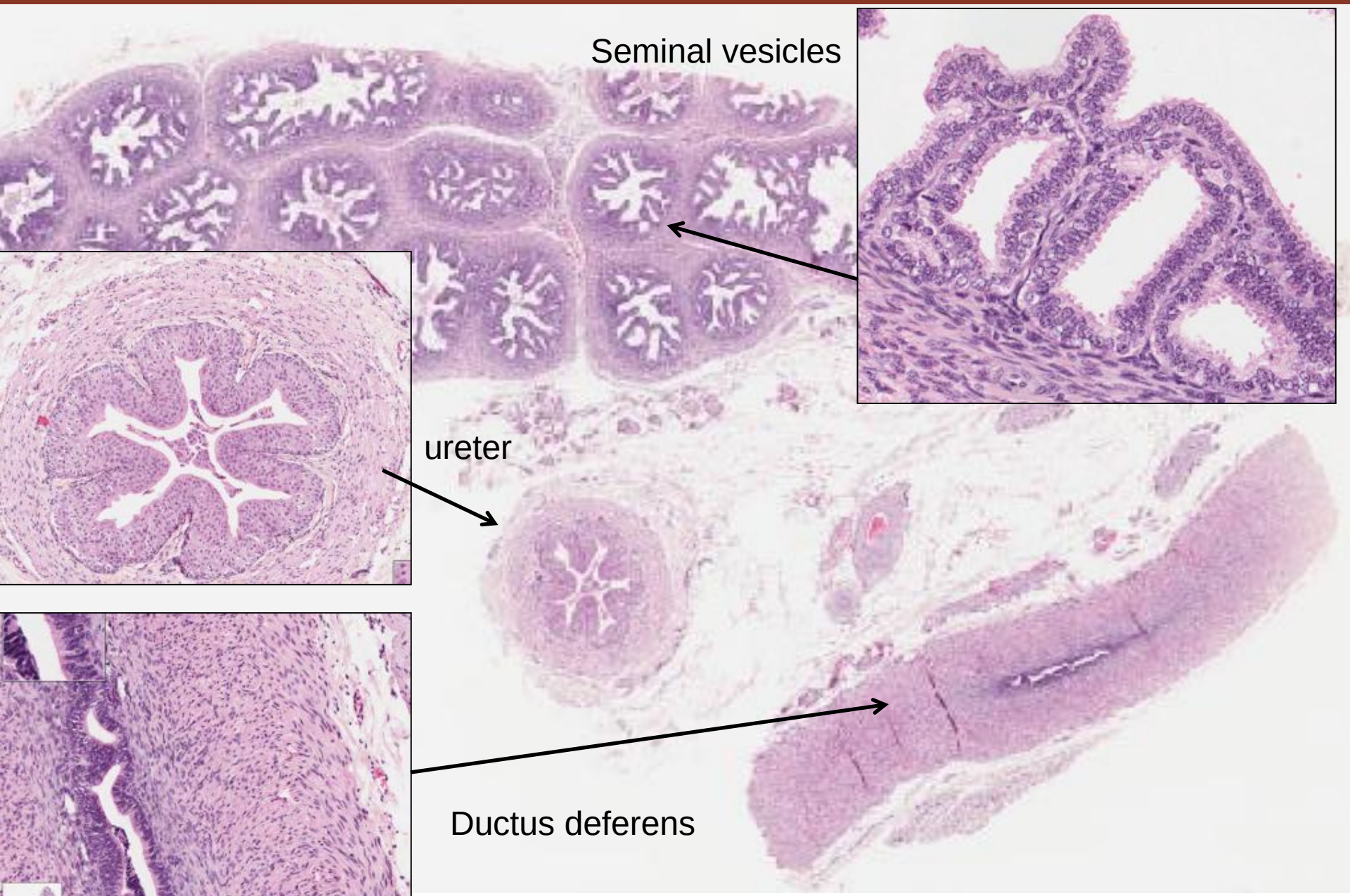


Prostatic concretions



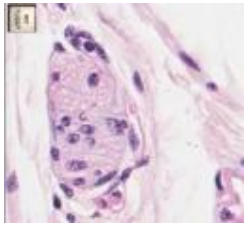
Male reproductive system



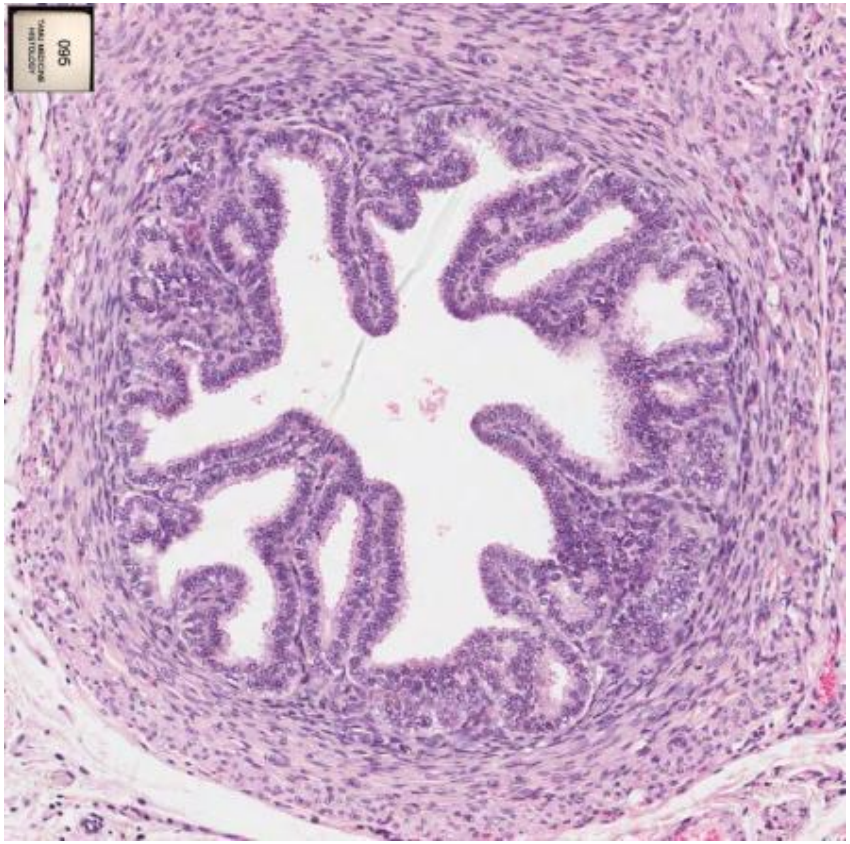


Slide 95: Seminal vesicle

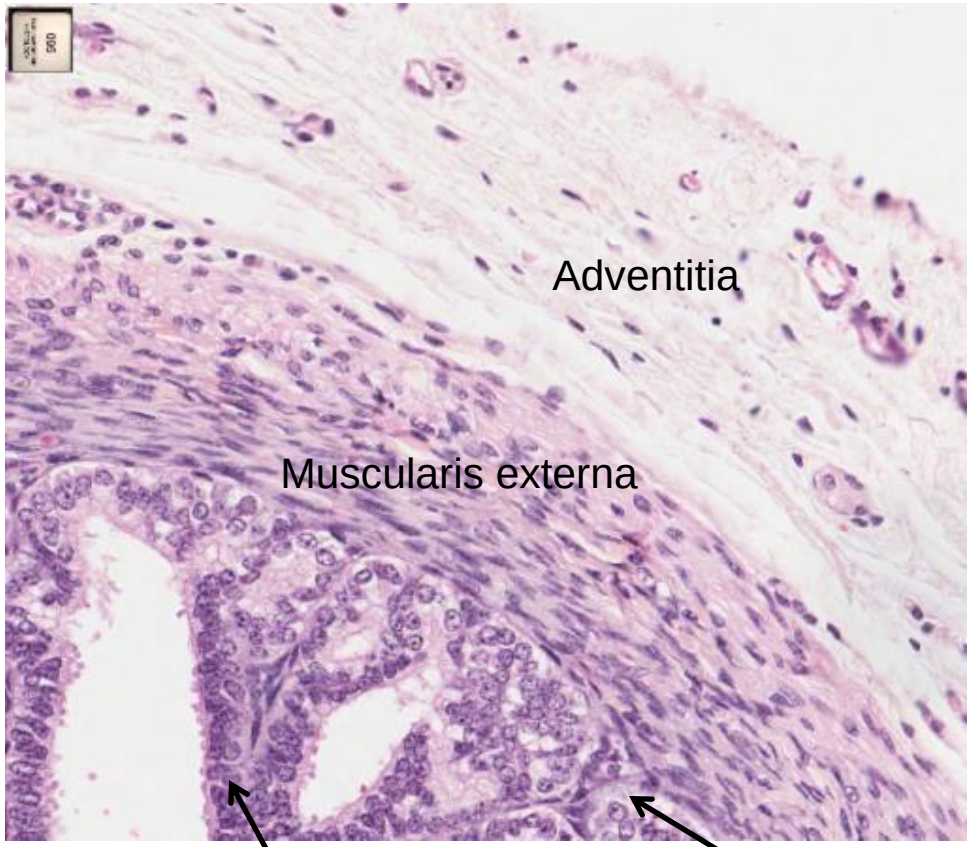
Slide 95: Seminal vesicle



Nerve in adventitia



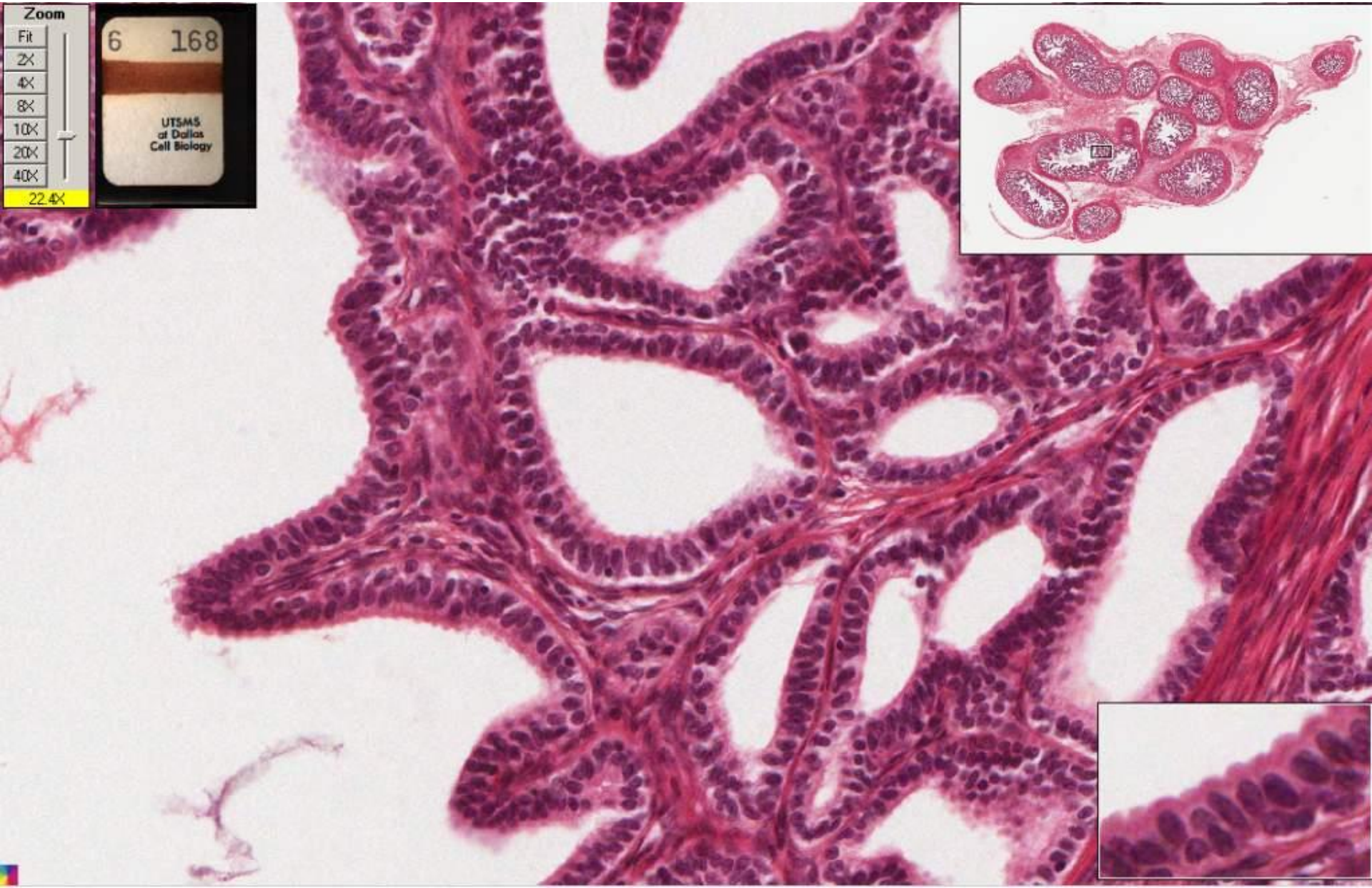
Seminal vesicle

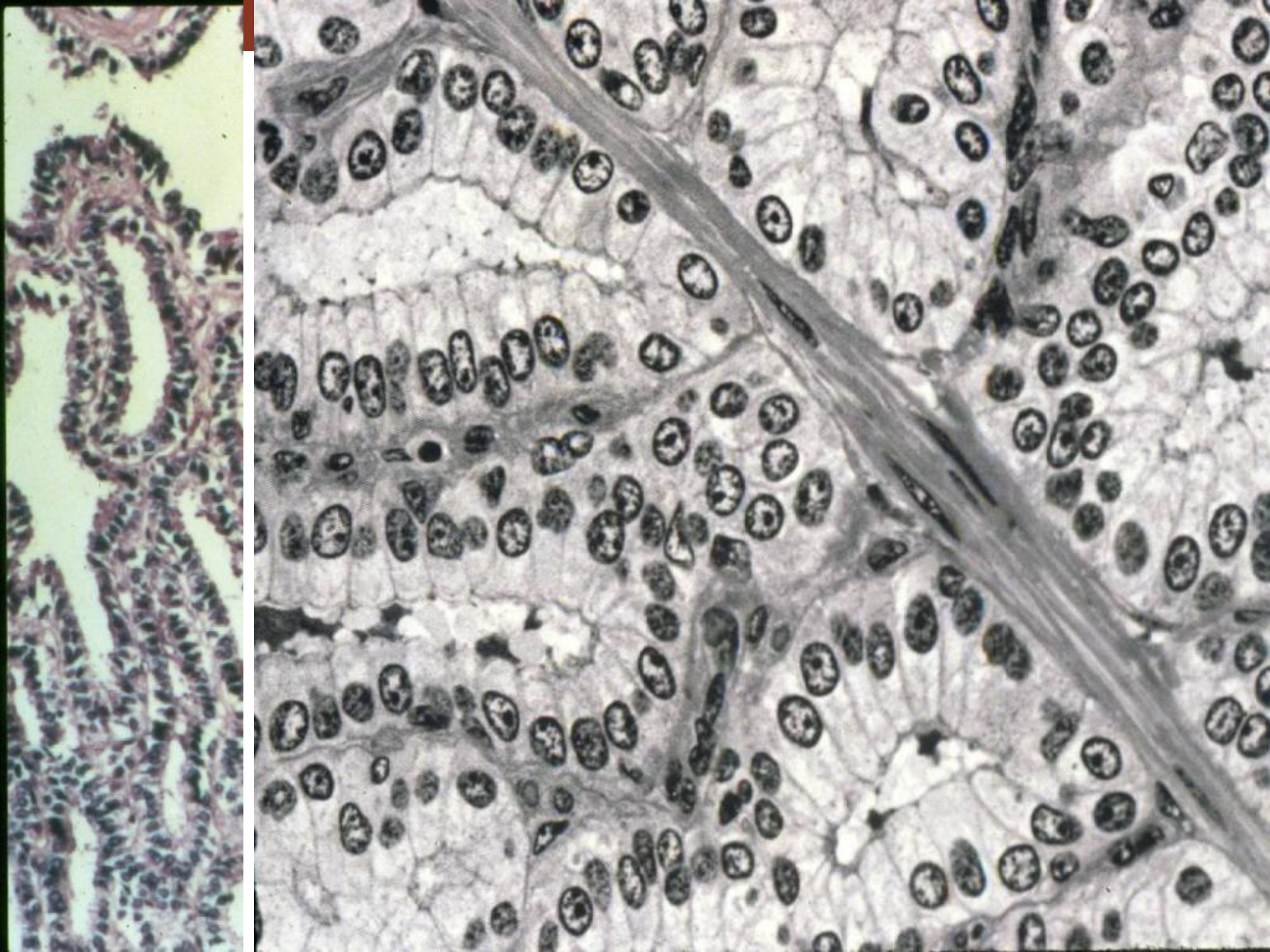


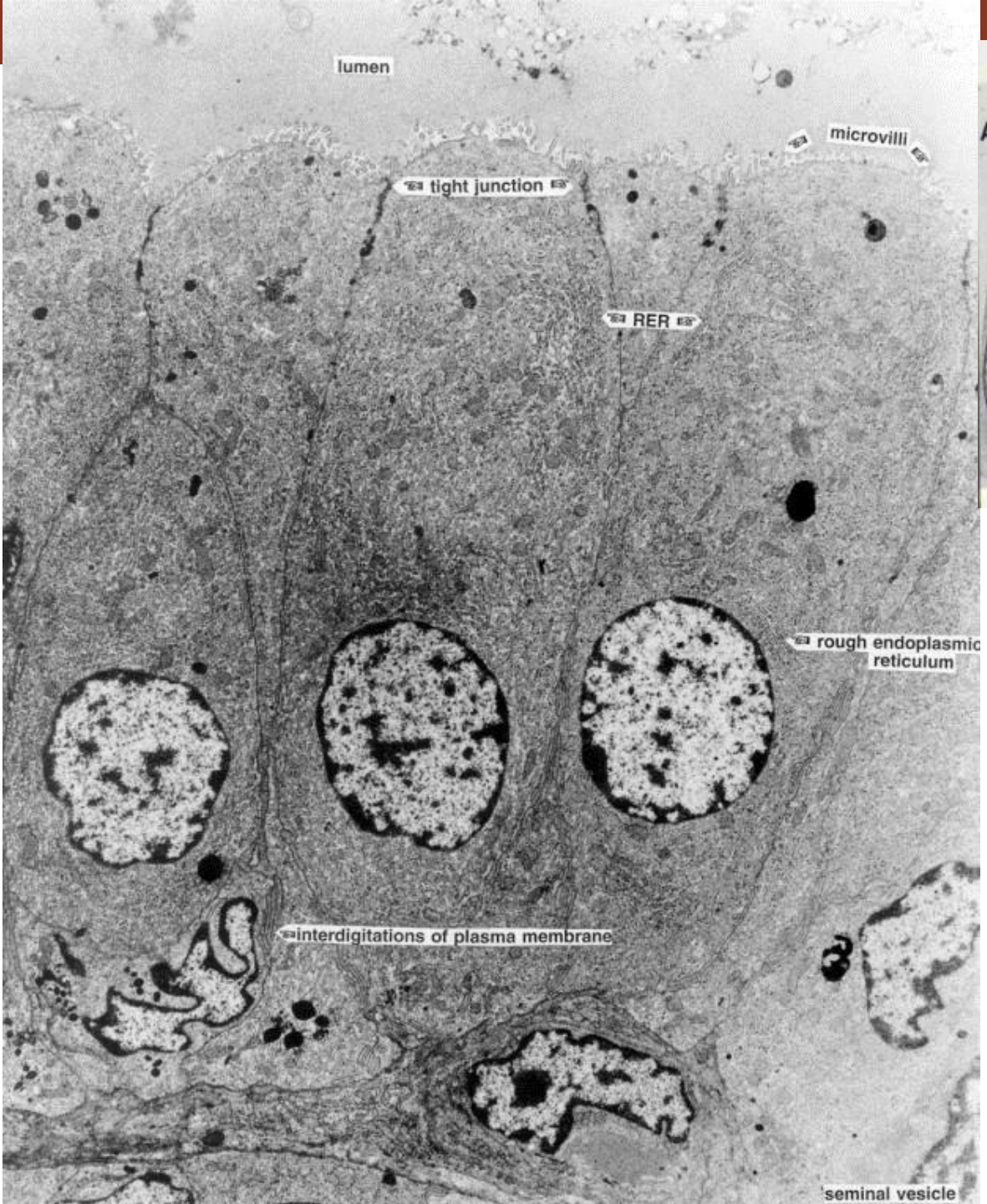
Columnar epithelium

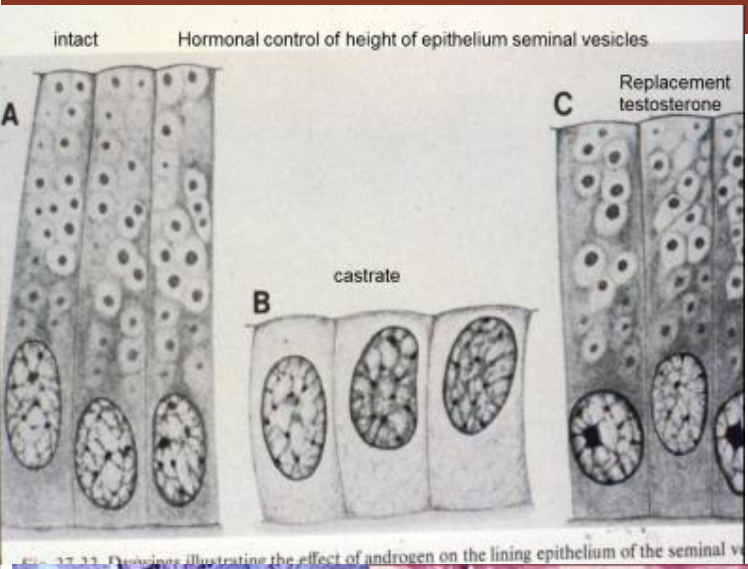
Lamina propria

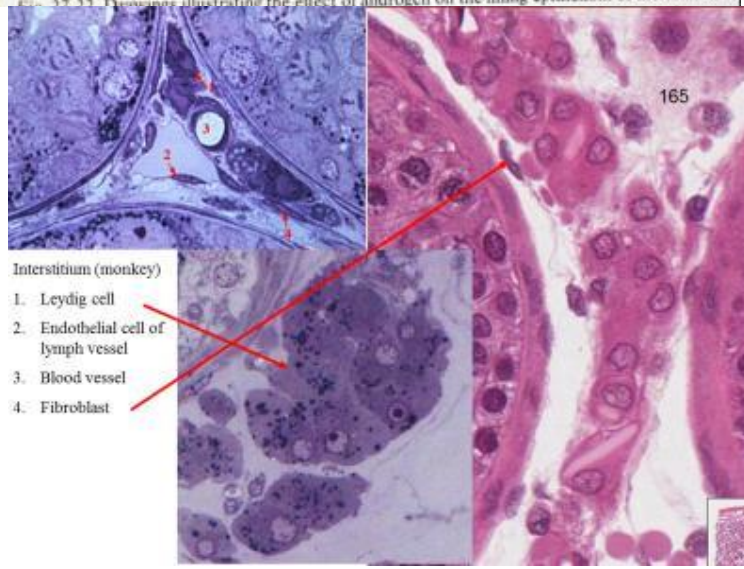
Seminal vesicle, monkey











Seminal vesicles

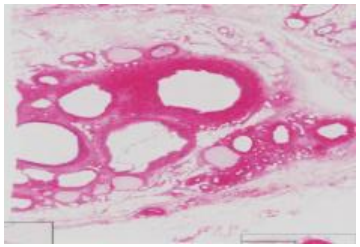
FUNCTIONAL PROPERTIES OF THE ACCESSORY GLANDS

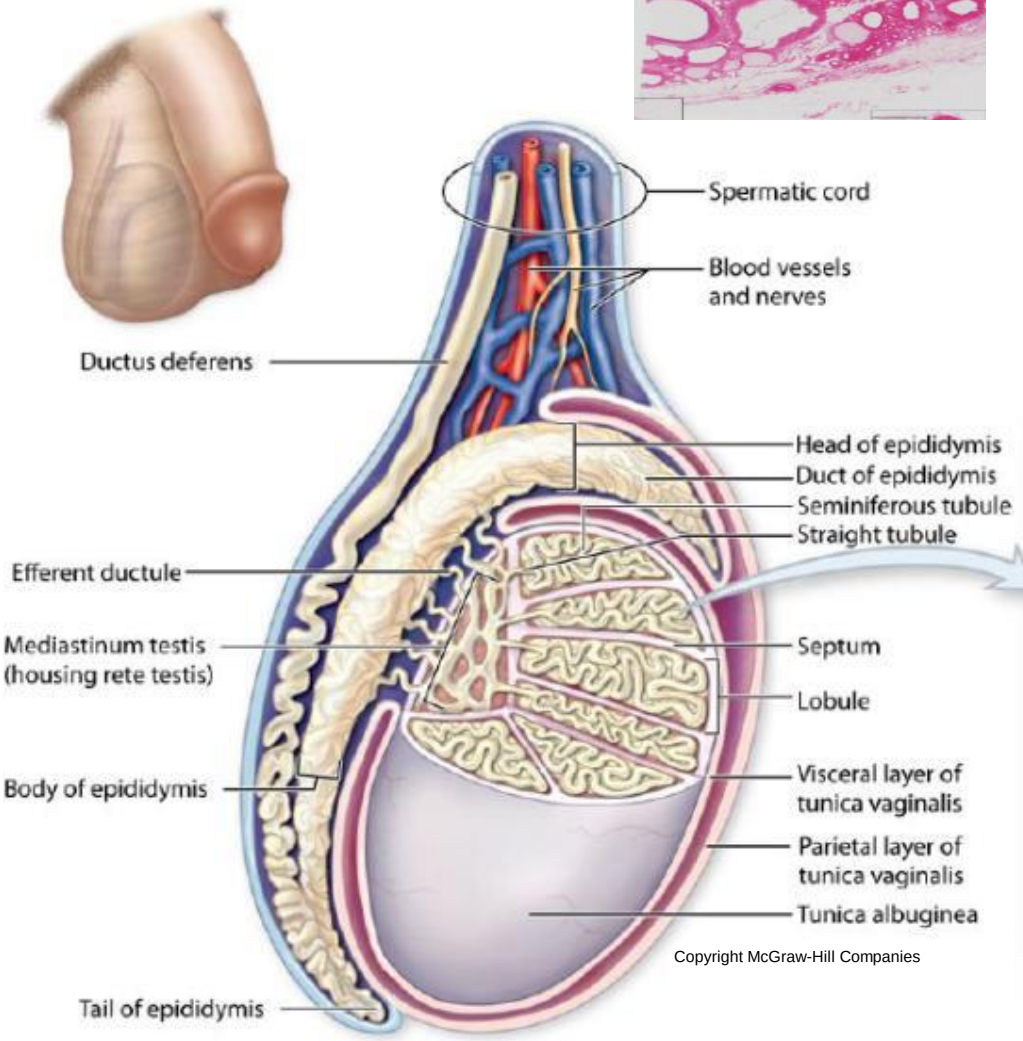
SPECIFIC CONTRIBUTIONS OF SEMINAL PLASMA AS MEASURED BY THE SPLIT EJACULATE METHOD

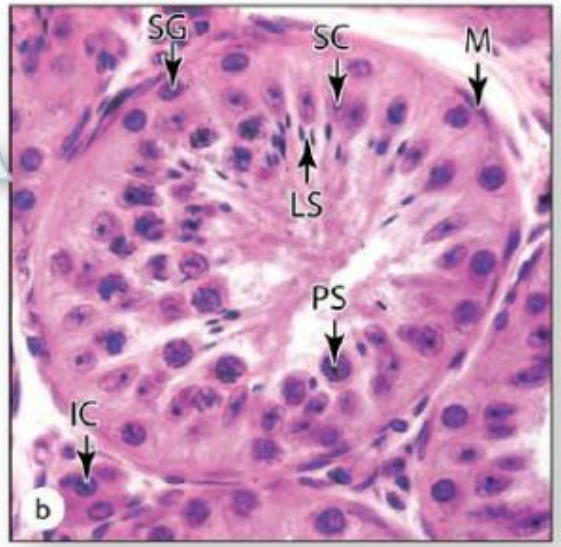
FRACTION of EJACULATE	CONTAINS	SOURCE
FIRST	90% OF ALL CITRATE	PROSTATE
	90% OF ALL SPERM	DUCTUS DEFERENS
LAST	90% OF ALL FRUCTOSE	SEMINAL VESICLES

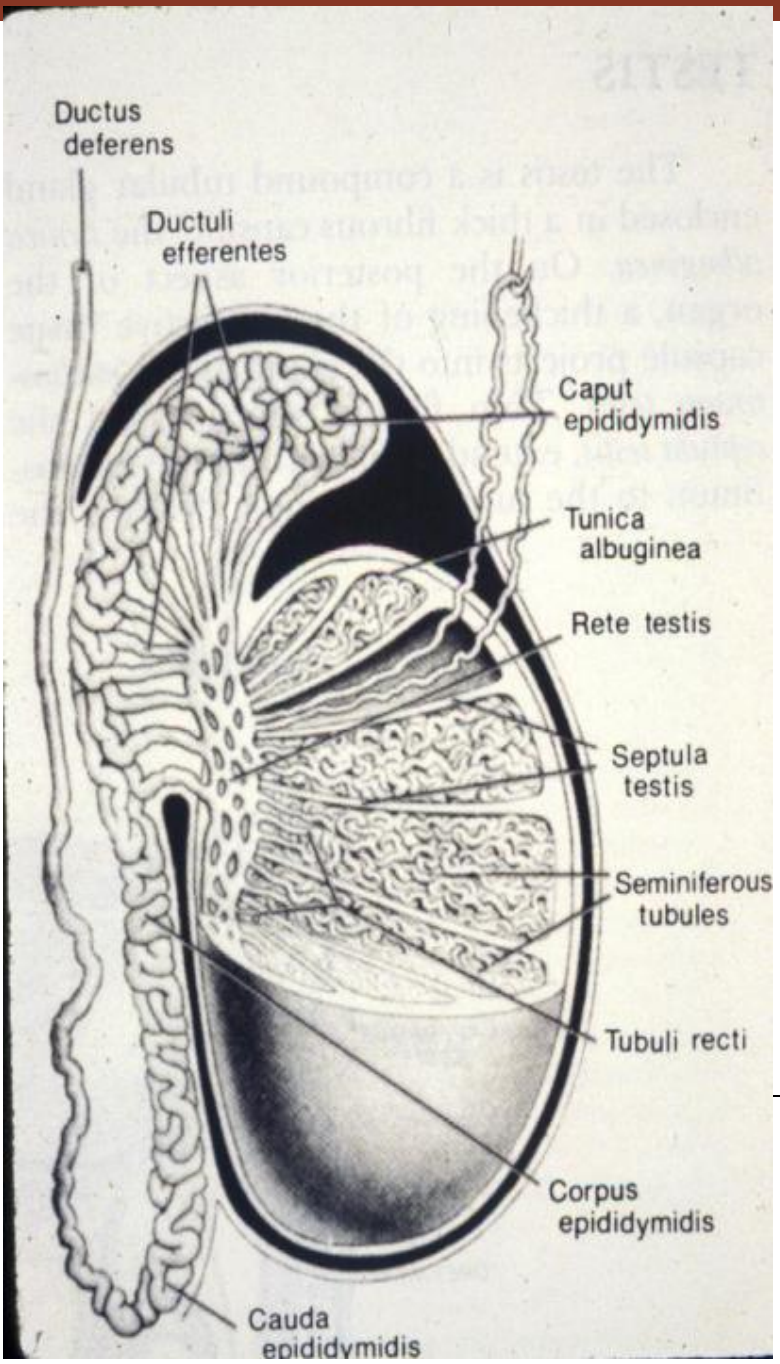
DEVELOPMENTAL RESPONSE TO ANDROGENS

Testes and seminiferous tubules









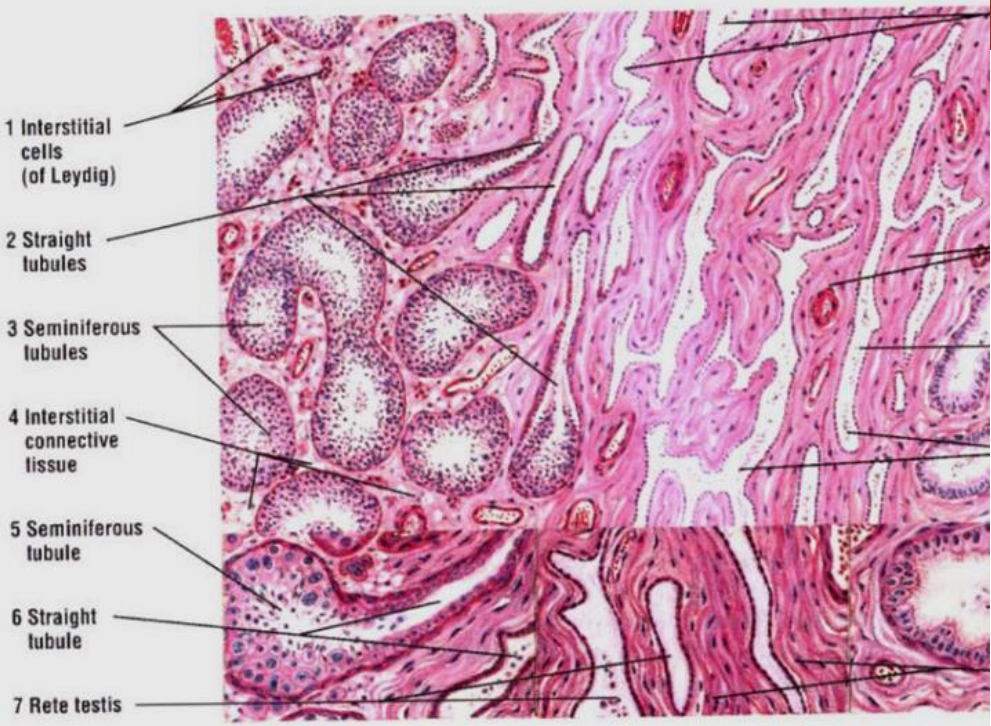
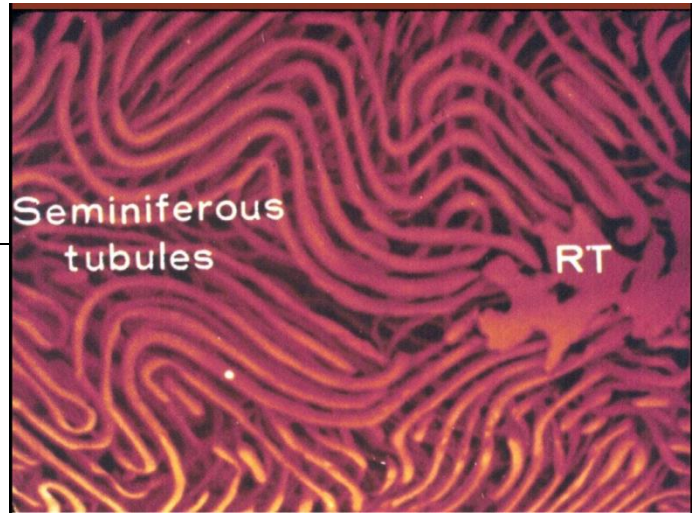


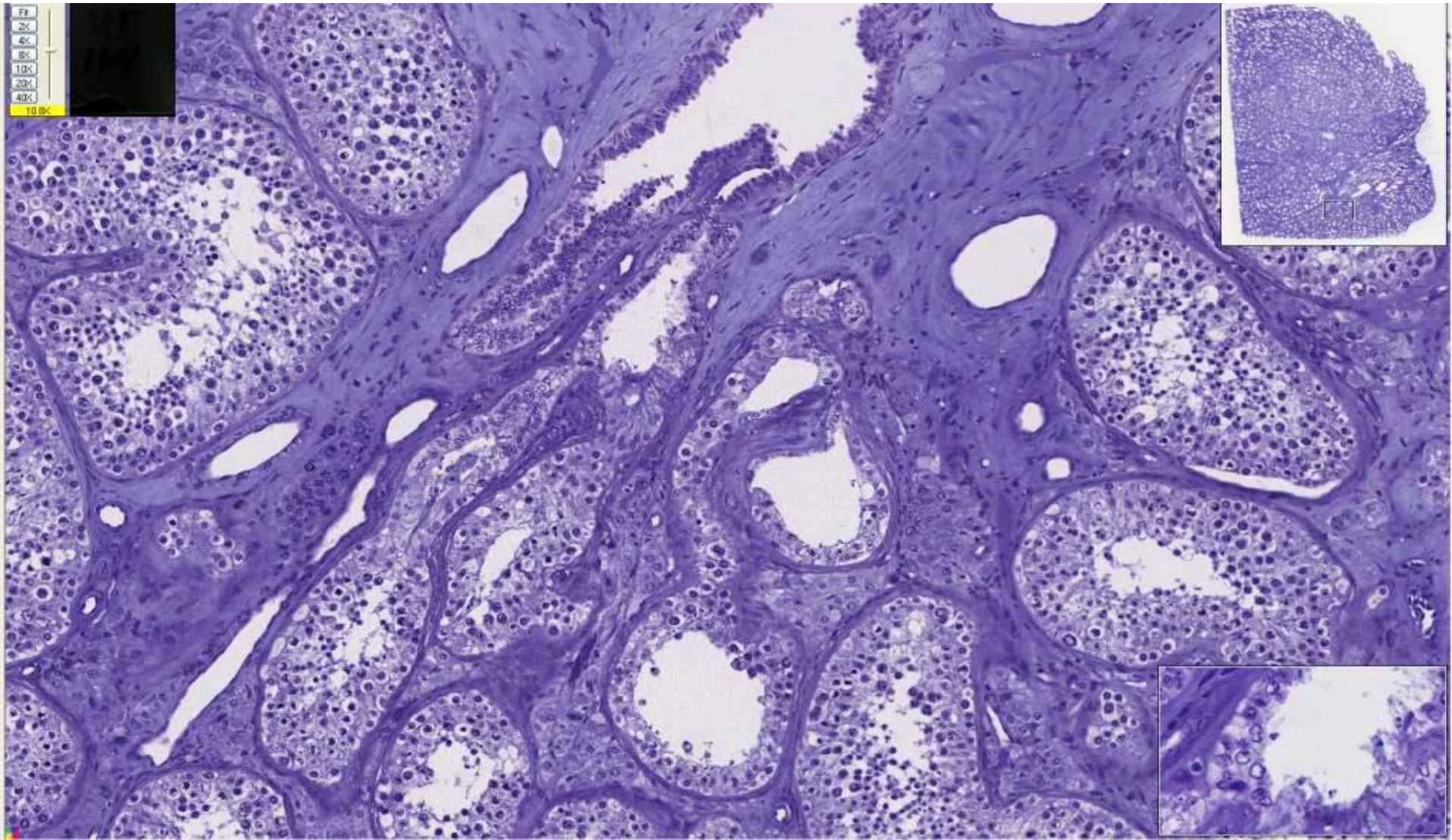
Fig. 17-2 Seminiferous Tubules, Straight Tubules, Rete Testis, and Ductuli Eff
Stain: hematoxylin-eosin. Low magnification (inset: high magnification).

di Fiore's **ATLAS OF HISTOLOGY** with FUNCTIONAL CORRELATIONS



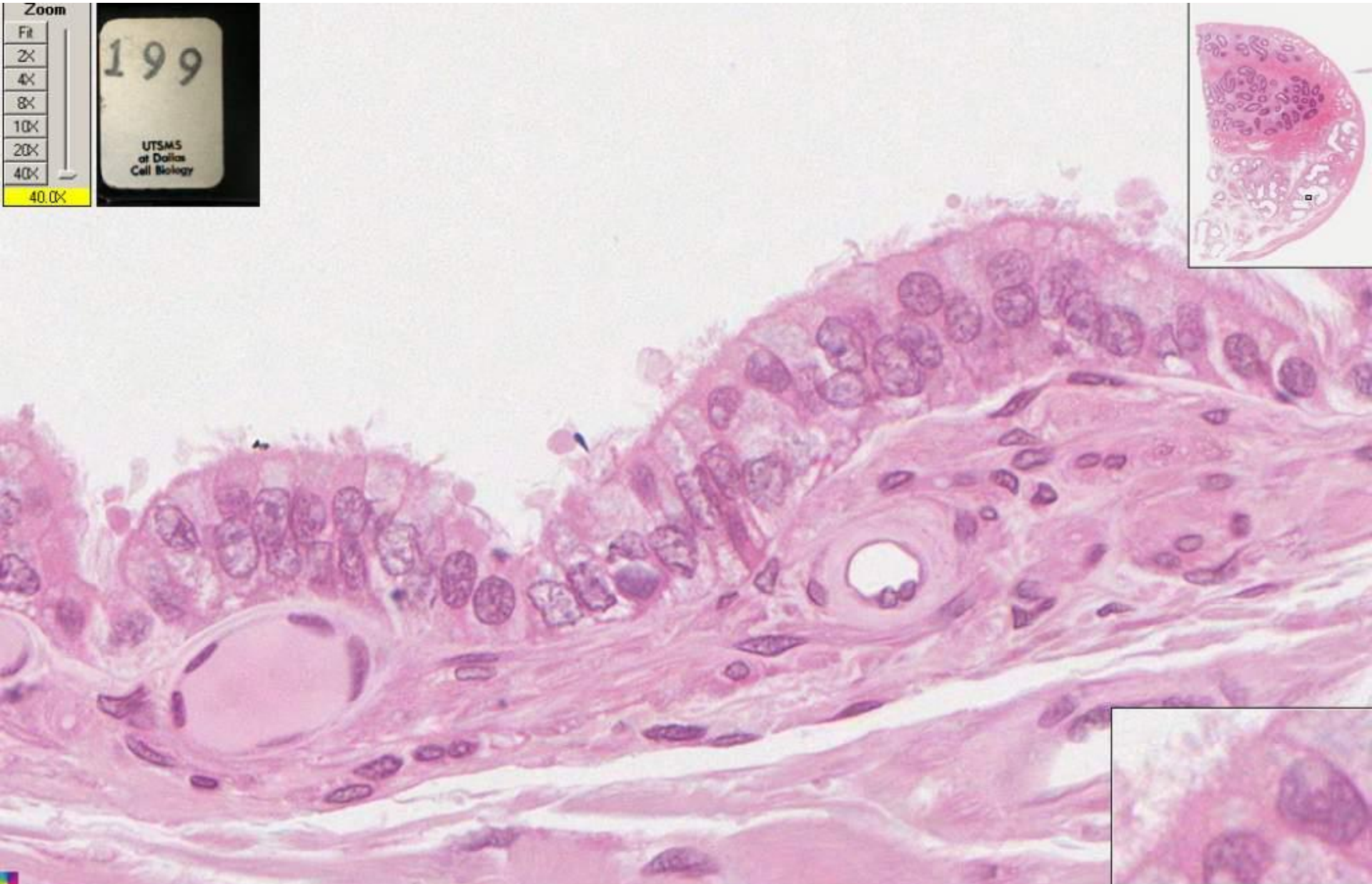
19709 human testis junction of seminiferous tubule and rete testis for sperm to exit (toluidine blue)

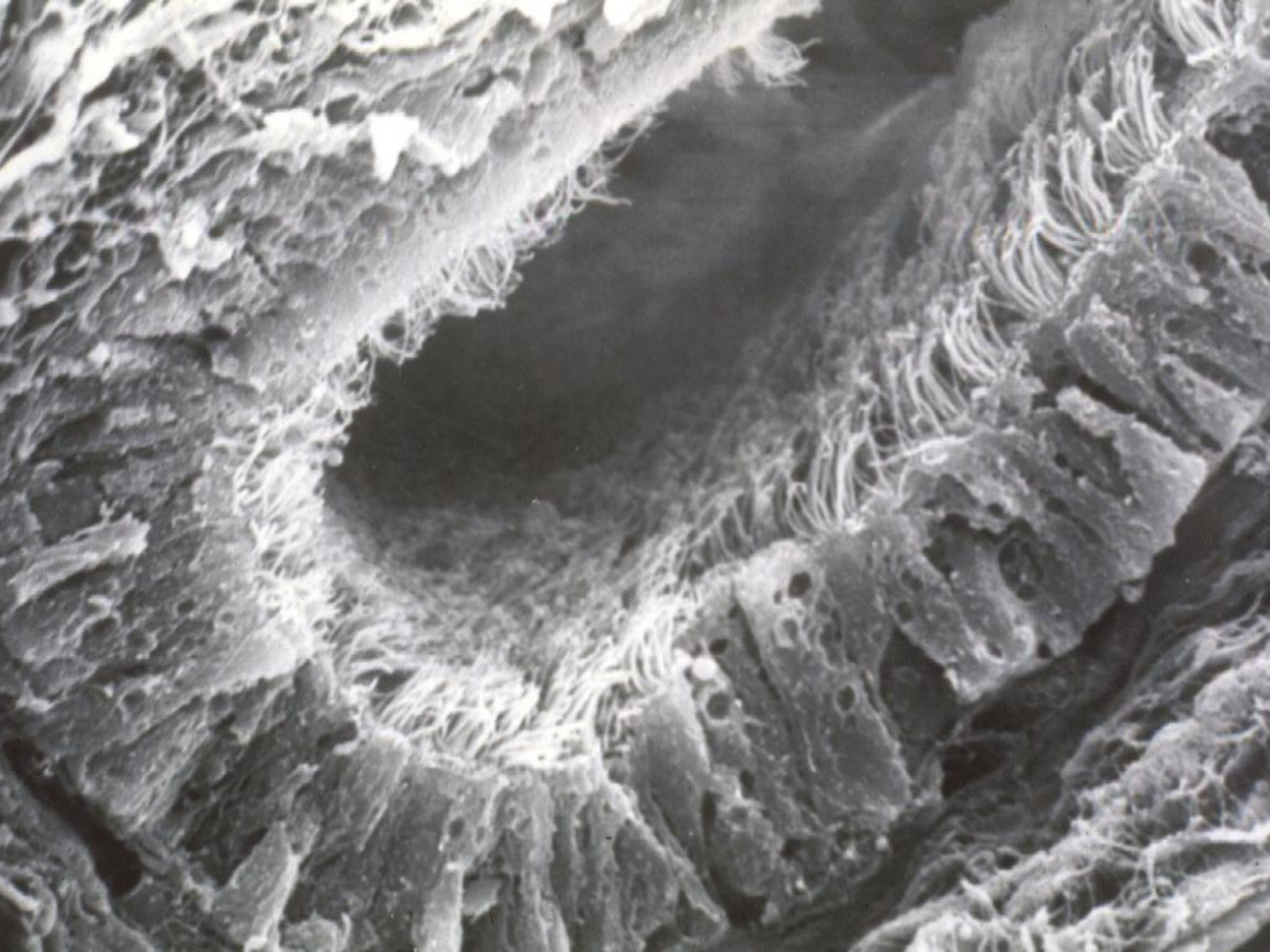
19709



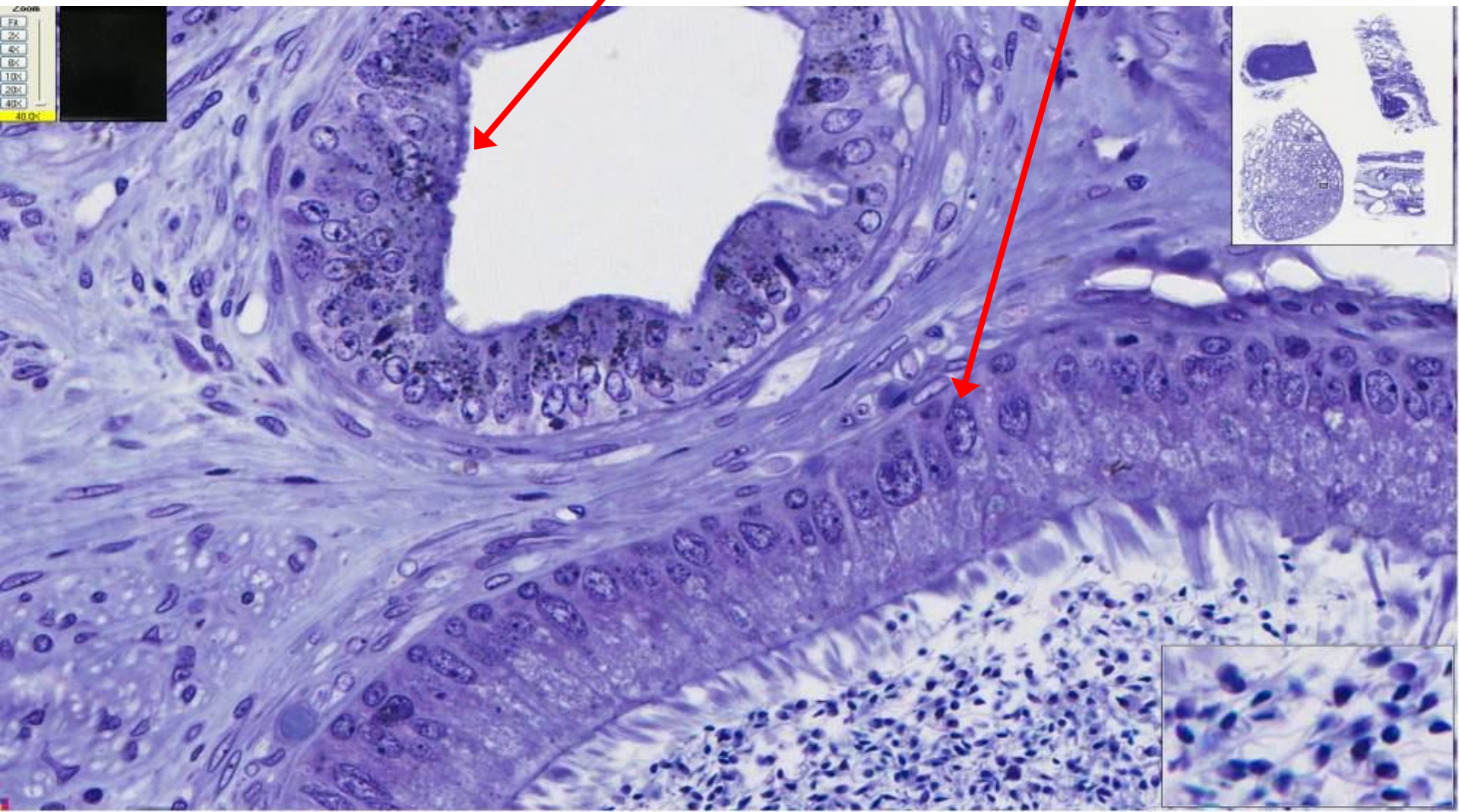

Ductuli
efferentes

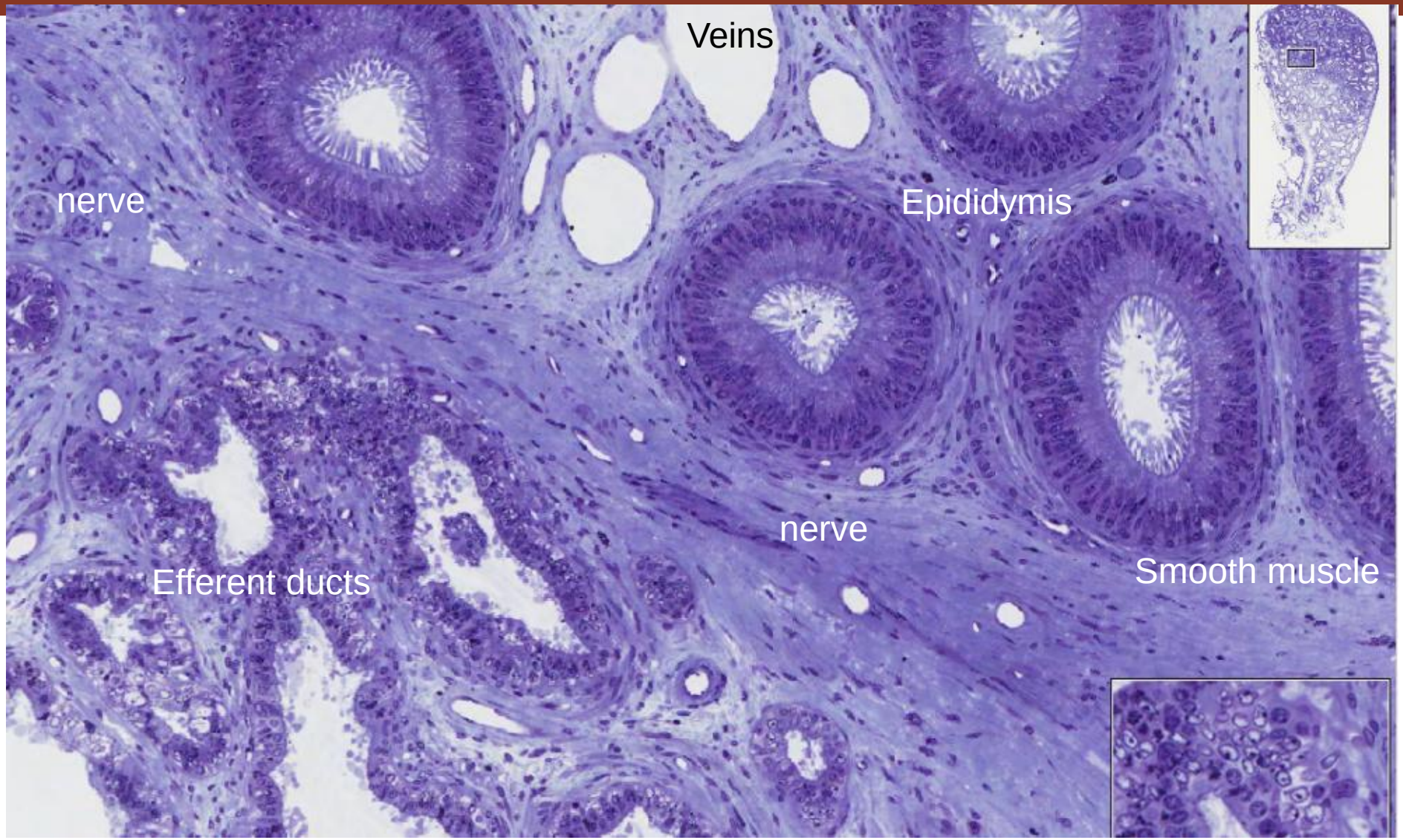
Epididymis – head; efferent ductules





True cilliated cells (efferent duct, top) and Stereocilliated cells (epididymis, with sperm in lumen) of psudostratified columnar epithelium (toluidine blue) slide 19678





Human head of epididymis

EPIDIDYMAL SPERM MATURATION

-FERTILITY

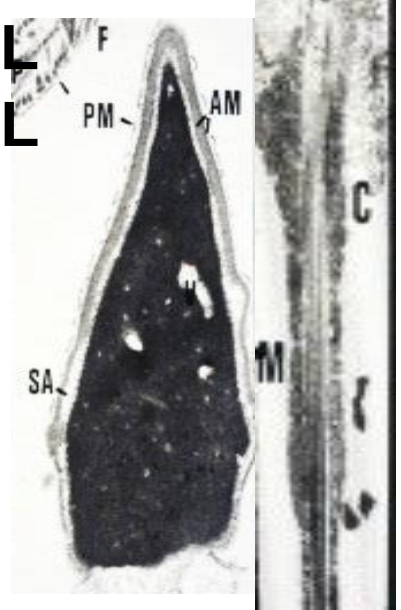
-MOTILITY

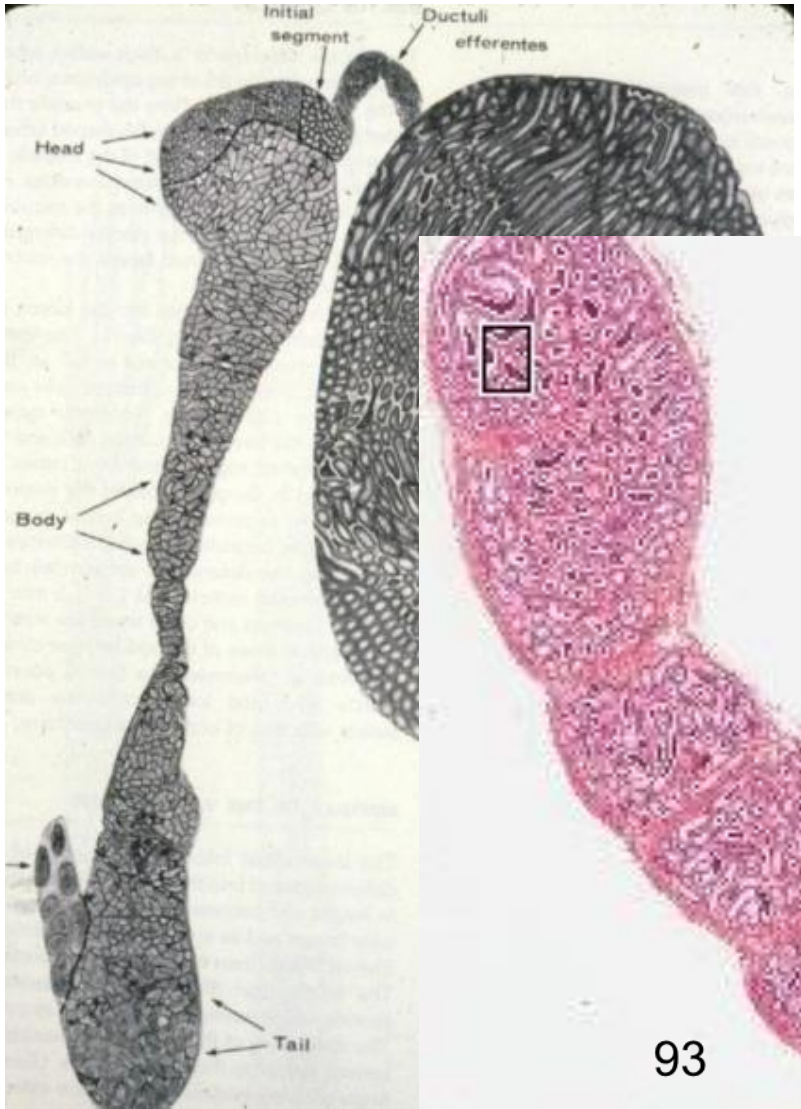
-NATURE OF PLASMA MEMBRANE

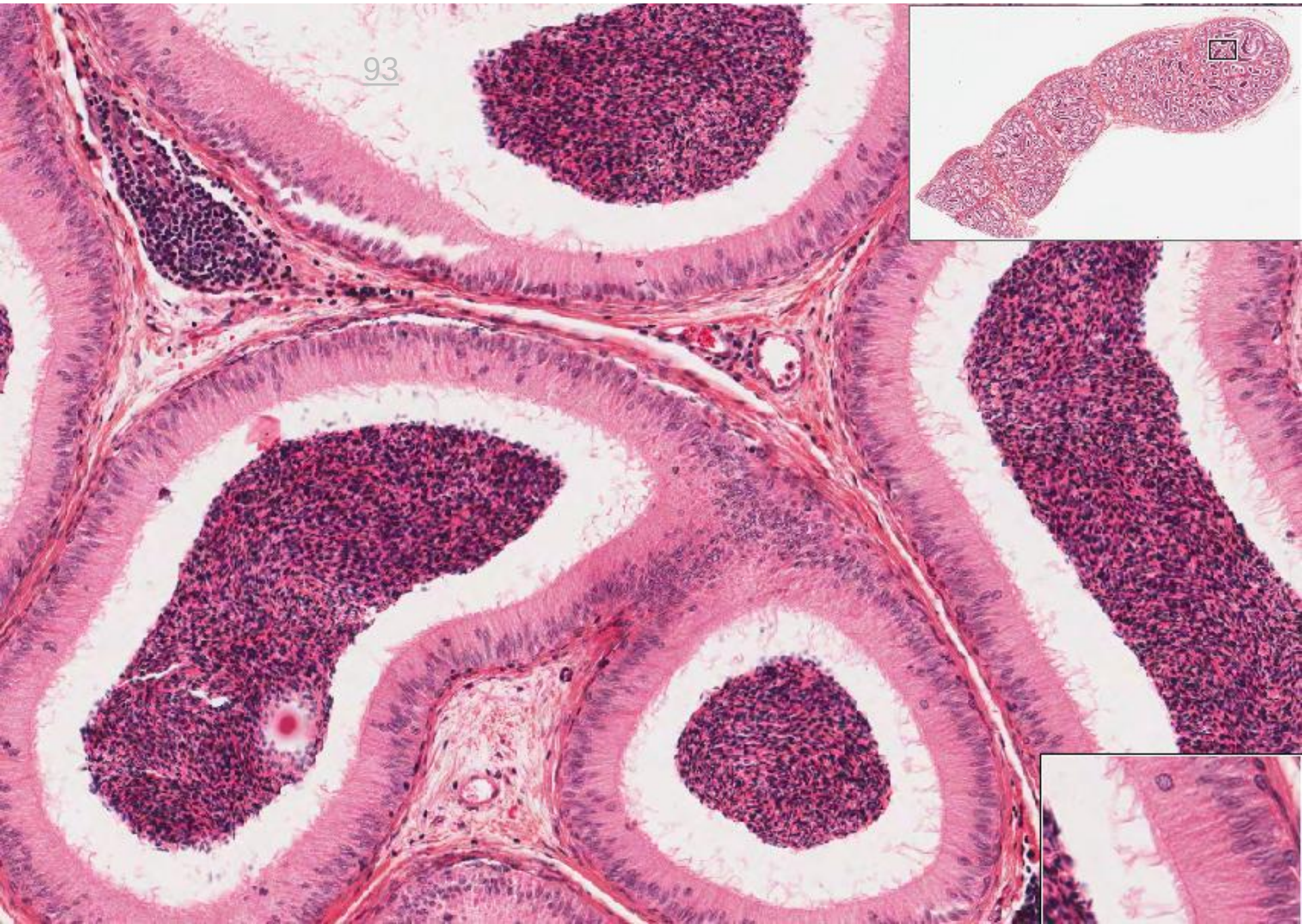
-MITOCHONDRIAL STRUCTURAL STABILITY

-CHROMATIN

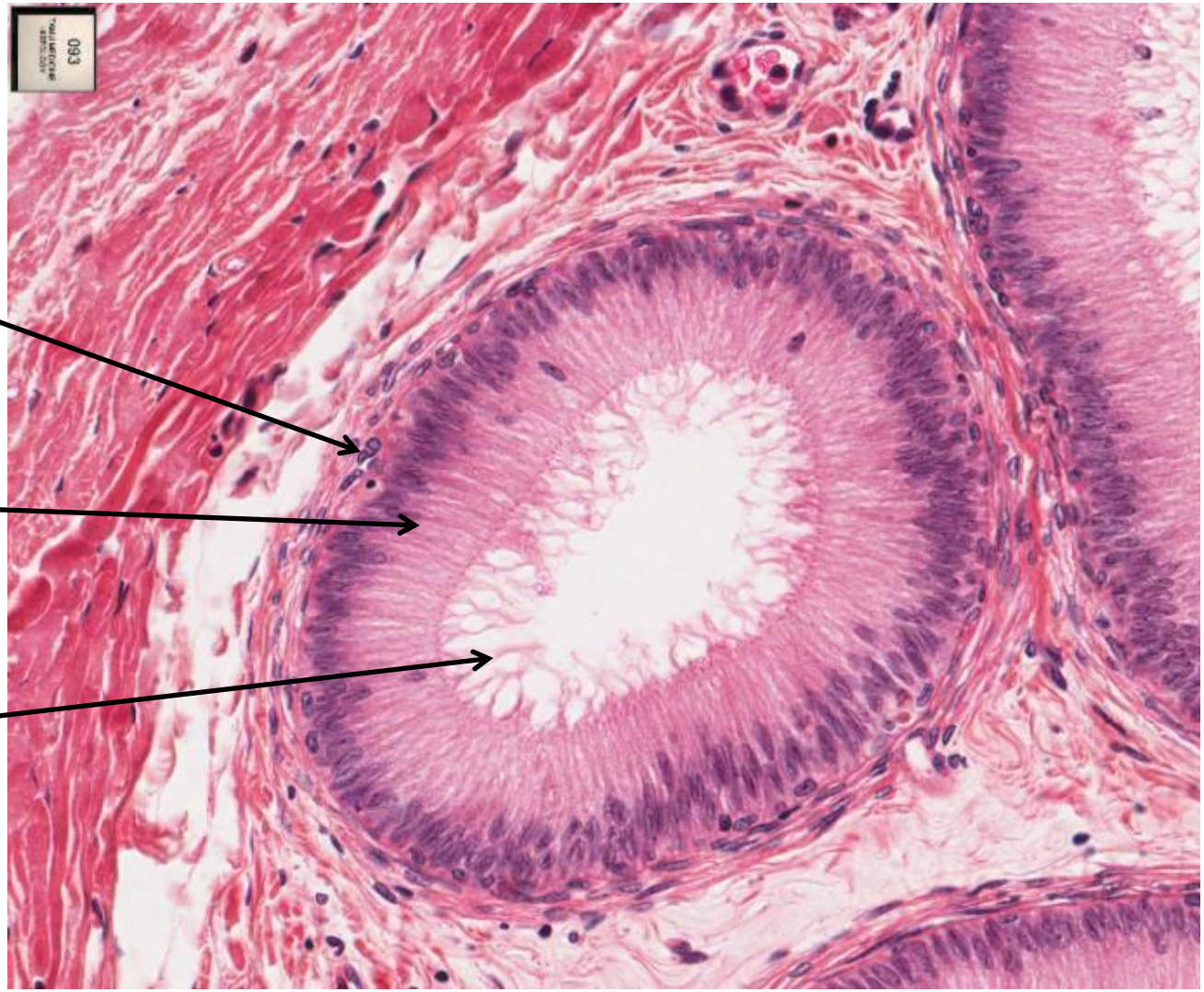
-STABILITY






93

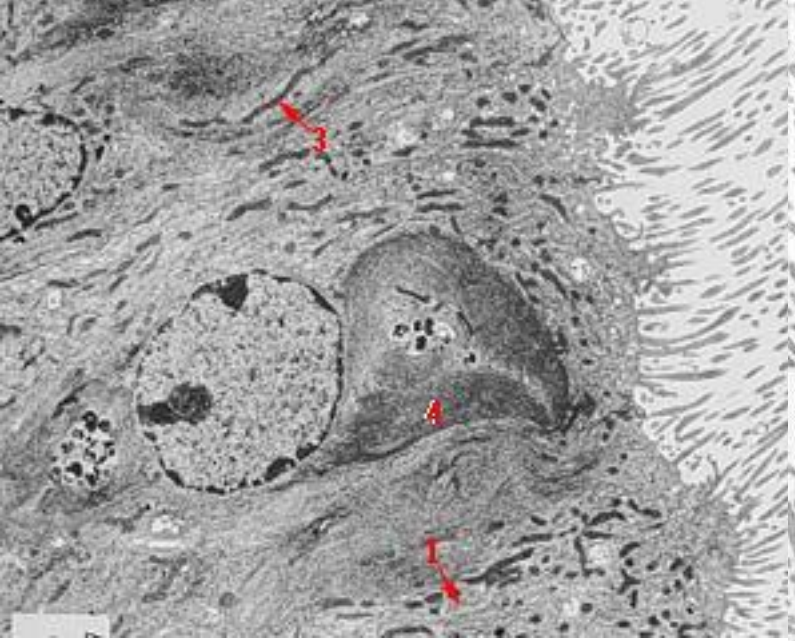
Slide 93: Epididymis

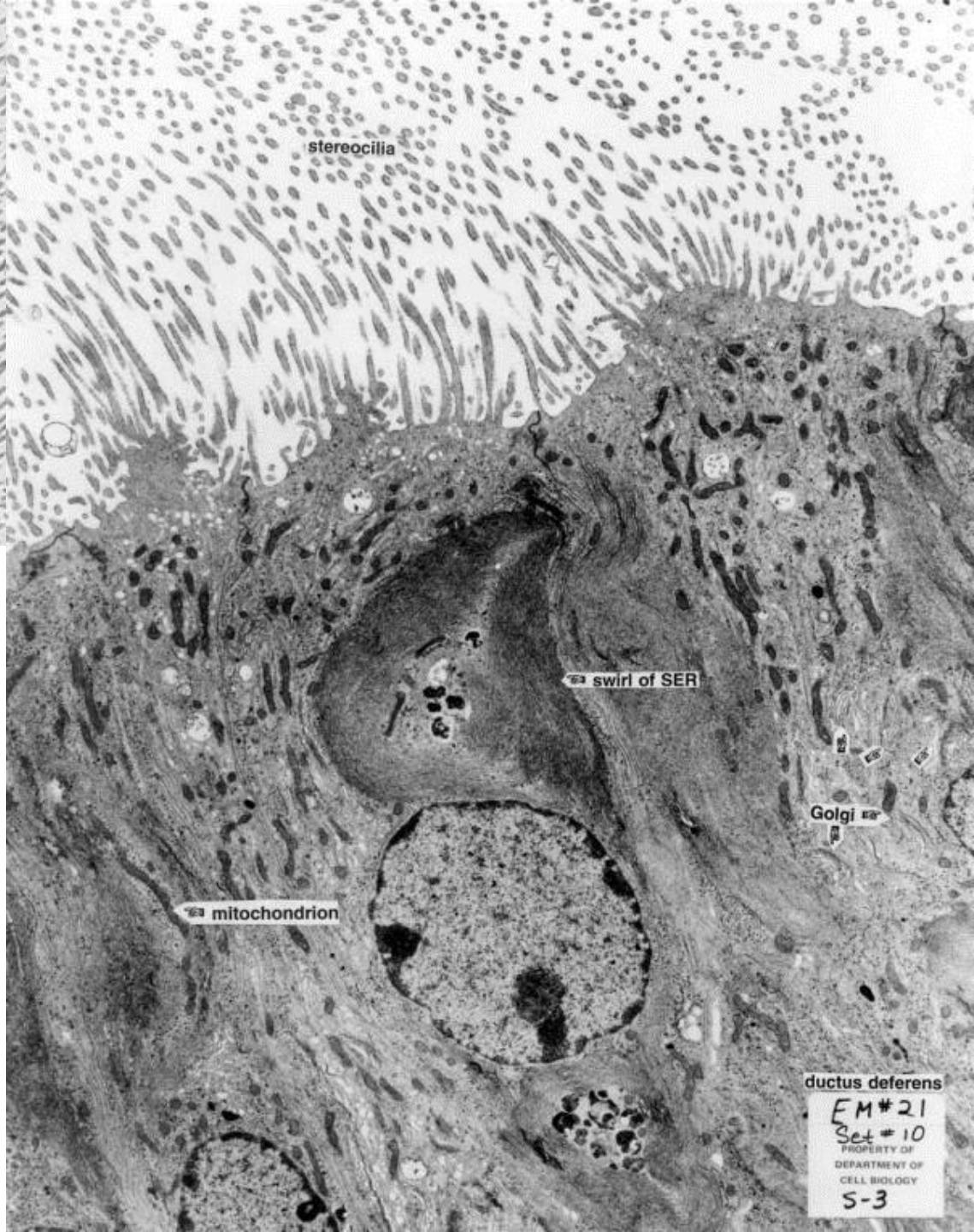


Smooth muscle

Pseudostratified columnar epithelium

Non-motile sterocilia

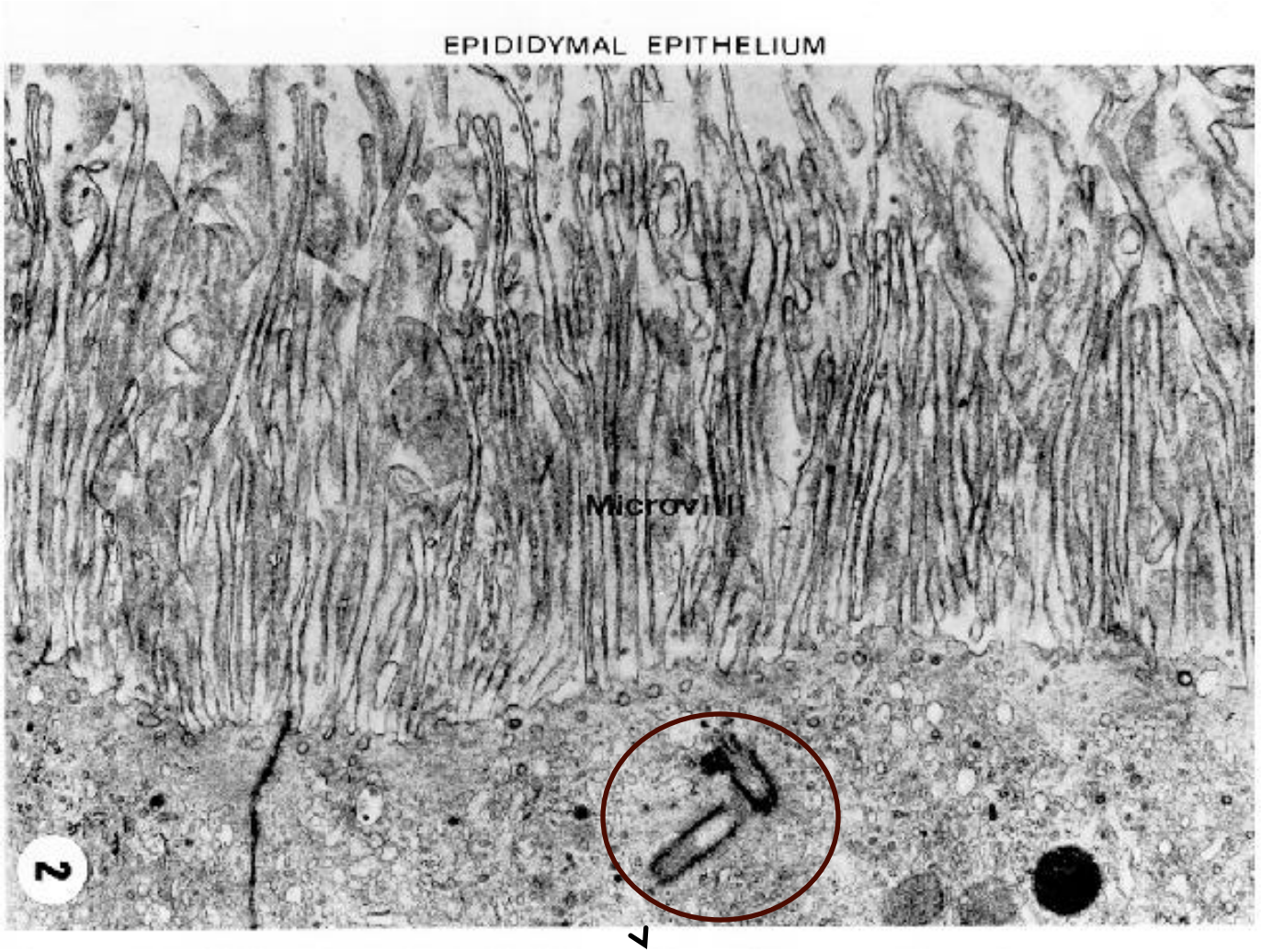




EM 21: ductus deferens; 11 000x

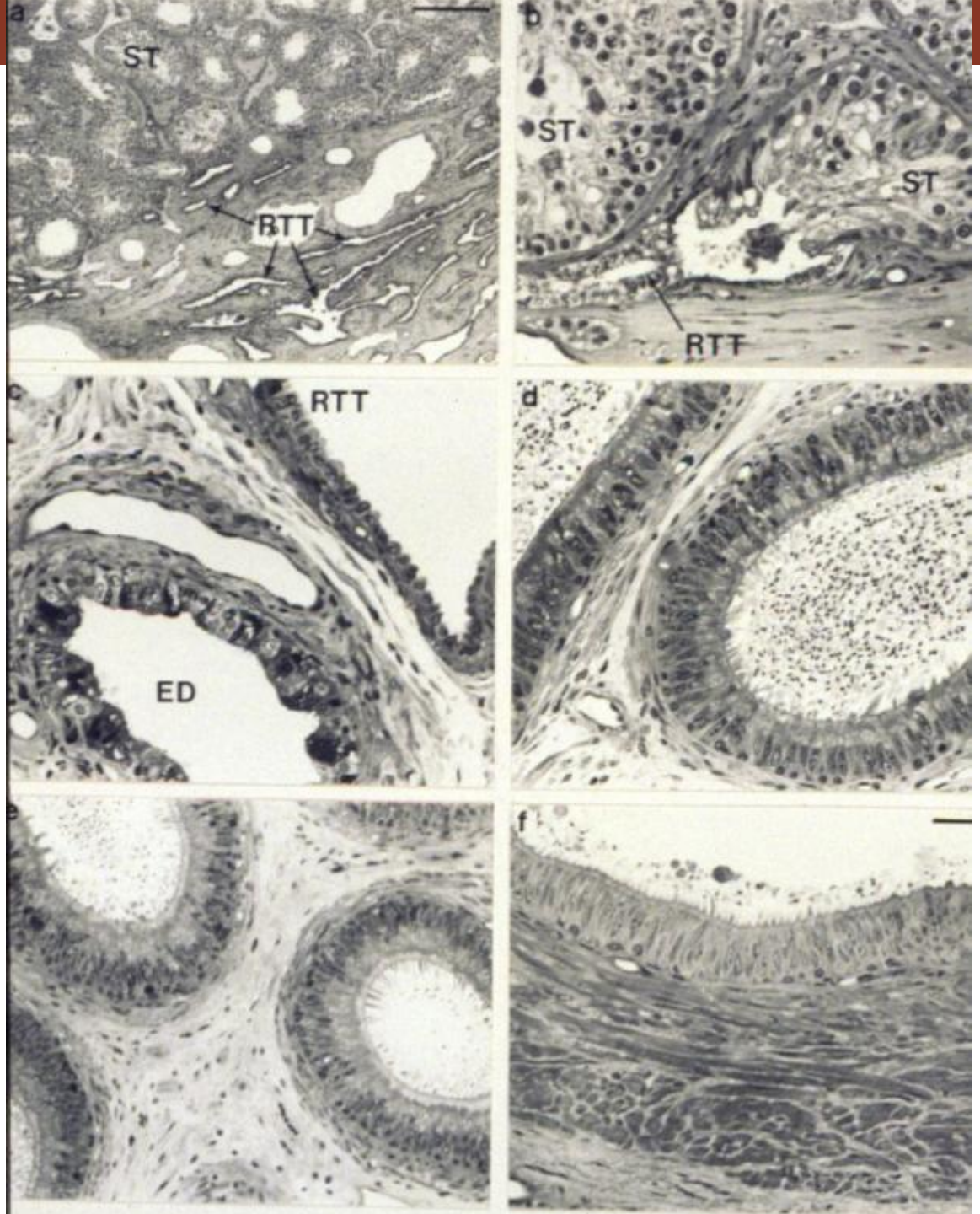
1. Golgi
2. Stereocilia
3. Mitochondria
4. Swirl of SER

EM 2: Epididymis



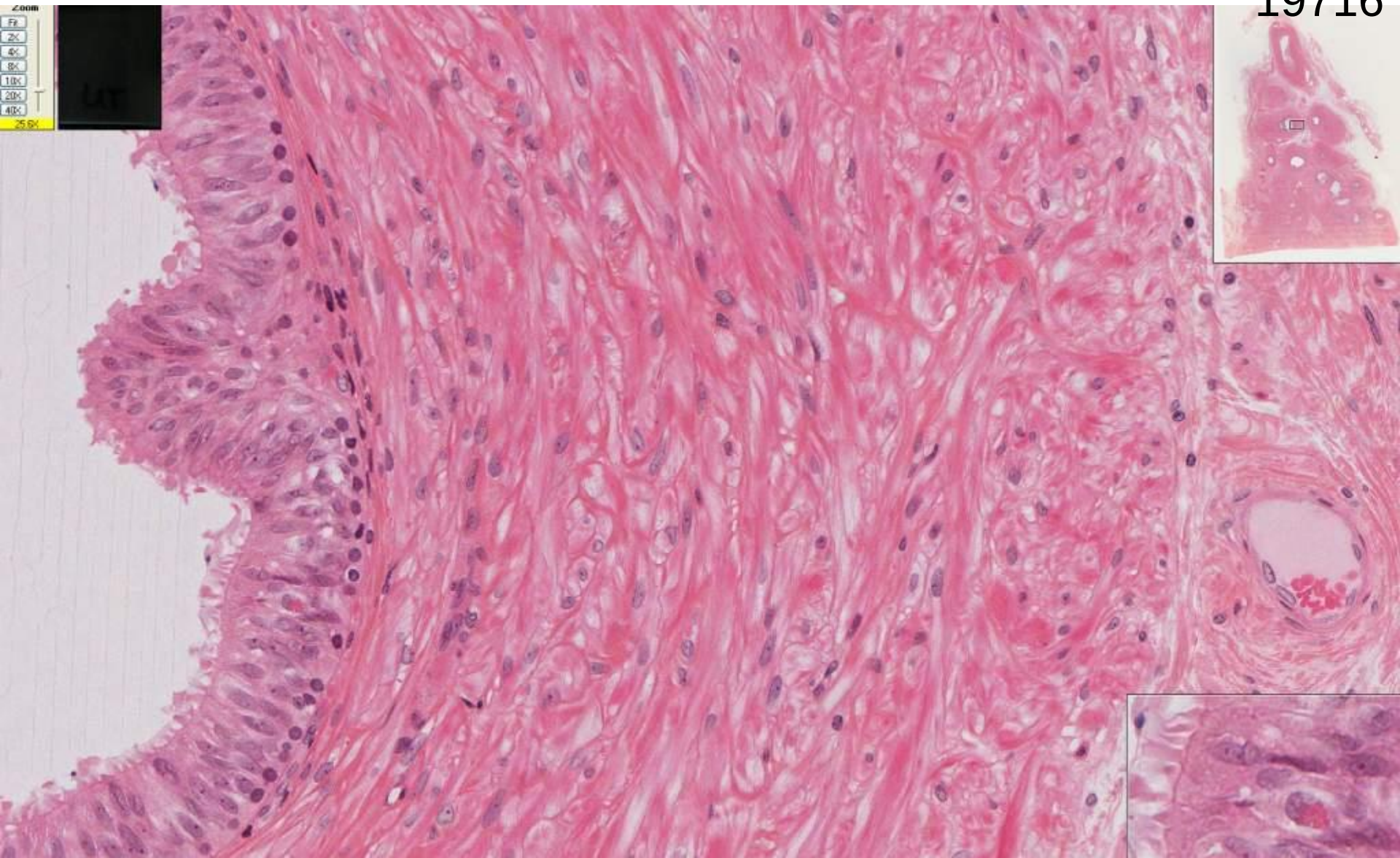
Centriole pair

In summary



Muscle layer of the epididymal duct increases in thickness in its more distal regions further away from the efferent ducts

Smooth muscle and psudostratified columnar epithelium in tail of epididymis slide 19716



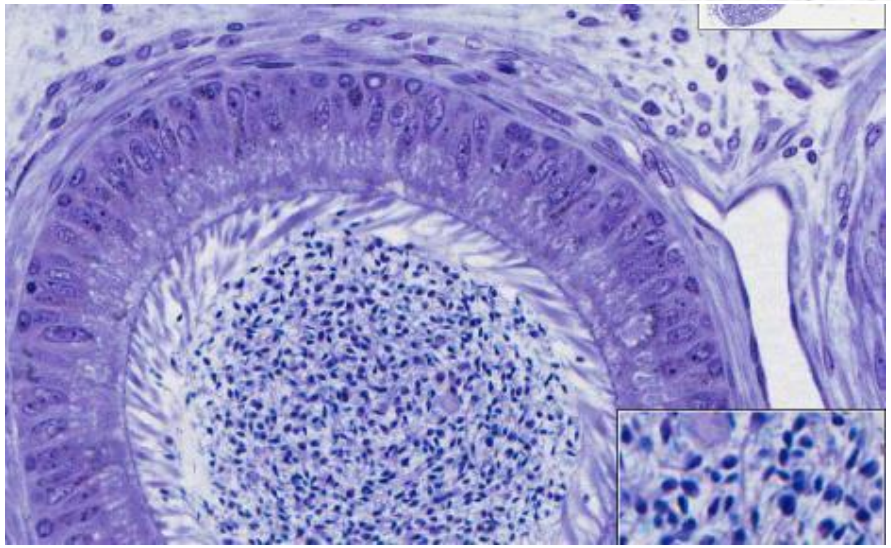
EPIDIDYMAL SPERM MATURATION (FERTILITY)

MODIFY DNA-PROTEIN COMPLEX

ENABLE ENERGY TRANSLATION FOR MOTILITY

DEVELOP SURFACE MASK FOR PROLONGED SURVIVAL IN FEMALES

DEVELOP MULTIPLE BINDING PROTEINS FOR EGG



CHARACTERISTICS OF FERTILE HUMAN EJACULATES

>20 million SPERM/ml

>80% SPERM WITH NORMAL MORPHOLOGY

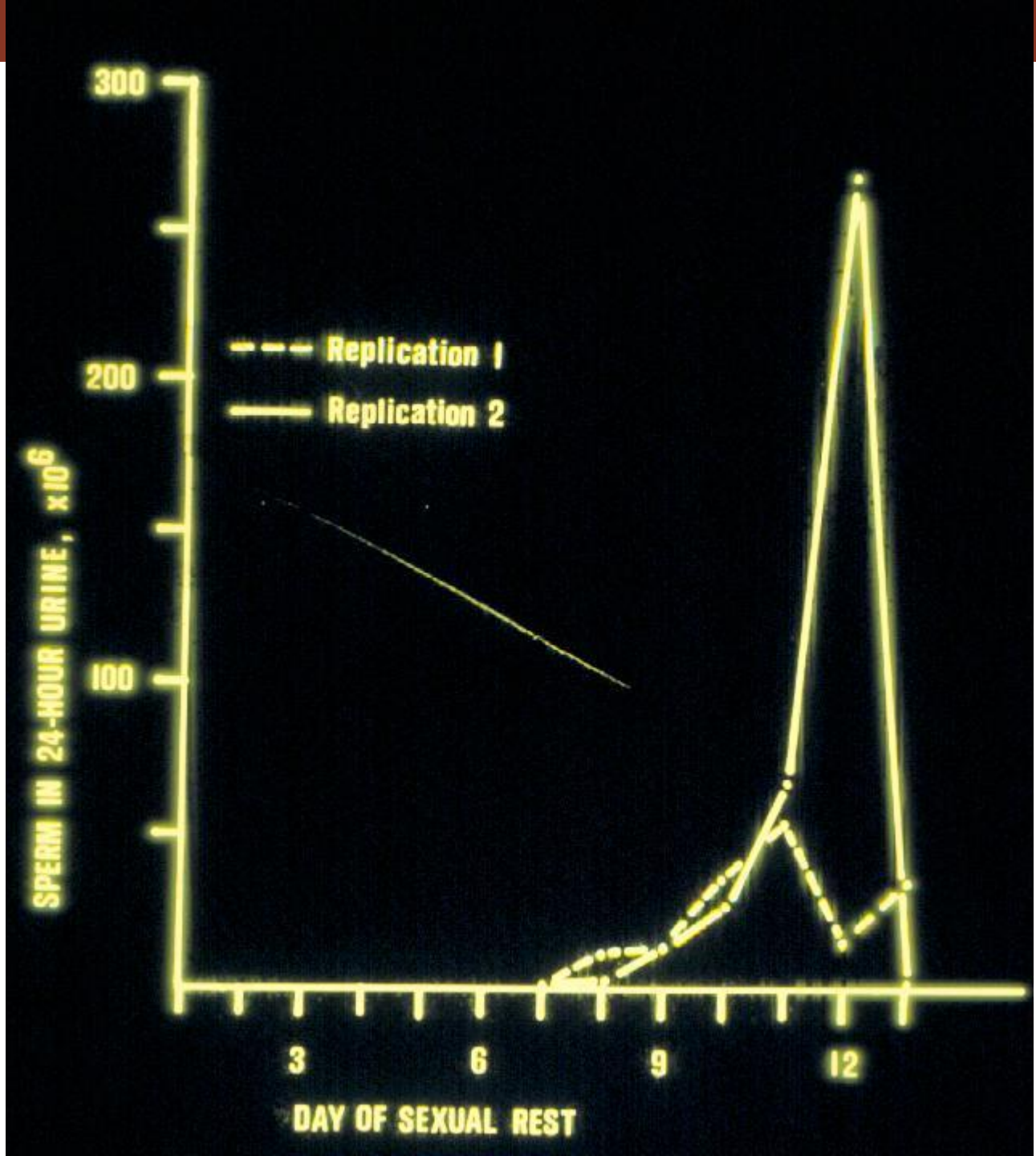
GOOD VISCOSITY (CLOT THEN DISPERSE)

about 3 ml in volume

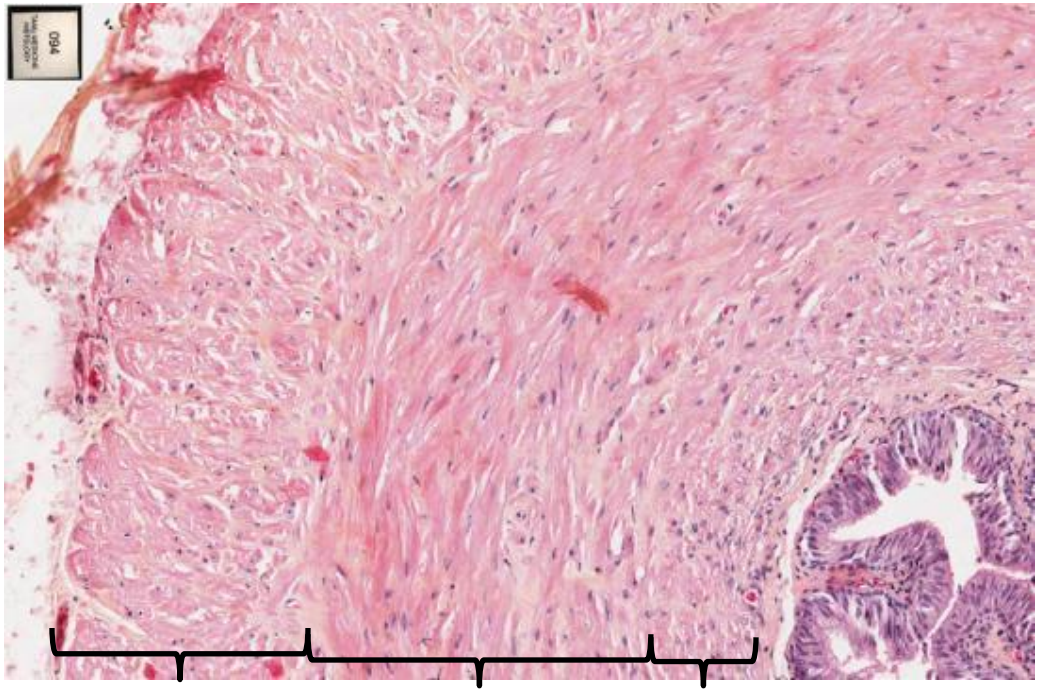
Sperm analysis

Spermatogenesis and edididymal maturation of sperm continues regardless of ejaculation frequency. Where do non-ejaculated sperm go?

Spermatozoa appears in urine after several days (7-8 days) of sexual rest in humans.



Slide 94: Ductus (vas) deferens



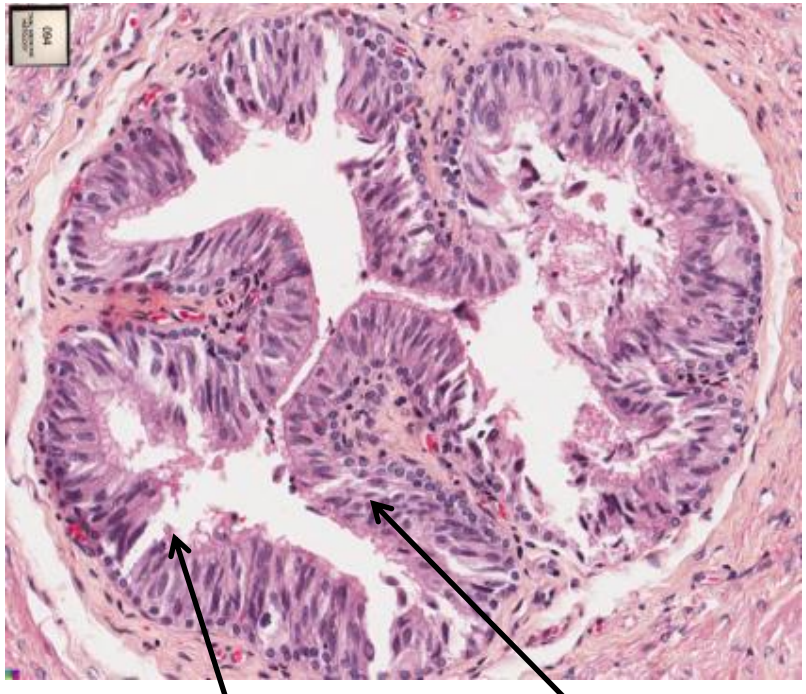
Thick longitudinal outer layer

Thick circular middle layer

Thin longitudinal inner layer

Mucosa

Thick muscularis externa

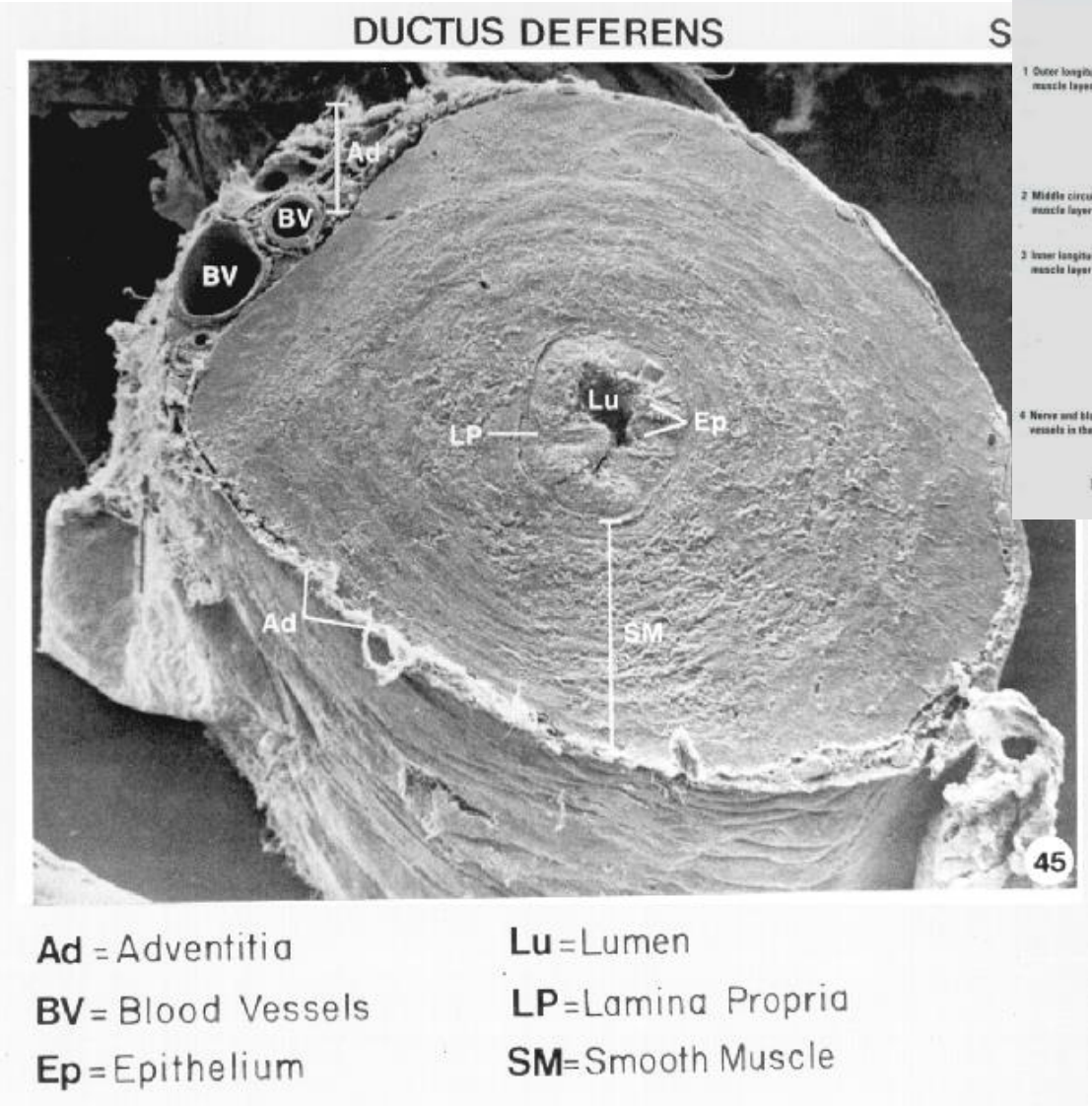


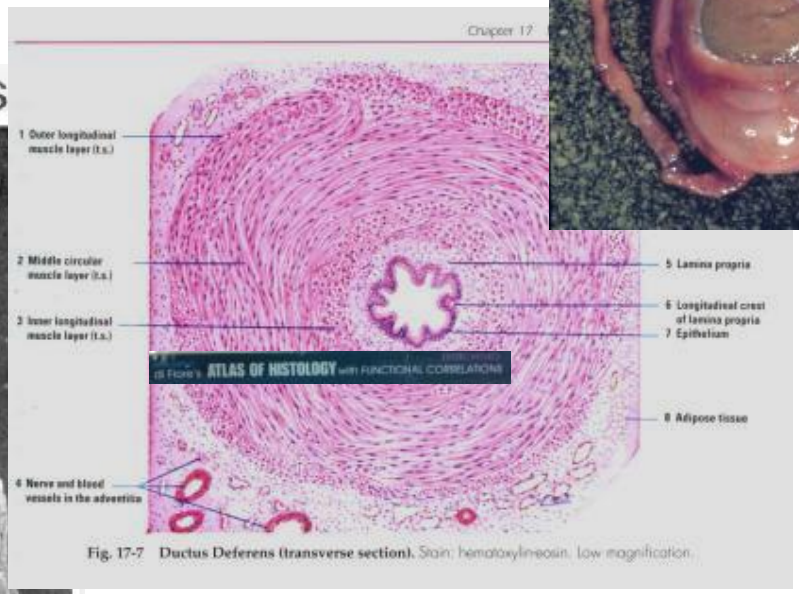
Non-motile sterocilia

Pseudostratified columnar cells

There are several nerves in this connective tissue (adventitia of the ductus) to control coordinated smooth muscle contractions.

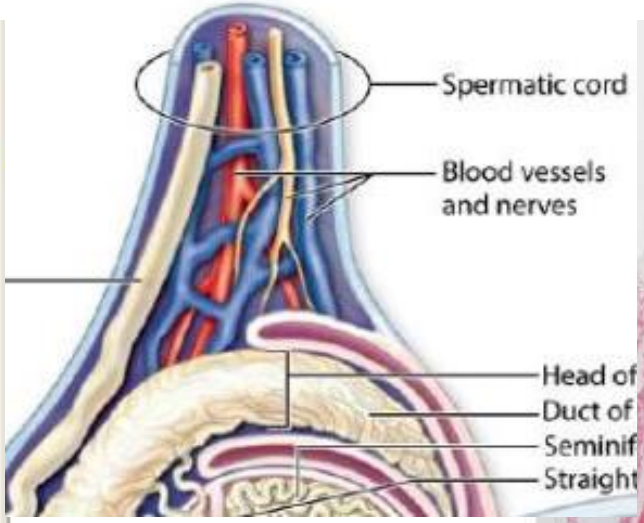
EM 45: Ductus (vas) deferens

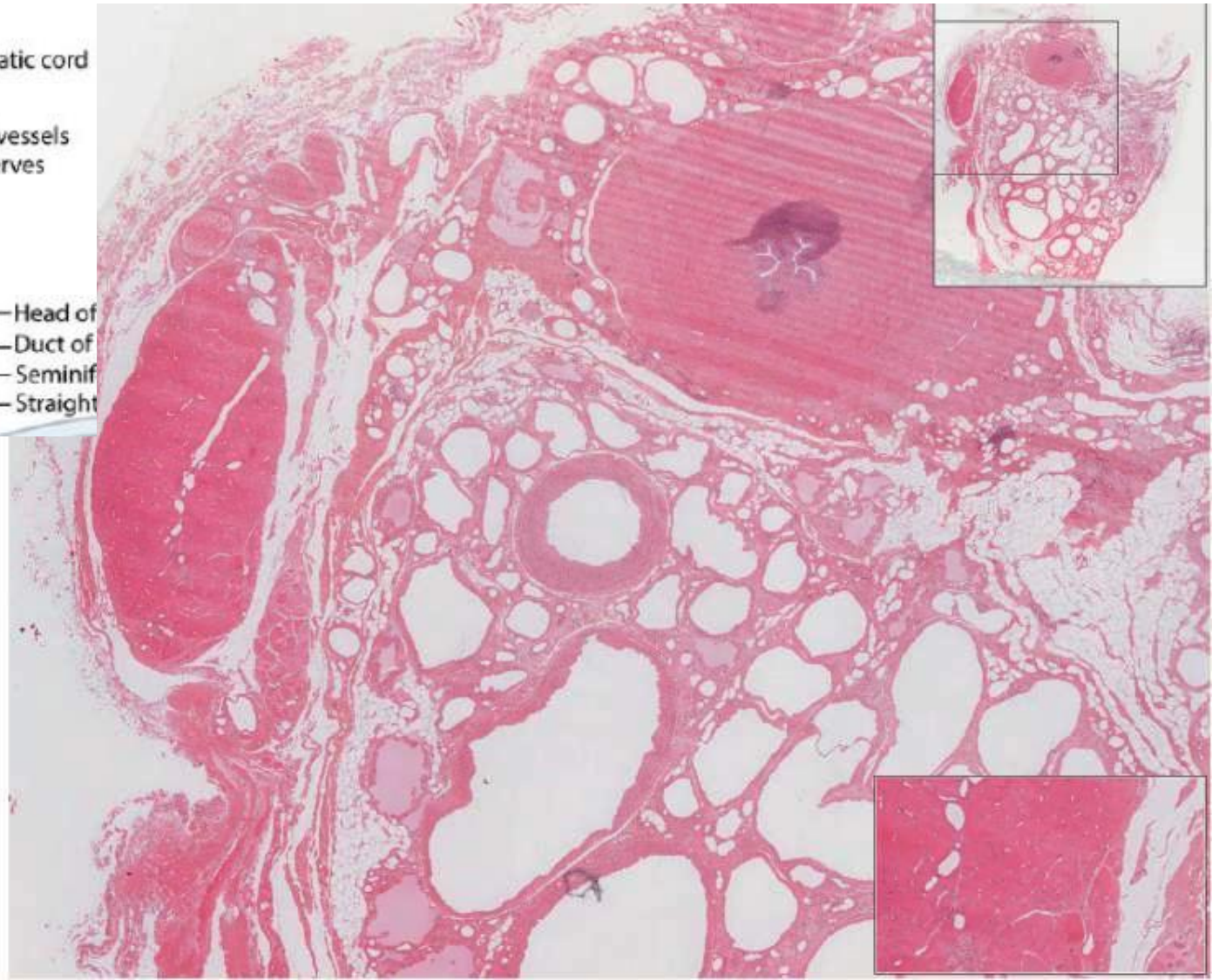




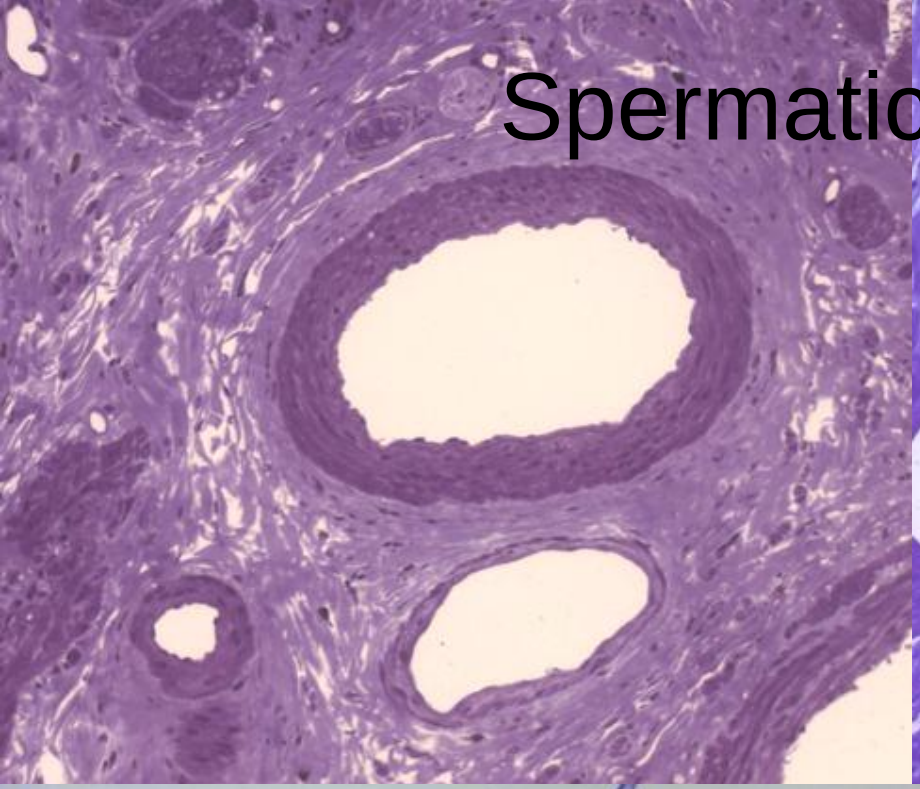
Under sympatric control, the thick muscularis externa of the vas deferens produces strong peristaltic contractions during ejaculation, which rapidly move spermatozoa along this duct from the epididymis to the ejaculatory ducts of the prostate just in time.

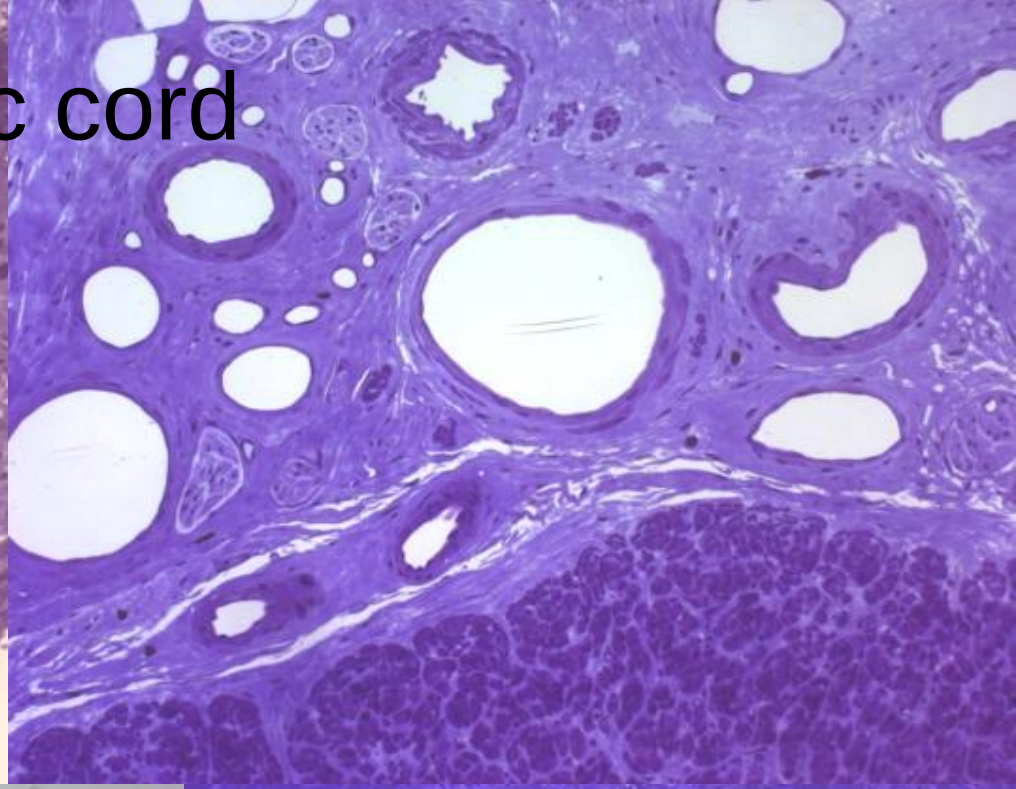
Skeletal muscle in spermatic cord UT 196



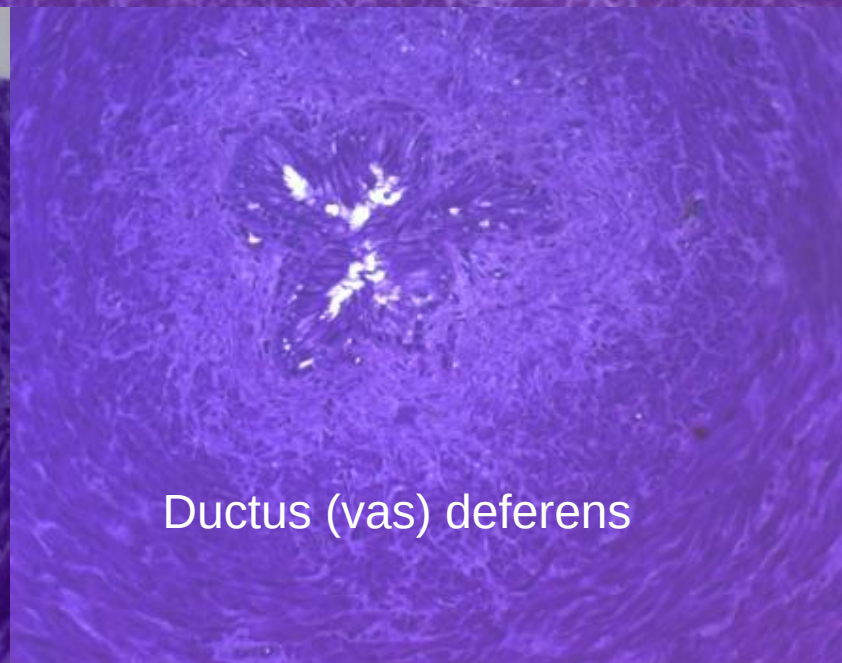


Spermatic cord





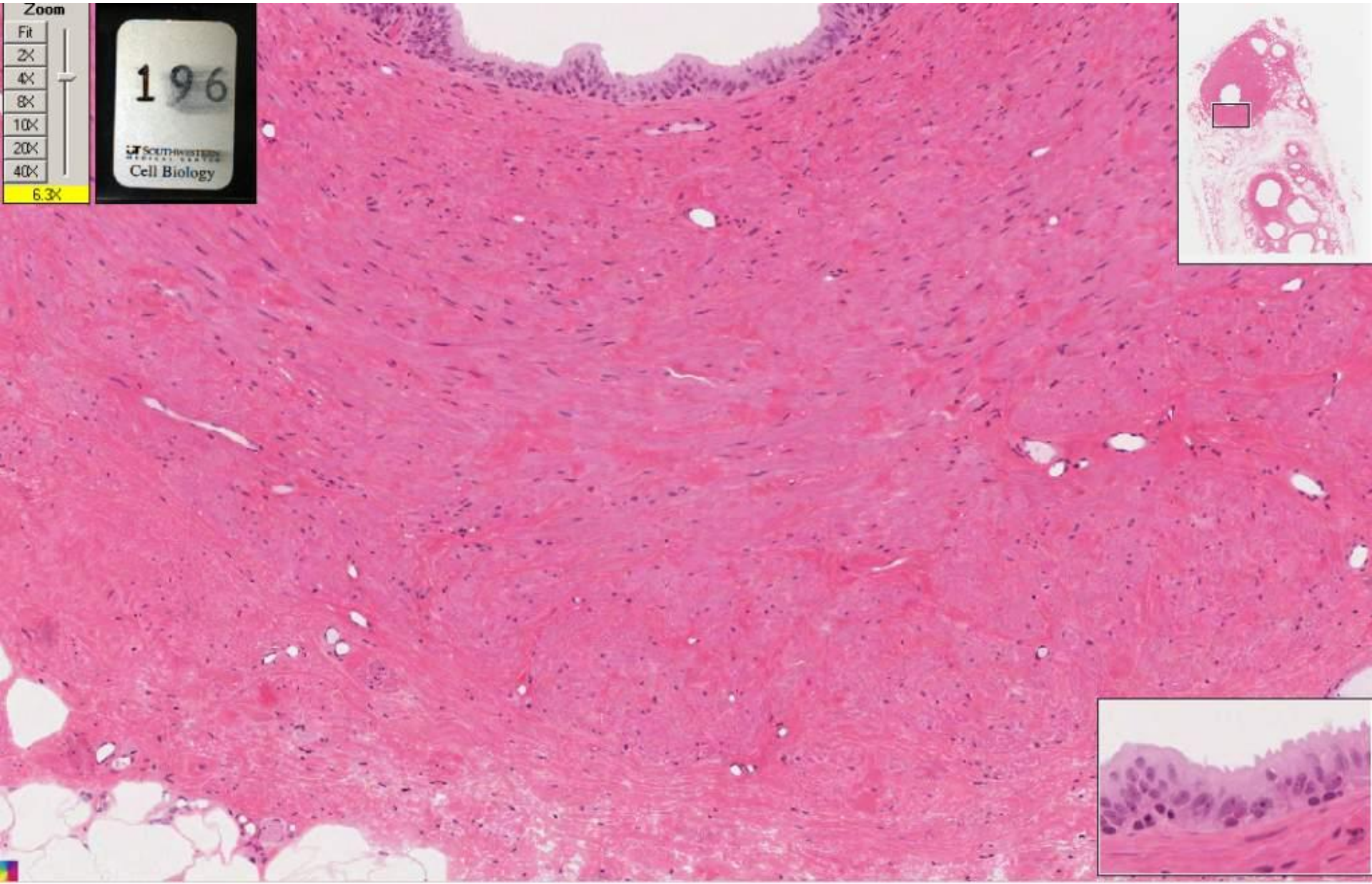
ut 196



Ductus (vas) deferens

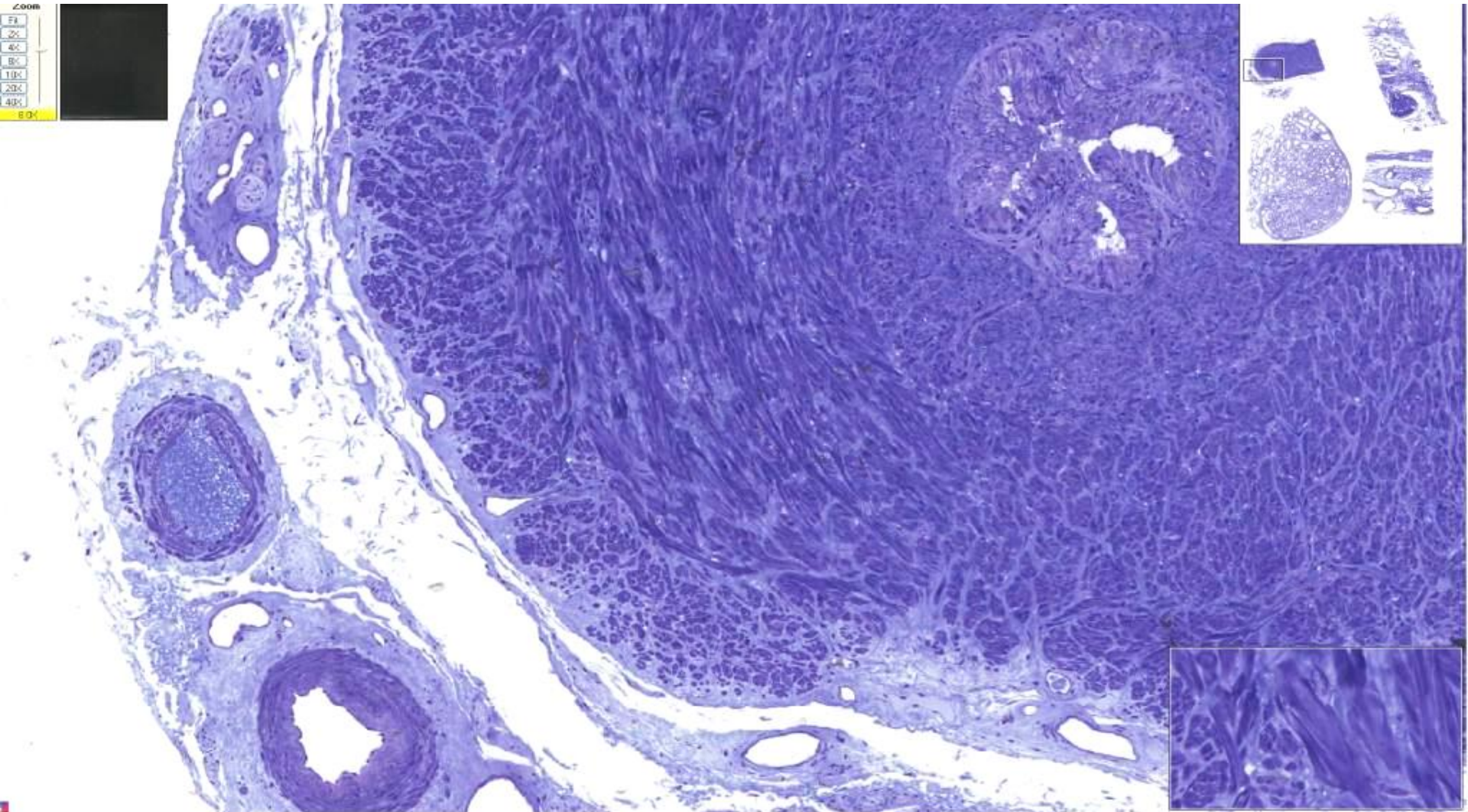
Spermatic cord

Ductus (vas) deferens



Smooth muscle and psudostratified columnar epithelium in ductus deferens (toluidine blue) slide 19678

19678



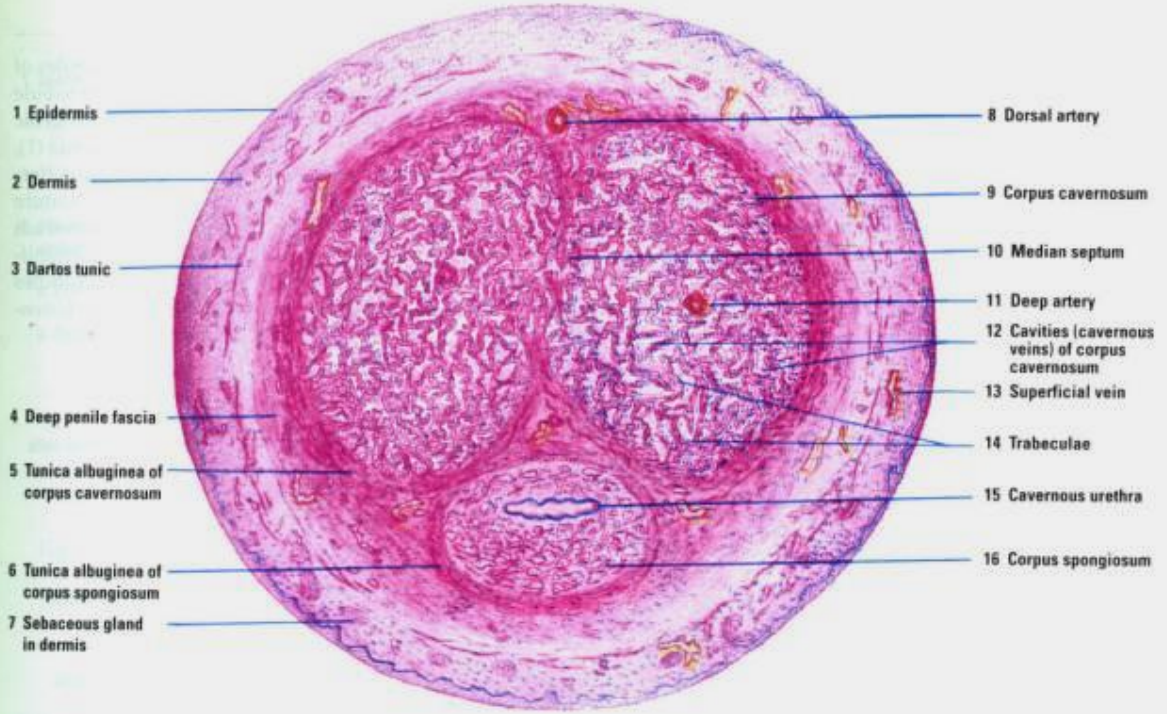
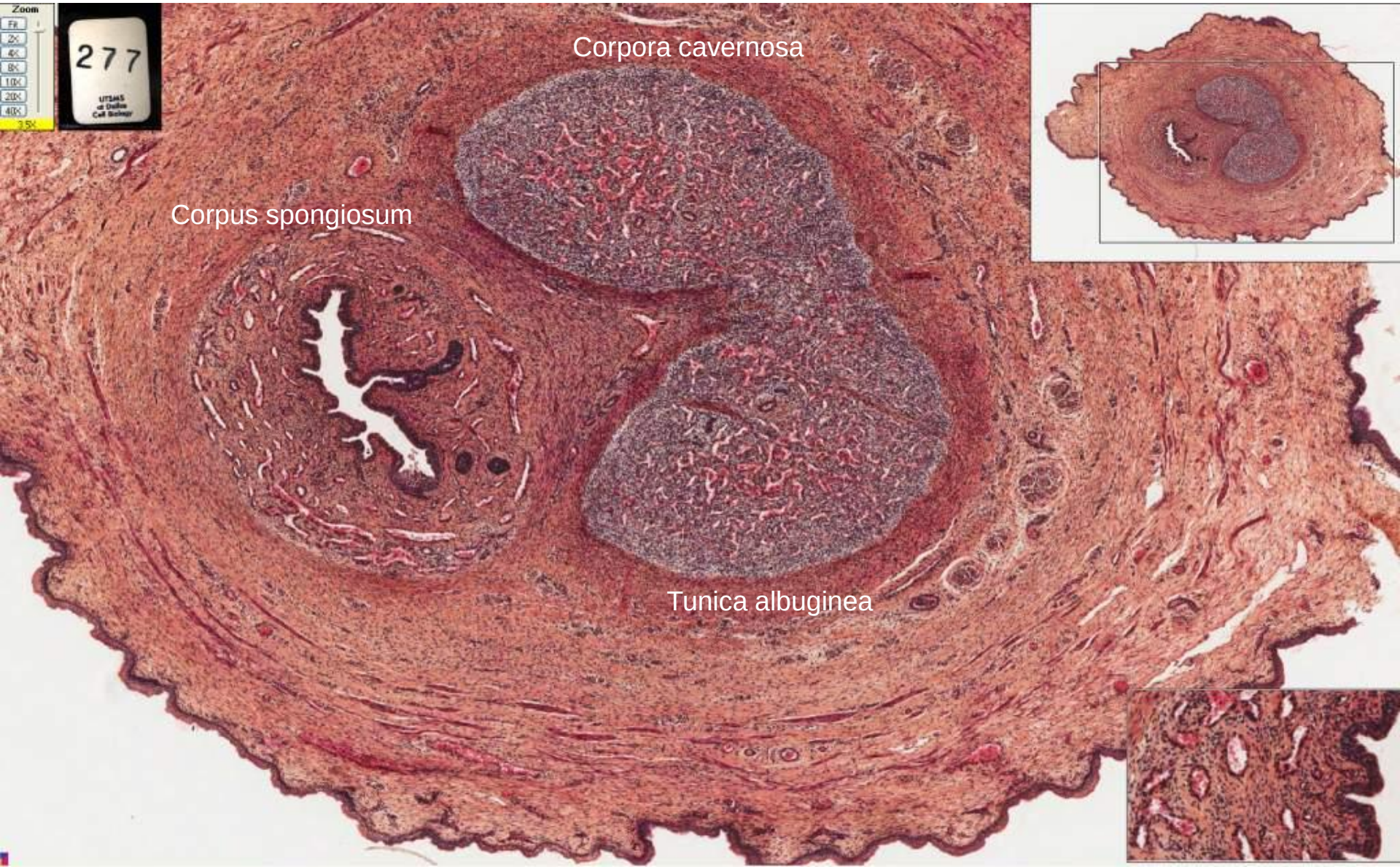


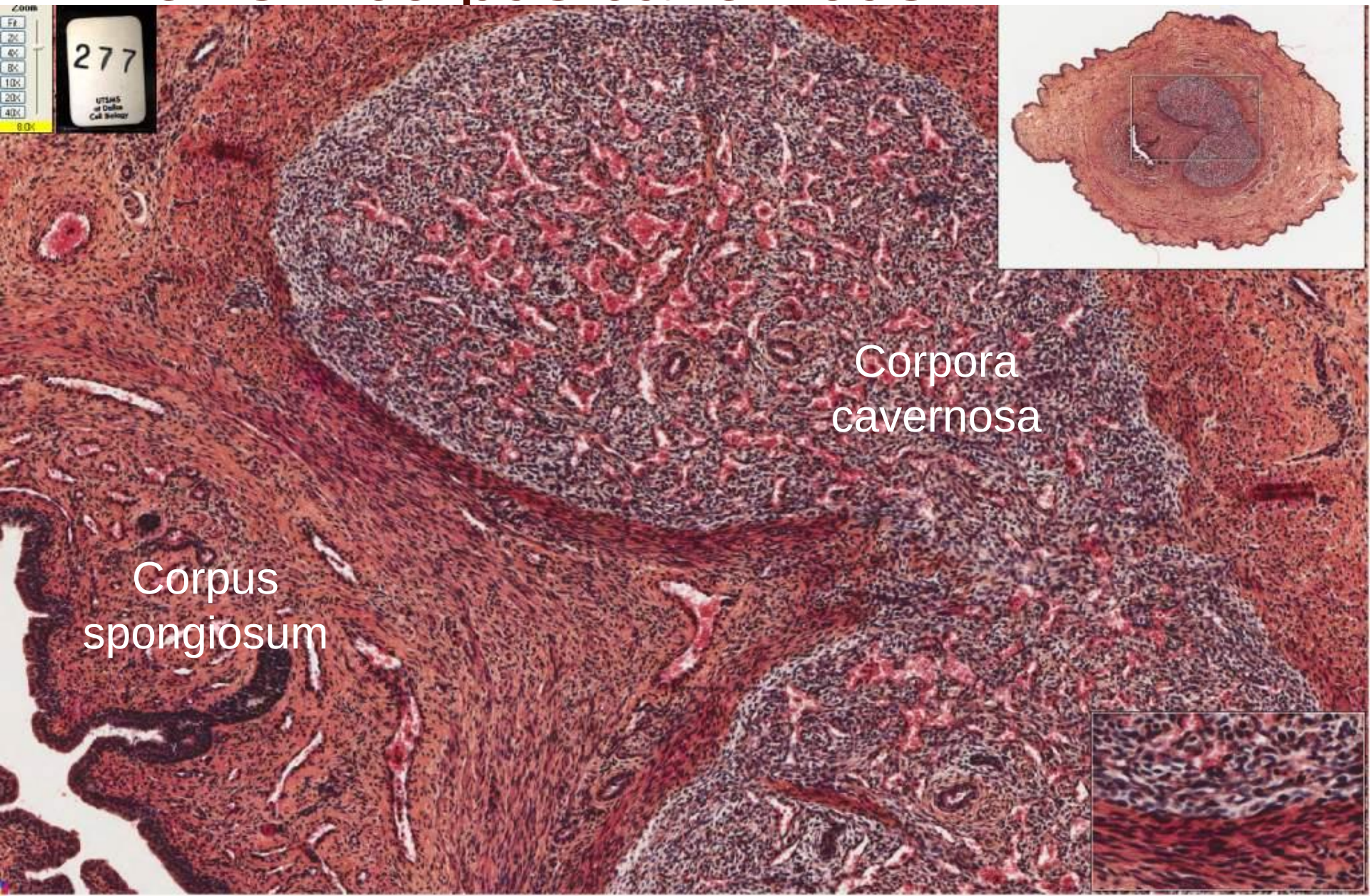
Fig. 17-13 Penis (transverse section). Stain: hematoxylin-eosin. Low magnification.

transverse section). Stain: hematoxylin-eosin. Low magnification.

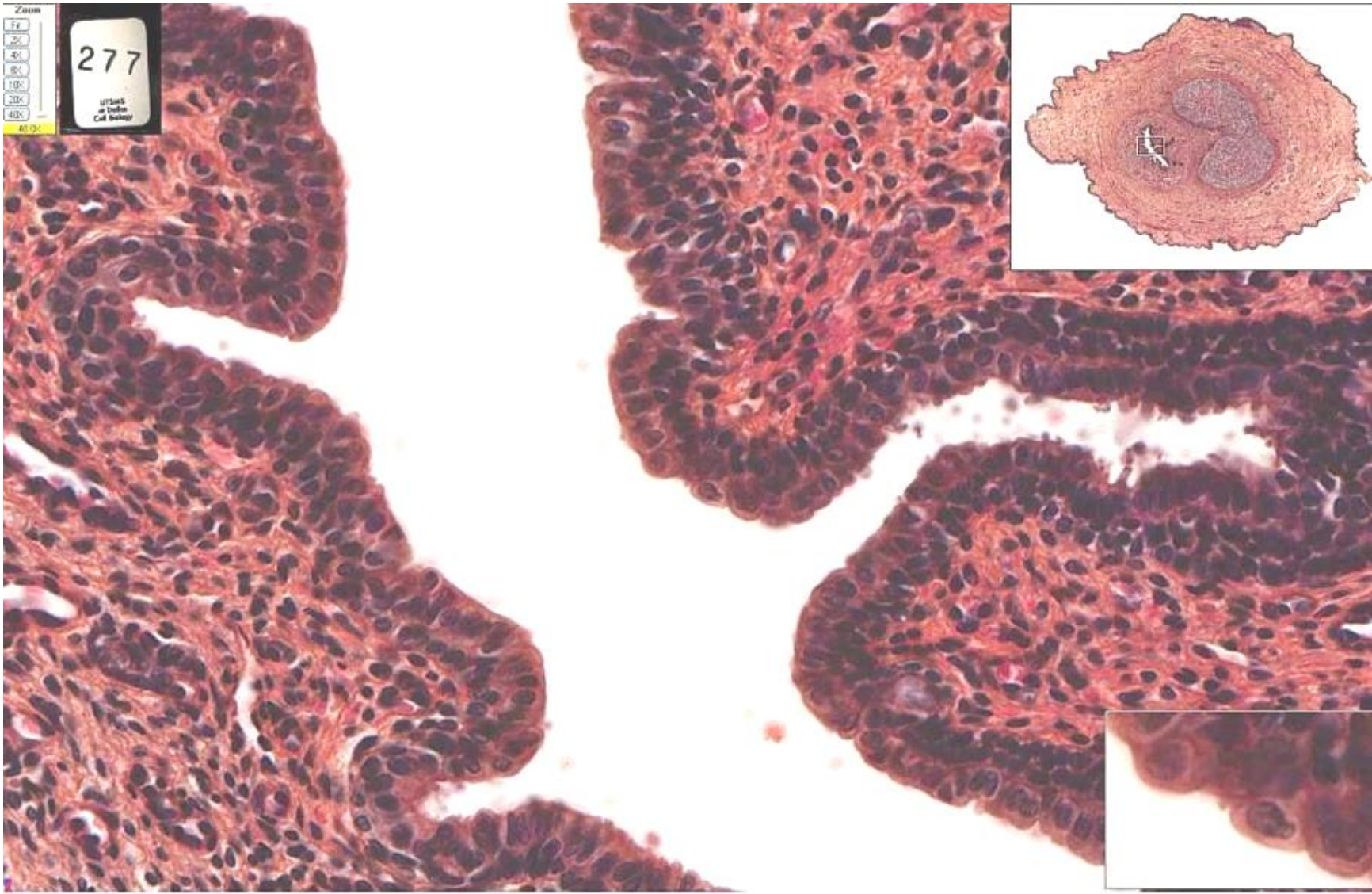
Human penis – transitional or stratified columnar epithelium and surrounding spongy cavernous of penal urethra



Penis – corpus cavernous

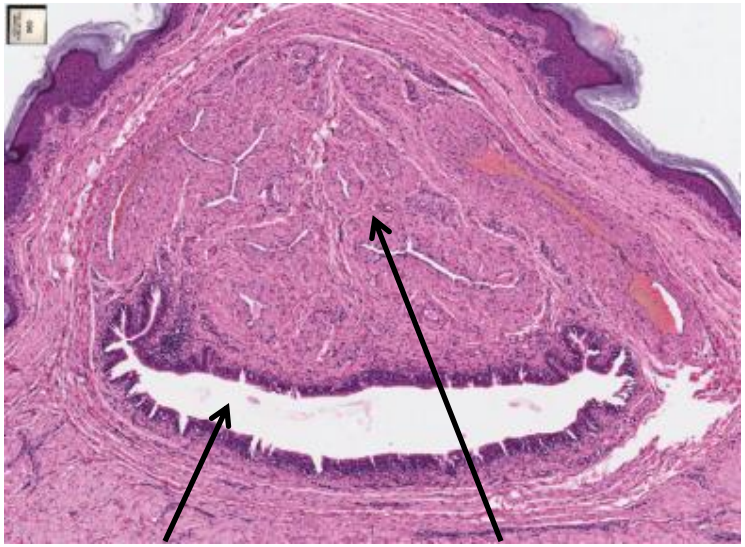


Penis - transitional or stratified columnar epithelium of penal urethra

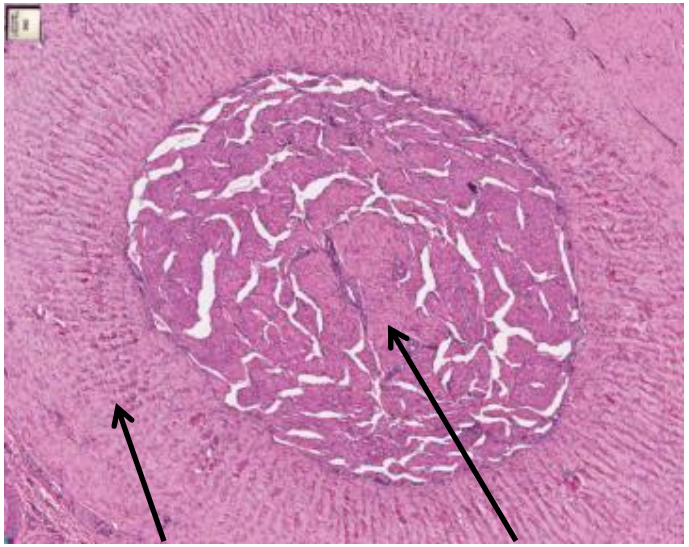


Slide 98: Penis (monkey)

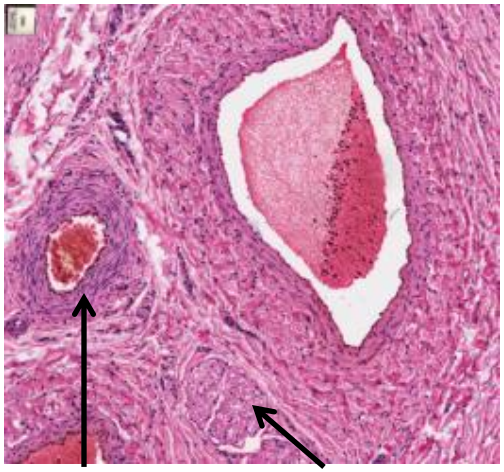
Vasodilation of this corpus tissue occurs in response to parasympathetic stimulation?



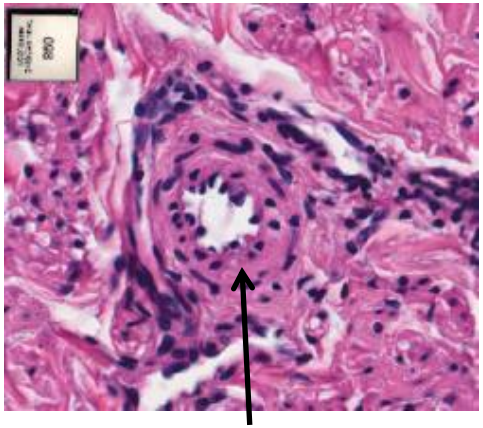
Urethra Corpus spongiosum



Tunica albuginea Corpora cavernosa



Blood vessels and nerve of penis



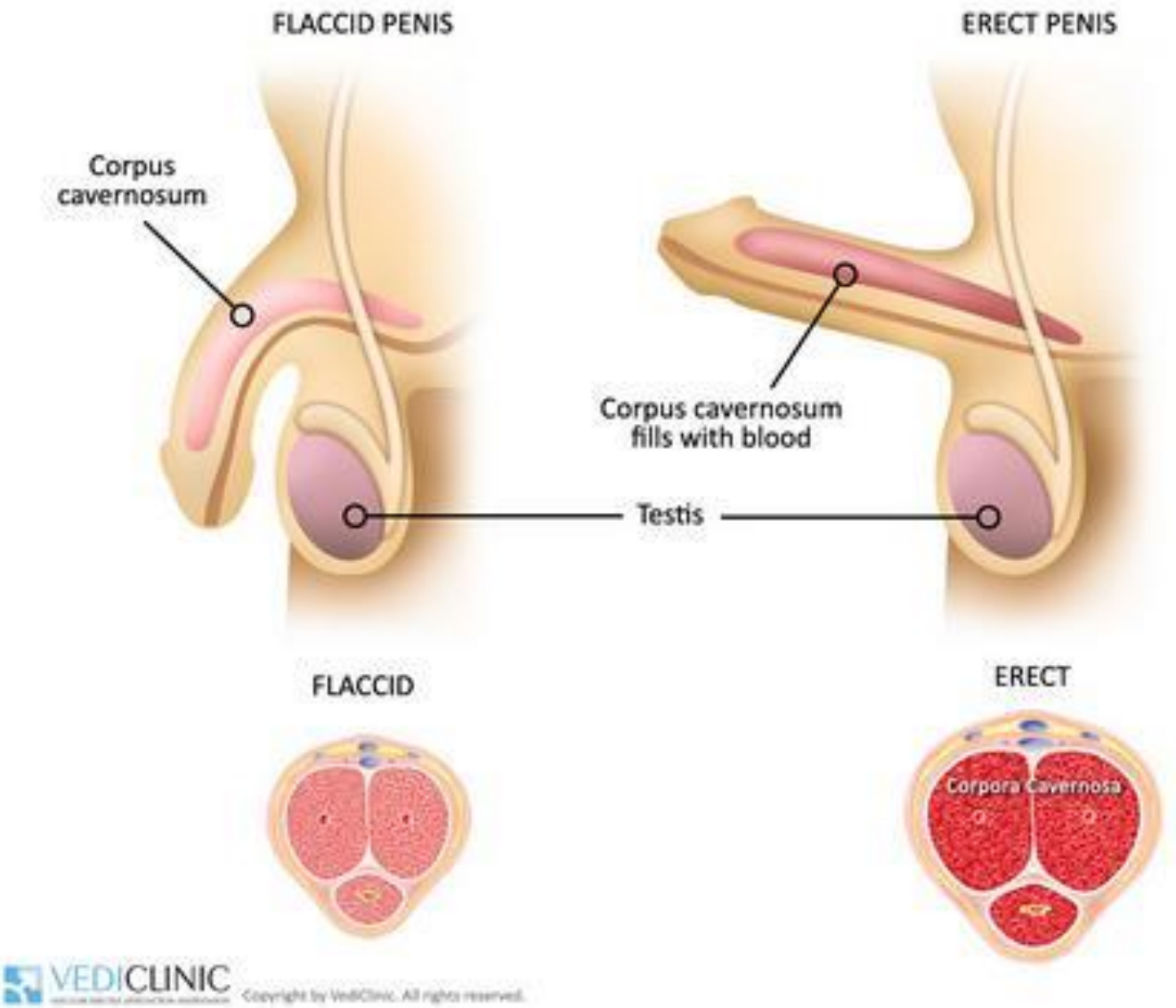
Small deep artery

Fig. Mechanism of erection

“Erection occurs as a complex process, constituted by psychological, neurological, hormonal, and vascular factors.

The penis is composed of three basic anatomical structures – two longitudinal cavernous bodies (a kind of chambers) and one spongy body, including the urethra. These are the cavernous bodies that (supplied by respective arteries) increase their volume during erection, owing to the inflowing blood. …Arteries (as opposed to veins)… – by dilation or contraction – regulate the blood flow”.

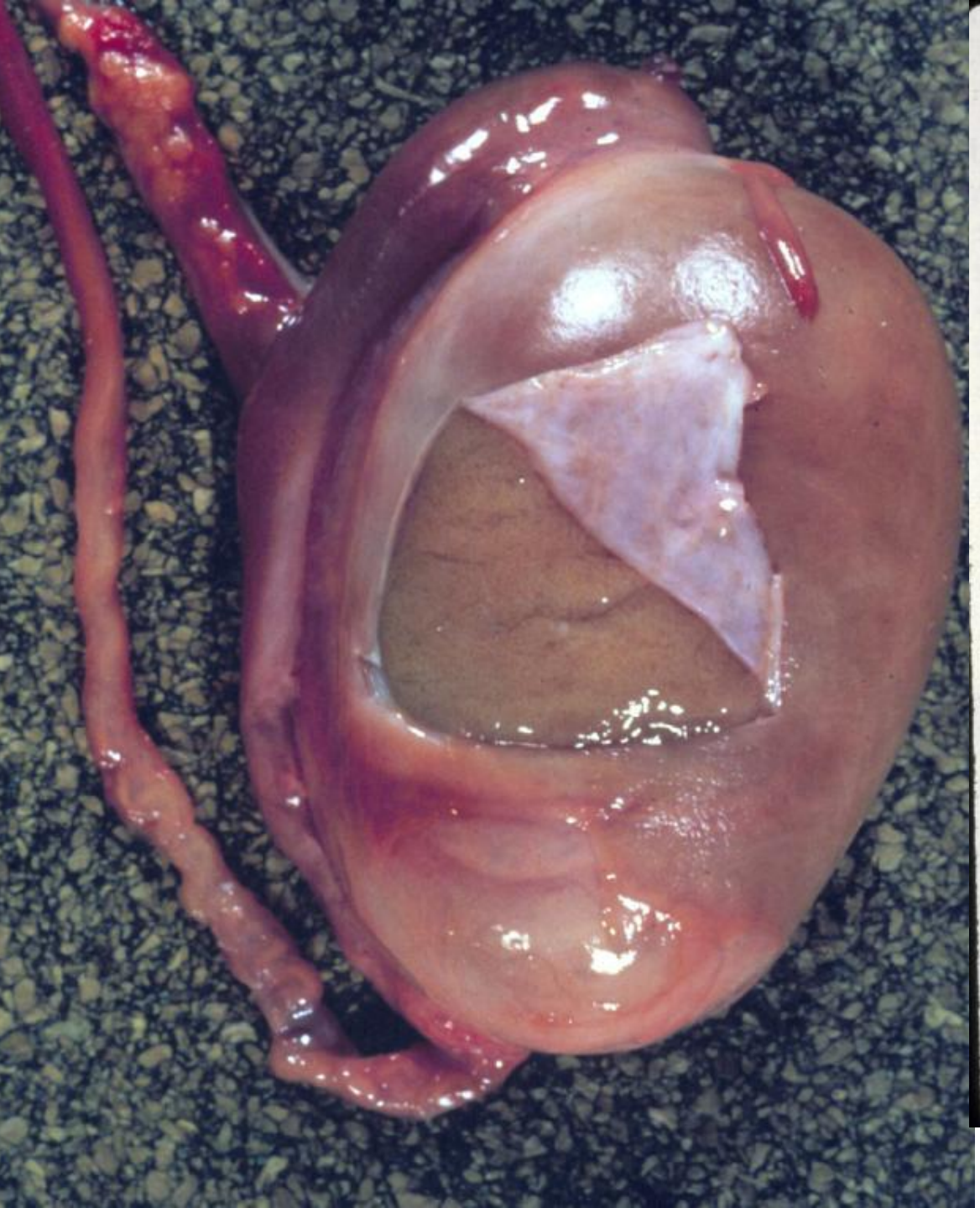
http://www.vediclinic.com/the-mechanism-of-erection.html

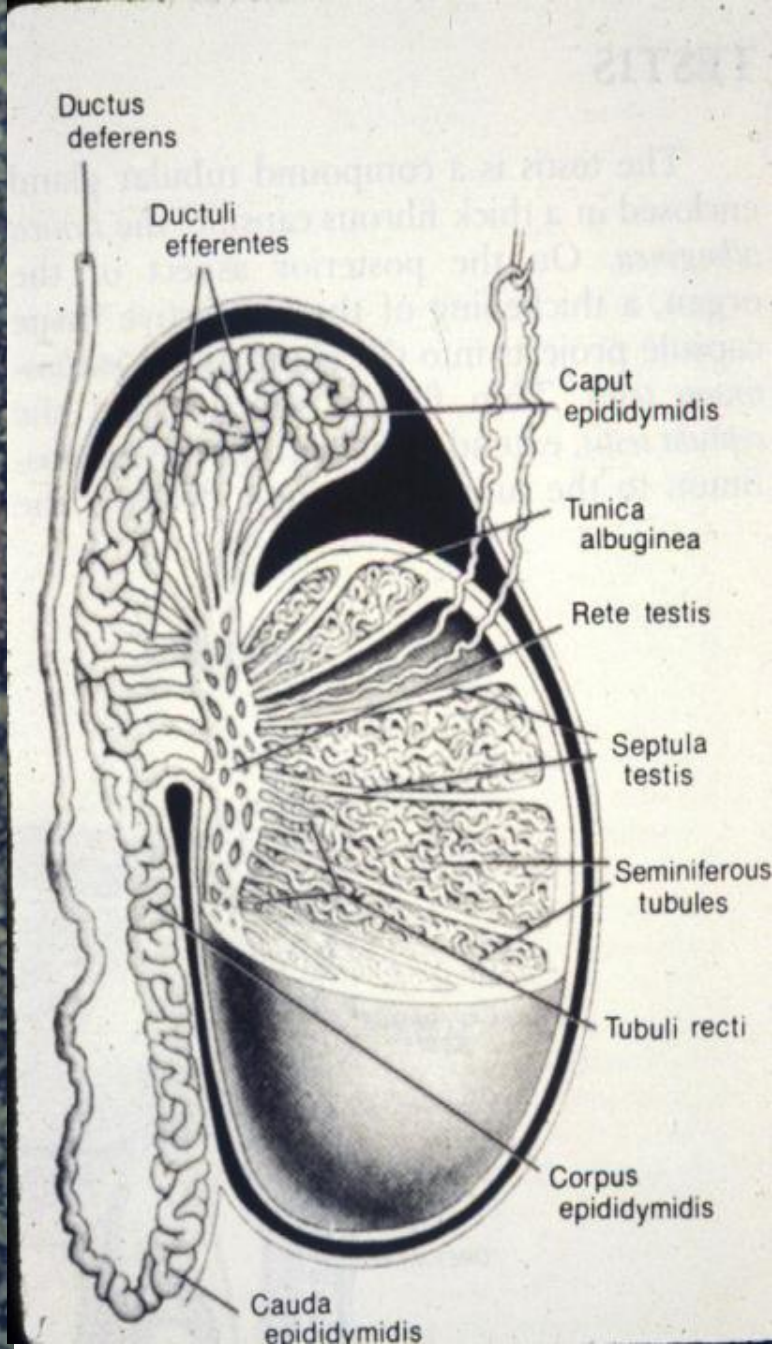


http://www.vediclinic.com/the-mechanism-of-erection.html

“..With sexual arousal the increasing activity autonomic nervous system stimulates the release of neurotransmitters at nerve endings in the cavernous bodies or in the endothelium of the arteries. This leads to secretion of NO – nitric oxide, which is one of the strongest smooth muscle relaxants. With dilated cavernous arteries, the amount of blood flowing into the penis increases, and its outflow is hindered by a physiological compression of some specific veins. Moreover, contraction of the ischiocavernous muscle stabilises the penis in erectile position. A key factor of effective erection is the condition of the vascular system, ensuring a proper perfusion of the reproductive organs. Any pathologies of this system (e.g., atherosclerosis, coronary disease, hypertension) lead to problems with erection”.

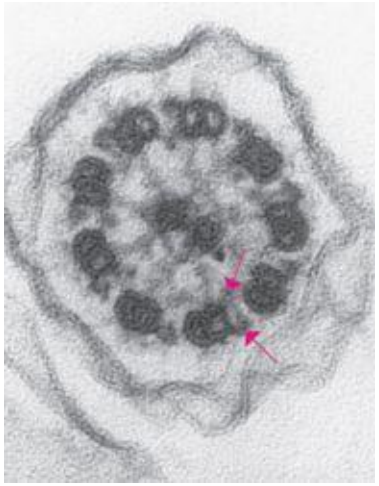
http://www.vediclinic.com/the-mechanism-of-erection.html

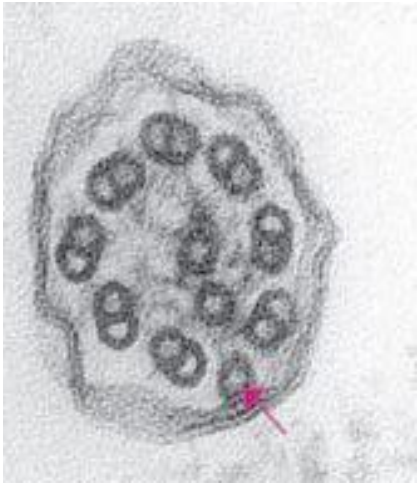



Ductus deferens
Ductuli efferentes
Caput epididymidis
Tunica albuginea
Rete testis
Septula testis
Seminiferous tubules
Tubuli recti
Corpus epididymidis
Cauda epididymidis

Clinical Correlation

A male patient suffers from infertility, immotile spermatozoa and repeated respiratory infections. You suspect Kartagener syndrome.





Images from Primäre ciliäre Dyskinesie und Kartagener-Syndrom at Lungenliga.de

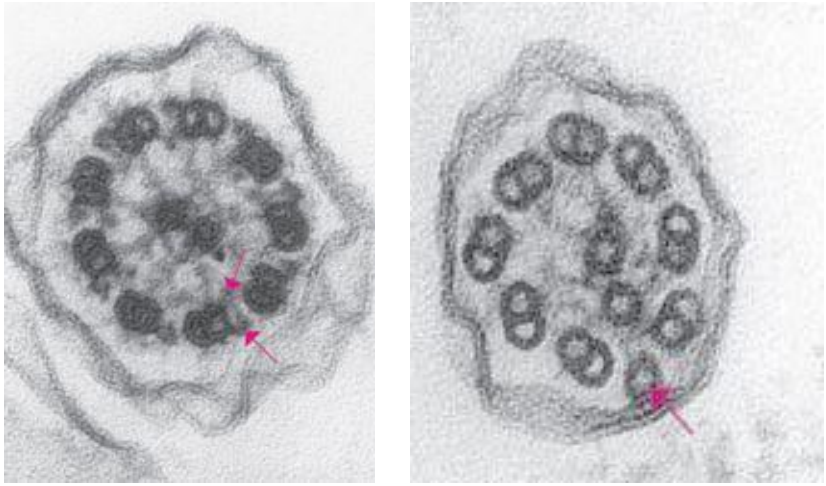
Normal cilia with proper dynein arms

Abnormal cilia lacking dynein arms of Kartagener patient

Clinical Correlation

A male patient suffers from infertility, immotile spermatozoa and repeated respiratory infections. You suspect Kartagener syndrome.

- Both sperm flagellum and respiratory epithelium cilia contain axonemes, which require proper dynein arms for mobility. In Kartagener syndrome, the patients' dynein arms are defective; and therefore, the patient lacks proper motility of sperm flagellum and respiratory epithelium cilia.
- This often results in male infertility (the sperm cannot swim to reach or penetrate the egg) and recurrent respiratory infections (cilia cannot move mucous).



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Normal cilia with proper dynein arms

Abnormal cilia lacking dynein arms of Kartagener patient

Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

- Bruce Alberts, et al. 1983. Molecular Biology of the Cell. Garland Publishing, Inc., New York, NY.
- Bruce Alberts, et al. 1994. Molecular Biology of the Cell. Garland Publishing, Inc., New York, NY.

- William J. Banks, 1981. Applied Veterinary Histology. Williams and Wilkins, Los Angeles, CA.

- Hans Elias, et al. 1978. Histology and Human Microanatomy. John Wiley and Sons, New York, NY.

- Don W. Fawcett. 1986. Bloom and Fawcett. A textbook of histology. W. B. Saunders Company, Philadelphia, PA.
- Don W. Fawcett. 1994. Bloom and Fawcett. A textbook of histology. Chapman and Hall, New York, NY.

- Arthur W. Ham and David H. Cormack. 1979. Histology. J. S. Lippincott Company, Philadelphia, PA.

- Luis C. Junqueira, et al. 1983. Basic Histology. Lange Medical Publications, Los Altos, CA.
- L. Carlos Junqueira, et al. 1995. Basic Histology. Appleton and Lange, Norwalk, CT.

- L.L. Langley, et al. 1974. Dynamic Anatomy and Physiology. McGraw-Hill Book Company, New York, NY.

- W.W. Tuttle and Byron A. Schottelius. 1969. Textbook of Physiology. The C. V. Mosby Company, St. Louis, MO.

- Leon Weiss. 1977. Histology Cell and Tissue Biology. Elsevier Biomedical, New York, NY.
- Leon Weiss and Roy O. Greep. 1977. Histology. McGraw-Hill Book Company, New York, NY.

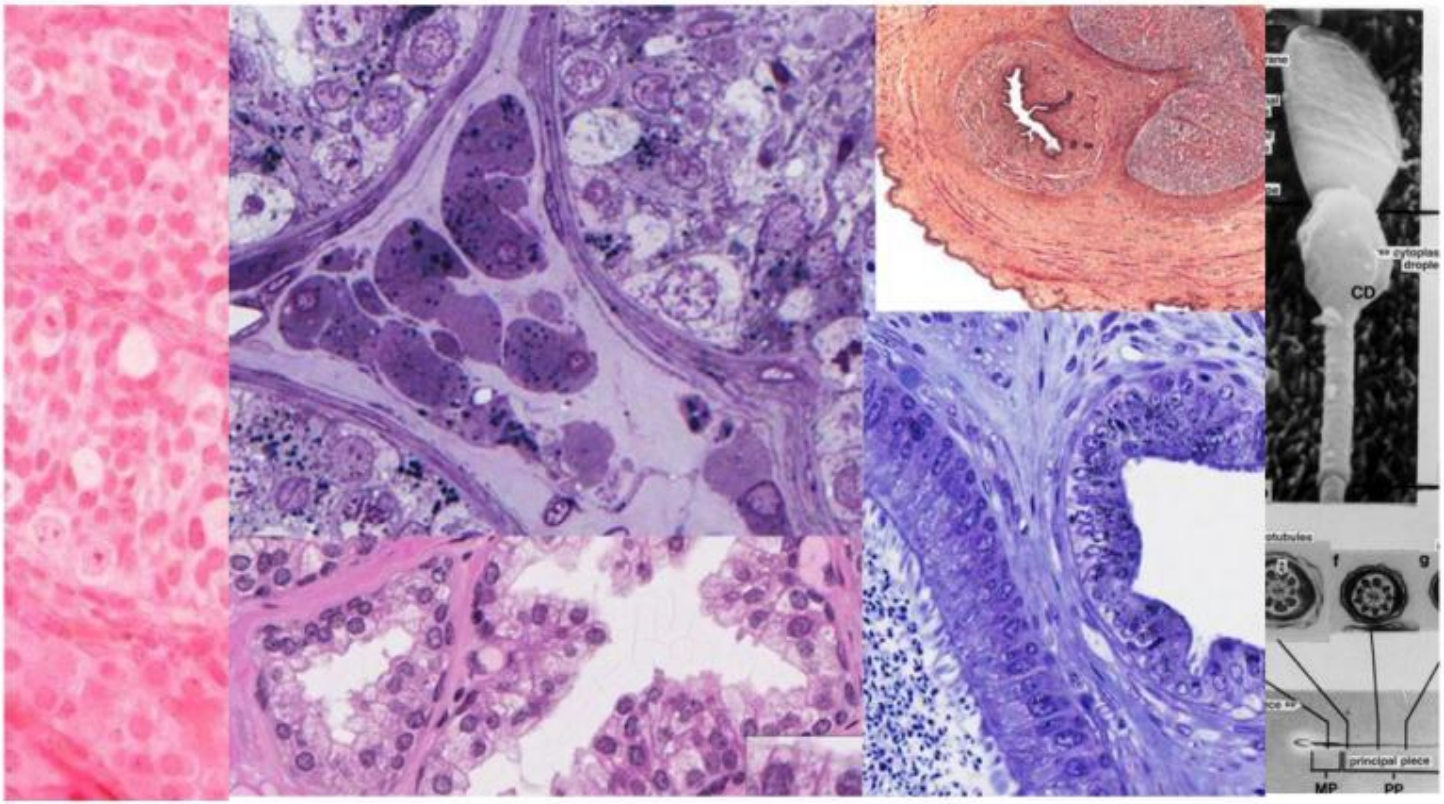
- Nature (http://www.nature.com), Vol. 414:88,2001.
- Arthur C. Guyton,1971.Textbook of Medical Physiology W.B. Saunders company, Philadelphia, PA
- WW Tuttle and BA Schottelius 1969 Textbook of Physiology C.V. Mosby Co.

- A.L. Mescher 2013 Junqueira's Basis Histology text and atlas, 13th ed. McGraw

- Douglas P. Dohrman and TAMHSC Faculty 2012 Structure and Function of Human Organ Systems, Histology Laboratory Manual - Slide selections were largely based on this manual for first year medical students at TAMHSC

End of

Male reproductive system: Part 2 Excurrent ducts



Dr. Larry Johnson Texas A&M University

The End!