EXERCISE 12 NEMATODA : OBSERVATION AND CLASSIFICATION OF SPECIMENS AND MICROSCOPIC STUDY OF SECTIONS OF *ASCARIS*

Structure

12.1 INTRODUCTION

The present laboratory exercise is based on Unit-4 (Section 4.7) of Block 2 of the Theory Course LSE-09 which deals with tlie features of Phylum Nematoda. You will recall from that unit that members of Phylum Nematoda (Greek *nematos*: thread) popularly called thread worms are wrongly referred to as worms, since these are not worms, In this unit you will study with the help of permanent slides the distinguishing features of tlie type specimen *Ascaris lumbricoides* of Phylum Nematoda.

Objectives

After performing this exercise you should be able to:

- identify tlie genus of the common human intestinal round worm *Ascaris* (male and female) as an example of Phylum Nematoda and give its scientific name,
- classify *Ascaris lumbricoides* upto the level of order.
- list common features of *A. lumbricoides* and also give its special feature justifying its classification.

  draw labelled diagrams of tlie male and female *Ascaris.*
- identify, describe and draw labelled diagrams of transverse sections (T.S.) of male and female *Ascaris lumbricoides*.

12.2 REVIEW OF CHARACTERISTICS OF PHYLUM NEMATODA AND ITS POSITION IN ANIMAL CLASSIFICATION

Nematodes may be free-living or parasites of plants or animals. However, all nematodes are similar in structure, irrespective of whether they arc free-living or parasites of plants or of animals and they never vary much in form, even in their larval stages. Before studying the type specimen – *Ascaris* of nematode let us first review tlie characteristic features and classification of nematodes.

12.2.1 Features of Phylum Nematoda

Phylum characteristics of Nematoda which are the world's most abundant multicellular organisms are as follows:

i) Nematodes occur in all types of habitat – fresh water, marine waters and terrestrial habitats and may be free living or parasitic on plants or animals.

ii) Nematodes are usually long, cylindrical animals with tapered rounded ends, though some parasitic forms become sac-like in shape.

iii) Nematodes are, bilaterally symmetrical, unsegmented or superficially segmented, triploblastic, pseudocoelomate animals.

iv) Nematodes are termed peseudocoelomate since their body cavity is a pseudocoelom which occurs between gut and body wall and develops embryologically from the blastocoel of the blastula embryo.

v) Nematode body wall is composed of (i) an outermost, strong, flexible, non-cellular cuticle layer, (ii) an inner epidermis and (iii) an innermost layer of longitudinal muscles.

vi) The pseudocoel cavity is small and is filled with the intestine and the reproductive system which consist of ovary and oviducts in females or vas deferens and testes in males.

vii) Digestive system consists of a straight tubular gut which includes mouth, muscular pharynx, pharyngeal glands and long intestine, that open posteriorly to the outside by a subterminal anus.

viii) Nematodes have specialized mouth parts, particularly in parasitic forms.

ix) Nervous system is simple, consisting of a circumpliaryngeal nerve around the pharynx that posteriorly gives rise to two nerves which run the length of the nematode, one on the dorsal (back) and one on the ventral (belly) side. A few tiny sense organs are located on the head of the nematode.

x) Excretory system is present. In some nematodes, specialized excretory cells are found; in some examples canals may be present, while still in some others both excretory cells and canals may be found.

xi) Flame cells are absent.

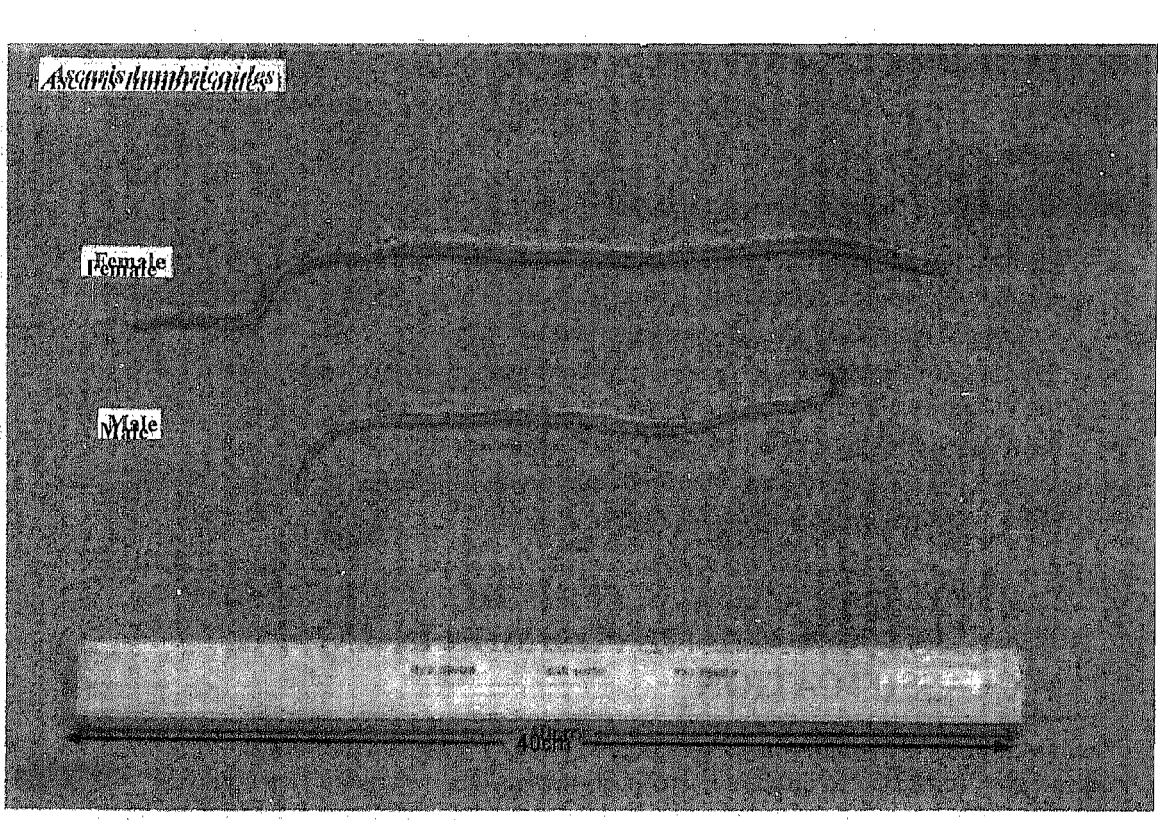


Fig. 12.1: Relative size of sexes of *Ascaris*. a) female, b) male.

xii) Respiratory and circulatory systems are absent in nematodes.

xiii) Nematodes reproduce sexually. Most species have separate males and females and so nematodes are called dioecious. Males are usually smaller than the female of the species (Fig. 12.1).

[Fertilization is internal. Parasitic round worms often have complex life cycles, involving two hosts or more.]

12.2.2 Systematic Position of Nematoda in Classification

Classification **and** its **Justification**

Kingdom	**Animalia**	Animals, multicellular organisms with cells that lack a cell wall. Many capable of movement or movement of some of their body parts or capable of movement at some time in their life cycle; hetrotrophic nutrition.
Sub-kingdom	**Eumetazoa**	Animals with tissues and organs.
Grade – 1	**Bilateria**	Bilateral animals.
Division A	**Protostomia**	Cleavage is determinate and commonly spiral, mouth arising from blastopore.
Sub-group	**Ecdyzoa**	Moulting animals.
Phylum	**Nematoda**	Bilaterally symmetrical, triploblastic, pseudo-coelomate, vermiform, non-segmented moulting animals with body covered with cuticle.

12.3 MATERIAL REQUIRED

1. Museum specimens of male and female *Ascaris lumbricoides*.
2. Permanent slides of transverse sections through body of male and female *Ascaris*.
3. Compound microscope.
4. Lab record book
5. Pencil.
6. Pen.
7. Eraser.

12.4 METHOD

Carefully examine tlie entire male and female specimens of *Ascaris lumbricoides*. Note the common features of the two sexes as well as tlieir differences. Draw labelled diagrams of male and female *Ascaris* in your practical record file. Also, study tlie transverse section of tlie body of male and female *Ascaris lumbricoides* under microscope and note tlieir similarities and dissimilarities. The points listed in this exercise and tlie drawings already given, will help you to perform your task.

12.5 MALE AND FEMALE *ASCARIS* LUMBRICOIDES – THE TYPE SPECIMEN OF PHYLUM NEMATODA

Ascaris lumbricoides unlike most free-living nematodes and a large number of parasites of plants and animals are not tiny or microscopic. Instead they are about 25 cm long and easily visible to tlie naked eye. *Ascaris lumbricoides* is an intestinal parasite of human beings and spends its adult life in tlie human intestine. Its main features are as Follows:

Features

i) *Ascaris lumbricoides* is commonly called round worm (Fig. 12.1 and 12.2 a & b).
ii) Body is elongated, cylindrical, tapering at both ends.
iii) Body surface is marked with four longitudinal lines, one mid-dorsa!, one midventral and two lateral lines.
iv) Mouth is provided with three lips (i) a median dorsal lip and (ii) a pair of symmetrical submedial ventral lips.
v) Sexes are separate and sexual dimorphism is well marked.
vi) Male is smaller than female and measures 15 to 31 cm in length (Fig. 12.1 and 12.2) with posterior end curved ventrally (Fig. 12.2 e and 12.2 h).

vii) Female is large, measuring a length of 20 to 35 cm with posterior end straight arid blunt (Fig. 12.2 g).

viii) Male has single testis and seminal vesicle. Seminal vesicle leads to tlie exterior via an ejaculatory duct located alongside tlie anus. It is also provided at tlie posterior end with a pair of curved spicules known as penial setae wliicli are the copulatory organs. Males also possess pre- and post-anal papillae, which are lacking in female (Fig. 12.2 h).

ix) The female has 2 ovaries, 2 oviducts and 2 uteri joining at a single vagina and opening through a gonopore also called genital aperture which lies at a distance of about one-third of tlie length of the body from tlie anterior end.

x) Excretory pore is small and lies on tlie ventral side about 2 mm away from the anterior end.

xi) Life cycle is simple and monogenetic. No secondary host is involved.

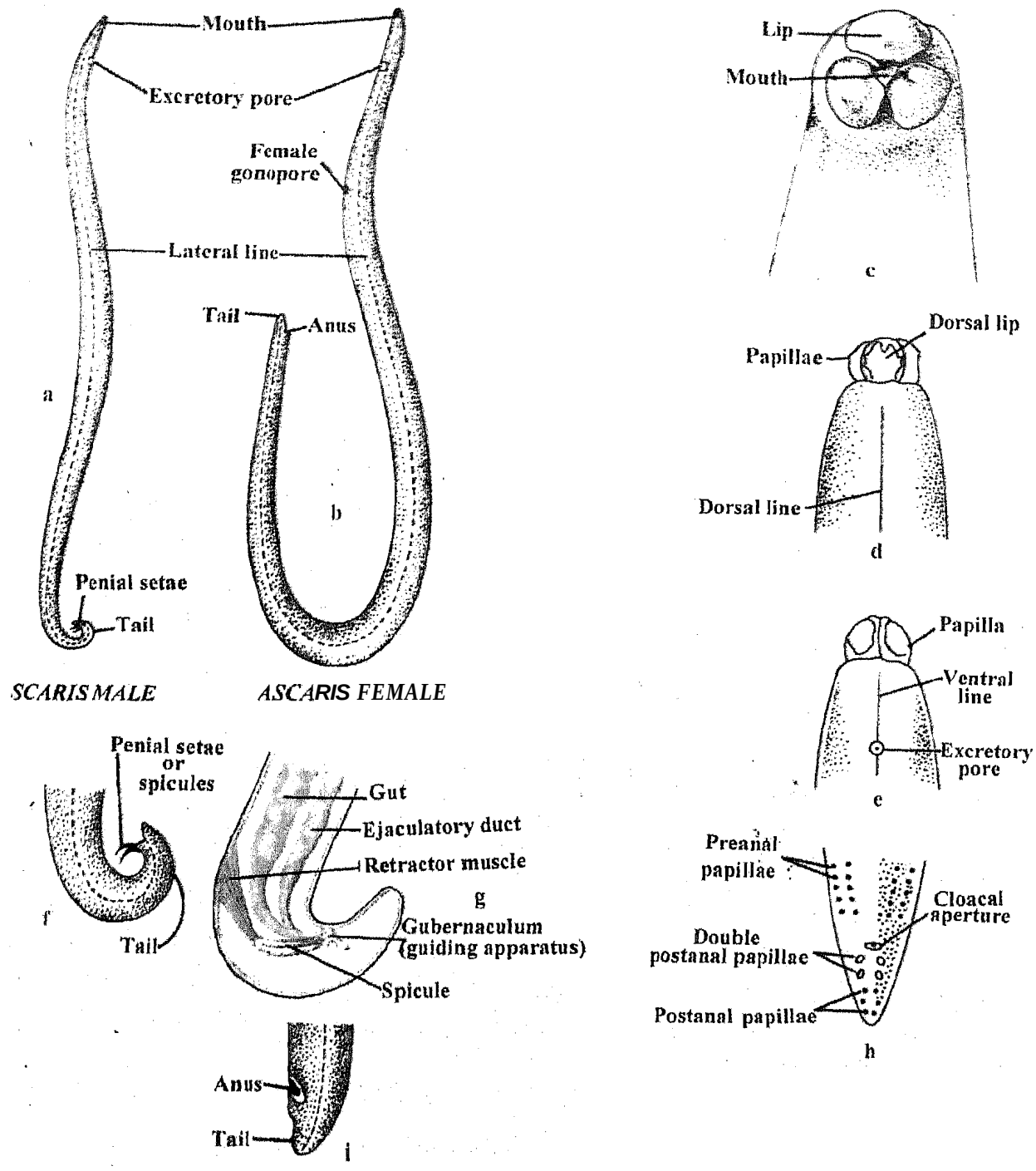


Fig. 12.2: *Ascaris lumbricoides.* a) Male. b) **Female.** c) Entire view of mouth **and** lips (''En face view''). d) Anterior end in dorsal view. e) Anterior end **in** ventral view. f) External view of posterior end of male. **g)** Internal view of posterior end of male. h) Posterior end of male in ventral **view** showing **papilla.** i) Posterior end of female.

Geographical Distribution

Ascaris is cosmopolitan in distribution. It is more prevalent in Pacific Islands, Korea, Philippines, China and India (Fig. 12.1).

Habit and Habitat

Ascaris lumbricoides is a common endoparasite found in the small intestine of humans in all parts of the world. 500-5000 adult ascaris may be present in a single host. They may cause abdominal discomfort and colic pain with diarrhea and vomiting. These symptoms may be called **ascariasis.**

Classification and its Justification

Kingdom	**Animalia**	Animals, multicellular organisms with cells that lack a cell wall. Marly capable of movement or movement of some of tlieir body parts or capable of movement at some time in their life cycle; hetrotrophic nutrition.
Phylum	**Nematoda**	Bilaterally symmetrical, triploblastic, pseudo-coelomate, vermiform, non-segmented moulting animals with body covered with cuticle.
Class	**Secernentea (Phasmidia)**	Body covered with a pair of minute, sensory pouches (phasmids) near posterior tip; similar pair of sense organs at anterior end called amphids which are poorly developed; excretory system with one or two lateral canals, with or without associated glandular cells; both free-living and parasitic forms.
Order	**Ascaridids**	Parasitic in intestine of vertebrates; three prominent lips, pharynx without a posterior bulb; tail in female straight and blunt while in males it is curved with two copulatory spicules.
Genus	***Ascaris***	
Species	***lumbricoides***	
Commmon name	**Round worm**	

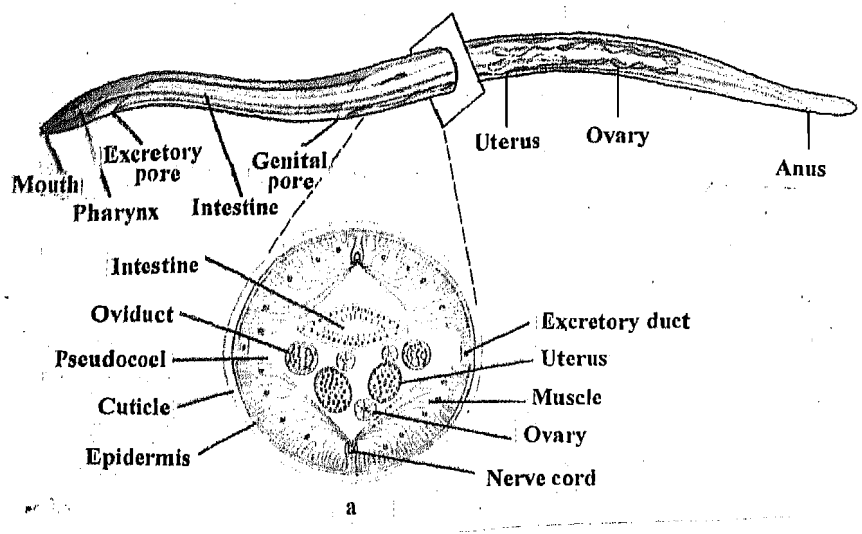
12.6 TRANSVERSE SECTION OF BODY OF *ASCARIS LUMBRICOIDES.*

The transverse sections of male and female *A, lumbricoides* exihibit some differences based on their sex.

12.6.1 T.S. of Female *Ascnris* (Pig. 12.3)

1. Body wall consists of tlie following:
   (a) **Cuticle** is the outermost layer. It is a thick, tough, elastic membrane covering the epidermis.
   (b) **Epidermis,** also called subcuticle, lies below tlie cuticle and is syncytial.
   (c) **Muscle** layer is the innermost layer of the body wall and is composed of a single layer of spindle-shaped muscle cells arranged longitudinally. .
2. Epidermis is thickened into ridges in four regions which project into tlie body cavity as the four longitudinal chords (also called lines) of which two are lateral, one dorsal and one ventral.
3. Presence of the four longitudinal chords results in.the easy identification of four bands of muscles - two dorso-lateral and two ventro-lateral.
4. Two lateral excretory canals are visible inside the two lateral lines or chords.
5. Dorsal and ventral nerves run in the dorsal and ventral lines respectively.
6. The space between the body wall and alimentary canal is the pseudocoel (false body cavity), Pseudocoel has fibrous tissue and fixed cells called coelomocytes or pseudocoelocytes or giant cells.

7. Pseudocoelom contains tlie transversely cut portions of alimentary canal, uteri, oviducts and ovaries.
8. In ovaries lumen is absent . Ovaries have a central rachis with the young eggs clustered around it.
9. Uterus has a wide lumen which is loaded with unfertilized eggs. Eggs have single nucleus and cytoplasm.
10. Oviducts contain eggs in lumen.
11. Ovary, oviduct and uterus are elongated and coiled structures for which reason they appear more than one in sections.
12. Intestine is visible as a dorso-ventrally flattened structure formed of a single layer of columnar epithelial cells, lined externally by a thin layer of cuticle. Intestine has no muscle layer.



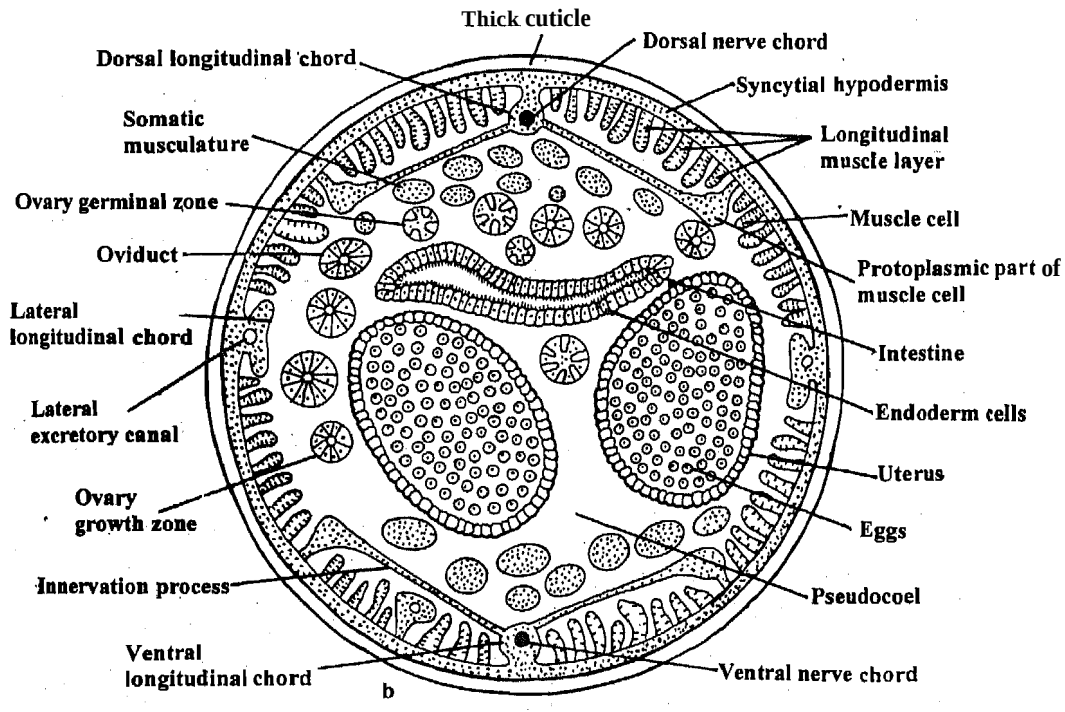


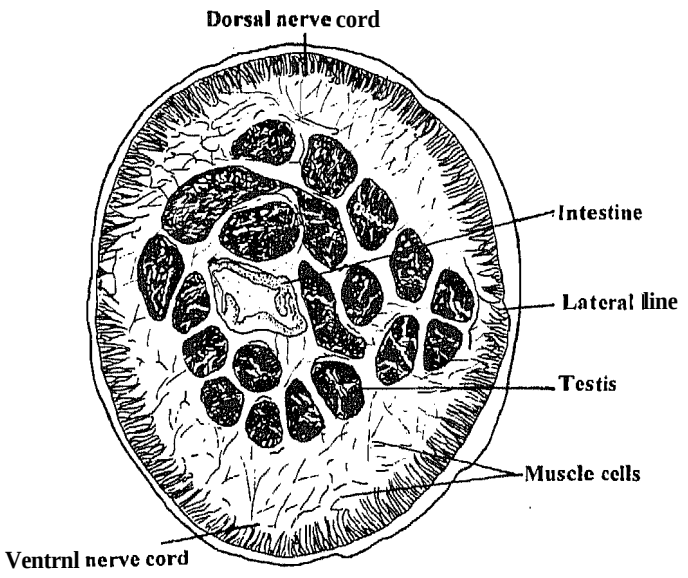
Fig. 12.3: Transverse Section of female *Ascaris*. a) As seen under the slide. b) As interpreted from slide.

12.6.2 T.S. of male *Ascnris* (Fig. 12.4).

1. Body wall consists of tlie following:

(a) **Cuticle** is the outermost layer. It is a thick, tough, elastic membrane covering the epidermis.
(b) **Epidermis**, also called subcuticle, lies below the cuticle and is syncytiat.
(c) **Muscle** layer is tlie innermost layer of the body wall and is composed of a single layer of spindle-shaped cells arranged longitudinally.

2. Epidermis is thickened into ridges in four regions which project into the body cavity as the four longtudinal chord (also called lines) of which two are lateral ones, one dorsal and one ventral.
3. Presence of tlie four longitudinal chords results in tlie easy identification of four bands of muscles- two dorso-lateral and two ventro-lateral.
4. Two lateral excretory canals are visible within tlie two lateral lines or cords.
5. Dorsal and ventral nerves run in the dorsal and ventral lines respectively.
6. The space between tlie body wall and alimentary canal is the pseudocoel (false body cavity). Pseudocoel has fibrous tissue and fixed cells called coelomocytes or pseudocoelocytes or giant cells.



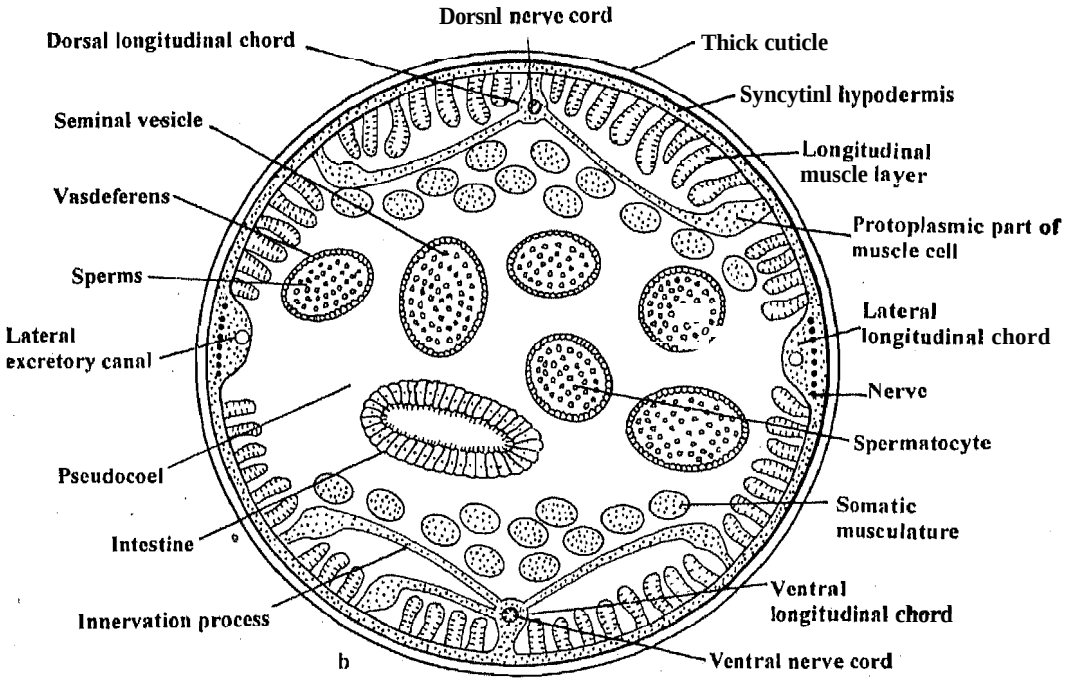


Fig. 12.4: T.S. of male *Ascaris*. n) ns seen in a slide. b) drawing as interpreted from the slide.

7. Transverse section also shows alimentary canal, testis, vasdeferens and seminal vesicles lodged within the pseudocoel.
8. Variously cut portions of the coiled testes are seen in the section. The testes do not have a lumen but possess a central rachis.
9. Sperm duct and seminal vesicles have lumen, filled with abundance of sperms.
10. Intestine is visible as a dorso-ventrally flattened structure formed of a single layer of long endodermal, nucleated epithelial columnar cells.

12.7 TERMINAL QUESTIONS

1. How would you externally distinguish between male and female *Ascaris lumbricoides*?

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2. What is the economic importance of *Ascaris lumbricoides*?

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3. What are the differences between the male and female T.S. of *Ascaris lumbricoides*?

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