

TABLE 50.11. COMPARISON : DIGESTIVE SYSTEM OF VERTEBRATE TYPES.

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
		ALIMENTARY CANAL			
1. Parts of alimentary canal	It consists of buccal cavity, pharynx, oesophagus, stomach, intestine and cloaca.	It consists of buccal cavity, pharynx, oesophagus, stomach, intestine and cloaca.	It consists of buccal cavity, pharynx, oesophagus, stomach, intestine and cloaca.	It consists of buccal cavity, pharynx, oesophagus, stomach, intestine and cloaca.	It consists of buccal cavity, pharynx, oesophagus, stomach, intestine and anus. Cloaca is absent.
2. Mouth opening	Small, crescentic at the ventral side of head, bounded by jaws and leads into buccal cavity.	Wide, terminal, horizontal, semicircular along the anterior end of head, bounded by jaws and leads into buccal cavity.	Wide, terminal along the anterior end of head, semicircular, bounded by jaws and leads into buccal cavity.	Terminal, wide slit-like aperture bounded by jaws and horny beaks and leads into buccal cavity.	Transverse, slit-like subterminal aperture at the snout, bounded by jaws and leads into buccal cavity.
3. Jaws and lips	Lower jaw movable, lips absent. Jaws covered by spi-	Lower jaw movable, lips hard and immo-	Lower jaw movable, lips hard, immovable and scales	Lower jaw movable, lips absent, beaks cover the	Lower jaw movable, lips present, fleshy and hairy.

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
	nous skin.		present.	jaws	Upper lip cleft bearing vibrissae.
4. Buccal cavity	Dorsoventrally flattened and spacious.	Wide and large.	Narrow anteriorly and broad posteriorly.	Somewhat triangular and narrow.	Large, spacious and wide.
(i) Vestibule	Absent.	Absent.	Absent.	Absent.	Narrow space between lips, cheeks and jaws is called vestibule in which mouth opens.
(ii) Teeth	Homodont; sharp, directed backwardly, several rows on the skin covering jaws and are replaced several times during life time (polyphyodont). These are modified placoid scales. used in grasping prey.	Small, conical teeth present on upper jaw only in one row, attached to jaw bones (acrodont) homodont and polyphyodont, used in holding the prey.	Teeth small, conical, acrodont and pleurodont present on both the jaws in a single row, used in grasping and holding the prey.	Teeth not found.	Teeth of several types on both the jaws (heterodont) embedded with their roots in the sockets of jaws (thecodont) and are replaced once in lifetime (diphyodont), used in cutting, holding and masticating the food.
(iii) Diastema	Absent.	Absent.	Absent.	Absent.	Diastema, a toothless space between incisor and premolar.
(iv) Palate	Absent, skull forms the roof of buccal cavity.	Absent, skull forms the roof of buccal cavity.	Absent, skull forms the roof of buccal cavity. A false palate is present in crocodilians.	Palate incompletely developed.	Palate developed, separates the nasal passage from food passage, hence, forms the roof of buccal cavity.
(v) Tongue	Tongue is thick, flat, non-muscular, non-glandular and non-	Large, muscular, sticky, attached anteriorly and free posteriorly	Large, muscular, glandular, attached midventrally, free anteriorly	Large, narrow, triangular attached ventrally and non-pro-	Large, muscular, attached mid-ventrally and grooved

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
(vi) Internal nares	protrusible fold of mucous membrane at the base of buccal cavity. Not used in food capture and taste buds also absent. Absent.	which is notched. Protrusible, used in capturing prey and bears few taste buds. Two small openings on the roof of buccal cavity in front of vomerine teeth.	which is bifid and protrusible covered with papillae having taste buds. Two small rounded openings near the anterior end on the roof of buccal cavity.	trusible covered with fine horny processes and few taste buds. Two small slit-like openings situated at the posterior end of buccal cavity or pharynx.	mid-dorsally. Anterior tip free, protrusible and covered with four kinds of papillae having taste buds. Both the nostrils open into a nasal passage which opens posterior to buccal cavity into the roof of the pharynx.
(vii) Pharynx	Posterior region of buccal cavity represents pharynx. Both are inseparable.	Posterior region of buccal cavity represents short pharynx.	Posterior broad region of buccal cavity represents the pharynx.	Buccal cavity merges behind into pharyngeal cavity.	Pharynx is short at the posterior end of buccal cavity and differentiated into nasopharynx , oropharynx and laryngopharynx .
(viii) Eustachian opening	Absent.	A pair of wide eustachian openings lie on the roof, one on either side laterally near jaw angles. Absent.	A pair of eustachian openings lie, one on either side of roof of pharynx. Absent.	Single eustachian opening in the middle of roof of pharynx. behind internal nares. Absent.	Sides of nasopharyngeal wall are pierced by a pair of oval eustachian openings. Absent.
(ix) Gill-slits	A pair of pit-like spiracle is present on the lateral wall of pharynx and 5 vertical gill-slits are present on either lateral side of pharynx.				
(x) Glottis	Since there is neither trachea	Median slit-like opening in the	Median slit-like opening at the	Oval opening on the floor	Median vertical slit-like

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
	nor lungs, hence it is absent.	floor of bucco-pharyngeal cavity leads into laryngo-tracheal chamber.	floor of pharynx leads into trachea.	of pharynx which leads into trachea.	opening in the floor of laryngo-pharynx, leads into larynx.
(xi) Epiglottis	Absent.	Absent.	Absent.	Absent.	Bilobed cartilaginous flap or epiglottis guards glottis against food entering into it.
(xii) Other bucco-pharyngeal structures	Mucous lining of the pharynx contains dermal denticles.	Floor of pharynx in males only contains an opening of vocal sac on either lateral side near jaw angles. Eye-balls bulge internally on the roof into buccal cavity.	Mucous lining of the pharynx is thrown out into distensible longitudinal folds.	Nasal passages open through internal nares into the roof of the pharynx.	Nasal passages open through internal nares into roof of the laryngo-pharynx.
5. Oesophagus	Short, wide tube with thick muscular wall having longitudinal mucous folds. Opens into cardiac stomach with a sphincter or oesophageal valve.	Short, wide, highly distensible with prominent longitudinal folds and not demarcated from pharynx and stomach.	Long, narrow, muscular tube with mucous folds and highly distensible.	Long, wide, distensible, muscular, thick-walled tube. At the base of neck, it expands into a thin-walled bilobed elastic sac called crop or food-reservoir.	Long, narrow, elastic, muscular tube of uniform diameter. No crop end opens into stomach.
6. Stomach	Long, muscular, U-shaped, divisible into proximal long, broad cardiac part and short, narrow distal pyloric part.	Large, broad, curved, muscular sac on the left side in the body cavity. Proximal cardiac and distal pyloric parts	Long, tubular, curved, muscular tube on the left side in the body cavity. Not demarcated into cardiac and pyloric parts	Represented by an anterior narrow tube-like glandular proventriculus and a posterior broad, thick-walled mus-	Large, bean-shaped on the left side in the abdominal cavity lying transversely and differentiated

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
7. Bursa entiana and gizzard	The junction is marked by a blind sac and a sphincter valve. Cardiac part has well developed longitudinal mucous folds. Bursa entiana is a small, thick-walled muscular sac at the distal end of pyloric stomach through which it opens into intestine. No gizzard.	not marked off externally. Blind sac and sphincter valve absent. Neither bursa entiana nor gizzard.	externally but cardiac part possesses well developed longitudinal muscular folds. Neither bursa entiana nor gizzard.	cular gizzard. It is internally lined by thick horny epithelium. Bursa entiana absent but a well developed, muscular gizzard present which contains stone grits to help in grinding the food.	into cardiac, fundic and pyloric parts. Bursa entiana and gizzard absent.
8. Intestine	Straight, short and wide tube. Not differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.
(i) Small intestine	Not differentiated into duodenum and ileum.	Differentiated into duodenum and ileum.	Duodenum and ileum well marked.	Duodenum and ileum well differentiated.	Duodenum and ileum well marked.
(a) Duodenum	Absent.	Straight tube, forms "U" with stomach, receives hepatopancreatic duct.	Straight tube, receives separate ducts from pancreas and gall bladder.	U-shaped tube, receives two ducts from liver and 3 ducts from pancreas.	U-shaped loop-like, receives one duct each from pancreas and gall bladder.
(b) Ileum and valve	Not distinct. Internal mucous lining is folded into a longitudinal spiral or scroll valve. Villi absent.	Small and coiled. Mucous lining forms several longitudinal folds. True villi absent. No spiral valve.	Long and coiled. Mucous lining forms folds but spiral valve and true villi absent.	Long and coiled. Inner mucous lining projects into several small finger-like villi. No spiral valve.	Very long and coiled. Villi numerous and well developed but no spiral valve.
(c) Accessory structures					
(i) Sacculus rotundus	Absent.	Absent.	Absent.	Absent.	Ileum at its distal end expanded to form sacculus rotundus.

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
7. Bursa entiana and gizzard	The junction is marked by a blind sac and a sphincter valve. Cardiac part has well developed longitudinal mucous folds. Bursa entiana is a small, thick-walled muscular sac at the distal end of pyloric stomach through which it opens into intestine. No gizzard.	not marked off externally. Blind sac and sphincter valve absent. Neither bursa entiana nor gizzard.	externally but cardiac part possesses well developed longitudinal muscular folds. Neither bursa entiana nor gizzard.	cular gizzard . It is internally lined by thick horny epithelium. Bursa entiana absent but a well developed, muscular gizzard present which contains stone grits to help in grinding the food.	into cardiac, fundic and pyloric parts. Bursa entiana and gizzard absent.
8. Intestine	Straight, short and wide tube. Not differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.	Coiled, long and narrow tube, differentiated into small and large intestines.
(i) Small intestine	Not differentiated into duodenum and ileum.	Differentiated into duodenum and ileum.	Duodenum and ileum well marked.	Duodenum and ileum well differentiated.	Duodenum and ileum well marked.
(a) Duodenum	Absent.	Straight tube, forms "U" with stomach, receives hepatopancreatic duct.	Straight tube, receives separate ducts from pancreas and gall bladder.	U-shaped tube, receives two ducts from liver and 3 ducts from pancreas.	U-shaped loop-like, receives one duct each from pancreas and gall bladder.
(b) Ileum and valve	Not distinct. Internal mucous lining is folded into a longitudinal spiral or scroll valve. Villi absent.	Small and coiled. Mucous lining forms several longitudinal folds. True villi absent. No spiral valve.	Long and coiled. Mucous lining forms folds but spiral valve and true villi absent.	Long and coiled. Inner mucous lining projects into several small finger-like villi. No spiral valve.	Very long and coiled. Villi numerous and well developed but no spiral valve.
(c) Accessory structures					
(i) Sacculus rotundus	Absent.	Absent.	Absent.	Absent.	Ileum at its distal end expanded to form sacculus rotundus.

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
(ii) Caecum	Absent.	Absent.	Junction of small and large intestines bear a large caecum and an internal ileocolic valve.	Junction is marked by the presence of a pair of short rectal caeca.	Large thin-walled, tubular, spirally constricted caecum present into which sacculus rotundus opens through ileo-caecal valve.
(iii) Vermiform appendix	Absent.	Absent.	Absent.	Absent.	Caecum ends distally into a blind vermiform appendix.
9. Large intestine	Distal end of intestine forms a short, narrow rectum which opens into cloaca .	Short and broad rectum opens into cloaca .	Represented by thin-walled narrow colon and thick-walled, broad rectum opening into cloaca .	Represented by a short but broad rectum only which leads into cloaca .	Long and consists of anterior sacculated colon and a posterior beaded rectum .
10. Rectal glands	Rectum receives a tubular rectal gland of unknown function dorsally.	Absent.	Absent.	Absent.	Absent.
11. Cloaca and associated structures	Rectum opens into simple cloaca through anus guarded by anal sphincter . It contains urinogenital apertures, a pair of abdominal pores from peritoneal coelom. Bursa Fabrici is lacking.	Single sac-like cloaca into which rectum opens by anus. It contains urinogenital apertures, and bursa Fabrici . Abdominal pores not found. Anal sphincter present.	Rectum opens into 3 linearly arranged chambers forming cloaca; coprodaeum , urodaeum and proctodaeum . Anal sphincter present but abdominal pores and bursa Fabrici not found.	Rectum opens into cloaca by anus guarded by anal sphincter . Cloaca 3 chambered as in lizard. Abdominal pores not found. In young birds only a thick-walled small pouch called bursa Fabrici present dorsally on proctodaeum.	Cloaca absent. Rectum opens directly to outside by anus having anal sphincter . Abdominal pores and bursa Fabrici not found.

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
12. Cloacal aperture	Cloaca opens out ventrally between pelvic fins by a longitudinal slit-like cloacal aperture.	Cloaca opens out through a circular cloacal aperture at the hind - end of trunk between hindlimbs.	Cloaca opens midventrally at the junction of trunk and tail by a transverse slit-like cloacal aperture.	Cloaca opens at the base of tail ventrally by a transverse slit-like cloacal aperture with tumid lips.	Cloacal aperture absent.
DIGESTIVE GLANDS					
1. Salivary glands	Absent.	Absent.	A few mucus-secreting salivary glands are said to be present in the buccal cavity.	Buccal glands of mouth cavity probably secrete mucus but they are not salivary glands.	Salivary glands of different kinds found which open into buccal cavity by separate ducts. They secrete saliva containing an enzyme ptyalin .
2. Gastric glands	Stomach contains gastric glands to secrete gastric juice containing HCl and pepsin .	Found in stomach lining secreting gastric juice containing HCl and pepsinogen .	Found in the mucous lining of stomach.	Found in the lining of proventriculus secreting gastric juice containing HCl and enzymes.	Present in the lining of stomach and secrete gastric juice containing HCl and enzymes.
3. Mucous glands	Aquatic forms have no mucous glands.	Lining of buccopharyngeal cavity and oesophagus contains mucous glands secreting mucus.	Scanty mucous glands.	Mucous glands few, present in buccal cavity and on tongue.	Mucous glands present in the entire inner lining of alimentary canal.
4. Pancreas and pancreatic duct	Compact, bilobed, whitish gland between cardiac and pyloric stomachs. A single pancreatic duct opens into proximal end of intestine.	Highly branched, irregular, cream-coloured gland lying between stomach and duodenum. Small pancreatic ducts open into bile duct.	Elongated, narrow, white-coloured gland between pyloric stomach and duodenum. A single pancreatic duct opens directly into duodenum.	Band-like, narrow, pinkish gland between the two limbs of duodenum. Three pancreatic ducts open separately into distal limb of duodenum.	Irregular, diffused, pinkish gland surrounded by duodenal loop. A single pancreatic duct leads into the distal end of duodenum.

(Contd.)

Characters	<i>Scoliodon</i> (Dogfish)	<i>Rana</i> (Frog)	<i>Uromastix</i> (Spiny-tailed lizard)	<i>Columba</i> (Pigeon)	<i>Oryctolagus</i> (Rabbit)
5. Liver	Large, bilobed, yellowish gland in abdominal cavity.	Large, 3-lobed, reddish brown gland.	Large, bilobed, dark red coloured gland. Right lobe extends up to gonad. A minor third lobe present according to some workers.	Large, compact, bilobed dark red coloured gland. Right lobe larger.	Large, red coloured, 5-lobed-right and left, lateral, caudate and Spigelian lobes.
6. Gall bladder and bile duct	V-shaped, thin-walled attached to right liver lobe in which bile is collected from both the liver lobes. A single bile duct from gall bladder opens into the beginning of intestine.	Large, spherical, greenish, situated ventrally between two main lobes of liver. Cystic ducts from gall bladder and hepatic ducts from liver join to form bile duct which receives several pancreatic ducts to form hepatopancreatic duct , that opens into duodenum.	A spherical gall bladder present between right and left lobes of liver ventrally. Two bile ducts open separately into duodenum.	Absent, Two separate bile ducts start from liver to open separately in the proximal and distal limbs of duodenum.	Elongated, dark green coloured gall bladder found ventrally in the posterior part of right central lobe of liver. A cystic duct from gall bladder meets with several hepatic ducts from liver to form a common bile duct , that opens into proximal limb of duodenum near pylorus.
FOOD AND FEEDING HABIT					
1. Feeding habit	Carnivorous and predaceous.	Carnivorous and predaceous.	Usually herbivorous, insectivorous also.	Chiefly herbivorous, sometimes insectivorous.	Herbivorous and also coprophagous.
2. Food	Crabs, lobsters, worms and small fishes.	Living insects, worms, small molluscs, crustaceans, small fishes and tadpoles.	Grasses, flowers, fruits, succulent leaves of wild shrubs and trees. Sometimes it preys on insects also.	Cereals, pulses, seeds and at times insects, snails, slugs, etc.	Green leaves, vegetables, grasses, cereals, roots, barks, etc.

Type 5. *Scoliodon* : A Cartilaginous Fish (The Dogfish)

149

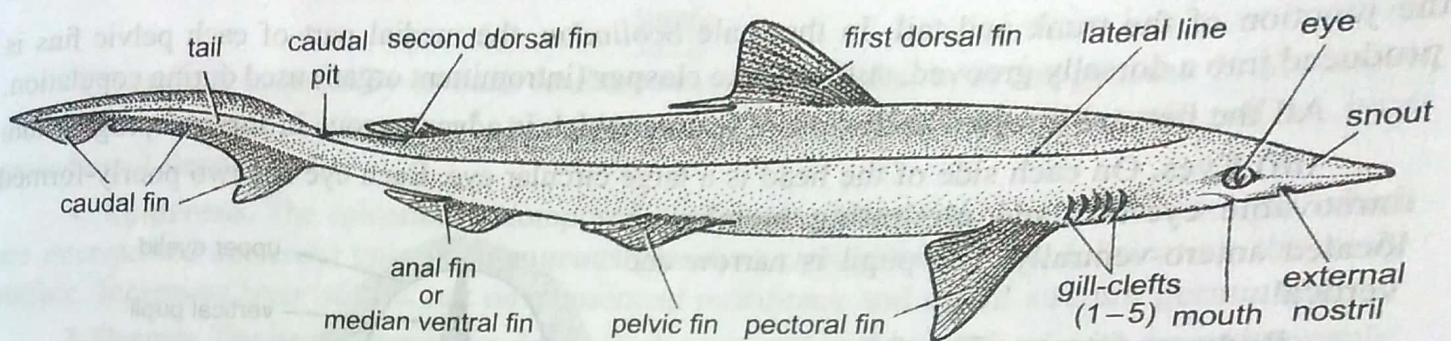


Fig. 14.1. *Scoliodon*. External features.

Division of Body

The body is divisible into **head**, **trunk** and **tail**, though there are no distinct boundaries between these regions.

(i) **Head.** The head is strongly compressed dorso-ventrally and is produced in front into a wedge shaped snout.

the pharynx enclosing the heart. It is enclosed between a tightly fitting smooth layer of lining the outer wall of the cavity and the inner pericardial layer which adheres to the heart itself. The pericardial cavity contains a clear colourless fluid, the **pericardial fluid**. The pericardial cavity communicates with the abdominal cavity through an aperture in the septum transversum, the **pericardio-peritoneal canal**.

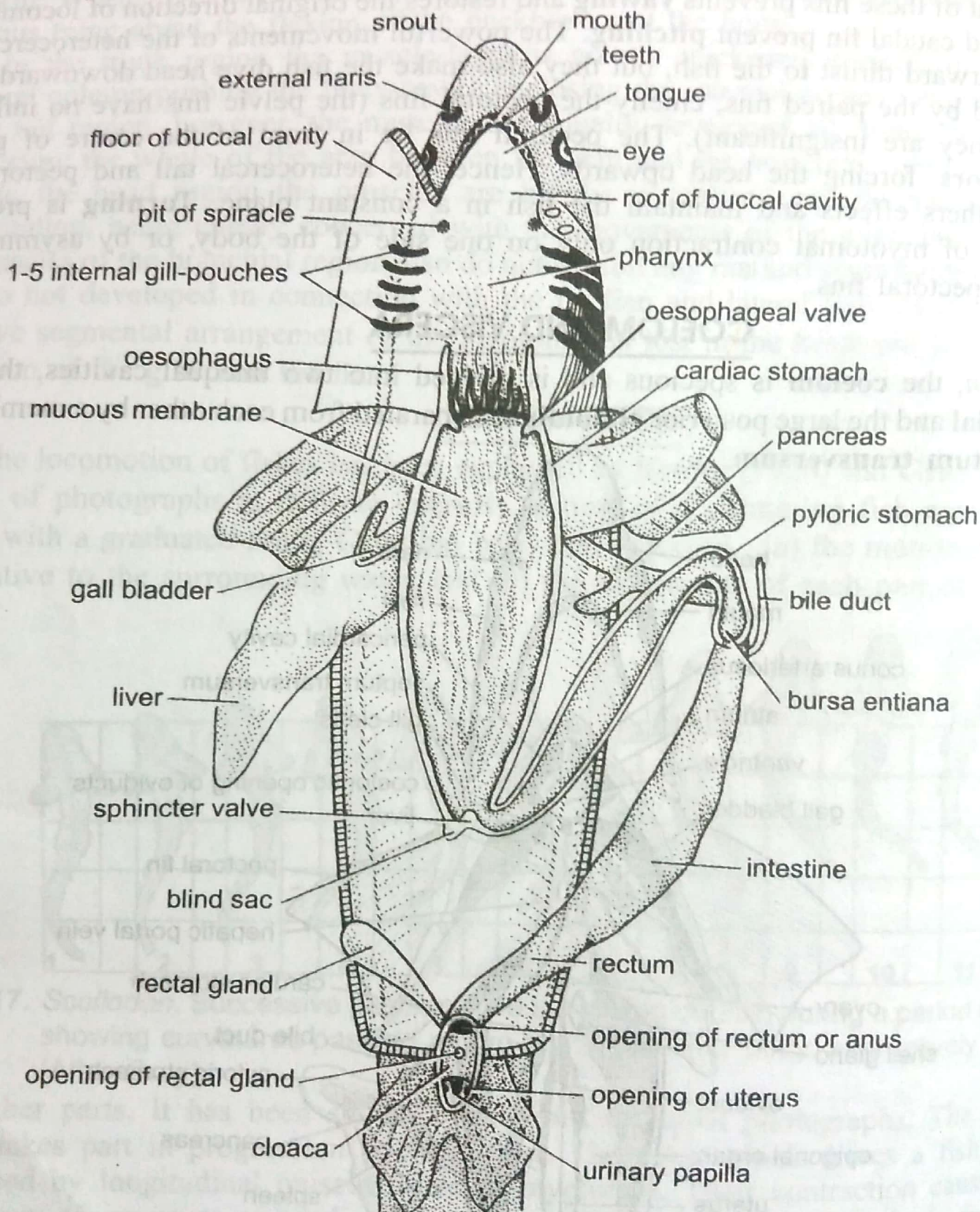


Fig. 14.19. *Scoliodon*. Dissection of digestive system in ventral view.

Abdominal cavity is very large surrounding the viscera (alimentary canal, liver, pancreas, etc.).

apertures. Cloaca opens to the posterior end of the body.

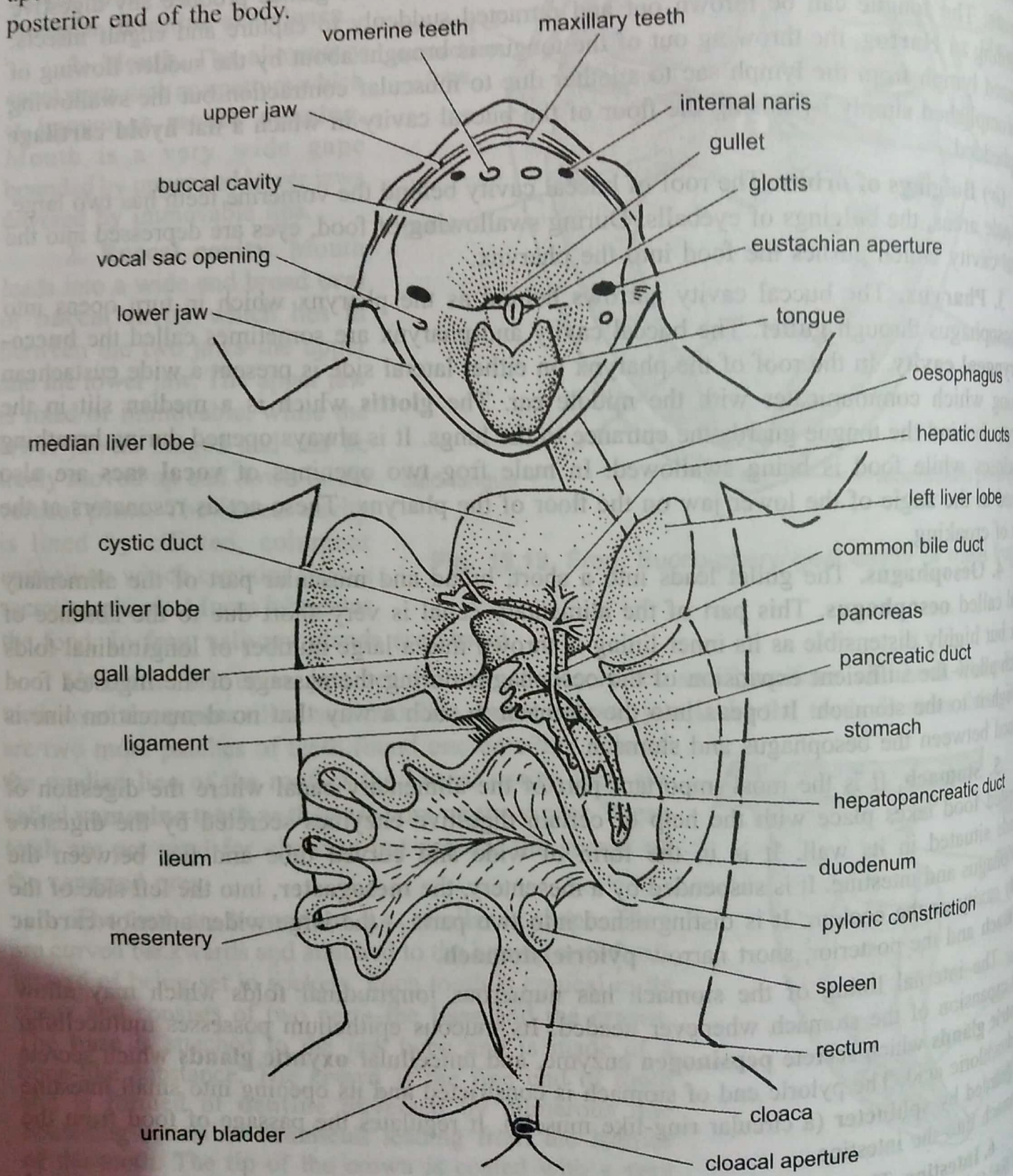


Fig. 18.21. Frog. Digestive system in ventral view.

lies in the left half of the body and is roughly U-shaped. The cavity by a fold of peritoneum called the **mesogaster**. The parts : anterior part is known as **cardiac stomach** which lies, and the posterior part is known as **pyloric stomach** which

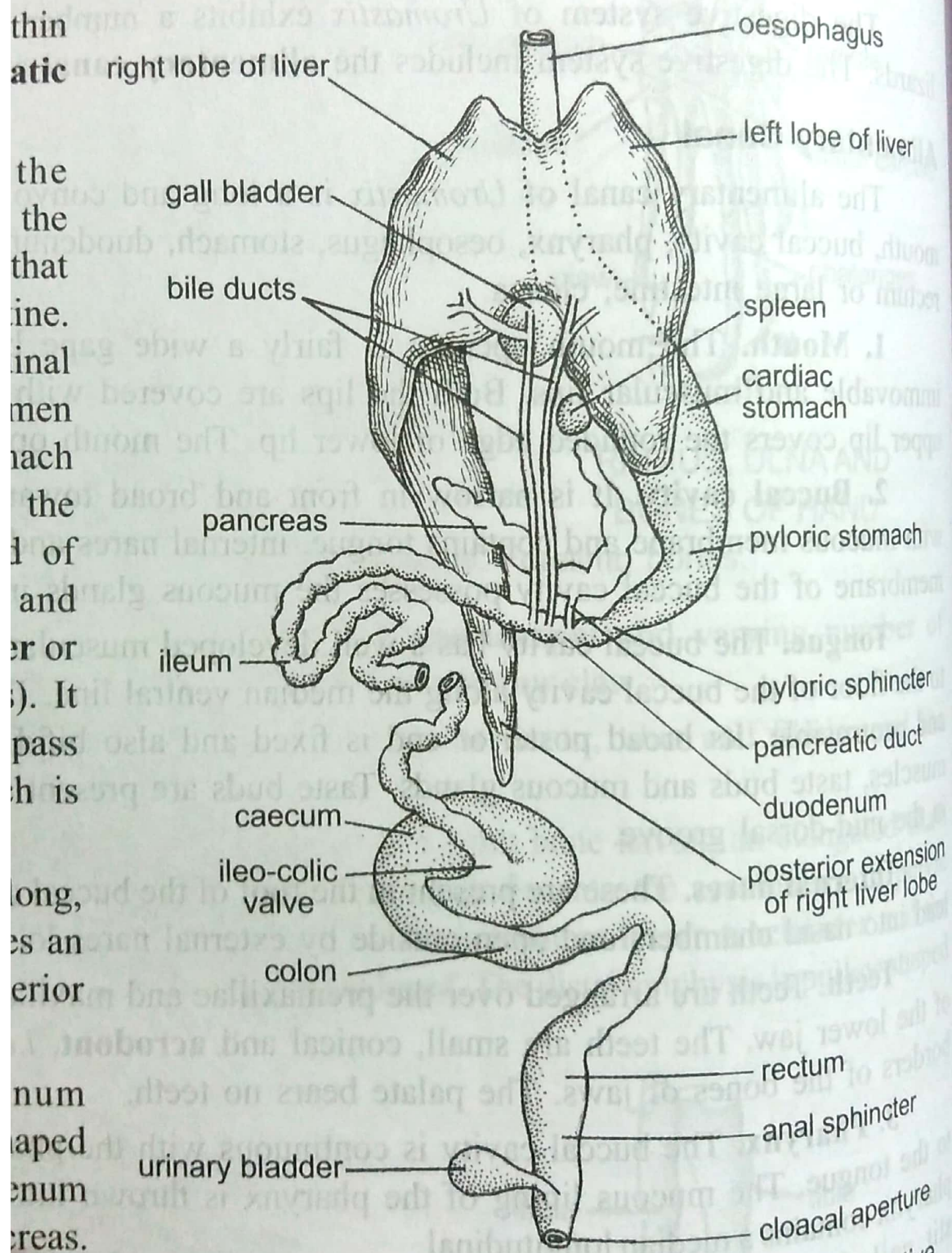


Fig. 21.19. *Uromastix*. Alimentary canal and digestive glands.

coiled tube and merged imperceptibly with the duodenum. The ileum the coelom by the **dorsal mesentery** which runs along the coils. m and ileum exhibit closely-set wavy longitudinal folds of mucosa. and absorptive area of the small intestine. The ileum is relatively

Trunk. The neck is followed by the long, broad and depressed trunk to which are attached two pairs of limbs. The trunk is smooth and flattened ventrally but rough and convex dorsally. Its lateral sides skin is loosely folded. On the ventral surface a thick-lipped transverse **cloacal aperture** is placed at the junction of the trunk and the tail.

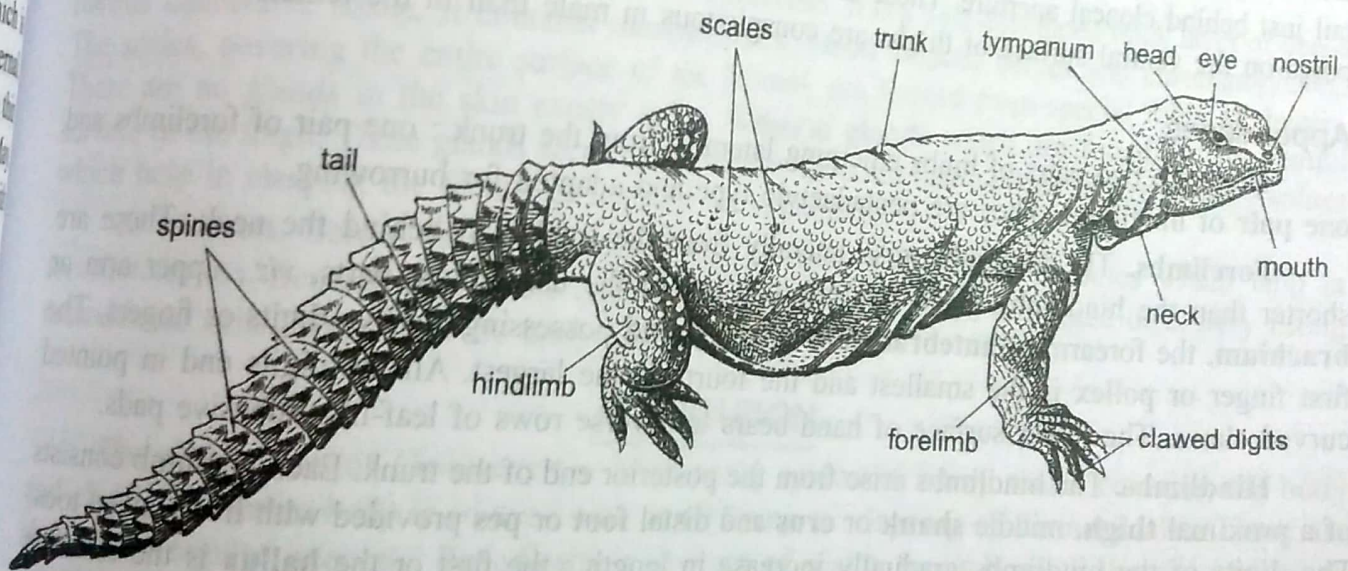


Fig. 21.1. *Uromastix*. External features.

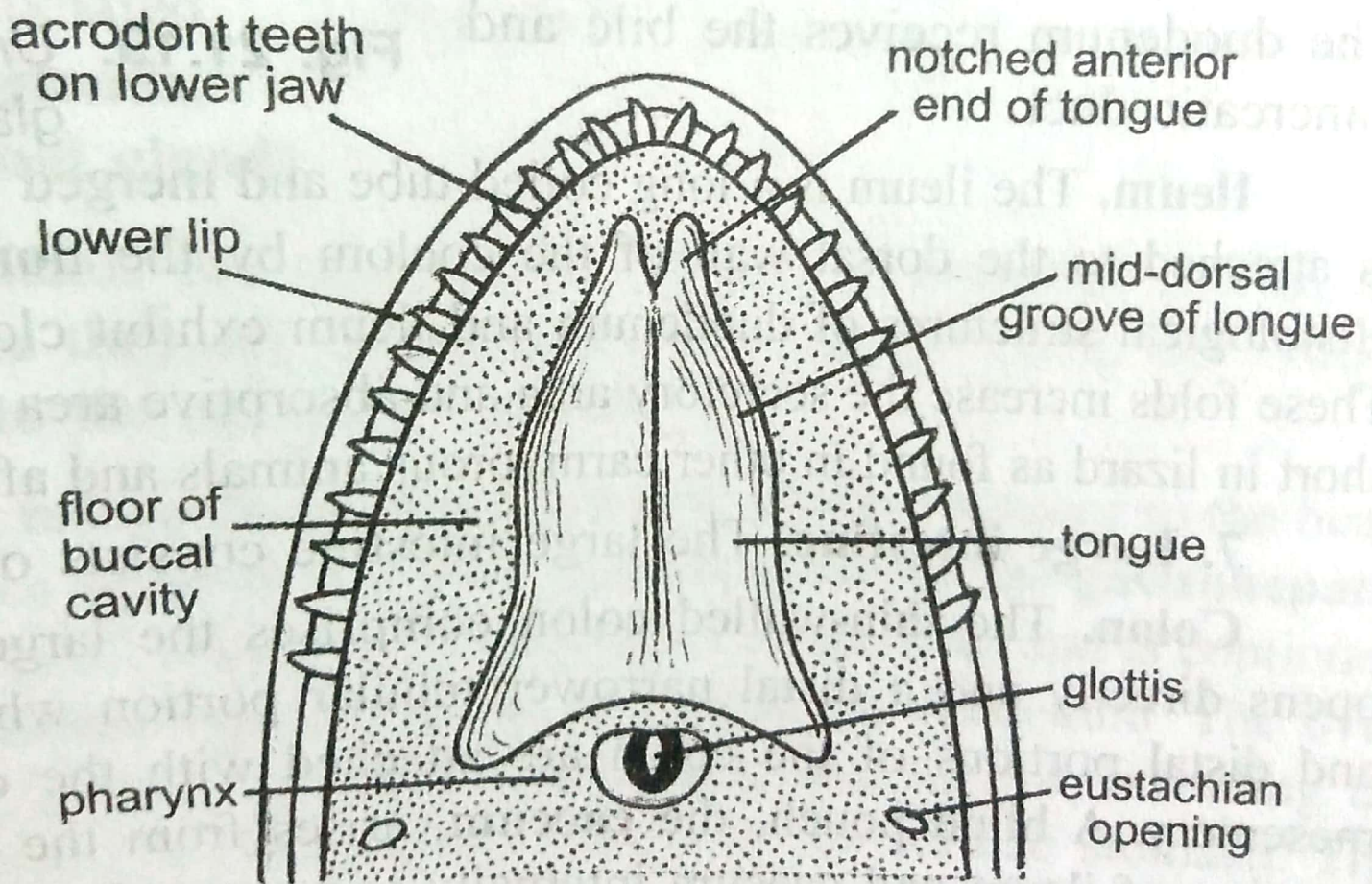


Fig. 21.18. *Uromastix*. Floor of buccal cavity.

corner of the eye. The eyelids lack eyelashes and eyebrows. (iv) **Ear apertures.** Below and behind each eye is an external **ear opening** which leads to a short tube, the external auditory meatus, closed by the tympanic membrane. These apertures are hidden under special auricular feathers.

2. Neck. The neck is long, flexible and well demarcated from head and trunk. It helps in handling of food and compensates the forelimbs which have modified into wings.

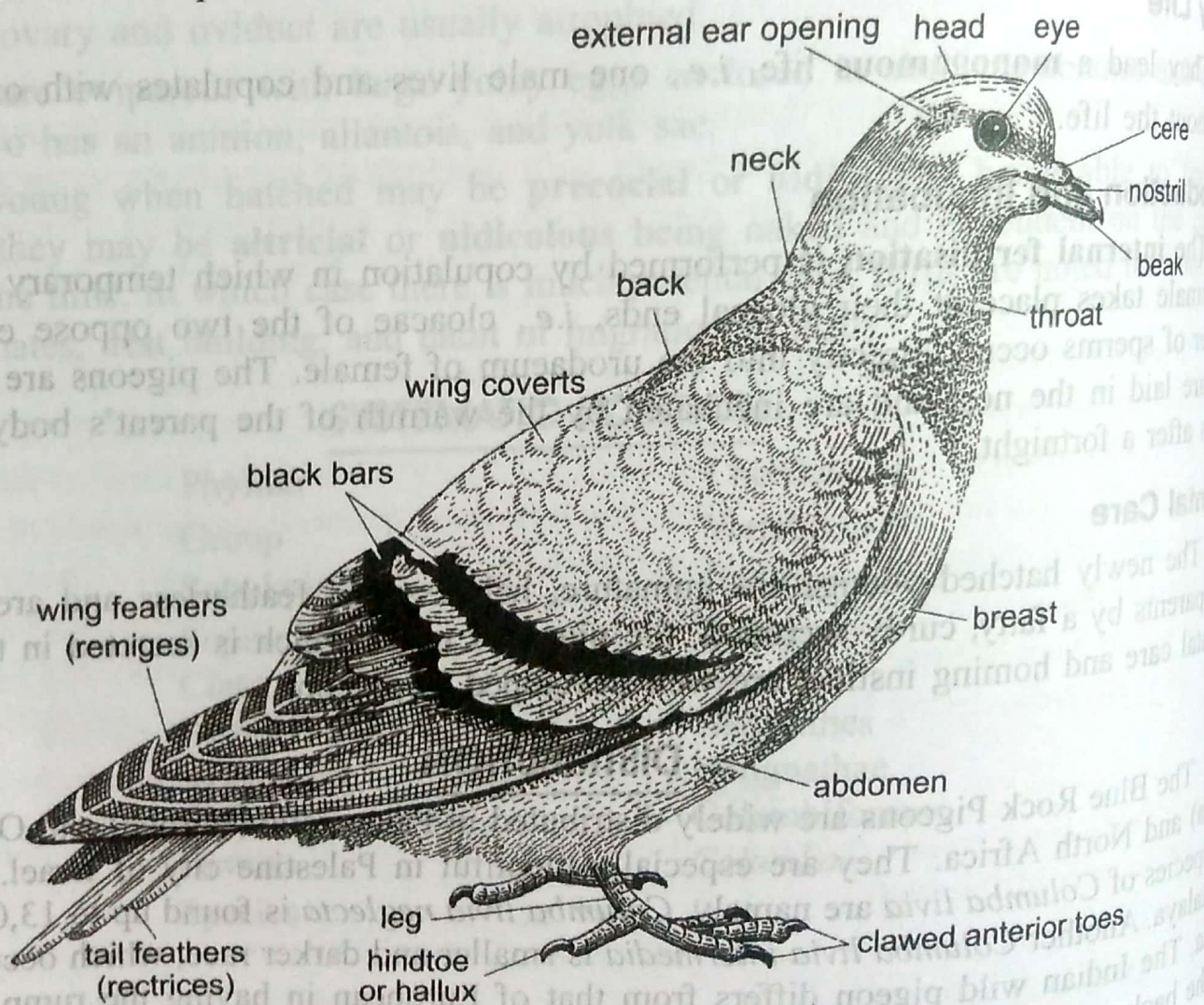


Fig. 26.1. Pigeon. (*Columba livia*). External features.

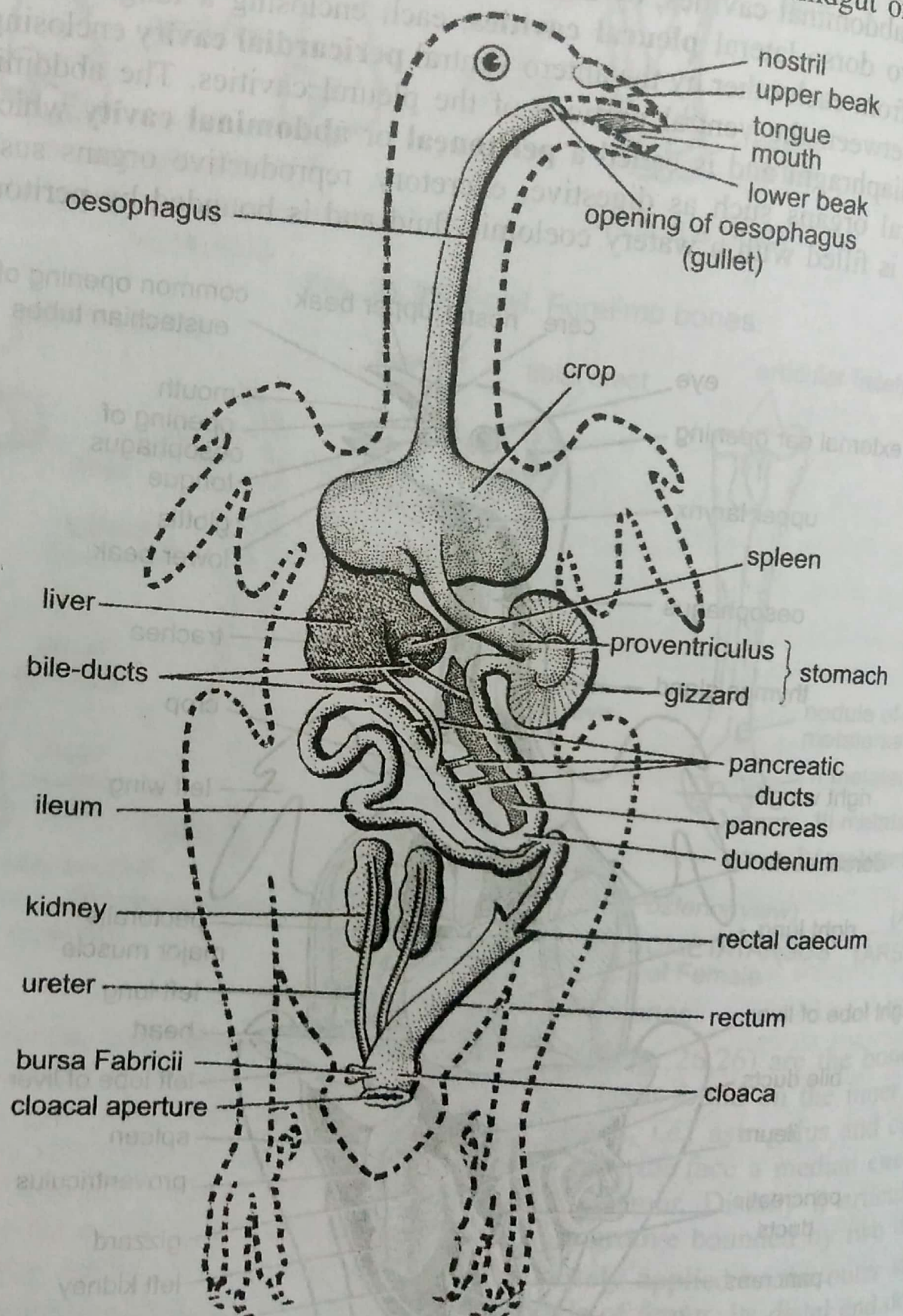


Fig. 26.28. Pigeon. Alimentary canal.

1. Foregut or stomodeum. The portion of alimentary canal from mouth to stomach region is called the foregut or stomodeum. It includes following organs :

(The Rabbit)

bulk of the
ne (dermal
own it is
nd shining
over root.
y is found
ue, blood
cavity is
t or bone
by many
oplasmic
Further,
aw bones
hermore,
n rooted
isors of
nts, pulp
se teeth
t life,
n close
cavity
due to
shment
cavity
eriorly
ll and
ivides
three
to the
h the
rynx
la or
with
rynx
nasal
has
ings
ings
ugh
the
ynx
ike
The
ed
It
en
oft
he

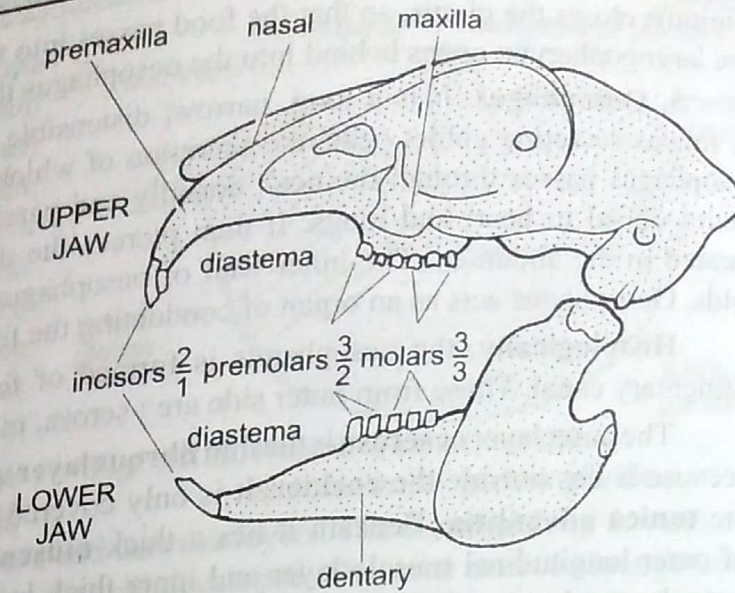


Fig. 29.26. Rabbit. Dentition. Arrangement of teeth on jaws.

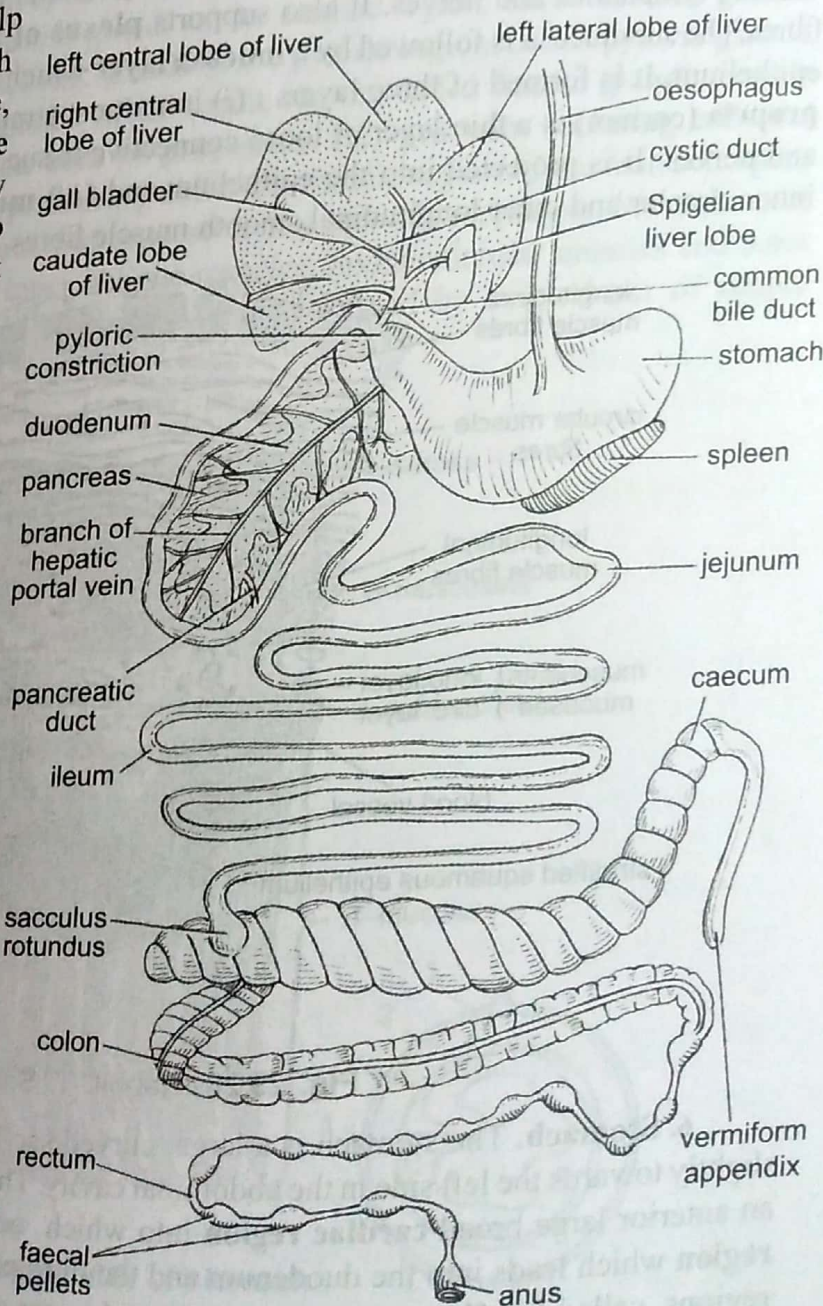


Fig. 29.27. Rabbit. Alimentary canal with associated glands.