VII
the seventh week of life
cleft lip period

I. EXTERNAL APPEARANCE

Fig. 7–1*A*

1. The specimens measure approximately 14 to 20 mm in length.
2. The head enlarges considerably and exhibits bulges produced by the cerebral vesicles. As the head raises from the ventral chest wall, the neck becomes better defined. A redundant layer of ectoderm called the *cervical fold* is sometimes visible in the cervicomandibular area.
3. The optic cup begins to migrate from the side of the head to the face. *Upper* and *lower eyelid folds* appear in the ectoderm above and below the cup, respectively.
4. The branchial arches and grooves disappear as the opercular fold covers over the more caudal arches. The first groove is surrounded by hillocks from which the *auricle* develops. The proximal part of the maxillary and mandibular processes blend with each other forming the *cheek.* The *primitive rima oris* is located between the distal part of the two processes. The surface features of the face are described in Section III, A.
5. The *arm, forearm* and *hand* become evident in the upper limb bud. The *thigh, leg* and *foot* appear in the lower limb bud. Five ridges separated by grooves form at the periphery of the *primitive hand* and *foot plates* and represent the *digits.* The limb buds rotate in such a way that what was formerly the ventral surface now faces medially. The ventral surface or *palm* of the hand is adjacent to the chest wall. The ventral surface or *sole* of the foot lies adjacent to the umbilical cord. *Thenar* and *hypothenar areas* of the palm are represented by elevations at the base of the thumb and little fingers, respectively.
6. The heart and liver form prominences in the ventral body wall.
7. A small bud on the lateral chest wall called the *mammary gland primordium* is the only remnant of the mammary ridge.
8. Although the umbilical cord remains very large, its size relative to the embryo is reduced.
9. The surface features of the external genitalia (perineal region) are described in Section IV, E.
10. All that remains of the *tail bud* is a short, blunt projection in the midline between the buttocks.

II. NERVOUS SYSTEM

A. CENTRAL NERVOUS SYSTEM (CNS)

Fig. 7–1*B*

GENERAL

1. Since the entire brain enlarges at a faster rate than the spinal cord, the latter becomes relatively smaller and shorter.
2. The primitive meninx differentiates into an outer, condensed layer called the *ectomeninx* and an inner, loosely arranged layer called the *endomeninx* located adjacent to the surface of the brain and spinal cord.

BRAIN

Telencephalon

1. Cerebral Vesicle

Striatal Part

a. The striatal part enlarges considerably and bulges into the third ventricle at the level of the interventricular foramen where it produces the *striatal ridge.*
b. The *primordial piriform cortex (paleopallium)* differentiates at the surface of the striatal part and will receive secondary olfactory fibers.

Suprastriatal Part

a. The suprastriatal part expands rostrally, dorsally and caudally producing the *pallium (primordial cerebral cortex).* The caudal portion begins to cover over the diencephalon.
b. The layer of tissue in the midline that separates the pallium on each side will become the *falx cerebri.* The medial wall of the pallium thins and invaginates into the lateral ventricle to form the *tela choroidea.* The line of imagination, called the *choroid fissure,* first appears at the level of the interventricular foramen.
c. Dorsal to the choroid fissure the medial wall bulges into the lateral ventricle as the *primordial hippocampus.* The clear outer layer represents the *primordial hippocampal cortex (arch/pallium).* It can be subdivided into a ventral area, the *primordial gyrus dentatus,* and a more dorsal area, the *primordial cornu Ammonis.* The medial surface in front of the lamina terminalis is the *precommissural septum (parolfactory area).* A small prominence on the ventromedial surface represents the *primordial olfactory bulb,* which receives the olfactory nerve fascicles. Caudal to the bulb is the *primordial tuberculum olfactorium.*
d. Most of the pallium lies between the primordial hippocampal cortex and primordial piriform cortex. This large area, referred to as the *primordial neopallial cortex,* is associated with non-olfactory sensations and will form many connections with the thalamus.

2. Telencephalon Medium

a. The *preoptic area* and *recess* are seen rostral to the optic chiasma of the diencephalon in the floor of the third ventricle.
b. The *lamina terminalis* in front of the recess represents the rostral end of the brain. It gradually diminishes in relative size and is covered by the pallium.
c. The *paraphysis* forms as an evagination of the paraphyseal arch in the roof of the third ventricle near the tel- and diencephalon junction. Usually it disappears during early fetal development (100 mm).

Diencephalon

1. A third sulcus, the *sulcus medius,* appears in the lateral wall between the sulcus dorsalis and sulcus ventralis. The three sulci divide the wall into four areas. From dorsal to ventral they are the *epithalamus, dorsal thalamus, ventral thalamus* and *hypothalamus.* A lightly staining, less cellular area called the *zona limitans intrathalamica* becomes evident near the sulcus medius and helps to separate the dorsal thalamus from the ventral thalamus. Increased proliferation in the mantle layer causes the hypothalamus to bulge into the third ventricle.
2. The *optic chiasma* becomes a thick band in the rostral part of the floor plate that connects the optic stalks across the midline. Caudal to the chiasma the solid *neurohyphyseal bud* is flanked on each side by the tuberal part of the adenohypophysis. The *mamillary area* remains as a slight outward bulge in the caudal part of the floor plate.
3. No significant changes occur in the *pineal bud area* in the caudal part of the roof plate.

Mesencephalon

1. Lamination begins to appear in the mantle layer of the *tectum.*
2. The *tegmentum* and *basis pedunculi area* subdivisions increase in size. A midline depression called the *interpeduncular* fossa forms between the peduncular area on each side in the region of the cephalic flexure.
3. As the mesocoele narrows it becomes the *cerebral aqueduct* connecting the third and fourth ventricles.
4. Cranial nerve III attaches to the wall of the interpeduncular fossa. Cranial nerve IV attaches to the roof of the isthmus.

Rhombencephalon

1. General

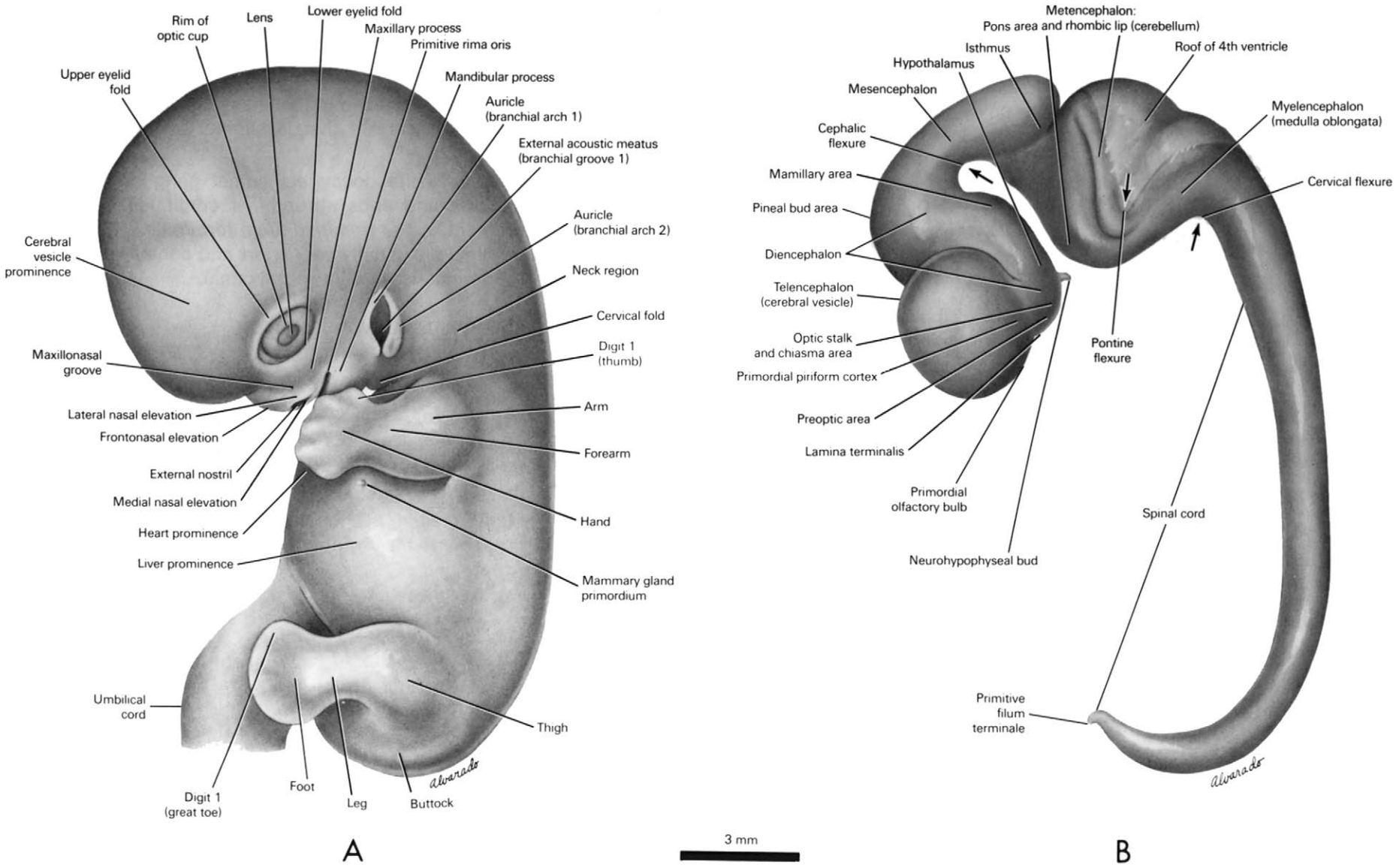


FIG. 7–1

A. External features of the 18-mm embryo.

B. Central nervous system of the 18-mm embryo. Arrows indicate the position of the cephalic, pontine and cervical flexures.

b. The thin, diamond shaped roof of the fourth ventricle continues to enlarge with the cranial part forming the roof of the metencephalon and the caudal part forming the roof of the myelencephalon.
c. There is no longer any evidence of the rhombomeres.
d. A midline raphe of crisscrossing fibers becomes prominent in the floor plate region along the entire length of the rhombencephalon.

2. Metencephalon

Pons Area

a. As the marginal layer of the basal plate thickens around the attachment of the trigeminal nerve it becomes the *basal portion of the pons.* The *ventral median sulcus* becomes apparent on the ventral surface.
b. The remainder of the basal plate together with the medial segment of the alar plate constitute the *tegmentum of the pons.* Neuroblasts in the mantle layer of the basal plate will form the *motor nuclei* of cranial nerves V, VI and VII. Neuroblasts in the alar plate will contribute to the formation of the *sensory nuclei* of cranial nerves V, VII, VIII and X.
c. Cranial nerve V attaches to the metencephalon in the middle of the pons area. Cranial nerves VI, VII and VIII attach at the caudal edge of the pons area.

Rhombic Lip (Cerebellum)

The rhombic lip is a slight thickening of the lateral segment of the alar plate where the roof of the fourth ventricle attaches. It can be divided into *intraventricular* and *extraventricular portions.*

3. Myelencephalon

a. The myelencephalon becomes a distinct subdivision of the adult brain between the pons area and the C-1 spinal nerve called the *medulla oblongata.*
b. Neuroblasts in the basal plate will form the motor *nuclei* of cranial nerves IX, X, XI (cranial part) and XII. Neuroblasts in the alar plate will contribute to the formation of the *sensory nuclei* of cranial nerves V, VII, VIII, IX and X.
c. The *pyramidal tract area* thickens on each side of the midline raphe.
d. The rootlets of cranial nerve XII attach just lateral to the pyramidal tract area. Cranial nerves IX, X and XI attach in series to the lateral wall of the myelencephalon.

SPINAL CORD

1. The spinal cord does not keep pace with the enlargement of the brain and becomes relatively narrower and shorter.
2. The layers increase in thickness converting the *neural canal* into a vertical slit that is slightly expanded at the sulcus limitans.
3. Caudal to the coccygeal spinal ganglion the spinal cord narrows and ends abruptly. It continues into the tail bud remnant as the *primitive filum terminale.* The primitive filum terminale is initially very short and contains a tiny canal that is continuous with the neural canal.

B. PERIPHERAL NERVOUS SYSTEM

Fig. *7–2A*

GENERAL

1. The diameter of the cranial and spinal nerves together with their sensory ganglia is relatively smaller since the nerves can not keep pace with the enlargement of the CMS.
2. Many named branches become apparent as the nerves course into the peripheral areas.

CRANIAL NERVES

Olfactory nerve (I)—The olfactory nerve passes as a group of fascicles from the olfactory epithelium to the primordial olfactory bulb. The *vomeronasal nerve* and *nervus terminalis* course from the vomeronasal organ and front part of the nasal septum, respectively, to the medial side of the primordial bulb.

Optic nerve (II)—The optic stalk lumen is barely visible because of the increased quantity of fibers from the optic cup causing the lumen to narrow. After the lumen disappears, the optic stalk is called the optic nerve.

Oculomotor (III), *trochlear* (IV) and *abducens* (VI) *nerves*—These nerves terminate in distinct premuscle masses surrounding the optic cup.

Trigeminal nerve (V)—The three divisions or branches of the trigeminal nerve course into their particular area of the face. The infraorbital branch of the maxillary nerve and the inferior alveolar and lingual branches of the mandibular nerve become apparent.

Facial nerve (VII)—The facial nerve does not yet spread onto the face but instead terminates in the cervicomandibular area. More proximally the chorda tympani, greater petrosal, posterior

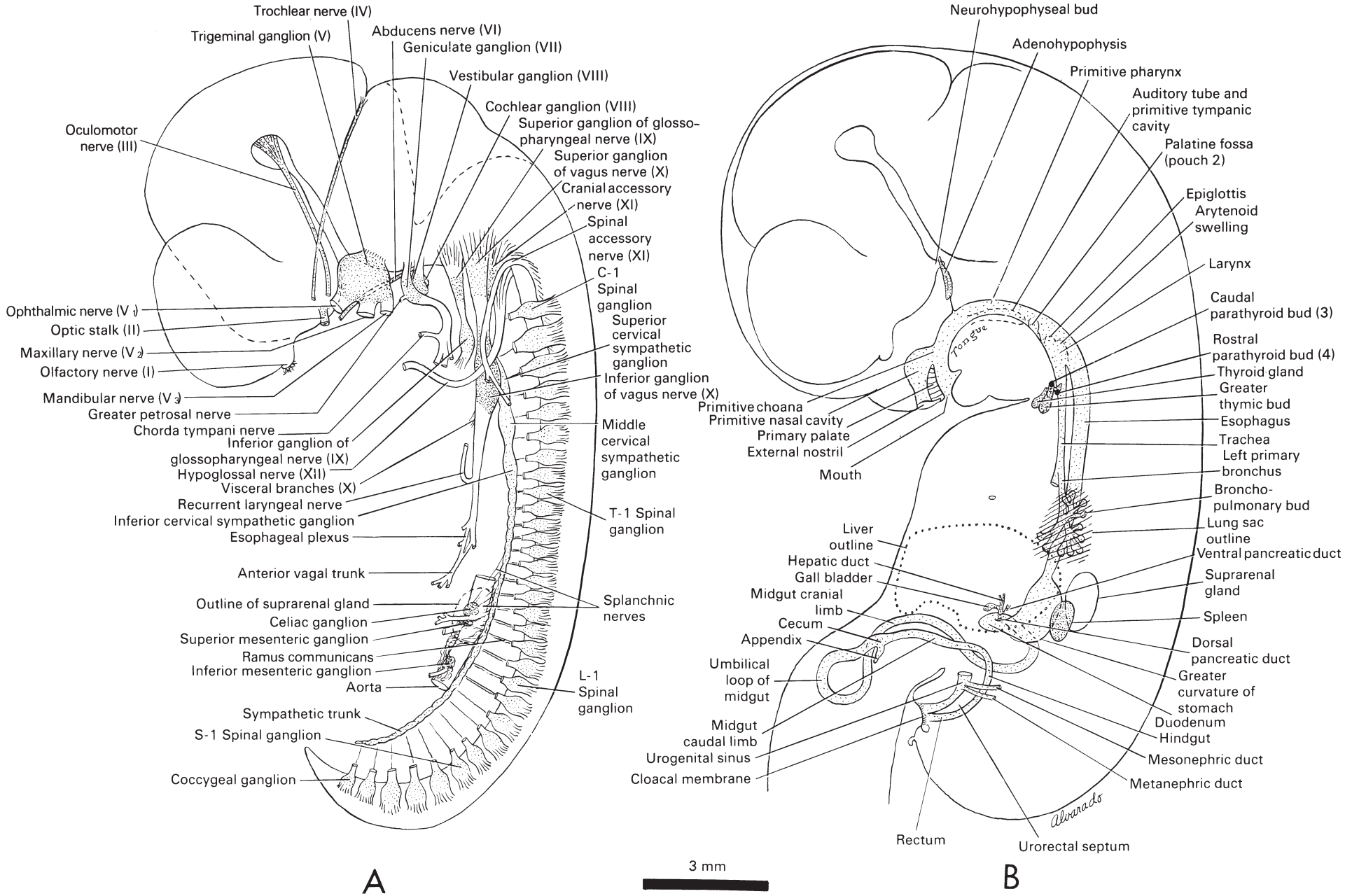


FIG. 7–2

A. Peripheral nervous system of the 18-mm embryo. In most instances, only the most proximal portion of the nerve is shown.

B. Alimentary and respiratory systems of the 18-mm embryo.

auricular and digastric branches can be identified. The chorda tympani branch joins the lingual nerve.

Vestibulocochlear nerve (VIII)—Short branches from the vestibular ganglion course to the future receptor area of the semicircular canals, saccule and utricle. The cochlear (spiral) ganglion gives branches to the cochlear pouch and spirals along with it.

Glossopharyngeal nerve (IX)—Before it terminates in the surface on the caudal part of the tongue, the glossopharyngeal nerve gives a minute branch to the stylopharyngeus premuscle mass.

Vagus nerve (X)—The vagus nerve joins its counterpart on the other side around the esophagus to form the esophageal plexus, which passes into the upper abdominal viscera as anterior and posterior vagal trunks.

Spinal accessory nerve (XI)—As the sternocleidomastoid and trapezius muscles become separate masses, they each receive a separate branch from the spinal accessory nerve.

Hypoglossal nerve (XII)—Separate branches of the hypoglossal nerve course to the muscles of the tongue as each muscle differentiates.

SPINAL NERVES

The branches of the nerve plexuses can be identified.

C. AUTONOMIC NERVOUS SYSTEM

Fig. 7–2A

Neuroblasts giving rise to postganglionic neurons collect together to form identifiable ganglia near their definitive position.

SYMPATHETIC NERVOUS SYSTEM

1. The individual ganglia of the sympathetic trunk become apparent. The superior, middle and inferior cervical ganglia are especially prominent because of their large size.
2. Many sympathetic neuroblasts collect together in the vicinity of the celiac, superior mesenteric and inferior mesenteric arteries to form preaortic ganglia with the same names. These ganglia are connected to the lower thoracic segments of the spinal cord by the splanchnic nerves and rami communicans.
3. Suprarenal gland—The cortex is a large acidophilic mass between the dorsal aorta and the cranial end of the mesonephros and gonad. The medulla is dorsomedial to the cortex and is composed of prechromaffin cells.

PARASYMPATHETIC NERVOUS SYSTEM

1. Parasympathetic neuroblasts collect in the head region to form four ganglia in close association with the divisions of the trigeminal nerve. Their origin is not clear as they are influenced by cranial nerves other than the trigeminal. The ganglia are as follows:
   a. The ciliary ganglion lies close to the ophthalmic division near the optic cup but receives its messages from the brain by the oculomotor nerve.
   b. The pterygopalatine ganglion is located on the maxillary division but receives brain messages by way of the facial nerve.
   c. The submandibular ganglion is close to the mandibular division but is also connected to the brain by way of the facial nerve.
   d. The otic ganglion is located on the mandibular division but receives impulses from the brain through the glossopharyngeal nerve.
2. The parasympathetic neuroblasts associated with the general visceral branches of the vagus nerve are scattered throughout the thoracic and upper abdominal viscera. Their origin is unclear but they may arise from crest cells in the rhombencephalic region. Since these neuroblasts never collect in large numbers, ganglia are not described.
3. Neuroblasts collect in the vicinity of the pelvic viscera and receive messages from the sacral part of the spinal cord by way of the pelvic splanchnic nerves. They also have an unclear origin but likely are derived from the neural crests in the sacral region.

III. ALIMENTARY AND RESPIRATORY SYSTEMS

Fig. 7–2B

A. ORONASOFACIAL REGION

1. The nasal pit on each side of the midline deepens to form the primitive nasal cavity. The cavity opens to the exterior at the external nostril and is separated from its counterpart on the opposite side by the nasal septum. The olfactory epithelium lies in the roof of the cavity. A small epithelial invagination called the vomeronasal organ forms in the medial wall of the cavity on each side of the septum.

2. The stomodeum is replaced by the *primitive oral cavity.* The primitive nasal and oral cavities are initially separated by a thick *oronasal membrane.* The membrane soon thins and ruptures thereby communicating the two cavities through an opening called the *primitive choana.* The primitive choana enlarges in the roof of the primitive oral cavity on each side of the nasal septum. Rostral to the primitive choana the nasal septum joins an area of the primitive oral cavity roof called the *primitive palate.* The primitive palate is continuous with the medial nasal and frontonasal elevations. Because it lies between the maxillary processes, it is also called the *intermaxillary segment.* Remnants of the *nasal fin* are sometimes apparent between the primitive palate and maxillary process. As the lateral wall of the primitive oral cavity enlarges, the inner side of the maxillary process protrudes into the cavity forming the *lateral palatine process.* The rostral part of the lateral palatine process is in contact with the lateral surface of the tongue. Its caudal part lies below the tongue in the *linguogingival groove* where it remains until shortly before palate closure.
3. The nose begins to appear around the external nostrils when the frontonasal elevation becomes prominent and blends with the nasal elevations. The *maxillonasal groove* disappears after its walls fuse to produce the *nasolacrimal duct.* The duct courses from the medial aspect of the eye and terminates in the primitive nasal cavity.
4. The maxillary process blends with the nasal elevations. The mandibular process joins in the midline with its counterpart on the other side causing the *median mandibular groove* to disappear. The dorsal adjacent portions of the mandibular and maxillary processes blend to produce the *cheek.* Their ventral portions contribute to the formation of the *primitive rima oris* that replaces the stomodeal opening.
5. The roof and lateral walls of the primitive oral cavity grow rapidly to keep pace with the expansion of the rostral part of the brain. As a result the point of attachment of the hypophyseal pouch to the roof is shifted caudally to a position dorsal to the foregut floor. The junction of the pouch with the roof narrows to produce the solid *stem remnant.* Dorsal to the remnant the pouch retains its lumen and forms the *adenohypophysis.* The adenohypophysis becomes U shaped flanking each side of the neurohypophyseal bud. The lower connecting part of the U becomes the *distal portion,* the upper part on each side is the *tuberal (infundibular) portion.*
6. The epithelial lining of the primitive oral cavity in the vicinity of the maxillary and mandibular processes thickens in a U shaped area to form the *labiodental lamina.* The lamina separates into an inner *dental lamina* and an outer *labiogingival band.*
7. The *parotid* and *submandibular buds* appear as epithelial sprouts of the primitive oral cavity lining. The parotid bud begins in the cheek; the submandibular bud develops in the floor of the linguogingival groove.

B. FOREGUT

1. The tubotympanic recess (pouch 1) elongates in a dorsolateral direction to form the *auditory tube* and the *primitive tympanic cavity.* The second pouch reduces to the shallow *palatine fossa.* The third and fourth pouches lose their connections with the primitive pharyngeal wall. Their derivatives migrate into the ventral aspect of the neck. The dorsal portion of the third pouch becomes the caudal *parathyroid bud,* its ventral portion becomes the *greater thymic bud.* The two portions remain connected for a short period. The dorsal portion of the fourth pouch becomes the *rostral parathyroid bud.* The fate of its ventral portion is unclear but it probably contributes to the formation of the *thymus (lesser thymic bud).* The *ultimobranchial body* (pouch 5) is probably incorporated into the thyroid gland.
2. The *thyroid gland* loses its connection with the floor of the primitive pharynx and develops *right* and *left lobes* that are joined across the midline by the *isthmus.*
3. The swellings in the floor of the primitive pharynx blend to produce a massive *tongue,* which bulges into the primitive oral as well as pharyngeal cavities. The rostral part of the tongue becomes round and narrows to a tip near the primitive choanae.
4. The pharyngeal constrictor muscles become evident in the condensation peripheral to the endodermal lining. Loose mesenchymal tissue between the primitive pharynx and the vertebral column forms the *retropharyngeal space.* The caudal part of the primitive pharynx that passes dorsal to the larynx is called the *laryngeal pharynx.*
5. Caudal to the larynx the pharynx narrows to form the *esophagus.* The *muscularis* layer is apparent in the condensation surrounding the endodermal tube. Peripheral to the muscularis layer the vagus nerves communicate to form

the *esophageal plexus,* which regroups at the caudal end of the esophagus to form the *anterior* (ventral) and *posterior* (dorsal) *vagal trunks.*

6. *Stomach* rotation is almost complete. The *pyloric antrum* is the slightly dilated portion to the left of the pylorus. The four layers of the stomach, *mucosa* (endodermal tube), *submucosa, muscularis* and *serosa*, become evident.
7. The boundaries of the *spleen* become discrete in the dorsal mesogastrium as it moves to a position dorsolateral to the stomach. The splenic blood vessels course through the dorsal mesogastrium to the spleen, stomach and dorsal pancreas.
8. The *dorsal pancreas* is represented by a branching duct that empties into the cranial part of the duodenum.

RESPIRATORY SYSTEM

a. *Laryngeal cartilages* begin to appear in the condensation around the laryngeal orifice. The orifice narrows to a vertical slit called the *primitive glottis.*
b. *Tracheal cartilages* begin to form in the condensation around the endodermal tube. The tracheal bifurcation migrates to the level of the upper thoracic segments. The secondary bronchi divided into numerous tertiary branches called *bronchopulmonary buds* near the periphery of the lung sac.
c. The *lung sac* begins to assume its definitive shape with a *base* at its caudal end and an *apex* at its cranial end. An *oblique fissure* in the left lung sac divides it into *upper* and *lower lobes.* In addition to the oblique fissure the right lung sac has a *horizontal fissure.* These two fissures divide the right lung sac into *upper, middle* and *lower lobes.*

C. MIDGUT

1. The *liver* increases tremendously in size enlarging more on the right than on the left. As the liver expands, the *gall bladder* enlarges and moves away from the bile duct. The proximal part of the gall bladder does not enlarge but becomes instead the *cystic duct* that empties the bladder into the bile duct.
2. The *ventral pancreas* moves to the left by passing dorsal to the duodenum. It is separated from the dorsal pancreas by the portal and superior mesenteric veins.
3. The *duodenum* assumes the shape of an arc coursing first dorsally and to the right, then caudally and to the left. It becomes continuous with the cranial limb of the midgut on the right side of the dorsal mesentery and superior mesenteric vessels. The lumen of the duodenum is partly obliterated in some areas but will become recanalized.
4. The midgut loop elongates at a rapid rate causing a greater portion to reside in the umbilical cord. It continues to rotate in a counterclockwise manner with the caudal limb passing to the left, above the cranial limb.
5. The primitive cecum lies in the proximal part of the umbilical cord and becomes the *cecum* after a diverticulum representing the *appendix* develops.
6. The *muscularis* of the midgut begins to differentiate from the mesenchymal condensation around the endodermal tube. It forms in the cranial limb before the caudal limb.

D. HINDGUT

1. The hindgut endodermal tube is surrounded by a thick condensation from which the muscularis differentiates. Differentiation of the muscularis in the hindgut lags behind that in the foregut and midgut.
2. When the urorectal septum joins the *cloacal membrane,* it divides the membrane into a ventral *urogenital part* and a dorsal *anal part.* The rectum terminates at the anal part, the urogenital sinus terminates at the urogenital part. See Section IV for discussion of the development of the urogenital sinus.
3. The area on each side of the anal membrane swells forming *anal folds.* The ectodermal depression between the folds is called the *proctodeum.*

IV. UROGENITAL SYSTEM

Fig. 7–3

A. MESONEPHROS

1. The number of segments occupied by the mesonephros is reduced, extending approximately from T-9 to L-3. The corpuscles and tubules in the cranial segment begin to degenerate.

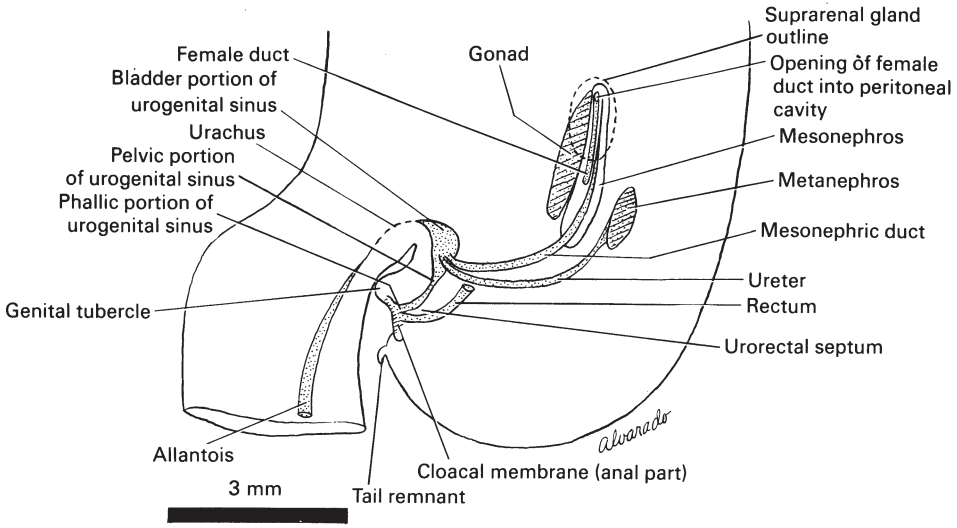


FIG. 7–3
Urogenital system of the 18-mm embryo.

2. The *mesonephric duct* is narrow at its cranial end but enlarges as it courses caudally on the ventral aspect of the mesonephros to terminate in the urogenital sinus.
3. The *female (paramesonephric* or *Müllerian) duct,* which will become the main genital duct in the female, begins as an invagination of the coelomic epithelium on the ventrolateral surface of the urogenital ridge. Initially the invagination is a solid bud which later canalizes. The duct grows caudomedially toward the pelvic part of the urogenital sinus. As it approaches the sinus, it meets and fuses with its counterpart on the other side.

B. METANEPHROS (KIDNEY)

1. The primitive renal pelvis bifurcates into *cranial* and *caudal major calyces* within the metanephrogenic mass. Each major calyx branches deeper into the mass thereby forming *collecting tubules.* The distal end of each tubule is covered by a condensation called the *renal capsule* that is derived from the cells of the metanephrogenic mass.
2. The metanephros attains its definitive position ascending to the level of the T-12 to L-2 segments.
3. The proximal segment of the metanephric diverticulum becomes the *ureter.* As the horn of the urogenital sinus is absorbed into the main chamber, the entrance of the ureter is relocated lateral to the entrance of the mesonephric duct.

C. UROGENITAL SINUS

1. The urorectal septum completely separates the primitive urogenital sinus from the more dorsal rectum. The resulting definitive *urogenital sinus* is divided into three portions: a cranial, dilated *bladder portion,* an intermediate, narrow *pelvic portion* and a caudal *phallic portion.* The phallic portion is essentially a vertical slit between the urogenital folds and is separated from the exterior by the *urogenital part of the cloacal membrane.*
2. The *allantois* is continuous with the apex of the bladder portion of the urogenital sinus. As the lumen in the junction area disappears, the allantois is replaced by a solid, ligamentous structure called the *urachus or median umbilical ligament.*

D. GONAD (INDIFFERENT STAGE)

1. The gonad in the indifferent stage is a lobular mass extending from approximately T-10 to L-2 segments. It attaches to the medial side of the mesonephros by the *gonadal mesentery* where it comes into contact with some of the mesonephric tubules.
2. The *primordial germ cell* from the yolk sac reside in the gonadal ridge. As they enter the gonad, the surface cells of the ridge proliferate into *gonadal cords* that extend into the underlying mesenchyme around the germ cells.

E. EXTERNAL GENITALIA

1. Since the external genitalia is identical in the male and female, it is not yet possible to distinguish the sex from the surface features.
2. The cloacal membrane remains in the midline and is subdivided into *urogenital* and *anal parts.* The urogenital part separates the phallic part of the urogenital sinus from the *urogenital groove.* The anal part separates the rectum from the *proctodeum.*
3. The urogenital groove is flanked on each side by a prominent *urogenital fold.* The proctodeum is flanked on each side by an *anal fold.*

4. The *genital tubercle* in the midline and the more lateral *labioscrotal swelling* become prominent raised areas.

V. COELOMIC CAVITY

1. The originally common coelomic cavity is partitioned into three separate cavities: the *peritoneal cavity* surrounding the abdominal viscera, the *pericardial cavity* surrounding the heart and a *pleural cavity* surrounding each lung. The pleuropericardial opening disappears completely, and the pleuroperitoneal opening is reduced to a minute communication dorsolateral to the liver.
2. Each cavity keeps pace with the related expanding viscera and is completely lined with a serous membrane that is given different names in each cavity (peritoneal cavity → *peritoneum;* pericardial cavity → *serous pericardium;* pleural cavity → *pleura).* The part of the serous membrane that covers the inner surface of the wall is called the *parietal layer*; the part that covers the surface of the organ is called the *visceral layer.* The visceral layer is also called the *serosa* on the abdominal organs. On the heart it is included in the *epicardium.*
3. The serous membrane produces serous fluid that completely fills each cavity. This fluid serves as a lubricant that allows for easy movement between various viscera or between viscera and the wall that encloses them.

VI. MESENTERIES

A. DORSAL MESENTERY

1. The segment of the *dorsal mesogastrium* between its midline attachment and the spleen lies adjacent to the ventral surface of the left gonad, mesonephros, metanephros and suprarenal gland. It contains the dorsal pancreas and splenic vessels. The segment of the dorsal mesogastrium between the spleen and greater curvature increases in length to form a redundant fold called the *greater omentum.* The lesser sac that is enclosed by the dorsal mesogastrium enlarges as the greater omentum extends caudally. The pneumoenteric recess disappears.
2. Differential growth patterns in the stomach and duodenum bring the dorsal and ventral pancreas together in the mesoduodenum.
3. As the midgut loop elongates, its *dorsal mesentery* assumes a fan shape and is twisted in a counterclockwise direction.
4. The *dorsal mesentery of the hindgut* is pushed to the left by the midgut loop.

B. VENTRAL MESENTERY

No significant changes will occur in the *lesser omentum* and *falciform ligament.*

VII. DIAPHRAGM

1. The diaphragm is a partition that separates the peritoneal cavity from the pericardial and pleural cavities. At this time it is largely composed of the *septum transversum.*
2. The *pleuroperitoneal membranes* expand to close the pleuroperitoneal opening and contribute to the dorsolateral part of the diaphragm.
3. Muscle tissue begins to differentiate in the dorsal part of the septum transversum where the *phrenic nerves* enter.

VIII. CARDIOVASCULAR SYSTEM

A. HEART

Figs. 7–4, 7–-5

FORMATION OF THE SEMILUNAR VALVES

Three tubercles form on the inside of both the ascending aorta and pulmonary artery at the junction of the truncus arteriosus and conus cordis *(truncoconal junction).* As they grow into the lumen, they become cuplike and together form a semilunar valve in each vessel.

CLOSURE OF THE INTERVENTRICULAR FORAMEN

The dorsal (inferior) endocardial cushion expands into the

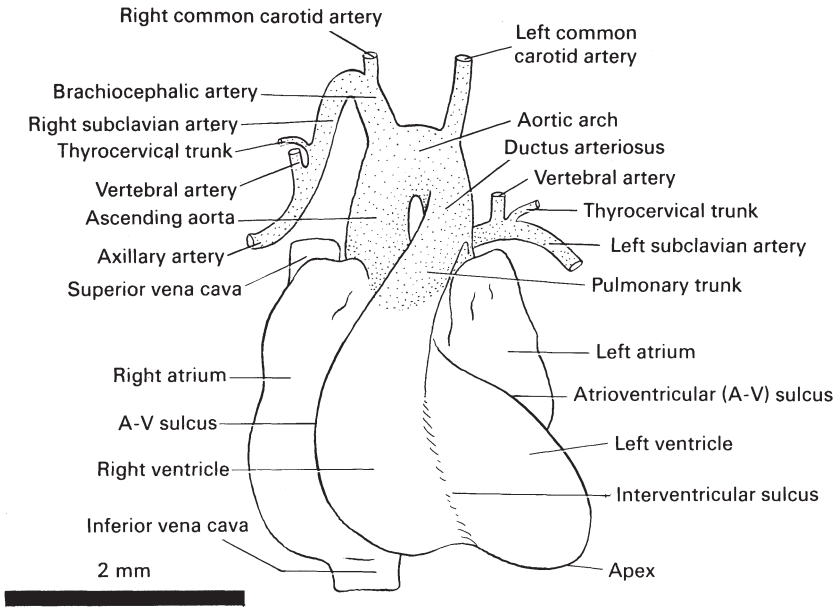


FIG. 7–4
Heart of the 18-mm embryo. (A-V, atrioventricular.)

interventricular foramen and fuses with the upper edge of the *muscular portion of the interventricular septum.* Simultaneously, it also fuses with the lower edge of the *conus septum.* As a result a thick partition is formed that closes the foramen. The partition later becomes thin and fibrous to form the *membranous part of the interventricular septum.*

FORMATION OF THE ATRIOVENTRICULAR (A-V) VALVES

The tissue around each atrioventricular canal bulges into the canal and the ventricle below it. The bulges become flaps of tissue that are attached in some areas to the ventricular wall. Three flaps develop around the right canal forming the *right atrioventricular (tricuspid) valve.* Two flaps develop around the left canal forming the *left atrioventricular (mitral) valve.* The attachments to the ventricular wall are replaced by dense connective tissue cords called *chordae tendineae,* which are connected to fingerlike processes of ventricular muscle known as *papillary muscles.*

SEPTUM FORMATION IN THE RIGHT ATRIUM

1. The *ostium primum* disappears as the caudal edge of the *septum primum* fuses with the endocardial cushions.
2. Simultaneously the cranial part of the septum primum breaks down forming the *ostium secundum.*
3. Most of the septum spurium and the left venous valve become incorporated into the *septum secundum* obliterating the septovalvular space. This causes the septum secundum to lengthen along the right side of the septum primum partially covering the ostium secundum.
4. The *right venous valve (valve of sinus venosus)* grows caudally to join the fused endocardial cushion near the orifices of the inferior vena cava and coronary sinus.

CHANGES IN THE EXTERNAL CONFIGURATION

1. The heart moves into the upper thoracic region.
2. The left ventricle becomes conical shaped with its blunted end forming the *apex* of the heart.
3. The transverse part of the sinus venosus and the left sinus horn become incorporated into the *coronary sinus* in the dorsal part of the atrioventricular sulcus.
4. Venous channels from the right and left lung sacs join near the heart to form the *common pulmonary vein,* which empties into the left atrium.

B. ARTERIES

Fig. 7–5*A*

DERIVATIVES OF THE AORTIC SAC, AORTIC ARCHES AND PAIRED DORSAL AORTAS

After the heart moves caudally through the cervical segments, the neck region becomes apparent. The arteries between the heart and the brain necessarily increase in length and narrow in relation to surrounding structures. Many dramatic changes occur in the aortic sac, aortic arches and the paired dorsal aortas. In most instances the changes differ on each side.

1. *Aortic sac*—The segment of the left horn of the aortic sac between the origins of the fourth and sixth aortic arches becomes the *proximal part of the definitive aortic arch.* The

corresponding segment of the right horn forms the *brachiocephalic artery.*

2. *Aortic arches*—On both sides, the *common carotid artery* is derived by an elongation of that segment of the horn of the aortic sac between the origins of the third and fourth aortic arches. The proximal segment of the *internal carotid artery* is formed by the third aortic arch, its distal segment by the cranial extension of the paired dorsal aorta rostral to the carotid duct. The *external carotid artery, a* new vessel, joins the internal carotid artery at its point of origin. On the left the *distal part of the definitive aortic arch* is formed by the fourth aortic arch and the segment of the paired dorsal aorta between the carotid duct and the seventh dorsal intersegmental artery; on the right side these segments form the *proximal part (base) of the right subclavian artery.* The proximal part of the sixth arch on each side becomes the stem of the *right* or *left pulmonary artery.* Its distal part on the right loses its connection with the dorsal aorta and disappears. The connection with the dorsal aorta is retained on the left forming the *ductus arteriosus.* The pulmonary arteries course to their respective lung through secondary channels located ventral to the primary bronchi.
3. *Paired dorsal aortas*—On both sides the segment of the dorsal aorta between the third and fourth arches *(carotid duct)* disappears. On the right side the segment between the origin of the seventh dorsal intersegmental artery and the junction with the left dorsal aorta also disappears. When this happens, the caudal segment of the left dorsal aorta becomes the *stem of the descending aorta,* and all of the blood for the lower half of the body flows toward the left.
4. As the cerebellum becomes established, the stems of the definitive arteries supplying it can be identified. The met- and myelencephalic arteries are replaced by the *pontine*, *superior cerebellar* and *anterior* and *posterior inferior cerebellar arteries.*
5. The seventh dorsal intersegmental artery forms all of the *left subclavian artery* and all but the proximal part of the *right subclavian artery.* The axial artery (definitive *axillary artery)* that passes through the brachial plexus to supply the derivatives of the upper limb bud is a lateral branch of its ventral division. The *vertebral artery* and *thyrocervical trunk* represent, respectively, post- and precostal anastomoses of its dorsal and ventral divisions with corresponding segments of more cranial intersegmented arteries. The *costocervical trunk* and *internal thoracic* (mammary) *artery* are formed, respectively, by precostal and ventral anastomoses of its ventral division with corresponding segments of more caudally situated dorsal intersegmental arteries.

AORTA

The formation of the *ascending aorta* is described in Chapter 6, Section VII, A. The development of the *aortic arch* is described above. The fused portion of the dorsal aortas forms the *descending aorta.* Additional definitive arteries that can be identified are as follows.

1. The dorsal intersegmental arteries arising from the thoracic part of the descending aorta become the *intercostal* and *subcostal arteries.* Those from the lumbar part become the *lumbar arteries.*
2. The lateral segmental or *mesonephric arteries* supply not only the mesonephros but also the adjacent gonad and suprarenal gland.
3. Many of the definitive branches of the *celiac, superior mesenteric* and *inferior mesenteric* arteries (ventral segmental arteries) can be identified.

C. VEINS

Fig. 7–5*B*

VITELLINE VEINS

1. The distal segment of the vitelline veins disappears at varying times. It sometimes remains prominent after the yolk stalk disappears, in which case it courses from the yolk sac through the umbilical coelom to the dorsal mesentery of the midgut loop where it joins the superior mesenteric vein.
2. When the duodenum changes to the shape of an arc, the *superior mesenteric vein* then passes ventral to the lower part of the arc, becoming the *portal vein* between the dorsal and ventral pancreas after it receives the *splenic vein.* The *portal vein* courses to the ductus venosus in the liver by passing dorsal to the upper part of the duodenal arc.

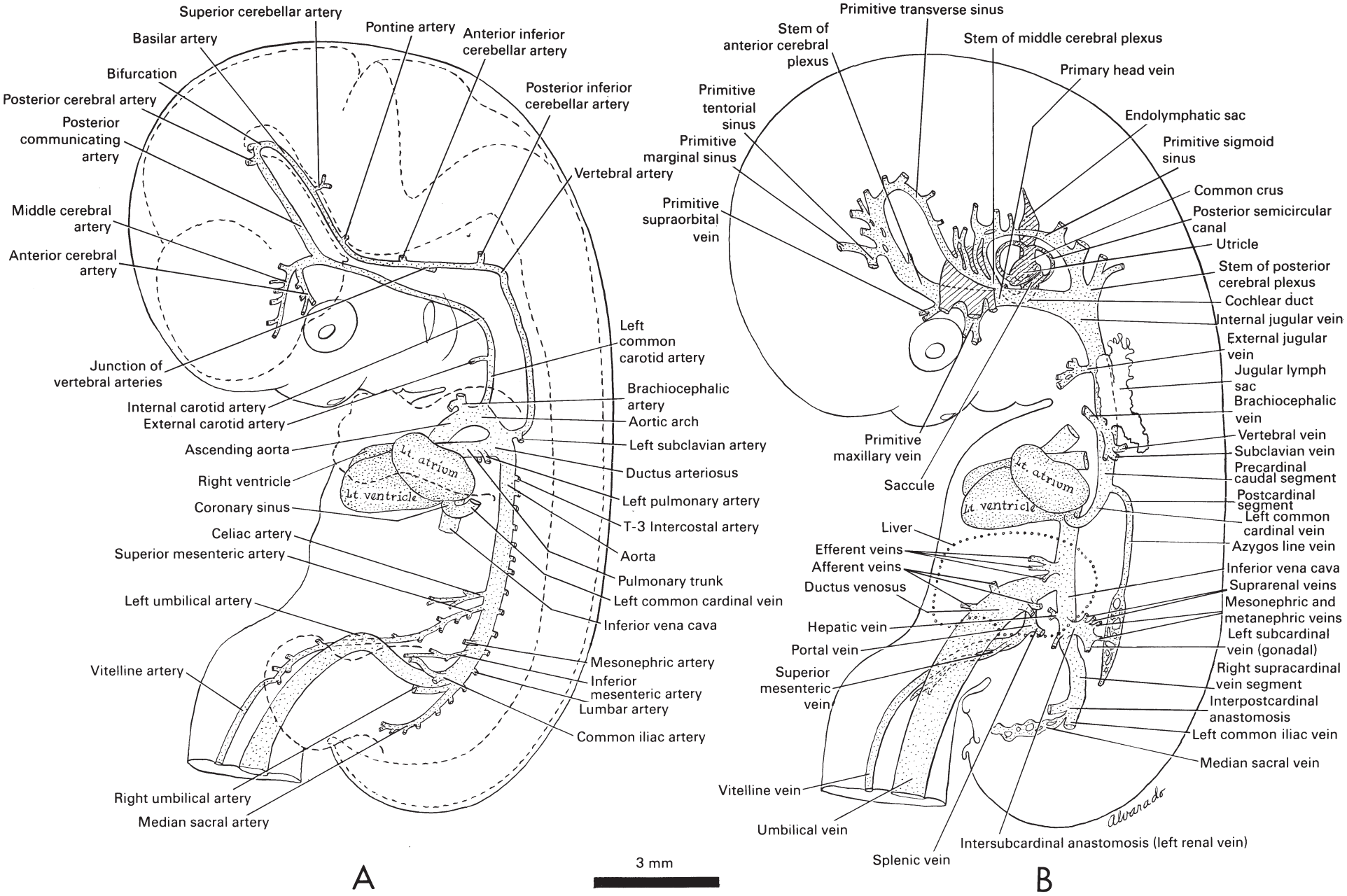


FIG. 7–5
Cardiovascular system of the 18-mm embryo.
A. Arteries.
B. Veins.
Most of the left atrium is composed of the left auricular appendage.

UMBILICAL VEIN

1. The single umbilical vein enlarges and passes through the liver as the *ductus venosus,* which terminates in the inferior vena cava.
2. Afferent veins to the hepatic sinusoids arise from the ductus venosus close to the entrance of the portal vein. Efferent veins from the hepatic sinusoids drain into the junction where the ductus venosus empties into the inferior vena cava.

CARDINAL VEINS

Left Common Cardinal Vein

The left common cardinal vein continues to narrow and eventually disappears so that it no longer drains into the *coronary sinus.*

Precardinal Vein Tributaries

1. Venous channels peripheral to the brain separate into superficial and deep portions. The superficial channels develop into *sinuses* within the ectomeninx. The deep channels become the *cerebral veins.* A narrow channel called the *primitive transverse sinus* passes ventrolateral to the pons area and connects the anterior and middle cerebral plexuses. A more prominent anastomosis is the *primitive sigmoid sinus,* which lies ventrolateral to the myelencephalon and connects the middle and posterior cerebral plexuses.
2. The stem of the anterior cerebral plexus receives the *primitive tentorial sinus* from the cerebral vesicle and the *primitive marginal sinus* from the diencephalon.
3. The rostral segment of the primary head vein between the internal carotid artery and trigeminal ganglion becomes the *primitive cavernous sinus,* which receives the *primitive maxillary* and *supraorbital veins.* The primary head vein becomes the precardinal vein lateral to the parachordal cartilage in the vicinity of cranial nerves IX, X and XI. In the cervical segments the precardinal vein becomes the *internal jugular vein.*
4. The internal jugular vein receives a large tributary in the cervicomandibular area that represents the *external jugular vein.* In the caudal part of the neck it is joined by the subclavian vein. The vessel between this junction and the heart is formed by the caudal segment of the precardinal vein and the common cardinal vein. On the right side the segment becomes the right *brachiocephalic vein* and *superior vena cava.* It disappears on the left when an anastomotic channel that will become the *left brachiocephalic vein* develops ventral to the aortic arch and connects the left internal jugular and subclavian veins with the superior vena cava.

Postcardinal Vein

The postcardinal vein either disappears or is incorporated into other channels. Its cranial segment on the right connects the *azygos line vein* that develops medial to the sympathetic trunk to the caudal segment of the precardinal vein. Its intermediate segment becomes a plexus dorsal to the kidney before it disappears completely. The *interpostcardinal anastomosis* between the caudal segments contributes to the formation of the distal part of the inferior vena cava.

Subcardinal Vein

The *intersubcardinal anastomosis* will become the major portion of the *left renal vein.* The cranial segment of the subcardinal vein on the right side dilates to form the suprarenal part of the inferior vena cava. On the left this segment becomes the *left suprarenal vein.* The caudal segment of the subcardinal vein on each side is incorporated into the *gonadal vein.*

Supracardinal Vein

A third longitudinal channel develops dorsomedial to the postcardinal vein and connects to both the postcardinal and subcardinal veins of the corresponding side. Only part of the caudal segment remains on the right side. It connects the postcardinal anastomosis with the intersubcardinal anastomosis forming the infrarenal part of the inferior vena cava. The sub- and supracardinal anastomosis on the left is incorporated into the renal vein.

Inferior Vena Cava

The inferior vena cava is the largest definitive vein in the body. It begins in the lower lumbar region at the junction of the *common*

iliac veins and ends in the right atrium. It is a composite structure forming only on the right side from the dilated segments of four major venous channels. Beginning caudally these channels are the 1) interpostcardinal anastomosis, 2) right supracardinal vein, 3) right subcardinal vein and 4) right hepatocardiac vein (proximal right vitelline vein).

PULMONARY VEINS

Distinct *right* and *left pulmonary veins* from their respective lung sac join near the left atrium to form the common pulmonary vein. The common pulmonary vein disappears as it becomes incorporated into the left atrial wall.

LYMPHATICS

1. The *jugular lymph sac* enlarges and extends cranially to the upper cervical segments lateral to the internal jugular vein. Near its termination in the internal jugular vein it receives the *axillary lymph sac* from the proximal part of the upper limb.

2. An *iliac lymph sac* appears around the iliac blood vessels from the lower limb.

3. The *mesenteric lymph sac* begins as small spaces dorsal to the inferior vena cava and aorta.

IX. SKELETAL SYSTEM

A. SKULL

NEUROCRANIUM

Cartilaginous Neurocranium (Chondrocranium)

1. Medial Part
   a. The parachordal condensation and occipital sclerotomes form the *parachordal (basal) cartilage* located between the hypophysis and the C-1 segment.
   b. The mesenchymal condensation lateral to the hypophysis becomes the *hypophyseal (polar) cartilage.*
   c. A narrow midline condensation in the septal region between the primitive nasal cavities represents the *trabecular cartilage.* It extends from the hypophysis to the nasal capsule condensation.
2. Lateral Part
   a. Cartilage appears in the *otic capsule* surrounding the semicircular canals and cochlear duct. The otic capsule joins with the parachordal cartilage.
   b. A condensation called the *alisphenoid* develops between the parachordal cartilage and the maxillary and mandibular nerves. It is separated from the otic capsule by the internal carotid artery.
   c. The *orbitosphenoid* is a well-defined cartilage in the ectomeninx around the optic stalk. It is separated from the alisphenoid by the cranial nerves III, IV and VI.
   d. The *nasal capsule* surrounds the primitive nasal cavity and unites with the trabecular cartilage.

Membranous Neurocranium

The dorsal and lateral surfaces of the brain are covered by the *ectomeninx,* which will give rise to the flat bones of the skull.

VISCEROCRANIUM

1. The first and second branchial arch condensations transform into prominent bars of cartilage.
2. The third arch cartilage separates from the laryngeal condensation becoming a curved, fingerlike condensation at the root of the tongue. It joins the ventral end of the second arch cartilage where the two together will form the hyoid bone.
3. The remainder of the arch cartilages are represented as laryngeal condensations.

B. POSTCRANIAL PART OF AXIAL SKELETON

VERTEBRAL COLUMN

1. The caudal condensed part of each sclerotome forms the *intervertebral disc.*
2. The cranial, less-condensed part gives rise to the cartilaginous *centrum.* A cartilaginous *neural arch* projects dorsally from each side of the centrum. Each pair of arches is joined dorsal to the spinal cord by the ectomeninx. Projecting laterally from each centrum is a short *transverse process.*

RIBS AND STERNUM

1. The 12 pairs of rib primordia become cartilaginous and extend ventrolaterally into the body wall. The enlarged end of the rib adjacent to the centrum forms the *head.* The lateral, thin part is the *shaft.* A *tubercle* is present where the rib makes contact with the transverse process.
2. On each side the distal ends of the primordial ribs are joined together by a longitudinally arranged strip of cartilage called the *sternal bar.* The sternal bars are separated by the large heart and liver. Cranially the two bars join together in the midline to form the *episternal cartilage.*

C. APPENDICULAR SKELETON

There is a proximodistal sequence of differentiation in the limb buds with the pectoral girdle being slightly more advanced than the pelvic girdle. The skeletal components of both girdles with the exception of the clavicle becomes discrete pieces of cartilages. The *clavicle* is a dense membrane that begins ossifying very early, even before chondrification begins in other areas.

X. MUSCULAR SYSTEM

A. HEAD MESODERM

AROUND THE OPTIC CUP

The individual extraocular muscles become evident and receive an innervation from cranial nerves III, IV or VI.

BRANCHIAL ARCHES

1. *Arch 1*—The *muscles of mastication* are a large premuscle mass that receives fibers from the *mandibular nerve.* The premuscle mass is located lateral to the first arch cartilage between the optic cup and the first branchial groove.
2. *Arch 2*—The *muscles of facial expression* appear as sheets of premuscle cells *(laminae)* that extend into the *occipital, cervical* and *mandibular* regions. Deep to each lamina is one or more branches of the *facial nerve.*
3. *Caudal arches*—It is difficult to separate the mesenchyme in the caudal arches. This mesenchyme collectively gives rise to the *muscles of the pharynx* (stylopharyngeus and pharyngeal constrictors) and *larynx,* which are innervated by branches of *cranial nerves IX* and X.
4. *Sternocleidomastoid-trapezius muscles*—These muscles become separate masses in the lateral cervical region. Each receives a separate branch of the *spinal accessory nerve.*

FLOOR OF THE PHARYNX

The *intrinsic* and *extrinsic muscles of the tongue* can be identified along with their innervation by the *hypoglossal nerve.*

B. MYOTOMIC DERIVATIONS

The myotomic derivations are indicated in Table 7–1.

C. LATERAL (PLATE) MESODERM

1. *Somatic layer*—Experimental studies on lower forms suggest that these mesenchymal cells give rise to the muscles of the limbs (see below) and also contribute to the formation of the muscles in the ventral and lateral body wall (see Table 7-1).
2. *Splanchnic layer*—The *muscularis layer* of the gut differ-

Table 7-1. Myotic Derivations

Region	Muscles of Epiaxial Division	Muscles of Hypaxial Division
Cervical	Semispinalis, longissimus, splenius, levator scapulae and rhomboideus major and minor	Longus, scalene, strap, deltoid, pectoral, serratus anterior and latissimus dorsi
Thoracic	Transversospinalis and erector spinae groups	External, internal and innermost intercostals, external and internal abdominal oblique, transverse abdominus and rectus abdominus
Lumbar	Same as thoracic	Iliopsoas and quadratus lumborum
Sacral	None	Pelvic diaphragm
Coccygeal	None	None

entiates from the condensation around the endodermal tube of the alimentary tract. Cartilages form in the condensation around the endodermal tracheobronchial tree.

D. LIMB MESODERM

1. Muscles differentiate *in situ* from the mesenchymal cells within the limb buds.
2. Individual muscles first appear proximally in each limb bud.
3. *Extensor muscles* develop in the dorsal part of the limb, *flexor muscles* develop in the ventral part.
4. In the upper limb the *radial nerve* supplies the extensors; the *musculocutaneous, median* and *ulnar nerves* innervate the flexors.
5. In the lower limb the pattern is more complex with some nerves innervating both extensors and flexors. The major nerves *(femoral, obturator, sciatic* and its *common peroneal* and *tibial branches)* can be identified.

XI. INTEGUMENTARY SYSTEM

A. SKIN

No significant changes are apparent in the ectoderm. The underlying mesenchymal cells produce a thick layer of loose tissue that separates the ectoderm from the deeper muscle masses.

B. MAMMARY GLAND

The major part of the mammary ridge disappears. Only a small circular area remains in the thoracic region at the level of the T-4 intercostal space. It represents the *mammary gland primordium* and begins to penetrate the underlying tissue (Fig. *7–1A).*

C. TEETH

The oral epithelium thickens on the maxillary and mandibular processes forming the *labiodental laminae* that are arranged in a U-shaped manner on the surface of each process. The laminae follow the configuration of the primordial jaws.

XII. SPECIAL SENSE ORGANS

A. EYE

OPTIC CUP
Fig. 7–1*A*

1. The three zones of the visual layer of the retina are limited to the deep four-fifths of the optic cup where the layer is thick and is called the *pars optica retinae.* The superficial one-fifth is thin and is referred to as the *pars* caeca *retinae.*
2. The three zones of the pars optica retinae will differentiate the following manner,
   a. The *ependymal zone* located next to the intraretinal space will become the photoreceptor layer of rods and cones.
   b. The *mantle zone* will produce the *ganglion* and *nuclear* layers.
   c. The *marginal zone* next to the optic cup cavity will form the *nerve fiber layer.*
3. The pars caeca retinae will differentiate into the *iris* and *ciliary body,* both of which contain smooth muscle.
4. Hyaloid blood vessels differentiate within the mesenchyme that passes through the choroid fissure into the optic cup cavity. These vessels supply the visual part of the retina and initially the lens. A delicate network of fibers, the *primordial vitreous body,* develops between the lens and the retina.

OPTIC STALK
Fig. 7–2*A*

1. The relative diameter of the optic stalk is reduced as it increases in length.
2. The optic stalk lumen that connects the intraretinal space with the third ventricle of the brain is reduced.

LENS
Fig. 7-1*A*

The lens cavity disappears as the deep lens epithelium becomes contiguous with the superficial lens epithelium. The deep layer forms the primary lens fibers which collectively make up the *nucleus of the lens.*

MESENCHYME AROUND THE OPTIC CUP

1. A space develops in the mesenchyme between the brim of the optic cup and the overlying ectoderm. This space becomes the *anterior chamber,* which separates the mesenchyme into two layers; a thin inner layer next to the lens called the *iridopupillary membrane* and a thick outer layer next to the ectoderm, which together give rise to the *cornea.*
2. The loose mesenchyme adjacent to the surface of the optic cup condenses to form a *capsule* next to the pigmented layer of the retina. At the brim of the optic cup the capsule is continuous with the cornea.

ACCESSORY STRUCTURES
Fig. 7–1*A*

1. Thick flaps of ectoderm, called *upper* and *lower eyelid folds,* contain mesenchymal cells and begin to grow over the surface of the eye.
2. The walls of the maxillonasal groove fuse to form the *nasolacrimal duct* that courses from the medial aspect of the eye to the primitive nasal cavity.
3. The *extraocular muscles* appear as distinct masses each receiving an innervation from either cranial nerve III, IV or VI. The *ophthalmic division* of cranial nerve V and the autonomic *ciliary ganglion* are evident in the vicinity of the eye.

B. EAR

INTERNAL EAR
Fig. 7–5*B*

Vestibular Pouch

1. Three separate *semicircular canals* (anterior, posterior and lateral) develop from three flat outpouchings of the upper part of the vestibular pouch. The central area of the wall of each outpouching fuses and disappears forming a curved duct. The anterior and posterior canals join to form a *common crus* so that there is a total of only five crura.
2. The five crura are received into a large sac called the *utricle* that develops from the lower part of the vestibular pouch.
3. The endolymphatic diverticulum arises from the lower part of the utricle. Its proximal narrow segment becomes the *endolymphatic duct.* Its distal end near the roof of the fourth ventricle dilates to form the *endolymphatic sac.*

Cochlear Pouch

1. A small sac known as the *saccule* differentiates from the upper part of the cochlear pouch.
2. The *cochlear duct* develops from the lower part of the pouch but remains in communication with the saccule. The duct begins to spiral.

Otic Capsule

Cartilage appears in the condensation around the derivatives of the vestibular and cochlear pouches.

MIDDLE EAR
Fig. 7–2*B*

1. As the tubotympanic recess elongates in a dorsolateral direction, its narrow proximal part becomes the *auditory tube* and its wide distal part forms the *primitive tympanic cavity.*
2. Mesenchymal condensations at the dorsal end of the first and second arch cartilages represent the middle ear ossicles. The condensations initially lie dorsal to the primitive tympanic cavity. The *malleus* and *incus* differentiate at the dorsal end of the first arch cartilage, the *stapes* differentiates at the dorsal end of the second arch cartilage.
3. A remnant of the second aortic arch, the *stapedial artery,* passes through stapes condensation accounting for the opening in its center. The artery is a transient structure.

EXTERNAL EAR
Fig. 7–1*A*

The auricle begins to take shape as the auricular hillocks blend around the first branchial groove. The groove gives rise to the *external acoustic meatus.*

C. OLFACTORY APPARATUS

See Section III, A.

THE 18-MM EMBRYO
STAGE 19
AGE 45 TO 47.5 DAYS
CROWN TO RUMP LENGTH 18.0 MM

Hooker-Humphrey collection 142

Reference
Streeter GL: Developmental horizons in human embryos. Description of age groups XIX, XX, XXI, XXII and XXIII. Contrib Embryol Carnegie Instn 32:133–203, 1951

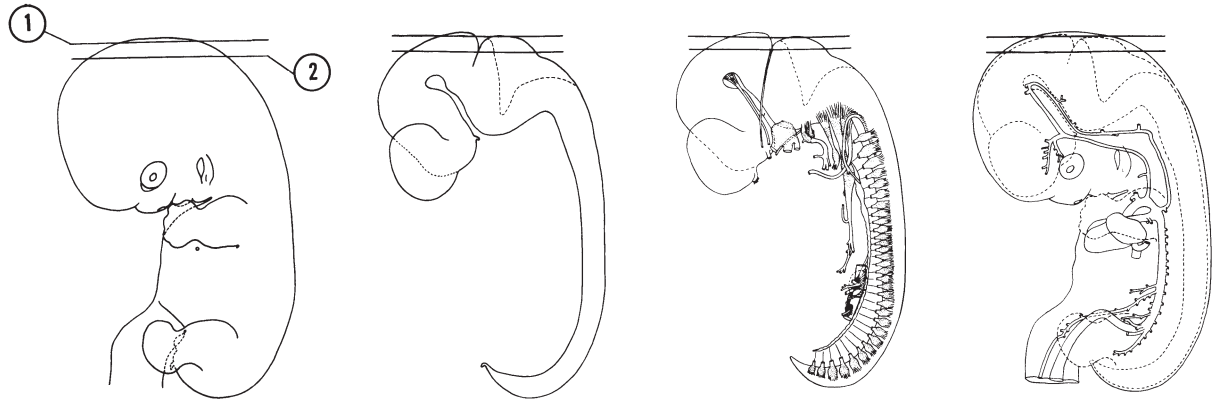
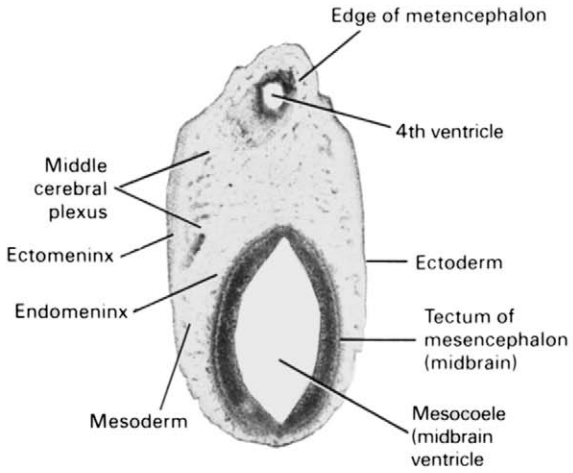
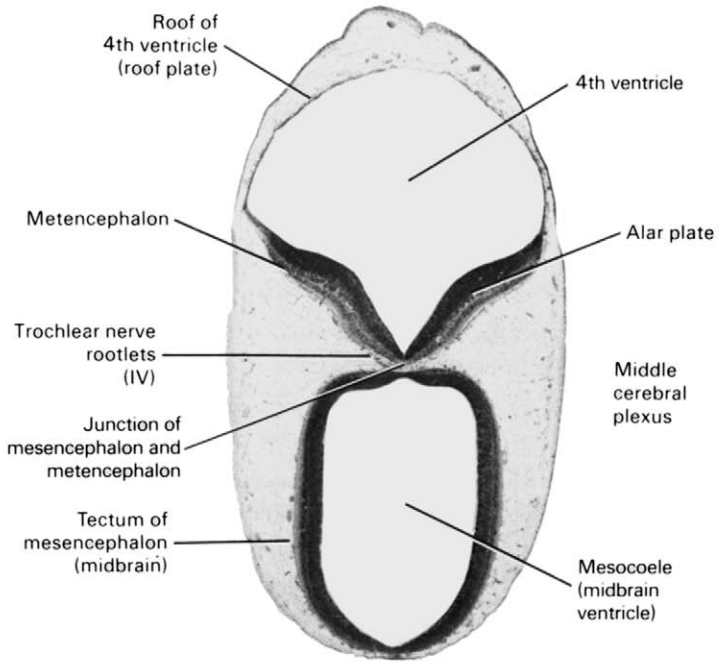


FIG. 7–6

SECTION 1
A section through the tectum of the mesencephalon and edge of the metencephalon.
Observe:
1. The dorsal part of the mesocoele and fourth ventricle.
2. The dorsal part of the middle cerebral plexus of veins in the ectomeninx.

SECTION 2
A section through the dorsal part of the mes- and metencephalon junction.
Observe:
1. The rootlets of the trochlear nerve arising from the junction area.
2. The thin roof of the fourth ventricle joining the alar plate of the metencephalon.


Edge of metencephalon
4th ventricle
Middle cerebral plexus
Ectomeninx
Endomeninx
Ectoderm
Tectum of mesencephalon (midbrain)
Mesoderm
Mesocoele (midbrain ventricle


Roof of 4th ventricle (roof plate)
4th ventricle
Metencephalon
Alar plate
Trochlear nerve rootlets (IV)
Middle cerebral plexus
Junction of mesencephalon and metencephalon
Tectum of mesencephalon (midbrain)
Mesocoele (midbrain ventricle)

1

2 mm

2

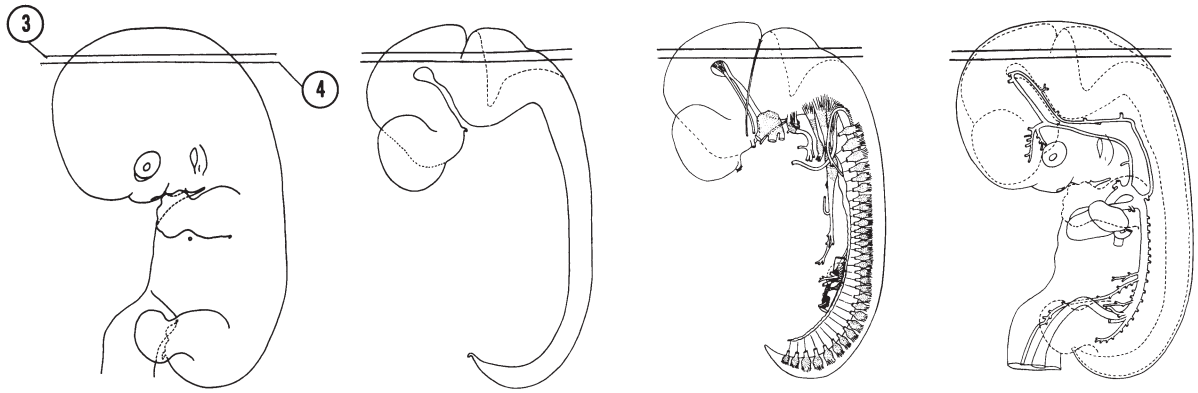
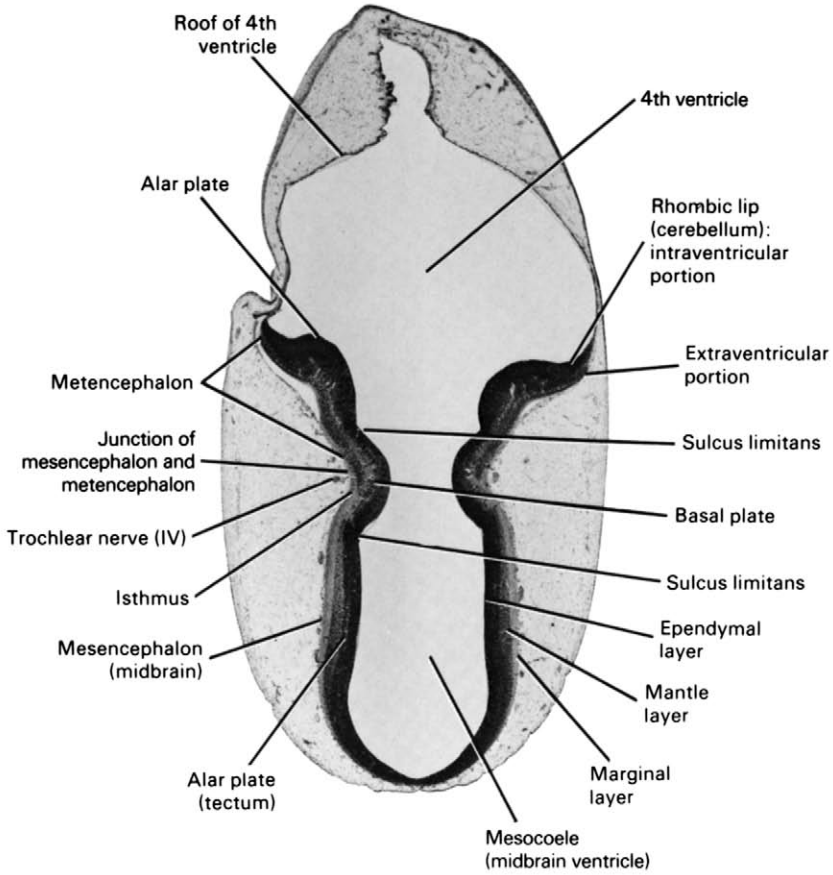


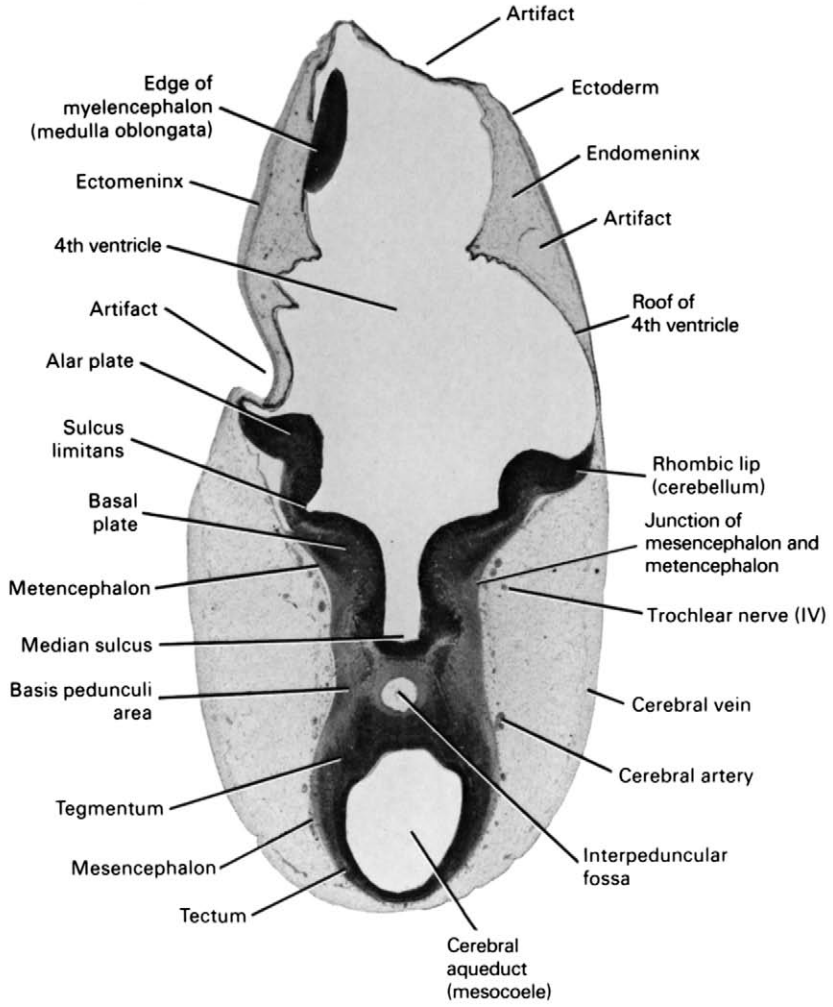
FIG. 7–7

SECTION 3
A section through the middle of the mes- and metencephalon junction.
Observe:
1. The communication of the mesocoele with the fourth ventricle through the isthmus.
2. The sulcus limitans separating the basal and alar plates.
3. The three layers of the brain wall.
4. The lateral part of the alar plate of the metencephalon called the rhombic lip, which gives rise to the cerebellum.
5. The intra- and extraventricular portions of the rhombic lip.

SECTION 4
A section through the ventral part of the mes- and metencephalon junction and edge of the myelencephalon.
Observe:
1. The minute trochlear nerve coursing ventrally at the lateral aspect of the junction region.
2. The continuity of the basal plates in the junction region.
3. The interpeduncular fossa separating the basis pedunculi areas.
4. The narrow portion of the mesocoele, which is becoming the cerebral aqueduct.
5. The roof of the fourth ventricle joining the dorsal edge of the myelencephalon.


Roof of 4th ventricle
4th ventricle
Alar plate
Rhombic lip (cerebellum): intraventricular portion
Extraventricular portion
Metencephalon
Junction of mesencephalon and metencephalon
Sulcus limitans
Basal plate
Trochlear nerve (IV)
Sulcus limitans
Isthmus
Ependymal layer
Mesencephalon (midbrain)
Mantle layer
Marginal layer
Alar plate (tectum)
Mesocoele (midbrain ventricle)

3


Artifact
Edge of myelencephalon (medulla oblongata)
Ectoderm
Endomeninx
Ectomeninx
Artifact
4th ventricle
Roof of 4th ventricle
Artifact
Alar plate
Sulcus limitans
Rhombic lip (cerebellum)
Basal plate
Junction of mesencephalon and metencephalon
Metencephalon
Trochlear nerve (IV)
Median sulcus
Basis pedunculi area
Cerebral vein
Cerebral artery
Tegmentum
Interpeduncular fossa
Mesencephalon
Tectum
Cerebral aqueduct (mesocoele)

4

2 mm

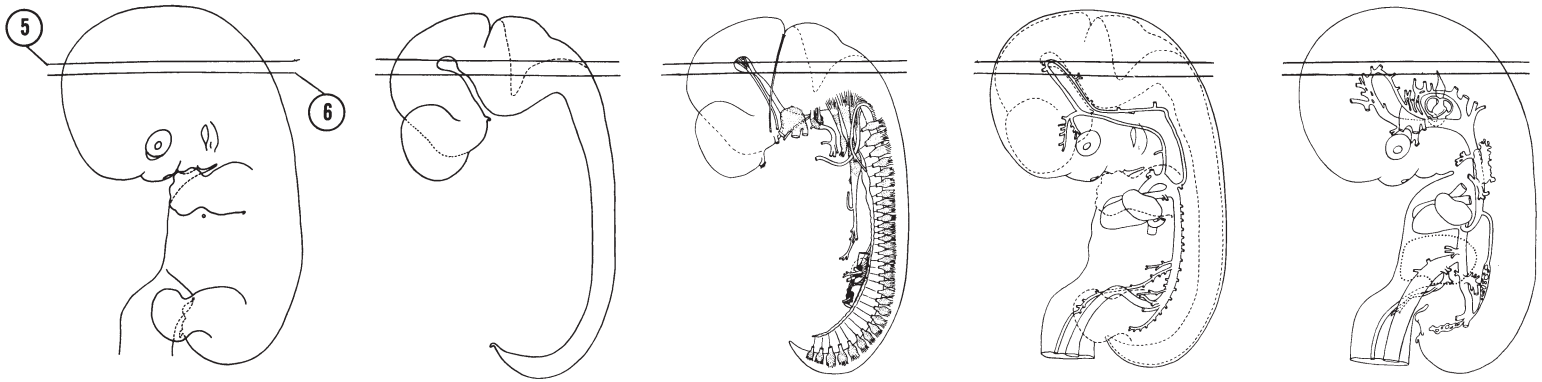


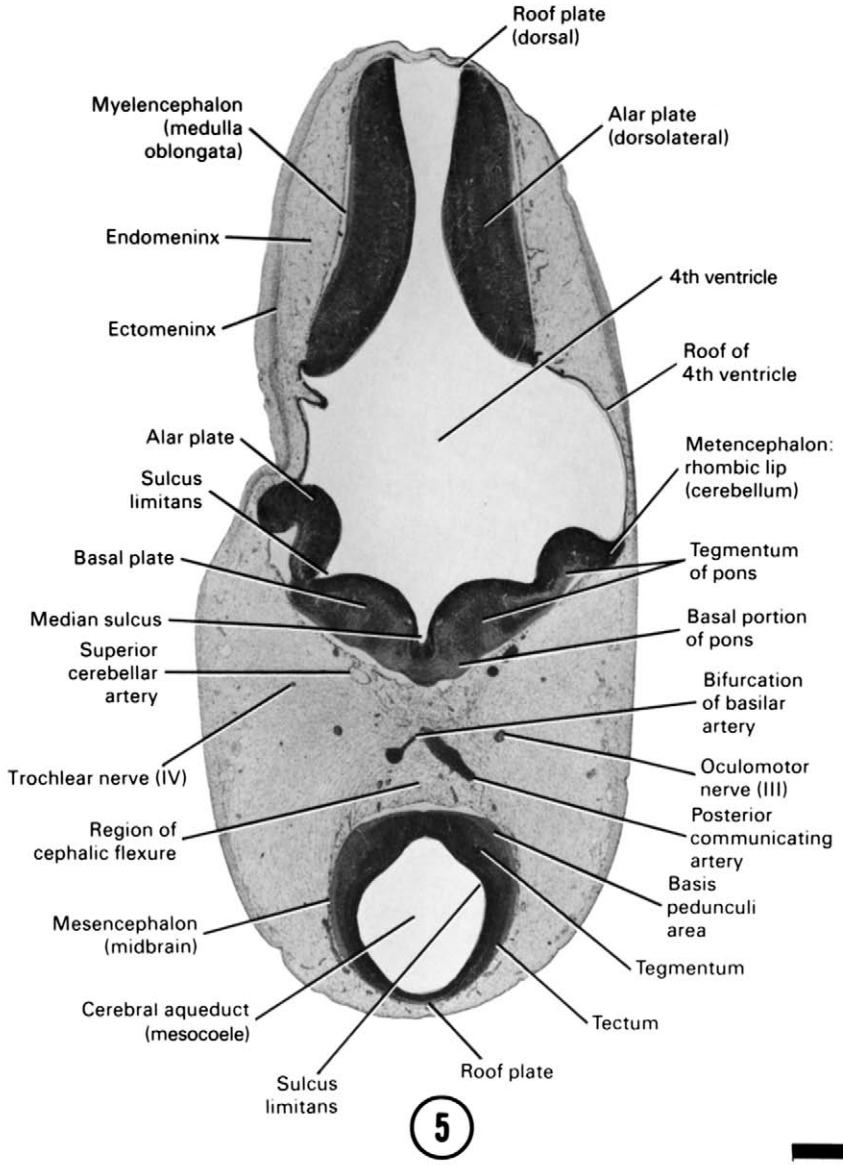
FIG. 7–8

SECTION 5
A section through the alar plate of the myelencephalon.
Observe:

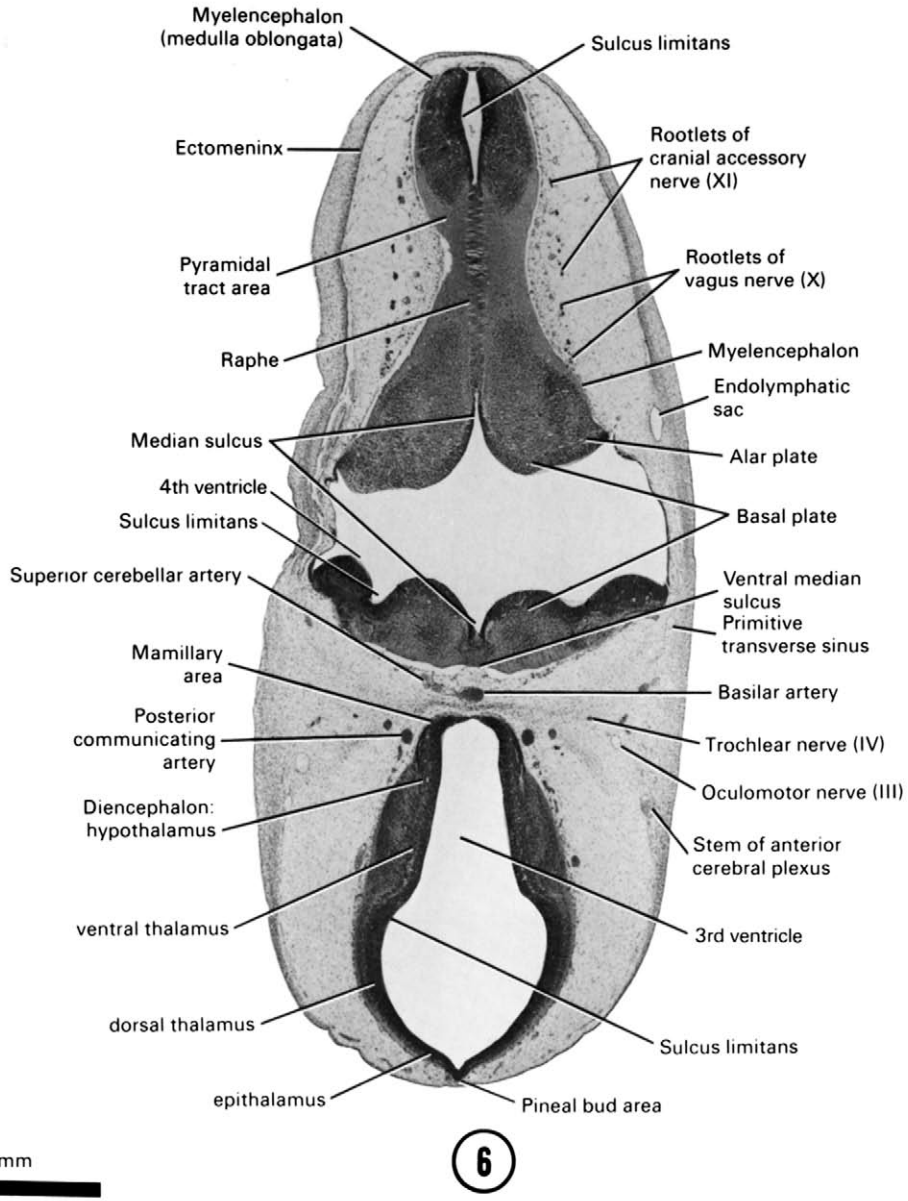
1. A transverse section through the mesencephalon showing its major subdivisions.
2. The region of the cephalic flexure containing the oculomotor nerve and the bifurcation of the basilar artery.
3. The major subdivisions of the metencephalon.
4. The superior cerebellar artery coursing laterally on the ventral surface of the metencephalon.
5. The two subdivisions of the primitive meninx lateral to the myelencephalon: ectomeninx and endomeninx.

SECTION 6
A section through the basal plate of the myelencephalon and caudal part of the diencephalon.
Observe:

1. The major subdivisions of the diencephalon and the continuity of the cerebral aqueduct in Section 5 with the third ventricle.
2. The median sulcus and sulcus limitans subdividing the floor of the fourth ventricle.
3. The close relationship of the endolymphatic sac to the roof of the fourth ventricle.
4. The midline raphe in the ventral part of the myelencephalon produced by crossing fibers.
5. The rootlets of the vagus and cranial accessory nerves that arise from the ventrolateral surface of the myelencephalon.


Roof plate (dorsal)
Myelencephalon (medulla oblongata)
Alar plate (dorsolateral)
Endomeninx
4th ventricle
Ectomeninx
Roof of 4th ventricle
Alar plate
Metencephalon: rhombic lip (cerebellum)
Sulcus limitans
Tegmentum of pons
Basal plate
Median sulcus
Basal portion of pons
Superior cerebellar artery
Bifurcation of basilar artery
Trochlear nerve (IV)
Oculomotor nerve (III)
Region of cephalic flexure
Posterior communicating artery
Basis pedunculi area
Mesencephalon (midbrain)
Tegmentum
Cerebral aqueduct (mesocoele)
Tectum
Sulcus limitans
Roof plate

5


Myelencephalon (medulla oblongata)
Sulcus limitans
Ectomeninx
Rootlets of cranial accessory nerve (XI)
Pyramidal tract area
Rootlets of vagus nerve (X)
Raphe
Myelencephalon
Endolymphatic sac
Median sulcus
Alar plate
4th ventricle
Basal plate
Sulcus limitans
Superior cerebellar artery
Ventral median sulcus
Primitive transverse sinus
Mamillary area
Basilar artery
Posterior communicating artery
Trochlear nerve (IV)
Oculomotor nerve (III)
Diencephalon: hypothalamus
Stem of anterior cerebral plexus
ventral thalamus
3rd ventricle
dorsal thalamus
Sulcus limitans
epithalamus
Pineal bud area

6

2 mm

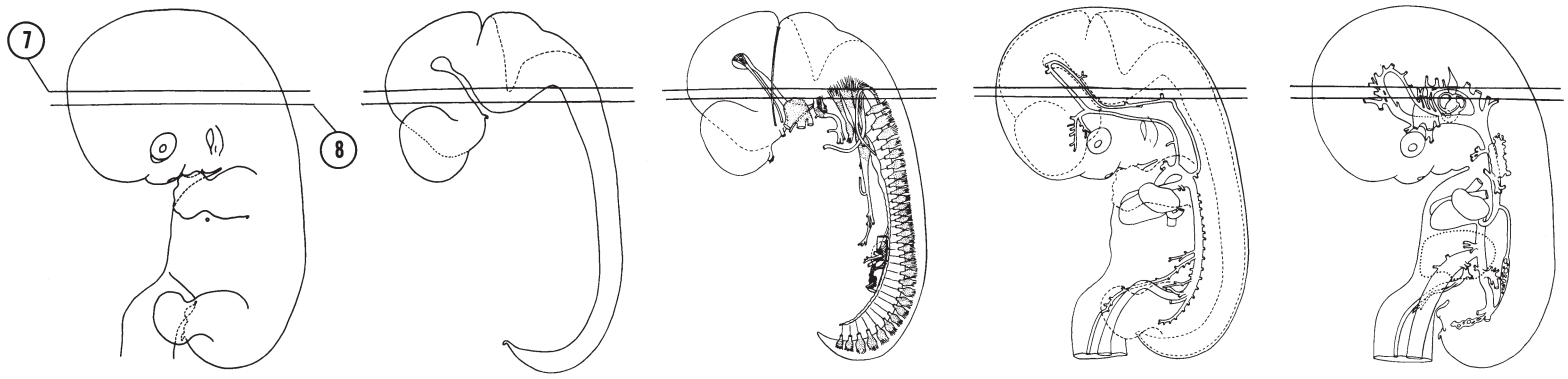
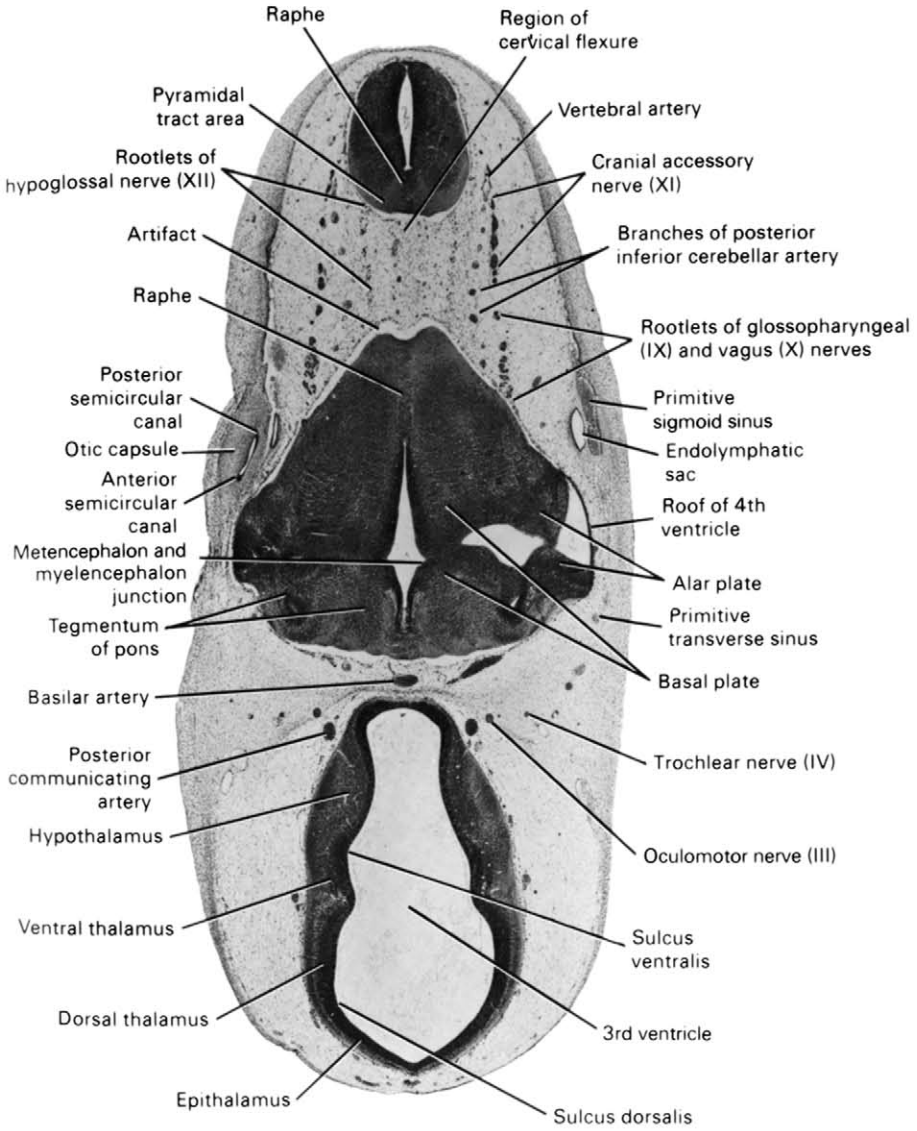


FIG. 7–9

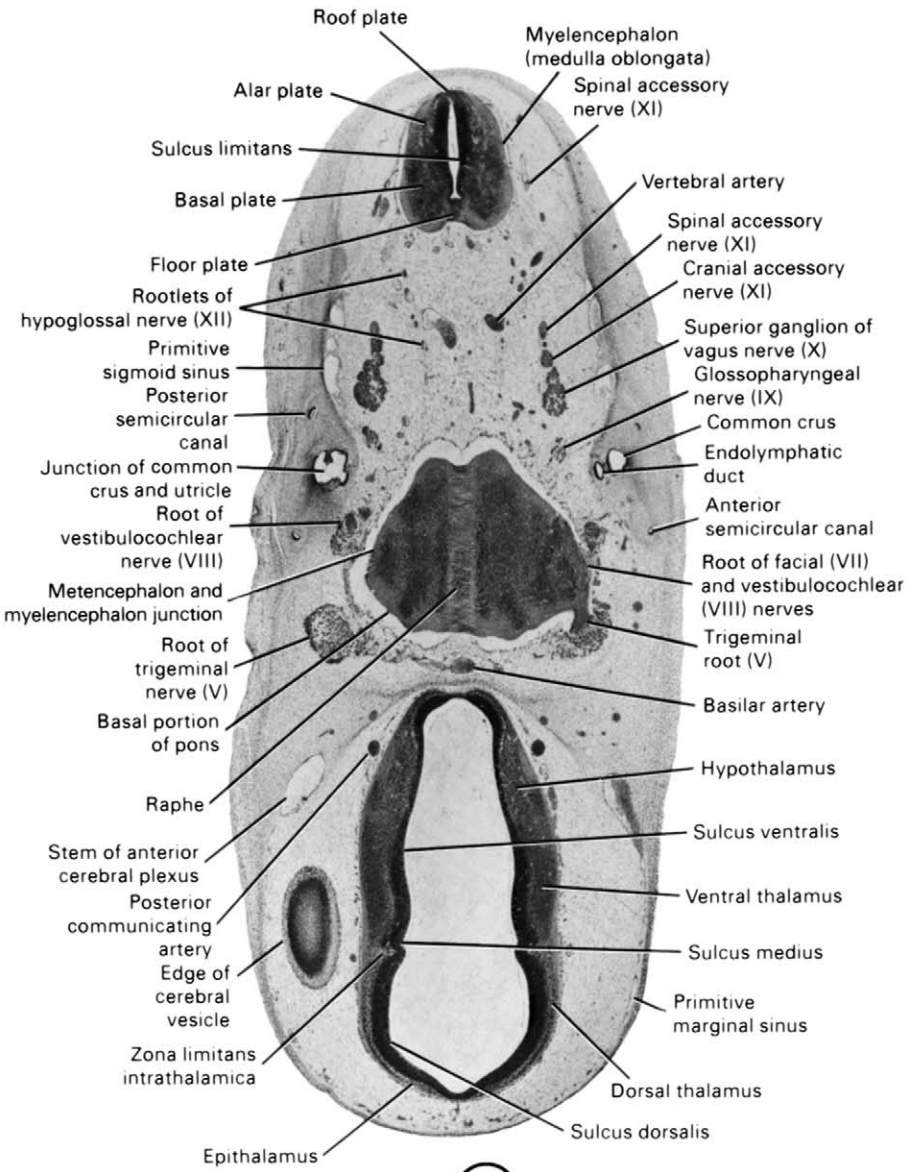
SECTION 7
A section through the met- and myelencephalon junction.
Observe:
1. The tegmentum of the pons area of the metencephalon.
2. The dorsal edge of the otic capsule showing the junction of the anterior and posterior semicircular canals.
3. The region of the cervical flexure containing the rootlets of the hypoglossal nerve.
4. The rootlets of cranial nerve IX arising in series with cranial nerve X.
5. The raphe separating the pyramidal tract areas in the ventral part of the myelencephalon.

SECTION 8
A section through the edge of the cerebral vesicle and basal portion of the pons area.
Observe:
1. The three sulci in the lateral wall of the diencephalon separating it into four subdivisions.
2. The root of the trigeminal nerve arising from the pons; the roots of cranial nerves VII and VIII arising from the region of the met- and myelencephalon junction.
3. The common crus and its junction with the utricle of the membranous labyrinth.
4. The venous sinuses in the ectomeninx.
5. The spinal accessory nerve in two regions and the junction of the cranial accessory nerve with the vagus nerve.


Raphe
Region of cervical flexure
Pyramidal tract area
Vertebral artery
Rootlets of hypoglossal nerve (XII)
Cranial accessory nerve (XI)
Artifact
Branches of posterior inferior cerebellar artery
Raphe
Rootlets of glossopharyngeal (IX) and vagus (X) nerves
Posterior semicircular canal
Primitive sigmoid sinus
Otic capsule
Endolymphatic sac
Anterior semicircular canal
Roof of 4th ventricle
Metencephalon and myelencephalon junction
Alar plate
Tegmentum of pons
Primitive transverse sinus
Basilar artery
Basal plate
Posterior communicating artery
Trochlear nerve (IV)
Hypothalamus
Oculomotor nerve (III)
Ventral thalamus
Sulcus ventralis
Dorsal thalamus
3rd ventricle
Epithalamus
Sulcus dorsalis

7

2 mm


Roof plate
Myelencephalon (medulla oblongata)
Alar plate
Spinal accessory nerve (XI)
Sulcus limitans
Vertebral artery
Basal plate
Spinal accessory nerve (XI)
Floor plate
Cranial accessory nerve (XI)
Rootlets of hypoglossal nerve (XII)
Superior ganglion of vagus nerve (X)
Primitive sigmoid sinus
Glossopharyngeal nerve (IX)
Posterior semicircular canal
Common crus
Junction of common crus and utricle
Endolymphatic duct
Root of vestibulocochlear nerve (VIII)
Anterior semicircular canal
Metencephalon and myelencephalon junction
Root of facial (VII) and vestibulocochlear (VIII) nerves
Root of trigeminal nerve (V)
Trigeminal root (V)
Basal portion of pons
Basilar artery
Raphe
Hypothalamus
Stem of anterior cerebral plexus
Sulcus ventralis
Posterior communicating artery
Ventral thalamus
Edge of cerebral vesicle
Sulcus medius
Primitive marginal sinus
Zona limitans intrathalamica
Dorsal thalamus
Epithalamus
Sulcus dorsalis

8

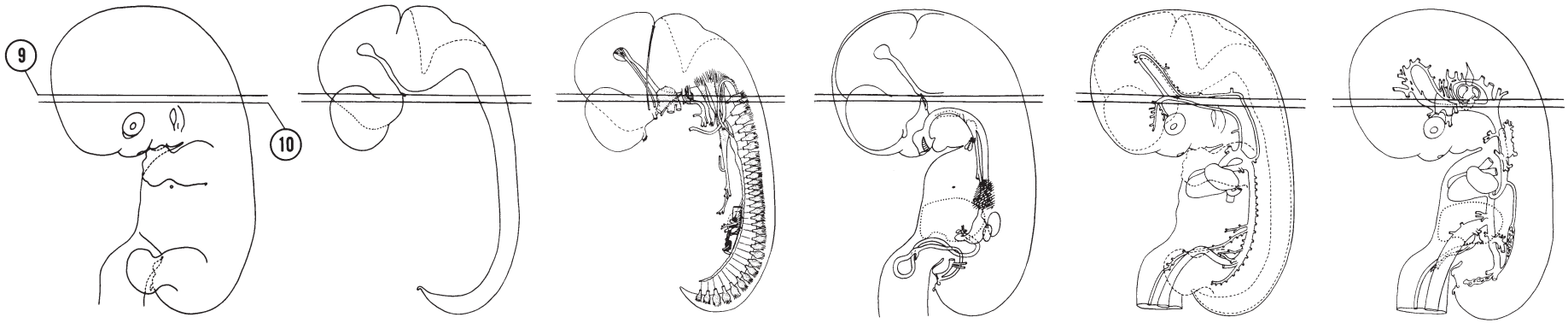
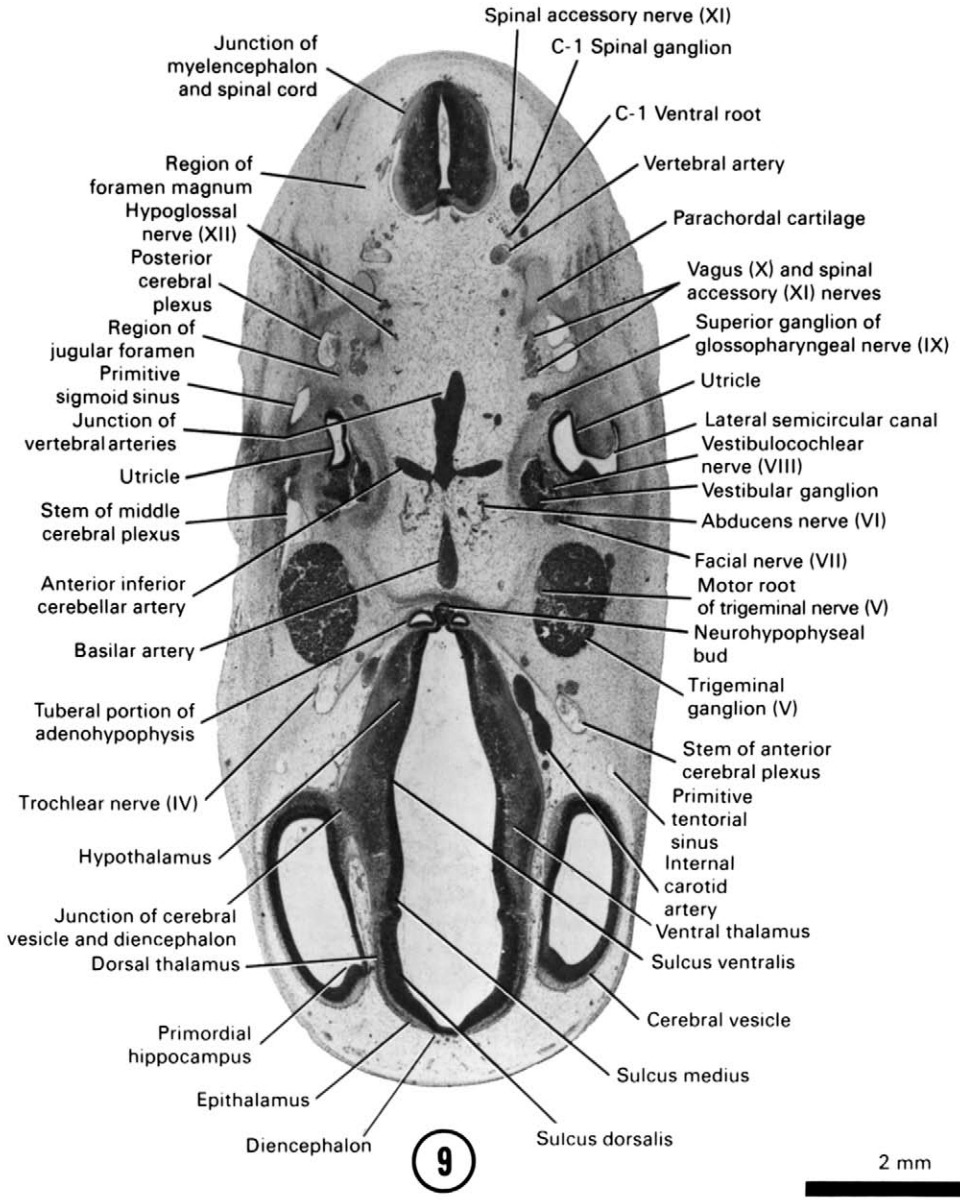
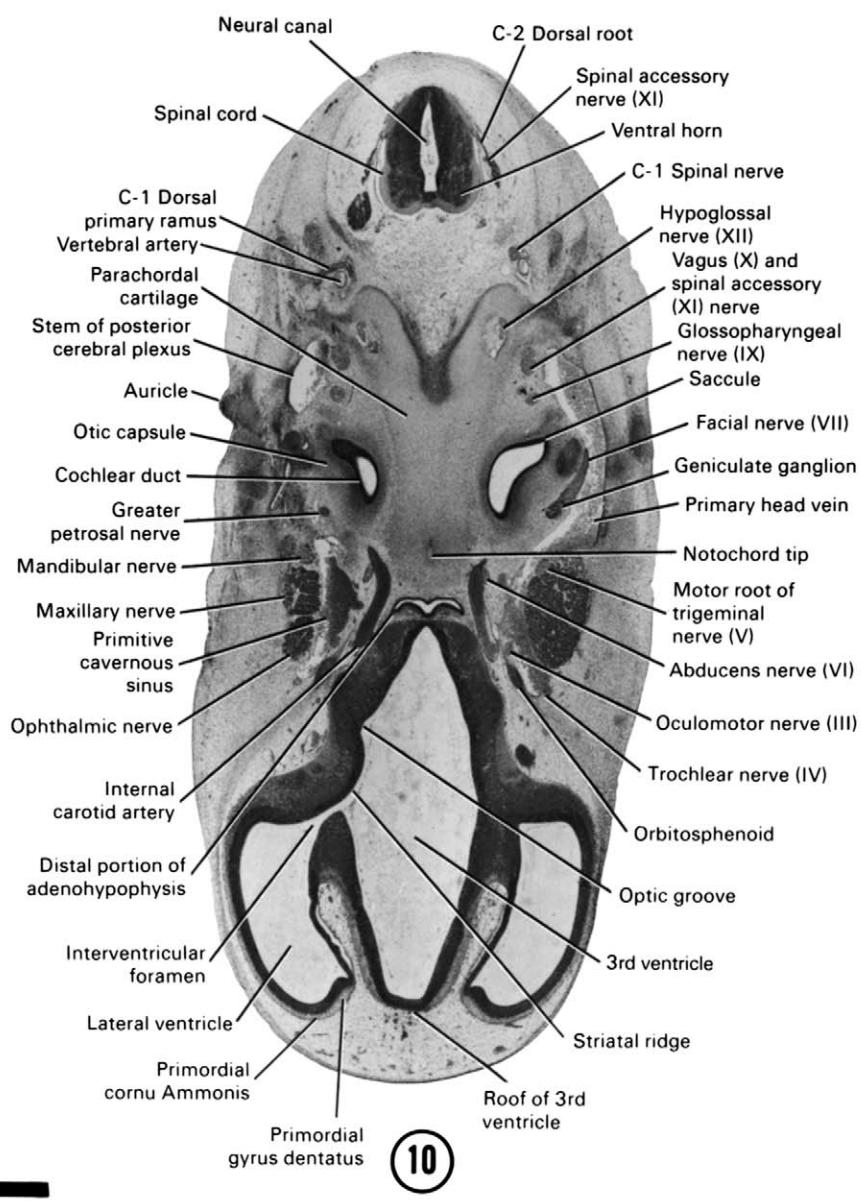


FIG. 7–10

SECTION 9
A section through the C-1 spinal ganglion at the junction of the myelencephalon and spinal cord.
Observe:
1. The junction of the cerebral vesicle with the diencephalon.
2. The tuberal portion of the adenohypophysis on each side of the neurohypophyseal bud.
3. The trigeminal ganglion with the motor root of V medially.
4. The junction of the vertebral arteries to form the basilar artery.
5. The junction of the lateral semicircular canal with the utricle and the relation of the vestibular ganglion to the cochlear and facial nerves.

SECTION 10
A section through the base of the developing skull (cranial tip of notochord and parachordal cartilage).
Observe:
1. The vessels and cranial nerves lateral to the distal portion of the adeno-hypophysis.
2. The three divisions of the trigeminal nerve; the ophthalmic, maxillary and mandibular nerves.
3. The geniculate ganglion on cranial nerve VII and its position lateral to the saccule and cochlear duct.
4. The junction of the primary head vein with the stem of the posterior cerebral plexus.
5. The relation of the C-1 spinal nerve to the vertebral artery.


Spinal accessory nerve (XI)
Junction of myelencephalon and spinal cord
C-1 Spinal ganglion
C-1 Ventral root
Region of foramen magnum
Vertebral artery
Hypoglossal nerve (XII)
Parachordal cartilage
Posterior cerebral plexus
Vagus (X) and spinal accessory (XI) nerves
Region of jugular foramen
Superior ganglion of glossopharyngeal nerve (IX)
Primitive sigmoid sinus
Utricle
Junction of vertebral arteries
Lateral semicircular canal
Vestibulocochlear nerve (VIII)
Utricle
Vestibular ganglion
Stem of middle cerebral plexus
Abducens nerve (VI)
Facial nerve (VII)
Anterior inferior cerebellar artery
Motor root of trigeminal nerve (V)
Basilar artery
Neurohypophyseal bud
Trigeminal ganglion (V)
Tuberal portion of adenohypophysis
Stem of anterior cerebral plexus
Primitive tentorial sinus
Trochlear nerve (IV)
Internal carotid artery
Hypothalamus
Ventral thalamus
Junction of cerebral vesicle and diencephalon
Sulcus ventralis
Dorsal thalamus
Cerebral vesicle
Primordial hippocampus
Sulcus medius
Epithalamus
Diencephalon
Sulcus dorsalis
9


Neural canal
C-2 Dorsal root
Spinal accessory nerve (XI)
Spinal cord
Ventral horn
C-1 Spinal nerve
C-1 Dorsal primary ramus
Hypoglossal nerve (XII)
Vertebral artery
Vagus (X) and spinal accessory (XI) nerve
Parachordal cartilage
Glossopharyngeal nerve (IX)
Stem of posterior cerebral plexus
Saccule
Auricle
Facial nerve (VII)
Otic capsule
Geniculate ganglion
Cochlear duct
Primary head vein
Greater petrosal nerve
Notochord tip
Mandibular nerve
Motor root of trigeminal nerve (V)
Maxillary nerve
Primitive cavernous sinus
Abducens nerve (VI)
Ophthalmic nerve
Oculomotor nerve (III)
Trochlear nerve (IV)
Internal carotid artery
Orbitosphenoid
Distal portion of adenohypophysis
Optic groove
3rd ventricle
Interventricular foramen
Lateral ventricle
Striatal ridge
Primordial cornu Ammonis
Roof of 3rd ventricle
Primordial gyrus dentatus
10

2 mm

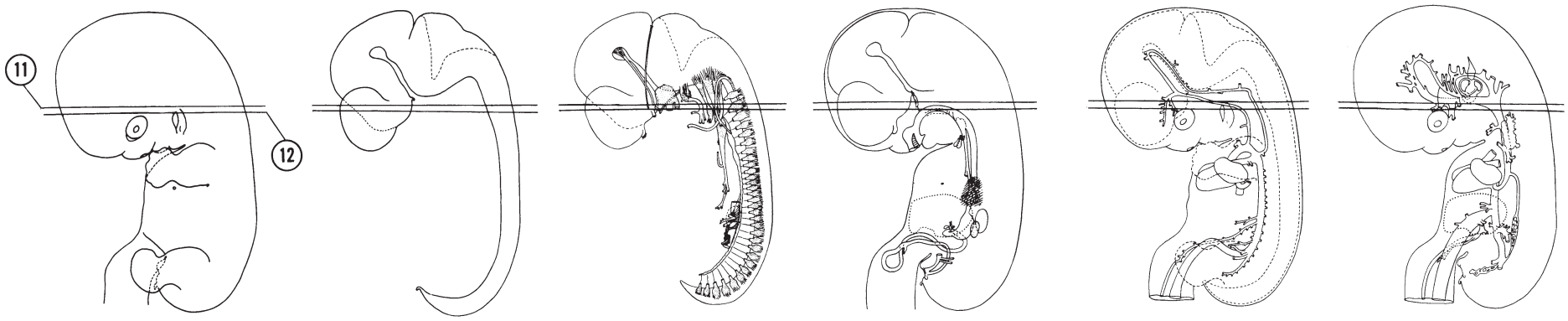
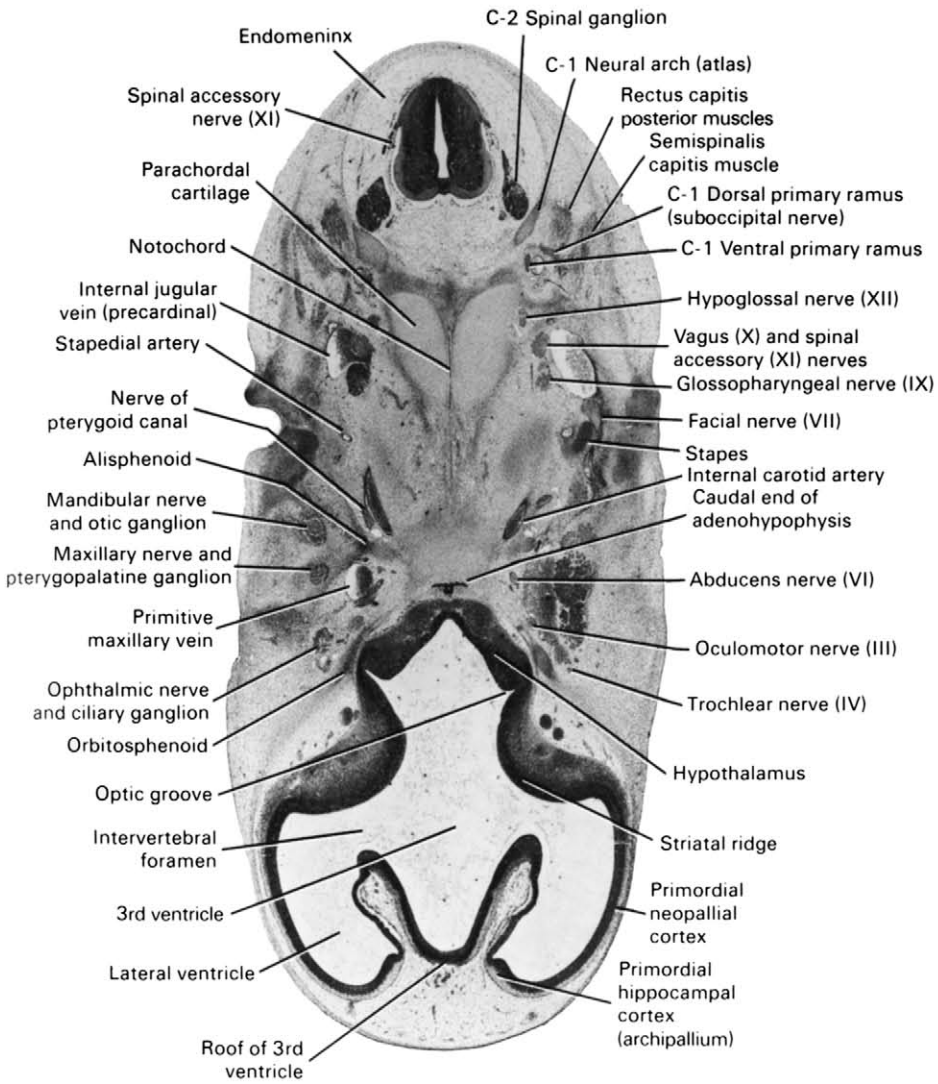


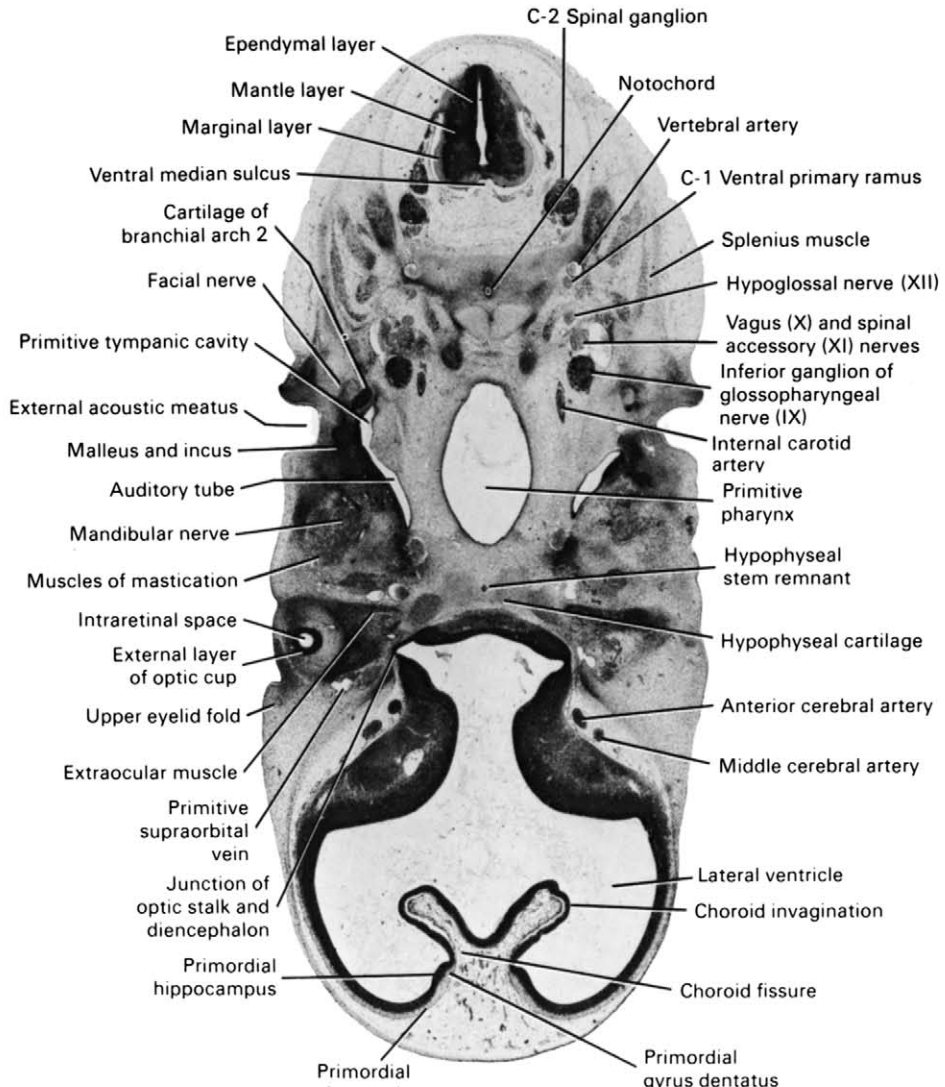
FIG. 7–11

SECTION 11
A section through the C-2 spinal ganglion. Observe:
1. The communication of the third ventricle with the lateral ventricle through the interventricular foramen.
2. The ophthalmic, maxillary and mandibular branches of the trigeminal nerve and their related parasympathetic ganglia.
3. The orbitosphenoid and alisphenoid of the developing skull.
4. The condensation representing the stapes ossicle in the middle ear area.
5. The relation of cranial nerves IX, X and XI to the internal jugular vein as they emerge from the skull.

SECTION 12
A section through the dorsal edge of the optic cup and primitive pharynx.
Observe:
1. The choroid invagination into the lateral ventricle and the relation of the primordial hippocampus and its cortex to the choroid fissure.
2. The junction of the optic stalk and diencephalon.
3. The hypophyseal stem remnant passing through the hypophyseal cartilage.
4. The mandibular nerve terminating in the muscles of mastication.
5. The condensations representing the malleus and incus ossicles between the external acoustic meatus and primitive tympanic cavity.


Endomeninx
C-2 Spinal ganglion
C-1 Neural arch (atlas)
Spinal accessory nerve (XI)
Rectus capitis posterior muscles
Semispinalis capitis muscle
Parachordal cartilage
C-1 Dorsal primary ramus (suboccipital nerve)
Notochord
C-1 Ventral primary ramus
Internal jugular vein (precardinal)
Hypoglossal nerve (XII)
Stapedial artery
Vagus (X) and spinal accessory (XI) nerves
Glossopharyngeal nerve (IX)
Nerve of pterygoid canal
Facial nerve (VII)
Stapes
Alisphenoid
Internal carotid artery
Mandibular nerve and otic ganglion
Caudal end of adenohypophysis
Maxillary nerve and pterygopalatine ganglion
Abducens nerve (VI)
Primitive maxillary vein
Oculomotor nerve (III)
Ophthalmic nerve and ciliary ganglion
Trochlear nerve (IV)
Orbitosphenoid
Hypothalamus
Optic groove
Striatal ridge
Intervertebral foramen
Primordial neopallial cortex
3rd ventricle
Lateral ventricle
Primordial hippocampal cortex (archipallium)
Roof of 3rd ventricle

11


C-2 Spinal ganglion
Ependymal layer
Notochord
Mantle layer
Vertebral artery
Marginal layer
Ventral median sulcus
C-1 Ventral primary ramus
Cartilage of branchial arch 2
Splenius muscle
Facial nerve
Hypoglossal nerve (XII)
Primitive tympanic cavity
Vagus (X) and spinal accessory (XI) nerves
Inferior ganglion of glossopharyngeal nerve (IX)
External acoustic meatus
Internal carotid artery
Malleus and incus
Auditory tube
Primitive pharynx
Mandibular nerve
Hypophyseal stem remnant
Muscles of mastication
Intraretinal space
Hypophyseal cartilage
External layer of optic cup
Anterior cerebral artery
Upper eyelid fold
Middle cerebral artery
Extraocular muscle
Primitive supraorbital vein
Lateral ventricle
Junction of optic stalk and diencephalon
Choroid invagination
Primordial hippocampus
Choroid fissure
Primordial cornu Ammonis
Primordial gyrus dentatus

12

2 mm

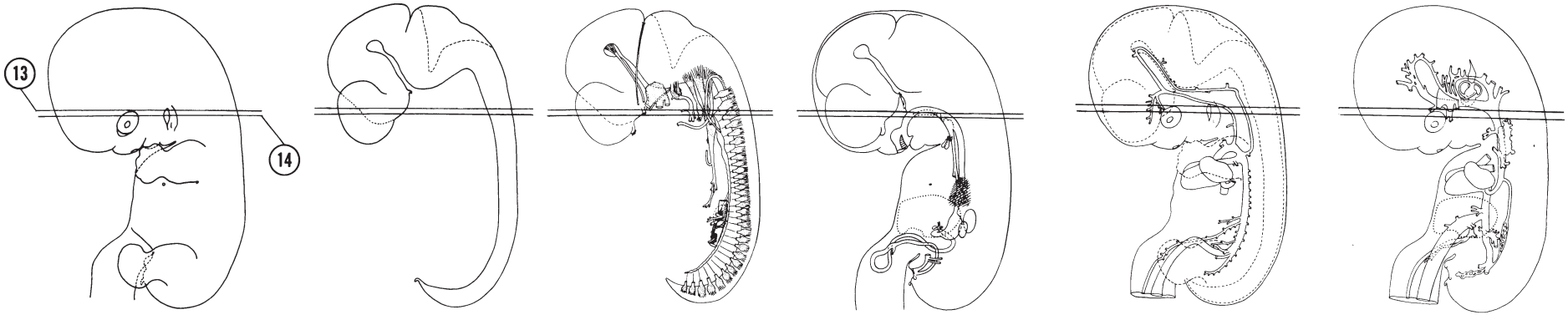
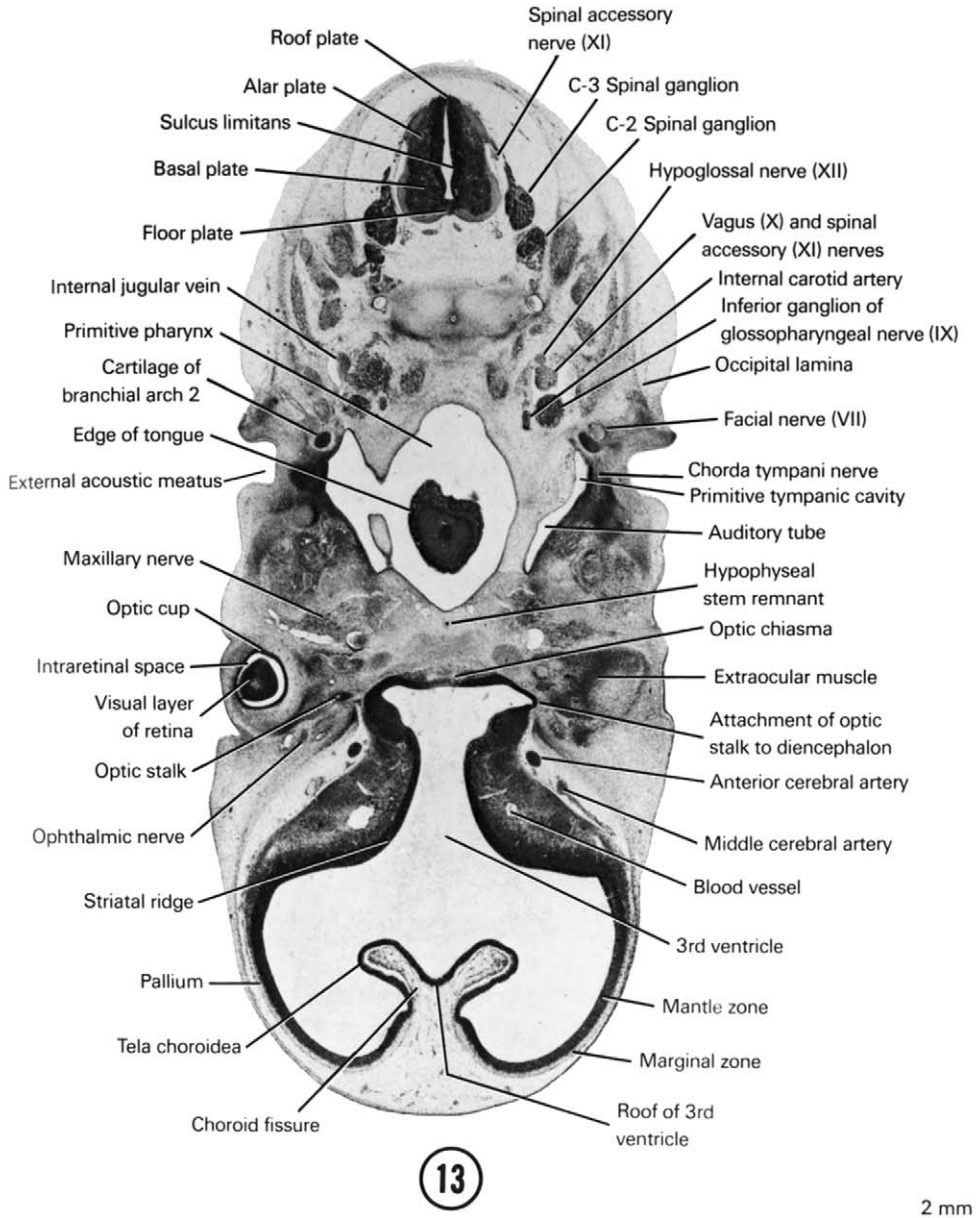
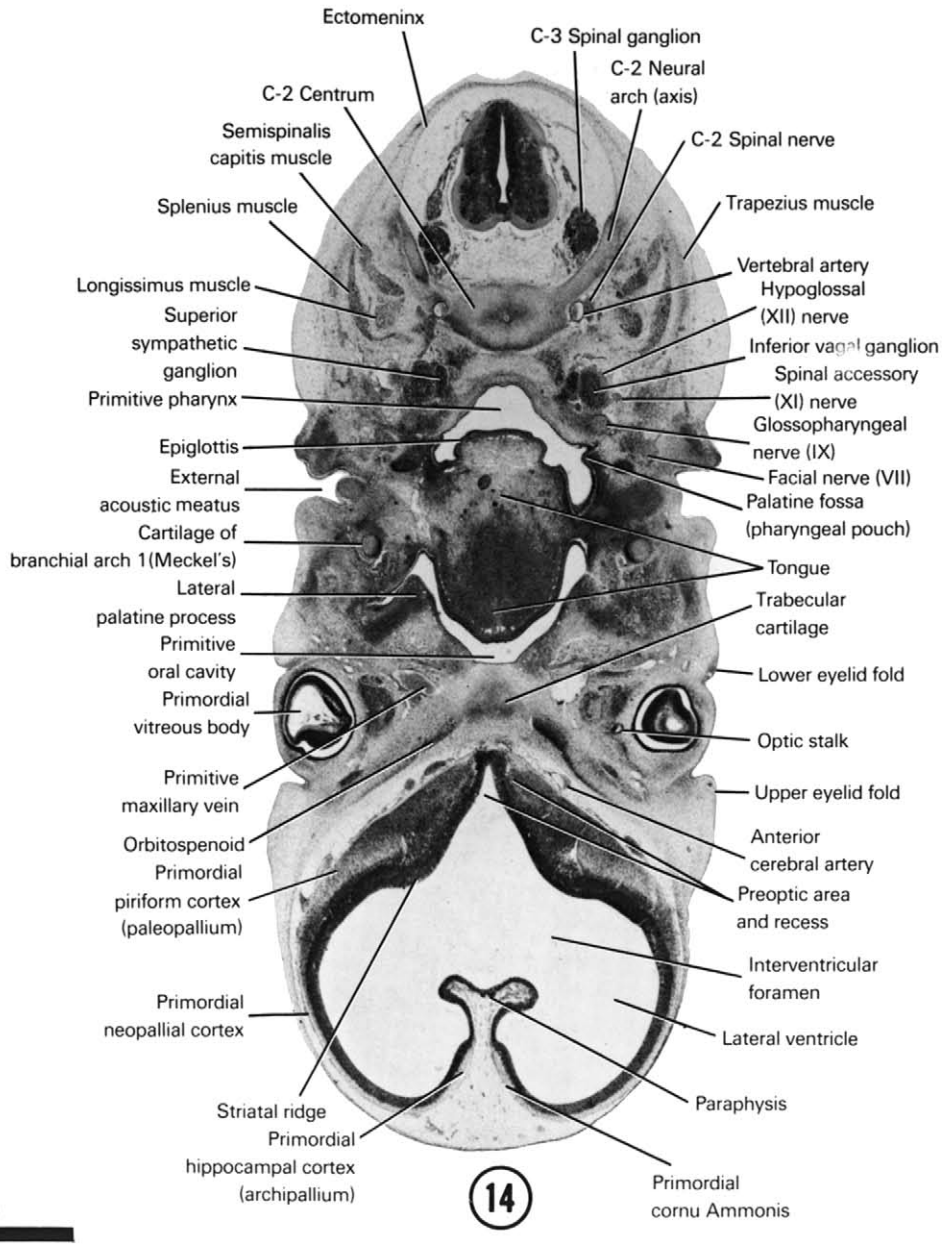


FIG. 7–12

SECTION 13
A section through the C-3 spinal ganglion and the junction of the auditory tube (first pouch) with the primitive pharynx.
Observe:
1. The rostral end of the diencephalon where the optic stalk arises and courses to the optic cup.
2. The condensations representing the extraocular muscles dorsal to the optic cup.
3. The relation of the ophthalmic and maxillary nerves to the optic cup.
4. The edge of the tongue in the floor of the primitive pharynx.
5. The chorda tympani branch of the facial nerve passing between the external acoustic meatus and the primitive tympani cavity.

SECTION 14
A section through palatine fossa (second pouch) and the primitive oral cavity.
Observe:
1. The three subdivisions of the pallium or primordial cerebral cortex.
2. The caudal part of the lateral palatine process where it is lateral to the tongue.
3. The epiglottis caudal to the tongue projecting into the primitive pharynx.
4. The major nerves lateral to the primitive pharynx.
5. The extensor muscles of the neck.


Roof plate
Alar plate
Sulcus limitans
Basal plate
Floor plate
Internal jugular vein
Primitive pharynx
Cartilage of branchial arch 2
Edge of tongue
External acoustic meatus
Maxillary nerve
Optic cup
Intraretinal space
Visual layer of retina
Optic stalk
Ophthalmic nerve
Striatal ridge
Pallium
Tela choroidea
Choroid fissure
Spinal accessory nerve (XI)
C-3 Spinal ganglion
C-2 Spinal ganglion
Hypoglossal nerve (XII)
Vagus (X) and spinal accessory (XI) nerves
Internal carotid artery
Inferior ganglion of glossopharyngeal nerve (IX)
Occipital lamina
Facial nerve (VII)
Chorda tympani nerve
Primitive tympanic cavity
Auditory tube
Hypophyseal stem remnant
Optic chiasma
Extraocular muscle
Attachment of optic stalk to diencephalon
Anterior cerebral artery
Middle cerebral artery
Blood vessel
3rd ventricle
Mantle zone
Marginal zone
Roof of 3rd ventricle
13


Ectomeninx
C-3 Spinal ganglion
C-2 Neural arch (axis)
C-2 Centrum
Semispinalis capitis muscle
C-2 Spinal nerve
Splenius muscle
Trapezius muscle
Vertebral artery
Longissimus muscle
Hypoglossal (XII) nerve
Superior sympathetic ganglion
Inferior vagal ganglion
Spinal accessory (XI) nerve
Primitive pharynx
Glossopharyngeal nerve (IX)
Epiglottis
Facial nerve (VII)
External acoustic meatus
Palatine fossa (pharyngeal pouch)
Cartilage of branchial arch 1(Meckel's)
Tongue
Lateral palatine process
Trabecular cartilage
Primitive oral cavity
Lower eyelid fold
Primordial vitreous body
Optic stalk
Primitive maxillary vein
Upper eyelid fold
Orbitospenoid
Anterior cerebral artery
Primordial piriform cortex (paleopallium)
Preoptic area and recess
Interventricular foramen
Primordial neopallial cortex
Lateral ventricle
Paraphysis
Striatal ridge
Primordial hippocampal cortex (archipallium)
Primordial cornu Ammonis
14

2 mm

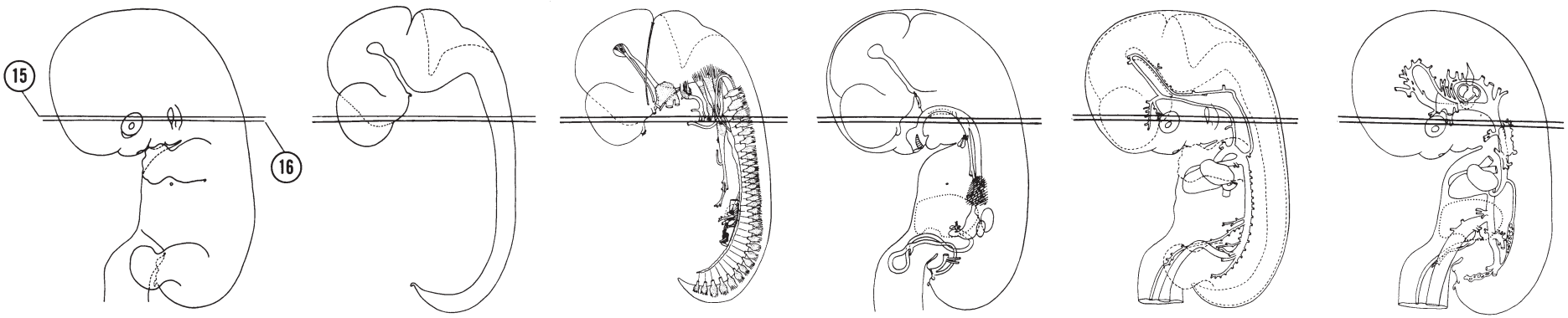
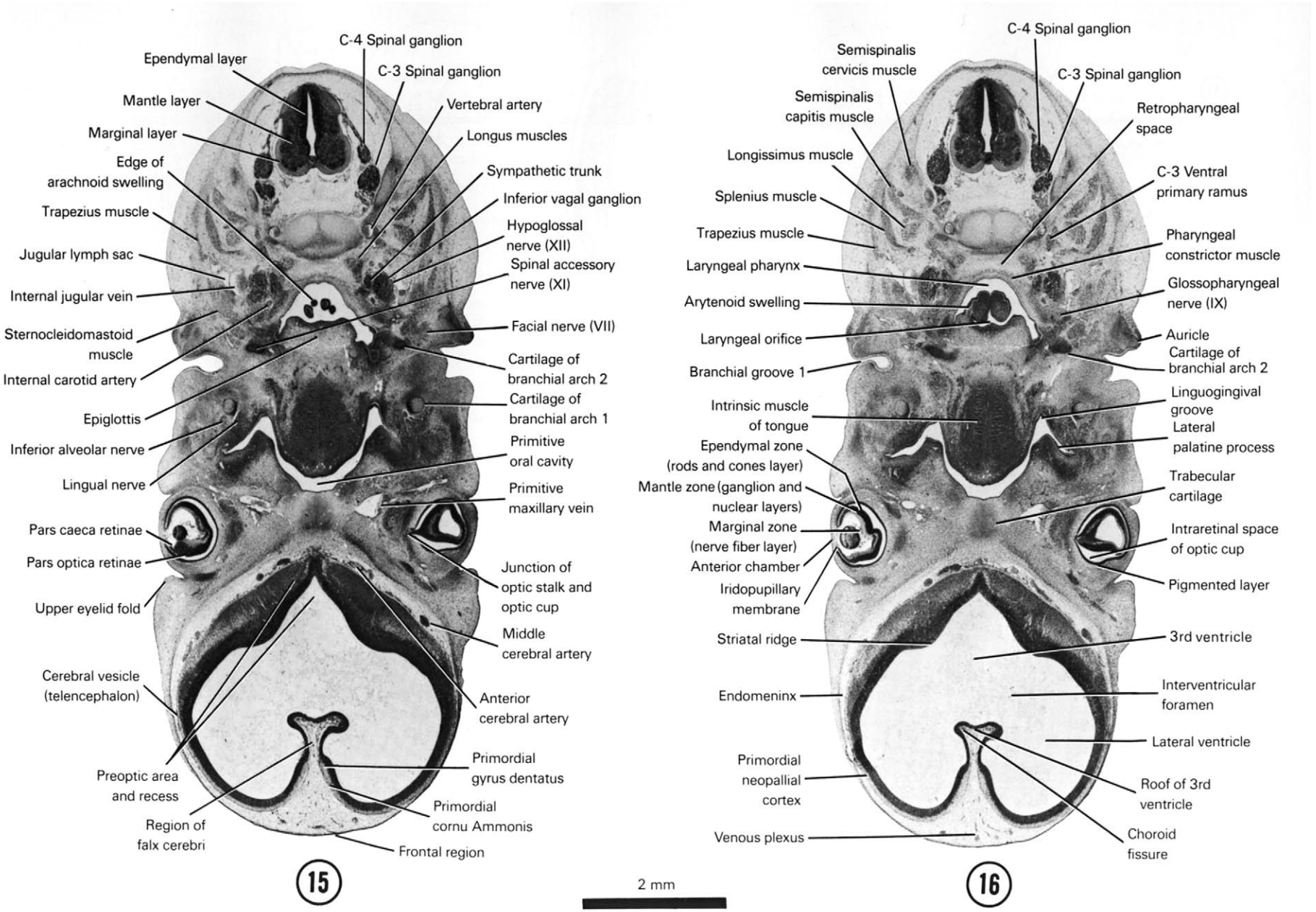


FIG. 7–13

SECTION 15
A section through the C-4 spinal ganglion and the preoptic area of the telencephalon.
Observe:
1. The junction of the optic stalk with the optic cup.
2. The two parts of the retina: pars caeca retinae and pars optica retinae.
3. The region of the falx cerebri between the cerebral vesicles.
4. The first and second branchial arch cartilages.
5. The three layers of the spinal cord in the midcervical region.

SECTION 16
A section through the middle of the optic cup and laryngeal orifice.
Observe:
1. The zones or layers of the optic cup and its surrounding structures.
2. The intrinsic muscles of the tongue flanked on each side by a lateral palatine process.
3. The linguogingival groove lateral to the tongue.
4. The auricle forming around branchial groove 1 (external acoustic meatus).
5. The arytenoid swelling between the laryngeal orifice and the laryngeal pharynx.


C-4 Spinal ganglion
Ependymal layer
C-3 Spinal ganglion
Mantle layer
Vertebral artery
Marginal layer
Longus muscles
Edge of arachnoid swelling
Sympathetic trunk
Trapezius muscle
Inferior vagal ganglion
Hypoglossal nerve (XII)
Jugular lymph sac
Spinal accessory nerve (XI)
Internal jugular vein
Facial nerve (VII)
Sternocleidomastoid muscle
Cartilage of branchial arch 2
Internal carotid artery
Cartilage of branchial arch 1
Epiglottis
Primitive oral cavity
Inferior alveolar nerve
Primitive maxillary vein
Lingual nerve
Pars caeca retinae
Pars optica retinae
Junction of optic stalk and optic cup
Upper eyelid fold
Middle cerebral artery
Cerebral vesicle (telencephalon)
Anterior cerebral artery
Primordial gyrus dentatus
Preoptic area and recess
Primordial cornu Ammonis
Region of falx cerebri
Frontal region
15
2 mm
C-4 Spinal ganglion
Semispinalis cervicis muscle
C-3 Spinal ganglion
Semispinalis capitis muscle
Retropharyngeal space
Longissimus muscle
C-3 Ventral primary ramus
Splenius muscle
Trapezius muscle
Pharyngeal constrictor muscle
Laryngeal pharynx
Glossopharyngeal nerve (IX)
Arytenoid swelling
Auricle
Laryngeal orifice
Cartilage of branchial arch 2
Branchial groove 1
Linguogingival groove
Intrinsic muscle of tongue
Lateral palatine process
Ependymal zone (rods and cones layer)
Trabecular cartilage
Mantle zone (ganglion and nuclear layers)
Intraretinal space of optic cup
Marginal zone (nerve fiber layer)
Anterior chamber
Pigmented layer
Iridopupillary membrane
Striatal ridge
3rd ventricle
Endomeninx
Interventricular foramen
Lateral ventricle
Primordial neopallial cortex
Roof of 3rd ventricle
Venous plexus
Choroid fissure
16

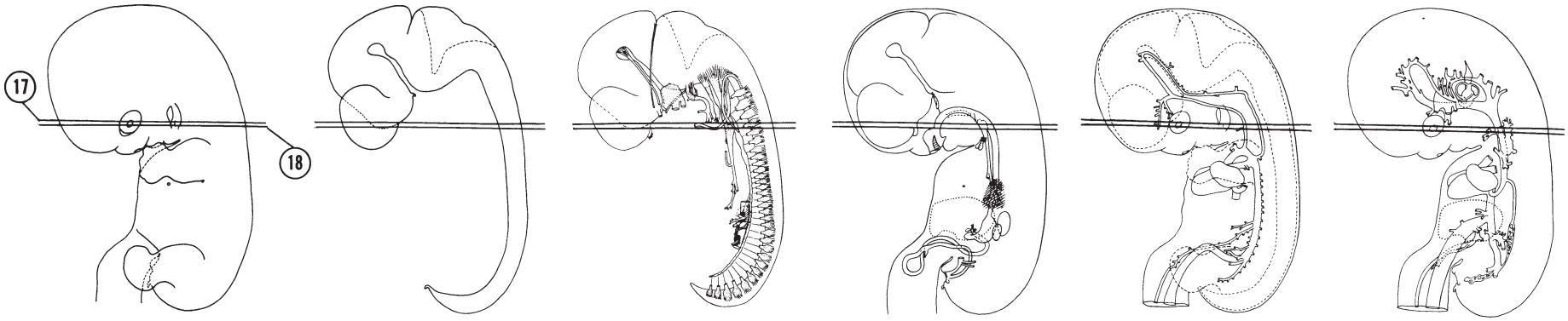
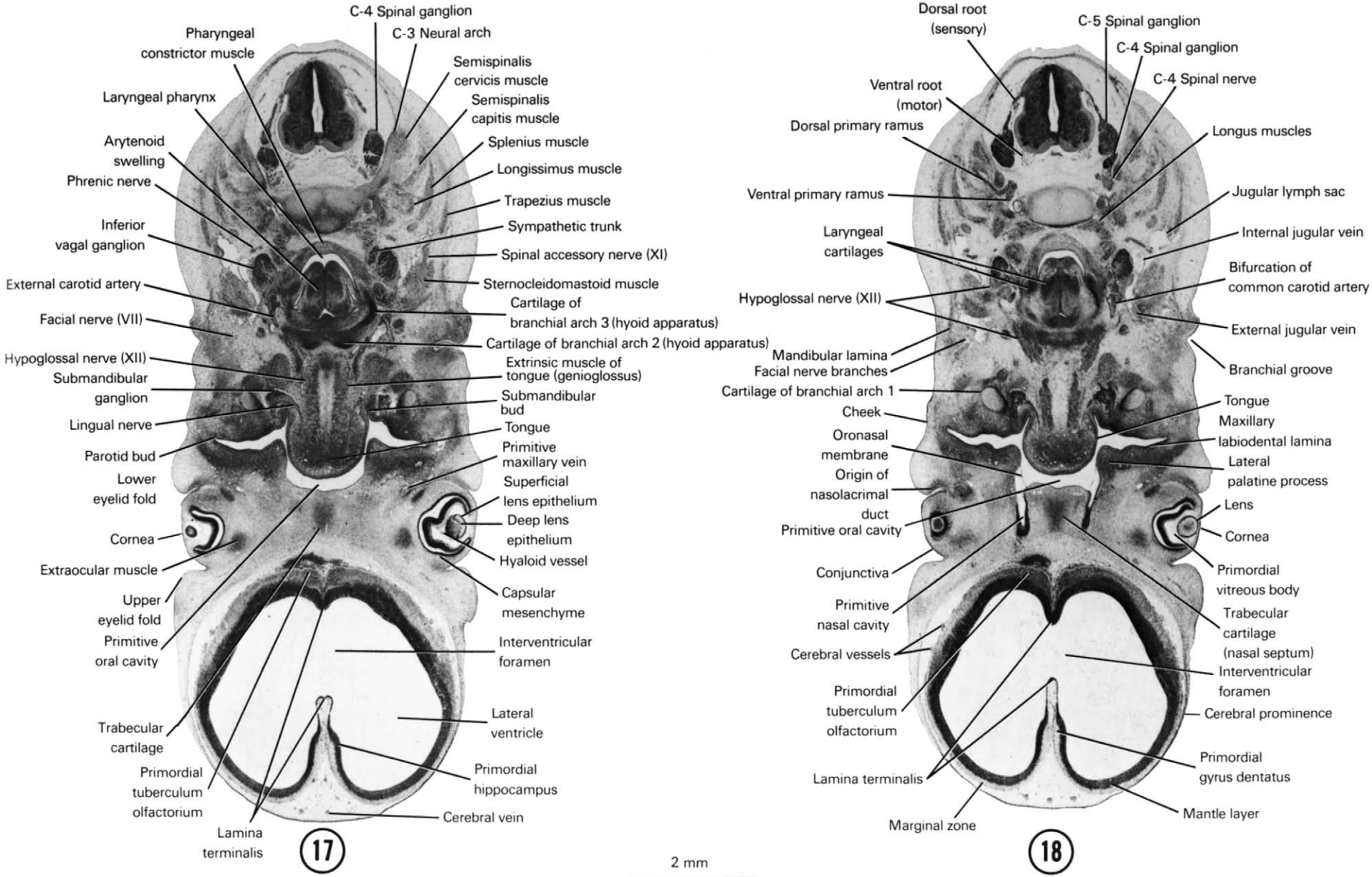


FIG. 7–14

SECTION 17
A section through the extrinsic tongue muscles and hyoid apparatus (second and third arch cartilages).
Observe:
1. The lamina terminalis and primordial olfactory bulb of the telencephalon.
2. The lens epithelium.
3. The eyelid folds beginning to cover the cornea.
4. The parotid and submandibular buds originating from the oral cavity epithelium.
5. The submandibular (parasympathetic) ganglion on the lingual branch of the mandibular nerve as it courses into the tongue.

SECTION 18
A section through the laryngeal cartilages and caudal part of the primitive nasal cavity.
Observe:
1. The oronasal membrane separating the primitive oral and nasal cavities.
2. The mandibular lamina located superficial to the terminal branches of the facial nerve.
3. The hypoglossal nerve coursing into the tongue.
4. The bifurcation of the common carotid artery.
5. The roots and primary rami of a spinal nerve.


C-4 Spinal ganglion
C-3 Neural arch
Pharyngeal constrictor muscle
Semispinalis cervicis muscle
Laryngeal pharynx
Semispinalis capitis muscle
Arytenoid swelling
Splenius muscle
Phrenic nerve
Longissimus muscle
Trapezius muscle
Inferior vagal ganglion
Sympathetic trunk
Spinal accessory nerve (XI)
External carotid artery
Sternocleidomastoid muscle
Facial nerve (VII)
Cartilage of branchial arch 3 (hyoid apparatus)
Cartilage of branchial arch 2 (hyoid apparatus)
Hypoglossal nerve (XII)
Extrinsic muscle of tongue (genioglossus)
Submandibular ganglion
Submandibular bud
Lingual nerve
Tongue
Parotid bud
Primitive maxillary vein
Lower eyelid fold
Superficial lens epithelium
Deep lens epithelium
Cornea
Hyaloid vessel
Extraocular muscle
Capsular mesenchyme
Upper eyelid fold
Primitive oral cavity
Interventricular foramen
Trabecular cartilage
Lateral ventricle
Primordial tuberculum olfactorium
Primordial hippocampus
Cerebral vein
Lamina terminalis
17
Dorsal root (sensory)
C-5 Spinal ganglion
C-4 Spinal ganglion
C-4 Spinal nerve
Ventral root (motor)
Dorsal primary ramus
Longus muscles
Ventral primary ramus
Jugular lymph sac
Laryngeal cartilages
Internal jugular vein
Bifurcation of common carotid artery
Hypoglossal nerve (XII)
External jugular vein
Mandibular lamina
Facial nerve branches
Branchial groove
Cartilage of branchial arch 1
Cheek
Tongue
Maxillary labiodental lamina
Oronasal membrane
Lateral palatine process
Origin of nasolacrimal duct
Lens
Primitive oral cavity
Cornea
Conjunctiva
Primordial vitreous body
Primitive nasal cavity
Trabecular cartilage (nasal septum)
Cerebral vessels
Interventricular foramen
Primordial tuberculum olfactorium
Cerebral prominence
Primordial gyrus dentatus
Lamina terminalis
Mantle layer
Marginal zone
18
2 mm

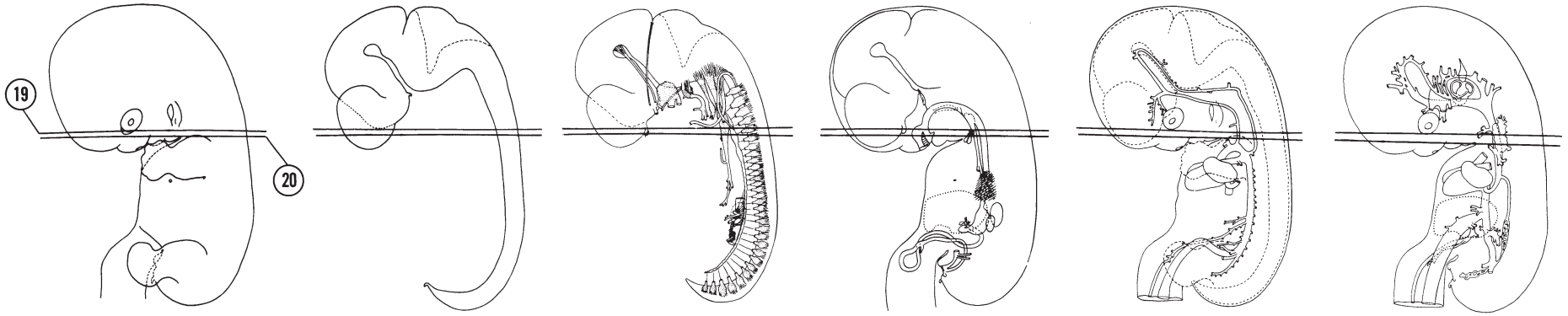
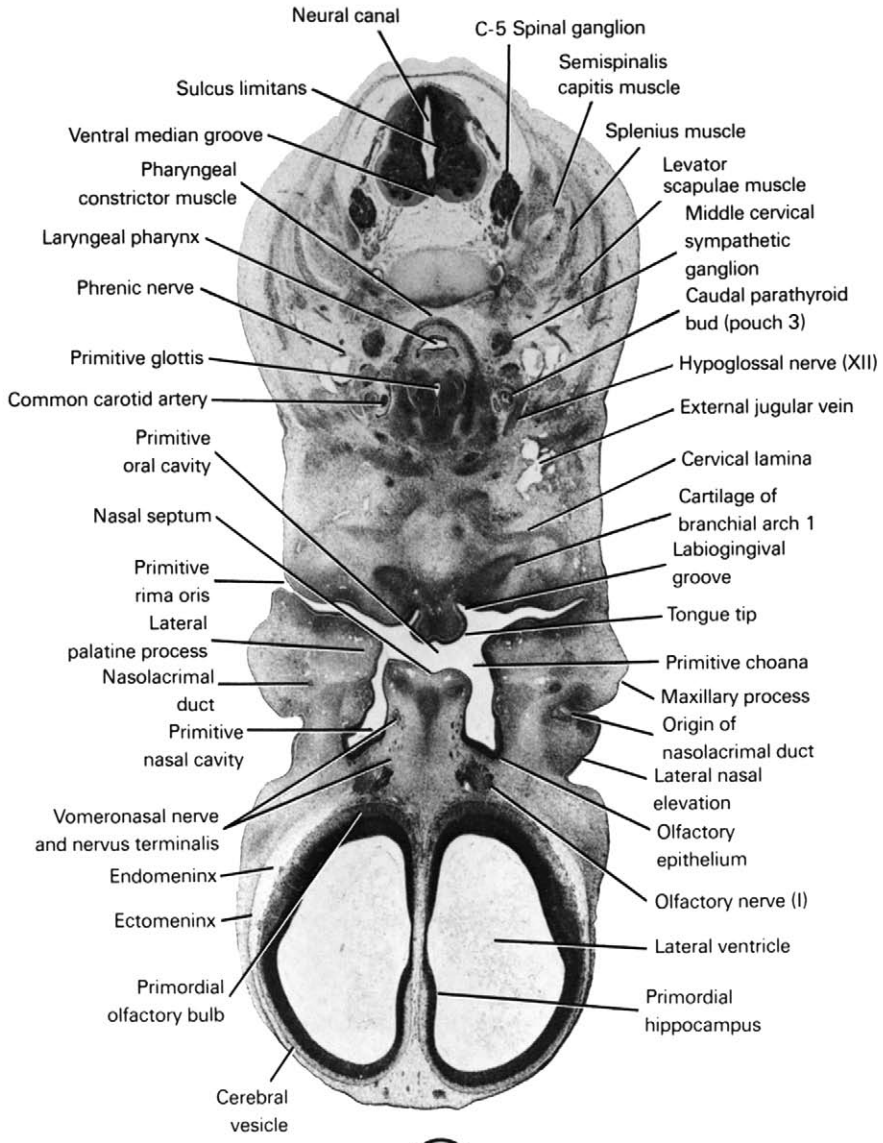


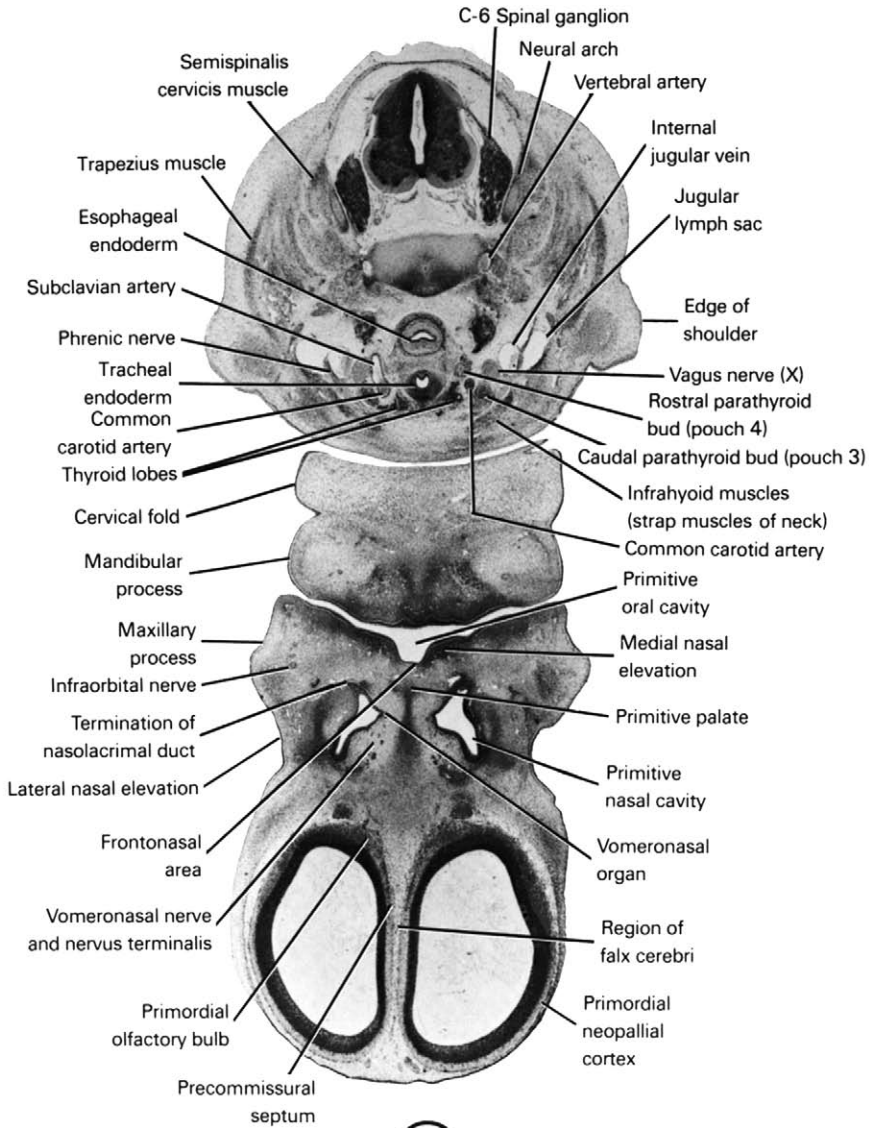
FIG. 7–15

SECTION 19
A section through the C-5 spinal ganglion and primitive choana.
Observe:
1. The olfactory nerve coursing from the olfactory epithelium.
2. The primitive choana between the lateral palatine process and the nasal septum.
3. The origin of the nasolacrimal duct between the lateral nasal elevation and maxillary process.
4. The tongue tip in the primitive oral cavity near the primitive rima oris.
5. The caudal parathyroid bud derived from the third pouch of younger embryos.

SECTION 20
A section through the C-6 spinal ganglion and the primitive palate.
Observe:
1. The vomeronasal nerve coursing from the vomeronasal organ.
2. The relation of the maxillary process and nasal elevations to the primitive palate.
3. The rostral (fourth pouch) and caudal (third pouch) parathyroid buds dorsolateral to the thyroid gland.
4. The trachea ventral to the esophagus.
5. The edge of the shoulder.


Neural canal
C-5 Spinal ganglion
Semispinalis capitis muscle
Sulcus limitans
Splenius muscle
Ventral median groove
Levator scapulae muscle
Pharyngeal constrictor muscle
Middle cervical sympathetic ganglion
Laryngeal pharynx
Caudal parathyroid bud (pouch 3)
Phrenic nerve
Primitive glottis
Hypoglossal nerve (XII)
Common carotid artery
External jugular vein
Primitive oral cavity
Cervical lamina
Cartilage of branchial arch 1
Nasal septum
Labiogingival groove
Primitive rima oris
Tongue tip
Lateral palatine process
Primitive choana
Nasolacrimal duct
Maxillary process
Origin of nasolacrimal duct
Primitive nasal cavity
Lateral nasal elevation
Vomeronasal nerve and nervus terminalis
Olfactory epithelium
Endomeninx
Olfactory nerve (I)
Ectomeninx
Lateral ventricle
Primordial olfactory bulb
Primordial hippocampus
Cerebral vesicle

19


C-6 Spinal ganglion
Neural arch
Semispinalis cervicis muscle
Vertebral artery
Internal jugular vein
Trapezius muscle
Jugular lymph sac
Esophageal endoderm
Edge of shoulder
Subclavian artery
Phrenic nerve
Vagus nerve (X)
Tracheal endoderm
Rostral parathyroid bud (pouch 4)
Common carotid artery
Caudal parathyroid bud (pouch 3)
Thyroid lobes
Infrahyoid muscles (strap muscles of neck)
Cervical fold
Common carotid artery
Mandibular process
Primitive oral cavity
Maxillary process
Medial nasal elevation
Infraorbital nerve
Primitive palate
Termination of nasolacrimal duct
Primitive nasal cavity
Lateral nasal elevation
Vomeronasal organ
Frontonasal area
Region of falx cerebri
Vomeronasal nerve and nervus terminalis
Primordial neopallial cortex
Primordial olfactory bulb
Precommissural septum

20

2 mm

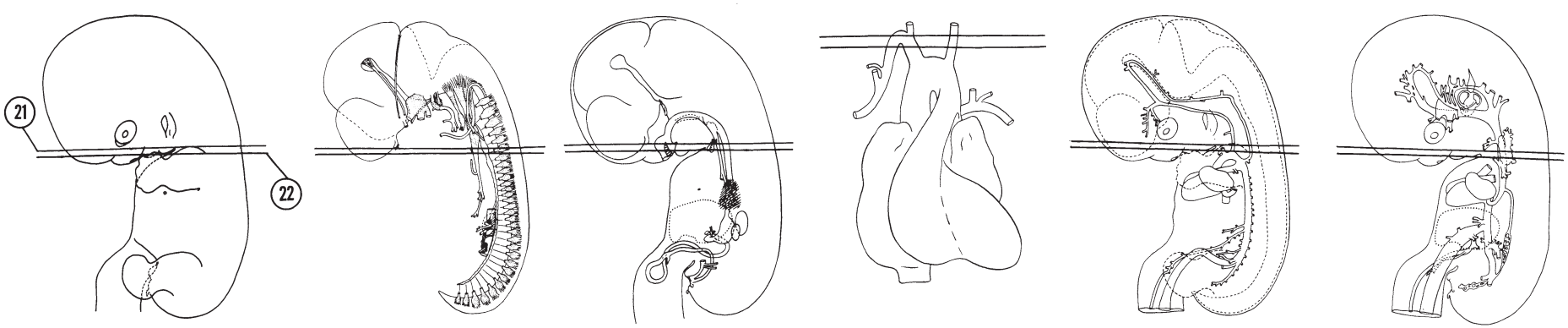


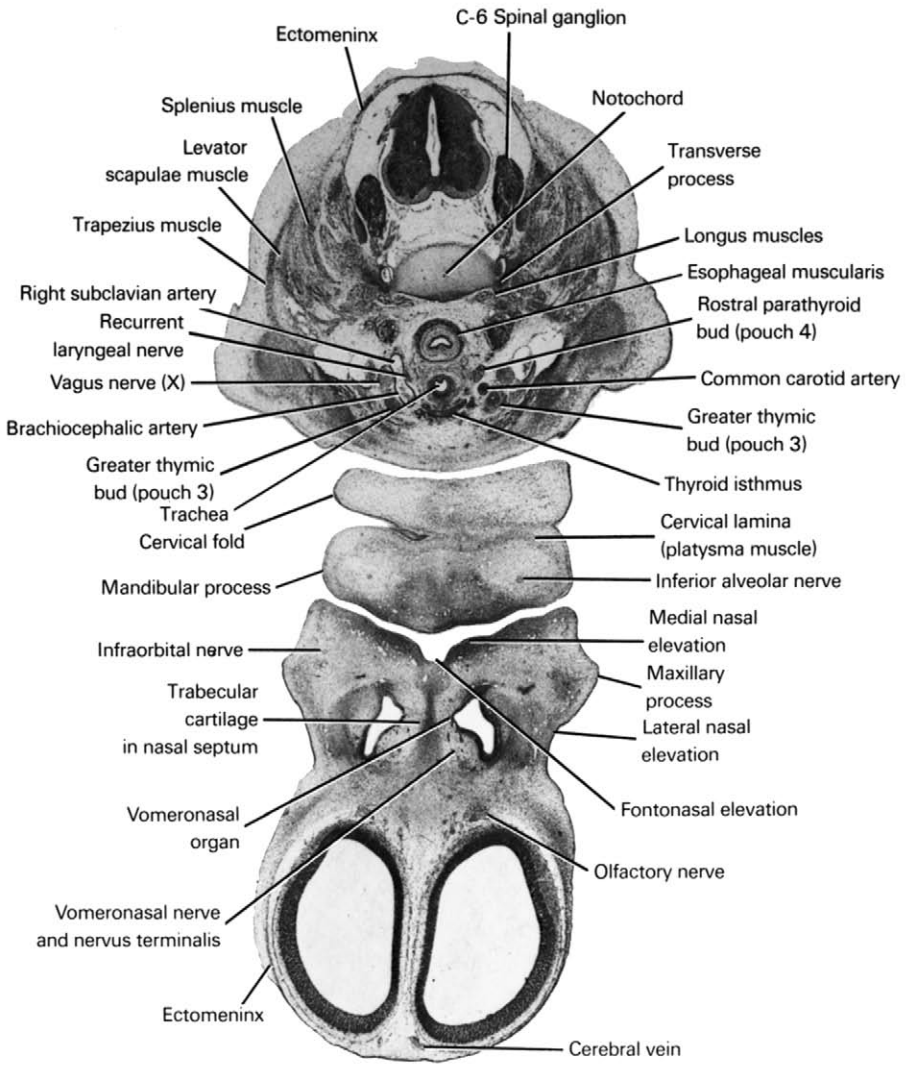
FIG. 7–16

SECTION 21
A section through the greater thymic bud (third pouch) and the isthmus of the thyroid gland.
Observe:

1. The trabecular cartilage forming in the nasal septum.
2. The infraorbital nerve in the maxillary process and the inferior alveolar nerve in the mandibular process.
3. The cervical muscle lamina in the mandibular process from which the platysma develops.
4. The origin of the right subclavian from the brachiocephalic artery.
5. The relation of the glands, vessels and nerves to the trachea and esophagus.

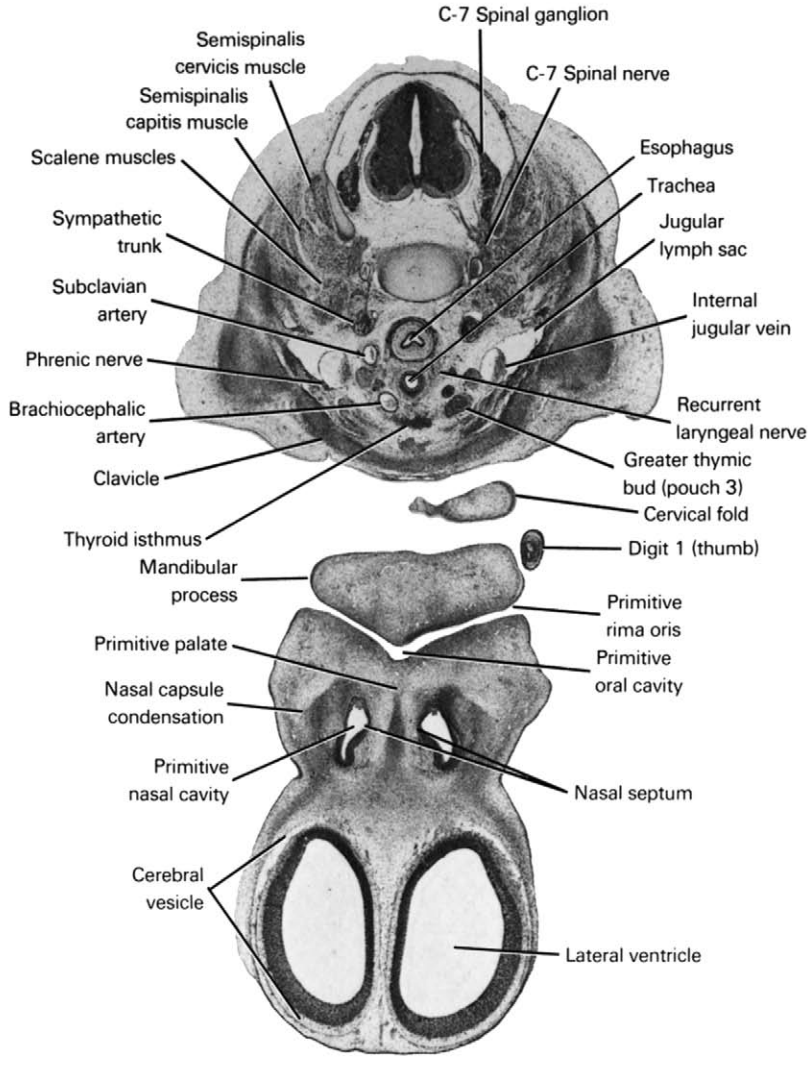
SECTION 22
A section through the C-7 spinal ganglion and clavicle.
Observe:

1. The nasal capsule condensation surrounding the primitive nasal cavity.
2. The primordium of the first digit of the hand.
3. The recurrent laryngeal nerve between the trachea and esophagus.
4. The jugular lymph sac lateral to the internal jugular vein.
5. The sympathetic trunk lateral to the esophagus.


Ectomeninx
C-6 Spinal ganglion
Splenius muscle
Notochord
Levator scapulae muscle
Transverse process
Trapezius muscle
Longus muscles
Esophageal muscularis
Right subclavian artery
Recurrent laryngeal nerve
Rostral parathyroid bud (pouch 4)
Vagus nerve (X)
Common carotid artery
Brachiocephalic artery
Greater thymic bud (pouch 3)
Greater thymic bud (pouch 3)
Thyroid isthmus
Trachea
Cervical fold
Cervical lamina (platysma muscle)
Mandibular process
Inferior alveolar nerve
Medial nasal elevation
Infraorbital nerve
Maxillary process
Trabecular cartilage in nasal septum
Lateral nasal elevation
Fontonasal elevation
Vomeronasal organ
Olfactory nerve
Vomeronasal nerve and nervus terminalis
Ectomeninx
Cerebral vein

21

2 mm


C-7 Spinal ganglion
Semispinalis cervicis muscle
C-7 Spinal nerve
Semispinalis capitis muscle
Esophagus
Scalene muscles
Trachea
Sympathetic trunk
Jugular lymph sac
Subclavian artery
Internal jugular vein
Phrenic nerve
Recurrent laryngeal nerve
Brachiocephalic artery
Greater thymic bud (pouch 3)
Clavicle
Cervical fold
Thyroid isthmus
Digit 1 (thumb)
Mandibular process
Primitive rima oris
Primitive palate
Primitive oral cavity
Nasal capsule condensation
Primitive nasal cavity
Nasal septum
Cerebral vesicle
Lateral ventricle

22

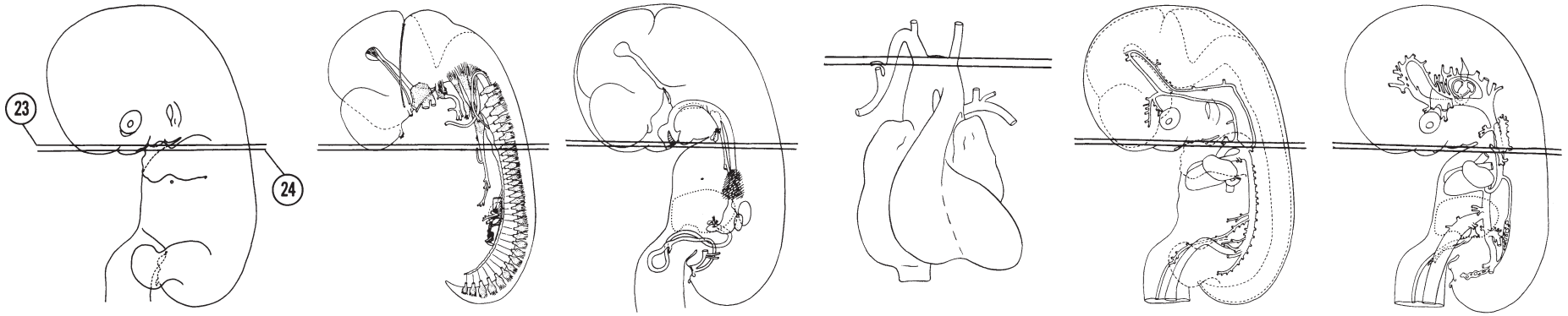
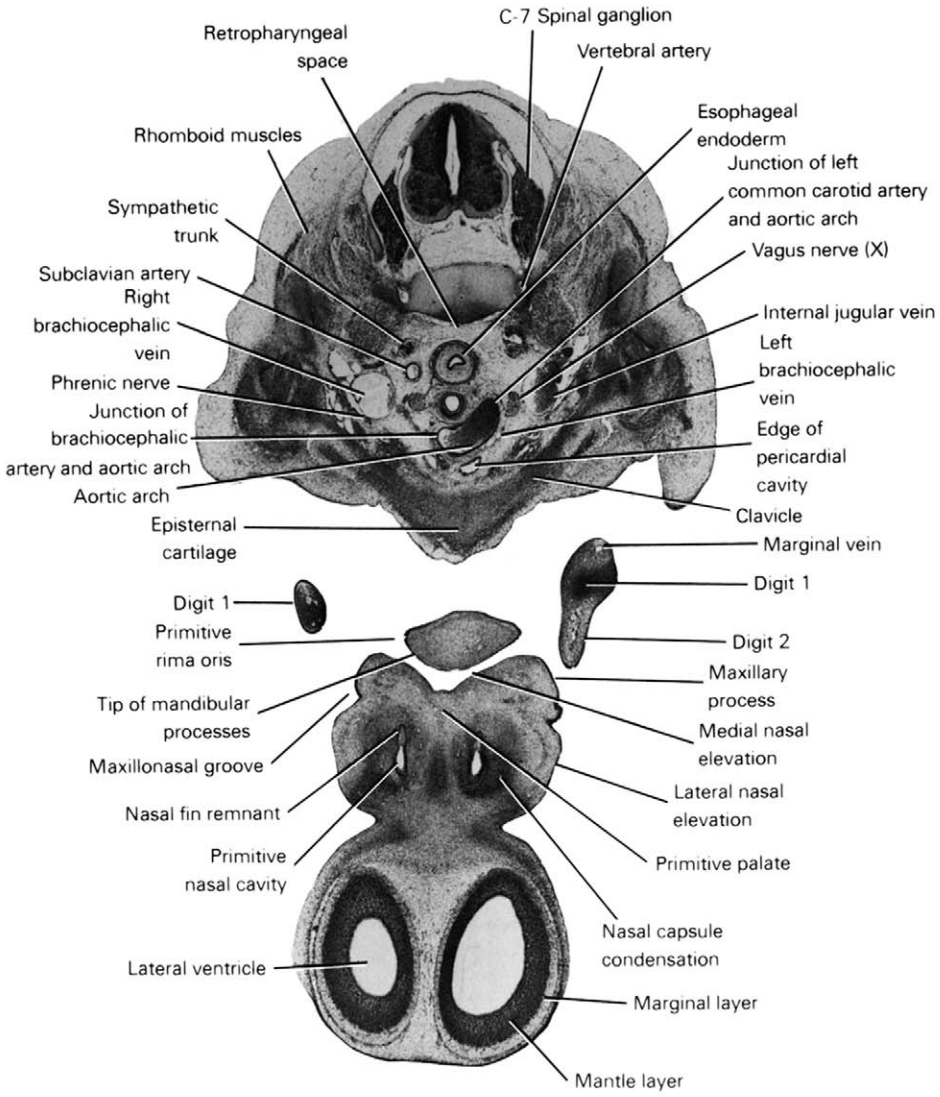


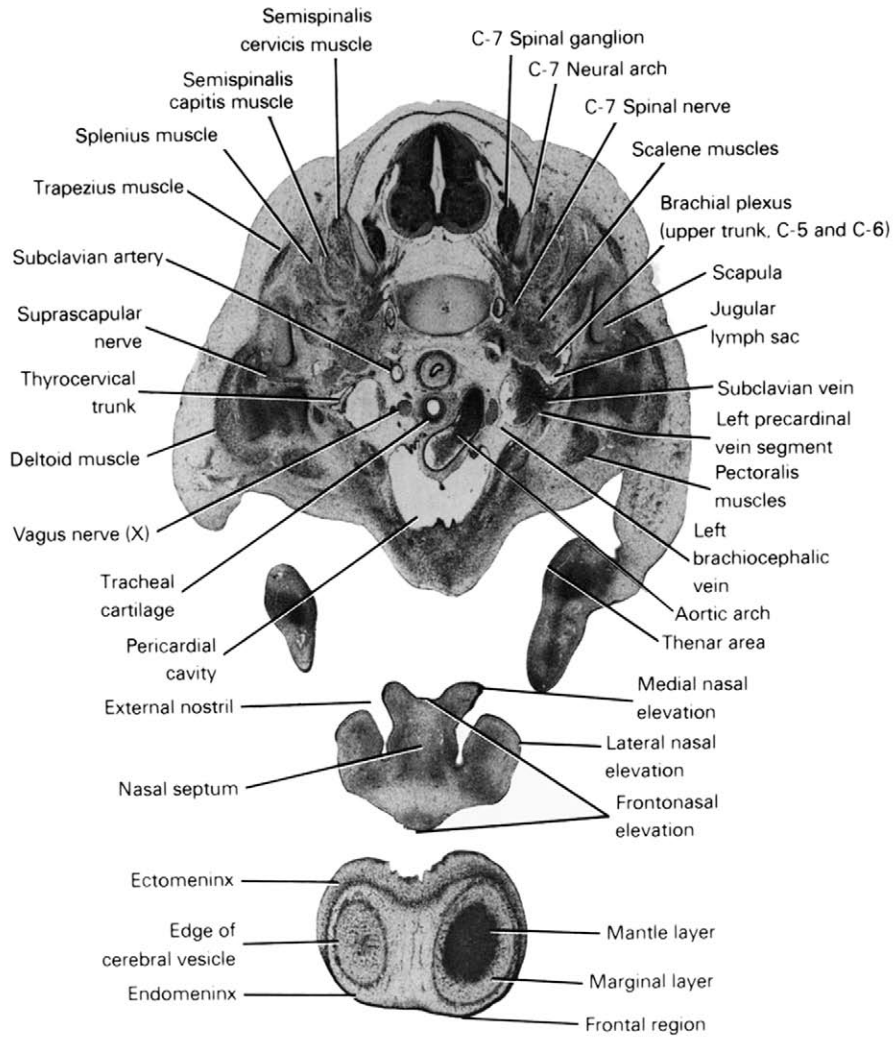
FIG. 7–17

SECTION 23
A section through the aortic arch and the tip of the mandibular process.
Observe:
1. The relation of the nasal elevations to the maxillary process.
2. The primordium of the second digit of the hand.
3. The clavicle joining the episternal cartilage.
4. The junctions of the brachiocephalic and left common carotid arteries with the aortic arch.
5. The close relation of the left vagus nerve to the aortic arch.

SECTION 24
A section through the external nostril and cranial part of the pericardial cavity.
Observe:
1. The edge of the cerebral vesicle surrounded by the endo- and ectomeninx.
2. The relation of the nasal elevations to the external nostril.
3. The oblique position of the aortic arch.
4. The muscles and nerves around the scapula.
5. The upper trunk of the brachial plexus passing through the scalene muscles.


C-7 Spinal ganglion
Retropharyngeal space
Vertebral artery
Esophageal endoderm
Rhomboid muscles
Junction of left common carotid artery and aortic arch
Sympathetic trunk
Vagus nerve (X)
Subclavian artery
Right brachiocephalic vein
Internal jugular vein
Left brachiocephalic vein
Phrenic nerve
Junction of brachiocephalic artery and aortic arch
Edge of pericardial cavity
Aortic arch
Clavicle
Episternal cartilage
Marginal vein
Digit 1
Digit 1
Primitive rima oris
Digit 2
Maxillary process
Tip of mandibular processes
Medial nasal elevation
Maxillonasal groove
Lateral nasal elevation
Nasal fin remnant
Primitive palate
Primitive nasal cavity
Nasal capsule condensation
Lateral ventricle
Marginal layer
Mantle layer

23


Semispinalis cervicis muscle
C-7 Spinal ganglion
C-7 Neural arch
Semispinalis capitis muscle
C-7 Spinal nerve
Splenius muscle
Scalene muscles
Trapezius muscle
Brachial plexus (upper trunk, C-5 and C-6)
Subclavian artery
Scapula
Suprascapular nerve
Jugular lymph sac
Thyrocervical trunk
Subclavian vein
Left precardinal vein segment
Deltoid muscle
Pectoralis muscles
Vagus nerve (X)
Left brachiocephalic vein
Tracheal cartilage
Aortic arch
Pericardial cavity
Thenar area
Medial nasal elevation
External nostril
Lateral nasal elevation
Nasal septum
Frontonasal elevation
Ectomeninx
Edge of cerebral vesicle
Mantle layer
Endomeninx
Marginal layer
Frontal region

24

2 mm

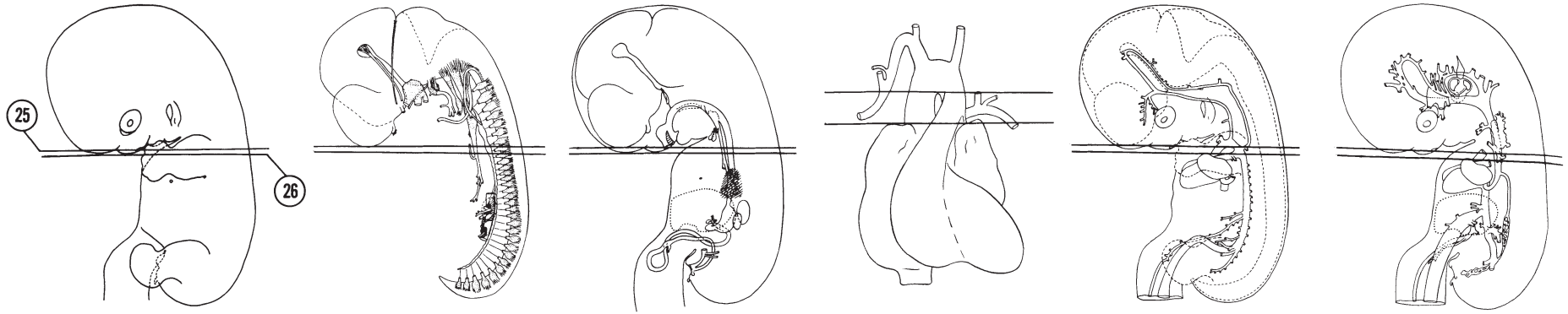
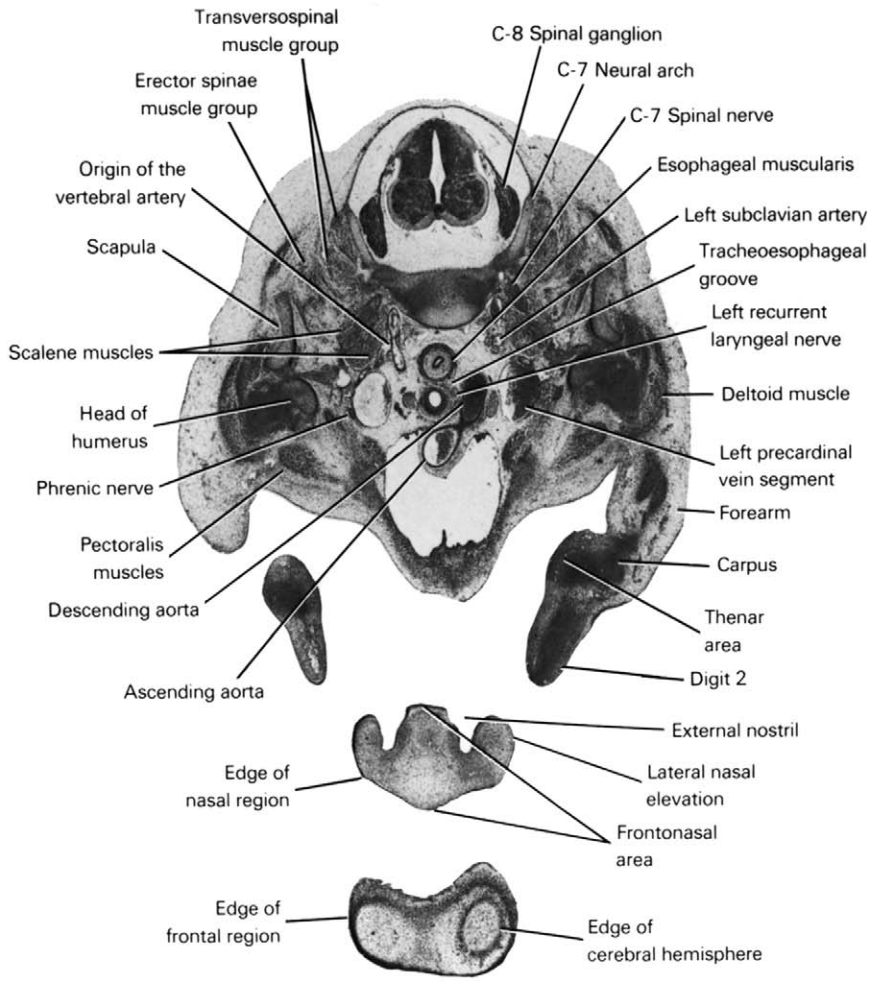


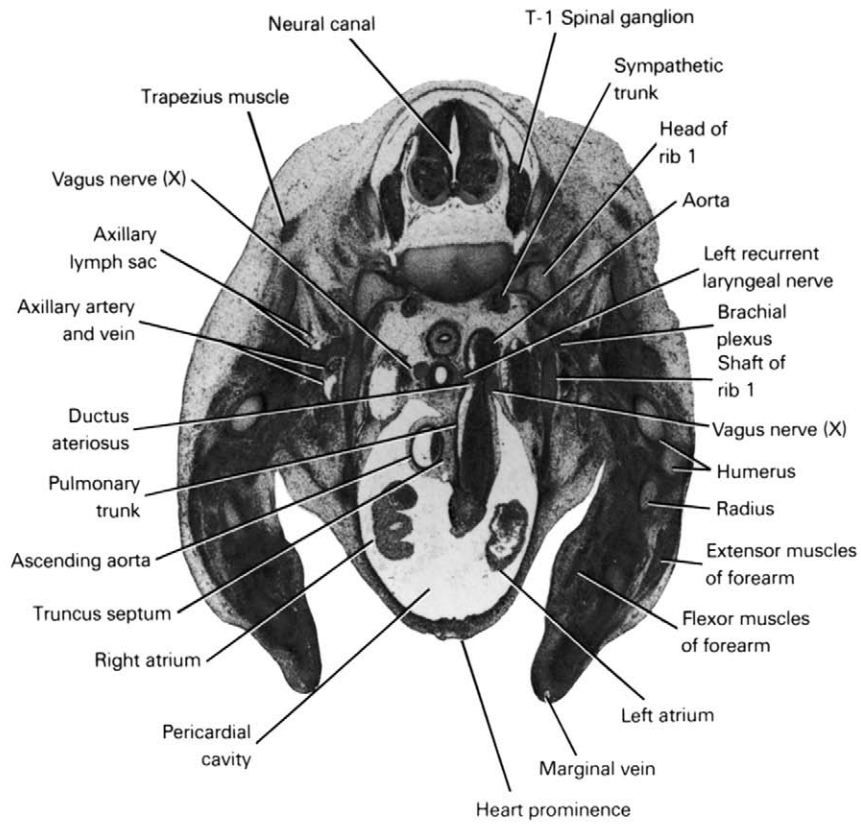
FIG. 7–18

SECTION 25
A section through the C-8 spinal ganglion and the edge of the frontal and nasal regions.
Observe:
1. The ascending and descending aortas that are continuous with the aortic arch in Section 24.
2. The left recurrent laryngeal nerve coursing to the tracheoesophageal groove.
3. The head of the humerus deep to the deltoid muscles.
4. The phrenic nerve lateral to the precardinal vein.

SECTION 26
A section through the T-1 spinal ganglion and cranial edge of the atria.
Observe:
1. The ascending aorta to the right of the pulmonary trunk from which it is separated by the truncus septum.
2. The ductus arteriosus connecting the pulmonary trunk and aorta.
3. The left vagus nerve lateral to the ductus arteriosus with its branch, the recurrent laryngeal nerve, medial.
4. The sympathetic trunk medial to the head of the first rib.
5. The relative position of the extensor and flexor muscles in the forearm.


Transversospinal muscle group
Erector spinae muscle group
Origin of the vertebral artery
Scapula
Scalene muscles
Head of humerus
Phrenic nerve
Pectoralis muscles
Descending aorta
Ascending aorta
C-8 Spinal ganglion
C-7 Neural arch
C-7 Spinal nerve
Esophageal muscularis
Left subclavian artery
Tracheoesophageal groove
Left recurrent laryngeal nerve
Deltoid muscle
Left precardinal vein segment
Forearm
Carpus
Thenar area
Digit 2
External nostril
Lateral nasal elevation
Frontonasal area
Edge of nasal region
Edge of frontal region
Edge of cerebral hemisphere

25


Neural canal
T-1 Spinal ganglion
Sympathetic trunk
Trapezius muscle
Head of rib 1
Vagus nerve (X)
Aorta
Axillary lymph sac
Left recurrent laryngeal nerve
Axillary artery and vein
Brachial plexus
Shaft of rib 1
Ductus ateriosus
Vagus nerve (X)
Humerus
Pulmonary trunk
Radius
Ascending aorta
Extensor muscles of forearm
Truncus septum
Flexor muscles of forearm
Right atrium
Left atrium
Pericardial cavity
Marginal vein
Heart prominence

26

2 mm

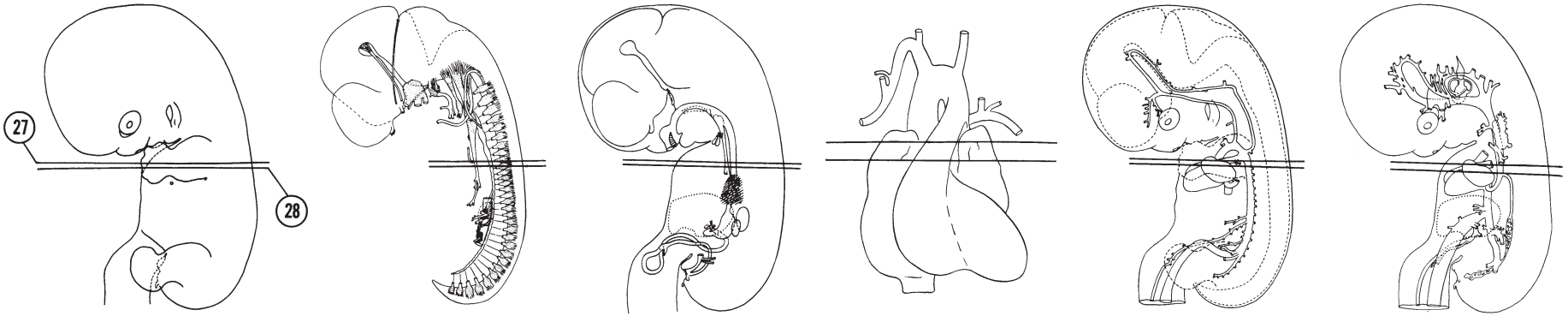
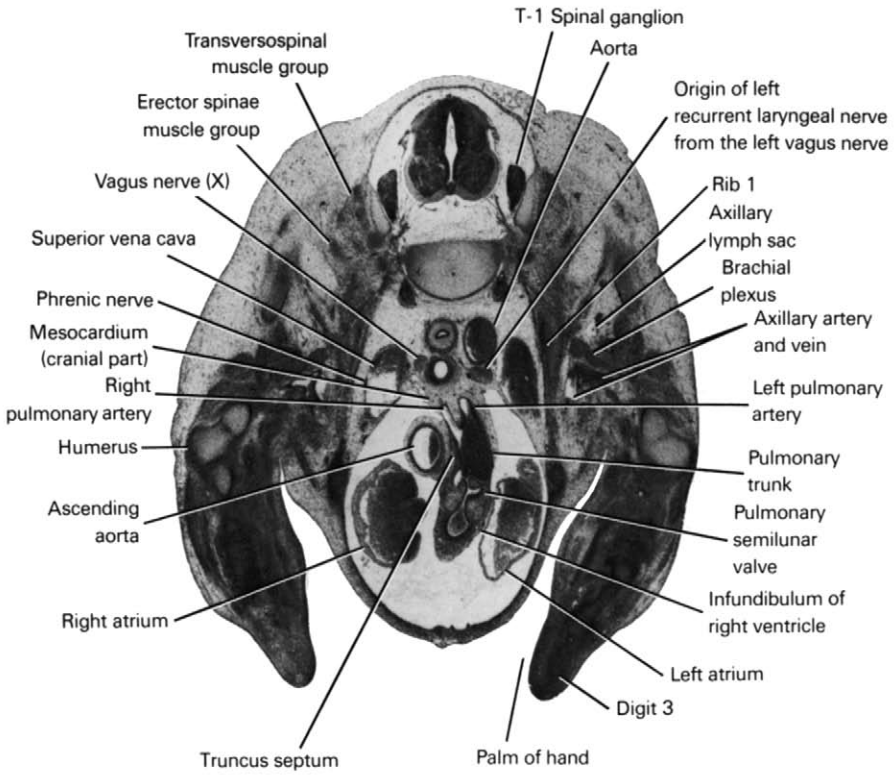
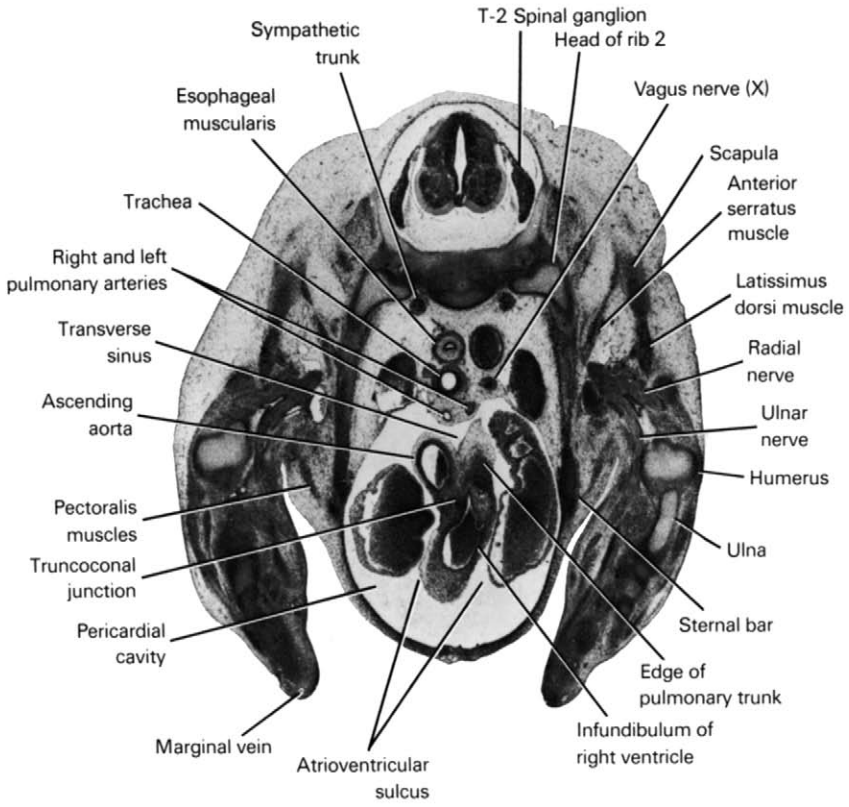


FIG. 7–19

SECTION 27
A section through the pulmonary semilunar valve.
Observe:
1. The infundibulum of the right ventricle below the pulmonary semilunar valve and the right and left pulmonary arteries arising from the pulmonary trunk above the valve.
2. The pulmonary arteries passing through the cranial part of the mesocardium.
3. The origin of the left recurrent laryngeal nerve from the left vagus nerve between the aorta and left pulmonary artery.
4. The brachial plexus and axillary artery, vein and lymph sac lateral to the first rib.
5. The primordium of the third digit of the hand.

SECTION 28
A section through the T-2 spinal ganglion.
Observe:
1. The ascending aorta dorsal to the infundibulum of the right ventricle at the level of the truncoconal junction.
2. The transverse sinus that separates the cranial (arterial) part of the mesocardium (see Section 27) from the caudal (venous) part (see Section 31).
3. The right pulmonary artery passing to the right between the ascending aorta and trachea.
4. The anterior serratus muscle attaching the scapula to the ribs.
5. The sternal bar at the ventral end of rib 2.


T-1 Spinal ganglion
Aorta
Transversospinal muscle group
Erector spinae muscle group
Origin of left recurrent laryngeal nerve from the left vagus nerve
Vagus nerve (X)
Rib 1
Axillary lymph sac
Brachial plexus
Superior vena cava
Axillary artery and vein
Phrenic nerve
Mesocardium (cranial part)
Right pulmonary artery
Left pulmonary artery
Humerus
Pulmonary trunk
Ascending aorta
Pulmonary semilunar valve
Infundibulum of right ventricle
Right atrium
Left atrium
Digit 3
Truncus septum
Palm of hand


T-2 Spinal ganglion
Sympathetic trunk
Head of rib 2
Esophageal muscularis
Vagus nerve (X)
Scapula
Anterior serratus muscle
Trachea
Right and left pulmonary arteries
Latissimus dorsi muscle
Transverse sinus
Radial nerve
Ascending aorta
Ulnar nerve
Humerus
Pectoralis muscles
Ulna
Truncoconal junction
Sternal bar
Pericardial cavity
Edge of pulmonary trunk
Infundibulum of right ventricle
Marginal vein
Atrioventricular sulcus

27

2 mm

28

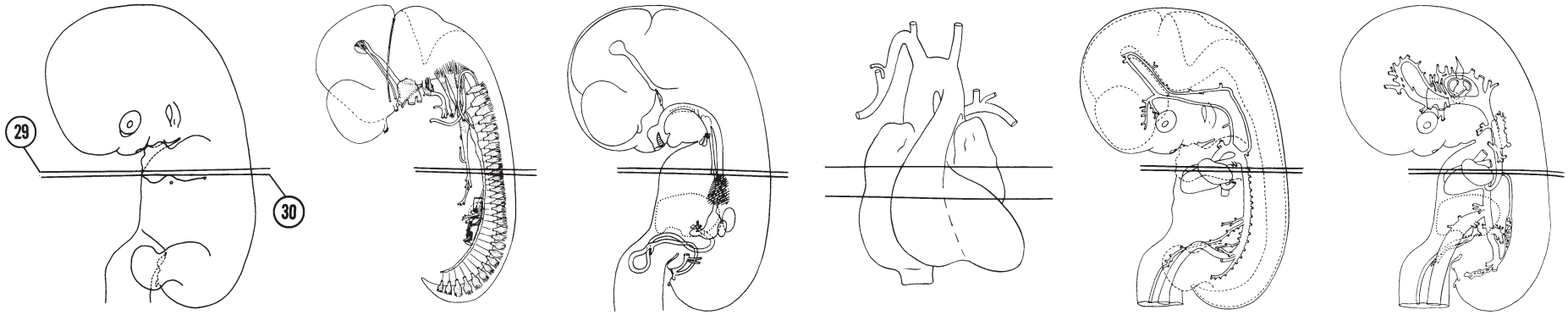
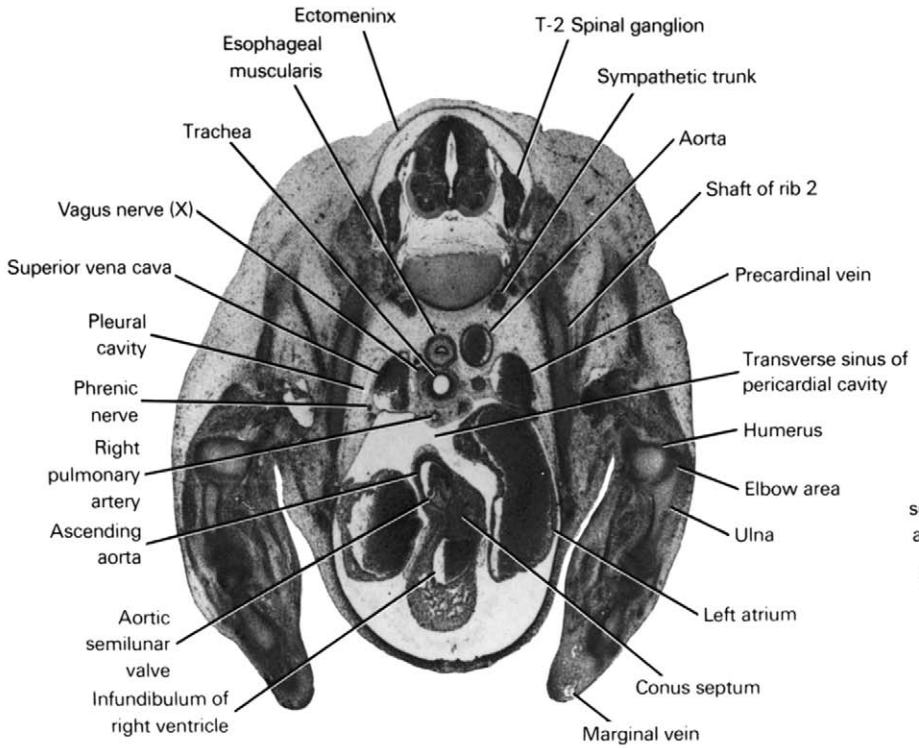
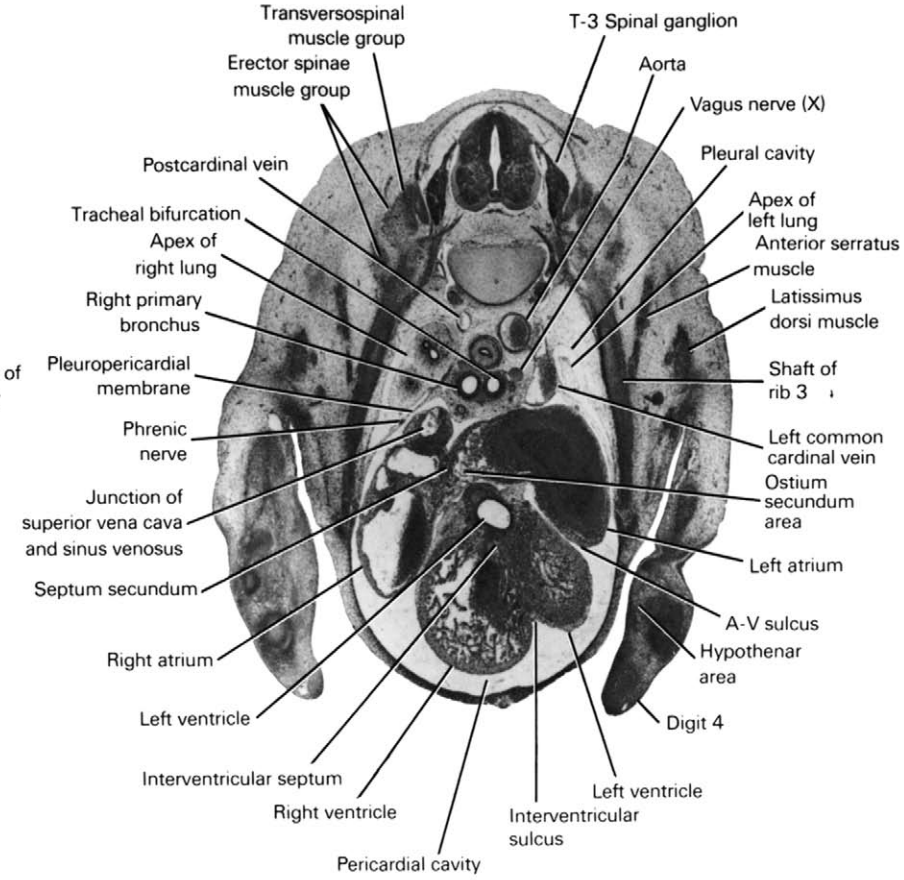


FIG. 7–20

SECTION 29
A section through the aortic semilunar valve.
Observe:
1. The conus septum separating the aortic semilunar valve from the infundibulum of the right ventricle.
2. The cranial edge of the pleural cavity on the right between the rib and superior vena cava.
3. The aorta to the left of the esophagus.
4. The phrenic nerve dorsolateral to the pericardial cavity and the vagus nerve lateral to the trachea.
5. The elbow joint area between the humerus and ulna.

SECTION 30
A section through the T-3 spinal ganglion and the tracheal bifurcation.
Observe:
1. The cranial part of the left ventricle dorsal to the right ventricle from which it is separated by the membranous part of the interventricular septum.
2. The septum secundum between the right and left atria and the ostium secundum through which the two atria communicate.
3. The entrance of the superior vena cava into the pericardial cavity and its junction with the sinus venosus.
4. The phrenic nerve coursing through the thin pleuropericardial membrane that separates the pericardial and pleural cavities.
5. The primordium of the fourth digit of the hand.


Ectomeninx
Esophageal muscularis
T-2 Spinal ganglion
Sympathetic trunk
Trachea
Aorta
Vagus nerve (X)
Shaft of rib 2
Superior vena cava
Precardinal vein
Pleural cavity
Transverse sinus of pericardial cavity
Phrenic nerve
Humerus
Right pulmonary artery
Elbow area
Ascending aorta
Ulna
Left atrium
Aortic semilunar valve
Conus septum
Infundibulum of right ventricle
Marginal vein


Transversospinal muscle group
T-3 Spinal ganglion
Erector spinae muscle group
Aorta
Vagus nerve (X)
Pleural cavity
Postcardinal vein
Apex of left lung
Tracheal bifurcation
Anterior serratus muscle
Apex of right lung
Latissimus dorsi muscle
Right primary bronchus
Shaft of rib 3
Pleuropericardial membrane
Left common cardinal vein
Phrenic nerve
Ostium secundum area
Junction of superior vena cava and sinus venosus
Left atrium
Septum secundum
A-V sulcus
Hypothenar area
Right atrium
Digit 4
Left ventricle
Interventricular septum
Left ventricle
Right ventricle
Interventricular sulcus
Pericardial cavity

29

2 mm

30

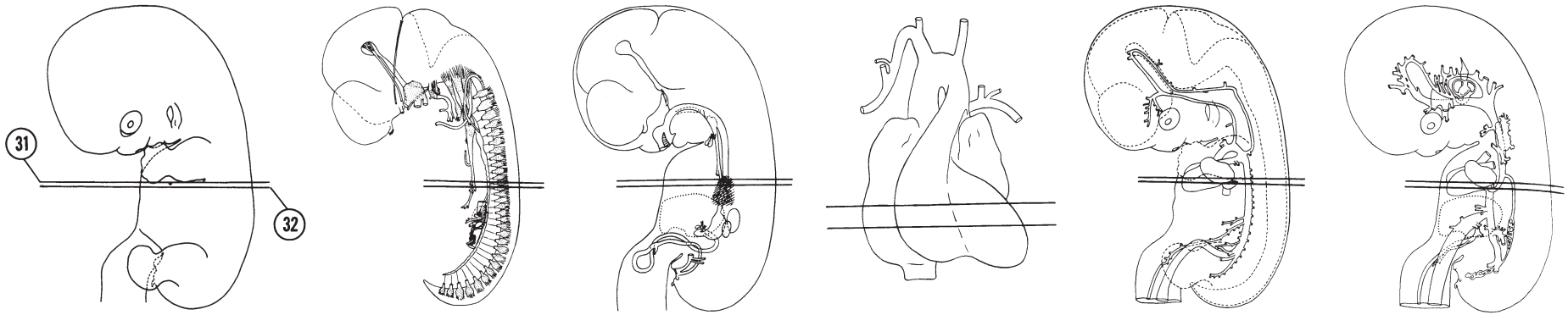
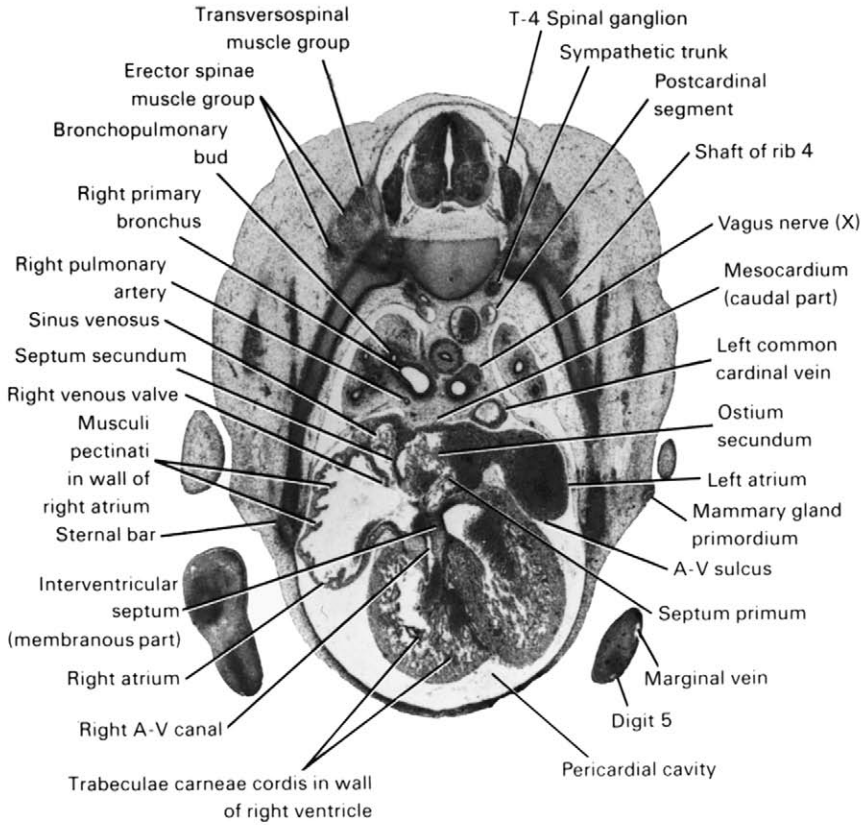


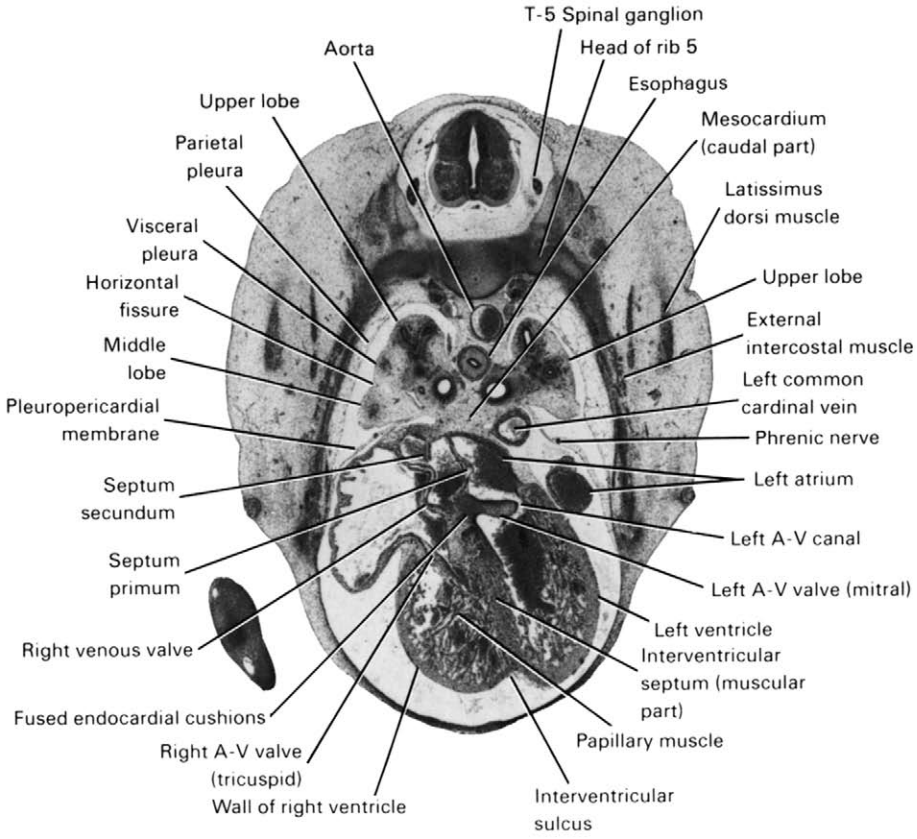
FIG. 7–21

SECTION 31
A section through the T-4 spinal ganglion and the right atrioventricular (A-V) canal.
Observe:
1. The trabeculae carneae cordis in the wall of the right ventricle and the musculi pectinati in the right atrial wall.
2. The sinus venosus between the septum secundum and right venous valve.
3. The entrance of the left common cardinal vein into the pericardial cavity, then passing toward the right, dorsal to the heart.
4. The right pulmonary artery coursing into the lung ventral to the right primary bronchus.
5. The primordium of the mammary gland and fifth digit of the hand.

SECTION 32
A section through the T-5 spinal ganglion and the right and left atrioventricular valves.
Observe:
1. A papillary muscle attaching a leaf of the right atrioventricular valve to the wall of the right ventricle.
2. The septum primum caudal to the ostium secundum (see Section 31) and left of the septum secundum.
3. The right venous valve joining the fused endocardial cushions.
4. The left atrioventricular canal connecting the left atrium with the left ventricle.
5. The esophagus passing ventral to the aorta.


Transversospinal muscle group
T-4 Spinal ganglion
Sympathetic trunk
Erector spinae muscle group
Postcardinal segment
Bronchopulmonary bud
Shaft of rib 4
Right primary bronchus
Vagus nerve (X)
Right pulmonary artery
Mesocardium (caudal part)
Sinus venosus
Left common cardinal vein
Septum secundum
Right venous valve
Ostium secundum
Musculi pectinati in wall of right atrium
Left atrium
Sternal bar
Mammary gland primordium
A-V sulcus
Interventricular septum (membranous part)
Septum primum
Right atrium
Marginal vein
Right A-V canal
Digit 5
Pericardial cavity
Trabeculae carneae cordis in wall of right ventricle

31


T-5 Spinal ganglion
Aorta
Head of rib 5
Esophagus
Upper lobe
Mesocardium (caudal part)
Parietal pleura
Latissimus dorsi muscle
Visceral pleura
Upper lobe
Horizontal fissure
External intercostal muscle
Middle lobe
Left common cardinal vein
Pleuropericardial membrane
Phrenic nerve
Left atrium
Septum secundum
Left A-V canal
Septum primum
Left A-V valve (mitral)
Left ventricle
Right venous valve
Interventricular septum (muscular part)
Fused endocardial cushions
Papillary muscle
Right A-V valve (tricuspid)
Interventricular sulcus
Wall of right ventricle

32

2 mm

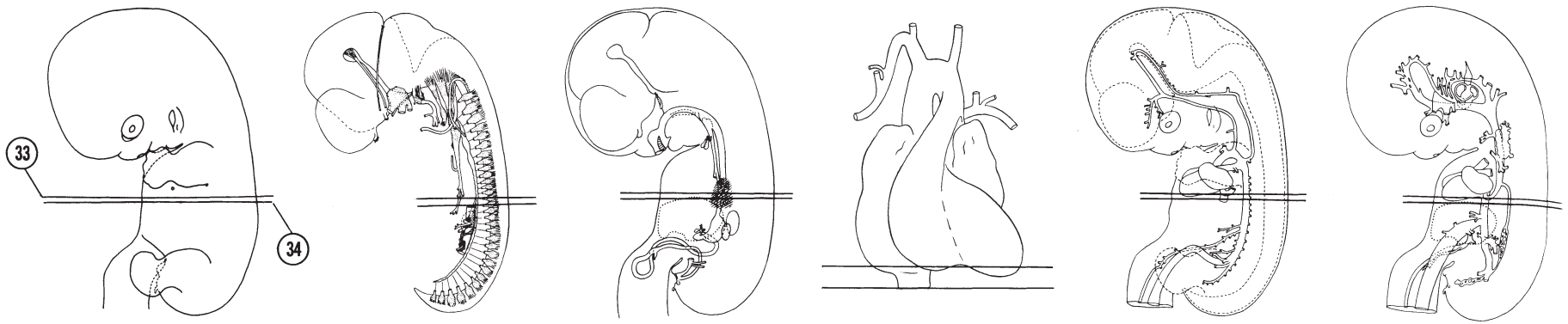


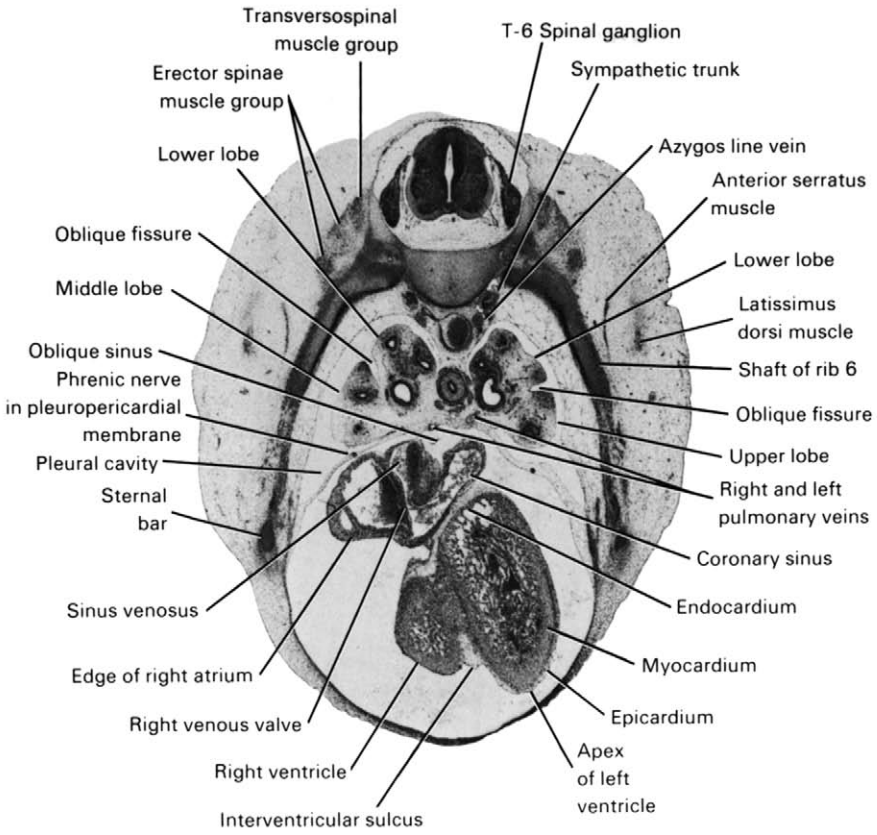
FIG. 7–22

SECTION 33
A section through the T-6 spinal ganglion and caudal edge of the ventricles.
Observe:

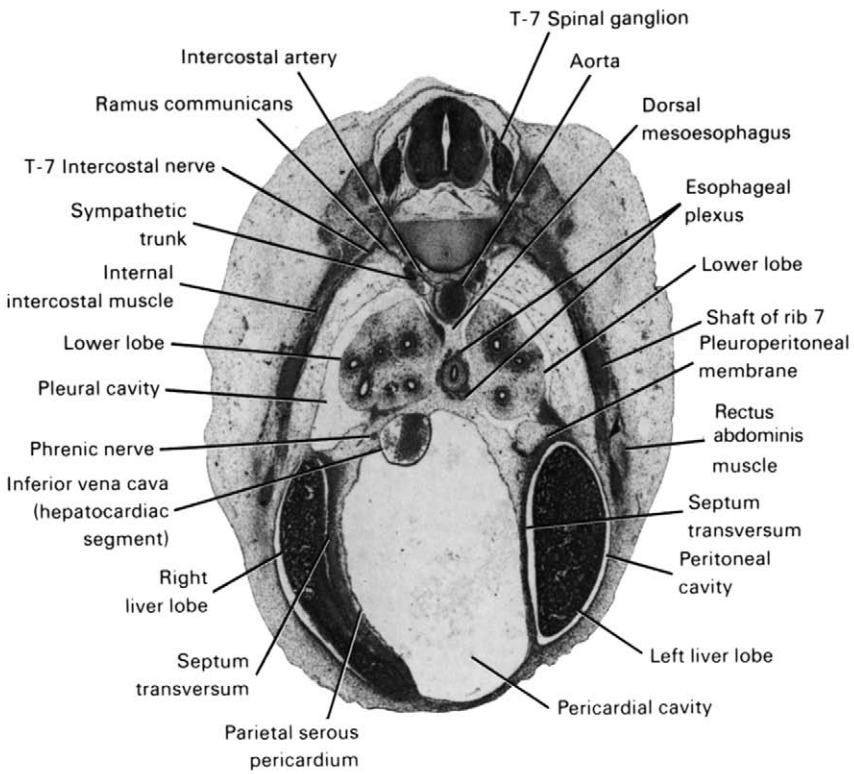
1. The apex of the left ventricle and three layers of the heart wall.
2. The continuation of the left common cardinal vein in Section 32 with the left sinus horn (coronary sinus) that empties into the sinus venosus.
3. The pulmonary veins that course cranially from the lungs through the caudal part of the mesocardium in Section 32 before they empty into the left atrium.
4. The phrenic nerves in the pleuropericardial membrane dorsolateral to the heart.
5. The fissures that separate the lungs into lobes.

SECTION 34
A section through the T-7 spinal ganglion and the cranial edge of the liver.
Observe:

1. The septum transversum separating the pericardial and peritoneal cavities and the pleuroperitoneal membrane separating the pleural and peritoneal cavities.
2. The right phrenic nerve lateral to the inferior vena cava.
3. The vagus nerves forming a plexus around the esophagus.
4. The dorsal mesoesophagus separating the pleural cavities between the aorta and esophagus.
5. A ramus communicans connecting the sympathetic trunk with an intercostal nerve.


Transversospinal muscle group
T-6 Spinal ganglion
Erector spinae muscle group
Sympathetic trunk
Lower lobe
Azygos line vein
Anterior serratus muscle
Oblique fissure
Lower lobe
Middle lobe
Latissimus dorsi muscle
Oblique sinus
Shaft of rib 6
Phrenic nerve in pleuropericardial membrane
Oblique fissure
Pleural cavity
Upper lobe
Right and left pulmonary veins
Sternal bar
Coronary sinus
Endocardium
Sinus venosus
Myocardium
Edge of right atrium
Epicardium
Right venous valve
Apex of left ventricle
Right ventricle
Interventricular sulcus

33


T-7 Spinal ganglion
Intercostal artery
Aorta
Ramus communicans
Dorsal mesoesophagus
T-7 Intercostal nerve
Esophageal plexus
Sympathetic trunk
Lower lobe
Internal intercostal muscle
Shaft of rib 7
Lower lobe
Pleuroperitoneal membrane
Pleural cavity
Rectus abdominis muscle
Phrenic nerve
Septum transversum
Inferior vena cava (hepatocardiac segment)
Peritoneal cavity
Right liver lobe
Left liver lobe
Septum transversum
Pericardial cavity
Parietal serous pericardium

34

2 mm

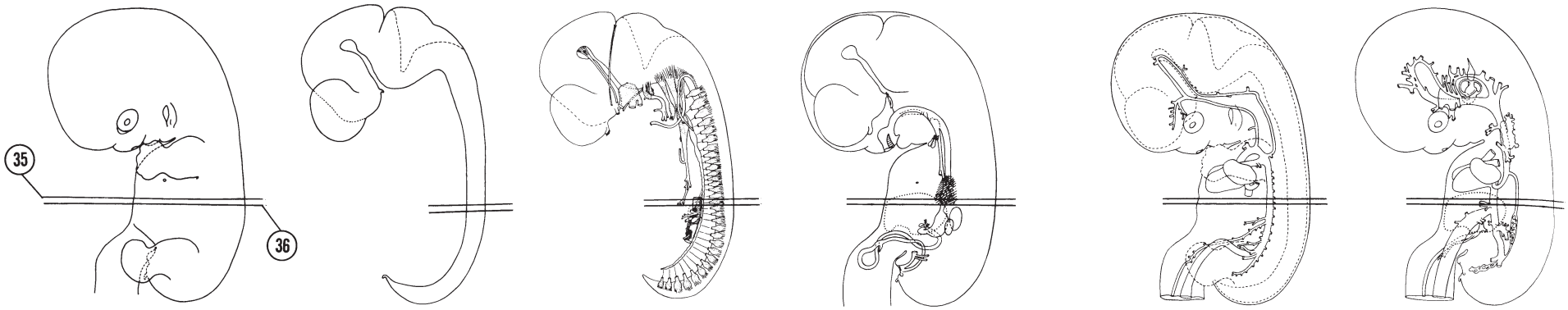
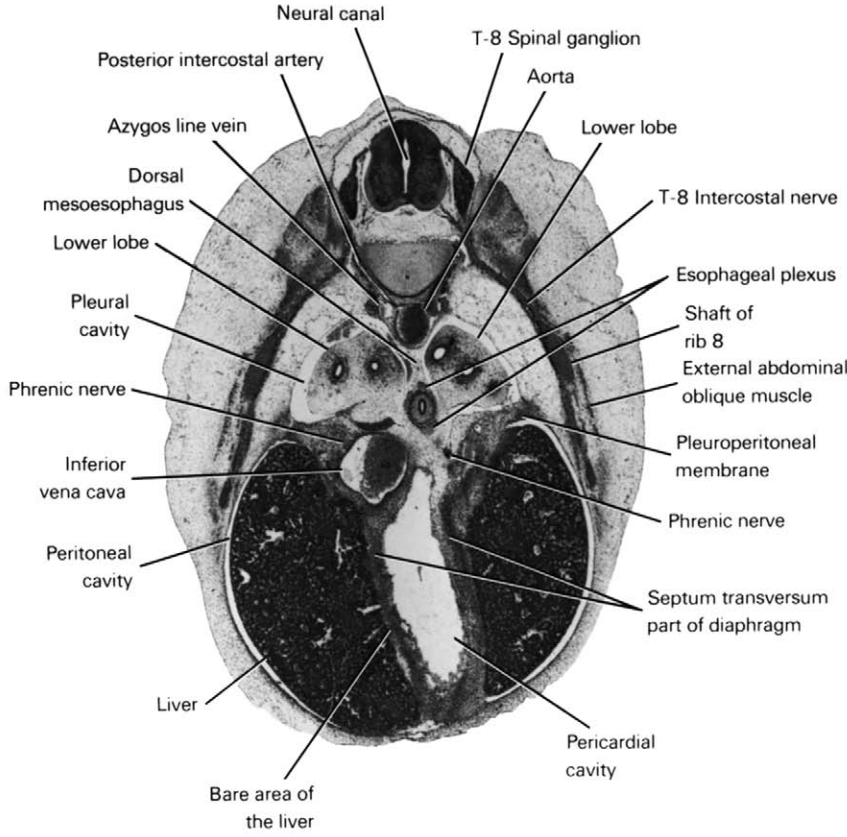
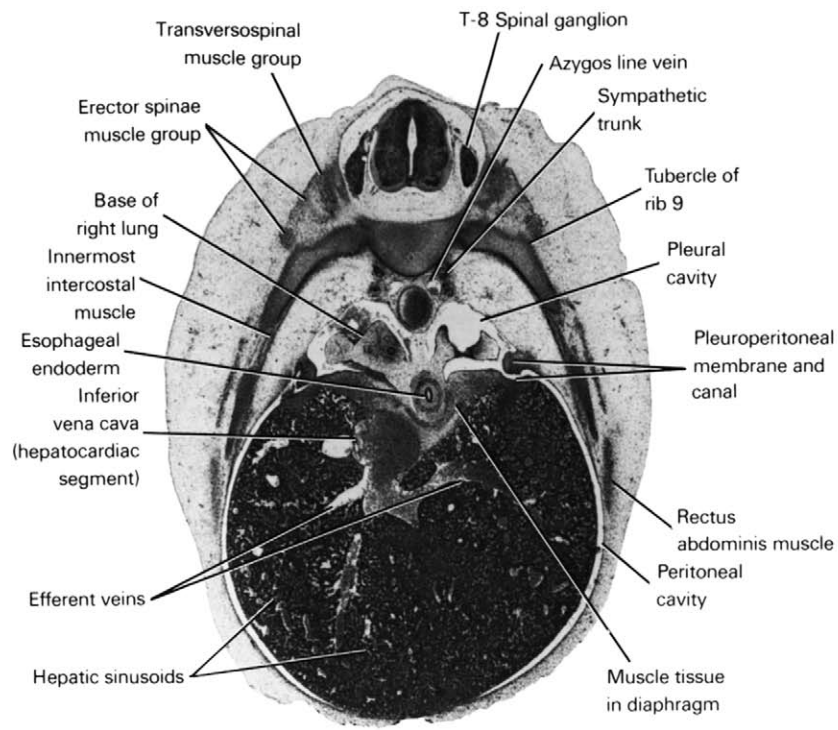


FIG. 7–23

SECTION 35
A section through the T-8 spinal ganglion and caudal part of the pericardial cavity.
Observe:
1. The phrenic nerves approaching the septum transversum part of the diaphragm.
2. The inferior vena cava near the bare area of the liver.
3. The lower lobes of the lungs separated by the esophagus.
4. The azygos line vein lateral to the aorta.
5. The origin of a posterior intercostal artery from the aorta.

SECTION 36
A section through the pleuroperitoneal canal and base of the lungs.
Observe:
1. The efferent veins of the liver draining blood from the hepatic sinusoids to the hepatocardiac segment of the inferior vena cava.
2. Muscle forming in the diaphragm near the esophagus.
3. The communication of the pleural cavity with the peritoneal cavity through the pleuroperitoneal canal.
4. The two subdivisions of the deep muscles of the back: erector spinae muscle group and transversospinalis muscle group.


Neural canal
Posterior intercostal artery
T-8 Spinal ganglion
Aorta
Azygos line vein
Lower lobe
Dorsal mesoesophagus
T-8 Intercostal nerve
Lower lobe
Esophageal plexus
Pleural cavity
Shaft of rib 8
External abdominal oblique muscle
Phrenic nerve
Pleuroperitoneal membrane
Inferior vena cava
Phrenic nerve
Peritoneal cavity
Septum transversum part of diaphragm
Liver
Pericardial cavity
Bare area of the liver


Transversospinal muscle group
T-8 Spinal ganglion
Azygos line vein
Erector spinae muscle group
Sympathetic trunk
Tubercle of rib 9
Base of right lung
Pleural cavity
Innermost intercostal muscle
Esophageal endoderm
Pleuroperitoneal membrane and canal
Inferior vena cava (hepatocardiac segment)
Rectus abdominis muscle
Peritoneal cavity
Efferent veins
Hepatic sinusoids
Muscle tissue in diaphragm

35

2 mm

36

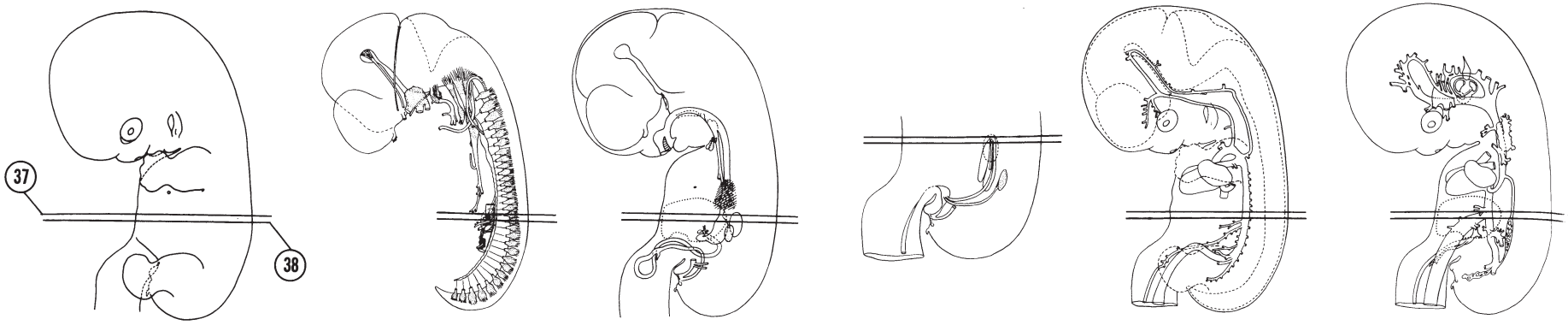
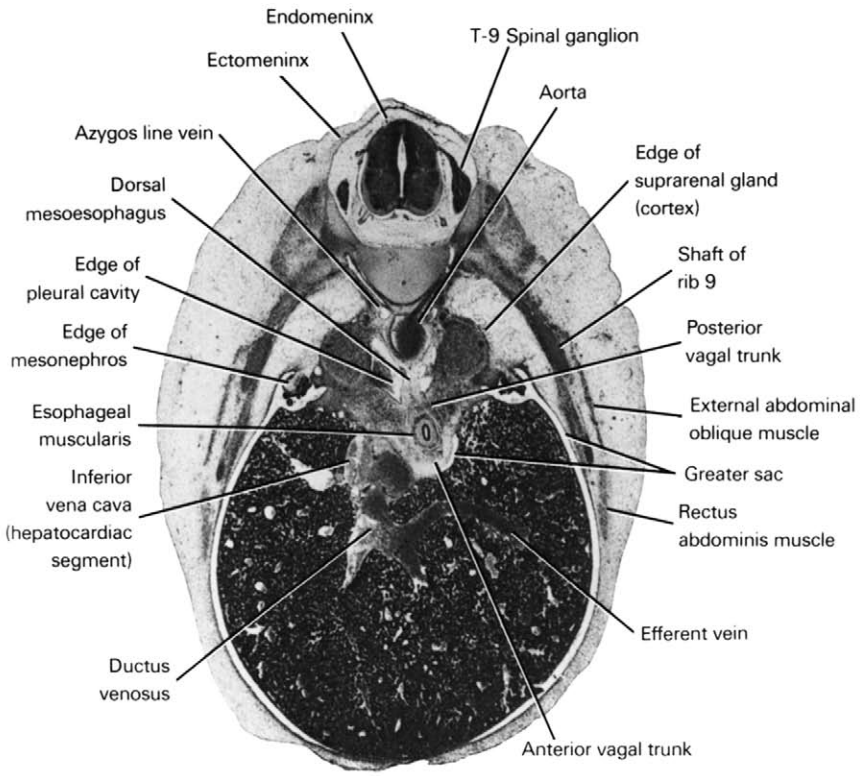


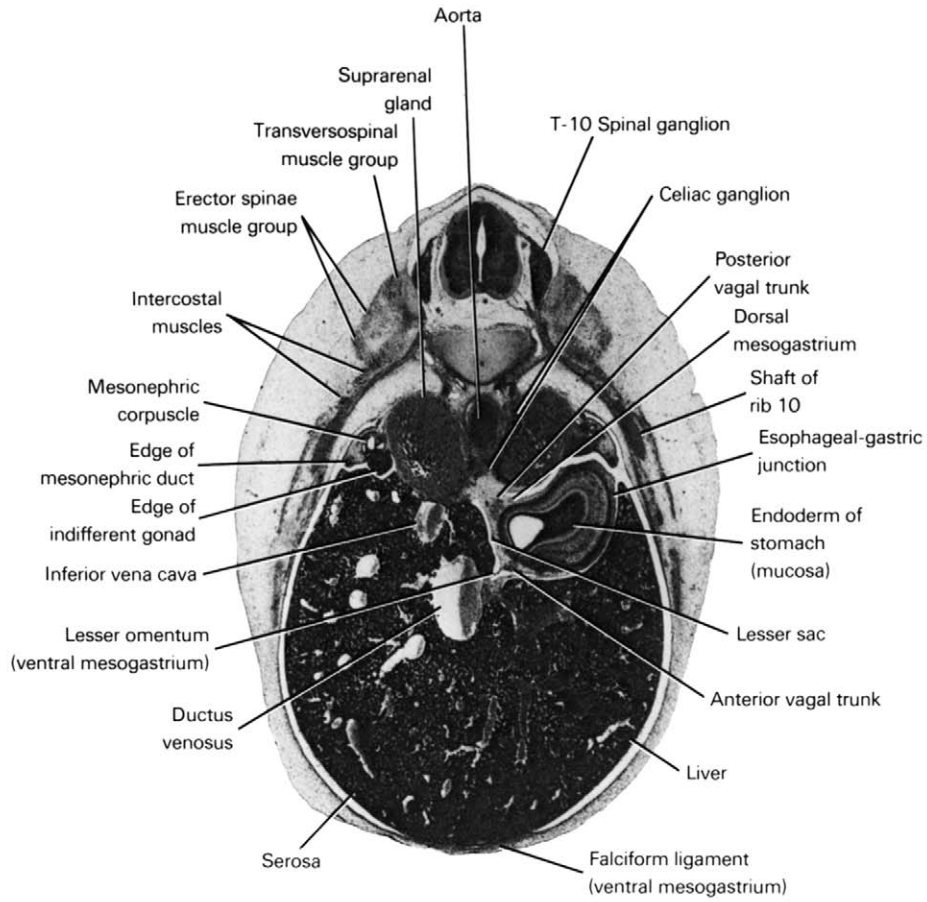
FIG. 7–24

SECTION 37
A section through the T-9 spinal ganglion and the cranial edge of the mesonephros.
Observe:
1. Efferent veins draining into the ductus venosus.
2. The junction of the ductus venosus with the hepatocardiac segment of the inferior vena cava.
3. The relation of the vagal trunks to the esophagus as it passes through the diaphragm in Section 36.
4. The cranial edge of the suprarenal gland, lateral to the caudal edge of the pleural cavity.

SECTION 38
A section through the T-10 spinal ganglion and the esophageal-gastric junction.
Observe:
1. The dorsal mesogastrium and the two divisions of the ventral mesogastrium: lesser omentum and falciform ligament.
2. The position of the vagal trunks in relation to the stomach.
3. The cranial edge of the mesonephric duct and indifferent gonad.
4. The celiac ganglion ventral to the aorta between the suprarenal glands.


Endomeninx
Ectomeninx
T-9 Spinal ganglion
Aorta
Azygos line vein
Edge of suprarenal gland (cortex)
Dorsal mesoesophagus
Shaft of rib 9
Edge of pleural cavity
Posterior vagal trunk
Edge of mesonephros
External abdominal oblique muscle
Esophageal muscularis
Greater sac
Inferior vena cava (hepatocardiac segment)
Rectus abdominis muscle
Efferent vein
Ductus venosus
Anterior vagal trunk

37


Aorta
Suprarenal gland
Transversospinal muscle group
T-10 Spinal ganglion
Erector spinae muscle group
Celiac ganglion
Posterior vagal trunk
Intercostal muscles
Dorsal mesogastrium
Shaft of rib 10
Mesonephric corpuscle
Esophageal-gastric junction
Edge of mesonephric duct
Endoderm of stomach (mucosa)
Edge of indifferent gonad
Inferior vena cava
Lesser sac
Lesser omentum (ventral mesogastrium)
Anterior vagal trunk
Ductus venosus
Liver
Serosa
Falciform ligament (ventral mesogastrium)

38

2 mm

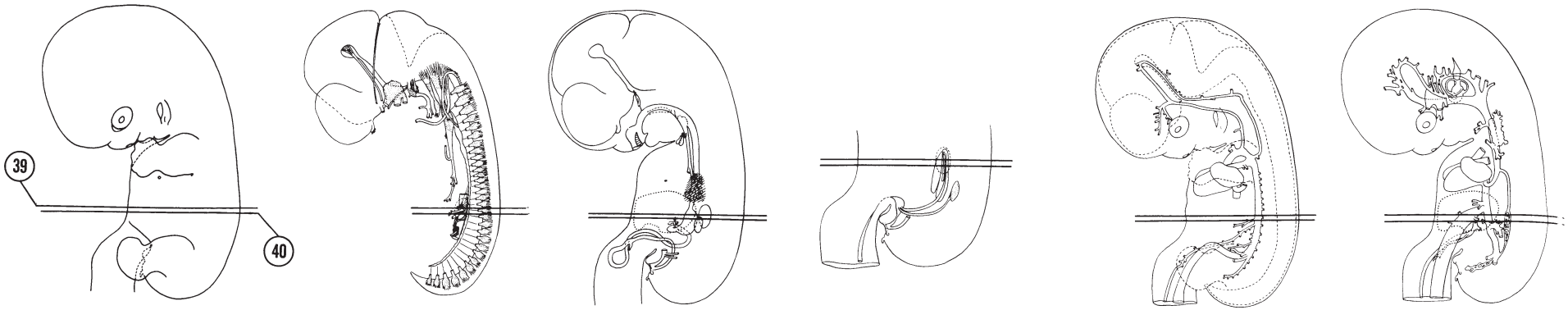
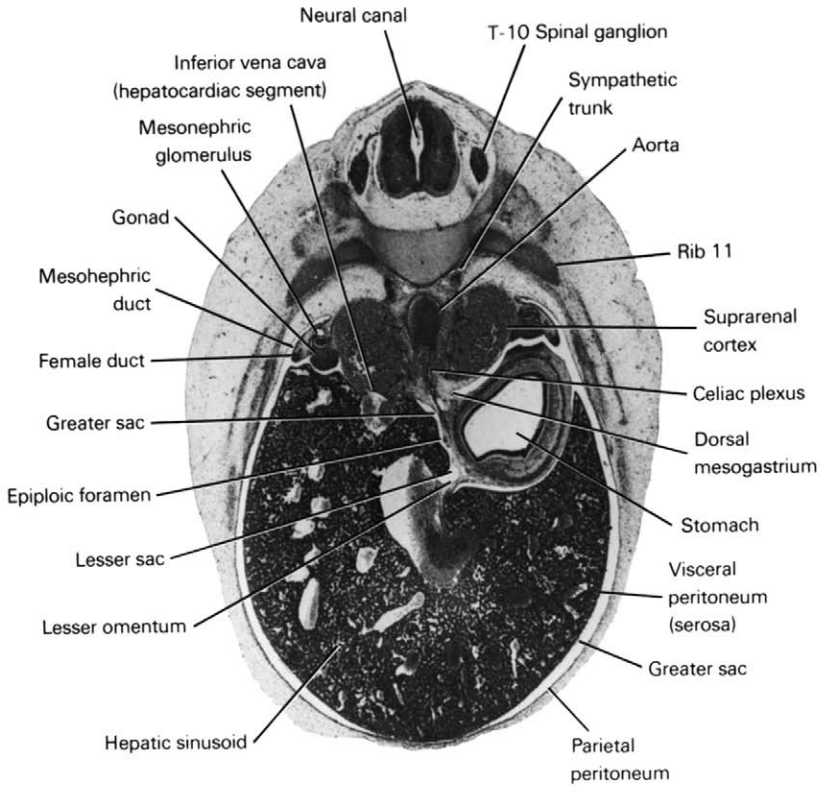


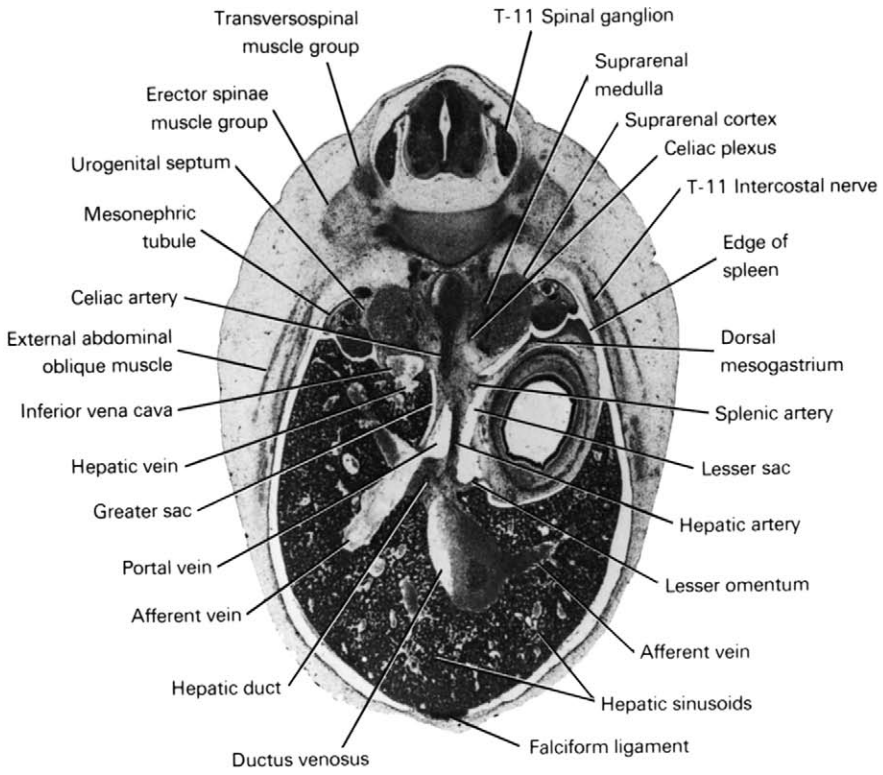
FIG. 7–25

SECTION 39
A section through the epiploic foramen.
Observe:
1. The two subdivisions of the peritoneum.
2. The growth of the stomach to the left.
3. The communication of the lesser sac with the greater sac through the epiploic foramen.
4. The minute female (paramesonephric) duct ventral to the mesonephric duct.

SECTION 40
A section through the T-11 spinal ganglion and the cranial edge of the spleen.
Observe:
1. The junction of the portal vein with the ductus venosus.
2. Afferent veins arising from the ductus venosus and bringing blood to the hepatic sinusoids.
3. The splenic artery (branch of the celiac artery) approaching the dorsal mesogastrium.
4. The hepatic artery (branch of the celiac artery) coursing to the liver with the portal vein.
5. The suprarenal medulla medial to the cortex and its close relation to the celiac plexus.


Neural canal
T-10 Spinal ganglion
Inferior vena cava
(hepatocardiac segment)
Sympathetic
trunk
Mesonephric
glomerulus
Aorta
Gonad
Rib 11
Mesohephric
duct
Suprarenal
cortex
Female duct
Celiac plexus
Greater sac
Dorsal
mesogastrium
Epiploic foramen
Stomach
Lesser sac
Visceral
peritoneum
(serosa)
Lesser omentum
Greater sac
Hepatic sinusoid
Parietal
peritoneum

39


Transversospinal
muscle group
T-11 Spinal ganglion
Suprarenal
medulla
Erector spinae
muscle group
Suprarenal cortex
Celiac plexus
Urogenital septum
T-11 Intercostal nerve
Mesonephric
tubule
Edge of
spleen
Celiac artery
External abdominal
oblique muscle
Dorsal
mesogastrium
Inferior vena cava
Splenic artery
Hepatic vein
Lesser sac
Greater sac
Hepatic artery
Portal vein
Lesser omentum
Afferent vein
Afferent vein
Hepatic duct
Hepatic sinusoids
Falciform ligament
Ductus venosus

40

2 mm

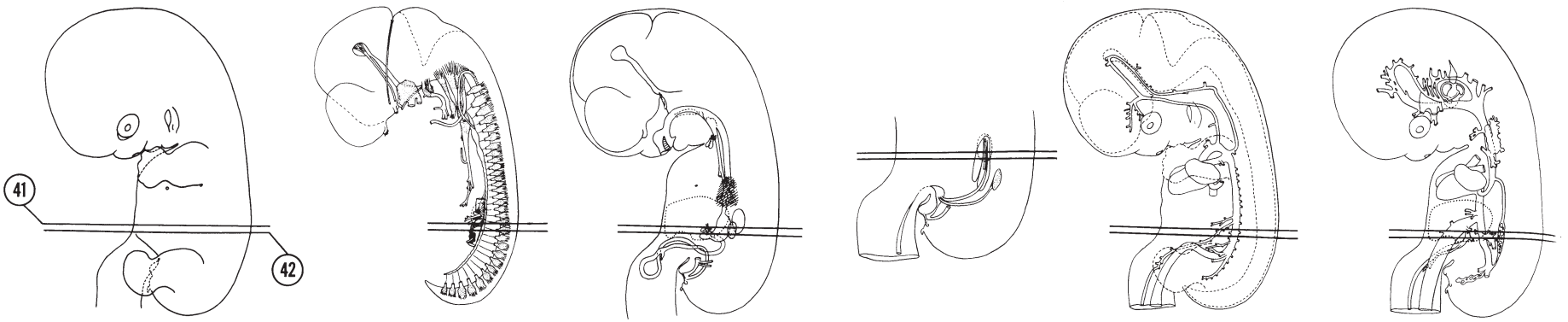
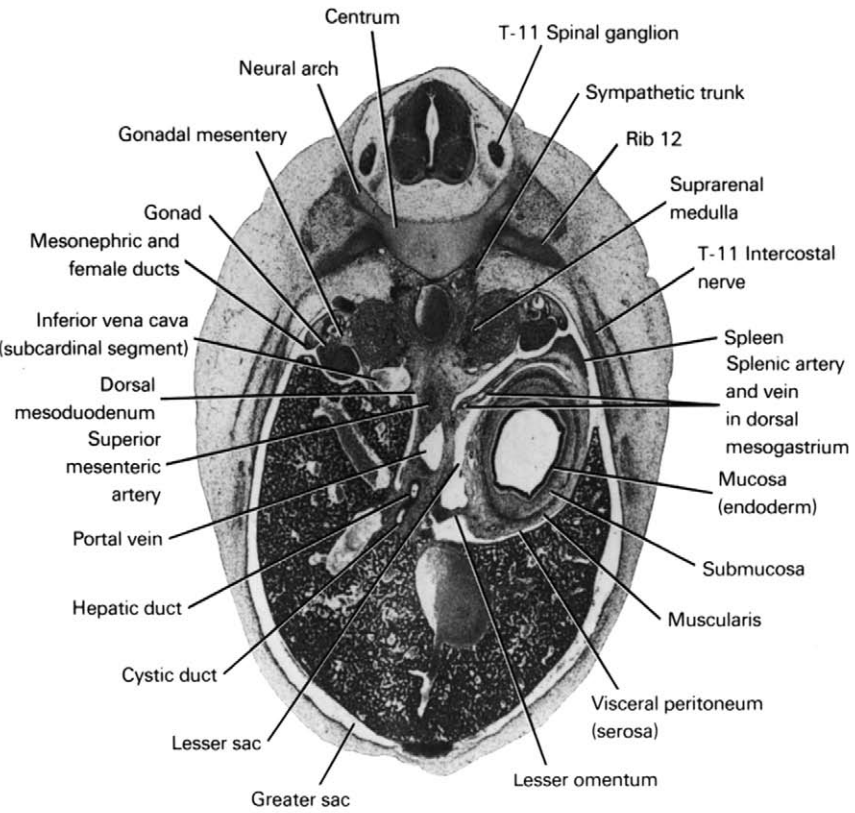


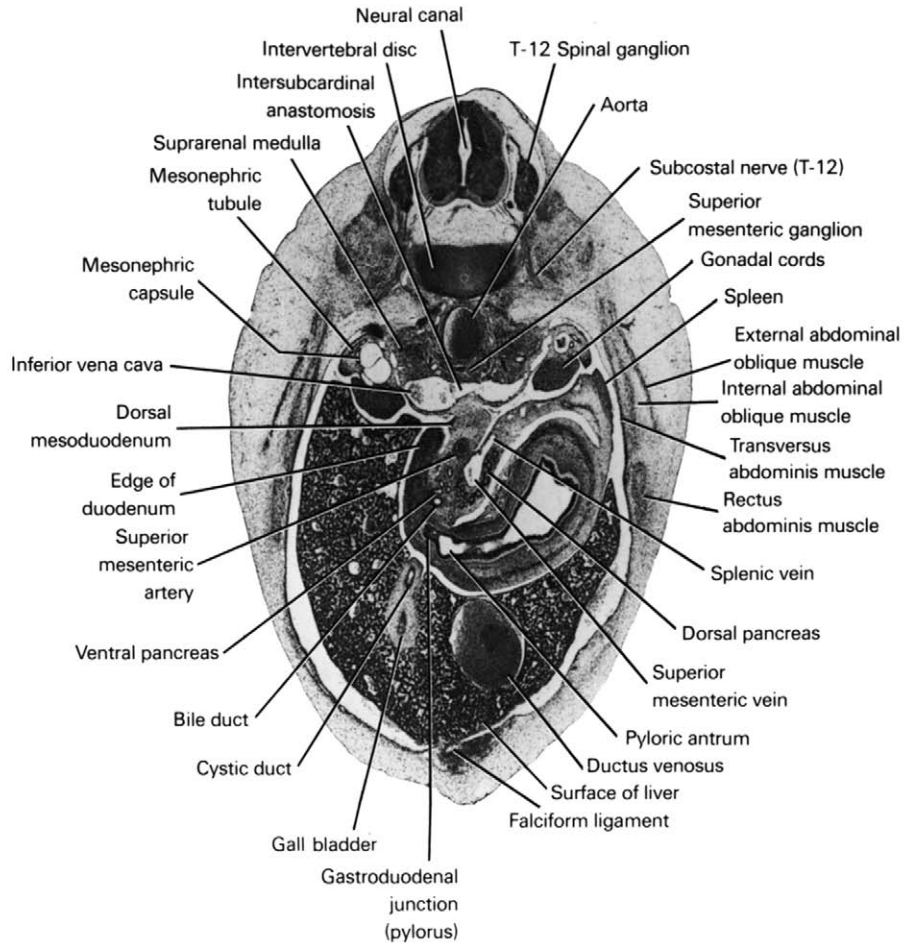
FIG. 7–26

SECTION 41
A section through the middle of the lesser sac.
Observe:
1. The four layers of the stomach wall.
2. The junction of the cystic and hepatic ducts to form the bile duct.
3. The splenic vessels coursing through the dorsal mesogastrium.
4. The superior mesenteric artery passing into the dorsal mesoduodenum with the subcardinal segment of the inferior vena cava on its right side.
5. The centrum and neural arch portions of a vertebra.

SECTION 42
A section through the T-12 spinal ganglion and gastroduodenal junction.
Observe:
1. The gall bladder on the caudal surface of the liver and drained by the cystic duct.
2. The junction of the splenic and superior mesenteric veins to form the portal vein in Section 41 between the dorsal and ventral pancreas.
3. The relation of the splenic vein to the dorsal pancreas.
4. The superior mesenteric ganglion ventral to the aorta and medial to the suprarenal medulla.
5. A mesonephric capsule and tubule.


Centrum
T-11 Spinal ganglion
Neural arch
Sympathetic trunk
Gonadal mesentery
Rib 12
Suprarenal medulla
Gonad
Mesonephric and female ducts
T-11 Intercostal nerve
Inferior vena cava (subcardinal segment)
Spleen
Splenic artery and vein in dorsal mesogastrium
Dorsal mesoduodenum
Superior mesenteric artery
Mucosa (endoderm)
Portal vein
Submucosa
Hepatic duct
Muscularis
Cystic duct
Visceral peritoneum (serosa)
Lesser sac
Lesser omentum
Greater sac

41


Neural canal
Intervertebral disc
T-12 Spinal ganglion
Intersubcardinal anastomosis
Aorta
Suprarenal medulla
Subcostal nerve (T-12)
Mesonephric tubule
Superior mesenteric ganglion
Gonadal cords
Mesonephric capsule
Spleen
External abdominal oblique muscle
Inferior vena cava
Internal abdominal oblique muscle
Dorsal mesoduodenum
Transversus abdominis muscle
Edge of duodenum
Rectus abdominis muscle
Superior mesenteric artery
Splenic vein
Dorsal pancreas
Ventral pancreas
Superior mesenteric vein
Bile duct
Pyloric antrum
Cystic duct
Ductus venosus
Surface of liver
Falciform ligament
Gall bladder
Gastroduodenal junction (pylorus)

42

2 mm

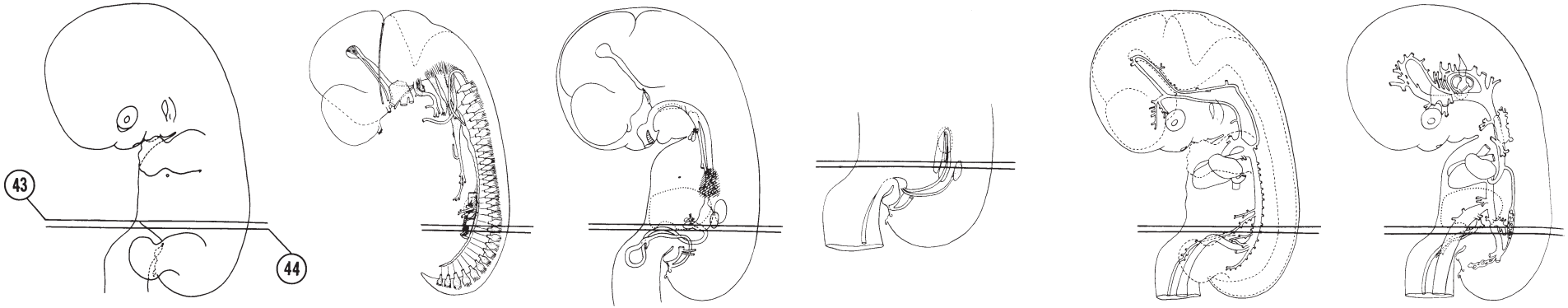
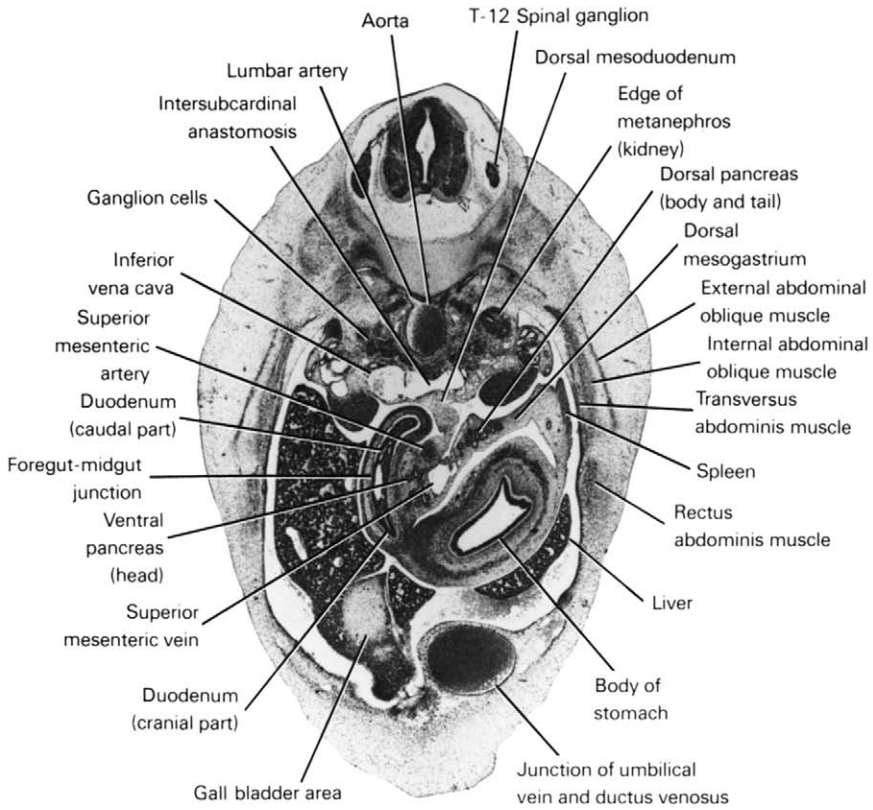
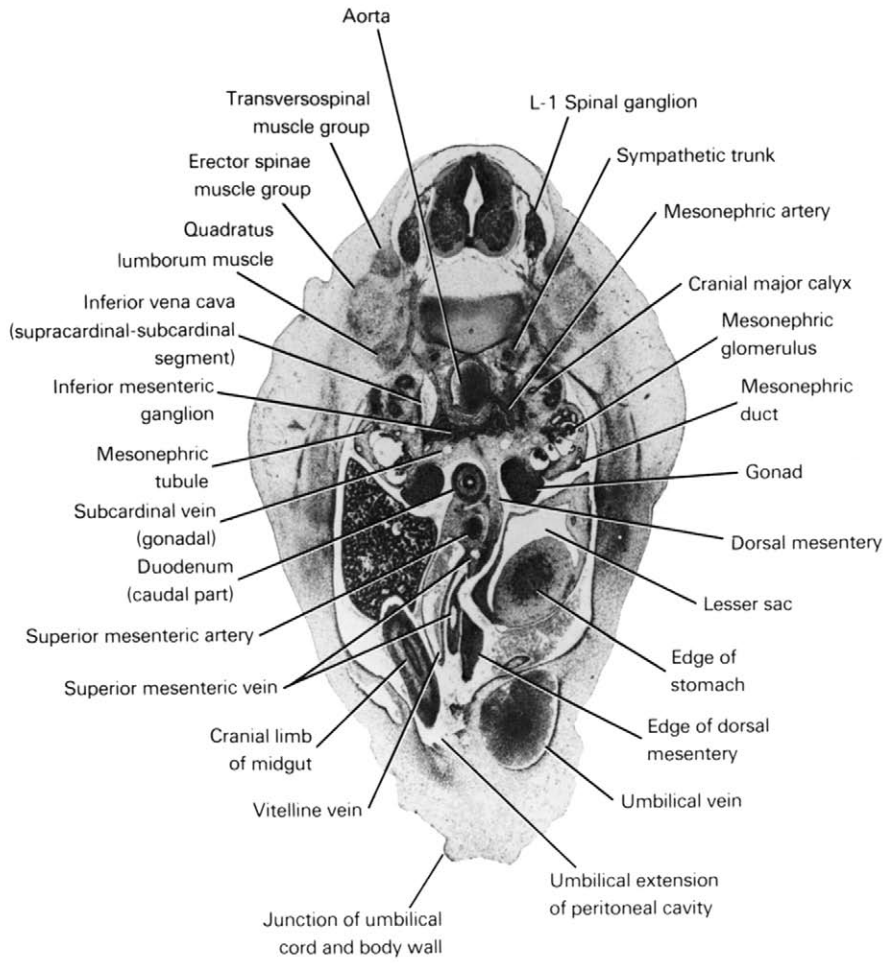


FIG. 7–27

SECTION 43
A section through the cranial edge of the metanephros.
Observe:
1. The junction of the umbilical vein and the ductus venosus at the surface of the liver.
2. The fore- and midgut junction on the duodenum.
3. The duodenum assuming a position dorsal to the superior mesenteric vessels.
4. The intersubcardinal anastomosis that will form the left renal vein.
5. The three muscles in the lateral abdominal wall.

SECTION 44
A section through the L-1 spinal ganglion and the cranial edge of the junction of the umbilical cord and the ventral body wall.
Observe:
1. The umbilical vein leaving the umbilical cord and the junction of the superior mesenteric veins.
2. The cranial major calyx of the primitive renal pelvis seen in Section 45.
3. The superior mesenteric vessels in the dorsal mesentery passing to the right and ventral to the caudal segment of the duodenum.
4. The subcardinal vein segment that will form the gonadal vein and the inferior vena cava segment that develops from the anastomosis between the right supra- and subcardinal veins.
5. The inferior mesenteric ganglion ventral to the aorta.


Aorta
T-12 Spinal ganglion
Dorsal mesoduodenum
Lumbar artery
Intersubcardinal anastomosis
Edge of metanephros (kidney)
Dorsal pancreas (body and tail)
Ganglion cells
Dorsal mesogastrium
Inferior vena cava
External abdominal oblique muscle
Superior mesenteric artery
Internal abdominal oblique muscle
Duodenum (caudal part)
Transversus abdominis muscle
Spleen
Foregut-midgut junction
Rectus abdominis muscle
Ventral pancreas (head)
Liver
Superior mesenteric vein
Duodenum (cranial part)
Body of stomach
Junction of umbilical vein and ductus venosus
Gall bladder area


Aorta
Transversospinal muscle group
L-1 Spinal ganglion
Erector spinae muscle group
Sympathetic trunk
Quadratus lumborum muscle
Mesonephric artery
Inferior vena cava (supracardinal-subcardinal segment)
Cranial major calyx
Mesonephric glomerulus
Inferior mesenteric ganglion
Mesonephric duct
Mesonephric tubule
Gonad
Subcardinal vein (gonadal)
Dorsal mesentery
Duodenum (caudal part)
Lesser sac
Superior mesenteric artery
Edge of stomach
Superior mesenteric vein
Edge of dorsal mesentery
Cranial limb of midgut
Umbilical vein
Vitelline vein
Umbilical extension of peritoneal cavity
Junction of umbilical cord and body wall

43

2 mm

44

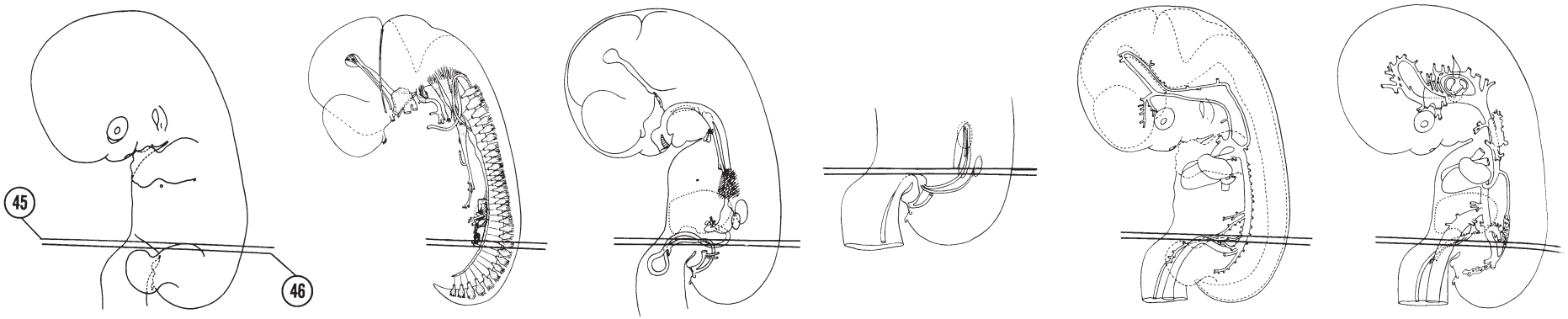


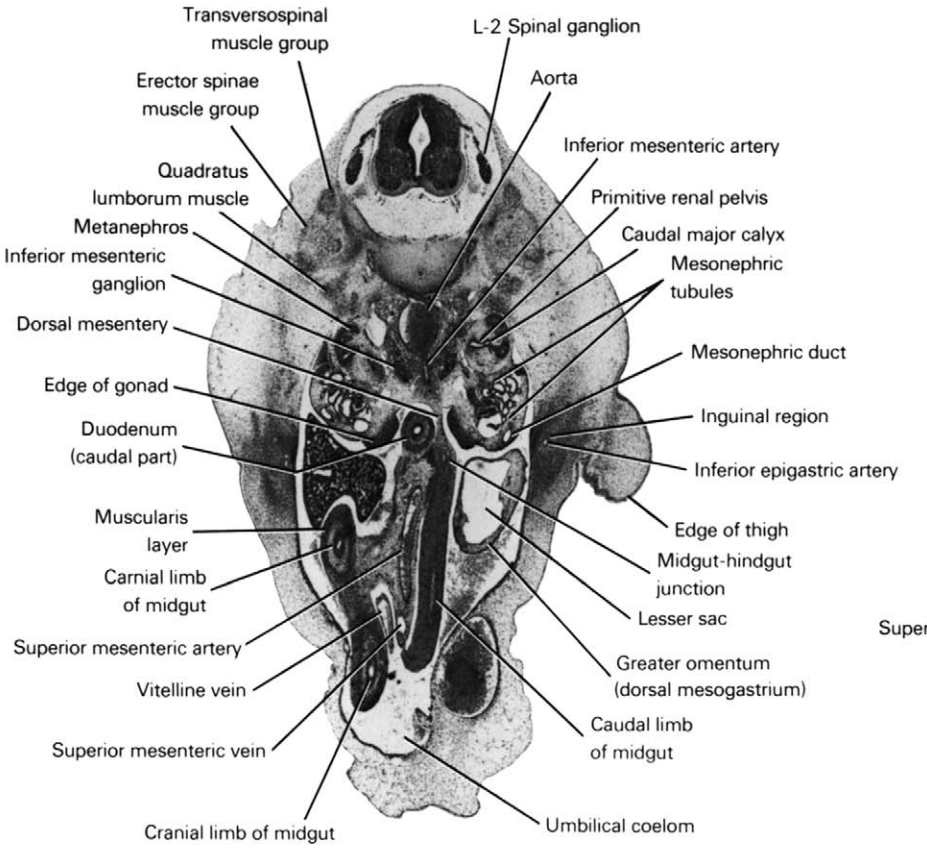
FIG. 7–28

SECTION 45
A section through the L-2 spinal ganglion and edge of the thigh.
Observe:

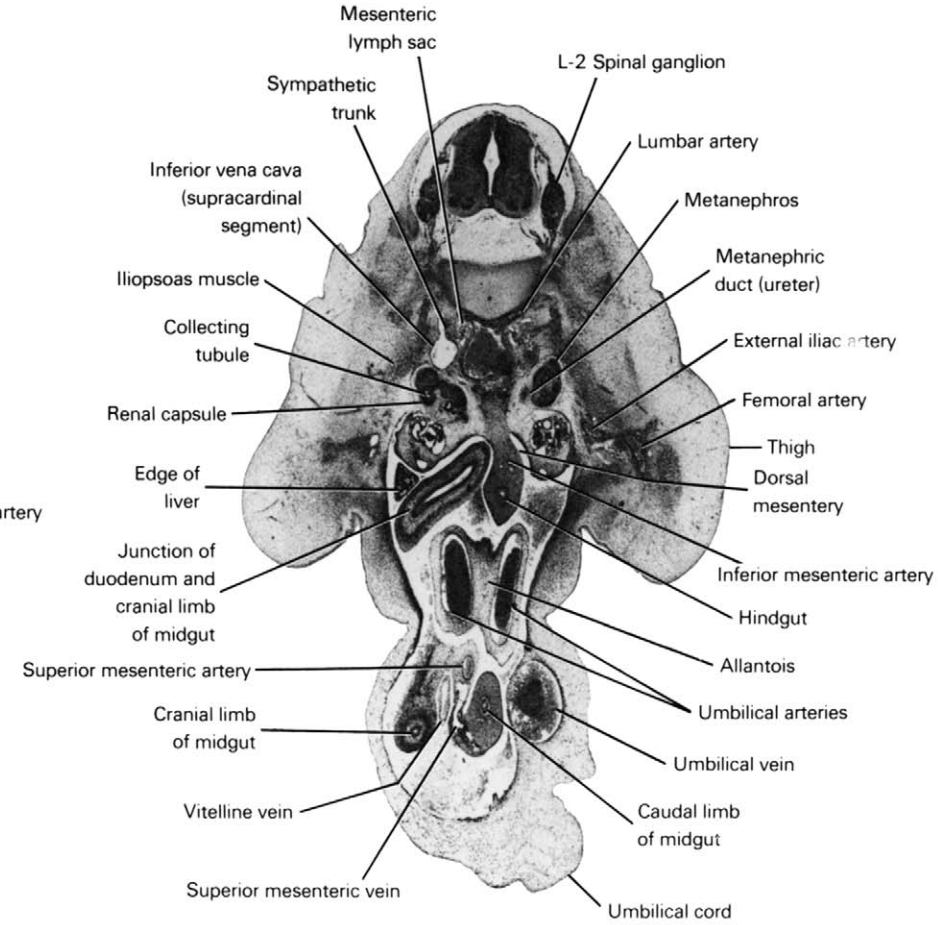
1. The extension of the peritoneal cavity into the umbilical cord to form the umbilical coelom that receives the herniated midgut.
2. The cranial limb of the midgut to the right of the caudal limb as a result of the counterclockwise rotation.
3. The mid- and hindgut junction near the midline in the dorsal mesentery.
4. The origin of the inferior mesenteric artery from the aorta.
5. The primitive renal pelvis medial to the metanephros where it gives rise to the caudal major calyx.

SECTION 46
A section through the cranial edge of the umbilical arteries and allantois.
Observe:

1. The herniated portion of the cranial and caudal limbs of the midgut separated by the superior mesenteric vessels.
2. The junction of the duodenum and the cranial limb of the midgut, caudal to the liver.
3. The renal capsule and collecting tubules of the metanephros, lateral to the metanephric duct.
4. The supracardinal segment of the inferior vena cava.
5. The external iliac artery entering the thigh as the femoral artery.


Transversospinal muscle group
L-2 Spinal ganglion
Erector spinae muscle group
Aorta
Inferior mesenteric artery
Quadratus lumborum muscle
Primitive renal pelvis
Metanephros
Caudal major calyx
Inferior mesenteric ganglion
Mesonephric tubules
Dorsal mesentery
Mesonephric duct
Edge of gonad
Inguinal region
Duodenum (caudal part)
Inferior epigastric artery
Edge of thigh
Muscularis layer
Midgut-hindgut junction
Carnial limb of midgut
Lesser sac
Superior mesenteric artery
Greater omentum (dorsal mesogastrium)
Vitelline vein
Caudal limb of midgut
Superior mesenteric vein
Umbilical coelom
Cranial limb of midgut

45


Mesenteric lymph sac
L-2 Spinal ganglion
Sympathetic trunk
Lumbar artery
Inferior vena cava (supracardinal segment)
Metanephros
Metanephric duct (ureter)
Iliopsoas muscle
Collecting tubule
External iliac artery
Renal capsule
Femoral artery
Thigh
Edge of liver
Dorsal mesentery
Junction of duodenum and cranial limb of midgut
Inferior mesenteric artery
Hindgut
Allantois
Superior mesenteric artery
Umbilical arteries
Cranial limb of midgut
Umbilical vein
Vitelline vein
Caudal limb of midgut
Superior mesenteric vein
Umbilical cord

46

2 mm

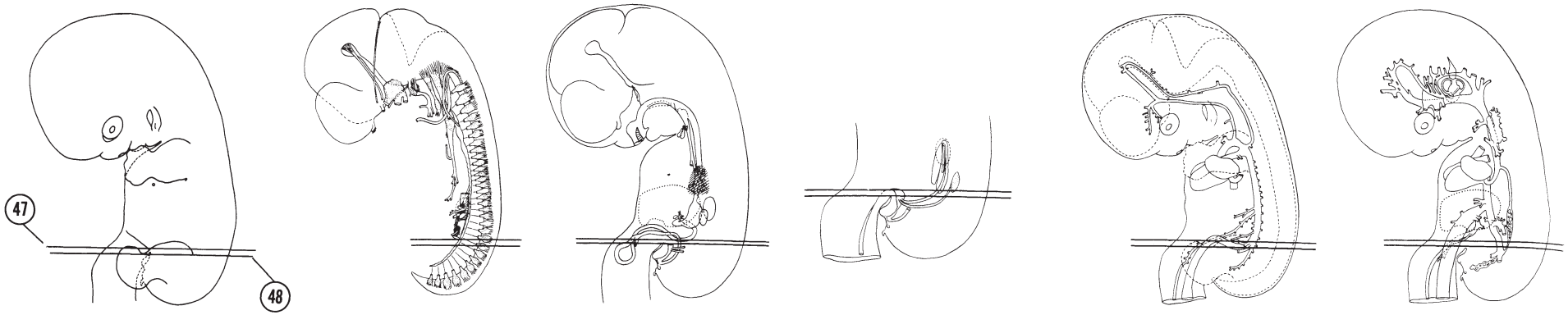
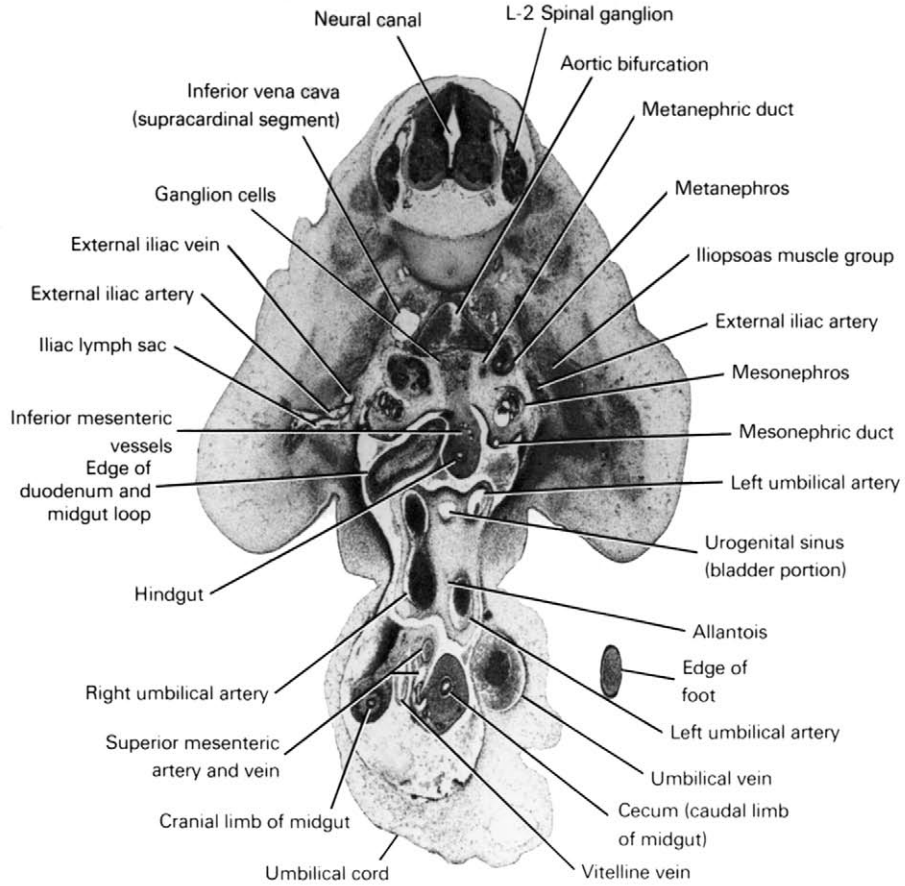
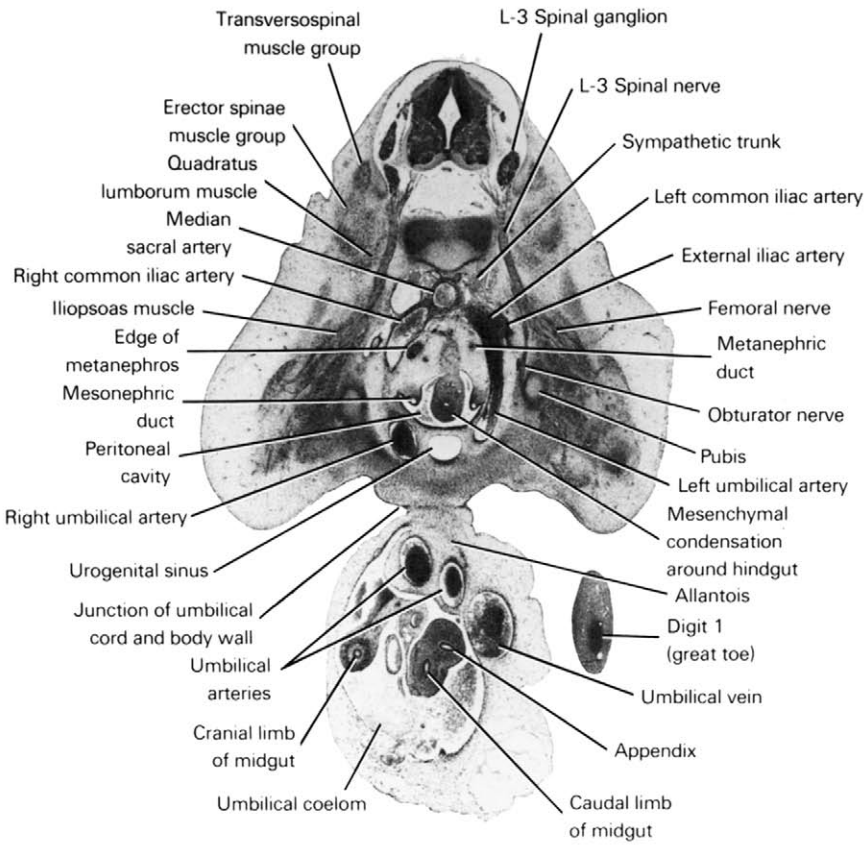


FIG. 7–29

SECTION 47
A section through the aortic bifurcation and the bladder portion of the urogenital sinus.
Observe:
1. The dilation on the herniated caudal limb of the midgut that represents the cecum.
2. The umbilical arteries and allantois entering the umbilical cord.
3. The mesonephric duct coursing toward the urogenital sinus.
4. The caudal edge of the junction between the duodenum and midgut loop.
5. The iliac lymph sac around the external iliac vessels.

SECTION 48
A section through the L-3 spinal ganglion and the caudal edge of the metanephros.
Observe:
1. The appendix represented as an outpouching of the caudal limb of the midgut.
2. The caudal edge of the junction of the umbilical cord and the ventral body wall.
3. The primordium of the first digit of the foot.
4. The obturator nerve coursing medial to the pubis of the developing pelvic bone.
5. The three terminal branches of the aorta: right and left common iliac and median sacral arteries.


Neural canal
L-2 Spinal ganglion
Aortic bifurcation
Inferior vena cava
(supracardinal segment)
Metanephric duct
Ganglion cells
Metanephros
External iliac vein
Iliopsoas muscle group
External iliac artery
External iliac artery
Iliac lymph sac
Mesonephros
Inferior mesenteric
vessels
Mesonephric duct
Edge of
duodenum and
midgut loop
Left umbilical artery
Urogenital sinus
(bladder portion)
Hindgut
Allantois
Edge of
foot
Right umbilical artery
Left umbilical artery
Superior mesenteric
artery and vein
Umbilical vein
Cecum (caudal limb
of midgut)
Cranial limb of midgut
Umbilical cord
Vitelline vein


Transversospinal
muscle group
L-3 Spinal ganglion
L-3 Spinal nerve
Erector spinae
muscle group
Sympathetic trunk
Quadratus
lumborum muscle
Left common iliac artery
Median
sacral artery
External iliac artery
Right common iliac artery
Iliopsoas muscle
Femoral nerve
Edge of
metanephros
Metanephric
duct
Mesonephric
duct
Obturator nerve
Peritoneal
cavity
Pubis
Left umbilical artery
Right umbilical artery
Mesenchymal
condensation
around hindgut
Urogenital sinus
Allantois
Junction of umbilical
cord and body wall
Digit 1
(great toe)
Umbilical
arteries
Umbilical vein
Cranial limb
of midgut
Appendix
Umbilical coelom
Caudal limb
of midgut

47

2 mm

48

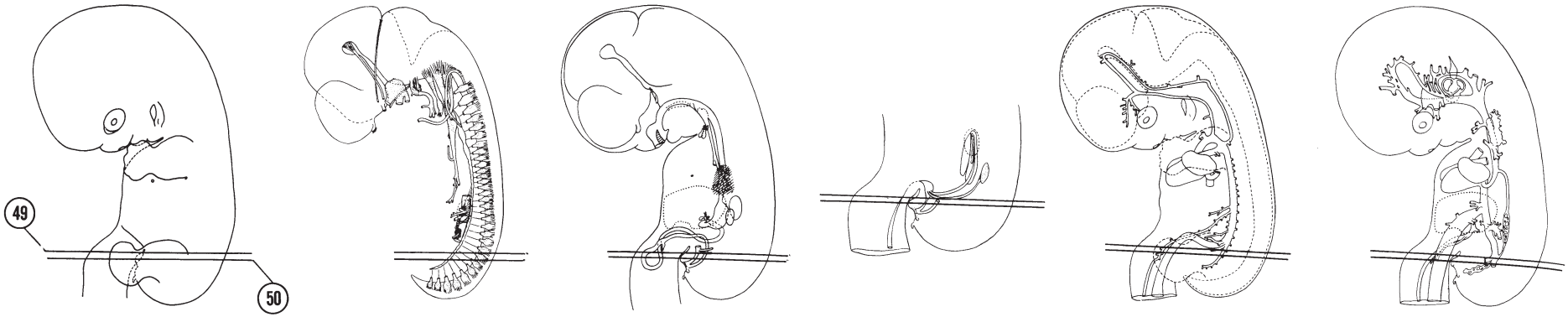
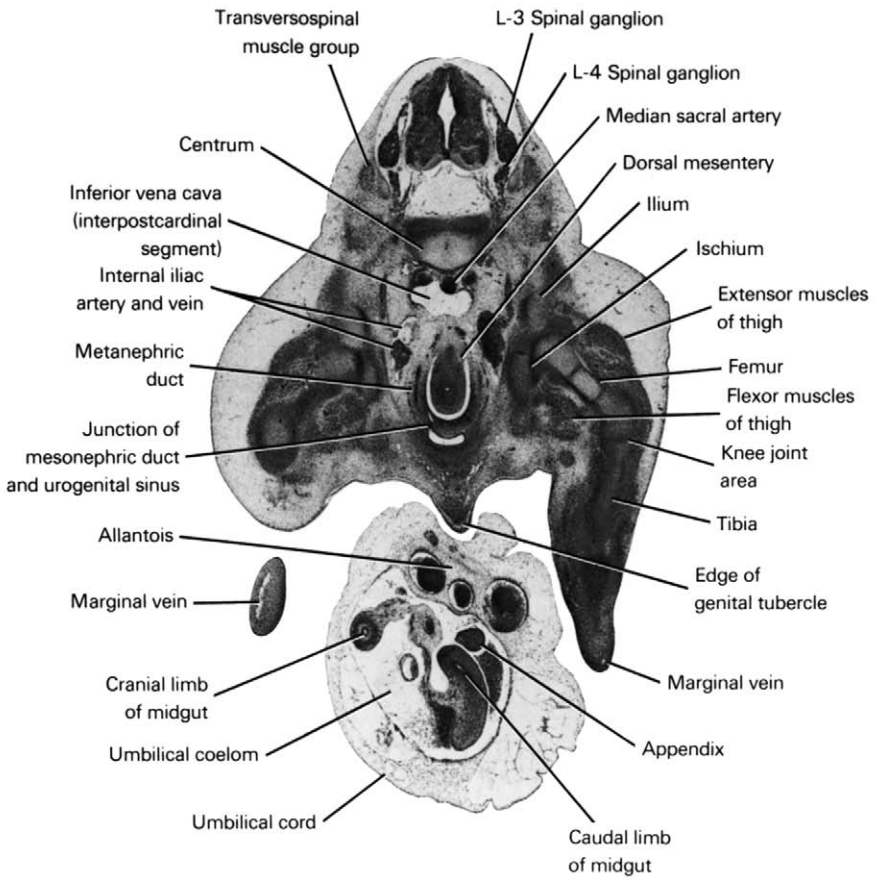
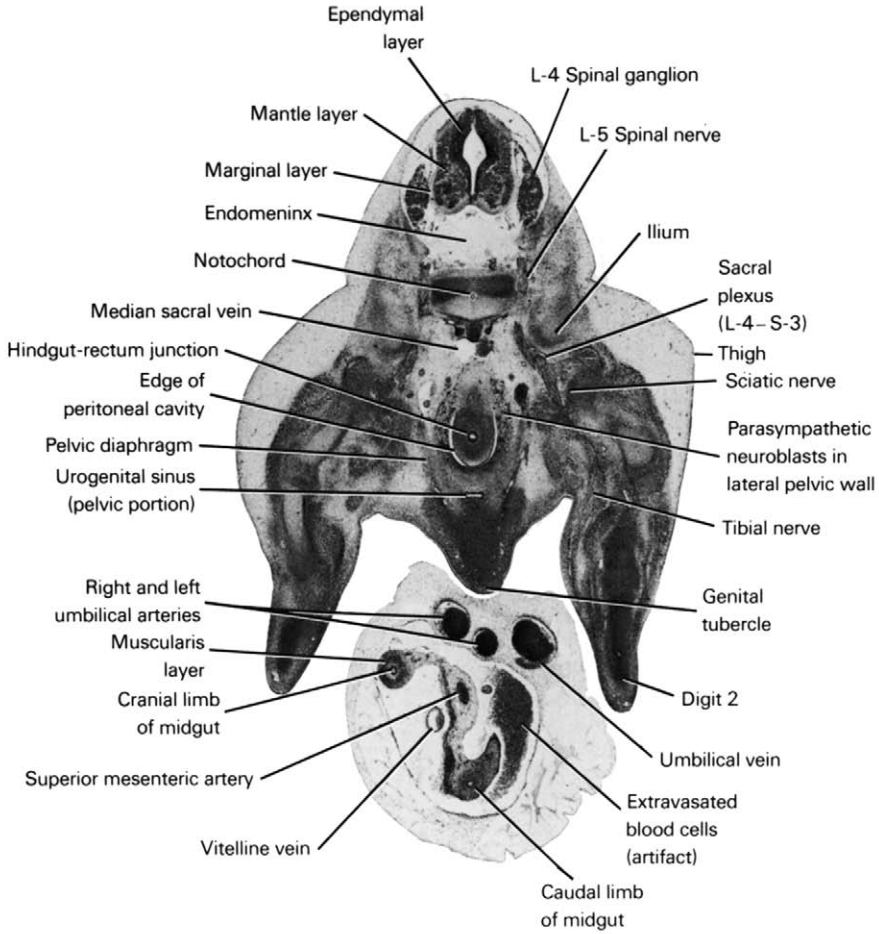


FIG. 7–30

SECTION 49
A section through the L-4 spinal ganglion and the cranial edge of the genital tubercle.
Observe:
1. The junction of the mesonephric duct and the urogenital sinus.
2. The metanephric duct coursing ventrally to join the urogenital sinus.
3. The inferior vena cava segment formed by the anastomosis of the post-cardinal veins.
4. The ilium and ischium of the developing pelvic bone.
5. The knee joint area between the femur and tibia.

SECTION 50
A section through the pelvic portion of the urogenital sinus and the caudal edge of the peritoneal cavity.
Observe:
1. The pelvic portion of the urogenital sinus deep to the genital tubercle.
2. The junction of the hindgut and the rectum.
3. The sacral plexus and sciatic nerve coursing into the thigh.
4. Parasympathetic neuroblasts in the lateral pelvic wall.
5. The primordium of the second digit of the foot.


Transversospinal muscle group
L-3 Spinal ganglion
L-4 Spinal ganglion
Median sacral artery
Centrum
Dorsal mesentery
Inferior vena cava (interpostcardinal segment)
Ilium
Ischium
Internal iliac artery and vein
Extensor muscles of thigh
Metanephric duct
Femur
Flexor muscles of thigh
Junction of mesonephric duct and urogenital sinus
Knee joint area
Tibia
Allantois
Edge of genital tubercle
Marginal vein
Marginal vein
Cranial limb of midgut
Appendix
Umbilical coelom
Umbilical cord
Caudal limb of midgut


Ependymal layer
L-4 Spinal ganglion
Mantle layer
L-5 Spinal nerve
Marginal layer
Endomeninx
Ilium
Notochord
Sacral plexus (L-4–S-3)
Median sacral vein
Thigh
Hindgut-rectum junction
Sciatic nerve
Edge of peritoneal cavity
Parasympathetic neuroblasts in lateral pelvic wall
Pelvic diaphragm
Urogenital sinus (pelvic portion)
Tibial nerve
Right and left umbilical arteries
Genital tubercle
Muscularis layer
Digit 2
Cranial limb of midgut
Umbilical vein
Superior mesenteric artery
Extravasated blood cells (artifact)
Vitelline vein
Caudal limb of midgut

49

2 mm

50

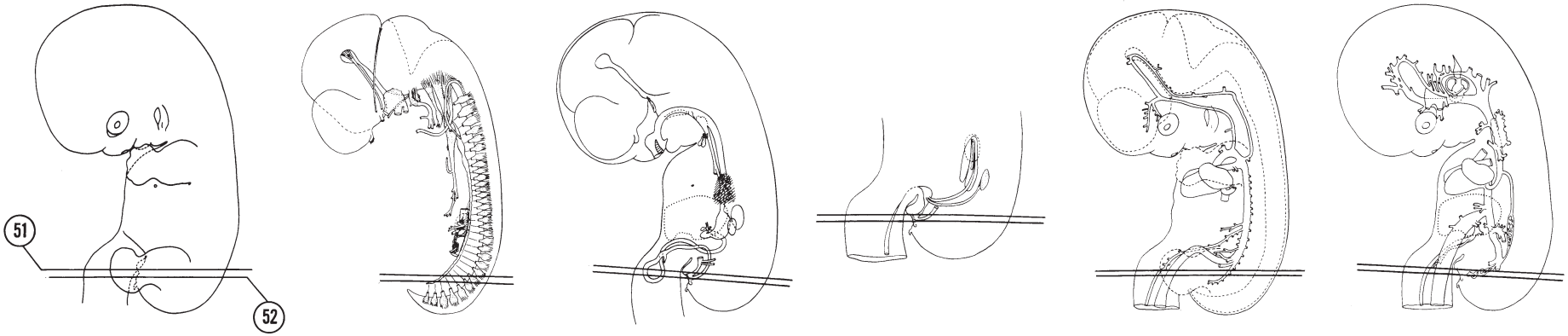
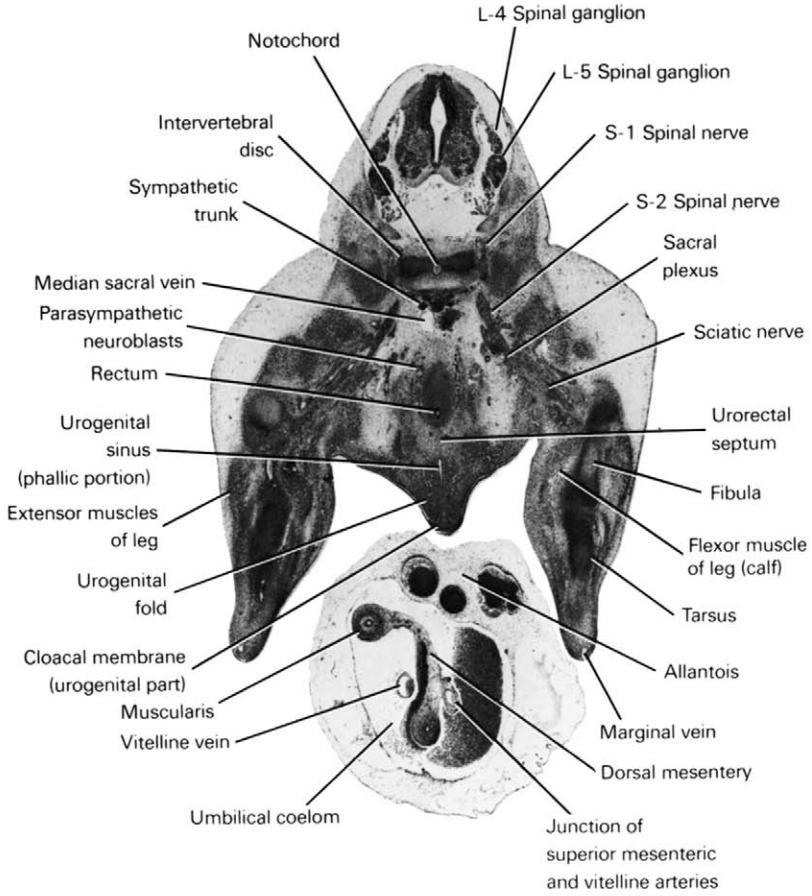


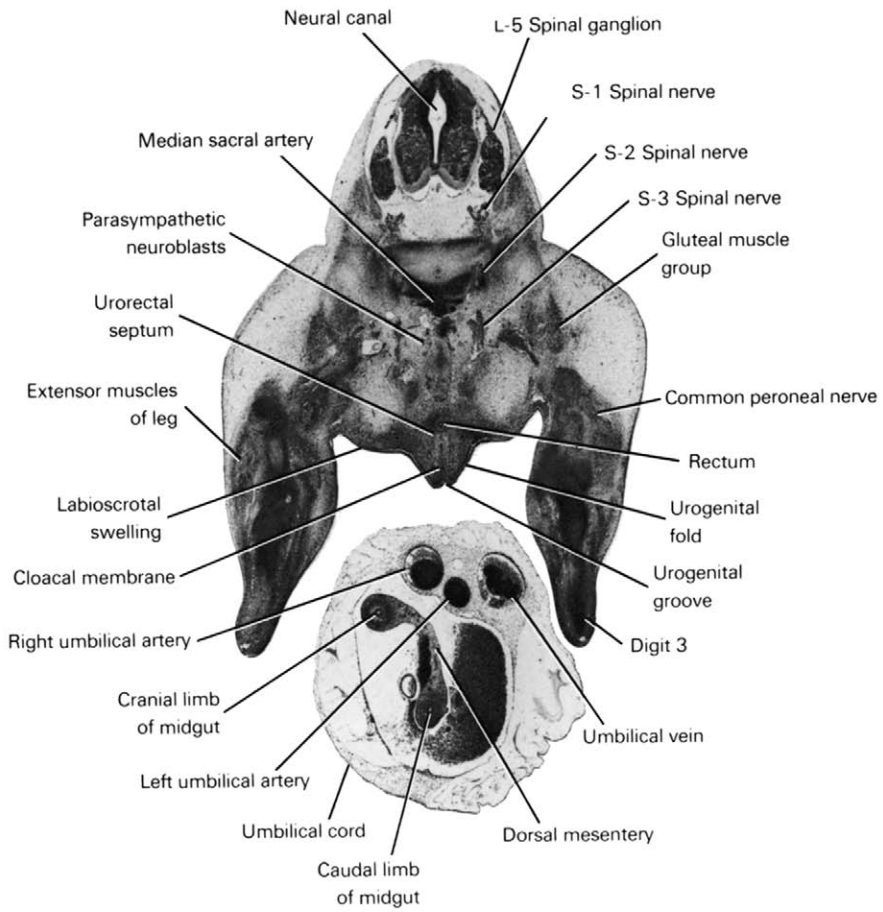
FIG. 7–31

SECTION 51
A section through the L-5 spinal ganglion and the phallic portion of the urogenital sinus.
Observe:
1. The superior mesenteric artery leaving the dorsal mesentery to become the vitelline artery.
2. The urogenital part of the cloacal membrane between the urogenital folds.
3. The phallic portion of the urogenital sinus separated from the exterior by the urogenital part of the cloacal membrane.
4. The urorectal septum separating the urogenital sinus and rectum.

SECTION 52
A section through the urogenital fold and groove.
Observe:
1. The labioscrotal swelling lateral to the urogenital fold.
2. The urorectal septum between the rectum and cloacal membrane.
3. The primordium of the third digit of the foot.


L-4 Spinal ganglion
Notochord
L-5 Spinal ganglion
Intervertebral disc
S-1 Spinal nerve
Sympathetic trunk
S-2 Spinal nerve
Sacral plexus
Median sacral vein
Parasympathetic neuroblasts
Sciatic nerve
Rectum
Urorectal septum
Urogenital sinus (phallic portion)
Fibula
Extensor muscles of leg
Flexor muscle of leg (calf)
Urogenital fold
Tarsus
Cloacal membrane (urogenital part)
Allantois
Muscularis
Marginal vein
Vitelline vein
Dorsal mesentery
Umbilical coelom
Junction of superior mesenteric and vitelline arteries

51


Neural canal
L-5 Spinal ganglion
S-1 Spinal nerve
Median sacral artery
S-2 Spinal nerve
S-3 Spinal nerve
Parasympathetic neuroblasts
Gluteal muscle group
Urorectal septum
Extensor muscles of leg
Common peroneal nerve
Rectum
Labioscrotal swelling
Urogenital fold
Cloacal membrane
Urogenital groove
Right umbilical artery
Digit 3
Cranial limb of midgut
Umbilical vein
Left umbilical artery
Umbilical cord
Dorsal mesentery
Caudal limb of midgut

52

2 mm

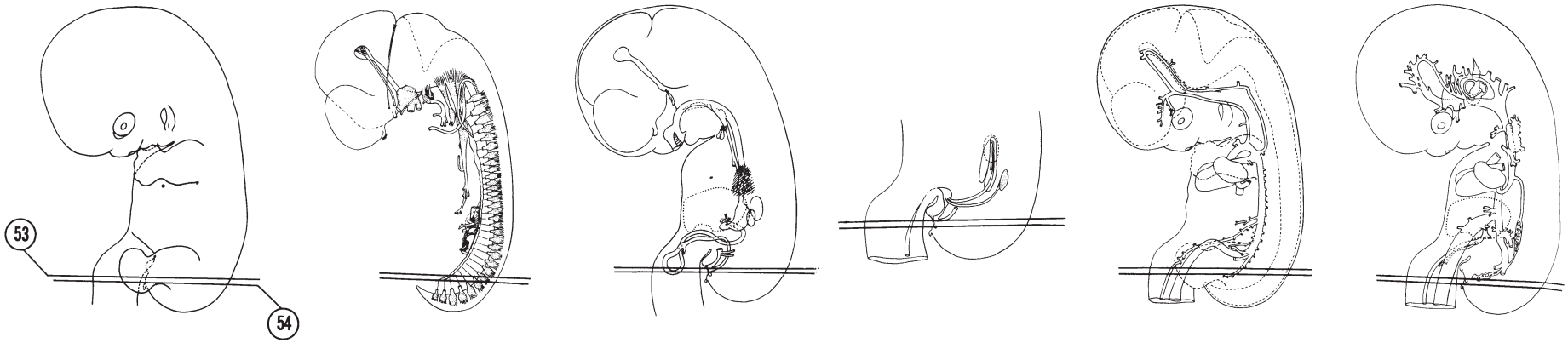
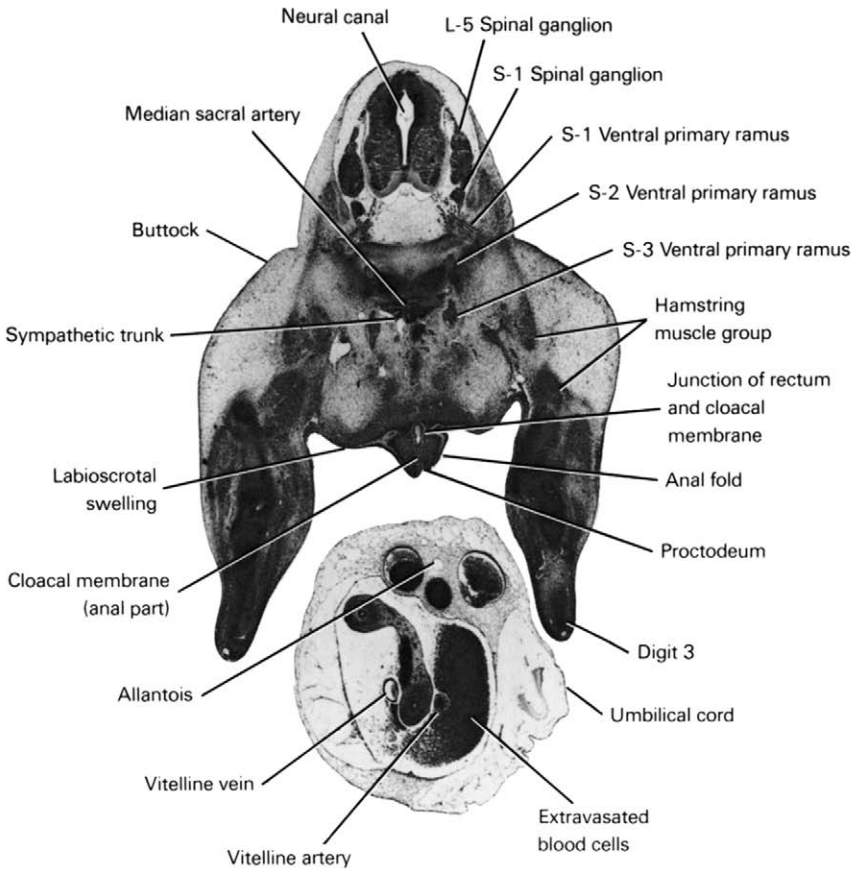
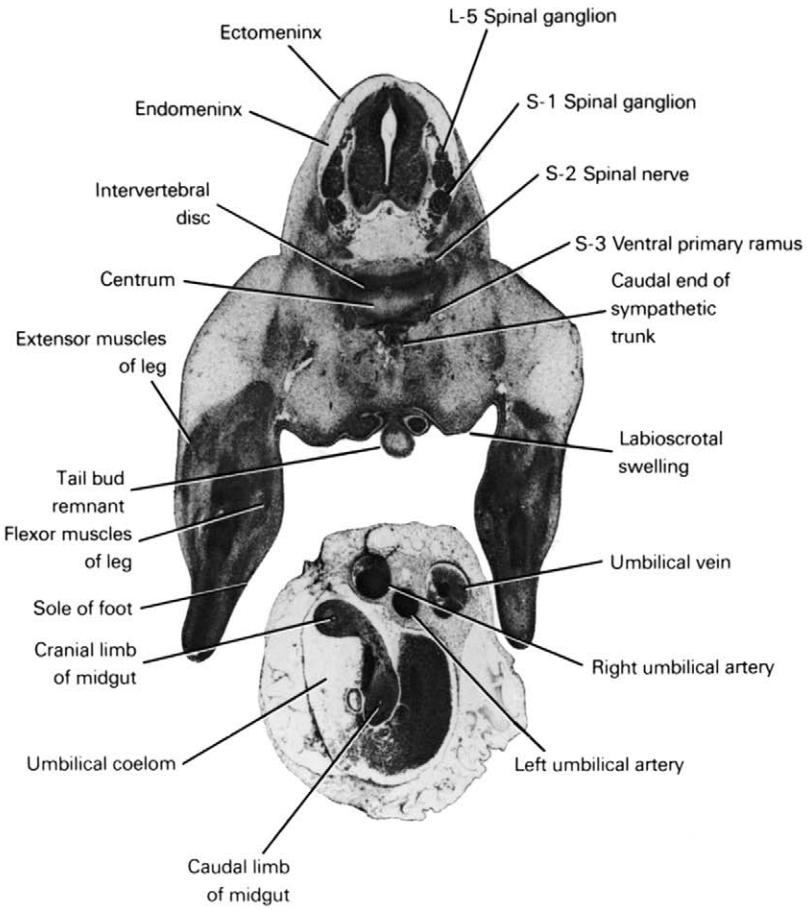


FIG. 7–32

SECTION 53
A section through the S-1 spinal ganglion.
Observe:
1. The caudal edge of the anal fold lateral to the proctodeum.
2. The junction of the rectum and the anal part of the cloacal membrane.

SECTION 54
A section through the tip of the tail bud remnant.
Observe:
1. The caudal end of the sympathetic trunk.
2. The relative position of the extensor and flexor muscles in the leg.


Neural canal
L-5 Spinal ganglion
S-1 Spinal ganglion
Median sacral artery
S-1 Ventral primary ramus
S-2 Ventral primary ramus
Buttock
S-3 Ventral primary ramus
Hamstring muscle group
Sympathetic trunk
Junction of rectum and cloacal membrane
Labioscrotal swelling
Anal fold
Proctodeum
Cloacal membrane (anal part)
Digit 3
Allantois
Umbilical cord
Vitelline vein
Extravasated blood cells
Vitelline artery


Ectomeninx
L-5 Spinal ganglion
Endomeninx
S-1 Spinal ganglion
S-2 Spinal nerve
Intervertebral disc
S-3 Ventral primary ramus
Centrum
Caudal end of sympathetic trunk
Extensor muscles of leg
Labioscrotal swelling
Tail bud remnant
Flexor muscles of leg
Umbilical vein
Sole of foot
Cranial limb of midgut
Right umbilical artery
Umbilical coelom
Left umbilical artery
Caudal limb of midgut

53

2 mm

54

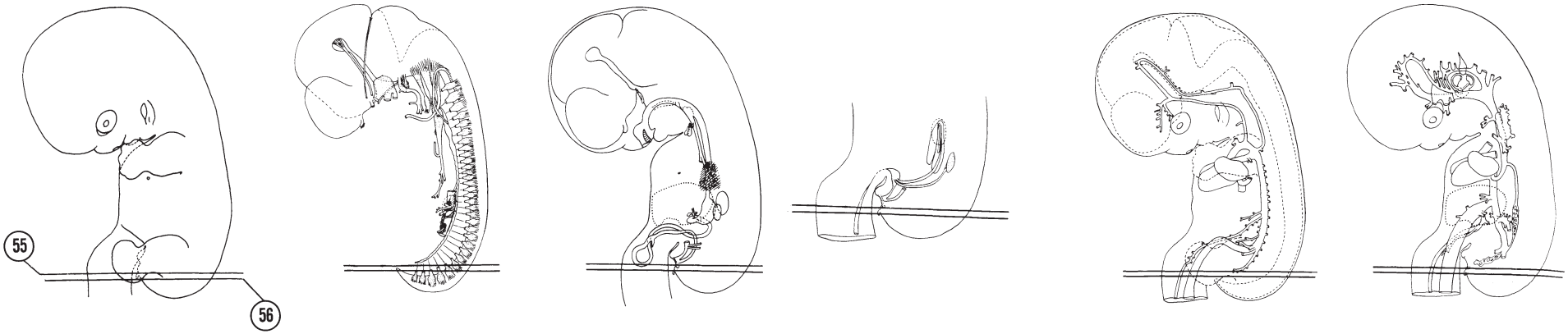
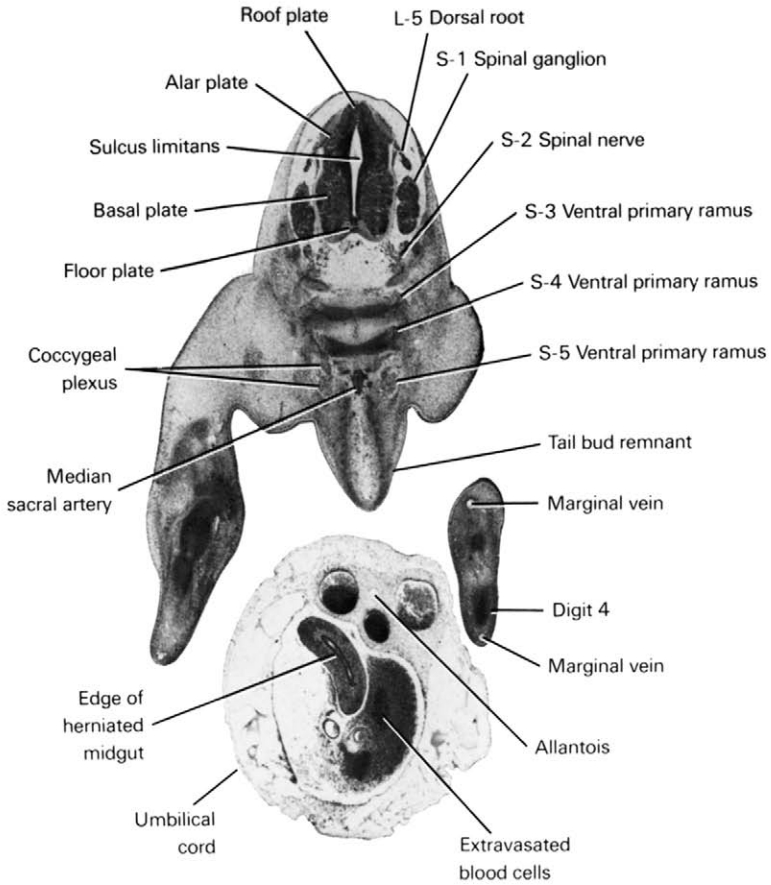


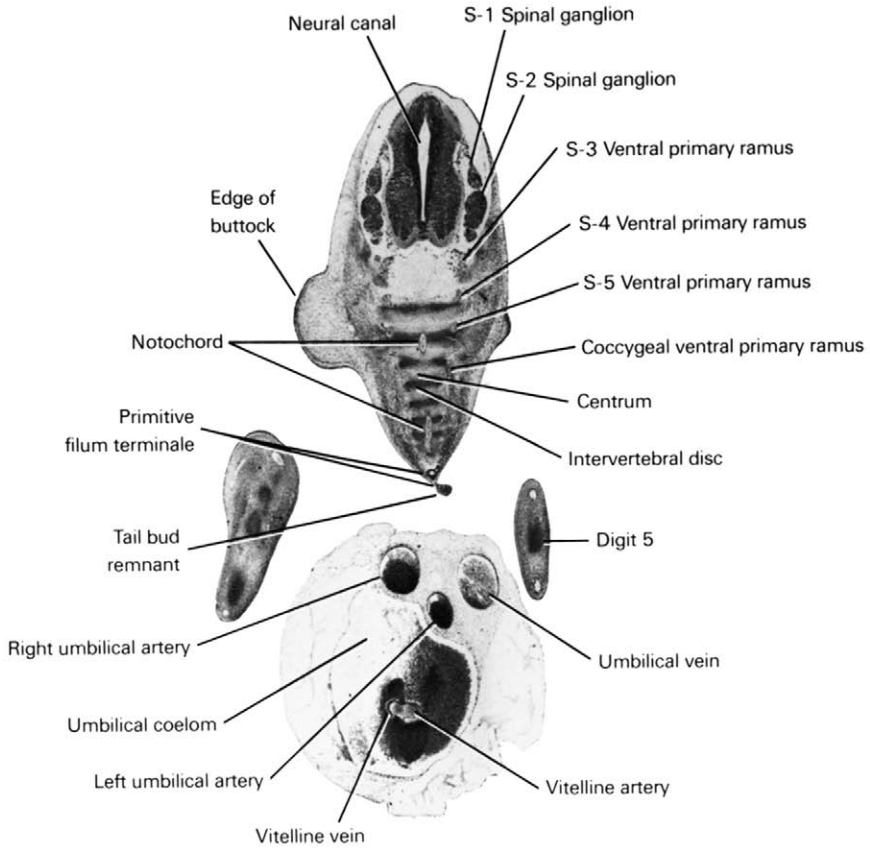
FIG. 7–33

SECTION 55
A section through the caudal edge of the herniated midgut.
Observe:
1. The primordium of the fourth digit of the foot.
2. The median sacral artery coursing into the tail bud remnant.
3. The four plates of the spinal cord in oblique section.

SECTION 56
A section through the S-2 spinal ganglion and the ventral primary rami of remaining spinal nerves (S-3 through coccygeal).
Observe:
1. The primitive filum terminale ending in the tail bud remnant where the coccyx will form.
2. The notochord in longitudinal section.
3. The centrum and intervertebral disc of the vertebral column.
4. The primordium of the fifth digit of the foot.


Roof plate
L-5 Dorsal root
S-1 Spinal ganglion
Alar plate
Sulcus limitans
S-2 Spinal nerve
Basal plate
S-3 Ventral primary ramus
Floor plate
S-4 Ventral primary ramus
Coccygeal plexus
S-5 Ventral primary ramus
Tail bud remnant
Median sacral artery
Marginal vein
Digit 4
Marginal vein
Edge of herniated midgut
Allantois
Umbilical cord
Extravasated blood cells

55


Neural canal
S-1 Spinal ganglion
S-2 Spinal ganglion
S-3 Ventral primary ramus
Edge of buttock
S-4 Ventral primary ramus
S-5 Ventral primary ramus
Notochord
Coccygeal ventral primary ramus
Centrum
Primitive filum terminale
Intervertebral disc
Tail bud remnant
Digit 5
Right umbilical artery
Umbilical vein
Umbilical coelom
Left umbilical artery
Vitelline artery
Vitelline vein

56

2 mm

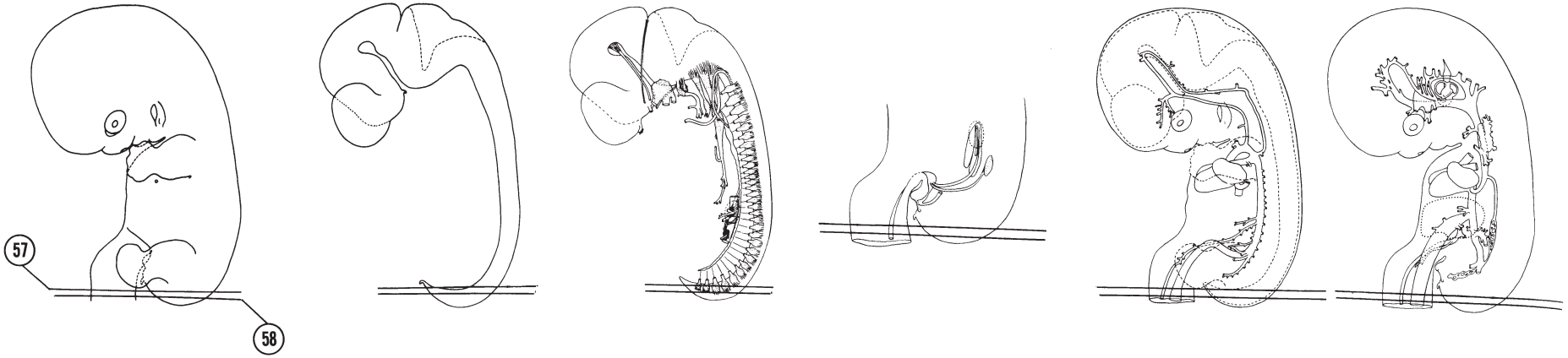
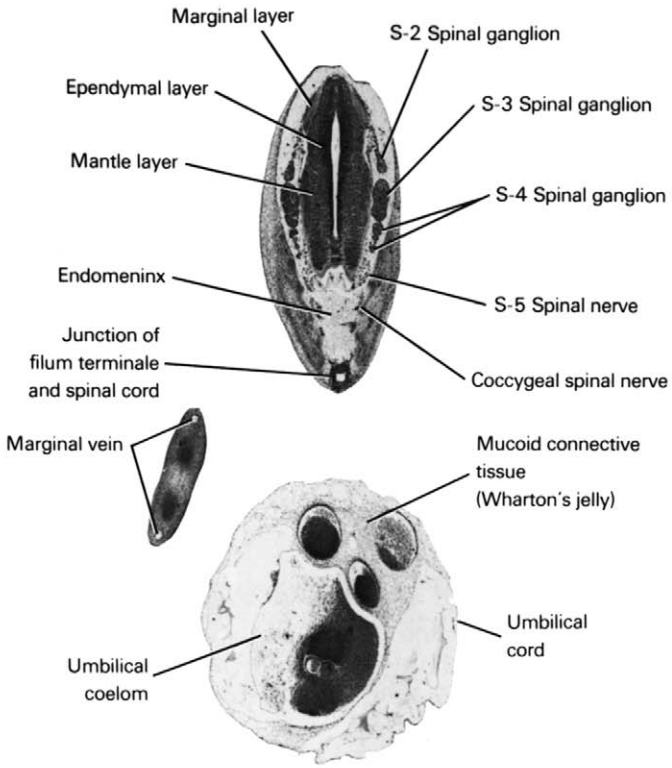
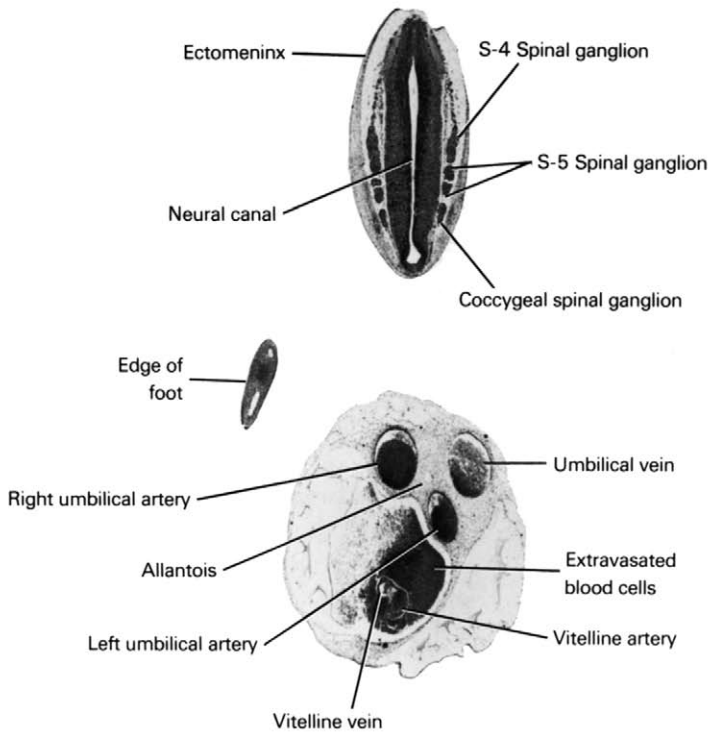


FIG. 7–34

SECTION 57
A section through the S-3 and S-4 spinal ganglia.
Observe:
1. An oblique section of the spinal cord showing its three layers.
2. The junction of the filum terminale and the spinal cord.

SECTION 58
A section through the S-5 and coccygeal spinal ganglia.
Observe:
1. A longitudinal section of the neural canal.
2. The caudal edge of the foot.


Marginal layer
S-2 Spinal ganglion
Ependymal layer
S-3 Spinal ganglion
Mantle layer
S-4 Spinal ganglion
Endomeninx
S-5 Spinal nerve
Junction of
filum terminale
and spinal cord
Coccygeal spinal nerve
Marginal vein
Mucoid connective
tissue
(Wharton's jelly)
Umbilical
cord
Umbilical
coelom


Ectomeninx
S-4 Spinal ganglion
S-5 Spinal ganglion
Neural canal
Coccygeal spinal ganglion
Edge of
foot
Umbilical vein
Right umbilical artery
Allantois
Extravasated
blood cells
Left umbilical artery
Vitelline artery
Vitelline vein

57

2 mm

58