

Stage 19 Lens Vesicle Completely Separated from Surface

11 1/2 Days, over 45 Somites, 6–7 mm

Horizon XVI
homo = 37 days
9–11 mm

External Form

A footplate ("handplate") has formed in the anterior limb bud, indicated by a definite constriction (*arrow* in Fig. 163). The posterior limb buds are not yet divided into leg and foot. In the human, both hand- and footplates are delimited in horizon XVI (Streeter). Their development is dissimilar to that in the mouse, and they are less useful to use as landmarks to indicate developmental stage.

The six low tubercles, which will form the pinna, can be discerned.

The nostrils are narrowed to small slits, and the nasolacrimal grooves are clearly visible.

The posterior somites are still sharply defined, and the tail is considerably longer than in the preceding stage.

Length. Most are 6–7 mm long. A few specimens of this age group may be somewhat smaller (KT 611).

Sagittal section (Fig. 171): Compared with the preceding stage, there is little change in the brain. The opening of Rathke's pouch is constricted. The thyroid primordium is growing deeper and is losing its lumen. The mesenchyme of the anterior primitive intervertebral discs is condensing. In the lumbar region and posterior to it, there is a gradual transition from loose mesenchyme to condensation of the posterior sclerotomic halves of the somites. The atlas is visible in Fig. 175.

Circulatory System

Within the *arterial system*, the aortic arch complex has become more mature (Fig. 172). The most anterior arch has disappeared, and the second is reduced. The third and sixth are well developed. All of them connect dorsally with the dorsal aorta. The vertebral artery is now forming parallel to the dorsal aorta. The primitive *arteria cerebri anterior* (olfactory artery) has enlarged considerably along with the further development of the nose.

In the *venous system*, the asymmetry of the umbilical veins is striking. The sinus venosus receives the cardinal veins, the right umbilical vein and the hepato-cardiac channel (primitive inferior vena cava) (Fig. 173). The sinus venosus conducts the blood through a small sinuatrial opening into the atrium.

The *atrium* is nearly completely partitioned off by the septum primum. The original broad communication is constricted to the foramen I, while the foramen II is forming above (Fig. 174).

The *ventricle* is still unpaired (*ventriculus communis*). It is delimited from the atrium by the atrio-ventricular cushions (Fig. 175). This figure illustrates how the arterial outlet is incompletely subdivided by the developing bulbar ridges. It also shows how the pulmonary artery branches off as a thin vessel from the sixth aortic arch. The opening of the sixth aortic arch into the large dorsal aorta is also visible in Fig. 175.

Intestinal Tract

In the region of the *foregut*, the elevation of the tongue is not yet apparent. Anterior to the foramen cecum, there is a small indentation (Fig. 176), which must not be confused with it. The thyroid primordium has invaded more deeply into the underlying mesenchyme (Figs. 171 and 176), and the primary (stem) bronchi are developing secondary branches (lobar bronchi). Lung lobation is determined genetically [61].

The pharyngeal pouches are now beginning to become specialized structures such as the thymus and parathyroid. They are not yet completely separated from the pharyngeal epithelium.

The *stomach* is much enlarged. It is separated from the outgrowing pancreas by the lesser sac (bursa omentalis). The *liver* is composed of broad hepatic cords, which are separated by large sinusoids containing nucleated erythrocytes. Hematopoietic foci are found intermingled with the hepatic cords.

The *cecum* is recognizable by a slight distension of the colon. It marks a clear distinction between colon and small intestine. Within the cloaca the uro-rectal septum is developing (Figs. 176 and 177). The cloacal membrane has not yet ruptured. Posteriorly, the hindgut is continued by the tail gut, which terminates in the blastema of the tail tip. The tail gut is very narrow, except for a slight terminal distension, and it has some pycnotic cells. The ventral ectodermal ridge [186] is confined to the region near the tail tip.

Urogenital System

The urogenital system is developing rapidly. The genital ridge, still in an indifferent state, contains numerous gonocytes (Fig. 168), which have now completed their migration [103]. The Wolffian ducts terminate blindly at the cloaca. The ureteric buds are considerably distended. They are surrounded by condensed metanephrogenic tissue [100] (Figs. 167 and 177). The *mesonephros* is more mature than in the preceding stage. Several glomerulusanlagen may now be recognized, and the mesonephric tubules are more distinct (Fig. 178).

Central Nervous System

Eye. The most conspicuous feature of this age group is the complete closure of the lens vesicle and its detachment from the ectoderm (Fig. 166).

The pigment layer of the optic cup contains numerous cells with pigment granules.

Ear. The endolymphatic duct is longer, and the utricle and saccule are becoming discernible.

Olfactory organ. The nose pit is separated from the oral cavity by the bucco-nasal membrane (Fig. 179). The epithelial wall of Hochstetter is invaded and perforated by mesenchyme (Fig. 169). In the medial wall, the invaginated organ of Jacobson is clearly visible.

The *ganglia* of the cranial nerves and the spinal ganglia are well developed and the anlage of the *sympathetic trunk* is discernible (Fig. 175).

The cellular degeneration, which began at 10 1/2 days in the anterior part of the roof of the 3rd ventricle, has progressed further.

Extraembryonic membranes. In the yolk sac, numerous well-vascularized superficial folds have formed.

Material	Age	
KT 1004-6	11 days 10 h	6 embryos, 6.1-6.5 mm (unfixed) 1 resorption
KT 630-31	12 days	7 embryos, 6-7 mm (copulation age advanced)
KT 611-12	11 days 21 h	4 embryos, 5-5.5 mm 2 embryos, 2-2.5 mm (hypoplastic)

FIG. 163. Embryo, right side, on millimeter scale, 11 1/2 days (nt 114).
Arrow indicates indentation delimiting the forefoot-plate. 9:1

FIG. 164. Embryo, left side, explanation in drawing Fig. 165 (nt 114). 9:1

FIG. 165. Explanation of Fig. 164.

Tel = cerebral hemisphere, *M* = mesencephalon, *Ns* = nostrils, *Rb* = rhombencephalon, *Tr* = nasolacrimal groove, *1, 2* = branchial bars, *V.c.a.* = vena cardinalis anterior, *He* = heart (ventricle), *So* = somite (1st lumbar), *Aa* = forelimb bud, *Hl* = hindlimb bud, *L₃* = spinal ganglion (3rd lumbar), *L* = lens vesicle (just closed).

FIG. 166. Eye, frontal section.

A.c. = arteria cerebri anterior, *Pi* = pigment epithelium, *R* = retinal layer, *Hy* = hyaloid plexus, *L* = lens vesicle (just closed).

KT 630a/6. 130:1

FIG. 167. Caudal end of Wolffian duct, with ureteric bud.

Coe = coelom, *Ur* = ureteric bud, *W* = Wolffian duct, *Me* = metanephrogenic tissue.

KT 630b/3. 130:1

FIG. 168. Sagittal section through germinal ridge.

Coe = coelom, *Ge* = gonocyte.

KT 630b/6. 700:1

FIG. 169. Cross section through forebrain and olfactory apparatus.

A = anterior section, nostril; *B* = intermediate section: dissolution of epithelial wall; *Tel* = telencephalon; *Sc* = tail, cross sectioned; *J* = vomeronasal organ (Jacobson).

KT 630a/7. 40:1

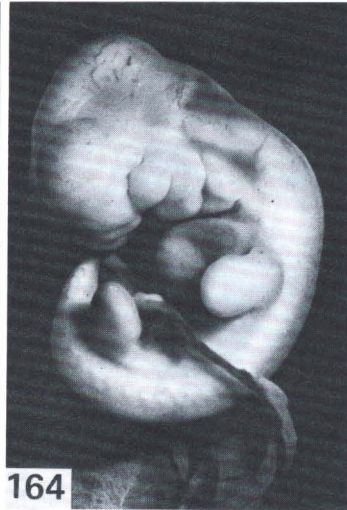
FIG. 170. Cross section through forebrain and olfactory apparatus.

C = posterior section with bucconasal membrane, *Tr* = nasolacrimal groove, *C.s.* = corpus striatum, *Sc* = tail.

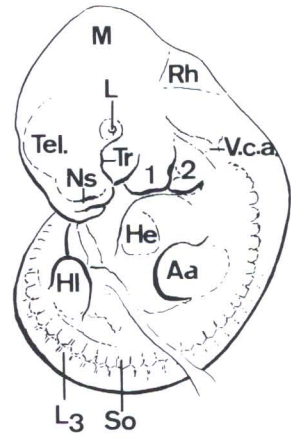
KT 630a/7. 40:1



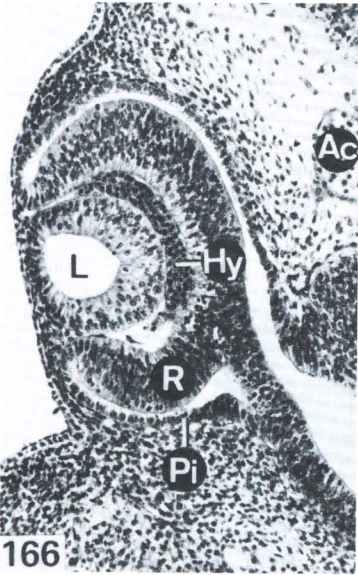
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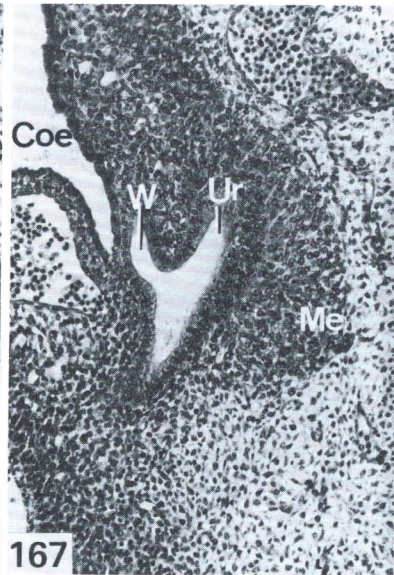
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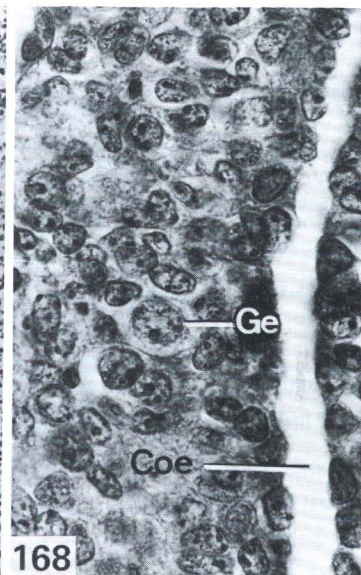
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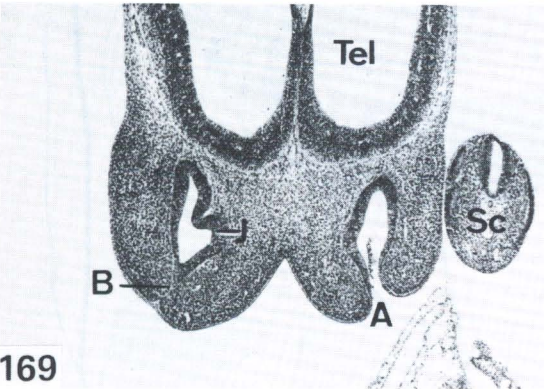
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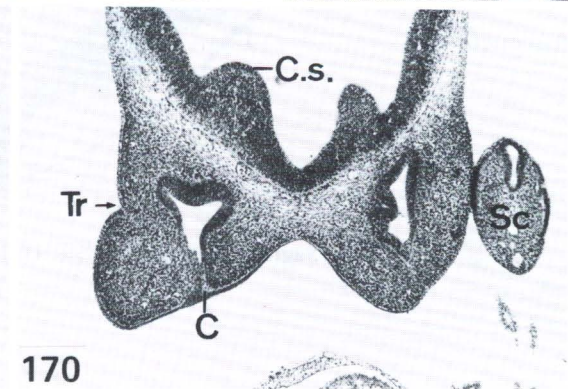
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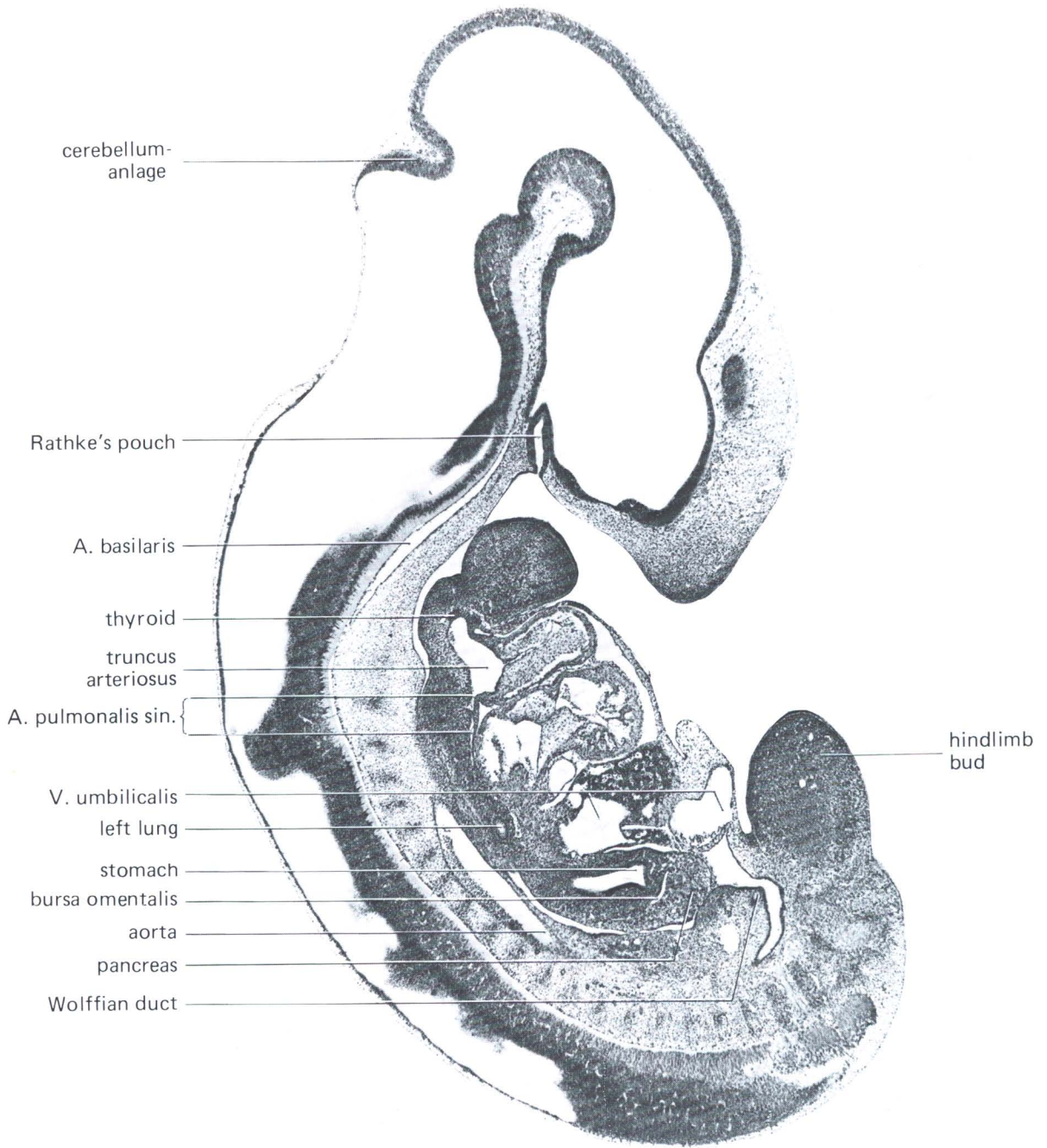


FIG. 171. Sagittal section, 11 days 10 h, 6.3 mm length.
KT 1005

FIG. 172. Reconstruction of the main blood vessels.
KT 630b

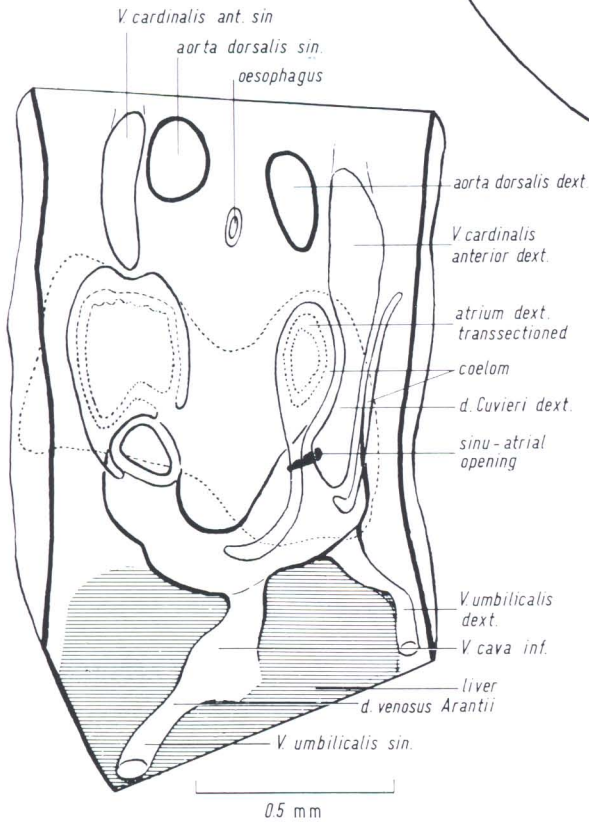
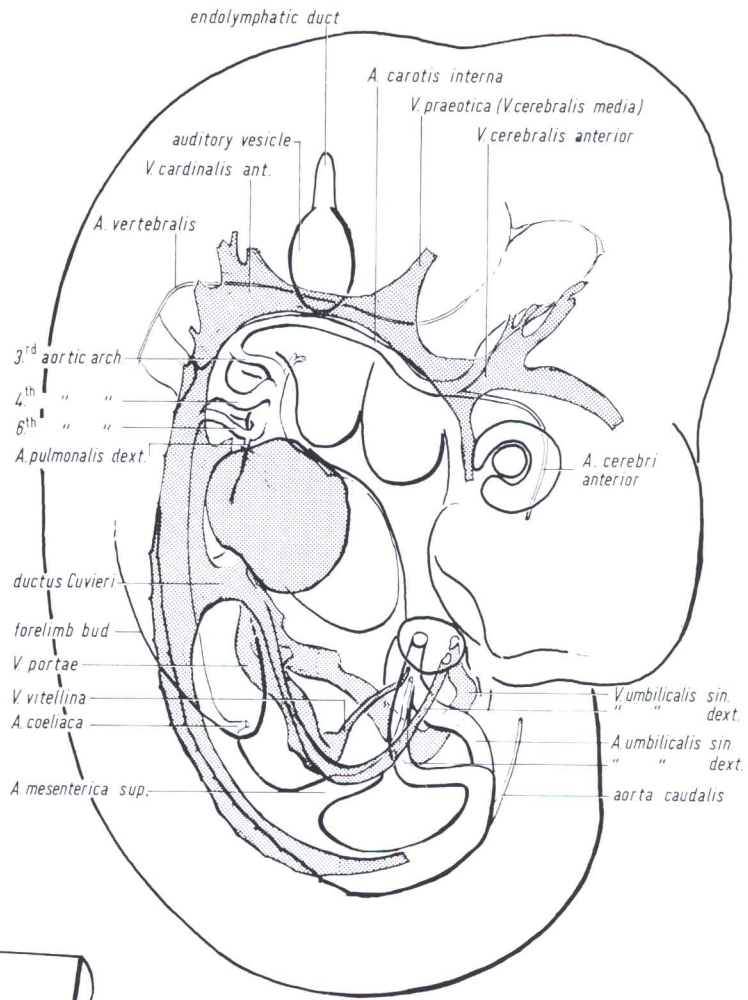


FIG. 173. Sinus venosus, dorsal view. Reconstruction. Stippled areas indicate contours of atrium.
KT 630c/4

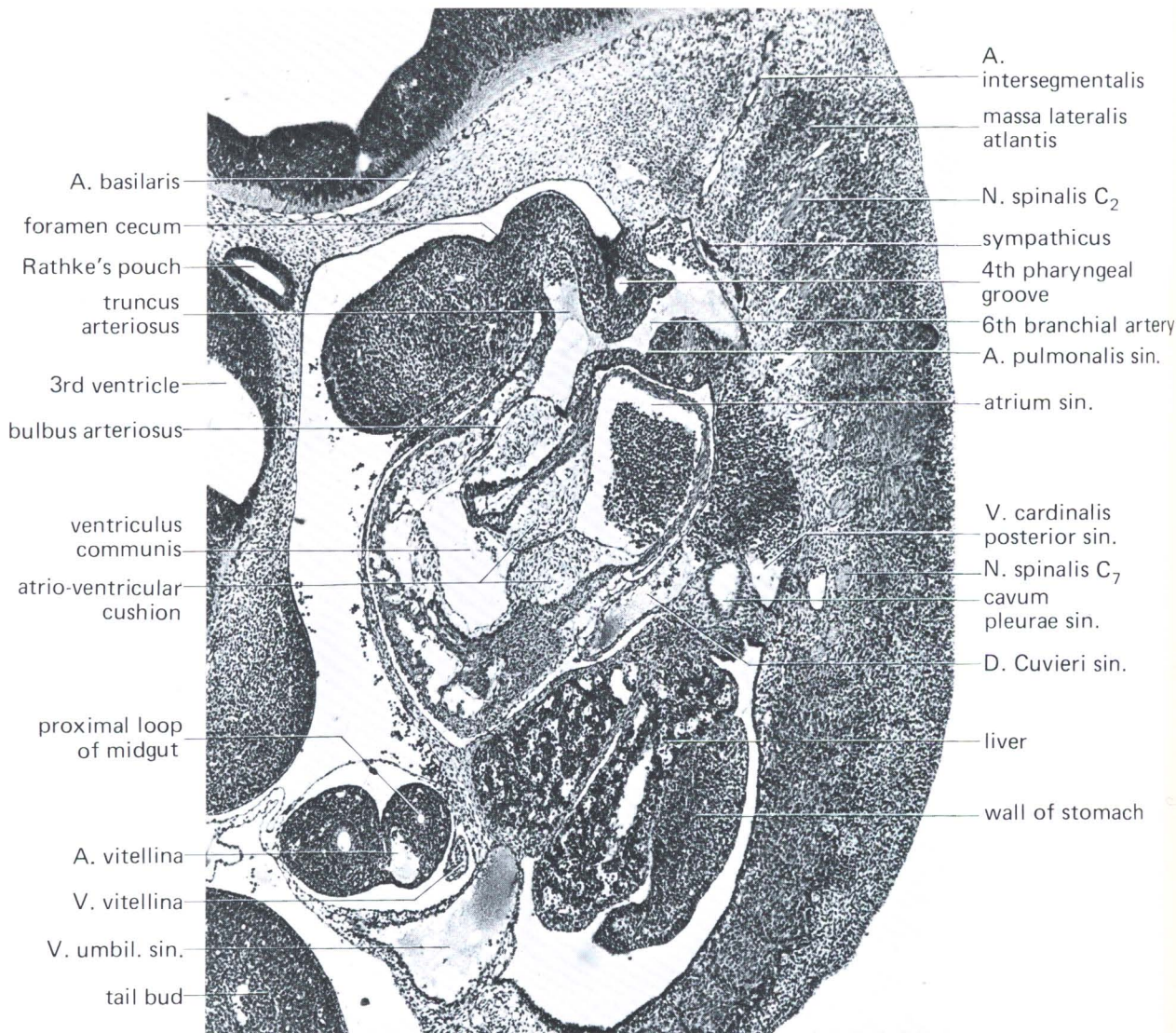


FIG. 175. Paramedian section. Nominal age 12 days, developmentally 11 1/2 days.
KT 630b

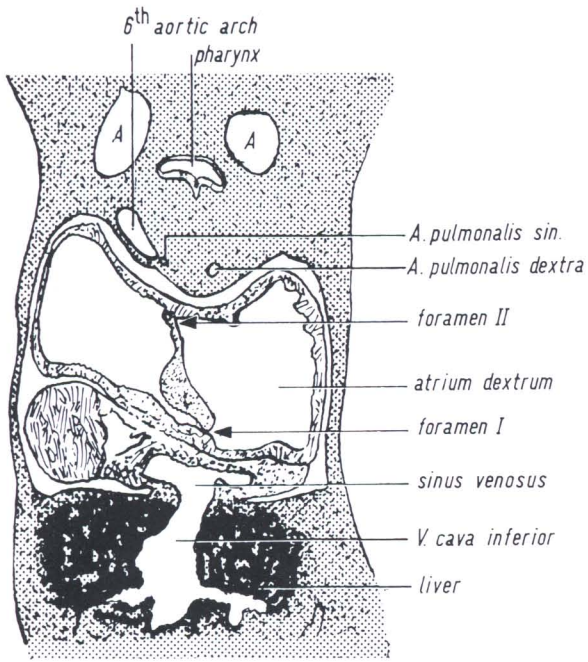


FIG. 174. Septation of atrium, frontal section, dorsal view.
 A = aorta dorsalis (paired).
 KT 630c/4

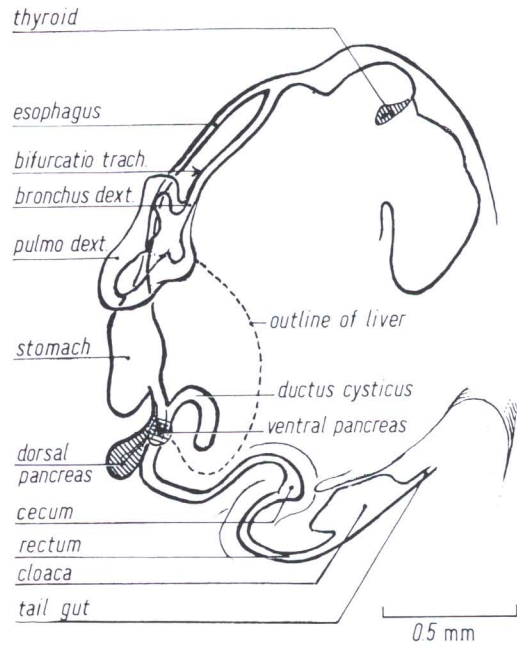


FIG. 176. Intestinal tract, reconstruction.
 KT 630b, 6 mm, developmental age 11 1/2 days

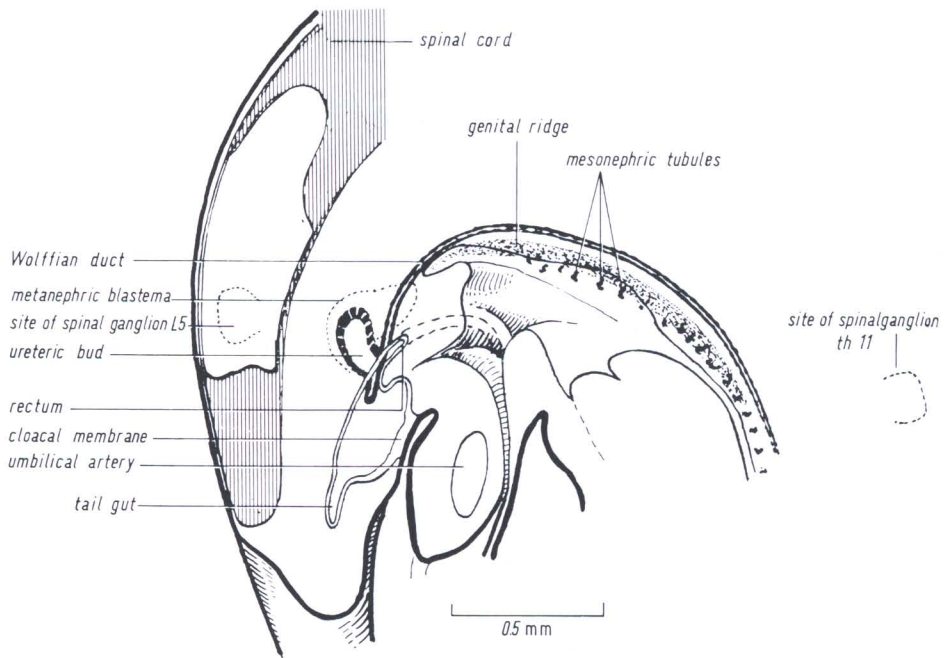


FIG. 177. Urogenital apparatus, left half, reconstructed.
 KT 630b

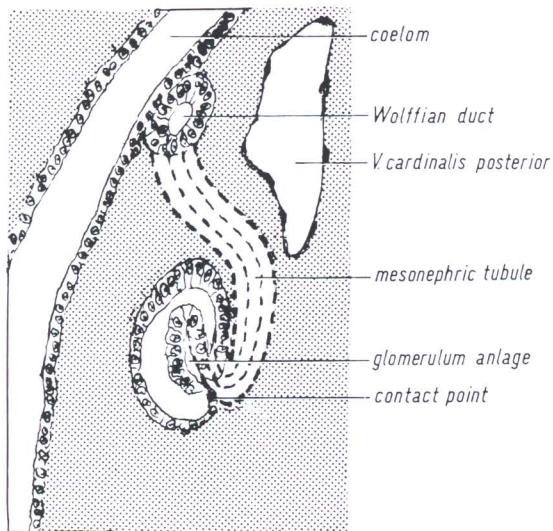


FIG. 178. Differentiation of mesonephros. Cross section.
KT 630a, developmental age 11 1/2 days

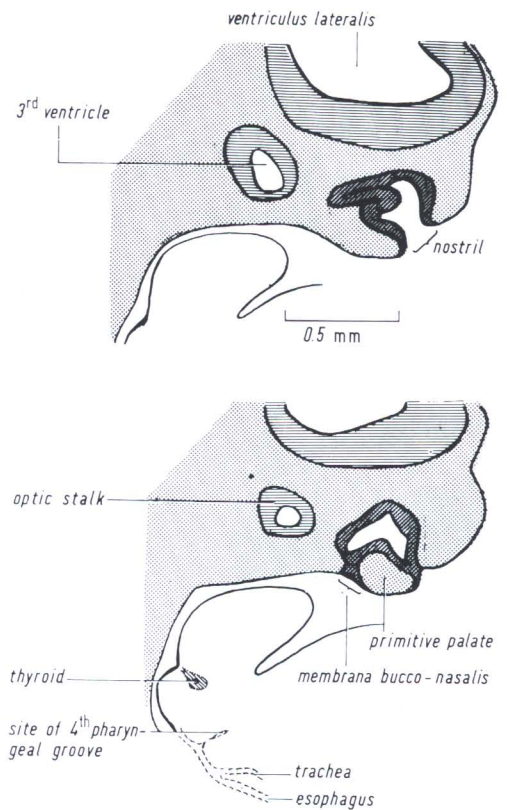
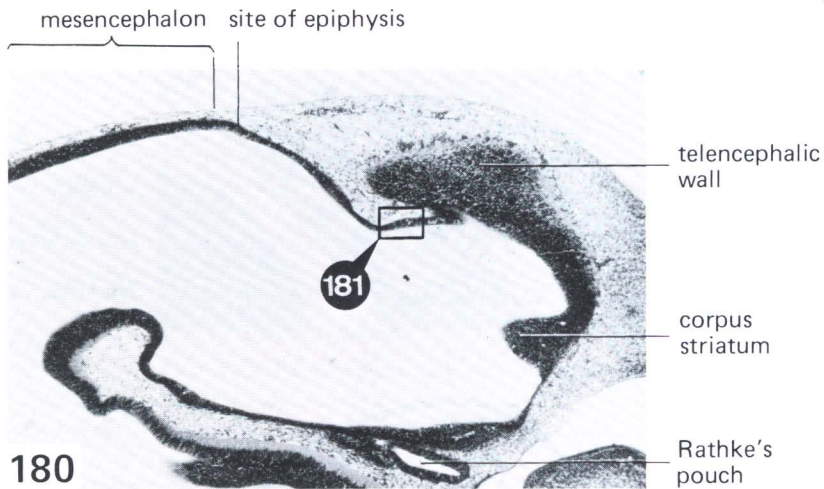
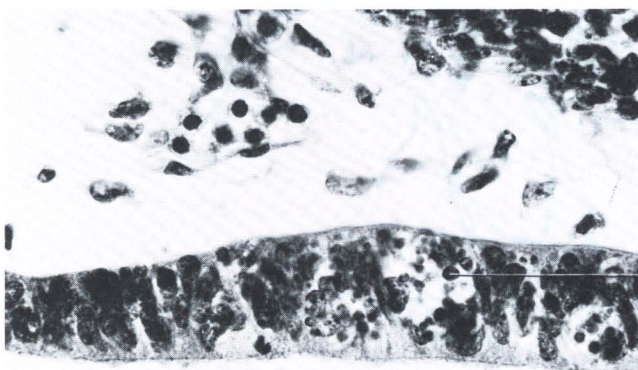


FIG. 179. Development of olfactory apparatus. Lateral section (above) and medial section (below), in sagittal direction.
KT 630b, developmental age 11 1/2 days



180



181

FIG. 180. Sagittal section through fore- and midbrain.
KT 1005/1, 11 1/2 days. 40:1

FIG. 181. Detail of Fig. 180. Disintegrating cells in the anterior roof of the diencephalon. 560:1