Stage 27 Newborn Mouse

19 Days, 23–27 mm.

External Features

The external appearance of the newborn mouse is not essentially different from the preceding stage (18 days), but the animal is considerably longer. The eyes and ears have closed. Histologically they are quite immature. The pigmented eye is still visible through the skin, which is thicker than in the 18-day fetus. The dark shadows of the liver and of the spleen (on the left side) can be seen through the body wall and the skin. Milk in the stomach can also be seen externally. The whiskers are long and clearly visible. The hair does not appear until the mouse is 2 or 3 days old.

The vagina remains closed for more than one month after birth.

Length. There is considerable variation in length, mainly due to different degrees of flexure of the body axis. Living newborns are usually 23 to 27 mm, but a few may be longer.

Circulatory System

The *ductus Botalli* (Fig. 293) has a tiny lumen for several hours after birth.

The blood vessels of the lungs are considerably distended.

The foramen ovale (Fig. 294) is anatomically open, but functionally closed.

Near their entrance into the heart, the veins have distinct valves, i.e., at the termination of the vena jugularis externa, interna, and at the inlet of the caval veins into the atrium (Fig. 294).

Intestinal Tract

The *oral cavity* has long been completely separated from the nasal cavities (Fig. 292).

The primordia of the incisors are shown in Fig. 292. The dental papilla (marked by the end of the line in Fig. 292) is bordered by tall odontoblasts. They already have formed some predentine. Peripherally, a layer of tall ameloblasts can be seen.

Derivatives of the Intestinal Tract

The *thyroid* (Fig. 295) is actively secreting. There are only two *parathyroids* in the mouse and they are bilaterally attached to the thyroid lobes. Displaced clusters of parathyroid cells are occasionally found within the connective tissue septa of the thymus [143].

The cortex of the *thymus* (Fig. 296) is subdivided into two zones:

1. an outer zone, containing large lymphoid cells, some of them in mitosis, and
2. an inner zone, with many small lymphocytes.

In the medulla there are clusters of large clear reticulum cells. Hassal's corpuscules are lacking.

FIG. 284. Newborn mouse, from the left, 27 mm.
L = liver, *Sp* = spleen, *M* = stomach (filled with milk). 2.5:1

FIG. 285. Same specimens as in Fig. 284, right side, with millimeter scale. 2.5:1

FIG. 286. Alizarin-cleared preparation, newborn.
S = supraoccipitale, *A* = arcus posterior atlantis, *Sc* = scapula dextra, *OJ* = os ilii, *F* = femur, *TC* = talus and calcaneus.
KT 891. 2.2:1

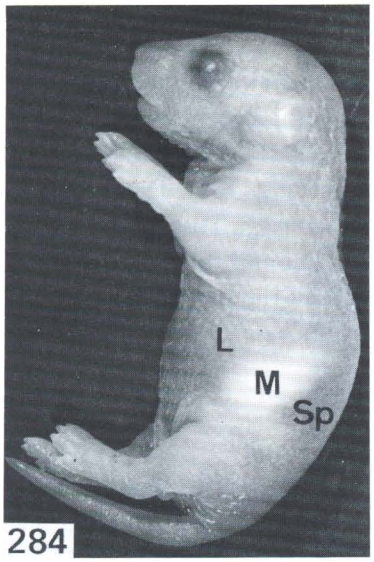
FIG. 287. First picture of dissection, newborn mouse.
T = thymus; *H* = heart, in pericardium; *Pc* = lobus postcavalis of right lung; *L* = liver; *B* = bladder, filled. 2.5:1

FIG. 288. Second picture of dissection, same newborn mouse. *Sm* = glandula submaxillaris, *T* = thymus, *P* = pancreas, *M* = stomach, *Sp* = spleen, *Si* = colon sigmoideum, *N* = left kidney, *C* = cecum, *J* = ileum. 2.5:1

FIG. 289. Sagittal section through 4th and 5th thoracic vertebra, 19 days.
Cs = notochordal sheath, *D* = dura mater. 90:1

FIG. 290. Eye, frontal section, newborn mouse.
O = nervus opticus, *Ln* = suture of eye lids, *G* = ganglion cell layer.
KT 1067. 55:1

FIG. 291. High power view of iris (Fig. 290).
I = iris, *Cc* = corpus ciliate, *Mi* = mitosis in lens epithelium. 270:1



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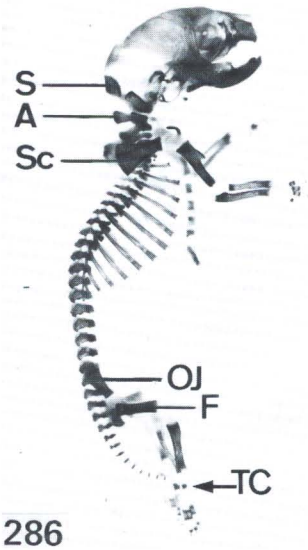

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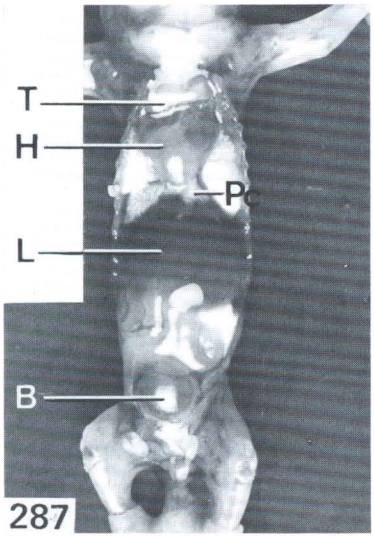

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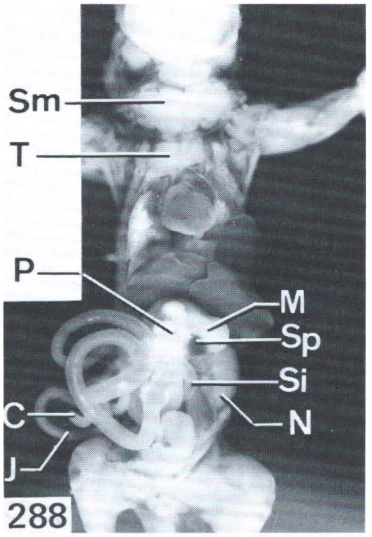

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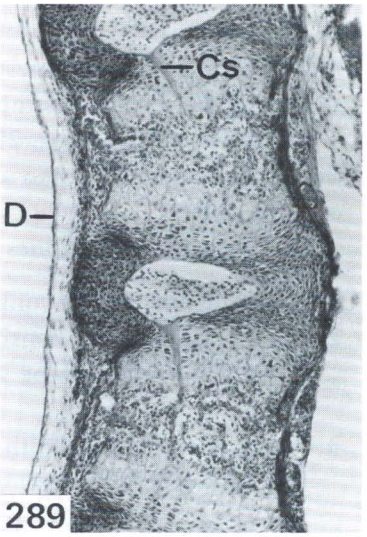

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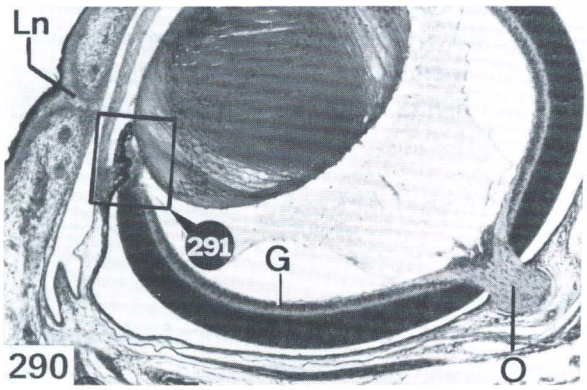

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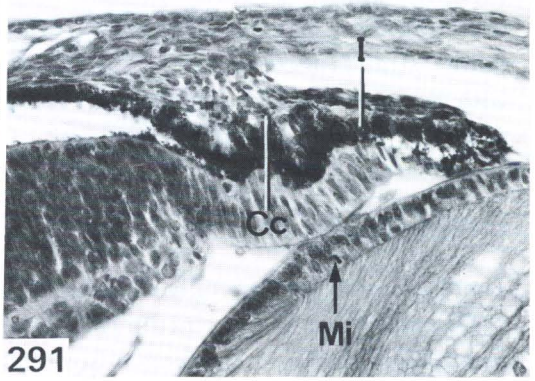

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Respiratory System

The left *lung* consists of one undivided lobe. The right lung is subdivided into 4 lobes. In addition to the upper-, middle-, and lower lobes there is a special lobus postcavalis. It is behind the heart, and extends quite far into the left side of the body (Fig. 294). Each bronchus lobaris gives off regular segmental and subsegmental bronchi (Fig. 301). The latter are connected to short terminal bronchi, which open into wide alveolar sacs. There is a gradual transition between the cuboidal epithelium of the terminal bronchi and the flattened cells lining the aveoli. Except for the stem bronchi, the bronchial walls of the mouse do not contain cartilage.

Abdominal Viscera

The *liver* and *spleen* are sites of active hemopoiesis. The most conspicuous type of hemopoietic cells is the megakaryocyte and it is found in both organs. In the spleen, a few nodules of lymphatic tissue have formed. These are more distinct after birth [57].

The *stomach* is relatively large. It shows signs of marked secretory activity. The duodenum is the widest part of the intestine, and it has numerous villi. The large intestine is of the same caliber as the small intestine (Fig. 292).

The *adrenal glands* (Fig. 292) are well developed. The cortex and medulla are now more distinctly demarcated than at 17 days (Fig. 298). The medullary cells are smaller than the cortical cells.

In the cortex, three zones may be distinguished (Fig. 298):

1. a narrow outer zone, composed of small, crowded cells.
2. a large middle zone, consisting of large cells with abundant cytoplasm in which vacuoles (dissolved lipids) can be seen sometimes. The cells are not arranged in parallel strands; and
3. a narrow inner zone with small, intensively stained cells. They are the precursors of the X-zone, which will develop after birth. It will regress at the age of one month.

In the medulla, the peripheral cells (bordering the cortex) are often clustered together, reflecting their original arrangement in small groups. Between them there are intensively stained strands of cortical cells. The clusters of young medullary cells should not be confused with hemopoietic foci. Their nuclei are larger and lighter than erythroblastic nuclei, and their cytoplasm is basophilic.

Urogenital Tract

There is a wide peripherally situated growth zone in the kidneys.

Diagnosis of sex. The perineum is definitely longer in the male. The distance between anus and genital papilla in the female is roughly one-half that in the male.

The topography of the *internal genital organs* is shown in simplified form in sketches of reconstructions (Figs. 303 and 304). The large seminal vesicle opens into a common orifice with the ampulla ductus deferentis into the urethra, at the colliculus seminalis. Later, a separate opening is often observed. The coagulating gland can be seen as a short sprout, situated immediately anterior (proximal) to the colliculus seminalis (Fig. 303). Other sprouts visible in Fig. 303 are primordia of the prostate (not labeled).

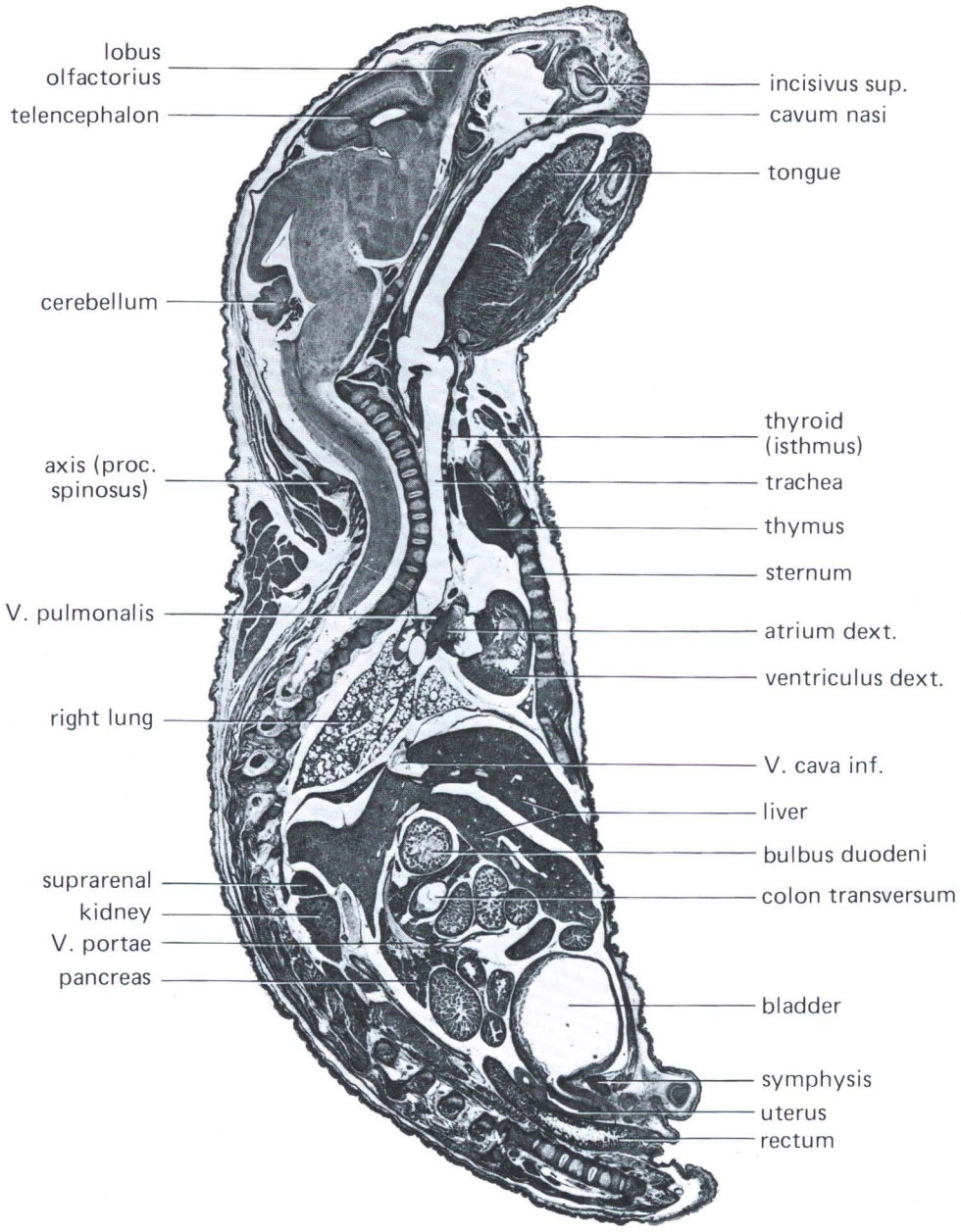


FIG. 292. Sagittal section through newborn female mouse.
KT 1067

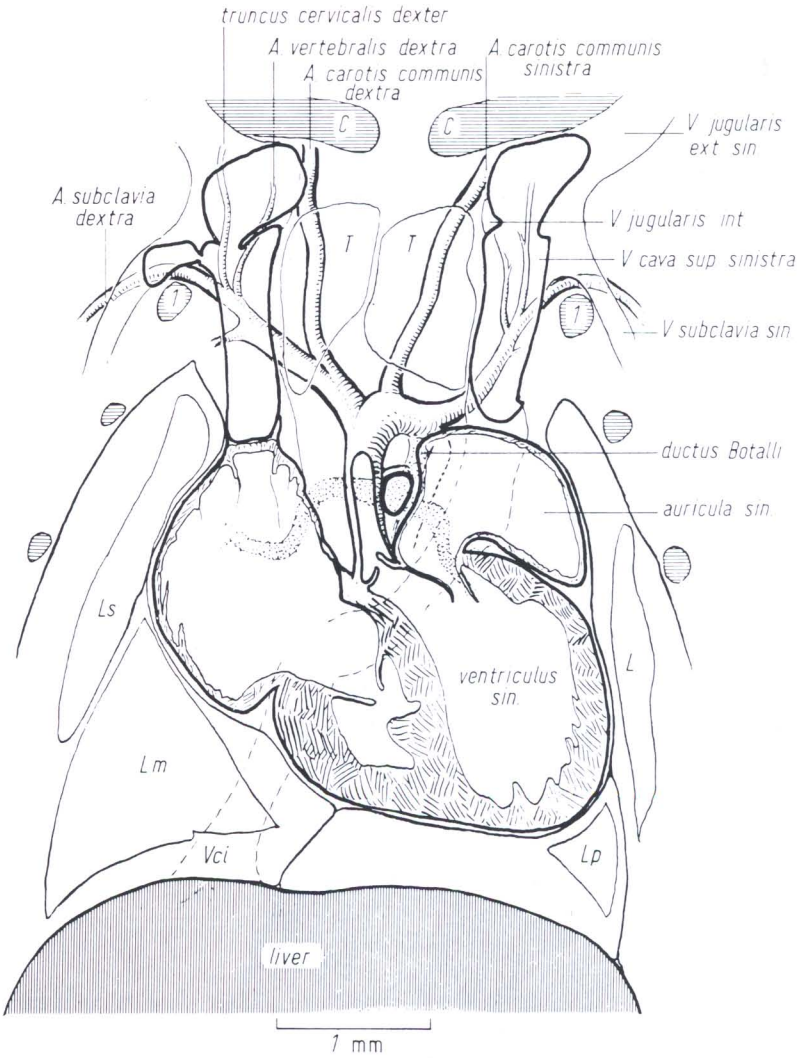


FIG. 293. Reconstructions of aorta and pulmonalis, superimposed on frontal section, ventral view.

Pulmonalis and ductus Botalli indicated by *stippled areas*; contours of large veins are indicated. *C* = clavicula, *1* = costa 1, *T* = thymus, *L* = left lung, *Lp* = lobus superior postcavalis (pulmonis dextri), *Lm* = lobus medius, *Ls* = lobus superior, *Vci* = vena cava inferior (projection).

KT 1067, newborn

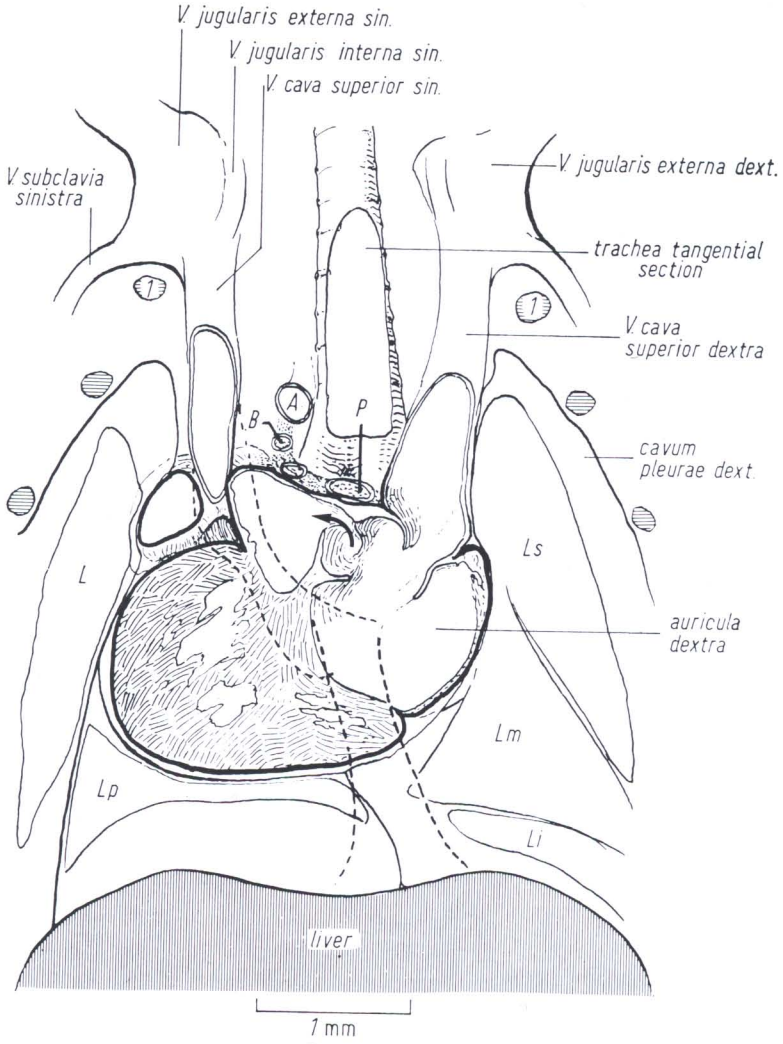


FIG. 294. Reconstruction of venous inlet, superimposed on frontal section. Dorsal view. *Broken lines* indicate course of caval veins. *A* = arcus aortae, *P* = arteria pulmonalis dextra, *B* = ductus Botalli, *L* = left lung, *Ls* = lobus superior, *Lm* = lobus medius, *Li* = lobus inferior, *Lp* = lobus postcavalis. *Arrow* indicates foramen ovale.
KT 1067

FIG. 295. Thyroid isthmus, newborn mouse.
F = follicle. 550:1

FIG. 296. Thymus, newborn mouse.
Arrow indicates mitosis of a lymphoblast. 550:1

FIG. 297. Liver, newborn mouse.
Me = megakaryocyte, *P* = branch of portal vein. 270:1

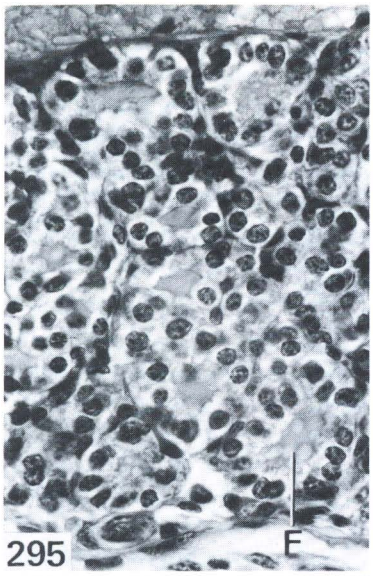
FIG. 298. Suprarenals, low power view, newborn mouse. 220:1

FIG. 299. High power view of boundary zone cortex–medulla (Fig. 298). 550:1

FIG. 300. Pancreas, newborn mouse.
In = pancreatic island.
KT 910. 550:1

FIG. 301. Frontal section through left lung, newborn mouse.
KT 1067. 40:1

FIG. 302. High power view of lung subsegment.
Sa = saccus alveolaris. 270:1



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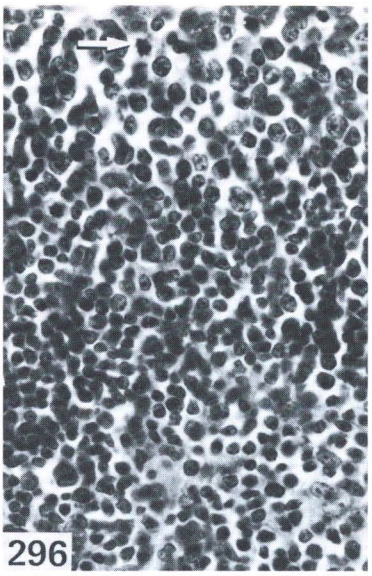

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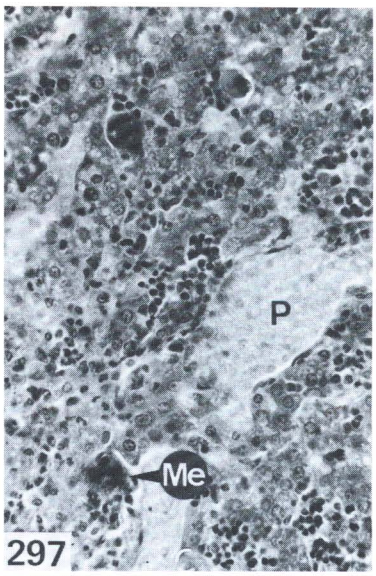

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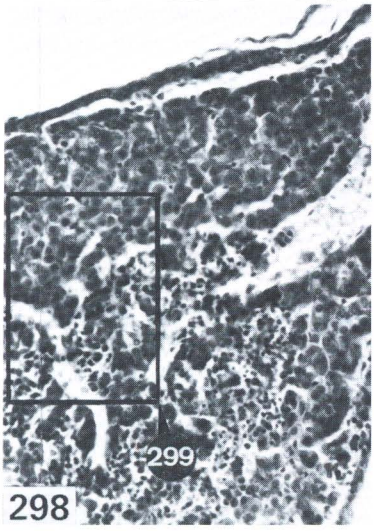

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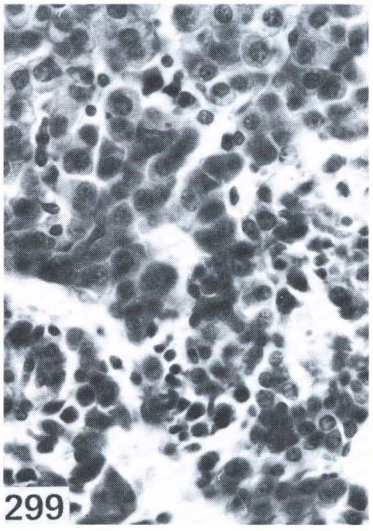

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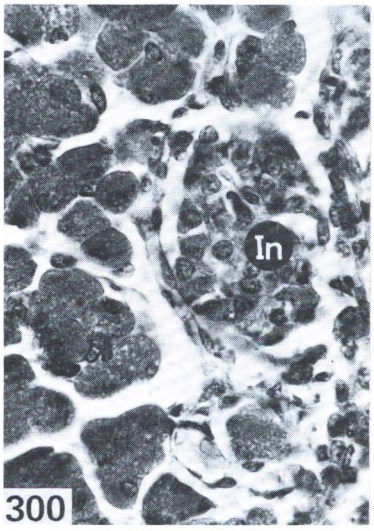

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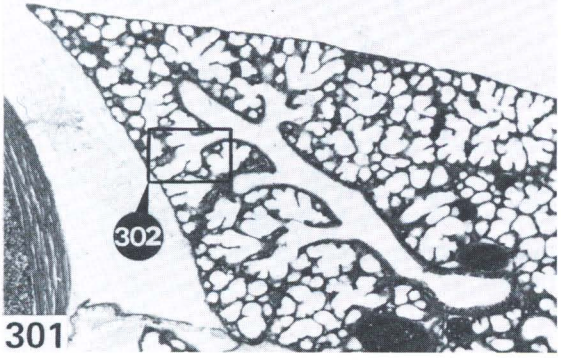

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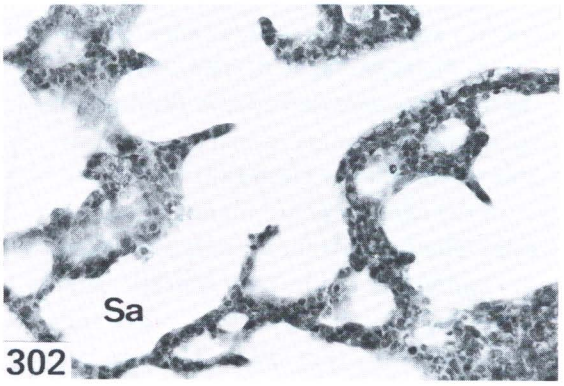

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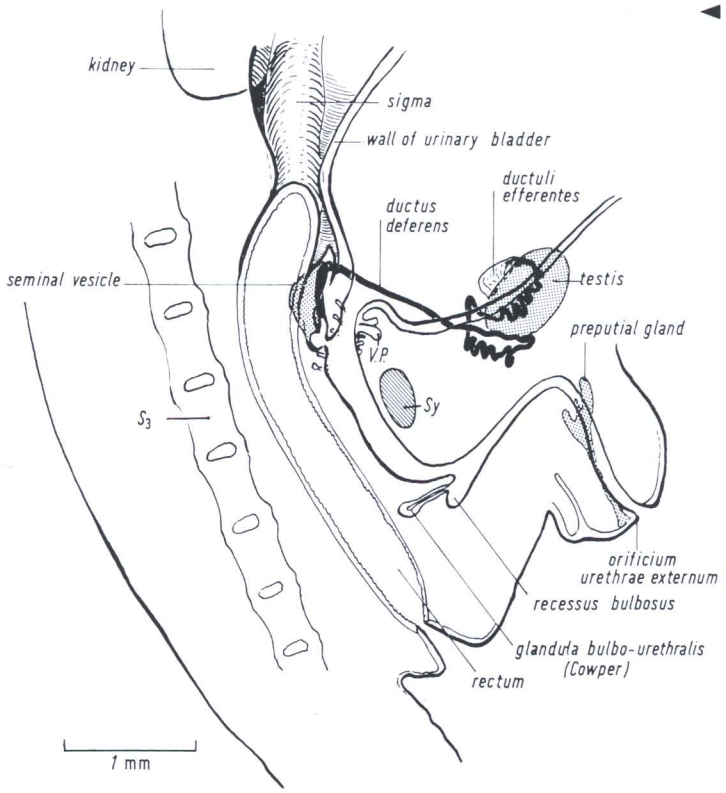
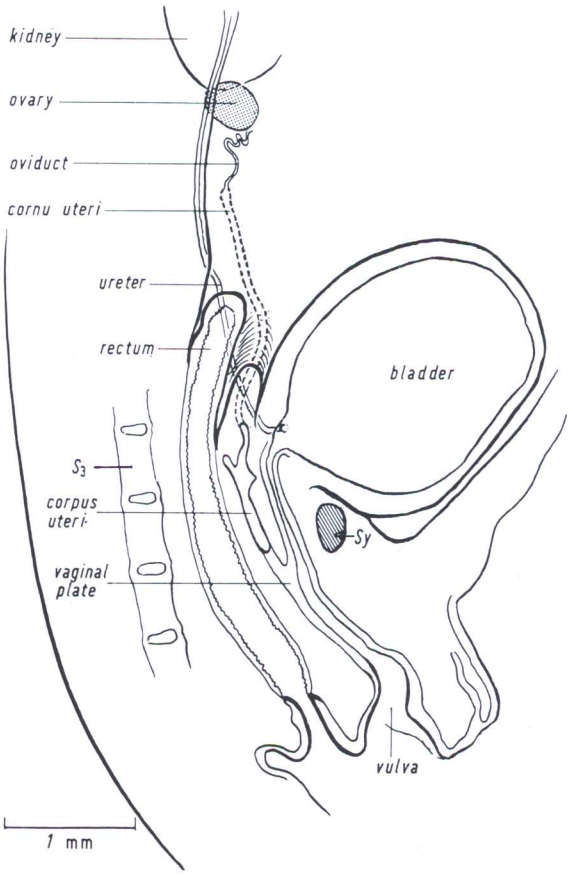


◄ FIG. 303. Male genital organs. Reconstruction, newborn mouse. Left half, viewed from the right.
Caput and cauda epididymidis shown in simplified form. *V.P.* = ventral prostat, *Sy* = symphysis, S_3 = 3rd sacral vertebra.
KT 910

FIG. 304. Female genital organs. Reconstruction, newborn mouse. Left half, viewed from the right.
Oviduct shown in simplified form. *Sy* = symphysis.
KT 1067
▼



In the *ovary* many cells with condensed chromosomes can be seen, mostly prophases of the first meiotic division of the oocytes. Some primary follicles have developed in the more central area of the ovary. In this region, the oocytes are in the dictyotene stage. Graafian follicles are absent. The surface of the ovary is exposed to the fluid-filled space of the bursa ovarica, which is almost completely closed [107].

In the *testis* there are many interstitial cells. The tubuli contorti are composed of numerous primitive Sertoli cells (nourishing and supporting cells) and large gonocytes (Fig. 305). The *gonocytes* are no longer dividing. Mitotic activity will be resumed during the first week after birth. Simultaneously, the gonocytes will migrate toward the basement membrane of the seminiferous tubules. The developing daughter cells will be

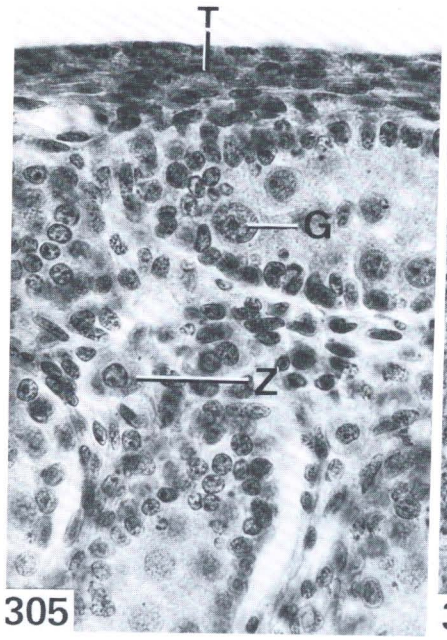


FIG. 305. Section through testis of newborn mouse.
T = tunica albuginea, *G* = gonocyte, *Z* = interstitial cells. 550:1

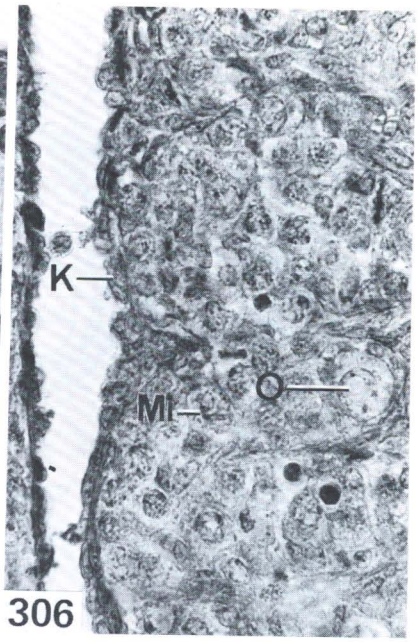


FIG. 306. Section through ovary of newborn mouse.
O = oocyte within primary follicle, *Mi* = mitosis (prophase of first maturation division), *K* = epithelium of ovary.
KT 1067. 550:1

smaller and are called immature spermatogonia type A. Mature spermatogonia will remain smaller. These cells are generally flattened and closely attached to the basement membrane. They appear at the initiation of spermatogenesis.

Central Nervous System

In the *cerebellum*, the fissures that developed in the previous stage have deepened considerably (Fig. 292). The structure of the hypophysis [136], which can be used as an indication of developmental age, has not changed, compared with Fig. 271 (18 days).

The accessory organs of the *eye* have appeared. The conductory system of the infraorbital gland is composed of numerous branches. The passage opens into the saccus conjunctivae, together with the neighboring solid sprouts of the lacrimal gland. The Harderian gland reaches the conjunctiva by a single, slender duct, in the neighborhood of the nicticating membrane. These glands are not differentiated histologically. The nicticating membrane, however, contains some cartilage.

The iris and corpus ciliare (Fig. 291) remain at the state of maturation attained one day earlier (18 days, Fig. 272).

The *internal ear* is only slightly changed since day 18. The external auditory meatus has closed. The auditory apparatus cannot function until the second week after birth, when the organ of Corti has completed its maturation [180].

Skeletal System

The *vertebral column* has changed between the stage of 18 days and the newborn, but the skull remains about the same. All ossification centers of the vertebral bodies of the trunk have formed, including cervical 3–5 (compare Fig. 307 to Figs. 280 and 281). Ossification is well advanced in the thoracic region (Fig. 289).

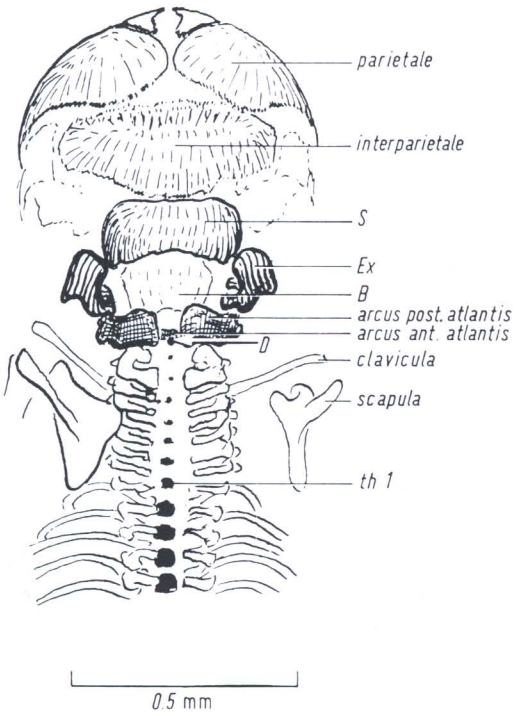


FIG. 307. Alizarin-cleared preparation. Anterior part of the body, dorsal view. Newborn. *S* = suproccipitale, *B* = basioccipitale, *Ex* = exoccipitale, *D* = ossification center in basis of dens (*black point*).
KT 891

In the *sternum* the sternebrae have enlarged considerably. When the ribs grow slightly asymmetrical, the sternebrae are correspondingly asymmetrical ("crankshaft-sternum," Fig. 308). In the *fore-* and *hindfeet*, nearly all bones of the phalanges have formed. The metacarpalia and metatarsalia had already appeared previously. Only the centers of the fifth middle phalanx (hindfeet) and of the first phalanx (forefeet) are absent.

The *carpals* have not yet ossified. In the *tarsus*, however, 2 ossification centers can be seen regularly: the talus and calcaneus. They are distinctively large, even though they have just recently appeared (Fig. 286).

Placenta

The structure of the placenta has not changed fundamentally since the 14-day stage (Fig. 309). Reichert's membrane usually ruptures shortly before birth. When it ruptures, it often rolls up like a carpet. Where it borders the placenta, however, the membrane remains stretched (Fig. 311). In the vicinity of the placental margin, short processes in Reichert's membrane appear at 14 days (Fig. 309).

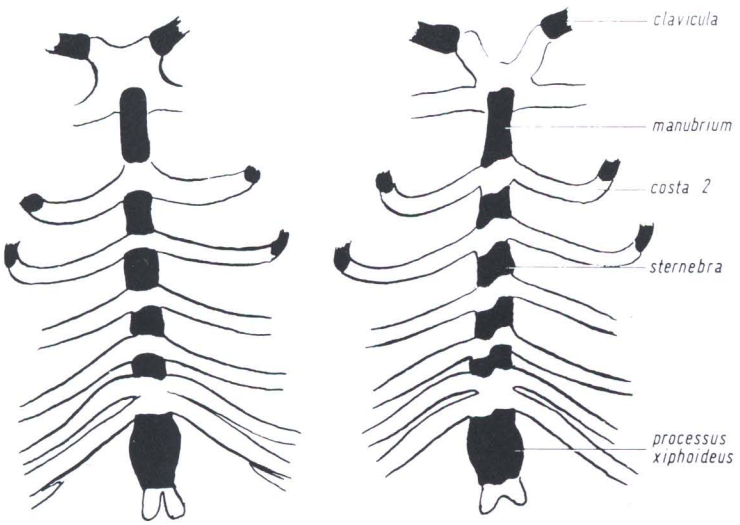


FIG. 308. Alizarin-cleared preparation of sternum. Note variable, but normal form of ossification centers ("crankshaft-sternum").
KT 865, 891

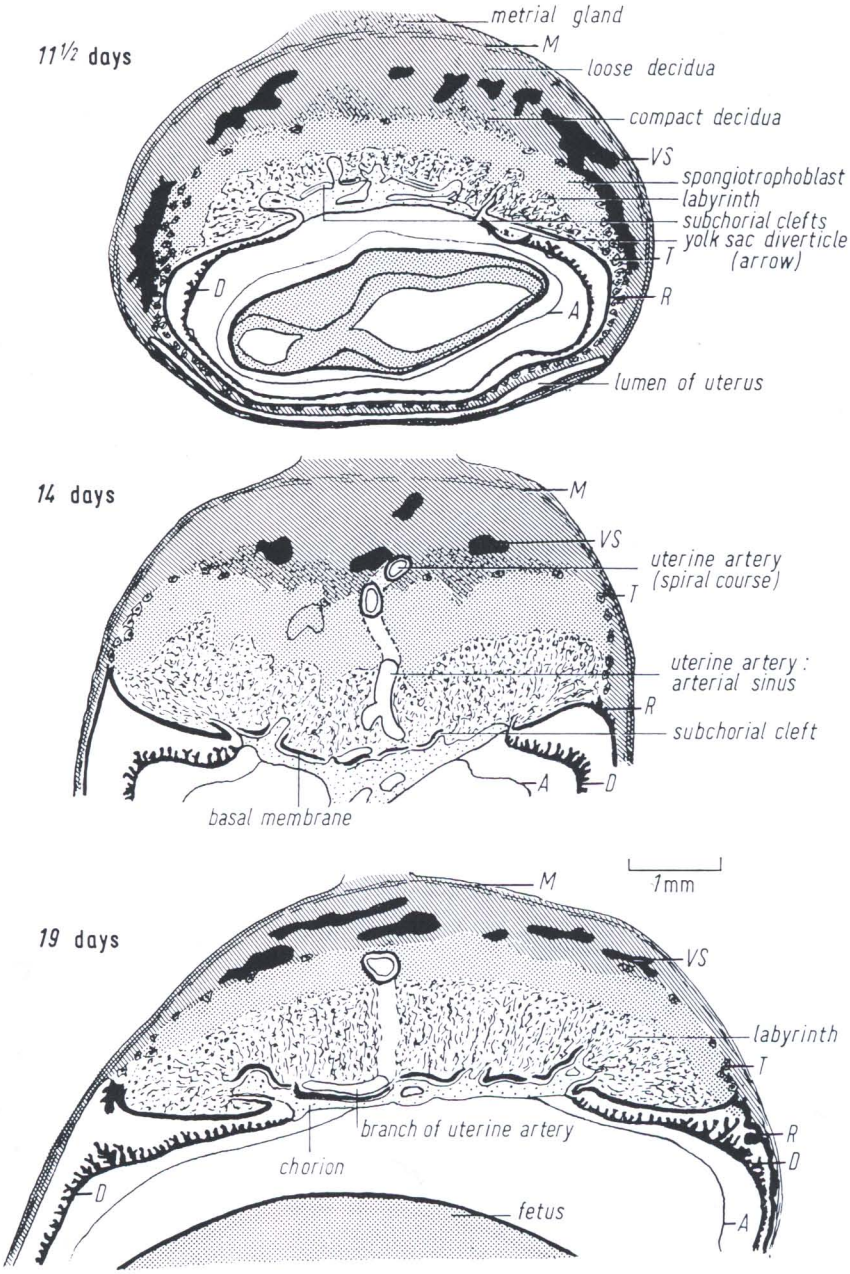


FIG. 309. Diagrammatic representation of placenta and extraembryonic membranes, from 11 1/2 days to birth.
M = muscle layer, *VS* = venous sinus, *T* = trophoblastic giant cells, *R* = Reichert's membrane, *D* = yolk sac, *A* = amnion.

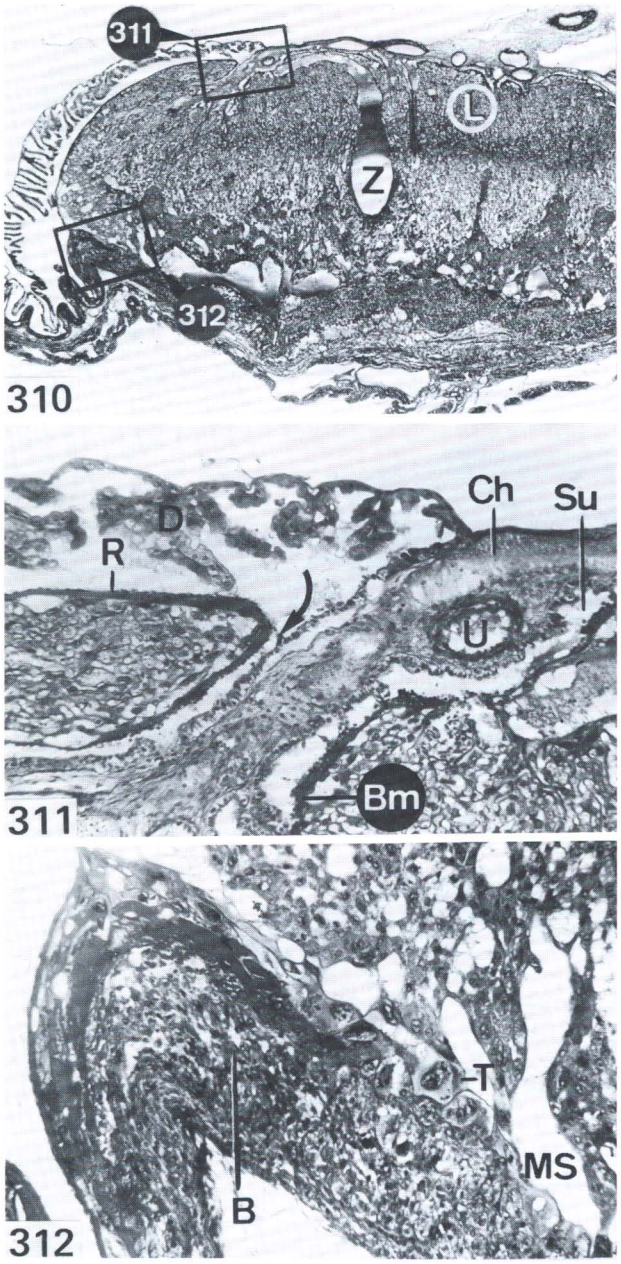


FIG. 310. Cross section through placenta of a newborn mouse, low power.
L = labyrinth, *Z* = central artery.
KT 1056. 14.5:1

FIG. 311. High power view of chorionic plate (*Ch*).
D = yolk sac, visceral layer; *R* = Reichert's membrane; *Bm* = basal membrane; *U* = umbilical vessel; *Su* = subchorionic space. *Arrow* indicates "yolk sac diverticle."
105:1

FIG. 312. High power view of basal plate (*B*).
MS = maternal blood sinus, *T* = trophoblastic giant cell. 105:1

At *19 days*, the placenta has not enlarged much. A dilated central artery enters the well-developed labyrinth from the mesometrial side of the placenta. This vessel conducts maternal blood directly under the chorionic plate, where the stems of the umbilical vessels pass. The labyrinth is demarcated from the chorionic plate by the narrow intraplacental space [33]. This space consists of subchorionic clefts bordered by two walls of characteristic structure. Toward the chorion, one wall is lined by a layer of cuboidal cells. Toward the labyrinth, the other wall is lined by flattened epithelial cells supported by a thick basement membrane (Fig. 311). The intraplacental space opens laterally into the lumen of the yolk sac [33], ("yolksac diverticles," marked by *arrow* in Fig. 311).

The *labyrinth* is composed of an intricate maternal blood space and numerous fetal blood vessels. Maternal and embryonic blood is separated by three cell layers, as shown by electron microscopic studies [34]. Two syncytial layers, which are closely approximated, are covered, near the maternal blood space, by single large trophoblastic cells.

The *spongiotrophoblast* (reticular zone or junctional zone) [38] contains exclusively maternal blood vessels. Large veins open from the decidua into extended (maternal) lacunae.

At the margins of the placenta, the spongiotrophoblast is bounded by the characteristic *giant cells* [39] mentioned above (Fig. 312).