

## A Human Embryo of Streeter Age Group XIII

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**=Abstract=**A human embryo was serially sectioned and was reconstructed with 172 sections. The length of the embryo was estimated to be 5.6 mm. The embryo was characterized by optic evagination with thickened lens ectoderm, absence of lens pits, the otic vesicle without endolymphatic appendage, distinct arm buds and leg buds, lung buds and absence of the ureteric buds. All these above mentioned findings corresponded to those expected in Streeter age group XIII. Although age group XIII and XIV share some features seen in this embryo, absence of lens pits was most helpful to distinguish this embryo from Streeter age group XIV. This embryo did not show any notable developmental abnormalities. Thus we concluded that this embryo was normally developed and was in the age group XIII of Streeter's developmental horizon.

**Key Words:** *Embryo, Streeter age group*

### INTRODUCTION

In studies of the human embryology, numerous descriptions of human embryos related to its ages have been made. However, there was no universal and rational criteria for the determination of accurate developmental age of the embryo, especially in the early stages of the embryonal development.

As for the occasion, Streeter (1945 & 1948) divided the developmental period of embryo into I to XXIII with 2 to 3 days interval according to the developmental status of internal organs, based upon the precise correlation in the main features of organogenesis.

In this study, a human embryo was serially sectioned and the developmental status of internal organs was observed by measure of reconstruction. This human embryo that precisely belong to the age group XIII of Streeter's developmental horizon is described.

### CASE REPORT

This human embryo was obtained accidentally in the hysterectomy specimen, and was fixed in 10% formalin solution and embedded in paraffin. The embryo was sectioned serially from the right side to the left in 7  $\mu$ m thickness. A total of 172 sagittal sections were obtained and stained with hematoxy-

lin and eosin. During embedding, the embryo was slightly tilted to the left side. The reconstruction was made with 172 sections.

**External appearance:** The external appearance of the embryo was deduced from the reconstruction as shown in Fig. 1. The embryo size was 5.6 mm in crown-rump length. There were prominent arm buds consisting of definite ridges and leg buds which began to develop (Plate 1). The embryo showed C-shaped curvature, and the mandibular, hyoid, glossopharyngeal bars were distinct. The amnion was closed in and ensheathed the body stalk, the coelomic space, and the stalk of the yolk sac. This marked the beginning of the umbilical cord. The heart was prominent in the ventral thoracic wall and its combined volume with the liver mass was about equal to that of the overlying head.

**Central nervous system and sensory organs:** There were three prominent primary brain vesicles and the two flexures (midbrain and cervical), demarcating the primary divisions of the brain (Plate 2). The optic evaginations had grown laterally (Fig. 2). The retina was still a flat disk whose proliferating nuclei resulted in its slight bulging backward into the lumen of the evagination, its outer surface was marked by widening nucleus-free marginal zone. Where the retina was in contact with the skin ectoderm, the latter had been thickened, indicating

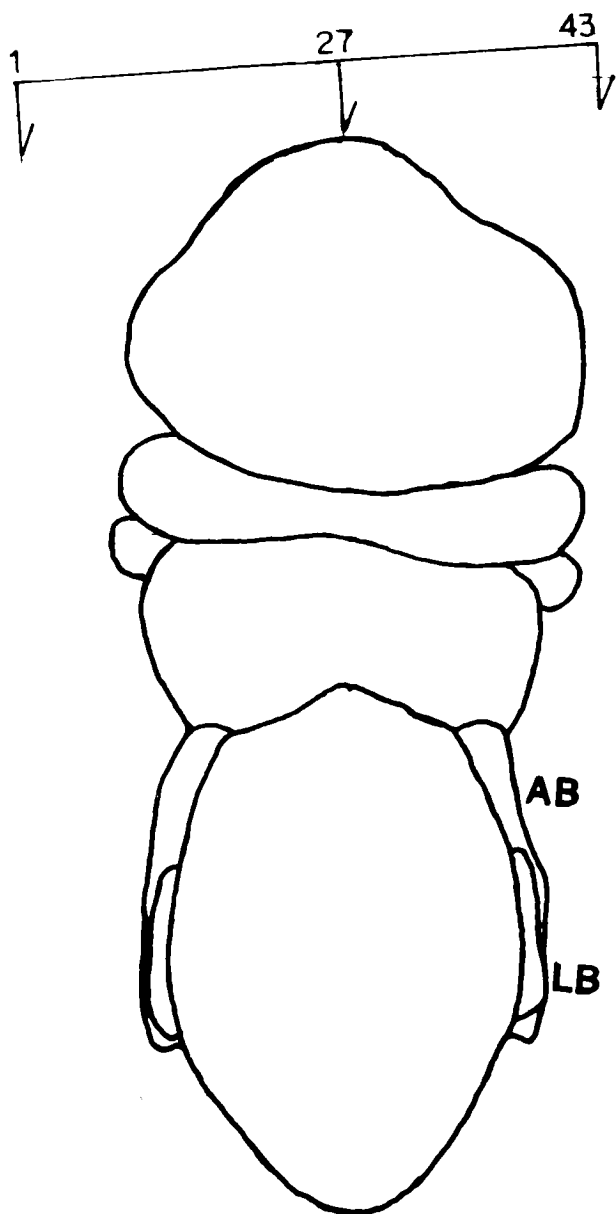


Fig. 1. Schematic reconstruction of the whole embryo. Number represents the number of section slide. AB: arm bud, LB: leg bud.

the future lens of the eye. There was no lens of the eye. There were no lens pits recognized (Plate 3). The otic vesicles were closed and there was some visible stalk of tissue still attaching the vesicle to the skin ectoderm (Plate 4). No endolymphatic appendages could be recognized (Fig. 1). The Rathke's pouch showed an upgrowth from the stomodeum (Plate 5).

**Digestive system:** The oropharyngeal membrane was already ruptured, bringing the primitive gut into communication with the amniotic cavity. the mandibular and hyoid bars were prominent, although the cervical sinus was not formed. Through the foramen cecum, median endodermal thickening in the floor of the primitive pharynx formed a downgrowth as the thyroid diverticulum

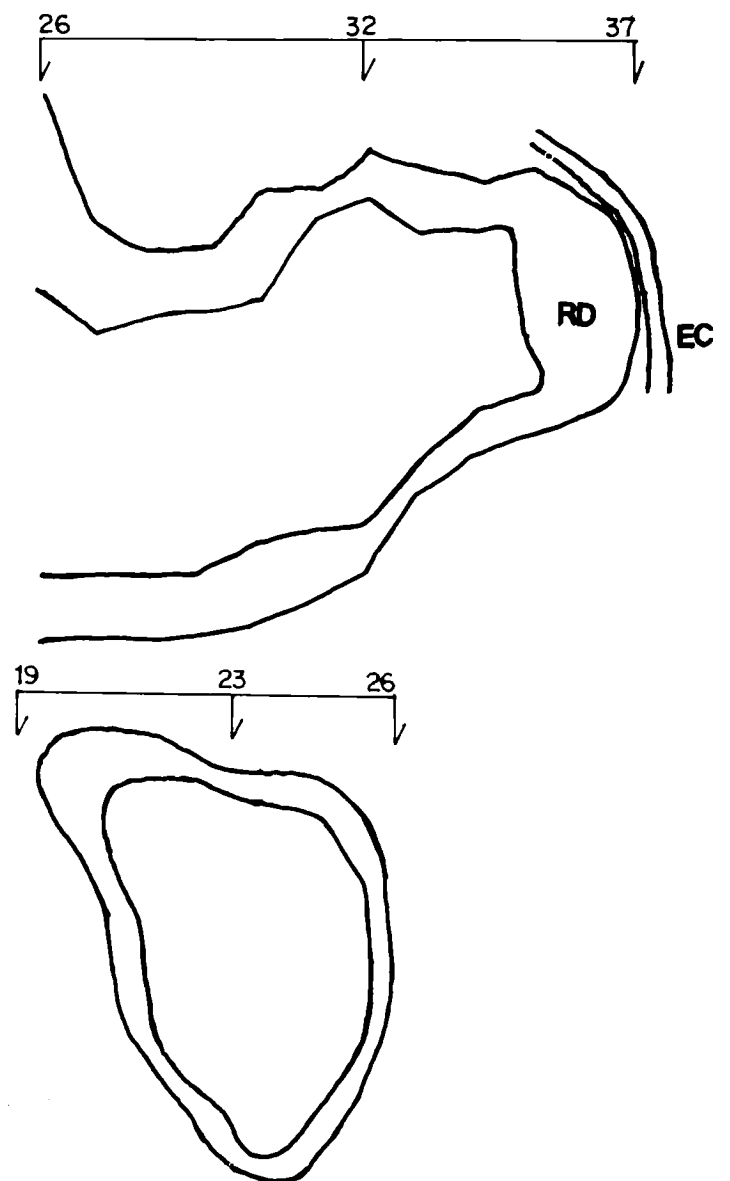


Fig. 2. Schematic reconstruction of the left optic evagination (frontal plane) and the right otic vesicle. RD: retina disk, EC: skin ectoderm.

(Plate 6). Just rostral to the foramen cecum, slight elevation (median tongue bud) appeared, on each side of which two distal tongue buds developed. The stomach was located posterior to the liver mass and was definitely spindle-shaped (Fig. 3). The liver was congested with blood, and epithelial trabeculae were prominent. The gallbladder was visible under the liver mass (Plate 7), and the dorsal pancreas was seen at the posterior wall of the gut near the gallbladder.

**Respiratory system:** The lung buds developed at the caudal end of the laryngo-tracheal tube and were divided into two knob-like bronchial buds with characteristic axial growth (Plate 8). The right primary bronchus buds which acquired more length was directed more downward, whereas the

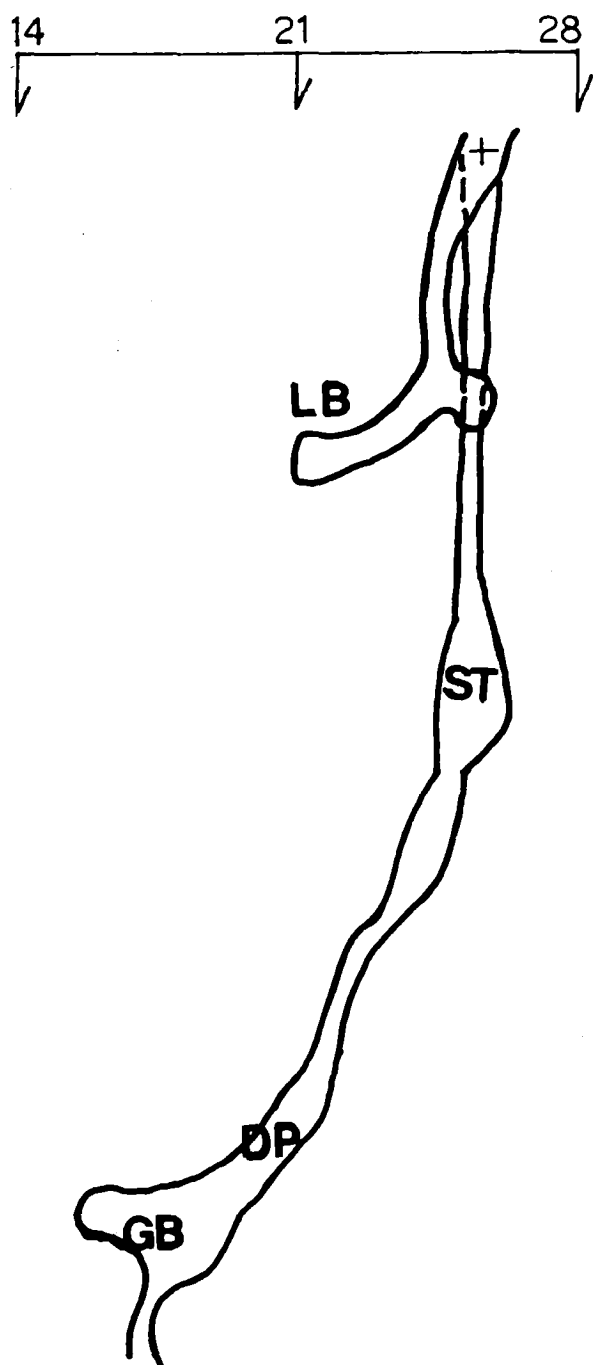


Fig. 3. Schematic reconstruction of the lung and part of the digestive system. The length is somewhat exaggerated. +: tracheo-esophageal junction, LB: lung buds, ST: stomach, DP: dorsal pancreas, GB: gallbladder

left bronchus was nearly transverse. The junctional level which the trachea and esophagus had a common lumen was near the bifurcation site (Fig. 3).

**Cardiovascular system:** The heart chambers were distended with plasma and blood cells, making them and heart as a whole more prominent. Loops and strands of differentiating myocardial cells of ventricular wall extended inward, indenting and interlocking with the endocardium, and thereby producing the trabecular character which dis-

tinguished the ventricle from the atria. The ventricular wall consisted of 1) surface residual mother cells which finally become the epicardium, 2) the thick primary myocardial plate, whose inner cells blended with the trabecular layer, 3) the trabecular layer, interlocked with the endocardium and 4) endocardium (Plate 9). The heart still lacked true valvular structures but endocardial cushions appeared at the superior and inferior borders of the atrioventricular (AV) canal (Plate 10). The cushion of gelatinous reticulum was found at the bulbus and along the aortic trunk, similar in character to the endocardial cushion at the AV canal. The AV canal gave access only to the primitive left ventricle and was separated from the bulbus cordis by the bulbo-ventricular flange. There was the septum primum which began to develop near the AV canal from the posterior atrial wall but the interventricular septum could not be recognized.

The large right and left hepatocardiac veins emptied into the sinus venosus and the right, and left umbilical veins were also drained into the sinus venosus. Yet the ductus venosus between the left umbilical vein and the peripheral loops of the liver plexus had not been formed. There were prominent connections between the 3rd and 4th aortic arches and the dorsal aorta, but 1st and 2nd aortic arches were nearly obliterated.

**Urogenital system:** The mesonephros and the mesonephric duct which acquired an opening into

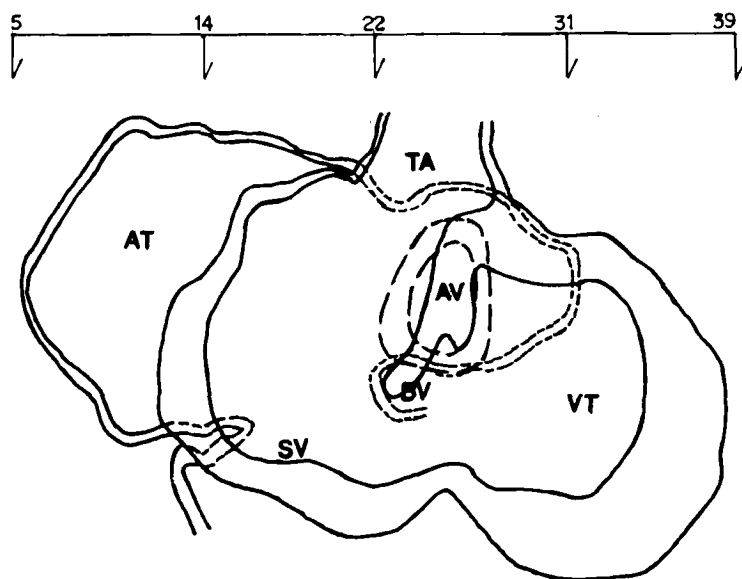


Fig. 4. Schematic reconstruction of the heart. AT: atrium, VT: ventricle, AV: atrio-ventricular canal, TA: truncus arteriosus, SV: sinus venosus, BV: bulbo-ventricular flange.

the urogenital sinus, were observed. The cranial end of the mesonephros was more advanced than the caudal end, which had partially vascularized Bowman's capsules, each connected by an S-shaped tubules with the mesonephric duct (Plate 11). The ureteric bud was not found.

**Other systems:** The somite differentiated into the dermatomes, the myotomes and the sclerotomes, and the myotomes were in close contact with the dermatomes (Plate 12).

### DISCUSSION

In the external appearance of this embryo under discussion, arm buds were prominent and leg buds appeared, which are important differentiating features of Streeter age group. These findings are seen in both Streeter age group XIII and XIV. In the Streeter age group XIV, however, the arm buds have become elongated and curved toward the body, which was not the finding in this embryo.

In the central nervous system, the optic evagination was not accompanied by the indentation of the lens vesicle. The otic vesicle had no endolymphatic appendage and there were some remnants of ectodermal stalk. In Streeter age group XIV, there must be such features as indentation of the lens vesicles, prominent endolymphatic appendages of the otic vesicles and no remnants of ectodermal stalk. Thus the findings of this embryo are younger than XIV, being compatible with Streeter age group XIII.

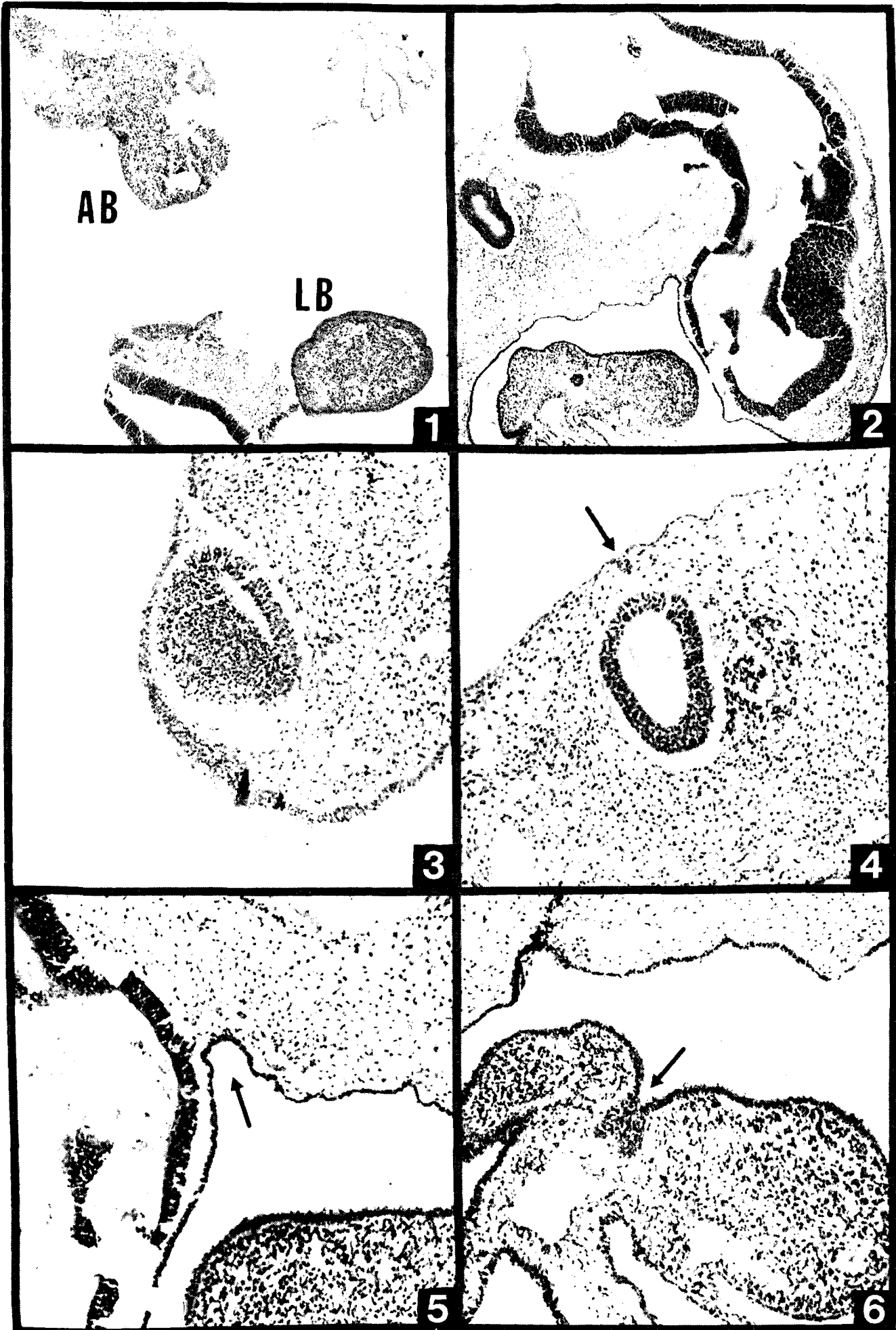
In the digestive system, the gallbladder and the hepatic diverticulum were prominent, and the ventral pancreas was not recognized in this case. These findings are seen in Streeter age group XIII

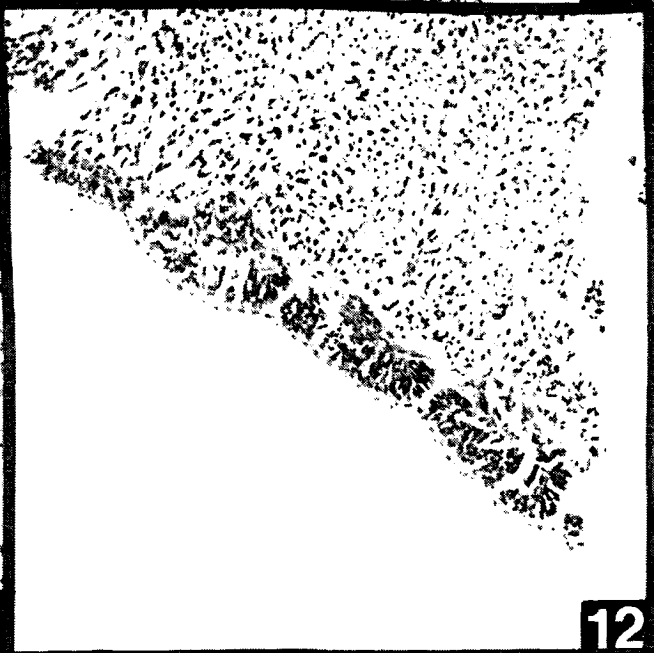
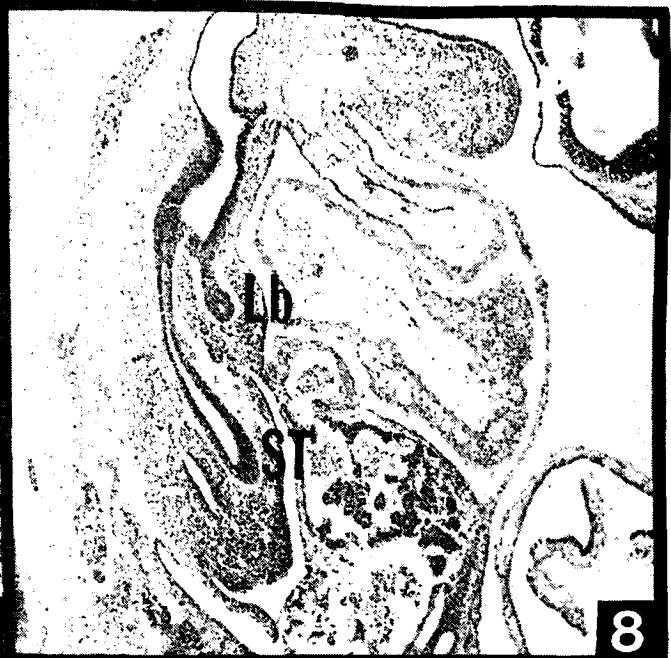
and XIV. In the respiratory system, the level at which the trachea and esophagus had a common lumen was near the bifurcation site of the primary bronchi, which are seen in Streeter age group XIII and XIV. In the cardiovascular system, 4 distinct ventricular wall components well-developed and the septum primum began to develop, which were findings indicative of Streeter age group XIII and XIV. However, in the urogenital system, ureteric buds were not formed from the mesonephric ducts which was a finding of Streeter age group XIII instead of XIV.

Summarizing the findings seen in this embryo, one could easily reach the conclusion that this embryo belongs to the Streeter age between groups XIII to XIV. Between these two, absence of lens pits and ureteric bud indicates group XIII is more likely. This embryo is definitely older than group XII (Chi *et al.* 1980) and younger than group XIV (Chi *et al.* 1983).

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=국문초록=

## 사람배아(Streeter 연령군 XIII)의 1예

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지제근 · 함돈일

자궁 적출술로 절제된 자궁에서 얻은 5.6 mm 크기의 사람배아를 연속선편하고 이를 현미경적으로 관찰하고 재구축하여 그 발생학적 특징을 기술하였다.

본 배아는 발생학적으로 정상 발육을 하고 있었으며 형태학적으로는 두터워진 수정체 외배엽과 더불어 안돌출이 있었고, lens pit는 아직 생기지 않았으며, 이소포는 endolymphatic appendage가 없었고, arm buds와 leg buds, lung buds가 나타났고 ureteric bud는 아직 없었다.

이상의 소견을 종합하여 이 재료는 정상발육중의 배아이고 연령군에는 Streeter의 제13군에 속하는 것이라고 판단되었다.

### LEGENDS FOR PLATES

- Plate 1. The left arm bud(AB) and the left leg bud(LB) are seen.  $\times 40$  (#34)  
Plate 2. The central nervous system. There are the midbrain and the cervical flexure, and the otic vesicle is seen in the left.  $\times 40$  (#25)  
Plate 3. The left optic evagination with thickened lens ectoderm is seen. There is no lens pit.  $\times 100$  (#35)  
Plate 4. The right otic vesicle is seen. There is a remnant of ectodermal stalk (arrow).  $\times 100$  (#21)  
Plate 5. The stomodeum and Rathke's pouch (arrow) are seen.  $\times 100$  (#25)  
Plate 6. The thyroid diverticulum (arrow) from the floor of primitive pharynx.  $\times 100$  (#26)  
Plate 7. The gallbladder (arrow) and the intestine are seen.  $\times 100$  (#16)  
Plate 8. The lung bud(LB) and the stomach(ST) are seen. The tracheo-esophageal junction is seen above the bifurcation site of the primary bronchi.  $\times 40$  (#25)  
Plate 9. The heart. A well-developed and trabeculated venticular wall is seen.  $\times 100$  (#31)  
Plate 10. The heart. The AV canal and endocardial cushions are seen.  $\times 100$  (#25)  
Plate 11. The mesonephros and the mesonephric ducts (arrows) are seen.  $\times 100$  (#22)  
Plate 12. The somites. The myotomes are in close contact with the dermatomes.  $\times 100$  (#16)