

CLEFT PALATE, MICROPTHALMIA AND OTHER ANOMALIES  
IN AN EMBRYO LIZARD (*LACERTA VIVIPARA* JACQUIN)

By

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In the summer of 1946 one of us received from the late Mr. J. Lester, a pregnant female *Lacerta vivipara* which was killed and opened on July 2nd. Its original place of capture is unknown. It contained six embryos in a fairly advanced state of development, each having a head-length of about 4.5 mm. Five of these embryos were normal, but one showed a series of interesting abnormalities of the head region. The most obvious of these were a defect of the upper jaw, which was shorter than the lower one so that the tongue tips projected in front of it (Plate 1, A, D), the apparent lack of eyes and eyelids and the prominence of the brain. The development of the shields over the top of the head was retarded, though elsewhere the scalation was as advanced as that in the normal sibling embryos. The ear drums were present in their normal positions, and the rest of the body showed no unusual features.

A number of serial sections were made of the anomalous embryo, and also of a normal sibling for purposes of comparison. From these it is clear that the former shows a condition of bilateral cleft palate in addition to its other abnormalities. Although cleft palate, in one instance associated with unilateral microphthalmia, has previously been described in snake embryos by Bellairs and Boyd (1957), no reptile showing the same combination of defects as this lizard has come to our notice. The condition, however, seems to be comparable with that produced experimentally in chick embryos by Silver (1960, who removed the eye primordia at the optic vesicle stage and obtained specimens with short upper beak, cleft palate and bilateral microphthalmia. Some of these defects have also been obtained by Ancel (1950) who injected toxic substances into the egg.

The upper jaw and palate are normally developed from the fusion of three main primordia, the frontonasal process medially and the two maxillary processes, one on each side. The premaxillary region and the tissues adjacent to the nasal septum are derived, at least in part, from the frontonasal process, while those further to each side, in relation to the maxillary bone, arise from the maxillary processes. In the anomalous embryo, however, these primordia have apparently failed to fuse, so that there is a cleft along the floor of each nasal cavity (i.e., the palate) throughout its length (Fig. 1, B—D). Both the external nostril and internal nostril are continuous with this cleft. In the photos taken before the embryo was sectioned (Pl. 1, A) the tip of the upper jaw appears to represent the anterior part of the frontonasal process, while the distinct projection on either side further back (Pl. 1, D) represents the front of each maxillary process.

Study of the sections shows that by comparison with the normal sibling, the front part of each nasal chamber is very short, but the posterior region,

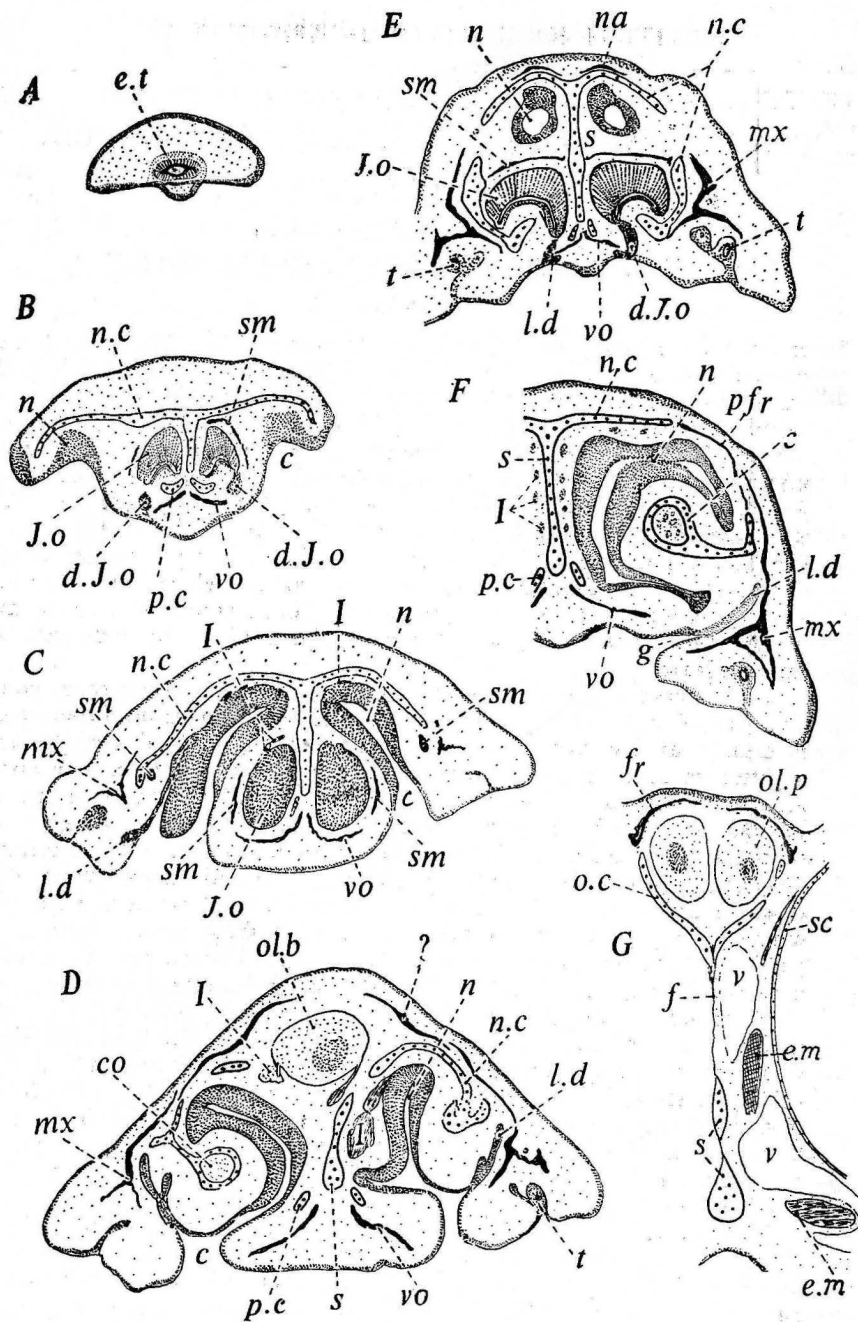


Fig. 1

A—D. Antero-posterior series of sections through snout of abnormal lizard (*Lacerta vivipara*) embryo. A, through tip of upper jaw showing egg-tooth; B, through duct of Jacobson's organ; C, through posterior part of Jacobson's organ showing division of septomaxilla and tip of lachrymal duct (on left); D, through nasal concha. x 43. E—G. Sections through normal sibling embryo. A, through Jacobson's organ; B, through nasal concha; C, through orbit showing inter-orbital septum. x 43.

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which is partly lined with olfactory epithelium and contains the nasal concha (Fig. 1, D) is not markedly abnormal. The premaxilla bears an egg-tooth of normal appearance (Fig. 1, A).

The organ of Jacobson (Fig. 1, B) is smaller than that in the normal embryo (Fig. 1, E) and slightly less advanced in differentiation, as indeed are the other structures of the snout such as the bones and cartilages. It is not obviously abnormal in shape nor in the manner of its nerve-supply, and it communicates with the mouth in the usual way by a duct which at this stage is still uncanalised. The differences in the appearance of this organ in the anomalous and normal embryos are probably due mainly to the less advanced state of development of the former, and perhaps also to a slightly different plane of section.

The septomaxillary bone of the anomalous embryo lies in its usual position, above and to the outer side of each organ of Jacobson. There is, however, a small isolated nodule of bone beneath the outer edge of the cartilaginous nasal capsule on each side (Fig. 1, C) which can be interpreted as a part of the septomaxilla, separated from the rest of the bone by the cleft in the palate. Essentially similar conditions were found by Bellairs

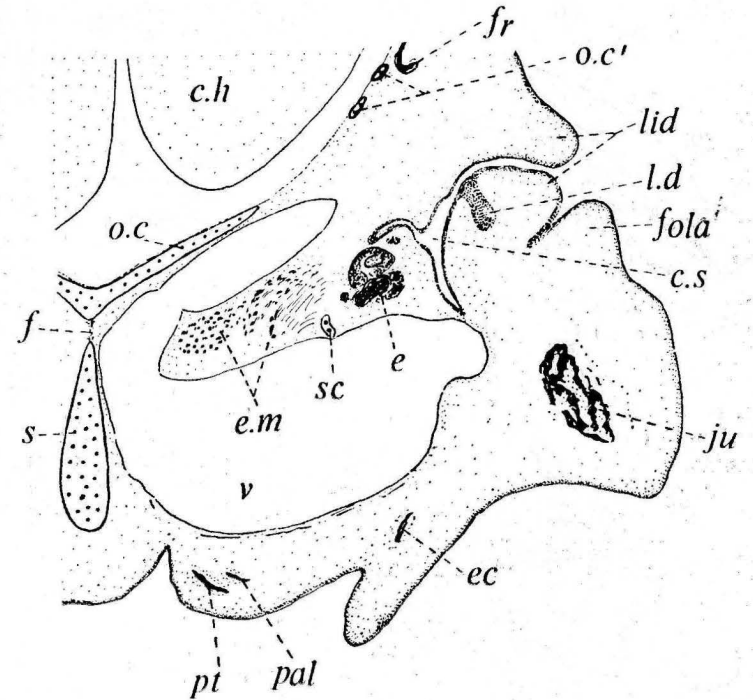


Fig. 2

Transverse section through abnormal embryo showing eyelids, eye rudiment, origin of lachrymal duct and interorbital septum. Level slightly in front of that of section in Pl. 1, E. x 80. Abbreviations, p. 176.

and Boyd in the snake embryos with cleft palate, and their embryological significance has been discussed. They suggest that the organ of Jacobson and the greater part of the septomaxilla arise within the tissues of the fronto-nasal process, but that a small lateral part of the bone is of maxillary process origin.

Some of the other bones are also abnormal. The nasals seem to be absent and the lacrymals could not be identified with certainty. On each side of the olfactory bulbs is a thin plate of bone labelled with a "?" in Fig. 1, D (owing to asymmetry of the brain only one bulb is visible at this level). Although this bone is separated here by a small gap from the ascending process of the maxilla, it fuses with the latter posteriorly, and further back still it apparently becomes continuous with the ossification regarded as the frontal (Fig. 2: Pl. 1, E). It is uncertain whether this bone represents a part of the maxilla, a part of the frontal, or the prefrontal; no other bone which might represent the prefrontal could be found.

The eyes (Fig. 2: Pl. 1, E, F) are small distorted rudiments deeply buried beneath the surface. Each consists of a mass of pigment cells, and of a vesicle of lighter cells which may also have originated from the optic cup. Within the vesicle is another mass which may represent the lens. The scleral cartilage is abnormally thick, and various unidentified eye muscles are present in close proximity to the enormous orbital venous sinus. The optic nerves, chiasma and optic tracts are absent on both sides, but on one there is a small strand of tissue attached to the base of the forebrain in the position where the optic chiasma might be expected in a normal embryo. Since the eye rudiments appear to contain some optic cup derivatives and the optic cup develops as an outgrowth from the brain, it may be supposed that optic stalks connecting the eye and the brain were present at an earlier stage of development, but subsequently degenerated.

The eyelids seem to be represented by two folds of tissue on each side, the lower one being identified as such on the grounds that the lacrymal duct originates from it (Fig. 2). Beneath it, however, there is another fold of doubtful nature, separated from it by a blind epithelial cleft. There is a conspicuous conjunctival space on each side, opening to the exterior by a minute aperture. From the space a small blind channel extends inwards towards the eye rudiment; the fold of tissue beneath this channel may possibly represent the nictitating membrane. No orbital glands could be identified. The condition of the accessory structures of the eye, in particular the presence of a thickened scleral cartilage, distorted eyelids and eye muscles, recalls that found in chick embryos in which microphthalmia has been experimentally induced (Weiss and Amprino, 1940; Amprino, 1951; Bellairs, 1955).

The lacrymal duct originates, as stated, from the lower eyelid, having only a single opening or canaliculus, instead of the normal two. It then passes forwards on the inner side of the maxilla and makes contact with the lining of the nose beneath the concha on the outer side of the cleft (Fig. 1, D). In normal lizards of this species the duct opens into a deep groove in the palate known as the choanal groove (Fig. 1, F) and finally terminates anteriorly in the mouth very close to the inner side of the opening of the duct of Jacobson's organ (Fig. 1, E). In the anomalous embryo, however, it is impossible to find any trace of the duct on the inner side of the cleft

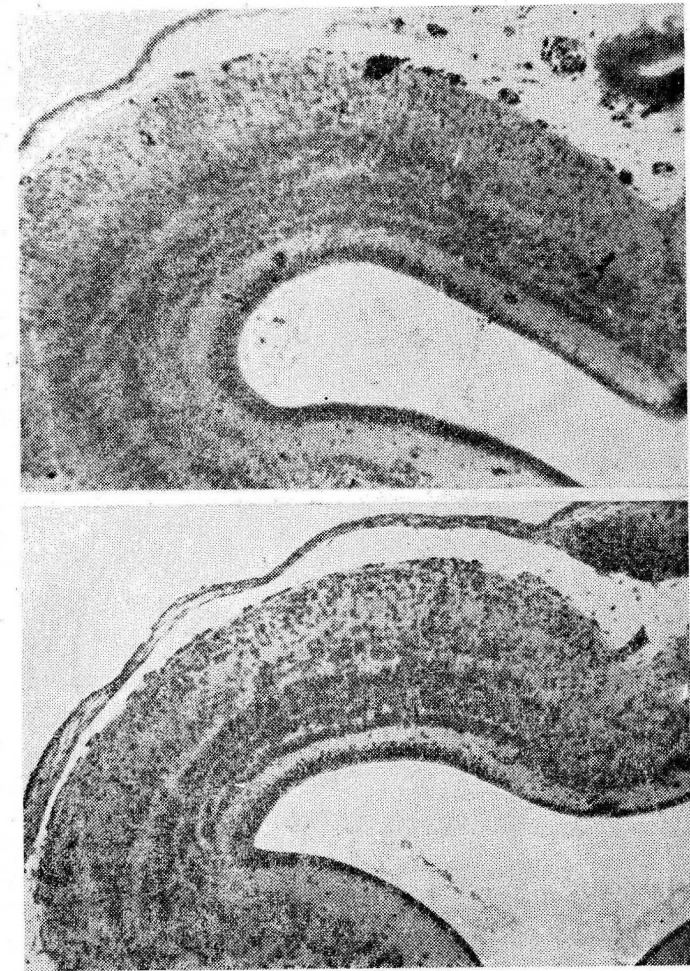


Fig. 3.

Photomicrographs of cross-sections through roof of midbrain of normal (top) and anomalous (bottom) embryos of *Lacerta vivipara*. The laminated arrangement of the nerve cells is shown. The midbrain of the anomalous specimen shows no obviously abnormal features.  $\times 100$ .

near Jacobson's organ; it appears to end blindly on the outer side of the cleft (Fig. 1, C). Similar conditions were found in the snake embryos by Bellairs and Boyd who discuss their embryological implications.

The cartilaginous septum between the eyes (interorbital septum) is essentially normal in shape, though it is both shorter and lower than usual, and contains smaller fenestræ (Figs. 1, G; 2: Pl. 1, E). This finding corre-

sponds with the observations of Bellairs (1958) and Silver (1960) on microphthalmic chick embryos. It is of interest since it suggests that the early development of the septum is not dependent upon any mechanical pressure exerted by the eyes, though the latter probably has some effect on its overall size.

The brain is on the whole remarkably normal in appearance, apart from the olfactory peduncles which are shortened, one more so than the other. The anterior, hippocampal and habenular commissures of the fore-brain are present, and so also is the parietal eye. The roof (tectum) of the optic lobes of the mid-brain shows an apparently normal laminated structure so far as the non-selective histological techniques employed allows us to judge (Fig. 3). Similar conditions have been reported by Collister (1957) in microphthalmic chick embryos lacking optic nerves. Presumably, however, since optic nerves and tracts are lacking, optic fibres are absent from the more superficial layers of the optic tectum. The apparent prominence of the brain seen in Pl. 1, A and D, seems to be due mainly to the alteration of the head contours resulting from the great reduction of the eyes.

#### SUMMARY

Some abnormal features of the head shown by an embryo of *Lacerta vivipara* were studied microscopically and compared with conditions in a normal sibling. The anomalies include shortening of the upper jaw, bilateral cleft palate and bilateral microphthalmia with absence of the optic nerves, chiasma and optic tracts. The structure of the organ of Jacobson, and of the cartilaginous interorbital septum differ only slightly from normal, and the optic lobes of the midbrain show no unusual features.

#### Abbreviations to Figs. 1 and 2

d.J.o., duct of Jacobson's organ. c, cleft in palate. c.h, cerebral hemisphere. c.co, nasal concha. e, eye rudiment. ec, ectopterygoid. e.m, eye muscle. e.t, egg-tooth. f, fenestra in septum. fr, frontal. g, choanal groove. J.o, Jacobson's organ. ju, jugal. l.d, lachrymal duct. mx, maxilla. n, nasal sac. n.c, nasal capsule. o.c, orbital cartilage. o.c', separated part of o.c. ol.b, olfactory bulb. ol.p, olfactory peduncle. pal, palatine. p.c, paraseptal cartilage. pfr, prefrontal. pt, pterygoid. s, nasal or interorbital septum. sc, scleral cartilage. sm, septomaxilla. t, tooth-germ. v, venous sinus. vo, vomer. I, olfactory nerve and nerve to Jacobson's organ. ?, ? prefrontal. c.s, conjunctival space. na, n sal bone,

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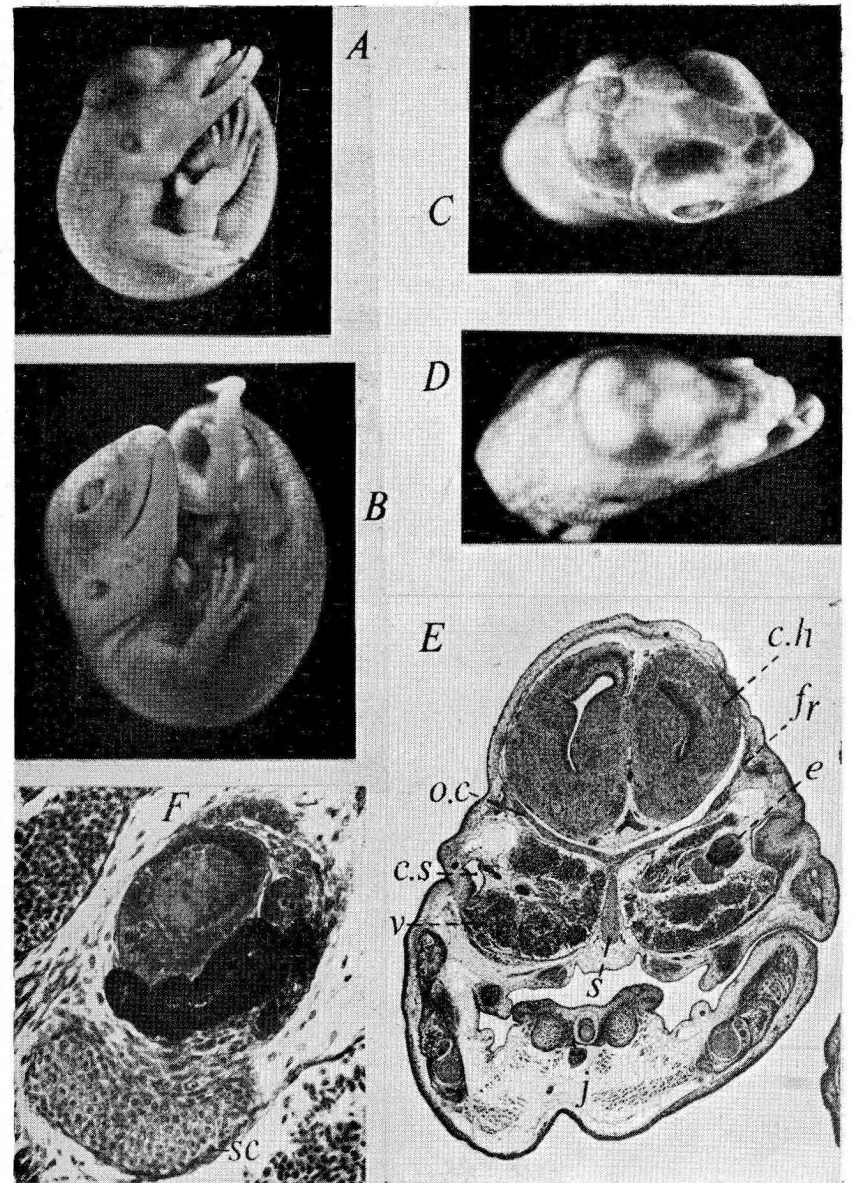


Plate 1

- A, D. Side view, and top of head of abnormal lizard (*Lacerta vivipara*) embryo.  
B, C. Similar views of normal sibling. A, B x 6; C, D x 8.
- E. Transverse section through head of abnormal embryo showing eye rudiment and interorbital septum. x 28
- F. Enlarged view of eye rudiment seen in E. The oval vesicle seen above the black pigment mass may represent the optic cup derivative, and the paler mass within it, the lens. x 212.

#### Abbreviations

c.h, cerebral hemisphere of brain. c.s, conjunctival space. f, frontal. e, eye rudiment. j, lower jaw. o.c, orbital cartilage. s, interorbital septum. sc, scleral cartilage. v, venous sinus.