The price of the complete work, therefore, is DM 102.50 or £8 14s. 6d. The four parts can be bought singly. A binding cover is offered at a moderate extra.

A text of this magnitude—and price—will only be bought by those sincerely and permanently interested in the subject, and to them it will be a source of information and stimulation, because no expert in this field will ever entirely agree with all the pronouncement of another. The beginner, too, could wish for no better Christmas gift.

To browse among the 752 black and white illustrations and the 21 index pages will keep him happily occupied for many weeks. The book has, of course, been written for German readers, the bibliography is heavily weighted on the German side and most references to herpetological journals are to those appearing in Germany. Yet, with a few adaptations the book might well be translated and published for the English speaking world. Let us hope that an enterprising publisher either here or on the other side of the Atlantic will make this book accessible to wider circles of herpetologists.

E. ELKAN.

THE SEXUAL CYCLES OF VERTEBRATES by J. F. D. Frazer. Hutchinson University Library, London, etc. 1959. 168 pp. Price 10/6.

Dr. Frazer's book is a valuable addition to this well-known series, and deals with a most important aspect of biology in which very active research is going on. It covers all the groups of vertebrates, but the treatment of breeding phenomena and the role of the endocrine glands in Amphibia is very full, as might be expected since the author has done much research on amphibian reproduction. A little more information about the spectacular courtship behaviour found in certain groups of lizards might perhaps have been welcome to herpetologists, but the book is, of course, more directed to the general student of zoology or physiology rather than to the specialist on any particular group. It is written in a remarkably clear style, with a minimum of unexplained technical terms, and is confidently recommended to anyone who seeks enlightenment on the zoological aspects of the facts of life.

A. d'A. BELLAIRS.

INTRODUCING DRAGONS, by V. J. Stanek, translated by Sylva Soucková. Spring Books, London. 79 pp.

This book consists of a series of splendid photographs of some of the more spectacular reptiles, such as crocodilians, giant tortoises, snapping turtles and the bigger lizards. The text, brief but accurate so far as it goes, is arranged as a series of captions to the figures. Like Z. Vogel's "Reptile Life", from the same publishing house, it sets a very high standard in reptile photography, and as a collection of photos has a real scientific value. The volume seems to have no price stated (I bought my copy off a remainder stall for 5/-, and very good value, too), and like Vogel's book has no date, a serious omission from the point of view of bibliographers.

A. d'A. BELLAIRS.

ZOOLOGICAL RECORD

Vol. 93, Sect. 16A of the Zoological Record for the year 1956, listing the papers on Amphibia, is now available. It can be obtained from the Zoological Society of London, Regent's Park, N.W.1, for 6/-.

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CONTENTS

Contributions should be addressed to Dr. A. d'A. Bellairs, St. Mary's Hospital Medical School, London, W.2. Articles should be typed in double spacing on *one side* of the paper only. Figures should be drawn in *Indian ink* on plain white paper, or preferably Bristol Board.

Contributors will be supplied with 25 free reprints or copies of the Journal; additional copies may be ordered at cost price.

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

By

A. d'A BELLAIRS and H. J. GAMBLE
Department of Anatomy, St. Mary's Hospital Medical School, London, W.2.

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,

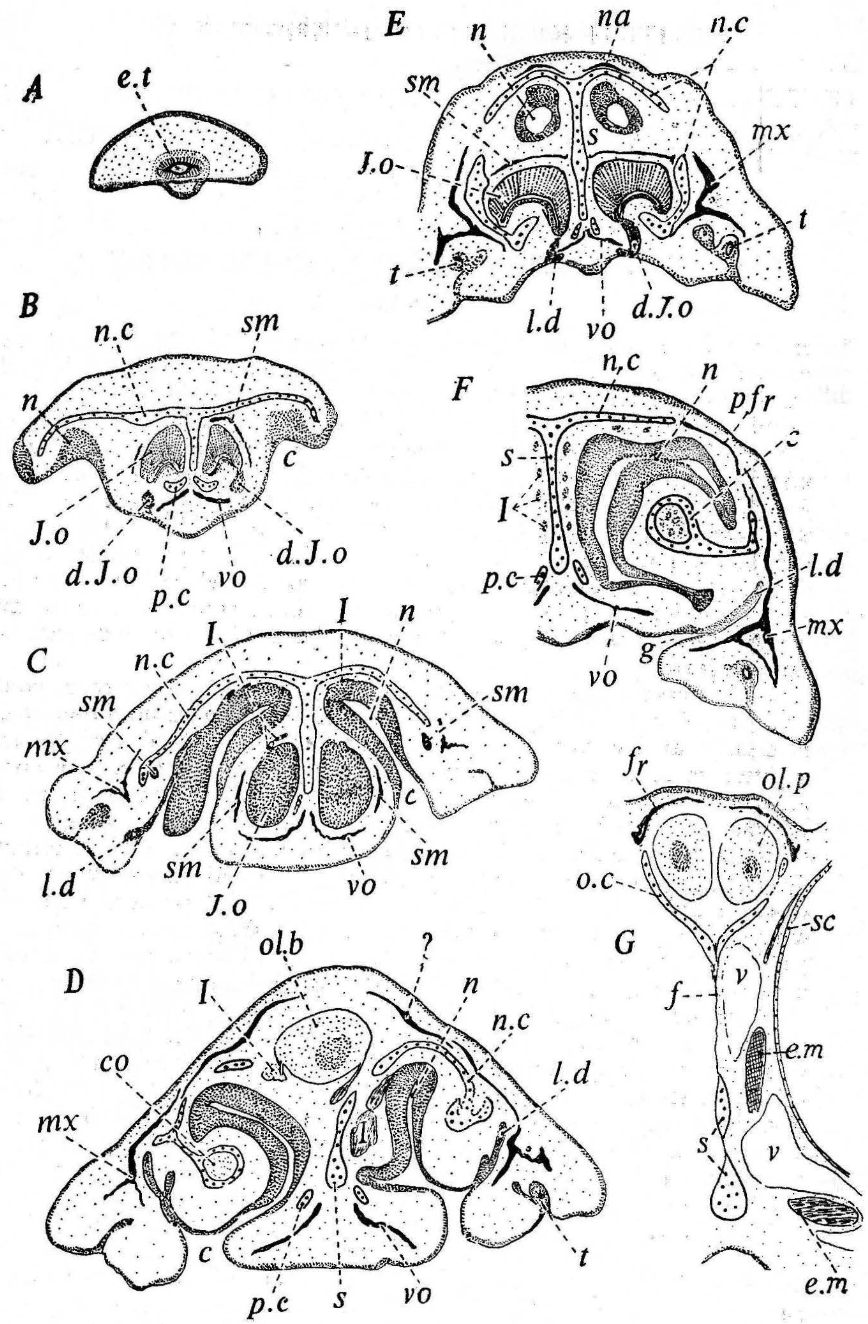


Fig. 1

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.

Abbrevations, p. 176

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

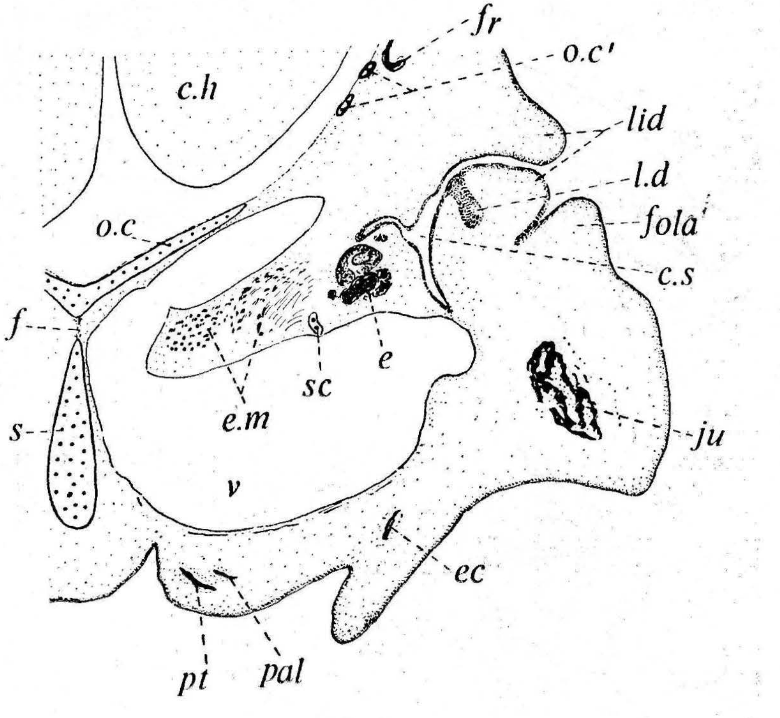


Fig. 2

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. **Abbrevations, 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 lachrymals 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 lachrymal 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 lachrymal 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

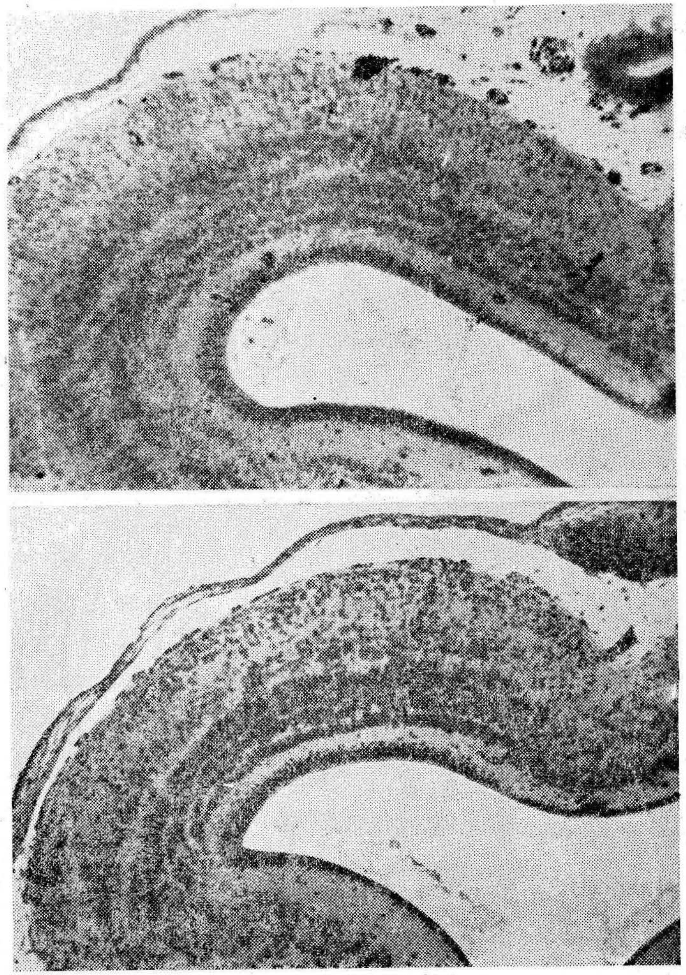


Fig. 3

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. x **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 corresponds 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 comissures of the forebrain 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,

References

Amprino, R. (1951). Developmental correlations between the eye and associated structures. *J. exp. Zool.*, ***118***, **71-100.**

Ancel, P. (1950). La chimiotératogenèse chez les vertébrés. Paris. G. Doin.

Bellairs, A. d'A. (1955). Skull development in chick embryos after ablation of one eye. *Nature*, Lond., *176*, 658-9.

Bellairs, A. d'A. (1958). The early development of the interorbital septum and the fate of the anterior orbital cartilages in birds. *J. Embryol. exp. Morph.*, *6*, 68-85.

Bellairs, A. d'A., and J. D. Boyd (1957). Anomalous cleft palate in snake embryos. *Proc. Zool. Soc. Lond.*, *129*, 525-39.

Collister, R. M. (1957). Anophthalmia and the optic system in the chick embryo. *J. Anat., Lond.*, *91* (Proceedings), 568.

Silver, P. H. S. (1960). Experimental study of head morphogenesis: removal of optic vesicles. *J. Anat., Lond.*, *94* (Proceedings), 283.

Weiss, P., and R. Amprino (1940). The effect of mechanical stress on the differentiation of scleral cartilage in vitro and in the embryo. *Growth*, *4*, 245-258.

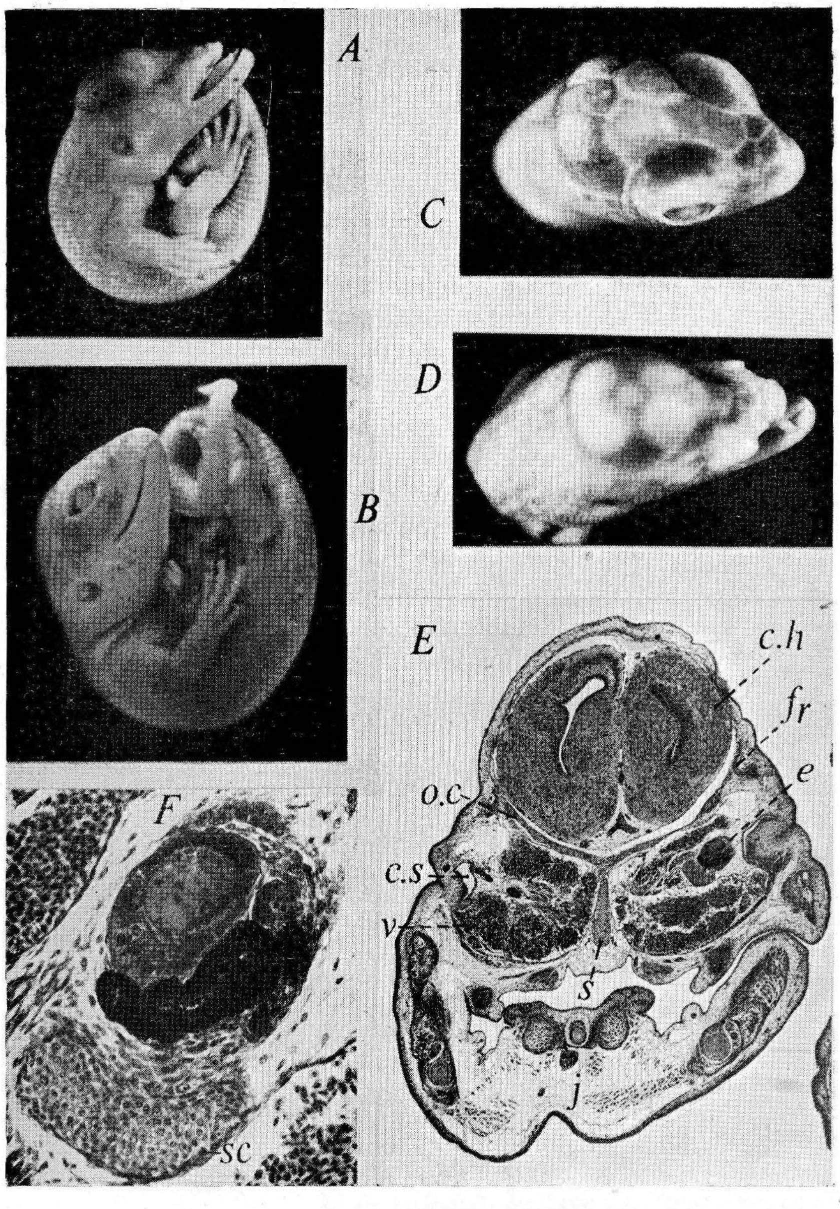


Plate 1

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.

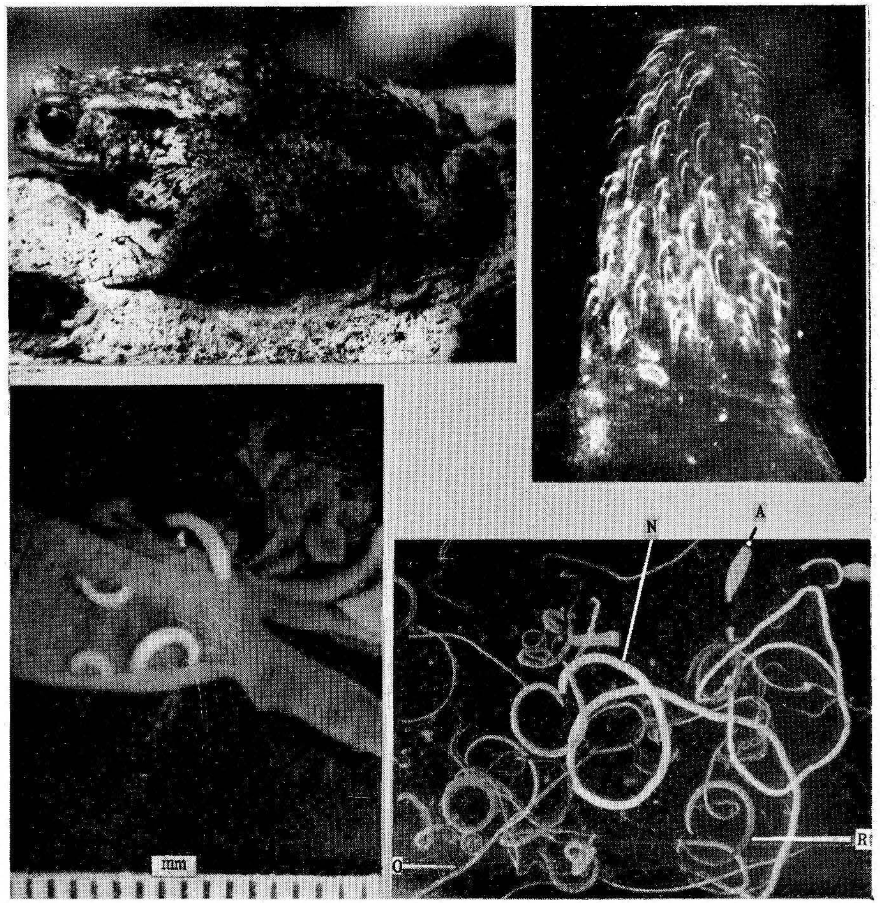


Plate 2

Top left. *Bufo bufo* with subcutaneous dorsal tumours due to fungal infection. (x 1)

Top right. Proboscis of *Acanthocephalus ranæ* (from *B. bufo*). (x 300)

Bottom left. *Acanthocephalus ranæ* in small intestine of *B. bufo*.

Bottom right. Parasitic worms from *B. bufo*. (x 4)

A, *Acanthocephalus ranæ*. N, *Nematotænia dispar*.

O, *Oswaldocruzia filiformis*. R, *Rhabdias bufonis*. All x 2.

THE COMMON TOAD (*BUFO BUFO* L.) IN THE LABORATORY

By

E. Elkan

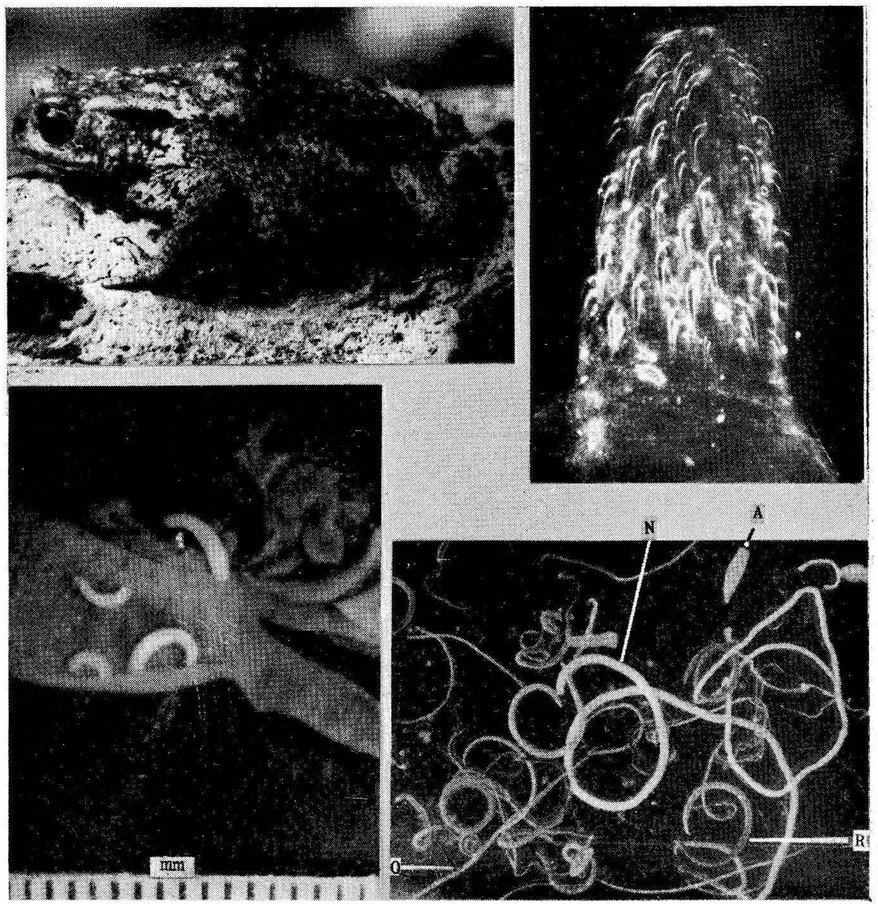
Group 9 Pathological Laboratory, Watford, Herts.

Large numbers of male Common Toads are being kept in laboratories since Mainini (1947, 1968) discovered the usefulness of these in Pregnancy Tests. In spite of our, as we hope meticulous, husbandry, we annually lose about half our stock from "unknown causes". This does not happen with *Xenopus*, the S. African Clawed Toad, which is kept captive in even greater numbers with a persistently negligible mortality. The situation is paradoxical. It is usually easiest to keep any animal in its country of origin, where both the climate and the food to which it is used are available. There are obviously other factors besides climate and food which determine the length of survival time of a captive animal.

One disconcerting factor makes it difficult to derive the greatest scientific profit from the high morbidity among a *Bufo* colony, and that is the fact that it is in most cases impossible to determine exactly which animal is ill and perhaps moribund and which is not. A toad may look fat because it has either blown up its lungs and fails to release the air or because it has filled its intestines with water. These two conditions only occur *in extremis* and are indistinguishable, externally, from the appearance of a really fat toad with a well developed fat-body. Nor can the death of a toad be predicted by its refusal to feed. Many freshly ingested mealworms are found in the stomachs of dead toads; these animals must have fed within a few hours of dying, and since animals which are diseased do usually not feed, it must be assumed that they did not feel ill at the time of their last meal. The fact then remains that out of a certain number of toads one or two will die within the next 24 hours and that we are unable to separate the victims *ante mortem* from the survivors. This is unfortunate because toads which have died in the night may, even on the next morning, show post mortem changes which interfere with the subsequent investigation of the cause of death. It would be greatly to our advantage if we could kill and preserve the moribund toads before they died spontaneously.

If, for reasons beyond our control, toads cannot be examined as soon as they are found to be dead, it is much better to place them into a refrigerator and freeze them as hard as possible than to fix them in formalin. Fixed animals are much more difficult to dissect; the splitting down of the alimentary canal in particular is much easier in fresh material. Frozen specimens must, of course, be thawed in warm water before dissection. If large numbers have to be examined the p.m. examination proceeds as follows :—

1. Inspection of surface and oral cavity.
2. Inspection of subcutaneous lymphatic sacs.
3. After the specimen has been pinned down on a cork mat an incision is made with small, sharp scissors from the chin to the xiphoid process through the skin. Here the incision divides like a Y and is carried downwards towards the leg on either side.



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4. The abdominal muscles are divided following the same plan and the flap formed by the two branches of the Y is pinned back between the legs. This method avoids an accidental injury to the bladder.
5. The shoulder girdle is split with stout scissors along the mid-line and the pins holding the fore legs are adjusted so as to expose liver and heart adequately.

All the viscera can now be inspected. The urinary bladder is sufficiently transparent for the location of parasites. Parasites in the gall bladder cannot be seen. Tumours, areas of inflammation or tuberculosis are immediately apparent. The lungs are invisible if they are collapsed but quite prominent if they are inflated.

6. Any organs or parts of organs which appear to be abnormal are now removed and immediately placed in fixing fluid. The method of Griffiths and Carter (1958) for sectioning material has been found useful. The intestinal canal is divided at the œsophagus and at the rectum. It is then dissected out *in toto* and placed in cold saline. All further manipulations, particularly the longitudinal opening of the intestine with scissors is done in this bath so that no small parasites contained in the gut can get lost.
7. The lungs are pulled forward and the main bronchus is divided with scissors. The lungs are then split longitudinally under saline and contents noted.
8. Unforeseen findings may make deviations from this scheme necessary. The central nervous system can only be satisfactorily examined after fixation and decalcification of the remaining parts of the toad. Up to this stage the whole procedure can be carried out with the help of 1 forceps, 2 pairs of scissors and a hand lens. The further microscopical investigation of the material is outside the scope of this paper.

The results obtained in the post mortem dissection of 100 male *Bufo bufo* fall into two groups: common and rare. The rare conditions are of little importance to the amateur herpetologist but are very interesting scientifically. Since this present report is based purely on British material, both groups give probably no complete picture of *Bufo* pathology. The fact that all the dissected toads were males may also distort the picture slightly. A detailed description of the rare conditions encountered is given by Elkan (1960). None of the toads investigated had been in captivity for more than about 10 months and most of them had not yet been used for tests of any kind.

TUBERCULOSIS

This condition was found in two toads which did not share the same cage. It affected most of the viscera, i.e., liver, kidney, intestine, lungs and the meninges. Its presence is easily detected by the appearance of a multitude of small whitish spots which raise the surface of the liver. Only an adenocarcinoma can produce a similar picture but while this was seen

in a specimen of *B. calamita* it was not observed in *B. bufo*. Tuberculosis is rarely seen in amphibians. It has been described by Weber and Taute (1905) and Küster (1905-28)A few more cases have since appeared in the literature (see Lichtenstein, 1921; Schwabacher, 1959). The bacillus, which is not identical with the human tubercle bacillus, probably invades the toad by the mouth, and finally produces an exact replica of the picture known as miliary tuberculosis, the liver being far more abundantly affected than the lungs. It seems that the toad resists the infection for a long time and does not transmit it to others even under conditions of crowding, also that the two affected specimens were already infected at the time they joined the collection.

INFLAMMATORY TUMOURS OF UNKNOWN ORIGIN

In two specimens it was found that one of the kidneys had been largely destroyed and replaced by a granulomatous tumour, composed of uniform small cells but showing no bacteria nor any areas of degeneration. The interest of these cases lies in two observations: in the first case, the tumour, which was in no way attached to the skeleton, contained an island of cartilage. The tumour must therefore have taken some time to develop. In the second case the inflammatory process destroyed every part of the renal uriniferous tubule with the exception of the ciliated parts which were preserved and in many places dilated. Why the ciliated sectors of the nephron should be more resistant than the others remains to be explained.

FUNGAL INFECTION

Infections by fungi are commonly seen in cattle and other warm-blooded animals. The fungi and their spores are as ubiquitous as the bacteria, yet amphibia are rarely affected. Of the three cases observed in *Bufo bufo* one does not strictly belong to this series since the specimen was sent in from outside and was not part of our own collection. Again the question of transmission from one toad to another does not arise. The second and third toads in which fungi were found did not share a cage nor were they affected in the same way. The first specimen (Pl. 2) showed two large dorsal subcutaneous tumours; the skin covering them was intact. The second toad showed a large ulcerated area covering the whole head where the skin was completely destroyed. The third toad had no external lesion at all but one of its kidneys was seriously affected. In each of these cases it was possible to demonstrate fungal threads in profusion and, so far as could be judged without further tests, there was no difference in the mycelial threads seen. The fungus probably gains entrance through an accidental injury. The normal amphibian skin seems to be an almost impassable barrier but once this is breached the animal has no further means of resistance against the invader and dies after several months of a very miserable existence. Analogous case histories have been published on salamanders.

PARASITES

Useful accounts of organisms which parasitise amphibians are given by Noble (1931), Hyman (1951) and by H. A. Baylis and R. S. J. Hawes in Smith (1951).

There was not a single specimen, among the hundred toads dissected, that was completely free of parasites. Most toads had lived and died harbouring a fair, sometimes a formidable collection of parasites of all shapes and sizes. The innumerable Protozoa, the Ciliates and Flagellates which inhabit the toad's rectum are not included in this survey since they are normal commensals which do not cause disease or death. There remain the worms which spend their whole or part of their lives in the toad and which seem to find in our Common Toad a particularly adequate habitat.

1. *Rhabdias bufonis* (Pl. 2). Short, curled dark brown worms ± 1 cm. long, 2-4 examples of which were found in every lung of the toads examined. All these worms are females crammed full with eggs. The host swallows these eggs which hatch in the intestinal canal, where the filariform young are universally present. These larval worms are passed with the toad's fæces and spend the sexual part of their life in the soil. The lungs of the toad show no defensive reaction against the worm; the relation of host and invader seems to be one of symbiosis though the benefits are all on the side of the worm which uses the toad both as a domicile and as a nursery for the young.

2. *Gorgodera vitelliloba*. A short, cylindrical worm with a tapering end, about 2 mm. long, which lives in the toad's bladder where it attaches itself by means of two suckers. Only three of these worms were seen, always single. They probably constitute no danger to the host unless they become very numerous.

3. *Oswaldocruzia filiformis* (Pl. 2). A very slender, hair-like white worm, 1-2 cm. long, examples of which were found in 90 of the hundred toads examined. They can be found in any part of the intestinal canal which is their permanent habitat. These and the following species were much more numerous in the early summer when the mortality of the toads was at its peak. Twenty to forty could then be recovered from a single toad. Later in the year their numbers dropped to 2-4 or, in exceptional cases, even to nil. Whether, in small numbers, they are actually harmful to the toad is doubtful.

4. *Nematotænia dispar* (Pl. 2). A small tapeworm, 1-5 cm. long, with a round body and a head armed with four suckers but no hooks. The danger of this worm lies in the fact that, when it occurs in large numbers, as it frequently does, it can cause intestinal obstruction. Many cases were seen where the bowels were obstructed by a ball of this worm with an acute area of inflammation above the obstruction. *Nematotænia* seems, therefore, to be the most dangerous of all the worms which inhabit our toad, not so much by the amount of food which it abstracts from the toad's ration, as by its tendency to cause intestinal obstruction, gangrene and death.

5. *Acanthocephalus ranæ* (Pl. 2). A short, cylindrical, 2-3 mm. long white worm, eight specimens of which were recovered only, and of these four occurred in the same toad.* The worm is usually found attached to the intestinal wall, its anterior end deeply buried in the mucosal lining.

* A toad with 15 Acanthocephali in the stomach has since been seen.

One specimen was recovered from the stomach where it was found free and unattached. This worm which has no mouth and, like the tapeworms, no digestive tract, has a powerful anterior proboscis which is densely covered with curved hooks. This proboscis can be withdrawn into the body of the worm and was found in that position in the specimen recovered from the toad's stomach. It may have been dead before it was found. All the other Acanthocephali were found firmly attached and it was indeed very difficult to dislodge them.

It can safely be assumed that our toads were infested with all these worms at the time of their arrival at the laboratory and that it would be vain to hope for any future consignment of uninfested toads. These could only be bred in the laboratory but such an attempt would hardly be made by anyone acquainted with the difficulty of bringing up young Salientia. This thought leads us to the conclusion that *Bufo bufo* is not an ideal laboratory animal. It can, in this respect, not compete with *Xenopus lævis*, for example, a species far less parasitized than *Bufo*. This conclusion is supported by another observation. Toads die in captivity not only at the time when intestinal worms are profuse, but also at seasons when very few worms are present. The total absence in all specimens dissected of a fat-body shows that these toads have, for some time, been unable to assimilate food. They starve to death in the presence of an abundance of flies and mealworms. Of all the possible explanations for this phenomenon the effect of crowding seems to be most likely. All amphibia are by nature solitary animals and the presence of too many of their own species seems to have an inhibitory effect on them. Kept singly or in such conditions that the individual specimens do not see much of each other, they survive in captivity for many years, they are indeed extraordinarily long lived in spite of all their parasites. But they do not do well in groups of 20 in a 12 x 12 x 24 in. tank even if they are given moss to hide beneath, water, and as much food as they will eat. They lose their appetite in the presence of too many competitors for the food and die of starvation since they cannot overcome this inhibition. They may still swallow a worm but it will be found undigested in their stomach. Amphibia are rigidly conditioned animals; even if it costs them their life they cannot learn. The whole picture might change if we could adjust our laboratories so that each toad had its own cage, a suggestion too uneconomical to deserve much consideration.

Acknowledgement

I wish to thank Dr. W. G. Inglis and Mr. S. Prudhoe, of the Department of Helminthology, the British Museum (Nat. Hist.), for their kind assistance and advice.

References

Elkan, E. (1960). Proc. Zool. Soc. Lond. In the press.

Griffiths, I., and Carter, M. E. (1958). Sectioning refractory animal tissues. Stain Technology, *33*, 209-214.

Hyman, L. H. (1951). The Invertebrates. Vols. 2 and 3. McGraw-Hill. New York.

Küster, E. (1905). Ueber Kaltblütertuberkulose. Münch. Med. Wochenschrift No. 2.

— — (1928). Die Kaltblütertuberkulose. In Kolle & Wassermann (Ed.). Handbuch der pathogenen Mikroorganismen. 3rd ed. Vol. *5*, pt. *2*, 1037. G. Fischer. Jena.

LICHTENSTEIN, ST. (1921). Ein Fall von spontaner Froschtuberkulose. Zentralbl. f. Bakt. Parasit. & Inf. Krankh., *85*, 249-252.
MAININI, C. GALLI (1947). Pregnancy test using the male toad. J. Clin. Endocrinology. *7*, 653.
— — (1948). Pregnancy tests with male Batrachia. Endocrinology. *43*, 349.
NOBLE, G. K. (1931). The Biology of the Amphibia. McGraw-Hill. New York.
SMITH, M. (1951). The British Amphibians and Reptiles. Collins. London.
SCHWABACHER, H. (1959). A strain of *Mycobacterium* isolated from skin lesions of a cold-blooded animal. *Xenopus lævis,* and its relation to atypical acid-fast bacilli occurring in Man. *Journ. of Hygiene, 57,* 57-67. Contains references to literature on tuberculosis in cold-blooded animals.
WEBER, A. and TAUTE, M. (1905) Die Kaltblütertuberkulose. Tuberkulosearbeiten a.d. Kaiserl. Gesundheitsamt. Berlin. Hefte 3.

NOTES ON THE EGGS, INCUBATION AND YOUNG OF *CHAMAELEO BASILISCUS*

By

CHARLES E. SHAW

Zoological Society of San Diego, San Diego, California.

On October 10th, 1957, the San Diego Zoo received a consignment of lizards, including *Chamaeleo basiliscus,* from W. A. McDonald of Kaduna, Northern Nigeria. Several female *C. basiliscus* in this shipment appeared to be gravid.

On December 4th, 1957, one of the female *C. basiliscus* was noted attempting to dig holes in several areas of the floor of the display cage, but usually in the corners of the cage. As the sand on the floor of the cage was too shallow as well as too dry to allow for normal egg deposition, the female was removed to an aquarium 48 inches long by 20 inches wide containing sand to a depth of about 12 inches. Three gallons of water were poured on the otherwise dry sand at one end of this aquarium in order to provide a moisture gradient in the substrate in which the female could select a proper nest site.

After the female had started several trial burrows during the preceding three days, she was noted at the surface of the sand in thoroughly emaciated condition on the morning of December 7th. Following considerable exploratory digging, eggs were discovered in an open chamber at the glass bottom of the aquarium about 20 inches distant from the burrow entrance at the sand surface. The burrow leading to the eggs forked into right and left branches, both ending on the floor of the aquarium, and it was in the chamber terminating the left branch that the female had laid 23 eggs in a cluster. The burrow leading to the floor of the aquarium had been filled with sand from the surface to the greater part of its length by the female chameleon.

The eggs, with pliant, creamy-white shells, were removed from the aquarium, numbered with Indian Ink, measured and weighed. In the tabulation below the first figure represents the length of the egg, the second the

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width of the egg and the third the weight of the egg; throughout this note all measurements are given in millimetres and weights in grams :—

1.	12.0	x	10.0	.6	12.	13.7	x	9.7	.7
2.	13.2	x	9.9	.7	13.	13.3	x	10.1	.7
3.	13.4	x	10.0	.7	14.	13.5	x	9.5	.7
4.	13.5	x	9.3	.6	15.	13.7	x	9.4	.7
5.	10.0	x	13.5	.7	16.	13.2	x	10.0	.7
6.	13.6	x	9.3	.6	17.	12.8	x	10.1	.7
7.	13.5	x	10.0	.7	18.	13.7	x	9.7	.7
8.	13.5	x	10.2	.7	19.	13.8	x	9.8	.7
9.	14.2	x	9.1	.6	20.	13.8	x	10.2	.7
10.	13.5	x	9.5	.6	21.	13.7	x	9.5	.7
11.	14.8	x	9.5	.7	22.	12.4	x	10.0	.6
					23.	13.4	x	9.3	.6

The average dimensions of the eggs were : Length, 13.31; width, 9.89; weight, 0.67.

For incubation of the clutch, a crock 6 inches in diameter by 3 inches deep, was used. Screen-sifted, dry, river sand to which 40 c.c. of water had been added and thoroughly mixed, was placed in the crock to a depth of two inches. The eggs were buried in the damp sand at a depth of about one-half inch. A cover glass was then placed over the top of the crock to prevent excessive evaporation during incubation. The crock containing the eggs was placed in one of the heated corridors of the reptile house where the minimum temperature is 80°F. throughout the year and the maximum temperature frequently reaches 95°F. even during the winter months.

During incubation the need for addition of moisture to the crock was indicated by the appearance of conspicuous depressions in the eggs. These were uncovered for examination by gently brushing away the overlying sand with a one-half inch fine-bristle paint brush. In all, 165 c.c. of water were added to the crock during incubation by slowly pouring it around the edge of the crock rather than directly upon the eggs. Water was added to the crock usually in 10 c.c. increments and on an average of every 11 days, the minimum interval being 5 days and the maximum 16 days.

On December 31st, 1957, egg. No. 2 was spoiled and on February 6th, 1958, eggs Nos. 3 and 14 were spoiled; the fertility of none of these was determined. On February 6th, 1958, the 62nd day of incubation, the eggs were again measured and weighed :—

1.	14.7	x	12.3	1.1	13.	15.7	x	12.4	1.1
4.	14.4	x	12.3	1.1	15.	15.1	x	11.6	1.0
5.	15.5	x	12.3	1.3	16.	15.5	x	12.4	1.2
6.	15.8	x	11.7	1.1	17.	15.3	x	12.6	1.2
7.	15.4	x	12.1	1.1	18.	15.6	x	12.3	1.2
8.	14.7	x	12.3	1.1	19.	15.6	x	12.0	1.2
9.	14.7	x	10.7	1.0	20.	15.1	x	12.5	1.3
10.	15.2	x	12.0	1.2	21.	15.8	x	11.9	1.1
11.	17.0	x	12.1	1.4	22.	14.7	x	12.1	1.0
12.	15.5	x	12.2	1.1	23.	15.4	x	11.5	1.0

The average measurements and weight of the surviving eggs at this time were : Length, 15.33; width, 12.07; weight, 1.14. During these first two months of incubation the eggs had increased 15.26 per cent. in length, 21.79 per cent. in width and 72.72 per cent. in weight.

On March 18th, 1958, the 102nd day of incubation, the eggs were again measured and weighed :—

1.	15.5	x	12.6	1.4	13.	15.8	x	12.6	1.5
4.	15.5	x	12.8	1.4	15.	16.2	x	12.3	1.4
5.	17.0	x	13.2	1.6	16.	16.4	x	13.1	1.5
6.	17.2	x	12.8	1.5	17.	15.7	x	12.9	1.6
7.	16.7	x	13.5	1.6	18.	16.6	x	12.6	1.6
8.	16.3	x	12.8	1.6	19.	16.8	x	13.3	1.7
9.	15.1	x	11.1	1.2	20.	16.5	x	13.4	1.7
10.	16.7	x	13.2	1.5	21.	17.2	x	12.7	1.5
11.	16.8	x	12.5	1.5	22.	14.7	x	12.4	1.3
12.	17.1	x	13.1	1.6	23.	16.2	x	12.1	1.4

At this time the average measurements and weight of the eggs were : Length, 16.30; width, 12.75; weight, 1.5. The average increment in measurements and weight since laying were : Length, 22.5 per cent.; width, 28.6 per cent.; weight, 127.27 per cent. Eggs. Nos. 19 and 20 both showed the rather astonishing increase of 142.85 per cent. over their weights at the time of laying.

On April 6th, 1958, egg No. 9 had spoiled. Examination showed that it contained a well developed dead embryo.

The eggs were not again measured nor weighed after March 18th, the 102nd day of incubation, since it was expected that they would soon hatch. I believe, however, that the maximum limit of increase in linear dimensions and weight had been achieved by this time. Frequent examination until hatching did not indicate any appreciable growth of the eggs subsequent to the last measurements.

On May 24th, 1958, the 169th day of incubation, the first of the eggs hatched. With the exception of May 31st, hatching continued every day to and including June 7th, when the last young chameleon appeared after 183 days of incubation. The frequency of hatching was as follows : May 24th (1); May 25th (3); May 26th (5); May 27th (2); May 28th (1); May 29th (2); May 30th (3); June 1st (1); June 7th (1). The mean incubation period was 172.8 days. Menzies (1958) notes more lengthy incubation as well as gestation periods for the eggs and young of several chameleon species. The comparatively shorter incubation period for our *C. basiliscus* eggs is probably due to the higher temperatures under which the eggs were incubated. As pointed out by Fox (1948) the rate of development during gestation in ovoviviparous *Thamnophis* is an artifact of thermal levels.

Measurements and weights of the 19 young that successfully completed incubation are given below. The first figure represents the length overall, the second figure tail length, and the third figure weight :—

55	25	.60	58	30	.65
60	28	.80	60	30	.70
55	27	.55	61	30	.80
59	31	.70	58	30	.65
60	30	.55	60	29	.80
58	28	.65	61	31	.80
59	30	.60	59	30	.80
61	30	.70	61	30	.90
60	29	.70	62	31	.60
57	30	.60			

The average measurements and weight of the young were : Overall length, 59.15; tail length, 29.42; weight, 0.69.

The young chameleons, perfectly formed miniatures of the adult, were kept in a screened cage which was placed outside in the sun for the greater part of each day. Fruit flies (*Drosophila*) in quantity were offered as the only food source, but were not too readily accepted. Moisture for drinking as well as for humidifying the environment was provided in a form of a fine spray administered several times daily and containing water soluble aureomycin. In spite of the considerable amount of care and attention given the young chameleons, they survived a very short time, the last one dying on June 20th, 1958.

References

Fox, Wade (1948), Effect of Temperature on Development of Scutellation in the Garter Snake, *Thamnophis elegans atratus*. Copeia, No. 4, 252-262.

Menzies, J. I. (1958), Breeding Behaviour of the Chameleon (*Chamaeleo gracilis*) in Sierra Leone. Brit. Jour. Herpetology, 2, 130-132.

SURVEY OF ADDERS IN EPPING FOREST

A survey of the adder population of Epping Forest, Essex, is being carried out by members of the British Herpetological Society and the Essex Field Club. Preliminary observations, made during the last three seasons suggest that :—

(1) Adders are abroad between early February and late November, when the ground temperature is above 50°F.

(2) The snakes frequent marshy clearings carpeted with grasses or heather and dotted with clumbs of silver birch, hawthorn and blackberry brakes, rather than dry heath. Viviparous lizards (*Lacerta vivipara*) and short-tailed field voles (*Microtus agrestis*) are also common in the adder habitats.

(3) The average adult size of the adders is 18-20 inches for the males, and 22-24 inches for the females, the maximum recorded size of the latter being 27 inches.

(4) Examination of stomach contents indicate that short-tailed field voles and viviparous lizards are probably the main food. Remains of slow worms (*Anguis fragilis*) and nestling birds have also been recovered.

The findings will in due course be published at length in the *Essex Naturalist*. The author of this note would welcome assistance from any members of the Society in continuing the Survey.

G. Malenoir, 309 Hainault Road, Leytonstone, London, E.11.

DR. MALCOLM SMITH

An Appreciation by

HIS ROYAL HIGHNESS PRINCE CHULA OF THAILAND,

G.C.V.O., M.A., F.R.G.S.

An Englishman, newly arrived in Bangkok, was lent a house by an English resident of many years' standing who was absent somewhere up-country. The newcomer went to a hilarious party, and his feelings can be imagined when on his return home he found a big live snake crawling about the room. He found a stick and set about killing the snake, and his success relieved him of any fears of possible hallucinations after such a gay party. When the host came home a few days later he was terribly upset at the loss of what was one of his favourite and harmless living specimens.

The host was Dr. Malcolm Smith, who died in 1958 at the age of 82, and who is still much missed by his many friends of different age groups. The present writer cannot recall any conscious period of his life when he did not know Dr. Smith. When Dr. Smith went to Thailand only a handful of Thais, who had studied medicine in Europe or America, were already in practice, and these were mostly in the Army or the Health Department, so that private patients relied largely on European physicians. Although officially he was the medical officer to the British Legation, my father succeeded in persuading Dr. Smith to become our family doctor and soon introduced him into the household of his mother, the Queen-Mother Saowabha. With his characteristic straightforward sincerity, Dr. Smith made it clear that the interests of the British community in Bangkok came first.

I knew him then only as a doctor, and in those days he had to be versatile. I can well recall him pulling out some teeth of my dear Thai nanny, and some big operations were also successfully performed. If I, at the age of nine, suffered excruciating pain from a course of anti-dysentery injections, it was from the medicine in those days and not his delicate hands. I well remember, in the not so hot season, how neat and smart he looked in his dark blue suit when he came in the evening.

The Queen-Mother was devoted to him and he received many rich gifts. I can still see him sitting on the floor by her bed, and my grandmother and he would chat for hours, exchanging stories of each other's land, with Smith speaking fluent Thai. My father looked upon him as a close friend, and Dr. Smith was one of the few with whom he relaxed completely. His friendship with my mother, who later lived in France until she died in January this year, continued till his death, and Dr. and Mrs. Smith, as well as his sons, often visited her at Neuilly-sur-Seine.

Dr. Smith was very fond of fruits of all kinds, and when he left the Royal Palace, the back seat of his car was piled high with them. Unfortunately he loved the durian—the fruit with the terrible smell—which I am told is delicious. We in the Palace were forbidden even to see this fruit, but some of the less exalted ladies of the court succeeded in smuggling in the best specimens for the popular Dr. Smith.

The last time I saw him was here in Cornwall when he visited his sons at their war-time evacuated school. Then I discovered his other, and hitherto hidden gift, ballroom dancing, and I was pleased to hear that he had won prizes in competitions.

Men of Dr. Smith's calibre will probably never be seen again, and those of us who knew him will never forget him.

ADDENDUM and CORRIGENDUM

Addendum to bibliography of the works of Malcolm Arthur Smith (Brit. J. Herpetol., Vol. 2, No. 8, Sept., 1959, p. 142) :—

Item 6 (1914) should read as follows :—

6. The snakes of Bangkok. [Pts. I and II]. J. nat. Hist. Soc. Siam, 1 : 5-18, 3 pls.; 93-104, 3 pls. [See No. 13].

Correction to "Malcolm Smith's contribution to herpetology."

Ibid., p. 138 (footnote). *For* Leonard Miall, *read* Louis C. Miall.

REQUEST

Dr. E. Elkan (62 Woodhall Gate, Pinner, Middlesex) would be most grateful for any unwanted specimens of reptiles or amphibians which die in captivity. In the summer these are best preserved in 10 per cent. formaldehyde, but in the winter they can be sent as they are.

REVIEW

PATHOLOGIE DER LABORATORIUMSTIERE : by P. COHRS, R. JAFFE and H. MEESEN. Publ. Springer, Berlin, 1958. Vol. I, pp. 799, with 356 illustrations. Vol. II, pp. 803, with 256 illustrations. Price : German Mark 298 (or approx. £27 10s. 0d.).

Animal houses attached to the larger hospitals should logically be under the care of veterinary surgeons. But they never are. They are supervised by those trained in human pathology. Strictly speaking, therefore, the unfortunate animals never "see a specialist".

For those whose work puts them in charge of laboratory animals, text-books on animal care and animal pathology, to say nothing of therapeutics, should therefore be more than welcome, and it is surprising to see how few of them have been written. If the unsuspecting reader should think that this review might be written with the object of encouraging him to read a new book on this subject, let me disabuse him at once. He will first have to mobilise nearly £30 in order to possess himself of these two volumes, for he will find it difficult to run a copy to earth among the libraries of the various scientific institutes which might be expected to have one. Let me make his task easier by divulging that the Commonwealth Bureau of Animal Health Veterinary Laboratory in Weybridge are the lucky possessors of a review copy.

The 1,602 pages of this well produced book deal with the pathology of a great many of the organic systems and of the special pathology of some of the smaller laboratory animals, though neither the dog nor the cat nor