REVIEWS

"SONG OF THE SNAKE" by Eric Worrell.
Published 1958 by Angus & Robertson Ltd. Price 27s. 6d.

This is a book which cannot fail to have a very wide appeal. In the first place, it is an absorbing adventure story which reflects the personality of the author. Eric Worrell is one of those fortunate but rare individuals who have found or made it possible to devote their lives to what they want to do most, and his lifelong interest has undoubtedly been reptiles. The book covers some years of his wanderings in his native Australia, from the Northern Territory to the islands of the Bass Strait, and it includes many exciting experiences while hunting snakes, most of them deadly, as well as crocodiles, buffaloes and quite a few other creatures. The background of some of the wildest parts of Australia and the people, black and white, whom he encounters there, makes all this extraordinarily interesting for anyone. The author's style has been described as "Australian journalese" but is nevertheless well suited to the atmosphere of the book, and the fifty or so quite good photographs are an added attraction.

For the herpetologist, the book has considerable extra interest. There is no doubt that Worrell knows his country's reptiles very well and the book includes a valuable store of first-hand information on many of them. His observations on taipans and tiger snakes, and a complete chapter on the Water Dragon, *Physignathus lesueuri,* are particularly informative. Altogether, the book can be recommended to all who are interested in the reptiles of Australia.

J. W. STEWARD.

"SNAKES AND SNAKE HUNTING" by Carl Kauffeld.

Published 1957 by Hanover House, New York. Price $3.95.

The author is Curator of Reptiles in Staten Island Zoo and a well-known herpetologist in his own country and abroad. In this book, he writes about some of the many hunting trips he has made over a period of years to collect snakes in various parts of the United States, from the swamps of Florida to the Arizona Desert and the pine barrens of New Jersey.

The subject is one which appeals to both herpetologists and non-herpetologists, and the author has endeavoured to make his book appeal to both. His genuinely enthusiastic style has assisted him considerably in this respect, and the result is a vivid and fascinating account of his encounters with many kinds of snakes, from deadly Diamondbacks to harmless King Snakes, Racers and Whip Snakes, under varied conditions and in very different habitats. He describes in detail how his expeditions have been planned and carried out, as well as the many different means he employs to find and catch his specimens. His observations on many of the species he has caught are exceedingly informative and in particular the information he gives about some of the rarer snakes, such as Willard's Rattlesnake and the Arizona Black Rattlesnake, adds much to what is generally known about these species.

There are 14 photographs, mostly excellent, and an extremely useful index giving the officially-approved common names as well as the technical names of all the reptiles and amphibians mentioned in the book.

J. W. STEWARD.

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CONTENTS

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

THE YOLK OF THE ADDER (*Vipera berus*)

by

RUTH BELLAIRS

Department of Zoology and Comparative Anatomy, St. Bartholomew's Medical College, and Department of Anatomy and Embryology, University College, London.

INTRODUCTION

The eggs of reptiles, like those of birds, contain a large amount of yolk. This is true, not only of oviparous forms, but also of those like the adder in which the eggs are retained inside the mother until the young are ready to be born. The yolk is enclosed in a bag known as the yolk-sac which is attached to the embryo and lies beneath it. Blood is carried from the embryo to the yolk-sac in vessels called the vitelline arteries; it returns from the yolk-sac to the embryo in the vitelline veins.

The main function of the yolk is to provide nourishment for the developing embryo, and like the food of the adult it is broken down by digestive juices (enzymes). In the chick embryo the yolk is partly digested within the yolk-sac; in this state it is absorbed by the vitelline blood vessels and then carried to the embryo where the digestive process is completed. It is probable, though not yet certainly known, that the digestion of yolk in reptiles occurs in a similar manner.

Much of the yolk is used up during embryonic life. In the adder, however, a considerable quantity is left over, and this, together with its enveloping sac, is withdrawn through the umbilicus into the body of the young snake about the time of birth. It probably then serves as a source of nourishment during the first few months of life (Bellairs, Griffiths and Bellairs, 1955).

While the composition and structure of the yolk of the hen's egg has been very thoroughly described (see Grodzinski, 1946 : Romanoff and Romanoff, 1949 : Needham, 1950), that of reptiles has received much less attention. Such work as has been done on it is reviewed by Grodzinski (1950) in his account of the yolk of the sand lizard (*Lacerta agilis*).

Generally speaking, the yolk of vertebrate eggs consists of a liquid containing spherical bodies or drops of various kinds and sizes. In the fowl and the sand lizard these drops are of two main types; some consist of aggregations of fat, others of fat and proteins combined, such substances being called lipo-proteins. This study was made in order to determine whether the yolk of the adder has a similar constitution, and to provide further information on the structure of the yolk drops themselves.

The yolk was examined both by the "ordinary" or light microscope, and by the electron microscope, an instrument capable of very much higher magnifications which has not been previously used, so far as I know, in the study of reptilian yolk. These observations are of a preliminary nature, since they are based on examination of only three fertile eggs, taken from two adders at the beginning of July when the embryos were at an early stage of development. The findings, however, were essentially similar in all three specimens.

Observations

When an unstained and undiluted sample of adder yolk was smeared on a glass slide and examined by light microscopy two main types of yolk drop could be seen floating in a liquid. Drops of the first type were golden yellow in colour, and some were as much as 40 microns in diameter. There were several reasons for considering these to be fatty drops.

In the first place, they had the glistening appearance so characteristic of fat, as well as a tendency to float on the surface if Ringer's saline or distilled water were added to the yolk smear. Secondly, they were attacked by fat solvents, for if xylene or benzene was introduced at one side of the smear these yellow drops were gradually broken up into smaller ones. Thirdly, if a cover-slip was placed on top of a smear and pressure applied to it, these droplets became distorted into pear-like or oval shapes; when the pressure was released they regained their rounded shapes.

A characteristic of fatty materials is that they stain brown-black, with osmic acid. Yolk smears, wet or dried, were therefore left in an atmosphere of osmic acid vapour for two hours. They were then quickly cleared in benzene and studied under the light microscope. The larger yolk drops had stained intensely black, though many of the very largest had apparently been washed out of the preparation during the clearing process, for round empty spaces, each about 30—40 microns in diameter, were visible.

Another characteristic of many types of fat is to stain readily with a dye known as Nile blue sulphate (Holtfreter, 1946). It was found, however, that when a 1% aqueous solution of this dye was added to a wet smear of the yolk, these drops remained yellow even though all the other components of the yolk were stained blue. Similarly, these drops remained yellow when treated with a 0.75% aqueous solution of the dye neutral red. It seemed possible that the failure of these drops to take up the dyes was due to their being surrounded by amembrane, or some other barrier,which the dyes were unable to penetrate

When examined by electron microscopy (see plate 1, fig. B) these yolk drops appeared intensely electron-opaque if the yolk had been fixed in osmic acid; a similar appearance is shown by certain drops in the yolk of the hen's egg which have previously been identified as fatty (Bellairs, 1958). With such intense electron opacity it was not possible to confirm the previous suggestion that each of these drops was surrounded by a membrane. This question was also investigated however, by fixing a yolk smear in potassium permanganate. This reagent is an excellent fixative for many cellular components, but it fails to fix certain types of fat drops so that the fat disappears from the preparation. Some smears were therefore treated with permanganate, and it was found that the yolk drops appeared in the electron micrographs as empty spaces, as they would be expected to do if they had previously contained fat (see plate 2, fig. D); furthermore, a single dark line could be seen surrounding each space (see plate 2, fig. E).

It was not possible to see more than one dark line in this region, even at much higher magnifications. Unfortunately it is difficult to decide whether this line constitutes a real membrane or not, for different investigators do not agree as to what a membrane should look like under the electron microscope.

The second type of drop found in adder yolk appeared grey when viewed under the light microscope by transmitted daylight; these drops were usually not more than about 10 microns in diameter. Some of these grey drops had much smaller droplets which I have called sub-yolk droplets enclosed within them. Similar droplets were also found independently in the yolk, frequently adhering to the outer surfaces of the grey drops. It seemed possible that these independent droplets had been liberated from grey drops which had been broken down during the process of digestion.

Unlike the larger yellow drops, the grey drops did not float if water or saline was added to the smear; nor were they attacked by fat solvents such as xylene and benzene. Hence it seemed unlikely that they were composed entirely of fat. On the other hand they were stained brown by osmic acid, suggesting that some fat was present in them.

It seemed probable, therefore, that these grey drops were composed of lipo-proteins, which, as previously stated, are generally present in the yolk of vertebrate eggs. This view is further supported by previous electron microscope studies, since the grey drops in adder yolk bear a close resemblance to structures in the yolk of the hen's egg which have been regarded as consisting of lipo-proteins (Bellairs, 1958).

The grey drops of the adder yolk often appeared under the electron microscope to contain other bodies of about one micron in diameter (see plate 1, fig. A); these were probably the sub-yolk droplets seen by light microscopy. Both the grey drops and their contained sub-yolk droplets appeared to be composed of small particles not visible under the light microscope, each being some 150-200 Angstrom units in diameter (see plate 1, fig. C). These small particles were probably responsible for the grey appearance of this type of yolk drop under the light microscope. The grey drops and their droplets varied in density, suggesting that they also varied in their chemical composition.

The liquid component of the yolk became pale blue in smears treated with Nile blue sulphate, pink in those treated with neutral red, and light brown in osmic acid preparations. Under the electron microscope it was found to contain particles similar to those found in the second (grey) type of yolk drop. Small membranous structures, usually no bigger than about 600 Angstrom units, were also seen (see pl.1A); these might perhaps represent the remains of yet another type of yolk drop, but it is possible that they were only artefacts due to the process of fixation.

Conclusions

The yolk of the adder, like that of the eggs of the hen and the sand lizard, contains both yellow and grey drops, the former consisting of fat and the latter probably consisting of lipo-proteins. The use of the electron microscope has shown that the structure of the grey yolk drops in the adder is not uniform; some contain sub-yolk droplets and others do not, and variations in the density of both drops and droplets were observed. The grey drops may therefore differ from one another in the types of proteins and lipo-proteins which they contain.

It may be that these findings indicate that several different types of grey drops are present as distinct entities in the yolk from the beginning of embryonic life. On the other hand it is possible that the differences

observed represent the appearances of grey drops of a basically similar type when seen at different stages of digestion, and that the structure of these drops is constantly being altered by the action of digestive enzymes.

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Description of Plates

Plate 1

A. Electron micrograph of adder yolk fixed in osmium tetroxide. 1., 2., 3. and 4.: the type of yolk drops which would appear grey if viewed with the light microscope; they are probably lipo-proteins. 4. which has probably lost its round shape during fixation contains sub-yolk drops. 5. which has also lost its rounded shape is the type of yolk drop which would appear yellow if viewed by light microscopy, and is probably composed of fat. Note the granular nature of 1., 2., 3., and 4. and the relative uniformity of 5. 6.: membrane present in the liquid component of the yolk. Magnified x 15,000.

B. Two of the fatty yolk drops after fixation in osmium tetroxide. Yolk drops of this type may be as large as 40 microns. Magnified x 13,000.

C. Higher magnification of a lipo-protein yolk drop to show the granules contained within it. Magnified x 35.000.

Plate 2

A. Electron micrograph of adder yolk fixed in potassium permanganate. An oval space lies in the centre of the field. This is the remains of a yolk drop which has lost its contents during preparation of the tissue, which is a characteristic of fatty drops which have been fixed in this way. The oval shape is due to compression during preparation. The liquid in which the fat drops float appears grey in this figure. Magnified x 8.900.

B. The edge of a large fatty yolk drop of the type shown in Pl. 2 A. 1, empty space from which fat has been lost. 2, liquid phase surrounding fat drop. 3, dark lnie at edge of fat drop. Magnified x 30,000.

C. Egg of cobra (*Naja melanoleuca*) prior to hatching, showing slits made by egg-tooth of young still inside. *c*, 2/3 nat. size Photo by T, Gillespie Esq F.R.Z.S. (Scot,)

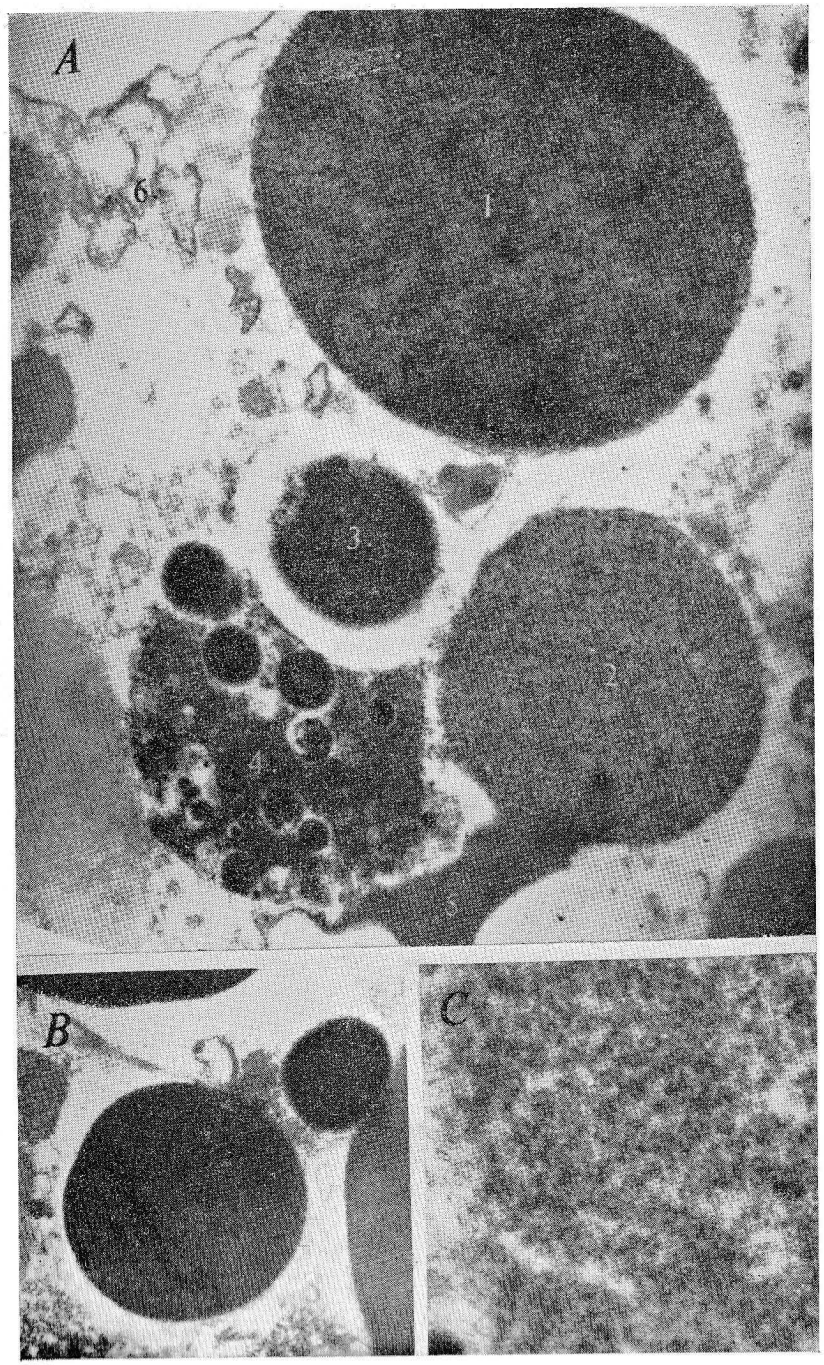
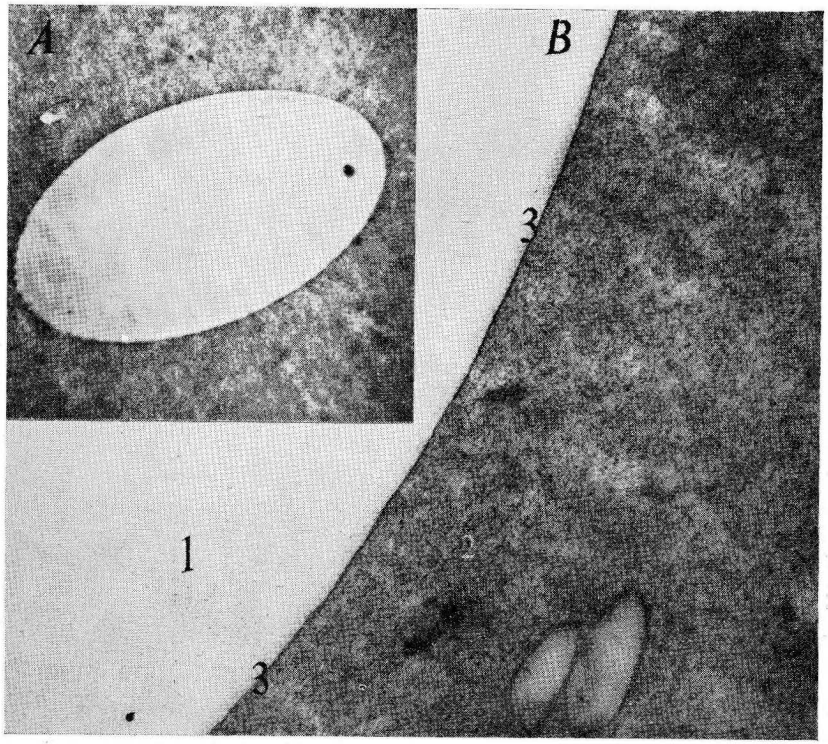


Plate 1



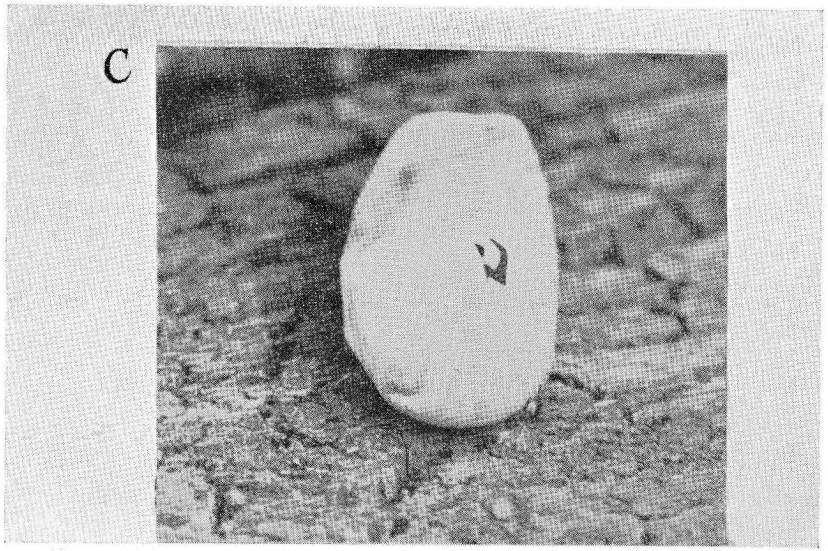


Plate 2

THE HATCHING AND REARING OF THE COBRA (*NAJA MELANOLEUCA*)

by

DAVID WILSON

The Reptile House, Royal Zoological Society of Scotland, Edinburgh, 12

A clutch of 17 Black and White Cobra (*Naja melanoleuca*) eggs was found in the Cobra cage in the Reptile House on the morning of the 23rd November, 1955. These had been laid by one of the six Cobras collected by G. D. Handman, Esq., of Blantyre, Nyasaland, and presented to The Royal Zoological Society of Scotland on 3rd July, 1951. The eggs ranged in size from 57 x 30 mm. to 66 x 31 mm.

The entire clutch was removed from the cage immediately, as past experience has proved that any eggs left in the cages for any length of time dry up very quickly and are sometimes flattened and misshapen by the cage inmates.

METHOD OF INCUBATION

A 10-inch flower-pot with a level rim (to ensure a good fit with the top glass and thereby promote good humidity) was half-filled with warm stable manure. Adequate drainage was provided with broken pot and pebbles placed in the base. On top of the stable manure a thin layer of sphagnum moss was spread. The 17 eggs were then arranged on this cushion of moss and covered with another thin layer of moss plus some more manure, filling the pot up to one inch from the top. Before covering the pot with a suitable size of $\frac{1}{4}$" plate glass, a few drops of "Germstroyd" disinfectant were added to discourage the growth of fungi or bacteria.

The flower-pot was then stood in a clay saucer filled with lukewarm water, and the complete apparatus placed on a steam radiator. The temperature of the water in the clay saucer during the day varied between 75°F to 80°F, falling to 65°F during the night. Servicing consisted of a daily light spraying of warm water over the outside of the flower-pot with a garden syringe; a check was also made to make sure that the incubating compost was slightly damp and no fungus or mould was growing.

HATCHING

Seventy-eight days later, on the 9th February, 1956, two young cobras were seen under the top glass. They were over-all light brown in colour and approximately 10 inches long; they appeared to be quite active. Without disturbing the surface of the incubating compost, only two snakes could be seen. It was decided to leave the flower-pot untouched for three more days before making a more thorough examination of the contents, since a bite from a newly hatched cobra might prove dangerous.

On the 81st day after laying the glass top was lifted and the two young cobras removed to a suitable case and kept at a temperature between 70°-75°F. The compost was then removed from the pot carefully until the egg layer was exposed. On examination of the eggs, 14 were found to have dried up, but one egg, although slightly discoloured, looked in good condition.

On more careful examination of this egg three parallel slits about ½ inch long and $\frac{1}{16}$ of an inch apart were seen (Pl. 2 C, opp. 159). These razor-like slits had obviously been made by the cobra's egg tooth; a slight movement inside the shell was also visible. About three hours later it was seen that the snake was trying to break through the shell and appeared to be in some difficulty, so a tiny cut was made across the three slits to enlarge them in the hope that this procedure would enable the snake to hatch.

Hatching, however, did not occur on that day and on the following day the snake was observed to be still trying to break through the shell. The slits were then enlarged further with scissors, allowing much clearer observation of the cobra, and it was then seen that parts of the embryonic membranes were still attached to it and were at the same time attached to the inner wall of the shell. The snake was then held gently with forceps whilst the anchored part of the embryonic membranes was freed from the shell and drawn gently with the forceps from the egg. Its attached yolk-sac withered within three days. The young snake lived only 48 days, during which time it refused all food, and was not observed to drink water.

Feeding, Sloughing and Behaviour

Records of the sloughing, feeding and behaviour of the two surviving young snakes were kept.

Characteristic hood-spreading when alarmed was not observed until 15 days after hatching; this was mostly carried out whilst the body was in a lateral position, with a few feeble attempts at the normal upright striking posture. After a month, however, both snakes were assuming almost adult-like hood spreading and striking mannerisms without much provocation. One of the cobras was slightly larger than the other, and this was termed A. A sloughed for the first time 12 days after hatching and B for the first time 20 days after hatching. Both took their first meal 31 days after hatching, consisting of a young mouse. They both continued to feed on young mice, two each per week for a further six weeks. After this period both accepted freshly killed adult mice, consuming two each per week.

On the morning of the 1st of June only a solitary snake, A, much plumper than normal, was found in the cobra cage. It is thought that both A and B started to swallow the same meal, a dead mouse (left in the cage after closing the Reptile House the previous evening), and that the larger snake had swallowed the smaller, B, in the process. At the time of writing (March, 1959), A still survives and is now quite a formidable specimen, measuring 4½ feet long and approximately 2½ inches in diameter. The rate of growth between hatching on 9.2.56 and 9.2.57 was from 10 inches to 2½ feet. At the end of 1958 A measured 4 feet.

During the period 15.5.57 to 14.4.58 A has sloughed 15 times, each slough being entire and perfect.

Feeding has been fairly regular, food even being accepted occasionally whilst the eye spectacles are opaque a few days before sloughing. During the period from 24.4.57 to 18.4.58 A consumed 107 adult mice and two half-grown white rats, all freshly killed.

Further Clutch of Eggs laid 1957.

The same incubation method, *i.e.,* using a flower-pot and manure, was carried out with a further clutch of 26 eggs laid on the 30th June, 1957. These were examined after a long incubation period of 85 days on the 29th of September and found to be dried up, with no signs of embryonic development.

Courtship Behaviour and Clutch of Eggs laid 1958

On the 16th April 1958, a pair of *Naja melanoleuca* were seen in courtship, which as in many snakes involves rubbing the heads and chinshields together; the male was also observed intertwining his body with the female's body, from head to tail. This continued for several hours. No further courtship behaviour was observed, so it was assumed that actual mating took place after the Reptile House was closed for the night.

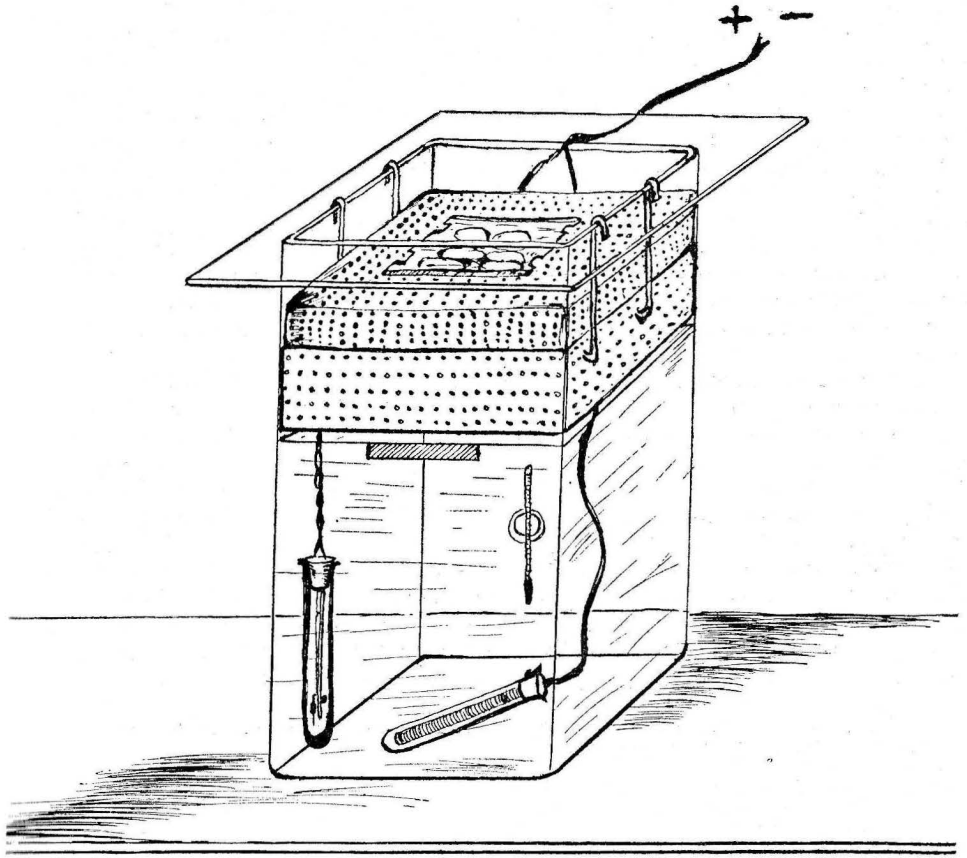


Fig. 1. Incubator made from accumulator jar and perforated aluminium container fitted with inspection window through which eggs can be seen. Temperature 84°-90°F. maintained with aquarium type heater and thermostat.

On the 12th of May, 1958, 25 eggs were found in the cobra's cage, in all probability laid by the female seen courting on 16.4.58; but this is not certain as there were four other cobras in the cage and the act of egg-laying was not observed.

Incubation Methods

This clutch of eggs was removed and nine selected eggs were picked out from the 25. It was decided to try out a more controlled method of incubating these eggs than the flower-pot method.

The method chosen was adapted from that used by M. E. White (1957) in her successful hatching of *Lacerta viridis* eggs. Whereas White used moist sand and moss as the hatching compost, however, only sphagnum moss was used for the cobra eggs.

The nine selected eggs were carefully placed in a bed of sphagnum moss contained in a perforated aluminium box eight inches square by four inches deep (see Fig. 1), and left uncovered to allow observation through a three-inch square piece of glass which was fitted into a lid made of the same perforated aluminium. This lid was made slightly smaller than the box and measured 1½ inches deep.

Four 6″ wire "lugs" were fitted to the sides of the box, two fitted to each side; these held the container ¼″ above the water-level. The box, complete with lid, was then lowered into an "old" accumulator jar (size 14″ x 8″), two-thirds filled with water and fitted with a tropical fish tank heater, thermostat and thermometer. The level of the water in the accumulator jar was marked by adhesive tape stuck on the outside of the jar and any loss of water due to evaporation was maintained by spraying over the perforations of the box with warm water. A 12″ square piece of ¼″ plate acted as a lid over the accumulator jar to preserve humidity; the thermostat was adjusted to give a variation of temperature between 84°-90°F.

Of the remaining 16 eggs from this clutch of 25, two were unusually small and misshapen, and were discarded. The 14 other eggs were placed in a 10″ flower-pot, but on later examination were found to contain no embryos.

Following the same method as used with the partly successful hatching of 9.2.56, both incubators were serviced daily from the 15th May until the 23rd of August before examining the eggs.

On examination of the nine eggs in the accumulator jar, three contained no traces of embryos, but the other six eggs were found to have quite well advanced embryos which were dead. It is now thought that the temperature 84° to 90°F may have been too high and caused embryonic death.

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CHAMAELEONS IN CAPTIVITY

by

Robert Bustard

Glenorchy, 14 Argyle Street, Maryfield, Dundee.

The true Chamaeleons (*Chamaeleontidae*) are restricted to the Old World. They occur in greatest abundance in tropical Africa and on the island of Madagascar, where about half of the known species live. The Common Chamaeleon (*Chamaeleo chamaeleon*) is found in countries bordering the Mediterranean and enters Europe through Southern Spain. A few species occur in Arabia and neighbouring islands—Socotra is the home of *Chamaeleo monachus*, a large species commonly measuring fifteen inches —and one species (*Chamaeleo zeylanicus*) lives in India and Ceylon.

The chamaeleons are a specialised group of lizards which are adapted to an arboreal way of life, although some have deviated from this habit. Such an example is *Chamaeleo namaquensis*, from Namaqualand and S.W. Africa, which lives largely on the ground (Rose, 1950). Their feet have become adapted to grasping twigs, and to aid this they have developed a type of opposable grasp, comparable with, though anatomically different from that which has been put to such good use by the higher primates. The feet have the five toes fused for most of their length and these terminate in claws. In the front feet three toes are turned inwards and two outwards, this arrangement being reversed in the hind feet. The tail is prehensile and acts as a fifth limb. It holds the chamaeleon firmly in place when it reaches out to catch a fly or other insect, and has only two feet on the branch.

The general shape of a chamaeleon is reminiscent of a leaf. The animals are usually thin, but the body may have considerable vertical height which can be exaggerated at times when the reptile is confronted by an enemy. Not only the animal's shape but also its habit of remaining motionless for long periods may help it to conceal itself. Although colour change may be a further adjunct to concealment, a chamaeleon does not necessarily change its colour to match the surroundings, and it is quite common to see a green chamaeleon on a brown twig and *vice versa*. The control of colour change is a complex process, and temperature, humidity and the state of excitement of the animal all play some part. Some chamaeleons will go very dark when annoyed, and when threatened they will frequently go through a range of colours, spots and splashes of colour often appearing and disappearing before one's eyes. At the same time the chamaeleon may blow itself up with air and then expel it, making a hissing noise, raising the body on the legs, and opening the mouth. This also occurs during threat display, which may sometimes be elicited if the animal is confronted with a slow-worm (*Anguis*).

The heads of many species are furnished with casques or, as in the case of *Chamaeleo jacksonii*, with horns which are usually better developed in the males than in the females. These horns are sometimes used in fights (Bustard, 1958a). Observations on horn development and viviparity in this species are given by Loveridge (1959).

The chamaeleon's tongue is also noteworthy; it is this organ which enables these slow moving creatures to catch the active insects on which they feed. The extended tongue is relatively longer in the dwarf chamae-

leons than in the larger species; in the former it is often almost the length of the animal's head, body and tail together. The tip of the tongue, which may have several lobes, is sticky, and to this the prey adheres. After seizing the prey the tongue is brought quickly back to the mouth where the sharp teeth chew the victim before swallowing takes place. The remarkable mechanism responsible for projection of the tongue involves the action of antagonistic sets of muscles and has been described in an interesting paper by Zoond (1933).

To enable the tongue to be projected with such accuracy the chamaeleon must have good eyesight and be able to judge distance accurately and quickly. The eyes are very large and covered by the scaly eyelids except for the small aperture over the pupil. When the animal is resting immobile among the foliage it may be seen that the eyes do not work in unison; one may be looking forwards while the other is directed backwards or upwards. In this way the chamaeleon is able to scan a wide area and to see more than would otherwise be possible. When an object of consequence such as an insect is observed, however, the head is turned towards it and both eyes are brought to bear on it. In this way the animal obtains binocular vision which is an important factor in the judgment of distances. Although the life-span of chamaeleons in the wild is not reliably known, these lizards often do not live long in captivity. The author has, however, kept a specimen of *Chamaeleo chamaeleon,* a form which is not well suited to vivarium life (see p.), for 20 months, when it was accidentally killed; even longer survival periods have probably been obtained.

The dwarf chamaeleons are in many ways the most suitable types to keep in captivity, although they may be hard to obtain from dealers. The South African dwarf species, *Microsaura pumila,* is very hardy and grows only some four to five inches in length. It is accustomed to cold nights in the Cape and does not require a high temperature. I have usually kept mine at 70°-75°F during the day; at night the temperature can fall to 45°-50°, or possibly a little lower. Nearly all specimens have a background colour of green on which brick-red, blue and pink markings can often be seen. Exceptional specimens have a brown background colour, and in my experience these seem unable to change to green. It would appear that the colour range of this species is less extensive than in many other chamaeleons. Unlike many species, *Microsaura pumila* is viviparous (or ovoviviparous). The birth of a batch of eleven young in the vivarium has previously been described (Bustard, 1955).

Another species of dwarf chamaeleon sometimes available is *Chamaeleo bitaeniatus elloti* from the Highlands of Kenya, and this does exceedingly well in captivity. Its predominant colour is brown, and it cannot turn green. Although its habitat is near the Equator, this species lives at altitudes of around 6,000 feet, and is accustomed to very cold nights, though the day temperatures may be high. I have found that specimens in a greenhouse are unharmed by temperatures of about 40°F during the night. Day temperatures of 70°F with a fluctuation of 5° either way are suitable, but the animals should not be overheated. This species does well on a basic diet of flies of various kinds which may be caught in traps. Under these conditions the chamaeleons often breed and I have obtained over 500 young in all of this species. This species is also viviparous, and the average brood

numbers about fifteen. The young are removed to a separate vivarium and fed on *Drosophila,* of which a constant supply is essential. I have found that young from broods of up to fifteen tend to thrive, whereas those from larger broods generally die quickly.

The common chamaeleon (*Chamaeleo chamaeleon*) is much more difficult to keep in captivity, although it is more often available from dealers. It grows up to 10 inches long and has a large appetite which is difficult to satisfy during the winter. Tropical silk moths can be bred and used for food. Young specimens are probably easier to keep.

The following suggestions, which I have also made elsewhere (Bustard, 1958b), are given for those who wish to keep chamaeleons in captivity in this country:

1. Chamaeleons should be kept apart from other reptiles and, if possible, from chamaeleons of other species.
2. The vivarium should be at least two to three feet in height. A greenhouse in which the animals are at liberty makes the best accommodation. My own chamaeleon house has a glass roof and sliding glass doors at the front. The back is built against a wall and the sides are brick for half their height, and of wire gauze of meatsafe type for the rest. This allows very free ventilation which appears important. The inside of the house contains many tree branches, among which grows an everlasting sweet pea plant, and also a young purple osier.
3. Food supplies must be plentiful, in constant supply, and varied. Many captive specimens probably starve through receiving only an intermittent food supply. Mealworms are not adequate as a staple diet, though they may be given as a change. One of the main reasons why the dwarf species are the easiest to keep is because they require so much less food.
4. Water should be sprayed on the vegetation every other day, as chamaeleons will not drink from a dish.
5. Only healthy specimens should be purchased. The condition of the eyes seem to me the most reliable guide to a chamaeleon's health. In sickly specimens the eye appears to sink into the orbit, and the rim of bone surrounding the eyeball is prominent. A healthy specimen will usually grip the hand firmly with its claws, and its tail will be comparatively thick and and not emaciated.

Further observations on chamaeleons in captivity are given in the books by Knight (1952) and Leutscher (1952), listed below.

The author would be glad to hear the observations of others who have kept chamaeleons, especially on longevity.

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NOTES

TREATMENT OF TORTOISES

In the Spring of 1958 a small tortoise (*Testudo graeca*) with a carapace length of just over 3 inches, was bought in an exhausted and dying condition. There was a running sore on the left side of the head, obliterating the eye, the left leg was damaged and the carapace was covered in mildew above the nuchal shield. The head and feet hung out of the shell and did not respond to touch.

The body temperature was gradually raised by placing the reptile on a moderately warm hot water bottle screened with blanket, and after a short time the side of the head was irrigated by means of an eye dropper containing a weak solution of boracic. The beak was wiped with warm glucose solution. The reptile was apparently unable to feed or drink. This treatment was continued hourly for eight hours and gradually the tortoise began to move freely. During the night it opened its beak and sucked the applicator. The whole jaw was then lowered into a milk bottle top of the glucose solution containing one minim of brandy. It drank this. From then on the tortoise was fed every hour and one minim of orange juice was added to the solution. The boracic irrigations were alternated with normal saline. After forty-eight hours the tortoise was moving about feebly and accepting drinks of warm water between feeds.

The mildew on the carapace was treated with saline and olive oil. Soon it was possible to see the outline of the eye, and one drop of castor oil was inserted each night. The leg which appeared not to be broken, was massaged with olive oil. The reptile was accepting dandelion petals, but was not able to pull them off for itself. When placed in its box, the tortoise immediately hid under a woollen cloth.

At the end of a week the eye was open and almost clean and the sight was apparently unimpaired. The tortoise was eating a normal diet for a small reptile and weighed 2 oz. Cod liver oil (Super Solvitax), (minim) was added to the food once a day, also orange juice and glucose. During the summer, while the tortoise lived a normal (captive) life in the garden with other tortoises, the limp disappeared entirely.

By September 1st it had apparently recovered and weighed 7 ozs., with a carapace length of $3\frac{1}{2}$ inches. Another small tortoise of the same species was placed with it.

As it was thought that these small tortoises might not survive normal hibernation, a controlled type of hibernation was adopted. A vivarium was made by removing the sides of an orange box and replacing them with acetate, and continuing this over the roof at either end to cut down draughts. A warm temperature was maintained by hot water bottles, moderately hot and wrapped in blanket. The floor of the box was covered in newspaper.

The reptiles apparently adjusted themselves to this life. Their activity was controlled by covering the box with a cloth for about 16 hours out of 24. When awake they ate and moved about, basking in any sun there was. The diet consisted mainly of greens, water cress, mustard and cress, cauliflower leaves, cabbage, carrot and turnip peelings, sprouts and chicory.

The lack of garden grit which they used to eat was compensated for by giving a cuttle fish "bone" which was sometimes chewed. The cod liver oil was increased to three minims a day. Once a week olive oil was sprinkled on the food; later this was changed to liquid paraffin.

Exercise was taken regularly on the floor, under supervision, and the reptiles appeared to be healthy and maintained a steady increase in growth and weight. The weight of the original tortoise on September 1st, 1959, was 12 ozs., and the carapace length 6 inches; the second weighed 9 ozs., and measured $5\frac{1}{4}$ inches.

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LIZARD KILLED BY BEETLE

In the summer of 1954 some Common Lizards (*Lacerta vivipara*) were placed in an outdoor vivarium in which the remains of a carcass of a newly-born calf had been left during the previous winter. There were a number of beetles in the vivarium. D. Owen observed a beetle climb on to the tail of a fully-grown common lizard and dig its mandibles into the lizard.

Within a few minutes the lizard became sluggish and was removed with the beetle still adhering. After a further few minutes the lizard died. A dark sunken patch was evident at the point of injury.

The beetle was identified by the British Museum (Natural History) as *Pterostichus madidus* Fabricius.

C. E. Owen and Dorothy Owen. All Saints' Natural History Museum, Colchester, Essex.

REVIEWS

KLINGELHOFFER, Terriarienkunde, 2nd ed., 1959.
A. Kernen, Stuttgart, publ.

In 1931 a German eye specialist, Dr. W. Klingelhöffer, published a book of 590 pages with the title "Terrarienkunde", a word which one might translate "Information on the Terrarium". But this book, while giving detailed instruction on how to arrange suitable cages for amphibians and reptiles, was a mine of information on the animals themselves and remained, until it became unobtainable, the only comprehensive text on this subject suitable for the amateur. The author died in 1953 and the book remained out of print until 1955, when a new publisher started to re-edit the book in instalments, the fourth and last of which has now reached us. The ancient gothic print has disappeared and better paper has been used throughout. The text has been revised and enlarged by Ch. Scherpner so as to run to 1,048 pages instead of the original 590. The arrangement of the book is now as follows :—

Part I. General remarks and technical detail. pp. 168; 1 colour plate. DM (German Mark) 13.40.
Part II. Amphibians. pp. 236; 5 colour plates. DM (German Mark) 25.70.
Part III. Reptilians. pp. 264; 4 colour plates. DM (German Mark) 24.50.
Part IV. Snakes, Crocodiles, Breeding, Index. pp. 380; 6 colour plates. DM (German Mark) 32.00