THE LIFE OF REPTILES, by Angus Bellairs. Weidenfeld & Nicolson, London, 1969. Two volumes, 590 pp., 48 black-and-white plates, 149 line drawings. Price 70/- each volume.

This book in two volumes is a further addition to the Weidenfeld & Nicolson Natural History series. This is a pity only in that the title has presumably been chosen to fit in with the series, and might suggest a rather more restricted field than the book actually covers.

Having read every word of the book's 590 pages, I finished up most enthusiastic about it, for two main reasons. One is that the author has succeeded in doing what so many authors on technical subjects try but fail to do. He has written a book which is detailed and authoritative enough to satisfy any zoologist, but in a style which makes it sufficiently readable and clear for anyone. The other is that it brings together so much up-to-date information not previously available in one book, that it will remain a valuable and exhaustive work of reference for a long time to come, and such books do not happen very often.

As might be expected from this author, there are detailed and well-illustrated chapters on every aspect of the physical features of reptiles, including their evolution and adaptation to habitat and behaviour. Similarly informative chapters deal with the nervous system, psychology and sense organs; sex and reproduction; embryonic development (with a short but adequate account of the recent discoveries of parthenogenesis in certain lizard species); growth, age and regeneration; and enemies and defence. There is little one might want to know about reptiles as forms of wild life which is not covered somewhere in this book. There is a useful classification of living reptiles (with a general indication of distribution of various forms), a bibliography of nearly 500 references, and a detailed index.

At £7 for the two volumes, the book may seem a little expensive. I feel sure that any herpetologist who can afford to buy it will find that he has got unusually good value for his money, and no serious herpetologist, however specialized, can afford to be without it.

J. W. STEWARD

REVISED ANNOTED CHECKLIST WITH KEYS TO THE SNAKES OF HONG KONG. J. D. Romer. Memoirs of the Hong Kong Natural History Society, No. 8, June 15, 1970. Copies at 8/- each may be obtained from the Hong Kong Natural History Society, c/o Department of Zoology, University of Hong Kong, Hong Kong.

The list is revised from 1961; six additional species have been recorded and additional specimens of four other species, each known from Hong Kong from a single specimen, have been found in the Colony. A list of references is cited.

H. FOX

Published by the British Herpetological Society and
Printed by Fox Publications Limited, London, N.7., England

BRITISH JOURNAL OF HERPETOLOGY

Vol. 4 *No.* 8 June 1971

Published by
THE BRITISH HERPETOLOGICAL SOCIETY

CONTENTS

The British Journal of Herpetology is published twice a year and is issued free to members. Application to purchase copies, and/or for details of membership to the Society should be made to the Hon. Secretary, British Herpetological Society, c/o The Zoological Society of London, Regents Park, London, N.W.1.

Contributions should be addressed to the Editor, Dr. Harold Fox, Department of Zoology, University College, Gower Street, London, W.C.1. 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 and suitably lettered for publication.

TEMPERATURE AND WATER TOLERANCES OF INCUBATING SEA TURTLE EGGS

By

H. Robert Bustard

Research School of Biological Sciences, Australian National University,
Canberra, A.C.T., Australia

(*Received* 14/4/70)

Introduction

Bustard and Greenham (1968) incubated eggs of the green sea turtle, *Chelonia mydas* (L.), at temperatures of 15, 20, 27, 32 and 38°C. Only those eggs at 27 and 32°C produced hatchlings. In order to more precisely define the limits of the temperature range over which the eggs would hatch further work was required.

As an extension to the work it was also decided to investigate survival following periods of water stress during the incubation period. The lowest moisture content recorded at the foot of a successful egg chamber dug by a green turtle was 3.8%. In nest failures (where dry sand caused the egg chamber to collapse during its construction) the lowest moisture content recorded was 2% (Bustard and Greenham, 1968).

METHODS

A clutch of green sea turtle eggs, collected at Heron Island, Great Barrier Reef, as they were laid, was flown to Canberra as hand luggage (to eliminate rough handling) and was in the laboratory incubators within 30 hours of being laid. Eggs were incubated following the methods employed by Bustard and Greenham (1968). Ten eggs were used in each experiment.

The container for the desiccation experiment was established with only 14 ml water giving a water content of 1.1% (compared to the control 7.8%). After 14 days this was brought up to 7.8% and then allowed to slowly dry out again. After six weeks the water content of the sand had fallen to 2.5%. At this time 30 ml of water were added (raising water content to 4.8%). No water was added subsequently. Incubation was carried out at 30°C.

RESULTS

(1) Temperature Tolerance

Percentage hatch at the various experimental temperatures is given in Table 1. The lower limit for a satisfactory level of hatching lies between 25 (20% hatch, Table 1) and 27°C (60% hatch, Bustard and Greenham, 1968). The upper limit is between 35 (60% hatch, Table 1) and 38°C (0% hatch, Bustard and Greenham, 1968). Thus the eggs of this turtle can be successfully incubated under constant temperature conditions over a range of about 10°C.

(2) Desiccation

A random sample of eggs was weighed at the time of laying at Heron Island and again on arrival in Canberra. There was no difference between mean egg weight (45.1g) at these two times. After one week at 1.1% sand moisture the eggs showed signs of desiccation which were considerably more pronounced after a further week (shells dented). Response to the water added at this stage was rapid, the eggs became turgid after about 24 hours. After six weeks with no additional water, when the water content of the sand had fallen to 2.5% the eggs were reweighed. The mean egg weight of the nine living eggs was 41.4 g. Thus the eggs had lost an average of 3.7 g (8.2%) compared to their weight when laid. The 30 ml of water added now was the only moisture added during the remaining two weeks' incubation. It was not possible to reweigh the eggs prior to hatching but the experimental conditions resulted in the weight of the eggs at the time of hatching being lower than at the time of laying (when the eggs are not "full"). Eggs would approximate 3 g lighter at the end of the incubation period compared to their weight at deposition. A 50% (normal) hatch was recorded on the eggs in this experiment indicating tolerance to this level of desiccation.

Temperature	% hatch
23	0
25	20
30 (control)[1]	43
33	60
35	60

Table 1. Percentage hatch of groups of 10 *Chelonia mydas* eggs in sand moistened with distilled water at different incubation temperatures (°C).

[1] Forty eggs were kept at this temperature.

DISCUSSION

A certain amount of temperature tolerance in *Chelonia mydas* eggs is essential for successful incubation under natural conditions. Sand temperatures at the level of the egg mass fluctuate by at least 2°C at Heron Island during the main incubation period. However, at this depth there is no diurnal temperature fluctuation. Furthermore, Bustard and Greenham (1968) indicated that a temperature rise of 5-6°C occurred in the egg mass during incubation at Heron Island due to metabolic heating. Additional work (unpublished) confirms this. Thus, in our experience, eggs must be able to survive a temperature range of at least 8°C.

Previous work (Bustard and Greenham, 1968) gave 60% incubation success at temperatures of 27 and 32°C suggesting choice of 30°C as control for the present work. The lower percentage hatch at 30°C compared to 33 and 35°C in the present work (Table 1) is not readily explicable. The data could be used to suggest that incubation success is better at these higher temperatures. However, since these temperatures do not occur in natural nests on Heron Island (near the southern breeding limit in eastern Australia) caution must be exercised in accepting this explanation.

One would expect the eggs of *C. mydas* to be adapted to survive some degree of water stress during their ten week incubation period. The conditions of the desiccation experiment, however, are likely to be at least as testing as any they will meet at Heron Island where in dry years the eggs at the top of the nest are prone to a certain amount of desiccation. When laid green turtle eggs are not "full" and they normally absorb several ml of water in the first few days of incubation to become turgid. The eggs in the desiccation experiment were unable to do this. Furthermore, not only were the eggs unable to gain water but they lost water — about 3 g or 6% of their weight at laying — at two stages of incubation.

A more detailed discussion of the role of water in incubating reptile eggs is given in the paper immediately following this.

SUMMARY

Eggs of green sea turtles from the Great Barrier Reef can be incubated at constant temperature over a range of about 10°C. A net gain of water by the incubating eggs is not essential for successful hatching.

REFERENCES

BUSTARD, H. R. and GREENHAM, P. M. (1968). Physical and Chemical factors affecting hatching in the green sea turtle, *Chelonia mydas* (L). *Ecology* **49**, 269-76.

TEMPERATURE AND WATER TOLERANCES OF INCUBATING CROCODILE EGGS

By

H. Robert Bustard

Research School of Biological Sciences, Australian National University, Canberra, A.C.T., Australia

(*Received* 14/4/70)

Introduction

The desiccation work on green turtle eggs described in the paper immediately preceding this (Bustard, 1971) together with studies on water requirements of lizard and snake eggs (Bustard, 1966; Dm'iel, 1967) suggested an investigation of incubation in additional types of reptile eggs. This paper presents data on crocodile eggs. Previous work on lizards and snakes (see Discussion) had shown that although very large amounts of water may be imbibed during incubation by squamate eggs, this was not essential for normal hatching to occur.

METHODS

A clutch of eggs of the New Guinea freshwater crocodile (*Crocodylus novaeguineae*) was collected on the Keram River (Sepik District), just after laying. The eggs were packed in damp newspaper in a foam cooler and sent to Canberra by air. Eggs were placed in the laboratory incubators about 7 days after laying. Considering the conditions of transportation it seems unlikely that the water content of the eggs at the commencement of the experiment differed significantly from that at time of laying. Eggs were incubated in silica sand at temperatures of 23, 26, 32 and 38°C with a water content of 7.8% using the same methods as for the turtle eggs. At least ten eggs were used in each experiment. Some eggs were incubated at 32°C but with a moisture content of 3.9 or 2.0%.

RESULTS

(1) Temperature Tolerance

No eggs hatched at 23 or 26°C. At this temperature the developing embryos died. Incubation success was high at 32°C. At 38°C three young (from 10 eggs) developed to full term but had to be helped out of the eggs. All had deformed tails.

(2) Water Uptake in Sand with 7.8% Water Content

The results for incubation of 12 eggs which produced hatchlings are given in Table 1. Although there is a considerable variation in the amount of water taken up it should be noted that no eggs lost water. They either remained at their initial weight or took up varying amounts of water during incubation.

(3) Desiccation

The results of a small desiccation experiment are given in Table 2. It should be noted that all eggs lost a considerable amount of weight in the first week of the experiment. The eggs maintained at 3.9% water content were opened after 1 month (when the water content was the same as after 2 weeks) (Table 2) and found to contain healthy live embryos. Those at 2% water content were allowed to go on developing and hatched. Percentage water loss after 5 weeks (1 week before hatching) was 17.6 and 24.7% respectively for the 2 eggs. The hatchlings were normal in every way.

Initial weight	Incubation time (days)					% wt change after 45 days
	16	24	32	38	45	
73.5	75	77	78.5	80	82	+11.0
72.5	73.5	75	74.5	74.5	74.5	+ 2.7
70	70.5	72	73.5	75	75.5	+ 7.9
69	67	67.5	68	69	74	+ 7.8
75	75.5	76	76	76	78.5	+ 4.7
66	66.5	66.5	65	65	60	no change
76	76.5	79	81	85	86.5	+13.8
81	81	81	81.5	83	86	+ 6.2
76.5	74.5	75	75	76	76.5	no change
68	66.5	67	67	68	68.5	+ 0.7
76	76	76	78.5	84	93.5	+23.0
73	73	73	75	76.5	76	+ 4.1
						mean + 6.8

Table 1. Weights (gm) of individual *Crocodylus novaeguineae* eggs during laboratory incubation in sand containing 7.8% water by weight.

Moisture content	% age weight change	
	after 1 week	after 2 weeks
7.8%	no change	+1.2
3.9%[1]	−14.2 (−11.1; −17.2)	−14.8 (−12.4; −17.2)
2.0%[1]	−14.8 (−11.7; −17.8)	−15.9 (−12.5; −19.2)

Table 2. Weight changes in *Crocodylus novaeguineae* eggs incubated in the laboratory in sand of varying moisture content at 32°C.

[1] Only two eggs were used in each of these groups. The actual % age weight changes are bracketed after the means.

DISCUSSION

The finding that 32°C is a good incubation temperature for *C. novaeguineae* eggs agrees with the data of Deraniyagala (1939) who reported 32°C as the nest temperature of *C. porosus* in Ceylon. The lower incubation temperature at which *C. novaeguineae* eggs will hatch, which is above 26°C, is not yet known. The upper limit is just below 38°C. The deformed tails in those hatching at 38°C, as in other reptiles, appear to indicate high temperature stress (Bustard, 1969).

The crocodile egg desiccation experiment, which must be considered as preliminary in view of the small numbers of eggs involved, like the turtle egg experiment (Bustard, 1971), indicates that eggs which are not able to absorb water from their external medium still hatch. Furthermore, in both classes, eggs, which due to water stress lost a net amount of water during incubation (up to 25% in the crocodile eggs), were able to survive.

These results are of considerable interest in the understanding of the role of water in the development of reptile eggs. Many squamate eggs absorb large amounts of water, increasing by up to 300% of their initial weight during incubation, but will hatch without access to this additional water (Bustard, 1966; Dm'iel, 1967). I suggest that this water uptake is a form of insurance against lethal levels of water stress at a subsequent stage of incubation should environmental conditions result in a sustained net loss of water from the eggs. Chelonian and crocodilian eggs possess albumen (lacking or virtually lacking in squamate eggs, Bellairs, 1957) which may explain why eggs of these Orders of reptiles do not show the phenomenal water uptake associated with many squamate eggs. The albumen is likely to reduce the rate of water loss under adverse conditions since albumen is hydrophilic. This factor was probably overlooked by Rand (1968) when trying to explain the slower rate of water loss of *Crocodylus acutus* eggs from which a section of the shell had been removed compared to intact eggs of *Iguana iguana*. It should be noted, however, that Rand's three intact *C. acutus* eggs lost appreciably less water over a period of 1 week (an average of about 2%) than the *C. novaeguineae* eggs incubated in sand of low moisture content over the same time interval (Table 2). While this may result from differences between the eggs the unduly low incubation temperatures used by Rand could perhaps be responsible.

There is considerable qualitative literature on incubation conditions of reptile eggs but a need exists for more controlled experimentation leading to quantitative results. It is known that parchment-shelled reptile eggs maintained at high relative humidity desiccate unless at least part of the egg is in contact with a moist surface (Clark, 1946). It is interesting that even when buried in sand with a water content of 3.9% crocodile eggs lost substantial weight (Table 2). This result indicates that at this water content "available" water was no longer present in the sand medium. On this basis one would expect the results at 3.9% and 2.0% moisture content by weight to be the same. In fact they are very similar. Similarly turtle eggs in sand which had fallen to a water content of 2.5% had already lost about 8% of their weight (Bustard, 1971). These data indicate the importance of substantial "available" water for both the parchment-shelled eggs of sea turtles and the porous but calcified eggs of crocodiles if they are to maintain their initial weight.

Although water loss was high during the first week in the crocodile egg desiccation experiments little further loss occurred in the second week or during the remainder of the incubation period. Albumen may have prevented water loss beyond this level.

SUMMARY

Crocodylus novaeguineae eggs absorbed water when this was available in the external medium. When water was not available they desiccated rapidly. However, eggs which had lost about 20% of their weight through desiccation produced normal hatchlings.

REFERENCES

BELLAIRS, A. d'A. (1957). *Reptiles*. Hutchinson, London.

BUSTARD, H. R. (1966). Notes on the eggs, incubation and young of the bearded dragon, *Amphibolurus barbatus barbatus* (Cuvier). *Brit. J. Herpet.* **3** (10), 252-59.

BUSTARD, H. R. (1969). Tail abnormalities resulting from high temperature egg incubation. *Brit. J. Herpetol.* **4,** 121-23.

BUSTARD, H. R., SIMKISS, K., and JENKINS, N. K. (1969). Some analyses of artificially incubated eggs and hatchlings of green and loggerhead sea turtles. *J. Zool. Lond.*, **158,** 311-15.

CLARK, H. (1946). Incubation and respiration of eggs of *Crotophytus c. collaris* (Say). *Herpetologica* **3,** 136-39.

DERANIYAGALA, P. E. P. (1939). *Tetrapod reptiles of Ceylon*. Vol. I. Testudinates and Crocodilians. Dulau and Co., London.

DM'IEL, R. (1967). Studies on reproduction, growth and feeding in the snake *Spalerosophis cliffordi* (Colubridae). *Copeia* 1967: 332-46.

RAND, A. S. (1968). Desiccation rates in crocodile and iguana eggs. *Herpetologica* **24,** 178-80.

SIMKISS, K. (1962). The sources of calcium for the ossification of the embryos of the giant leathery turtle. *Comp. Biochem. Physiol.* **7,** 71-79.

NOTES ON THE HABITS OF THE CALABAR GROUND PYTHON (*Calabaria reinhardtii* Schlegel) IN CAMEROON, WEST AFRICA

By

J. S. GARTLAN[1] & T. T. STRUHSAKER[2]

(*Received* 10/12/69)

Little is known of the habits of the monotypic Calabar Ground Python (*Calabaria reinhardtii* Schlegel). Cansdale (1961) observed one captive *Calabaria* eat large worms and another captive constrict a small mouse which it did not eat. Schmidt (1923), referring to the field notes of Herbert Lang, wrote of a freshly collected *C. reinhardtii* that disgorged a mouse prior to being injected with preservative. Lang also observed *Calabaria* "crawling about in the forest among the moist dead leaves". The same author also noted that when a *Calabaria* is seriously annoyed "it rolls itself into a compact ball, the head in the centre, which it is very difficult to straighten out". This latter response has also been described by Villiers (1950) and Cansdale (1961) and a picture of it is included in Schmidt's article. Lang further observed that *Calabaria* ". . . never tries to bite" when it is disturbed.

Villiers (1950) indicated that this python is nocturnal and fossorial, and usually lives in rodent burrows or under plant debris, but that it is also capable of burrowing very rapidly.

The following observations were made on *Calabaria* during the course of field studies of rain forest primates in Cameroon.

On 1st February, 1968, between 08.30 and 08.40 hours, an adult *C. reinhardtii* was found with its head in the nest of a mouse. The nest was roughly spherical and built on the ground. The snake was holding a live, immature mouse (*Dasymys incomtus longipilosus*) by the hind legs. When the nest was disturbed another mouse of similar appearance fled. This incident occurred in secondary forest that had been derived from a cacao plantation abandoned some 40 years ago. The height of the canopy was 60′, the understorey was dense, and the ground was covered with loose basalt boulders. This forest was adjacent to the Idenau Palms Plantation, 4° 15′ N., 9° E., West Cameroon.

On 13th March, 1968, in the Southern Bakundu Forest Reserve 4° 30′ N., 9° 30′ E., between 08.18 and 08.46 hours an immature *Calabaria reinhardtii* 45.7 cm in length was observed immobile on a shrub 106.6 cm from the ground. Under the shrub on the ground surface was the nest of a mouse around which an extremely agitated female *Hybomys univitatus* was running. The nest was roughly spherical, constructed of leaves and grass. The forest was secondary with a broken canopy at 40′ and a dense, tangled undergrowth. The mouse ran out up to 60 cm from the nest and returned repeatedly despite our attempts to catch her. The mouse was finally taken and found to be in parturition. The *Calabaria* was taken and placed in a canvas bag. At about 18.30 hours we opened the bag and found it contained the snake plus two live and squeaking baby mice that it had regurgitated. When the snake and the mice were put into a dark wooden box, the latter were immediately eaten without any prior constriction. *Calabaria* thus does not always kill its prey, but like many other snakes, takes small and innocuous animals alive. In captivity this individual failed to show any interest in raw, chopped meat, insects, de-shelled snails or termites. A specimen 101.6 cm long also failed to take any of these foods. However, this individual showed considerable interest in freshly killed adult house mice on four occasions. The snake

---

[1] The Rockefeller University, New York City 10021, and Department of Psychology, University of Bristol, 8-10 Berkeley Square, Bristol 8.

[2] The New York Zoological Society and the Rockefeller University, New York City 10021.

brought its head into close contact with the mouse and moved the head gently to and fro just above the level of the fur. When a mouse was partly shaved the behaviour persisted for a longer time and involved contact of the tongue with the skin. On no occasion were mice eaten in captivity.

Three other encounters with *Calabaria* were recorded in Southern Bakundu (26th September at 07.15 hours, and 15th and 25th October, 1968, at 15.15 and 11.20 hours respectively). Two individuals were on the forest floor in fairly open high forest with the canopy at 110′. The ground was flat and the soil sandy in one case and lateritic in the other. There was a fairly thick carpet of dead leaves in both locations. On neither occasion were the animals near mouse holes. A third specimen was found some 60 cm from the ground, immobile on a rotten log. A further encounter with *Calabaria* occurred in the Ekona Forest Reserve (4° 10′ N., 9° 20′ E.) in November 1967. This animal was 142 cm from the ground, crawling along the horizontal buttress of a fallen and partially decomposed ironwood tree, *Cynometra hankei*. All these observations were made in what is classified as secondary forest. There was no consistency in weather conditions on the separate occasions. The encounter on 13th March was in dry, sunny weather with the ground and forest floor debris dry and brittle. In contrast, on 15th October there had been heavy rain during the night, the forest floor was wet, the leaves damp and dripping, and there was a heavy mist over the forest. On the other occasions weather was intermediate between these two extremes.

The reaction of this species to human touch is either to hiss and strike at the hand of its captor, or to roll immediately into a tight ball with its head in the centre, as described by Lang.

Calabaria reinhardtii definitely feeds on rodents, and presumably prefers young and immatures. It is not restricted to subterranean activity and occasionally climbs to a metre or more above the surface of the ground. An earlier statement by Villiers (1950) that it is strictly nocturnal is incorrect.

ACKNOWLEDGEMENT

The mouse specimens were kindly identified by Mr. D. R. Rosevear and are now housed in the British Museum of Natural History.

REFERENCES

CANSDALE, G. S. (1955). *Reptiles of West Africa*. Penguin Books Ltd., London, England.

CANSDALE, G. S. (1961). *West African Snakes*. Longmans, Green & Co. Ltd., London, England.

SCHMIDT, K. P. (1923). Contributions to the herpetology of the Belgian Congo based on the collection of the American Museum Congo Expedition. Part II. Snakes. *Bull. Am. Mus. Nat. Hist.* **49**, 1-146.

VILLIERS A. (1950). *Les Serpents de l'Ouest Africain*. I.F.A.N., Dakar, Senegal.

DESCRIPTION HISTOLOGIQUE DE LA " DENT DE L'ECLOSION " OU CARONCULE CHEZ *CHELONIA MYDAS* (L.)

Par

J. BONS[1] et J. C. BONARIC[2]

(*Received* 5/5/70)

Les modalités et le mécanisme de la rupture de la coque de l'oeuf chez les Reptiles et chez les Oiseaux montrent d'une manière constante la présence d'un organe dur capable de casser ou de scier l'enveloppe plus ou moins rigide de l'oeuf.

Ces organes de perforation sont en réalité d'origine et de constitution différentes. Chez les Squamata, la dent d'éclosion est une véritable formation dentaire connue depuis les travaux de Weinland (1856 et 1858). Chez les Geckonidae, les deux dents du prémaxillaire voisines de la ligne médiane prennent un grand développement et sont dirigées vers l'avant. Chez les Ophidiens, Chamaeleontidae, Agamidae, Lacertidae, il n'existe qu'une seule dent portée par le prémaxillaire provenant dans certains cas (*Gongylus*, *Mabuya*) du développement asymétrique d'une des deux dents du prémaxillaire.

Chez les Oiseaux, les Rhynchocéphales, les Crocodiliens et les Chéloniens la caroncule est un tubercule corné porté par la face dorsale ou la pointe du museau (Rose, 1892; Sluiter, 1893). *Sphenodon* (Rhynchocéphale) possède une excroissance cornée sur le bord antérieur de la mâchoire (Schauinsland, 1903). Les Crocodiliens présentent un tubercule corné bifide placé sur l'extrémité du museau. Chez les Chéloniens enfin, la coque de l'oeuf est percée à la fois par les écailles des pattes et par une expansion cornée située sous les narines à l'extrémité du bec (Lampkin, 1966).

Le but de la présente note est de décrire la structure de l'expansion cornée chez *Chelonia mydas* et de préciser son aspect histologique. Pour plus de détails sur les espèces étudiées et sur la structure de la dent de l'éclosion des Squamata nous renvoyons au travail très complet de Fioroni (1962).

1. ASPECTS EXTERNE (FIG. 1)

La machoire supérieure fortement cornée est revêtue par une grande plaque en V dont la pointe est dirigée vers l'avant. Cette plaque est formée par la soudure de deux écailles supralabiales avec une écaille rostrale antérieure. Elle montre à l'avant un mamelon corné conique de teinte brune (DE), la " dent de l'éclosion "; l'extrémité de cette pointe est depigmentée. L'écaille nasale molle portant les deux narines est située au-dessus de la " dent " en position de retrait par rapport à celle-ci.

L'importance des muscles supérieurs du cou (comparables au couvre-nuque observé chez les Oiseaux à l'éclosion permet d'expliquer la puissance des mouvements de la tête et le rôle de scie joué par la " dent de l'éclosion " dans la rupture de l'oeuf.

2. ASPECT HISTOLOGIQUE (FIG. 2, 3, 4)

L'examen histologique d'une coupe sagittale passant par la " dent de l'éclosion " (DE) nous montre que cette expansion est formée par une prolifération dermique, complétée par un épaississement accru de l'assise épidermique (e). Celle-ci est surtout renforcée par une dégénérescence cornée importante.

L'existence d'une lame dentaire à la machoire supérieure a été observée chez *Chelonia mydas* par Rose (1892). A l'éclosion, nous n'avons retrouvé aucune trace de cette lame dentaire sur les coupes histologiques.

Le tissu osseux alvéolaire (t o) du prémaxillaire montre un bombement vers l'avant, mais au niveau de la " dent " elle-même une zone non ossifiée est visible.

La nomenclature employée dans la description suivante est celle que Gabe et Saint-Girons (1964) ont utilisée dans l'étude histologique du *Sphenodon punctatus*.

Le derme montre deux zones, la région superficielle de tissu conjonctif lâche et la zone profonde de tissu conjonctif compact, le passage entre les deux couches est progressif.

La couche profonde présente de nombreuses fibres collagènes à orientation

---

[1] Laboratoire de Biogéographie et Ecologie des Vertébrés de l'Ecole Pratique des Hauts Etudes, Montpellier, France.

[2] Laboratoire de Zoologie, Faculté des Sciences, 34 Monpellier, France.

régulière, parallèle à la surface du tégument. La couche superficielle est pauvre en cellules conjonctives, mais présente de nombreuses fibres élastiques et surtout collagènes. La plupart de ces fibres sont disposées parallèlement à la surface tégument dans la partie se trouvant autour de la " dent " (Fe, Fig. 4). Mais au niveau de la dent elle-même la structure change; les fibres collagènes (Fe, Fig. 3) prennent une orientation nettement perpendiculaires à la surface; ces tractus de fibres ascendantes se terminent au niveau de la membrane basale.

Les cellules de la couche basale de l'épiderme formant le stratum basale (sb) ont 10 à 12μ de hauteur et un gros noyau généralement arrondi; cependant au niveau de la " dent " les noyaux sont ellipsoïdaux, leur grand axe étant parallèle aux fibres collagènes (soit perpendiculaire à la surface externe du tégument).

Le *stratum spinosum* (s s) de 15μ d'épaisseur est généralement formé de 2 couches cellulaires à noyau ovale; les tonofibrilles y sont bien nettes.

Le *stratum intermedium* (s i) de 10 à 15μ d'épaisseur qui fait suite comprend une ou deux assises de cellules allongées parallèlement à la surface du tégument, les noyaux fortement ellipsoïdaux ont la même orientation. Les cellules en voie de kératinisation présentent des noyaux picnotiques; le rapport nucléo-cytoplasmique $\frac{N}{C}$ qui est de l'ordre de 1/4 pour les cellules de la couche basale atteint 1/2 dans les cellules du stratum intermedium par suite de l'appauvrissement des cellules en cytoplasme lié à la dégénérescence cornée.

Le *stratum corneum* (s c) superficiel de 60μ sur le bord supérieur du bec corné prend un énorme développement au niveau de la " dent " ou il atteint 300μ d'épaisseur. La couche inférieure du stratum corneum comprend des cellules dont la kératinisation est très avancée et qui ont cessé de vivre. L'emplacement des noyaux est indiqué par des granules foncés; la couche supérieure est plus compacte et l'on ne peut pas apprécier le nombre de couches cellulaires.

Au moment ou la caroncule du museau de *Chelonia mydas* remplit sa fonction de scie de la coque de l'oeuf, elle possède une épaisse couche externe cornée, un épithelium vivant mince et surtout un tissu conjonctif dont la trame est disposée perpendiculairement à la surface de la peau et dont les fibres semblent se terminer dans la couche basale de l'épiderme. A notre connaissance, cette particularité du derme n'avait pas encore été observée. Les descriptions réalisées chez les Crocodiliens se rapportaient essentiellement à la structure de l'épiderme (Sluiter, 1893).

RESUME

La structure histologique de l'expansion cornée appelée " dent de l'éclosion " chez la tortue *Chelonia mydas* est remarquable par l'épaisse couche cornée, l'épithélium très fin et surtout par les fibres conjonctives du derme disposées perpendiculairement à l'épiderme et se terminant contre la membrane basale de l'épithélium.

SUMMARY

The histologic structure of the corneous tubercle named " egg-tooth " in *Chelonia mydas* is interesting for its thick stratum corneum, its very thin epithelium and chiefly for the collagenous fibres of the dermis, which are disposed perpendicularly to and end at the stratum basale of the epidermis.

BIBLIOGRAPHIE SOMMAIRE

FIORONI, P. (1962). Der Eizahn und die Eischwiele der Reptilien. *Acta Anat.* **49,** 328-66.

GABE, M. et SAINT-GIRONS, H. (1964). Histologie de *Sphenodon punctatus.* Ed. du C.N.R.S. Paris.

LAMPKIN, W. M. H. (1966). *Turtle and Tortoise. Soc Journ.* **1,** 4-5.

MULLER, J. (1841). Ueber eine eigenthümliche Bewaffnung des Zwischenkiefers der reifen Embryonen der Schlangen und Eidechsen. *Arch. Anat. und Physiol.* 329-31.

ROSE, C. (1892). Ueber die Zahnleiste und die Eischwiele der Sauropsiden. *Anat. Anz.* **7,** 748-58.

SCHAUINSLAND, H. (1903). Beiträge zur Entwicklungsgeschichte der Wirbeltiere. *Sphenodon, Callorhynchus, Chamaeleo. Zoologica,* **39,** 1-98.

SLUITER, E. P. (1893). Uber den Eizahn und die Eischwiele einiger Reptilien. *Morph. Jb.* **20,** 75-89.

WEINLAND, D. F. (1856). Ueber den Eizahn der Ringelnatter. *Würtlemberg naturwiss J.* **12,** 90-5.

WEINLAND, D. F. (1858). On the Egg-Tooth of the Snakes and Lizards. *Proc. Essex Inst.* **2,** 28-32.

Fig. 1. Tête de jeune *Chelonia mydas.* DE: dent de l'éclosion.

Fig. 2. Coupe sagittale de l'extrémité du museau de *Chelonia mydas.* d : derme; e : assise épidermique; te : tissu cartilagineux; to : tissu osseux alvéolaire.

Fig. 3. Derme et épiderme au niveau de la caroncule. fe : fibres collagènes; sb : stratum basale; sc : stratum corneum; si : stratum intermedium; ss : stratum spinosum.

Fig. 4. Derme et épiderme normaux; même légende.

Fig. 1

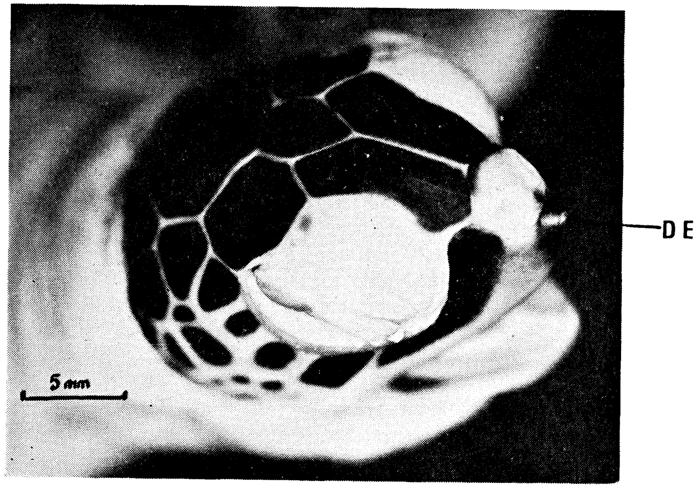
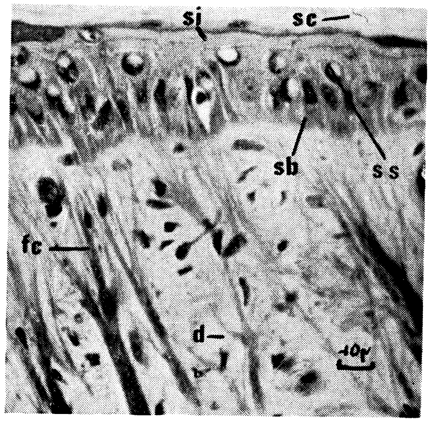


Fig. 3



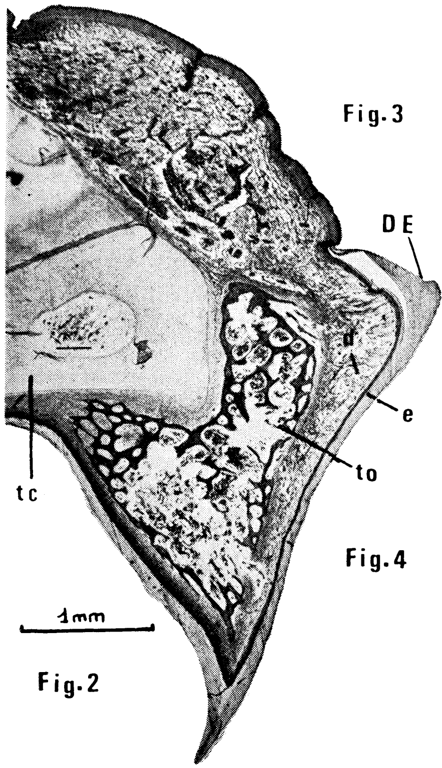
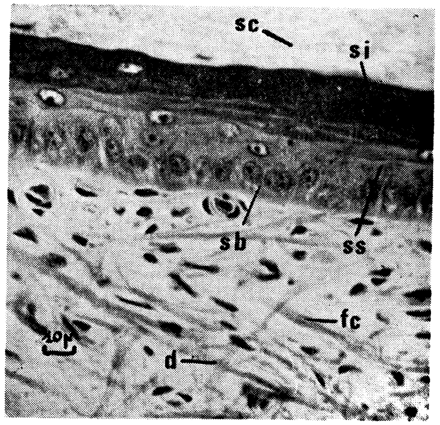


Fig. 2

Fig. 4



FURTHER COMMENTS ON THE AEGEAN 4-LINED SNAKE, *ELAPHE QUATUORLINEATA* (LACEPEDE), INCLUDING A CONSIDERATION OF THE AMORGOS *ELAPHE* SNAKES

By

RICHARD J. CLARK
1 & 2 The Street, Molash, Canterbury, Kent

(*Received* 25/7/69)

At the time of writing "Comments on the subspecies of the snake *Elaphe quatuorlineata* in Greece" (Clark, 1967), the author was unaware of two other papers dealing with the same subject, viz. Buchholz (1961) and Wettstein-Westerheimb (1963). He wishes, therefore, to rediscuss the taxonomy of the Aegean subspecies of *E. quatuorlineata* since the total collected material of this snake from the Cyclades is small, and controversy still continues as to the taxonomic status and relationship of its subspecies. Additional specimens of *E. rechingeri* are also discussed.

Buchholz considers *E. quatuorlineata praematura* Werner (type locality Ios) to be a synonym of and identical to *E. quatuorlineata muenteri* Bedriaga (type locality Myconos). He gives the range of *praematura*=*muenteri* as Myconos, Naxos and Ios. The present author, quite independently, came to the same conclusion, but pointed out that Paros, Amorgos and Santorini should also be included within the range of this subspecies. On the other hand, Wettstein (1963) considers the subspecies *E. quatuorlineata praematura* is present only on Ios and that the snake from Myconos and Naxos belong to the nominal form *E. q. quatuorlineata.* This is quite clearly incorrect and one cannot accept Wettstein's statement that Werner's diagnosis of the Myconos snake as being identical with *praematura* is a "slip of the pen". Bruno (1968) evidently also overlooked the papers by Buchholz and Wettstein. He lists in a footnote "*muenteri*" from Myconos and "*praematura*" from Ios, thereby following the arrangement in Mertens and Wermuth (1960).

A situation of particular interest arises on Amorgos where, in addition to *E. quatuorlineata muenteri,* the apparently endemic species *E. rechingeri* is found. Buchholz's and Wettstein's examination of the problem surrounding the nomenclature of the Amorgos taxa is inconclusive. As far as the author is aware the form *rechingeri* was hitherto known only from the type specimen which Werner (1932) originally described as a new species. Wettstein (1953) renamed it *E. longissima rechingeri.* Mertens and Wermuth (1960) adhered to the latter name. But recently both Buchholz and Wettstein considered this to be more closely related to *E. quatuorlineata* than to *E. longissima.* Buchholz quotes the pholidose of the type specimen as follows: dorsals 25 or 23 in the midbody region, ventrals 205. For *E. quatuorlineata* he quotes usually 25 dorsals (seldom 23) at the midbody—in fact two of the present author's specimens from Paros and Ios had 23, as does one from Naxos collected by Buchholz himself in 1956. Ventrals he gives as 195 to 234. *E. longissima* has 21 or 23 dorsals and 212 to 248 ventrals.

The author has already reported (Clark, 1969) his finding on Amorgos of one specimen of *E. quatuorlineata praematura* (=*muenteri*) and two specimens of *E. rechingeri.* The *E. rechingeri* specimens differ so markedly from any *E. quatuorlineata* examined that there is no doubt that they belong to a distinct species. It is not surprising that other workers have been vague as to the identity of the Amorgos *Elaphe,* since no one till now has found both species there together. What is of particular value is that one of the two *E. rechingeri* specimens is a juvenile. Buchholz remarked that the systematics would become clearer once a juvenile was found. For description of these specimens, together with a juvenile *E. quatuorlineata muenteri* collected recently (24.4.69) from Paros, see below.

Comparison shows that *E. rechingeri* differs from *E. quatuorlineata* in both adult and juvenile appearance and in the low subcaudal count. In adult *E. rechingeri* there is scarcely a trace of striped pattern and the juveniles are brown with brown cross bars, whereas all *E. quatuorlineata* juveniles are distinctly greyer. Although Buchholz quotes a range of 56-90 subcaudals for *E. quatuorlineata,* the present author has never found this snake in Greece with a count lower than 69. His two *E. rechingeri* had counts of 60 and 61 and there is no question of their tails being damaged. If the juvenile on Amorgos belonged to *quatuorlineata* rather than to *rechingeri,* then it would be reasonable to suppose that the dark stripes would be more rather than less prominent in a specimen nearly half as big again (as, say, the Paros *E. quatuorlineata muenteri* juvenile), especially as the adult *quatuorlineata* on Amorgos had such exceptionally bold stripes. *E. longissima* also has a subcaudal range of about 60-90 (Hellmich, 1962).

Both Buchholz and Wettstein may be correct in their view that *rechingeri* does not belong to *longissima* but they are quite incorrect in assuming that it is a form of *quatuorlineata.* To find two distinct varieties of the same species inhabiting a small island the size of Amorgos would be contrary to accepted evolutionary tendencies. On the other hand, in Greece *E. quatuorlineata* is sometimes found alongside *E. situla*, viz. on Paros and Spetsai. There is no reason therefore, why it should not coexist with another *Elaphe* species on Amorgos. As yet *E. situla* has not been reported on from Amorgos so it would be very interesting if this too occurred here.

It should be emphasized that Werner originally gave *rechingeri* specific rank. Why other herpetologists have seen fit to reduce its status to the level of a subspecies — and then to admit to not knowing for certain to which recognised species it belongs — is incomprehensible. It would be courteous as well as correct to recall Werner's original diagnosis and revert to the name *Elaphe rechingeri* Werner.

Naturally much more material is needed before it can be said definitely to which member of the genus *E. rechingeri* has closest affinities. But it is distinctive enough to stand at specific level until more evidence to the contrary is produced. However, the question of its origin and isolation on Amorgos remains unresolved. The author is reluctant to accept the solution of " introduction " because *E. rechingeri* cannot be closely identified with any other living *Elaphe* species, nor is the time scale of man's activities long enough for it to have diverged in isolation sufficiently from its ancestor. On the other hand, while some European *Elaphe* species have wide distributional ranges (*E. quatuorlineata, E. longissima, E. situla* and *E. dione*), others are much more local and limited (*E. scalaris, E. hohenackeri* and *E. rechingeri*). In case it should be thought that a species endemic to such a small island is somewhat improbable it is worth recalling that Santorini has a skink, *Chalcides moseri* AHL, that has not yet been found elsewhere.

DESCRIPTION OF SPECIMENS

Amorgos — *Elaphe quatuorlineata muenteri* (adult male) total length 1175 mm.; snout to vent 925 mm.; dorsals 25-23-21; ventrals 207, anal divided; subcaudals 70 x 2; supralabials 8, with nos. 4 and 5 touching the eye.

Darkish brown above with 4 longitudinal black stripes, much more prominent than usual, the upper pair twice the width of the lower. Ground laterally pale yellow-fawn. Belly pale yellow with a few faint greyish flecks. Dark streak from eye to angle of jaw.

Amorgos — *Elaphe rechingeri* (adult male and juvenile) total lengths 987.5 mm., 549 mm.; body lengths 815, 462 mm.; dorsals 25-25-23, 25-25-21; ventrals 219, 215, anal divided; subcaudals 60 x 2, 61 x 2; supralabials 8, nos. 4 and 5 touch the eye.

Adult male fairly uniform medium brown. Only a *very* faint trace of a darker dorso-lateral stripe. Belly pale yellow with pale grey mottlings. Tinge of pink on throat, head and neck.

Juvenile light fawn-brown with buff cross bars down length. A very faint dorso-lateral darker stripe and a row of small buff lateral spots, interconnected faintly with a darker line. Belly pale fawn, marbled with fawn-grey. Head with a dark bar across prefrontal/frontal region and a dark streak from eye to angle of jaw.

Paros — *Elaphe quatuorlineata muenteri* (juvenile) total length 376 mm. Ground silver-grey with more or less regular but narrow dark-grey cross bars down the length, the centre of each scale in these bars having a longitudinal buff streak. Between the bars some very faint grey on the ground. Down the flanks a row of dark spots, alternating with the dark dorsal bars. Four stripes just visible down length. Horseshoe-shaped marking on back of head. Three dark bars across the head, only the anterior one being continuous. A dark streak from eye to angle of jaw. Belly silver-grey with dark-grey markings.

Note — The author's specimens discussed are deposited in the Senckenberg Museum, Frankfurt.

SUMMARY

1. The conclusions drawn previously by the author (Clark, 1967) stand unchanged, though the older name *Elaphe quatuorlineata muenteri* Bedriaga is substituted for *Elaphe quatuorlineata praematura* Werner.

2. Both *E. quatuorlineata muenteri* and another *Elaphe* species live on Amorgos. This other species is quite distinct from *E. quatuorlineata* in its appearance and subcaudal count, and is reinstated as *Elaphe rechingeri* Werner.

REFERENCES

BRUNO, S. (1968). I serpenti Europei della collezione Edoardo de Betta conservata nel Civico Museo di Storia Naturale di Verona. Considerazioni sui serpenti d'Italia. Estratto dalle Memorie del Museo Civico di Storia Naturale—Verona. Vol. XV, 1967, pp. 173-211, 1 fig.

BUCHHOLZ, K. F. (1961). Uber *Elaphe quatuorlineata* von den Zykladen und das *Elaphe*—Taxon von der Insel Amorgos (Reptilia: Colubridae). *Bonner zool. Beitr.*, **12,** 68-86.

CLARK, R. J. (1967). Comments on the subspecies of the snake *Elaphe quatuorlineata* in Greece. *Copeia* No. 4, 868-71.

CLARK, R. J. (1969). A collection of snakes from Greece. *Brit. J. Herpet.* **4,** No. 3, 45-48.

HELLMICH, W. (1962). *Reptiles and amphibians of Europe.* (English edition, edited by A. Leutscher). London (Blandford Press).

MERTENS, R. and WERMUTH, H. (1960). *Die Amphibien und Reptilien Europas.* Kramer: Frankfurt.

WERNER, F. (1932). Eine neue Schlange aus dem Cycladen-Archipel. *Anz. Ak. Wiss. Wien,* **99,** 232.

WETTSTEIN, O. (1953). Herpetologia aegea. *Sber. Akad. Wiss. Wien. Abt.* **1,** 162.

WETTSTEIN-WESTERSHEIMB, O. (1963). Bemerküng zu der Arbeit von K. F. Buchholz uber *Elaphe quatuorlineata* von den Zykladen (*Bonner Zool Beitr.* 1961). *Ann. Naturhist. Mus. Wien,* **66,** 407-8.

A CONVENIENT SYSTEM FOR HOUSING " OFF-EXHIBIT " REPTILES IN BROOKFIELD ZOO, CHICAGO

By

RAY PAWLEY

Curator of Reptiles, Brookfield Zoo, (Chicago Zoological Park)
Brookfield, Illinois, U.S.A.

(*Received* 3/5/1970)

Because the Reptile House at Brookfield Zoo is limited in cage space the quartering of " off-exhibit " or quarantine herpetozoans is a major problem.

Prior to 1965 no area of the building had been set aside for this purpose other than for a few random boxes and odd-sized aquariums.

However, it was decided that holding enclosures were vitally important for the welfare of the herpetozoan collection and that efforts should be made to install a convenient reptile-holding facility:

(A) Incoming specimens should be isolated for observation to prevent the possibility of exposing the entire collection in the Reptile House to infestation by parasites or disease. In quarantine the animal is confined and this facilitates retrieval of faeces for stool-checking; observation for mites, ticks and old or fresh injuries.

(B) " Stand-by " specimens can be maintained to replace an exhibit animal that is nearing the end of its expected longevity.

(C) Convalescing reptiles can be kept under close observation in surroundings free from molestation by other animals or noisy public.

(D) Gravid reptiles can be kept away from exhibition, preparatory to giving birth or laying eggs.

(E) Some species can be encouraged to mate in these " off-exhibit " enclosures.

(F) A " buffer zone " is provided for any immediate overflow of specimens as a result of a successful reproductive programme, or a seasonal influx of donated specimens.

Due to lack of space in the building we had to concentrate on the advantages offered in the form of a small room with considerable ceiling height. The floor space measured 10′ by 10′. Three walls were constructed of glass brick which admitted some light but in Winter considerable cold was experienced. For this reason our facility could not be built against a wall.

Financial restrictions forced us to keep costs to an absolute minimum.

Since we could purchase ready-made enclosures more cheaply than have a specially made-up series, it was decided to buy individual tanks and arrange these in as suitable a system as possible.

We selected three sizes of terrarium tanks, equivalent in volume to 5, 10 and 15 gallon aquariums. These offered the advantage of having a perforated aluminum " guillotine " lid that slid along stainless steel channels, so that when the lid closed the rim was entirely enclosed in a channel except for the facing side, which could be locked securely by a small padlock. The terrariums are constructed of stainless steel framing with glass sides and bottoms.

These enclosures owing to their construction are relatively easy to clean or sterilize. Their size enables a keeper to replace a tank without disturbing adjacent enclosures. Disadvantages, however, include easy breakage of glass if the tank is slightly stressed and because of its steel and glass construction the physical dimensions of each cannot be altered.

Rather than install the tanks on tabletops of shelving, we investigated the advantages of heavy-duty perforated angle-iron used in building temporary warehouse shelving, etc. We felt that this material would allow the most flexibility in the design of a tank-holding system.

We eventually constructed two racks so that our tanks were arranged in rows, one above the other. In order to install four rows of tanks per rack and give the keeper ample servicing room it was decided to mount the tanks at an angle of nearly 45° (Fig. 1).

Installation of tanks in the manner illustrated requires that care must be taken to support each tank equally wherever it comes in contact with the rack. Some special construction must be undertaken to meet this requirement.

When the rows of tanks are thus arranged due care must be taken of their weight owing to the large amount of gravel supported by the rack. One rack of tanks can weigh many hundreds of pounds, a feature of importance especially if the floor is anything but stone or concrete.

There are numerous advantages:

(A) Because an attendant does not have to reach over and down into a tank (necessary when tanks are arranged conventionally) he has much more freedom of movement when servicing an active herpetozoan.

(B) In a space where only two rows of tanks may be installed in a conventional manner, four rows can now be installed.

(C) By filling each tank half-full of gravel or other medium, maximum depth of several inches can be achieved, allowing for much better drainage than in a cage conventionally arranged. Viewing through the glass at either end permits checking the water-level in the gravel. Humidity may be altered or maintained at the Curator's discretion (Fig. 2).

(D) To keep the lid secured, a lock MUST be engaged, otherwise the lid will slide off the tank . . . a reminder for persons who tend to forget to lock a cage. This is especially important as these facilities are used for venomous as well as non-venomous reptiles.

(E) A snake can rest with its body against a glass surface that *angles* upward over its back giving the reptile an added sense of security.

(F) The sliding door enables the attendant to adjust the aperture when servicing dangerous reptiles. He is better protected when cleaning the tanks.

(G) An attendant can view his charges by *looking down* on them from above or *looking across* at them from a side position (Fig. 3).

(H) Nervous or active snakes are less able to rub or injure their rostral regions because the sloping sides of the enclosure do not abruptly interfere with their movements.

(I) Specimens or cage furniture can be removed or replaced from the tanks more easily.

(J) Permitting a specimen to move on the substratum formed by the hypotenuse of the angle at which the cage rests provides more floor-space than if the cage remains in its usual upright position.

(K) Ventilation is greatly increased as perforations of the lid extend to the " ground level " of the reptile. This permits far better air circulation and reduces the possible build-up of carbon dioxide in the dead air space, which would occur with the usual enclosure arrangement.

(L) The tanks are more securely arranged and almost impossible to move.

It would probably be preferable to have individual drains built in to each tank and to exchange the perforated metal sliding door for one constructed of some transparent plastic material such as plexi-glas. A series of electrical outlets built along the facing edge of each row of tanks would improve the heating and/or illumination for each occupant.

Advantages of this system have so far outweighed the disadvantages and after six years of use, we would probably incorporate this same design into any future building.

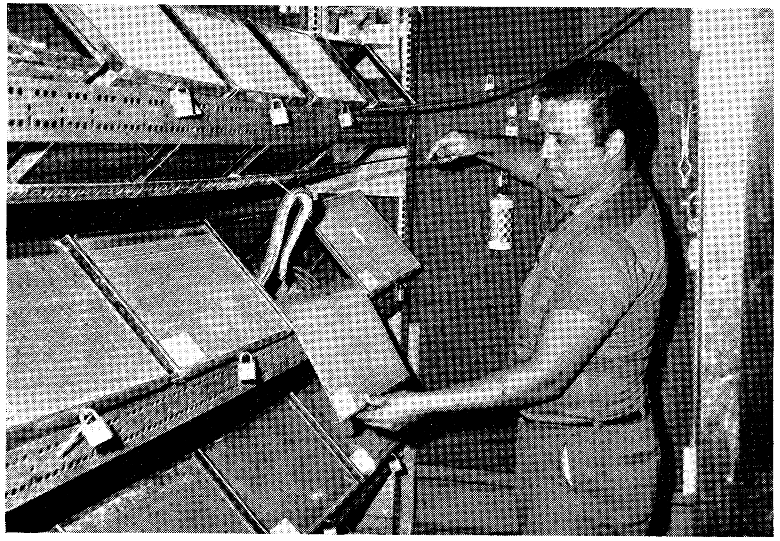


FIGURE 1.

A keeper lifts specimens up and then out of a cage as with water dishes and cage furniture. This illustrates: the use of the lid as a partial baffle, ease of access to the enclosure and the arrangement of the cages that offers maximum usage in relatively limited space.

FIGURE 2.

Humidity is controlled for each cage by adding or siphoning off water to the correct level, as viewed through the glass. The gravel level "between the fingers" is kept dry to protect the scutes of lizards or snakes from excessive moisture. This proportion would satisfy the requirements of at least most species of *Colubridae* and *Boidae*.

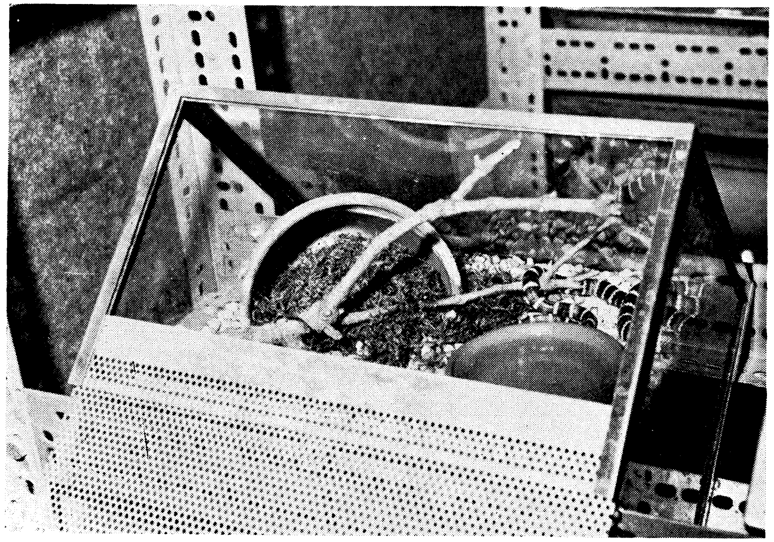


FIGURE 3.

A keeper's eye-view of an enclosure complete with water tray, tree-limb "furniture", uncut sphagnum moss (slightly dampened) to aid in skin-shedding, and a flowerpot fragment for concealment. In this enclosure is a King Snake (*Lampropeltis zonata multicincta*).

EGGS IN URINARY BLADDER OF BULLFROG

By

ROBERT C. FEUER

The Philadelphia College of Pharmacy and Science,
Philadelphia, Pennsylvania, U.S.A.

(*Received* 1/5/1970)

A bullfrog, *Rana catesbeiana*, purchased for student dissection from a biological supply house, was found to have its urinary bladder swollen with eggs. (Fig. 1). The frog, 161 mm. from snout to vent, had 123 ml. of eggs in its urinary bladder. Subsequent dissection revealed the right ovisac swollen to a spheroidal shape, approximately 4 cm. in diameter and containing an estimated 33 ml. of eggs. The cloaca was also jammed with eggs to the vent but was not apparently swollen. The left ovisac was empty and collapsed, resembling an extra mesentery on the medial side of the right one. The upper portions of the oviducts were empty. The ovaries were collapsed and membranous, in the " spent " condition that follows ovulation (Fig. 2).

A similar situation was described in an alligator snapping turtle, *Macroclemys temmincki,* by Dobie (1968). In this individual, a deformed carapace placed pressure on the cloaca, constricting it. Two shelled eggs were found in the urinary bladder. The shells were pitted and nodular, suggesting that they had been in the urinary bladder for some time. Dobie decided that the most probable cause of this phenomenon was that eggs entered the cloaca from both oviducts at once. The cloaca, constricted by the carapace, was not large enough to allow both the eggs to pass. One of the eggs was forced into the urinary bladder. This jamming occurred twice.

Displacement of structures can occur during the mass processing of specimens at the supply house. It is conceivable that pressure on part of the abdomen and on the vent of the frog at the time of preservation could have forced eggs into the urinary bladder. However, it does not seem likely that the ovaries and oviducts (except for the right ovisac) would have been left empty. Further, it might be expected that pressure of this sort would force some of the eggs into the abdominal cavity. It is also unlikely that the eggs were forced into the urinary bladder long before the death of the frog. Had this happened, the urine would have caused swelling of the gelatinous coating, resulting in greatly increased pressure on the internal organs.

It is likely that the eggs entered the urinary bladder shortly before the frog's death. For some reason, there was a blockage of the lower cloaca, backing the eggs into the urinary bladder. Possible causes could be swelling of the eggs upon contact with water in the cloaca; muscular contraction; a fecal mass, later removed by the preparator; or an egg jam, such as hypothesized by Dobie. Subsequent exposure to an aqueous preservative would cause hydration and swelling of the coats of the eggs. For example, the frog might have been collected during amplexus. At this time, the cloaca would have contained eggs. When the frog was collected, it would have voided the contents of its urinary bladder, wetting the coats of the eggs and leading to the blockage of the cloaca.

REFERENCE

DOBIE, J. L. (1968). Shelled eggs in the urinary bladder of an alligator snapping turtle, *Macroclemys temmincki. Herpetologica,* **24,** 328-30.

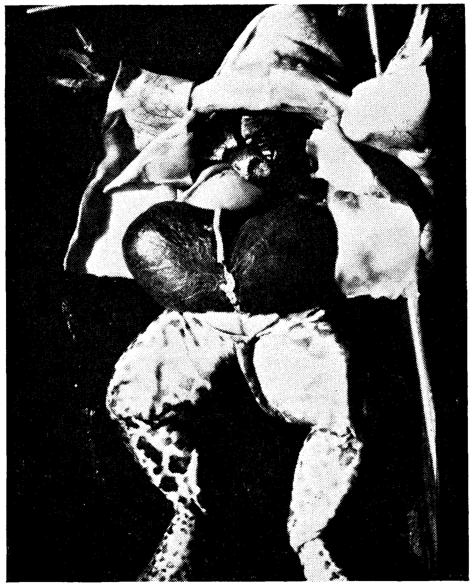


Fig. 1. Bullfrog showing urinary bladder swelled by eggs. Tear, beneath ventral abdominal vein, caused by handling.

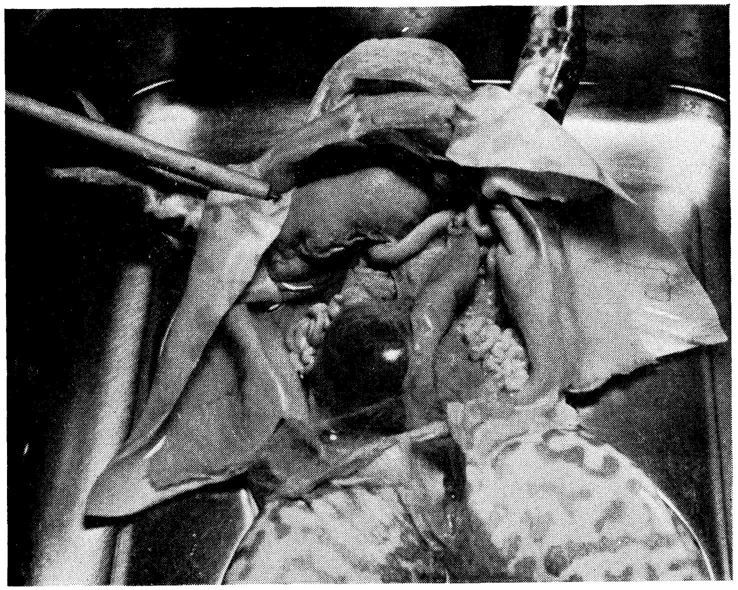


Fig. 2. Bullfrog with urinary bladder removed. Right ovisac swelled with eggs. Left ovisac (alongside of intestine) collapsed and membranous. Ovaries (right ovary between stomach and right ovisac) empty and membranous.

OBSERVATIONS ON THE FEEDING BEHAVIOUR OF A BLIND WARTY NEWT (*TRITURUS CRISTATUS*)

By

A. S. COOKE and W. G. FULFORD

Monks Wood Experimental Station, Abbots Ripton, Huntingdon

(*Received* 29/7/70)

It has been suggested (Cooke, 1970) that exposure to pp'-DDT may cause tadpoles of the common frog *Rana temporaria* to become hyperactive and so be more readily detected and preyed upon by a predator. In these laboratories, using untreated tadpoles and tadpoles previously treated with DDT, we have carried out a series of experiments on selective predation by newts. Preliminary studies indicated that the warty newt *Triturus cristatus* was more suitable for this investigation than the smooth newt *Triturus vulgaris* since its tadpole consumption is greater and it is able to catch and eat larger tadpoles. It was also found that males are more voracious than females. Warty newts remained healthy when fed twelve 50-100 mg. tadpoles once every two days.

During the preliminary tests it was realised that one male warty newt was blind. Its eyes were opaque and blue instead of clear and brown, and it did not respond to a pencil point being moved against the glass on the outside of its tank, an action that stimulated other warty newts to lunge as if at moving prey. This newt, which had been collected from the field during the previous week, appeared to be healthy and was in breeding condition.

Newts were individually maintained in tanks 40 cm. long by 20 cm. by 20 cm. filled to a depth of 7.5 cm. with tap water. The floor of each tank was covered with fine gravel. To test their tadpole-eating capacity, newts were kept without food for a day and then ten tadpoles were released into each tank. The mean number eaten in two hours was 5.9 (12 newts; 30 trials), while the blind newt ate six in two hours when under test. It was noted, however, that it had greater difficulty in catching larger tadpoles (weight greater than 100 mg.).

The usual feeding technique for warty newts was to stalk tadpoles after first locating them by sight. When within about 2 cm., the newt lunged forward snapping at the tadpole. The inefficiency of this crude method is illustrated by the fact that only 40 kills were recorded for normal, healthy newts out of 311 attempts, a ratio of 1 : 7.8. The blind specimen did not respond to any tadpole unless it was within about 1 cm. of its snout, when a lunge was sometimes made. Twenty-two lunges were observed, of which eight were successful, a ratio of 1: 2.8. This animal is therefore a more efficient killer than the average, sighted newt and this presumably accounts for it surviving despite its blindness. Its success at hunting is, however, probably more dependent on a high density of tadpoles than that of a normal newt, and it may be relatively less successful outside the confines of a small tank.

A glass rod being moved close to its snout was frequently snapped at, while other newts either ignored or retreated from this treatment. This suggests that although it is believed newts detect food by both sight and smell (Smith, 1969), this blind newt apparently employs sense of touch, either by physical contact with the tadpole or by detecting turbulence caused by the tadpole's movements.

REFERENCES

COOKE, A. S. (1970). The effect of pp'-DDT on tadpoles of the common frog (*Rana temporaria*). *Environ. Pollut.* **1**, 57-71.

SMITH, M. (1969). *The British Amphibians and Reptiles*. Collins.

A PRELIMINARY LIST OF PARASITES COLLECTED FROM REPTILES AND AMPHIBIANS IN NORTHERN NIGERIA

By

R. A. AVERY

Department of Zoology, University of Bristol

(*Received* 22/4/70)

This paper lists the metazoan parasites found in reptiles and amphibians captured on the campus at Ahmadu Bello University, and at the Yankari Game Reserve, in Northern Nigeria, during January and February 1967. New host records for parasite species are denoted by an asterisk (*); parasites which have not been recorded before as occurring in West Africa are shown by a cross (†).

It is a pleasure to thank Professor A. P. Mead for providing facilities in the Department of Biological Sciences at Ahmadu Bello University, and my friend Dr. J. G. E. Lewis for his hospitality whilst I was in Nigeria.

Host Scientific name	Vernacular name	Parasites	Comments
Agama agama	Rainbow lizard	*†*Thelandros rotundus* Malan	A rather maggot-like nematode found in the large intestine and rectum of all the *A. agama* examined.
		Strongyluris brevicaudata Mueller	Nematodes in the intestine.
		Oochoristica tuberculata (Rud.)	Tapeworm; found in the intestine of one lizard
Agama benueensis		**T. rotundus* **S. brevicaudata*	Not so abundant as in *A. agama*, and many of the lizards were not infected.
Agama sankaranika		**T. rotundus* **S. brevicaudata*	Ditto
Varanus exanthematicus	Bosc's monitor	*Abbreviata baylisi* (Baylis and Daubeney)	Found commonly in the stomach of monitors; nematodes.
		*†*Ophidascaris filaria* (Duj)	A large nematode found in the stomach. Not so common as the previous species.
		**Proteocephalus niloticus* (Beddard)	Tapeworm; one specimen found.
		Aponomma exornatum (Koch)	Ticks.

Mabuya quinquetaeniata	Five-lined skink	**T. rotundus*	
		**S. brevicaudata*	
Mabuya maculilabris	White-lipped skink	No parasites were found in six specimens.	
Hemidactylus brooki	Brook's gecko	*Thelandros* sp.	
Ptyodactylus hasselquisti	Fan-footed gecko	*Thelandros* sp.	
		**Abbreviata* sp.	Nematode; intestine.
		Thamugadia sp.	A nematode in the thoracic cavity; most specimens were infected, and microfilariae were found in the blood.
Python regius	Royal python	*Kalicephalus* sp.	A nematode in the oesophagus; very abundant.
		Polydelphis sp.	A large nematode species in the intestine.
		Ophiotaenia sp.	Tapeworm.
		Aponomma latum (Koch)	Ticks, infesting all of the pythons examined.
Naja nigricollis	Black-necked cobra	*Kalicephalus* sp.	Very abundant.
		**Abbreviata* sp.	In the stomach.
		**Porocephalus clavatus* (Wyman)	Pentastomids in the body cavity and lungs.
		Armillifer annulatus (Baird)	Pentastomids in the lungs.
		Aponomma latum	
		Aponomma exornatum	
Causus rhombeatus	Night adder	**Thelandros* sp.	
Leptotyphlops bicolor	Burrowing snake	No parasites were found in three specimens	
Xenopus mulleri	Savannah clawed toad	*†*Camallanus kaapstaadi* Southwell and Kirshner	Bloodsucking nematodes in the oesophagus and stomach.
		†*Procamallanus xenopodis* Baylis	Ditto.
		Cephalochlamys namaquensis (Cohn)	Tapeworms. Most toads were infected.

		(Cohn)	
		†*Protopolystoma xenopi* (Price)	Trematode in the bladder.
Rana galamensis	Lake Galam frog	*†*Cosmocerca* sp.	Nematode in the rectum.

BOOK REVIEWS

FROGS OF COLUMBIA. By the late Doris M. Cochran and C. J. Goin. Bull. 288, Smithsonian Institution, United States National Museum, Washington, D.C. Obtained from Superintendent of Documents, Govt. Printing Office, Washington, D.C. $4.00 paper back.

The authors have listed 212 species and sub-spp. of frogs and have compiled what is known of the frogs of Columbia. This labour of love (p. 6) — a handsome piece of scholarship, of 655 pages, 68 plates and 27 pages of references, is the best obituary the late Dr. Doris M. Cochran, Curator, Division of Reptiles and Amphibians, U.S. National Museum, would have wished for.

H. FOX

AUSTRALIAN LIZARDS. By R. Bustard. Collins, Sydney & London. pp. 161. Price (Australian) $5.95.

Readers of this Journal will know of Dr Bustard's work on Australian lizards. He has now written a book on this group of reptiles in Australia, including aspects of his own investigations.

The first chapter, shortish but highly detailed and rather " academically " geographical may be quickly passed over by those wishing to read about lizards. Thereafter, apart from a brief introduction to lizards generally, there are chapters on Monitors (*Varanidae*), Gekkos (*Gekkonidae*), Flap-footed *Pygopodidae*, Dragon lizards (*Agamidae*) and Skinks (*Scincidae*). Finally the book is rounded off by chapters on Conservation and Research in lizards and lizards in captivity. Books of this type frequently result in a mere catalogue of the various species in a given habitat, their colouring, feeding and reproduction etc. Only a masochist would wish to wade through some of these but to Bustard's credit he has managed to keep some of these more boring aspects to a minimum. Personally I enjoyed the chapter on the *Pygopodidea* the most. These vestigial-legged lizards include only 13 species, all but two of them (in New Guinea) solely confined to Australia. *Pygopus* and *Delma* actually mimic venomous snakes, not only in their colouring but in behaviour also. I was interested to learn that the New Guinea Monitor (*Varanus salvadorii*) is 16 ft. long — the world record for this group (p. 44); the largest Australian Monitor is the perentie (*V. giganteus*), which is about 7 ft. long (p. 47); the S.E. Asian Gecko *Ptychozoon* glides from tree to tree using a skin membrane along each side of its body (p. 59). In this regard reference may be made to the recent paper by Dr. John in: *Brit. J. Herpet.* Dec. 1970, on *Draco volans*. *Oedura* species, because of the stored fat in their tails, may live without food and water for up to six months or a year if water is present (p. 72). Likewise I was impressed by the account of *Diplodactylus williamsi*, which meets its enemies by squirting liquid at them from its tail (p. 70), and by the colour illustrations of the Frilled lizard *Chlamydosaurus kingii* (plate 54 and frontispiece) and the picture of the curious, fearsome, though harmless *Moloch horridus* (plate 65). Of course none of the Australian lizards are venomous and most are not dangerous at all.

The real value of this book would seem to be for reference on the lizard fauna of Australia; it is a welcome addition to a rather thin literature in this field. There are 80 plate figures many of them in handsome colour. The author and the publishers have produced a delightful little book for those interested in Australian lizards.

H. Fox

DIE TERRARIENTIERE. By Nietzke Günther (1969). Publ. E. Ulmer, Stuttgart. 4 colour Plates, 109 black and white photographs, 43 technical drawings. Vol. I. pp. 344. Technical data; Food and Feeding; Diseases; Tailed and tailless Amphibia; Chelonia. Price: D.M. 48.

Klingelhoeffer's monumental work on this subject is still unsurpassed but it is too expensive for the general reader. The present volume therefore may be very welcome to German-reading herpetologists. They have to know the language well because the book is written in a colloquial style. Its contents testify to the great and obviously varied experience of the author, a plant pathologist with extensive herpetological experience. His book is illustrated with excellent photographs and there seem to be few faults in the text. One might object to the statement (p. 221) that " young and unfertilized female *Xenopus* " were used for pregnancy tests. In the Anura " fertilized females " do not exist since impregnation of the eggs takes place in the water. Indeed, every mature female *Xenopus* may be used for a pregnancy test. The short paragraph on blindness in Chelonians (p. 320-321) too is confused and does no credit to the work that has been carried out on the subject. The name of your reviewer f. expl. has been changed to " M. Eklin ". But these are minor blemishes in a most useful book which contains everything the herpetological beginner may want to know or learn about.

E. ELKAN

THE SNAKE. [Apparently] published by The Japan Snake Institute, Yabuzuka-Honmachi, Nitta-gun, Gunma Prefecture, 379-23, Japan.

I have just received Nos. 1 and 2 of this Journal (1969-70), which I have not previously seen. These numbers contain articles on venomology, reproduction, and snake pathology, in Japanese with English titles and summaries. It appears to be of a high standard and will be of special interest to those concerned with poisonous snakes and their venoms.

A. D'A.B.

REQUEST

I should be extremely grateful for any clutches of living grass snake eggs which readers of this journal may come upon during the summer; the embryos would be used for research on the development of the skeleton and eye. The eggs can be packed in slightly damp moss, sawdust, etc., and the cost of transport would gladly be paid.

Please send to: Prof. A. d'A. Bellairs, St. Mary's Hospital Medical School, Paddington, London, W.2.