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# NOTES ON THE EGGS, INCUBATION AND YOUNG OF SOME AFRICAN REPTILES

By

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BOULENGERINA ANNULATA STORMSI

On August 4, 1960, the San Diego Zoo received two adult female water cobras (*Boulengerina annulata stormsi*) collected by C. J. P. Ionides in Lake Tanganyika at Mupulungu, Northern Rhodesia. On August 9, 1960, one of these specimens laid 22 eggs, one of which was much smaller than the remainder of the clutch, and, because of its assumed infertility, was discarded. The most striking feature of this clutch of eggs, in contrast to the many hundreds of snake eggs that have been laid and successfully incubated at the reptile house of the San Diego Zoo, was their coloration. Unlike the whitish snake eggs we had previously seen, the *Boulengerina* eggs were decidedly yellowish in color. This coloration became noticeably less bright yellow three days after laying and the eggs gradually faded to the more usual whitish coloration during incubation.

The eggs were numbered with Indian Ink and weighed and measured. In the tabulation below the first figure represents the length of the egg, the second figure the width of the egg, and the third the weight of the egg; throughout this note all measurements are given in millimetres and weights in grams.

| | | | | |
|---|---|---|---|---|
| 1. | 63.1 | x | 30.9 | 37.1 |
| 2. | 53.3 | x | 34.7 | 36.7 |
| 3. | 54.6 | x | 33.4 | 36.3 |
| 4. | 59.5 | x | 32.2 | 34.3 |
| 5. | 51.9 | x | 34.1 | 35.2 |
| 6. | 60.0 | x | 32.2 | 39.2 |
| 7. | 59.8 | x | 32.7 | 38.3 |
| 8. | 52.7 | x | 32.6 | 33.6 |
| 9. | 52.5 | x | 32.5 | 32.0 |
| 10. | 55.0 | x | 32.5 | 34.9 |
| 11. | 57.4 | x | 32.1 | 35.1 |
| 12. | 52.3 | x | 34.2 | 35.1 |
| 13. | 54.2 | x | 34.6 | 35.4 |
| 14. | 58.1 | x | 32.6 | 35.4 |
| 15. | 63.9 | x | 32.2 | 38.3 |
| 16. | 59.5 | x | 32.4 | 35.7 |
| 17. | 57.7 | x | 32.6 | 36.0 |
| 18. | 55.8 | x | 33.8 | 34.8 |
| 19. | 59.1 | x | 31.2 | 34.4 |
| 20. | 57.0 | x | 31.8 | 35.1 |
| 21. | 55.9 | x | 32.7 | 34.5 |

The average dimensions and weight of the eggs were: Length, 56.82; width, 32.76; weight, 35.59.

The eggs were incubated in crocks 6 inches in diameter by 3 inches in depth. A damp paper towel, folded double to make a square, was placed on the bottom of the crock and over this a dry paper towel folded in the same manner was placed. The eggs were then placed on the dry paper towel and a cover glass put on top of the crock to prevent excessive evaporation of moisture during incubation. The clutch of 21 eggs was incubated in four crocks. The crocks containing the eggs were placed in one of the heated corridors of the reptile house where the minimum air temperature is 80° F. throughout the year and the maximum air temperature frequently reaches 95° F.

During incubation need for the addition of moisture to the crocks was signaled by the appearance in the egg shells of conspicuous dents or longitudinal depressions. During the incubation period and varying with the tightness of fit of the cover glass on top of the crock, one crock required the addition of 5 cc of water, two crocks had 15 cc of water added and one crock 35 cc of water.

On August 25, 1960, egg no. 4 was spoiled and found to be infertile. On September 16, 1960, egg no. 16 was also spoiled but found to contain a small dead embryo.

On October 7, the 60th day of incubation, the surviving eggs were again weighed and measured:

| | | | | |
|---|---|---|---|---|
| 1. | 64.4 | x | 32.0 | 38.1 |
| 2. | 52.4 | x | 35.7 | 36.7 |
| 3. | 56.3 | x | 32.8 | 33.6 |
| 5. | 52.8 | x | 34.3 | 34.1 |
| 6. | 61.4 | x | 33.1 | 30.0 |
| 7. | 60.8 | x | 33.5 | 31.7 |
| 8. | 53.6 | x | 32.7 | 28.3 |
| 9. | 51.8 | x | 32.7 | 27.8 |
| 10. | 53.4 | x | 33.4 | 28.1 |
| 11. | 57.8 | x | 33.5 | 34.6 |
| 12. | 53.9 | x | 34.7 | 34.1 |
| 13. | 53.8 | x | 35.0 | 33.5 |
| 14. | 59.5 | x | 33.2 | 34.6 |
| 15. | 64.1 | x | 34.1 | 35.4 |
| 17. | 58.6 | x | 33.3 | 35.4 |
| 18. | 54.3 | x | 34.9 | 33.5 |
| 19. | 60.4 | x | 31.5 | 31.6 |
| 20. | 56.6 | x | 33.0 | 32.7 |
| 21. | 55.8 | x | 32.4 | 31.0 |

The average measurements and weight of the remaining eggs at this time were: Length, 56.93; width, 33.46; weight, 32.88.

During these first 60 days of incubation the eggs had increased 0.69 per cent in length, 1.98 per cent in width, but had lost 7.77 per cent in weight.

On October 25, 1960, eggs no. 6, 7, and 10 had, on the inside of the shell, what appeared to be scratches made by an egg tooth. With the idea





that these young snakes were perhaps not strong enough to slit the egg shell by themselves, the eggs were opened with scissors. All 3 eggs contained dead but almost full-term embryos with penial anlage protruding. On this date also, eggs no. 8 and 9 were slit with scissors and found to contain living young which were not removed from the egg.

The first normal hatching occurred on October 25, after 78 days incubation, when egg no. 17 was found slit and with the young snake's head protruding at 8 p.m. Not including eggs no. 8 and 9, the frequency of hatching was: October 25 (1); October 26 (3); October 27 (4); October 28 (3); October 29 (2); October 31 (1).

Seven of the *Boulengerina* hatchlings, including nos. 8 and 9 which had their egg shells slit with scissors, died within the first 16 days subsequent to hatching. All of the young snakes shed within 12 to 14 days after hatching.

The measurements, weights and sex of the young, exclusive of no. 8, are given below. The first figure represents the length overall, the second figure tail length, and the third weight:

| | | | | |
|---|---|---|---|---|
| 1. | 421 | 82 | 18.7 | ♀ |
| 2. | 412 | 88 | 18.9 | ♂ |
| 3. | 387 | 75 | 15.5 | ♀ |
| 5. | 378 | 77 | 16.7 | ♂ |
| 9. | 350 | 68 | 14.0 | ♀ |
| 11. | 402 | 81 | 19.2 | ♂ |
| 12. | 374 | 77 | 16.4 | ♂ |
| 13. | 430 | 82 | 20.3 | ♀ |
| 14. | 353 | 71 | 19.0 | ♀ |
| 15. | 309 | 64 | 16.0 | ♂ |
| 17. | 327 | 65 | 13.0 | ♂ |
| 18. | 422 | 82 | 20.2 | ♀ |
| 19. | 387 | 74 | 17.4 | ♀ |
| 20. | 341 | 69 | 19.8 | ♂ |
| 21. | 335 | 68 | 14.5 | ♀ |

The average measurements and weight of the young were: Males, overall length, 363.6; tail length, 74.43; weight, 17.14. Females, overall length, 385.6; tail length, 75.25; weight, 17.45.

Of the nine surviving young, most refused to feed despite offerings of mosquito fish (*Gambusia affinis*) as well as very small live mice that had been rubbed in anchovy viscera to impart a fish odor. The evident non-feeders commenced dying, in an emaciated condition, on December 9, 1960, continuing until January 18, 1961, when the sixth and last specimen died. The three remaining water cobras settled down to a steady diet of small mice rubbed in anchovy, a procedure that was continued until April 26, 1961, when the first mice, without benefit of added fish odor, were offered. Interestingly enough the small cobras eagerly seized and ate the mice and have continued to do so up to this time. At this writing, almost two years after their hatching, there are two surviving snakes, the third specimen having been accidentally killed on July 31, 1961. Both survivors have grown at a rather astonishing rate and are now approximately 3 feet in length.

DASYPELTIS SCABRA

An exceptionally large specimen of the egg-eating snake (*Dasypeltis scabra*) measuring approximately 1018 millimetres in total length was received at the Zoo on September 22, 1961. This snake was collected 1 mile south of Simons Town, Cape Province, South Africa, while attempting to secure the contents of a goose egg. The egg shell proved too thick for the snake to complete the normal process of deglutition for which this genus is so highly specialized.

On December 1, 1961, the *Dasypeltis* laid 10 white eggs. The eggs were numbered with Indian Ink and weighed and measured as follows:

| | | | | |
|---|---|---|---|---|
| 1. | 42.3 | x | 20.2 | 11.1 |
| 2. | 40.8 | x | 19.7 | 9.9 |
| 3. | 36.1 | x | 20.4 | 9.0 |
| 4. | 38.4 | x | 19.6 | 9.0 |
| 5. | 42.2 | x | 18.5 | 9.4 |
| 6. | 37.6 | x | 20.2 | 9.6 |
| 7. | 38.3 | x | 19.8 | 9.0 |
| 8. | 36.3 | x | 19.6 | 9.2 |
| 9. | 37.8 | x | 19.4 | 9.1 |
| 10. | 39.1 | x | 19.5 | 9.4 |

The average dimensions and weight of the eggs were: Length, 38.39; width, 19.69; weight, 9.47.

These eggs were incubated in exactly the same manner and under the same conditions as described above under *Boulengerina*. During incubation, 60 cc of water were added to the crock in which the eggs were incubated as the need for additional moisture was indicated by the appearance of dents or depressions in the pliant egg shells.

On January 29, 1962, after 60 days incubation, egg no. 3 was slit and a head protruded from it. At this time the remainder of the unhatched eggs were again weighed and measured to determine any increase or loss in dimensions or weight during incubation.

| | | | | |
|---|---|---|---|---|
| 1. | 41.4 | x | 19.3 | 9.4 |
| 2. | 40.5 | x | 19.9 | 9.7 |
| 4. | 37.8 | x | 19.4 | 7.9 |
| 5. | 42.3 | x | 18.6 | 9.1 |
| 6. | 37.3 | x | 20.2 | 8.5 |
| 7. | 37.2 | x | 19.5 | 8.3 |
| 8. | 36.1 | x | 19.4 | 8.3 |
| 9. | 37.3 | x | 20.1 | 8.5 |
| 10. | 38.9 | x | 19.5 | 9.1 |

At this time the average measurements and weight of the nine remaining unhatched eggs were: Length, 36.95; width, 19.53; weight, 8.75. In length the eggs had increased an average of 5.09 per cent; in width there was an average decrease of .40 per cent; in weight there was an average decrease of 8.09 per cent. Both of the latter decreases were most likely due to the imminence of hatching of the eggs since there is generally a very noticeable loss of moisture from the egg and consequent shrinkage just prior to hatching.





The frequency of hatching of these eggs was: January 29 (1); January 30 (2); January 31 (6); February 1 (1) within a range of 60 to 63 days incubation.

The measurements, weights and sex of the young *Dasypeltis* are given below. The first figure represents the length overall, the second figure tail length, and the third weight:

| | | | |
|---|---|---|---|
| 252 | 29 | 5.9 | ♀ |
| 249 | 28 | 5.8 | ♀ |
| 253 | 37 | 6.1 | ♂ |
| 247 | 39 | 6.0 | ♂ |
| 266 | 30 | 5.6 | ♀ |
| 235 | 18 | 5.4 | ♀ |
| 253 | 27 | 5.9 | ♀ |
| 232 | 29 | 5.2 | ♂ |
| 248 | 36 | 5.3 | ♂ |
| 248 | 36 | 5.5 | ♂ |

The average measurements and weight of the young were:
Males, overall length, 245.6; tail length, 35.4; weight, 5.62. Females, overall length, 251.0; tail length, 28.5*; weight, 5.72.

As of October, 1962, all of the young *Dasypeltis* are still alive and thriving on a weekly force-feeding of egg yolk with an eye dropper.

MALACOCHERSUS TORNIERI

Eighteen African soft-shelled tortoises were received from Herman Ruhe on June 7, 1959. Presumably, these speciments were collected in the vicinity of Mr. Ruhe's animal compound at Mt. Meru, near Arusha, Tanganyika.

On June 26, 1959, a single, immaculate white, hard-shelled egg was found in the outdoor enclosure containing the tortoises. The length, width and weight of this egg were:

45.1 x 29.5 24.1

The egg was incubated in a cold-cream jar measuring 3½ inches in width by 3 inches in height. This had been filled nearly to the top with sand to which 10 cc of water had been added. No further moisture was added during incubation. A cover glass was placed over the jar to prevent excessive evaporation of moisture and the jar was placed in one of the heated corridors of the reptile house where the air temperature ranges from 80° F. to 95° F.

On October 16, 1959, after 112 days of incubation, a hatchling appeared at the surface of the sand. The measurements and weight of the young tortoise were as follows:

| | |
|---|---|
| Carapace length ... ... | 40.4 |
| Carapace width ... ... | 40.5 |
| Carapace thickness ... ... | 19.0 |
| Weight ... ... ... | 15.5 |

* Not including the female specimen with a deformed tail only 18 mm in length.

At three years of age on October 16, 1962, the young tortoise had the following measurements and weight:

| | |
|---|---|
| Carapace length ... ... | 107.5 |
| Carapace width ... ... | 79.6 |
| Carapace thickness ... ... | 41.2 |
| Weight ... ... ... | 176.4 |

During this three year period the young tortoise had increased its carapace length by 163 per cent and its weight by 1038 per cent.

On November 13, 1961, two more eggs were found in the soft-shelled tortoise enclosure. The length, width, and weights of these eggs were:

| | | | |
|---|---|---|---|
| 1. | 47.5 | 28.4 | 22.6 |
| 2. | 45.7 | 28.8 | 22.3 |

These eggs were incubated in a crock 3 inches in height by 6 inches in diameter to which fine sand had been added to a depth of 2 inches. 15 cc of water had been thoroughly mixed with the sand before the eggs were placed in it for incubation. A cover glass was placed over the crock, located in one of the heated corridors of the reptile house, and no further moisture was added during incubation.

Egg no. 1 spoiled during incubation and its fertility was not determined.

On May 17, 1962, after 185 days of incubation, egg no. 2 hatched. The young tortoise had the following measurements and weight:

| | |
|---|---|
| Carapace length ... ... | 37.2 |
| Carapace width ... ... | 41.5 |
| Carapace thickness ... ... | 19.4 |
| Weight ... ... ... | 15.3 |

Another *Malacochersus* egg was found on April 8, 1962. It had the following measurements and weight:

43.1 30.1 23.1

This egg was also incubated in a 6 by 3 inch crock to which 2 inches of screened sand containing 20 cc of water had been added.

On October 7, 1962, the young tortoise was observed in the act of hatching after 183 days of incubation. It had the following measurements and weight:

| | |
|---|---|
| Carapace length ... ... | 38.7 |
| Carapace width ... ... | 39.4 |
| Carapace thickness ... ... | 20.3 |
| Weight ... ... ... | 16.4 |

The rather widely differing incubation periods of 112, 183, and 185 days are undoubtedly reflections of varying seasonal temperature conditions under which the three sets of eggs were incubated. Although the minimum temperature of the reptile house corridors is artificially controlled at 80° F., the period from June to October is one of higher outside temperatures and resultant higher average temperatures inside the reptile house than during the remainder of the year.





VARANUS EXANTHEMATICUS ALBIGULARIS

Two Rock Monitors (*Varanus e. albigularis*) from Mozambique were received at the Zoo on August 12, 1961.

On October 1, 1961, nine eggs were found in the heated house in the monitor enclosure, a large, oval outdoor area. Eight of these eggs were in good condition and one was broken, most likely by the teeth of another monitor in the same enclosure. This broken egg was discarded. On October 5, four and possibly five monitor egg shells were found in feces while the monitor house was being cleaned. On October 8, four more monitor egg shells were found in fecal matter in the monitor house. Thus, at least 17 and possibly 18 eggs were laid by the female.

The eggs were numbered with Indian Ink and weighed and measured. In the tabulation below, the first figure represents the length of the egg, the second, the width of the egg, and the third, the weight of the egg:

| | | | | |
|---|---|---|---|---|
| 1. | 65.9 | x | 33.7 | 40.2 |
| 2. | 65.8 | x | 33.8 | 41.0 |
| 3. | 68.8 | x | 33.7 | 42.2 |
| 4. | 64.5 | x | 34.8 | 41.7 |
| 5. | 65.0 | x | 35.4 | 43.5 |
| 6. | 67.7 | x | 32.8 | 40.3 |
| 7. | 68.5 | x | 33.8 | 42.6 |
| 8. | 63.2 | x | 33.2 | 39.0 |

The average dimensions and weight of the eggs were: Length, 66.17; width, 33.9; weight, 41.3.

The eggs were incubated in two crocks 6 inches in diameter by 3 inches in depth. Two inches of screened sand to which 40 cc of water had been added and thoroughly mixed were placed in each crock. The eggs were buried sufficiently deep to just cover them with sand. The crocks were then placed in one of the heated corridors of the reptile house where the minimum temperature is 80° F. throughout the year and the maximum temperature frequently reaches 95° F.

During incubation the eggs were occasionally examined by gently brushing away the overlying sand with a fine brush. Need for additional moisture was signaled by the appearance of conspicuous dents or longitudinal depressions in the egg shells. During the incubation period one crock received an additional 140 cc of water and the other crock 110 cc of water.

Egg no. 7 spoiled at an unrecorded date prior to February 1, 1962, and its fertility was not determined.

On February 1, 1962, the 124th day of incubation, the eggs were again weighed and measured:

| | | | | |
|---|---|---|---|---|
| 1. | 65.1 | x | 37.4 | 47.4 |
| 2. | 65.3 | x | 37.5 | 47.4 |
| 3. | 68.4 | x | 36.8 | 48.4 |
| 4. | 64.3 | x | 35.2 | 42.1 |
| 5. | 64.5 | x | 37.7 | 48.3 |
| 6. | 67.1 | x | 35.9 | 45.9 |
| 8. | 62.7 | x | 36.5 | 43.7 |

The average measurements and weight of the remaining eggs at this time were: Length, 65.34; width, 36.7; weight, 46.17. During the first 124 days of incubation the eggs had lost .76 per cent in length while there was an increase of 8.25 per cent in width and 11.78 per cent in weight.

The monitor eggs were not again measured or weighed prior to hatching, which commenced on March 20, the 170th day of incubation. The frequency of hatching was: March 20 (1); March 24 (2); March 25 (2); March 26 (1).

Egg no. 3 failed to hatch but was found to contain a nearly full-term embryo with deformities that also appeared in two of the hatchlings. In the dead embryo, the upper jaw was skewed to the right and the egg tooth was situated well to the right of the mid-line of the rostrum. The lower jaw was appreciably longer than the upper and the right orbit was less than one-half the diameter of the left orbit.

The measurements and weights of the six young monitors that successfully completed incubation are given below. The first figure is the length overall, the second figure, tail length, and the third figure, weight.

| | | | |
|---|---|---|---|
| 1. | 213 | 101 | 27.9 |
| 2. | 217 | 105 | 28.6 |
| 4. | 200 | 100 | 23.6 |
| 5. | 207 | 100 | 27.2 |
| 6. | 201 | 102 | 28.3 |
| 8. | 204 | 99 | 27.6 |

The average measurements and weight of the young were: Length overall, 207; tail length, 101.2; weight 27.2.

The young monitors from eggs no. 1 and 6 both hatched with the same deformities that were found in the dead embryo from egg no. 3. In both the living monitors the upper jaw was noticeably twisted to the right as well as being foreshortened to the extent that the lower jaw was about 3 millimetres longer than the upper. In both young also, the right orbit was approximately one-half the size of the left. The reduced orbits appeared to possess functional eyes. The first of these deformed young died on May 18 and the second on August 7.

The remaining young have done quite well on a diet that indicates they have a decided preference for bits of fish and crustaceans such as shrimp, as opposed to ground meat or young mice. Occasional insects such as moths, beetles, cutworms and crickets are also relished.





## CAPTIVE SNAKES IN GHANA

By

J. B. Harper

### 1. Black-necked or Spitting Cobra (*Naja nigricollis*)

The snakes were kept during 1959-60, never more than four being in captivity at a time. They ranged from juveniles of some 350 mm. to adults of 1800 mm. All the specimens were blue black on the dorsal surface (adults) and dark or light grey (young). They all possessed irregular salmon pink markings on the ventral surfaces ranging from the throat to just short of the anal plate where the colour changed gradually to **blueblack.**

This species was very easy to keep as all the specimens would readily take the common toad found in the compounds of most Ghanaian dwellings. The adult snakes would take three or four toads weekly, the juvenile specimens normally only one. The specimens observed would not accept wild or laboratory mice. As a rough guide to the size of toad taken, it was noticed that the snakes were able to swallow quite easily toads that were about twice as wide at the hindquarters (in a squatting position) as was the width of the snake's head.

*N. nigricollis* is a cannibal. Different generations were kept together without loss but on one occasion a juvenile specimen temporarily housed with a young specimen of *Psammophis elegans* (the Beauty Snake) swallowed the latter during the single hour in which its own housing was being cleaned. The young cobra was not able to digest the larger snake, however, and in regurgitating it some hours later, expired.

After this, the snakes were housed separately, the adult specimens being allotted about 6-8 cubic feet of space each, the juveniles 3-4 cubic feet. Each snake was provided with water which was changed twice weekly. The size of water container was sufficient to allow the specimens to immerse themselves either totally or partially. The juvenile specimens would spend whole days immersed with only the head resting on the rim of the container. Due to their regular eating habits the mature snakes would slough every 4-5 weeks, the juvenile specimens much less frequently.

Sand was used for a floor covering for the juvenile and one of the adult specimens. The largest snake had a closely meshed floor covering whose only advantage was in providing ventilation, as the mesh was too fine to admit the passage of the faeces or sloughed skins. All the boxes had glass fronts for safe viewing and the sides or lids possessed $\frac{1}{2}$" wire netting covered with mosquito netting to provide ventilation and restrict the passage of expectorated venom. The mosquito netting was placed on the inside to prevent the juveniles from climbing between the two layers. All the boxes and containers had to be isolated from the ground and marauding ants by standing all supports in tins of paraffin or diesel oil.

It is essential that the glass-fronted side used for viewing should not even have the slightest gap as the writer learned by personal experience. Whilst photographing an adult specimen through the glass front, it became excited and spat accurately at the writer's face. The venom landed on a joint between two glass panels and some drops splattered through into the photographer's left eye. The sensation was, I suppose, similar to splash-

ing the eyeball with an astringent after-shave lotion. The eye was immediately bathed in clean water and although vision was not entirely lost it was very blurred for some hours afterwards and for several days strong sunlight was very painful. The eye showed all the external appearances of conjunctivitis.

It was observed that the snakes would spit more readily in the vivaria than in the open. For purposes of photography it was found possible to carry one at arm's length on a T-shaped stick. The snake did not spit if manual handling was avoided. On these occasions, as on all cleaning operations, spectacles were worn and proved adequate protection although completely enclosing goggles, if obtainable, would have been preferred.

*N. nigricollis* is not very photogenic, as unlike the Egyptian cobra, *N. haje*, or the Black and White Cobra, *N. melanoleuca*, it seldom spreads its hood and nearly always tries to slither away. In this it resembles *Pseudohaje nigra*, the Tree Cobra, also practically hoodless.

It was found necessary at monthly intervals at least to remove faeces and sloughed skins from the vivaria and to remove the coagulated venom from the internal surfaces of the glass. This last operation was performed wearing gloves as venom newly sprayed on to the glass could wash off into an open cut on the hand with unpleasant results. To perform the cleaning out operations the snake had to be bagged and removed from its box. This was done by first pinning its head gently but firmly to the floor with a T-stick, with the other hand enclosed by a bag, and seizing the snake by the neck. The T-stick was then abandoned and the snake's anterior portion supported by the hand thus freed. Whilst still holding the snake's head in the bagged hand the bag was drawn over the snake's body and tail, the neck of the bag tied and the snake's head, now in the bag, released.

This last method was suggested by reading the biography of C. J. P. Ionides.

It is realised of course that specially designed vivaria are preferable to avoid all unnecessary handling of the reptiles. Had the writer's stay in Ghana been longer the additional expense would have been worthwhile but under the circumstances the housing proved quite adequate.

A totally unexpected aspect of *N. nigricollis*'s behaviour was the ability to climb with almost arboreal agility displayed by an adult specimen which escaped and for an hour evaded recapture in the rafters of an open walled structure. The snake could quite easily have escaped into the open grassland but sought the rafters of its own accord.

2. West African Beauty Snakes (*Psammophis* sp.)

The snakes kept were all native to the area containing the Volta River Dam site which is thick forest with small cultivated clearings. The colouration of the genus *Psammophis* is perhaps the most beautiful of all African snakes, *P. elegans* having dorsal stripes running from nose to tail of reddish brown and dark green edged with black. The eye is sometimes ringed in blue. The ventral surface is yellow, spotted with blue from the chin for about one fifth the body length, the remaining ventral surface being cream





tinted with brown or grey. The whole dorsal and ventral surfaces are quite glossy. *P. sibilans* has more muted colouration with double-edged patterns on the dorsal surface of the head. A variety exists without any longitudinal stripes but possessing the same base colouring of olive brown.

*Psammophis* are active snakes and require considerable vivarium space, 30 cubic feet (of a chicken cabin) being considered sufficient for 2-3 five foot specimens. *P. sibilans* when full grown is thicker in the body than a man's thumb and can be contained by $\frac{1}{2}$" chicken netting. *P. elegans* is a slimmer snake and could only be safely retained by mosquito proof netting. A dry sandy floor was provided with sufficient water for drinking purposes.

*P. elegans* appeared to be of more nervous disposition than *P. sibilans* and did not feed as readily, although all species would take frogs, toads, lizards and laboratory mice. A four foot specimen of *P. sibilans* swallowed two 12" specimens of *Atractaspis*, the burrowing viper, but was bitten by a third two days later with fatal results for the *Psammophis*. It was found possible to keep *Psammophis* with other genera of equal size with the exception of cobras and file snakes (*Mehelya* sp.) which are cannibals.

Like most other back fanged snakes *Psammophis* are not aggressive and it has been the writer's experience that they will never try to bite even when excited. However one was seen attempting to bite a person handling it roughly, under the mistaken impression that it was dangerous.

3. The West African Night Adder (*Causus rhombeatus*)

A dozen specimens were kept, varying in size from juveniles of 4 ins. to adult specimens of 21 ins. Although named the Night Adder, all the specimens were taken in daylight and appeared to be active in the heat of the day. *C. rhombeatus* is probably the most numerous poisonous snake in Ghana and as it feeds readily on the ubiquitous common toad it can easily be kept in vivaria.

In appearance *C. rhombeatus* is comparatively slender for a viper (about the thickness of a little finger), has no distinct neck and does not possess the typical viperine head. In colouration the specimens varied from khaki to a dark brown base on the dorsal surface. They all possessed twenty to thirty black chevrons on this base colour and were all coloured cream ventrally. *C. rhombeatus* gives the impression to the observer of being several sizes too small for its skin. Even when surfeited by a meal or swollen in angry agitation it still gives this appearance of possessing a loose skin, unique in snakes in their prime but sometimes observed in underfed pythons.

*C. rhombeatus* is an active snake and can travel quite rapidly for a viper, at a speed estimated by the writer at 3-ft./sec. or more than 2 m.p.h. When agitated it inflates its whole body length and, deflating, repeats the process with a loud angry hissing. It is quick to strike when held in a gloved hand and retains its bite for some while, unlike other vipers which normally strike and withdraw immediately. While all the adult specimens fed readily on one toad per week it was not found possible to keep the juvenile specimens for long observation as sufficiently small toads were not readily available and these were released. The adults would not take geckos or skinks due possibly to the superior speed of these latter and showed no interest in laboratory mice.

Specimens were kept for periods of several weeks with specimens of colubrine, boigine and viperine snakes without quarrelling. They were kept

four to a cage of 2 cubic feet capacity containing a sanded floor and a jam jar of fresh water in which individuals would immerse for long periods, even after a heavy meal. The snakes appeared to slough at monthly intervals, this regularity probably being due to their regular feeding. It was noticed with other viperine snakes that those not feeding (in particular *Bitis nasicornis,* always difficult to feed in captivity) did not slough, although one large specimen of *Bitis gabonica* which fed regularly did not shed during a four month period of observation. In general, it was noticed that vipers such as *Causus, Echis* and *Atractaspis* sp. sloughed much more frequently than the larger more sluggish *Bitis* group, suggesting some relationship between skin shedding and the higher metabolic rate of the smaller more active vipers. It was observed that with regard to vipers in general, the regularity of skin shedding appears to be an indication of the snakes' ability to do well in captivity.

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## A SPECULATION ON THE PALLID TADPOLES OF *XENOPUS LAEVIS*

By

R. Maxwell Savage

*Xenopus laevis* is remarkable for a number of things, among them its very high reproductive potential. Bles (1906) recorded 15,000 eggs from one female in a year. Other observers have not found so many, but there is no doubt that upwards of 10,000 is a common figure. This is a high rate for any anuran, most of which seem to breed at 2 years old. I have had a pair that bred for the first time when only ten months old, from the egg. This pair laid fewer eggs at one laying than the parent frogs, and laid less frequently, but if even a few animals in their natural habitats breed as early as this, there is one more term in the geometrical progression of unchecked increase, so that the rate of unchecked increase would be prodigious. I am not aware of any other anuran that breeds when a year old, and not many exceed *X. laevis* in the number of eggs.

On the usual assumption that, given a stationary level of population, all but two of the progeny die before maturity, there must be an enormous death rate somewhere in the life-cycle. Very little field work has been done on this animal, so that we do not know where these losses occur. Batches of tadpoles, whether from a natural spawning or from spawning induced by the injection of hormones, always contain a substantial proportion of "abnormal" tadpoles. These are pallid animals, and are conspicuous among the crowd of normal specimens, not only because of their pallor, but because towards the end of their lives, they swim sluggishly. They all die before metamorphosis, although some may reach a considerable size.

I now turn to another species, *Bombina variegata,* the little discoglossid toad found in France, Switzerland and other Western European countries.





This toad, although not completely aquatic as *X. laevis* is, spends the summer almost always in the water, or basking in the hot sun just out of the water. It lays its eggs, much as *X. laevis* does, a few at a time, attached to weed (Savage, 1932) at intervals during the summer. Like *X. laevis* each female lays repeatedly in a season. In several ways, therefore, *B. variegata* has breeding habits rather like those of *X. laevis.* But it only lays 80-100 eggs in a season. A pair I raised from the egg bred at two years old (1935), and Bannikov (1950), working in Russia on the closely allied species, *Bombina bombina,* concluded from a size-frequency analysis that the animals first breed at two years old. If *Bombina* can manage with only 80 eggs, why does *Xenopus* need 10,000? This is all the more remarkable when it is considered that *B. variegata* lives often in very temporary water. In the summer of 1961, I found two breeding places in different places in Switzerland, each of which consisted of the wheel-ruts of building contractors' vehicles in soft excavated material, dumped on waste ground. These places had adults and a dense population of thriving tadpoles, all in a few gallons of water. It all seems very risky, but on the average it cannot be, with that low rate of unchecked increase.

*Scaphiopus* is the spade-foot toad of North America. Bragg (1961) points out that these toads breed *only* in temporary water. No flooding, no breeding. Bragg, confirming Orton (1954) and extending her work, has shown that the tadpoles of *S. bombifrons* are dimorphic. One type is cannibalistic, the other is not. The cannibalistic type is modified in structure and habits for this life—its job is to eat its fellow non-cannibalistic tadpoles, although it can eat other food as well. Now, in nearly all cases, cannibalism is a hopelessly inefficient way of life, because it involves inserting another link in the food-chain. It can be assumed that seven times the number of animals can live directly on some food supply as can live indirectly by eating an animal that eats the food. There must always be some special reason for cannibalism. *X. laevis* adults eat their own tadpoles. This is not an aquarium artefact—Dr. Elkan tells me that frogs killed at the African ponds contain their own tadpoles. Although *B. variegata* can eat under water, it does not eat its own tadpoles. In captivity, the best way of rearing the tadpoles is to leave them with the adults. In a terraquarium out of doors, the excreta of the adults fertilises the algae on which the tadpoles feed, and just as in the field, adults and tadpoles flourish together. I cannot assert that a toad never eats a tadpole—all that I can say is that there is no noticeable diminution of the numbers of tadpoles during the weeks of development. Moreover, with only 80 eggs in a year, and a breeding age of two, the rate of unchecked increase is about that of song-birds, which breed at one year old, and actually protect their young. It is impossible that *Bombina* should make a habit of cannibalism.

Cannibalism works when the animals that are eaten function as collectors of food that the cannibals would not otherwise get. There must be a large amount of this food. Consider, with Bragg, *Scaphiopus.* The water is temporary. Soon it will all be gone, and it is urgent that the supply should be harvested quickly. The sacrificed tadpoles are so many extra mouths, eating it up for the benefit of the species, but not for themselves.

Now I come back to *Xenopus.* The tadpoles feed exclusively on plankton. This food is far too small to act as food for the adults. With a suffici-

ently high rate of reproduction, and a surplus of tadpoles, these completely aquatic frogs, unable to leave their ponds to forage, as *Bombinas* sometimes do, could efficiently use cannibalism as a means of collecting food from the pond. *Xenopus* ponds sometimes dry up, and the animals aestivate. When the rain comes, there must be a delay while their prey (aquatic larvae of insects and so on) are developing. The plankton, however, can build up in a few days. *X. laevis,* I suggest, becomes a farmer, using its own tadpoles as stock to graze the plankton, and in due course eats the tadpoles. Hence the advantage, and the reason, for 10,000 eggs. Lethal genes, no doubt the cause of the pallid tadpoles, are well enough known in various animals, but normally natural selection would act against individuals that carried such genes. This pressure would be much less if most of the tadpoles were in any case destined to be eaten by the parents, and if indeed, the pallid tadpoles are easier to see and to catch, natural selection might even favour their production.

All this is highly speculative, and therefore fair game for a field worker in Africa to demolish by another explanation.

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## THE MARBLED GECKO (*PHYLLODACTYLUS PORPHYREUS*), IN CAPTIVITY, WITH SPECIAL REFERENCE TO EGG INCUBATION

By

Robert Bustard

The Marbled Gecko (*Phyllodactylus porphyreus*), a native of South Africa, is a small, retiring creature which is able to change its colour from a pale putty shade to dark brown in a few minutes. Most specimens are marbled or mottled in shades of brown. Adults measure 8-9 cms. in total length. The range and habitat are given by Rose (1950) as follows: "Western Cape Province and Little Namaqualand into South-West Africa. It is very plentiful near Capetown and may often be found in secluded corners of gardens, in crevices or bark or under logs in woods and under stones on the mountain slopes."

The form of the feet in geckoes is most significant, and, indeed, is the main basis for classification. It also dictates the habits of the species, those





without adhesive lamellae being of necessity ground dwellers. In *P. porphyreus* the tips of the toes are dilated and flattened, therefore this gecko is a good climber. Captive specimens have no trouble in climbing a vertical sheet of glass or resting upside down on the roof of the vivarium. Owing to their agility it is important to take precautions to prevent escapes.

I became interested in this gecko in the autumn of 1955 and my method was to establish a community as I had done previously, very successfully with *Hemidactylus brooki* (Bustard 1957). Unfortunately *P. porphyreus* proved a shy, secretive creature which seldom appeared in the daytime or when the light in the vivarium was on. This was in complete contrast to *H. brooki* which was active under bright light especially during the early morning or late evening (Bustard 1957). I kept about fifteen *P. porphyreus* in a vivarium 20" x 20" x 20", the temperature being maintained at about 75-80°F for at least 10 hours daily and falling to about 50-55°F at night. All my heating was done by pearl light bulbs and has been outlined in a recent article (Bustard 1958). The geckoes were fed on flies and bluebottles. The furnishings of the vivarium consisted of a layer (1") of sand covered by dry moss and pieces of bark were placed round the sides with a hollow log in one corner. The inmates spent their time under the moss or bark. Under these conditions the geckoes thrived.

It was hoped to obtain some data on the incubation time and the necessary conditions; some knowledge on technique having been gleaned from past experiments. For instance work on *H. brooki* (Bustard 1957) had shown that if the eggs were not removed they were liable to be eaten. *P. porphyreus* laid their eggs in no apparent order and most were found lying under the moss beside the geckoes. Each female laid two eggs at a time. The average size of the eggs is 9 x 6½ mms. (Rose 1950). The clutches were removed and placed in an incubator for safety. The incubator consisted of a small box about 6" x 4" x 2" deep with a layer of sand covered by dry moss. This was left in the vivarium and was, therefore, subject to the temperature variation described above. Each clutch of eggs was placed in a depression in the moss and a small number tag was laid beside it so that the various clutches would not be confused, and the accurate incubation period of each be readily known. I was fortunate to have eight clutches of eggs to work on so that a good sample of the incubation period could be obtained. The incubation periods which, of course, will vary with the temperature within certain limits, are tabled below. Vivarium and incubator were searched daily, so the following data are correct.

| CLUTCH | DATE LAID | DATE HATCHED | INCUBATION PERIOD (DAYS) |
|---|---|---|---|
| No. 1. | 28/10/55. | ——— | Opened 14/3/56. Infertile. |
| No. 2. | 12/11/55. | 24/2/56. | 104. |
| | | 26/2/56. | 106. |
| No. 3. | 13/11/55. | 24/2/56. | 103. |
| | | 27/2/56. | 106. |
| No. 4. | 16/11/55. | 14/3/56. | 5 hatched. 119. |
| No. 5. | | 20/3/56. | 1 hatched. 124. |
| No. 6. | | | |
| No. 7. | | 23/3/56. | 1 hatched. 127. |
| | (remaining egg infertile) | | |
| No. 8. | 28/11/55. | 30/3/56. | 2 hatched. 120. |

The table indicates that there is a variation of some three weeks in the hatching time. All the eggs were placed in the same incubator and were therefore subjected to identical conditions. It is interesting to note that eggs from the same clutch usually hatch within a few days of each other, if not on the same day. The two eggs of clutch 1 and those of clutch 2 hatched with two and three days between. Eight eggs were laid on 16th November, 1955, and five of these hatched on the same day—20th March, 1956, 119 days later. Both the eggs of clutch 8 also hatched on the same day. The extremes were 103 and 127 days with an average incubation period of 115 days.

The young on hatching measured, on average, 2.3 cms. total length. The tail was long, accounting for more than half of the total length, and the body was slim. The young differed from the adults in having a characteristic red-orange coloured tail. Those that were observed at birth sloughed within half-an-hour. They were placed in a special vivarium by themselves where they grew rapidly on *Drosophila*.

*Conditions of incubation. P. porphyreus,* like many geckoes, lays eggs with hard calcareous shells. In this they differ from many reptiles which lay eggs with parchment-like shells, which are difficult to hatch owing to the importance of regulating the humidity. Humidity does not appear to be so important in the case of eggs which have calcareous shells. However, some humidity may be necessary for the incubation of *P. porphyreus* eggs. I have found that an occasional sprinkling about once a fortnight was sufficient. The moss absorbs and retains some moisture for a considerable time. The water requirements of gecko eggs will vary according to the habits of the adults and the site chosen for egg-laying. In certain species, no sprinkling may be required and many eggs might well hatch without this attention.

*Summary. Phyllodactylus porphyreus* is a small secretive gecko which lives well in the vivarium. Eight clutches each of two eggs were under observation, of which 13 hatched. The average incubation period was 115 days. The young sloughed within half an hour of hatching. They had conspicuous red-orange tails which accounted for rather more than half of their total length of approximately 2.3 cms. They were successfully reared on *Drosophila*.

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## NOTES ON THE BREEDING BEHAVIOUR OF *RANA TEMPORARIA*

By

R. S. Oldham

Whilst conducting experiments on homing behaviour in *Rana temporaria* in Sheffield, Yorkshire, the following observations were made.

On March 7th, 1957, there were five clumps of spawn in six inches of water at the south end of a breeding pool. Breeding frogs were moving about in the vicinity of these clumps. The spawn was moved to a new position two yards away at the same end of the pool. On March 8th the frogs were gathered around the spawn at the new position. There were then two new spawn clumps in addition to the five and there was a new clump at the old position. All the spawn was moved to yet another position two yards further on. On March 9th all the frogs and three new spawn clumps were in this new position.

A second pool was situated 35 yards from the above pool. In this case spawning and related activity, including croaking, was occurring at a depth of from one to two feet. There were some 15 spawn clumps at the site. On March 9th five of these were moved to shallower water (10 inches) and on March 10th there were frogs in both positions and three new spawn clumps, one at the old site and two at the new. Twelve clumps, six from each site, were then moved to the northern end of the pool which was approximately 6"-8" in depth and, in contrast to the other sites, abundantly supplied with aquatic vegetation. On March 11th there was spawning activity and two new spawn clumps at this new site. At the other two sites there was neither activity nor spawn. On March 12th, although there was one new spawn clump, general breeding activity had ceased. In the second pool from Mar. 9th to 15th, 67 frogs were caught at the deep spawning site. From March 10th to 15th 42 frogs were caught at the shallow site.

These experiments on the translocation of spawn masses suggest that frogs respond to the presence of spawn. Savage (1961 : page 169) mentions a captive female which clambered on top of one of the previously laid clumps and laid her eggs there, even though this spot was a very small fraction of the available space. He states that this behaviour is often found in ponds. Frazer (personal communication) suggests that this may have some connection with the heat conserving properties of spawn. Year by year fidelity on the part of a breeding population to a particular site in a pool has been reported by several authors (e.g., Savage 1935; Smith 1954).

On the subject of spawning depth, Frazer (1953b) reports that toads were caught down to 20 feet in Lake Windermere, and there is good evidence that they were spawning at least down to 10 feet and maybe even to 15 feet. There is no mention of whether there was any singing beneath the water. Leutscher (1953) describes observations taken over a period of 19 years, during 17 of which a spawning community of *Rana temporaria* was seen at the same site in the same pond each year except the last year,

1952. During this year heavy rain raised the level of the water and at the normal site the depth was nearly 2 feet. The frogs moved to a different site and spawned at the normal depth of about 1 foot. In the frog and toad breeding records compiled by Frazer (1953a; 1953c; 1955; 1956), spawning depths are given for *Rana temporaria* and the average for 112 records is 11 inches. The greatest depths recorded were 66, 43 and 36 inches, and the smallest half an inch. Unfortunately there are no comments relating to the type of spawning activity at these deep spawning sites. Wright and Wright (1933) note that since a frog's mouth is closed during croaking it can croak under water and several authors have reported that this does occur (Bles 1905, Holmes 1927, Smith 1954, Storm 1960). Underwater breeding activity is of particular interest in connection with orientation mechanisms. It seems unlikely that distant orientation on land could be accomplished by means of stimuli emanating from a submerged community, since the intensity of the sound is so very much reduced.

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## DICEPHALISM IN THE ADDER (*VIPERA BERUS*)

By Kai Curry-Lindahl

With reference to the recent note by J. W. Steward (1961) on a case of dicephalism in the Adder (*Vipera berus*) it may be of interest to record that such anomalies in this species are known from Sweden in at last four cases. They have all been published but only in Swedish literature, so it is no way astonishing that Steward has not been able to find these records.

Adders in similar condition as described by Steward have been reported, captured and preserved in Sweden in the following instances: 1. Juvenile specimen caught near Göteborg on 1st September, 1896; died in captivity on 25th September, 1896 (published 1907 in Fauna och Flora 2:125-128). 2. Juvenile specimen caught in the province Bohuslän (north of Göteborg) on 5th September, 1941; died in captivity on 16th October, 1941 (Nybelin 1942). 3. Juvenile specimen caught in the province of Värmland in the autumn of 1948; died in captivity on 24th November, 1948 (Naturhistoriska Riksmuseum, Stockholm). 4. A female killed in Skane, the southernmost province of Sweden, in the latter half of August, 1950, gave postmortem birth to seven or eight young, of which three were captured. One of these had two separate heads. This abnormal specimen measured 13 cm and was about 5 cm shorter than the normal young in the same litter. It died shortly after its birth. (Lagerlund and Hanström 1951.)

In all these cases the abnormal adders have been just or recently born young, which after the capture lived only a short time. The lack of records of elder specimen seems to indicate that even in nature double-headed adders do not live for a long period. All the four double-headed adders found in Sweden have had their heads fully developed in the same way as described for the English specimen. X-ray photographs of two of the Swedish specimens show in both cases that the forking of the vertebral column is between the 7th and 8th vertebrae behind the head, which is exactly what Steward estimated on his living specimen. Thus it seems that the pattern of anomaly in double-headed adders is very similar.

I had opportunity to observe one (No. 2) of the four two-headed Swedish adders alive. Both heads apparently operated quite normally in this specimen in the same way as was the case with the two-headed *Lampropeltis getulus*, mentioned by Steward. I observed this individual in the zoo of San Diego, California, in 1956. Its behaviour and reactions have been described by Shaw (1956, 1959). This double-headed King-snake reached an age of 6½ years. During his life he grew from 12 to 31½ inches.

In the German literature there are, as far as I know, two records of double-headed adders, both captured alive, one on 2nd October and the other at the end of October (Dorner 1873, Borgert 1896).

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## NILE CROCODILES ATTACKING SMALL BOATS

By

BRYAN R. BURRAGE

The articles of Jackson (1962, *Copeia,* pp. 204-206), and Richardson and Livingston (1962, *Copeia,* pp. 203-204) regarding Nile crocodiles (*Crocodylus niloticus*) attacking small boats warrants further discussion. These authors state that Nile crocodiles occasionally attack outboard motorboats because the noise of the motor irritates them. Mr. Jackson approaches the truth when he says that the attacks were possibly territorial in motivation. The attitude of the attacking crocodiles as described in the aforementioned articles, plus earlier observations, indicates that the attacks were territorial in answer to the noise of the outboard motor, which closely resembles the vocalised challenge of the bull crocodile to combat.

Rose (1950, *The Reptiles and Amphibians of South Africa,* 378 pp.; p. 355) describes the territorial challenge of the Nile crocodile as resembling a "sharp bark". Schmidt (1919, Bull. Am. Mus. Nat. Hist., vol. 39, artic. II, pp. 385-624; p. 429) describes it as resembling the bellow of a hippopotamus (*Hippopotamus amphibius*), which is a series of short, sharp, guttural grunts, sounding very similar to an outboard motor.

The territorial challenge of the American alligator (*Alligator mississipiensis*) is well-known. A bull of this species will answer the "challenge" of the roar of jet engines, the "knok-knok" of an air compressor, the hammering of a pneumatic drill, the thumping of a jack hammer, or anything else approaching, ". . . the sound of B flat two octaves below middle G (57 vibrations per second) . . ." (Oliver, 1955, *The Natural History of North American Amphibians and Reptiles,* 359 pp.; p. 213). Yet no one has said a pneumatic drill "irritates" alligators. If an enclosure is entered while captive alligators are answering such artificial challenges, they often advance in an aggressive manner.

Barrett (1950, *Reptiles of Australia,* 168 pp.; p. 11), discussing the marine crocodile (*Crocodylus porosus*) which has a call similar to that of the Nile variety, states it will come to combat if the challenge is duplicated. Barrett notes that sharp, guttural noises bring the best results.

My father, Mr. R. J. Burrage, who was Station Manager for British Overseas Airways Corporation at Bathurst, Gambia, West Africa, has noted (pers. communic.) that Nile crocodiles in the River Gambia used to behave in an aggressive manner towards any small (under 16 feet long with a low freeboard) motorboat, inboard or outboard, but especially the latter. These boats were used to service the flying boats and to ferry passengers to and from the aircraft to shore. The crocodiles would answer—as alligators do—an airplane warming up. Many other BOAC officials have noted this behaviour of the Nile crocodile throughout BOAC stations in Africa.

It seems that as an alligator mistakes the noise of various man-made devices for its territorial challenge, so, too, does the Nile crocodile. In the





case of the articles in question, the noise of an outboard motor obviously approximates the challenge of the Nile crocodile, so that certain crocodiles forthwith attack the offending object as an aggressive rival encroaching upon their territory. Furthermore, a small motorboat, with a low freeboard, probably resembles a rival bull to the attacking crocodile.

The writer is indebted to Mr. Charles E. Shaw, Curator of Reptiles, San Diega Zoo, for critically reading the manuscript and offering helpful suggestions.

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## NOTES ON THE DISTRIBUTION AND ECOLOGY OF REPTILES AND AMPHIBIANS IN THE EREWASH VALLEY AREA OF NOTTINGHAMSHIRE AND DERBYSHIRE

By

A. WOOLLACOTT

This article summarises observations made over the last twenty-five years. The area (see references) is roughly ten miles in length and from two to four miles in width. The alluvial deposit of the valley is of considerable thickness and covers wide areas on either side of the River Erewash, beyond which is a medium stiff clay due to the grey-coloured shales. Reference to a map will show the numerous stretches of water.

Species noted :

Common Frog (*Rana temporaria temporaria*). By far the commonest species. Found in practically all moist situations. A nuisance in garden fishponds at breeding time. (Average date of occurrence of spawn : end of third week in March.)

Common Toad (*Bufo bufo bufo*). Not in such numbers as Common Frog, but equally widely distributed. Found in places too dry for frog. (Average date of occurrence of spawn : end of second week in April.)

Smooth Newt (*Triturus vulgaris vulgaris*). Far commoner than Warty Newt. Most ponds have a large breeding population each Spring. (Average date of occurrence of spawn : last week of March.)

Warty Newt (*Triturus cristatus cristatus*). Much less frequent than above. During last ten years has disappeared from many of its former haunts; has not appeared in any new ones.

Palmate Newt (*Triturus helveticus*). Occurred in one pond eighteen years ago. Not been seen since.

Ringed Snake (*Natrix natrix helvetica*). Widespread and common. Partial to disused colliery tips, disused railway banks, banks of brooks and streams. Never goes far from cover.

Slow-worm (*Anguis fragilis*). Undiscovered till May, 1959. One locality only.

Adder (*Vipera berus berus*). Does not occur.

*Summary*. Some possible explanations of population changes may be given.

In the account of the Common Frog, shifts of population were mentioned, and it seems worthwhile to enlarge upon this a little. For many years there were few changes in the area which might have affected these creatures. Of recent years, however, many changes have taken place, both large and small scale, some of the effects of which I am still working out.

The first of these changes in environment consists, in fact, of the removal of a large part of it. New housing estates, in particular, have recently taken the place of large tracts of open field and woodland in the district, and where ponds occurred in these areas, they have been filled in. An immediate problem thus presents itself—where are these creatures to breed? I do not think great hardship is felt during the remainder of the year, as frogs and toads in particular are quite at home in a garden. It must mean, however, that they have a very much more difficult task to find and reach some stretch of water in which to spawn. I have an idea, also, that the length of time spent in the water by newts after spawning has finished, has tended to become extended by this very fact (i.e., fewer places in which to live when out of water).

In addition to the growth of housing estates, large stretches of the Cromford and Pinxton Canals have become more or less completely drained owing to disuse, the lock gates in many instances having rotted away. This leaves only a narrow piece of water in the centre, which is often flowing fairly quickly, and therefore not the spot for a respectable amphibian.

A third factor in the area is the presence of open-cast coal mining. Large areas are being mined in this way, and all the vegetation is, of course, completely removed or buried. The workings last for several years (the most recent, and nearest, is scheduled to be under way for ten years or so). It is true that large areas of water collect in these workings but are not very attractive, one would imagine, to amphibians. At least, I have never found any in any of these stretches of water. Where a stream flows through an outcrop working, it is often given a concrete bed after the land is returned to its former contours—not the ideal environment for wild life.

Recent years, too, have seen the arrival and establishment of attested herds of cattle on the farms round about. The local vegetation supports dairy cattle, and the result on many farms has been the draining and filling in of many ponds which had supported a varied cross-section of aquatic and other life. The ponds have been replaced by concrete drinking troughs, with piped clean water controlled by cisterns, admirable for the cattle but not so for the amphibia.

The effects of all these changes? As I mentioned earlier, it is a problem on which I am still working, but some changes are already noticeable.

In two or three local ponds which I have under observation, one of them a garden pool, several striking facts have been observed. The garden pool, for instance, has a complement of goldfish, who each year were joined by the Common Frog at spawning-time. A pond roughly half a mile away over the fields has been filled in, and was formerly tenanted by Smooth Newts. These newts, or presumably these newts, have now moved into the garden pool mentioned above. The result is that the frogs enter and spawn first, and are closely followed by the newts. There is very little natural food for them, so they subsist on the eggs of the frog. The eggs





themselves are neatly extracted from the jelly, leaving a mass of jelly from which, to all intents and purposes, the tadpoles have emerged in the course of nature. The eggs of the newt are laid in due course, but the emerging tadpoles are eaten both by the newts themselves and the goldfish.

Smooth newts kept in an aquarium will spend a considerable time in searching out their own eggs and eating them, and it has occurred to me to wonder whether this egg-eating has been an ecological factor in the disappearance of the Warty Newt from many of its former haunts. Are the eggs of the Warty Newt larger, easier to find, and more worth finding? Are Smooth Newts being compelled to share waters with their warty brethren owing to shortage of suitable ponds, and are food supplies suffering in consequence, leading to more widespread egg-eating? And if, as I have occasion to suppose, newts are staying longer in the water after spawning, does this mean that larger numbers of eggs and young tadpoles would be eaten by the parents?

All in all, some very intriguing problems are posed, and some interesting work awaits those who, like myself, would like to know more of what is happening in our ponds and streams and their environs.

The area dealt with is covered by Ordnance Survey (National Grid) Sheets SK 45 and SK 44.

—Brooklands, Crosshill, Codnor, Derbyshire.

## ON THE POSSIBILITY OF AN AUTUMNAL MATING IN THE TORTOISE (*TESTUDO GRAECA IBERA*)

By

R. J. Clark

Whilst engaged upon a survey of the reptiles and amphibians of the Greek Island of Spetsai I chanced to pay a visit to the nearby Island of Poros. (Both islands are situated in the Saronic Gulf and very close to the Peloponnese mainland.)

I was walking, more for pleasure than for the sake of finding specimens, in a heavily wooded valley not far from the harbour when my attention was drawn to a curious noise which sounded not unlike cows munching meadow pasture. Proceeding carefully in the direction of the sound I came upon two tortoises—*Testudo g. ibera*—in the act of courtship. The sound, made by the male, had carried a good 25 or 30 yards on a day of very little wind. Upon my approaching the male ceased to give vent to this noise, but otherwise appeared undeterred by my presence, and it was possible to sit down at a distance of no greater than five yards and observe the procedure.

The male was mounted, in the usual position for copulation, on the back of the female's carapace; his forelimbs nearly halfway along. There was a considerable disparity in size, the male having an estimated length, over the curve of the carapace, of 200-225 mm., the female being perhaps nearer 300 mm. The carapace of the latter was less convex in appearance

than in the male. Both co-partners remained more or less motionless, the female emitting a low wheezing sound with each inhalation. At the end of this time the female dislodged the male from his position by moving slowly away, and finally disappeared into some thick herbage in a small gully. The male remained for three or four minutes and then too ambled away, but not before he had peered around to see, presumably, if he could locate the whereabouts of the female; not, however, with any great determination.

No copulation was seen to have taken place. The reason may be two-fold: (i) that I had only witnessed the final scene in the sexual act. From the description given by Ditmars in "Reptiles of the World" this would seem to be very possible. (The passage quoted below is of the behaviour in *T. gigantea* from the Aldabra Islands in the Indian Ocean):

> "During the time of love-making the male behaves in a curious fashion. He stalks round the female in a circle, frequently stopping in a position facing the side of her shell. Here he raises as high as his stubby limbs will permit and batters his shell against her, repeating the operation a dozen times or more. . . ."

(ii) that the tortoises were disturbed by my presence. The latter explanation does not seem very plausible as neither gave any evidence of alarm. It is also probable, as yet a third alternative, that copulation did not occur at all, though I would not care to be too dogmatic about this.

A further point of interest arises in the presence of another much smaller male tortoise—estimated size perhaps 150 mm.—a bare two or three yards from the pair. Throughout the time that it was observed, i.e., some ten minutes, it remained motionless with its head halfway out of its shell. Had rivalry occurred between the two males, or was the presence of the second male purely coincidental? I might add, that in all a total of five tortoises were seen in a small area within less than three-quarters of an hour.

The possibility of an Autumn mating is not without interest. Literature on the subject is scant, and there is the chance that this observation may be of value in our understanding the behaviour and sexual cycle of the European Cryptodira.

It should be realised that the Autumn in Southern Greece is akin to a preliminary Spring but separated from the real Spring by the short and sometimes vicious Winter. The rains at the end of September—marking the end of Summer—and the consequent sharp drop in temperature from the 30°C to the low 20°C is a terrific incentive to the reptiles towards greater activity after their somewhat torpid, reticent existence during high Summer.

### References

R. L. Ditmars: "Reptiles of the World"—1910, 1933; 11th printing 1953.
H. Hellmich: "Reptiles and Amphibians of Europe." Blandford—1962.

Hill Mount, Charing Hill, Charing, Kent.





# OBSERVATIONS ON THE MATING OF THE COMMON TOAD (*BUFO BUFO*)

By

John Reed, F.R.Z.S. (Scot.)

The following observations were made with the assistance of school children at a small lake about two miles East North East of Llanfihangel-y-creuddyn, Cardiganshire (Ordnance Survey SN/694767), between the 6th and 12th April, 1962.

Toads were seen all round the edge of this lake at a depth of between six and twelve inches. Between 45 and 50 toads were counted. The females were greatly outnumbered by the males; only four females were seen and each of these was in amplexus with a male. When I removed one such pair from the lake and tried to separate them the male issued a series of loud cries. After considerable difficulty I separated the pair and replaced them; they resumed amplexus immediately.

Those males which had no mates were swimming vigorously around apparently searching for them. On two occasions males were observed attempting to separate a pair already in embrace, but both these males were unsuccessful. One male tried to pair with another male, but after climbing the other's back soon moved off. Another male mounted a stick that was put into the water, and adhered to it very tightly even after the stick had been removed from the water. Another attempted to mount a child's hand when it was placed in the lake. These examples showed clearly that the male toad will readily seize anything resembling a female toad in size at this particular time of the yearly cycle.

No toad spawn was found, yet the spawn of the Common Frog (*Rana temporaria*) was plentiful and was concentrated at two particular regions of the lake. Despite diligent searching only one female frog was found. This was standing upright in the water with its abdomen ripped open, the oviducts hanging out. It was still alive and had to be killed. High on the banks of the lake were found dismembered oviducts of frogs, some still freshly blood-stained, others with spawn attached. There are large numbers of crows and magpies in this area and we concluded that they were attacking the frogs, and finding the oviducts and spawn objectionable, discarded them. Regurgitated pellets containing frog bones were found near the lake, showing clearly that owls, which prey on frogs, had also visited this site.

I am grateful to Miss H. Sanders for typing this article.

—Sheerwater County Secondary School, Woking, Surrey.

## TOADS CONTINUING TO MIGRATE FOR SPAWNING TO A NOW VANISHED POND

By

NORA F. MCMILLAN

The purpose of this note is to draw attention to an interesting piece of behaviour on the part of common toads. It concerns their persistence in returning to the site of a now non-existent pond.

The pond in question was a water-filled marl-pit, probably about two hundred years old, and about a third of an acre in area. It was situated nearly in the centre of an "island" site of some 20-30 acres, in Bromborough, Cheshire. Formerly well farmed, by 1940 the land was derelict and no doubt ripe for development. On all four sides suburban roads surround the area, and when I first knew it in 1933 there were only occasional groups of houses along the roadsides.

To the N.W., beyond the bounding road, lies a large school with a field on either side. Beyond this is another field, and then the deep wooded gorge through which the Dibbin flows on its way to the River Mersey. The distance from the spawning pond to the Dibbin is a quarter of a mile.

Yearly, at a date ranging from early March to mid-April, numbers of adult toads migrate from the direction of the Dibbin valley to this pond and there spawn. I have noted this migration annually from 1937 until this Spring (1962), and have local information covering many previous years. The migration is only from the direction of the Dibbin valley; in 25 years' observations I have not seen toads on the three other roads bounding the area where the pond is, nor heard of their having been found by others.

Once the return journey was observed; on a very wet August day in 1951 myriads of minute toads were seen crossing the road in the middle of the afternoon towards the Dibbin valley whence the adults had come earlier in the year. The spawning migration takes place at night, and seems to be completed in one night or possibly two.

"Development" of the island site for building purposes was rapid after the war, and by the end of 1957 the pond was obliterated and the whole area built over. Yet still the toads continue to migrate towards their vanished pond, in the years 1958-1962 inclusive. I have not been able to ascertain whether any of the toads now reach the actual site of the former pond, but they cross the road and travel towards the site just as they have done for so many years.

It seems to me that fewer now migrate, but I have no figures to support this idea. Presumably the migration will only continue for the lifetime of those toads which last spawned in the pond before its disappearance.

—City of Liverpool Museum.





## A MICROSPORIDIUM AFFECTING THE COMMON TOAD (*BUFO BUFO* L.)

By

E. ELKAN

During investigations into the cause of death of male common toads, kept for the performance of pregnancy tests, it was found that, apart from the usual variety of helminths, a great number of them were heavily infected with a parasite affecting the striated muscle. The toads, bought from a dealer in 1961, all came from the district of Waters End, Hemel Hempstead (Hertfordshire). Of the original number of 200, thirty are alive now. All casualties were inspected and over half of them were found heavily infested with a parasite, forming innumerable white fusiform depots in every striated muscle. The heart was never infected. The diseased toads became extremely emaciated and died, after varying periods, from inanition. The fact that infected and uninfected toads could be taken from identical cages where they had lived, for many months, in the closest proximity, showed that the toads did not infect each other. Attempts to infect *Bufo* tadpoles were not successful. Artificial infection of healthy adult toads obtained from another district (Surrey) succeeded in every case. Detailed investigation showed the parasite to be a microsporidian. Sporonts produced a variable number of sporoblasts, always greater than 16, often 40-100. The parasite was therefore considered to belong to the genus *Plistophora* (Gurley, 1893). The longest polar filament seen measured 220$\mu$. The filament could best be extruded by pressure, chemical measures being less successful. After artificial feeding with infected muscle the toads showed the first depots of parasites in the muscle after 18 days. The depots were not surrounded by a capsule and confluence of depots took place in old cases. Host reaction in the form of invasion by phagocytes was limited to old cases only, there being no visible cellular reaction in early infections.

A complete description of the findings obtained will be published elsewhere.

—Group IX Laboratories, Shrodells Hospital, Watford, Herts.

## THE MARSH FROG IN ENGLAND

By

J. I. MENZIES

It has been brought to my notice that a statement in my paper (Menzies, 1962) is an apparent contradiction, without reason, of a previously published record (Knight, 1948). The intention of my introduction (p. 46) was to list all previously published references to the distribution of this frog and compare them with the situation at the time the work was being carried out. Obviously, the population is not static and, at the

edges of the occupied territory, there is a great deal of change, a place with frogs one year may not have any the next or ever again. Another important point is that a frog so large as the marsh frog attracts a great deal of attention from humans and is often carried away from the marshes only to be liberated or escape elsewhere. Such new introductions rarely last more than a few years. The great lake at Bedgebury is such an example.

Knight has now pointed out to me that his records (1948) of marsh frogs at Hythe and Tenterden were correct. However, during the recent work no frogs were found nearer than two to three miles from either of these towns so the writer felt justified in omitting them from the map (Fig. 1).

c/o The Herbert Whitley Trust,
Paignton, Devon.

References

Knight, M. (1948). Mystery of the marsh frog. Country Life 104. 2705. 1213.
Menzies, J. I. (1962). The marsh frog (*Rana esculenta ridibunda* Pallas) in England. Brit. J. Herpet. 3, 43.

## REVIEWS

*REPTILES AND AMPHIBIANS OF EUROPE:* by Walter Hellmich, English edition edited by Alfred Leutscher. Blandford Press Ltd., London, 1962. 160 pp., 68 coloured illustrations. Price 16s.

The original German edition (Die Lurche und Kriechtiere Europas) by Dr. Walter Hellmich was published by Carl Winter Universitätsverlag, Heidelberg, in 1956, and was the first attempt by anyone to provide in one volume a reasonable description of the whole herpetofauna of Europe. As such it was by and large a very good effort and filled a long-felt want. It is therefore very pleasing to find that Alfred Leutscher has now produced this English translation, which cannot fail to become a standard work of reference for many English-speaking herpetologists.

The work describes in general terms the various species of Reptilia and Amphibia found in Europe, their distribution and habits, but does not go into any great detail in respect of most of the subspecies into which some European species have been divided. It is therefore a book for the general herpetologist rather than the specialist. A few of the classifications are out of date, and it is possibly for this reason that the editor has been careful to point out that for some purposes reference should be made to the 1960 European check-list (Die Amphibien und Reptilien Europas; Dritte Liste, by Mertens and Wermuth). The latter work is the more authentic where discrepancies exist between the two. As an example, Hellmich deals with *Lacerta hispanica* and *L. bocagei* as two separate species, where they have subsequently been classified as both belonging to the same species, *L. hispanica.*

The coloured illustrations by Irmgard Daxwanger are very good, not so much for detailed accuracy (in fact, the detail here and there is quite odd) as for the excellent general impression they give of live specimens of the species portrayed.

In general, the translation is excellent, but some mistakes have crept in. Anyone surprised to see the Dice Snake mentioned on page 32 as one



of the species which eats lizards, mice, grasshoppers and eggs may be relieved to learn that this observation was not included in this particular sentence in the original. On the same page, the paragraph on poisonous snakes makes confusing reading, due to a bad paraphrasing of the original, which reads quite lucidly. Much the same may be said of the subsequent two paragraphs. There are a few spelling mistakes which also do not derive from the original, such as the names *Lacerta vipera* and *Emys orbularis* on page 36, which are correctly given in the German edition as *L. vivipara* and *E. orbicularis*. Some minor errors in actual translation can also be found by comparing the two editions.

I have checked over this book very carefully because it is what all British herpetologists at least have been waiting for. I would like to see a second edition in due course, brought up to date and correcting the minor errors, and perhaps expanded somewhat to include more detail of some of the subspecies barely mentioned. Doubtless this will come, but in the meantime I do not see how any member of the BHS can afford to be without this edition. It is certainly excellent value at the price.

J. W. Steward.

*AMPHIBIANS AND THEIR WAYS:* by H. Rucker Smyth. The Macmillan Company, New York, 1962. 292 pp.

The author of this work would seem to be quite a remarkable woman. While she would apparently prefer to be regarded as an enthusiastic amateur herpetologist rather than as a "scientist", and generally debunks the purely scientific approach to zoology, she has nevertheless written a book which few scientists would fail to find acceptable.

For the experienced herpetologist, the book has undoubtedly some shortcomings. It deals mostly with the American species, and references to amphibians of other countries are mainly limited to some four works by other authorities. The fussy taxonomist could point out that some classifications are out of date, and it is perhaps a pity that one of the examples chosen to explain Appendix III (Scientific Classification and Common Names) was the Southern Rough-Skinned Newt *Taricha granulosa twittyi,* after this subspecies had been considered invalid by Riemer in 1958. A few misspellings of scientific names have also got past the proof stage.

Nevertheless, it would be churlish to dwell on these points, since as a popular work the book is reasonably comprehensive and the author's enthusiastic and enlightened approach to many problems of herpetology, together with the excellent style, provide stimulating reading. The broad range of habitats which different amphibians occupy is well described, as well as the habits and physical features which enable them to occupy these habitats. The chapter "How to learn more about amphibians" gives some useful tips on collecting, keeping and studying amphibians. The drawings and photographs are quite useful.

For beginners, the book is highly to be recommended and may well become a standard work. The "scientists", and anyone at all interested in zoology, should enjoy reading it.

No price is indicated but the copy I obtained cost 49 shillings.

J. W. Steward.