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EDITOR'S NOTE

The Editor would welcome more articles on the keeping of reptiles and amphibians in captivity, and on general topics such as hibernation.

COITAL MOVEMENT PATTERNS IN PAIRINGS OF A MALE *TERRAPENE CAROLINA BAURI* WITH A FEMALE *TERRAPENE C. TRIUNGUIS*

By

NORMAN LIN

On 9/6/55, five box turtles were taken from their quarters, a glass tank measuring 20 x 12 x 10½ inches and temporaily placed in a bathtub. Among the female turtles were two adult *Terrapene carolina carolina,* one adult *Terrapene carolina triunguis* and one immature *Terrapene carolina bauri.* The single male was an adult *Terrapene carolina bauri.*

At 3.30 p.m. the male *Terrapene carolina bauri,* and the female *Terrapene c. triunguis* were found in coitus. The turtles assumed the typical position with the male raised vertically, its front feet hanging limp, and hind feet wedged behind the female's thighs and inner rear lateral parts of her carapace. The male's tail lay under the female's, and was sticking, almost in its entirety within her cloaca.

Two movement patterns used by the male increased the distance between his shell and the female's to approximately one quarter inch and then decreased the distance to the extent that the shells snapped together. In the first observed pattern (leg extension) the male slowly pulled his shell from the female, by extending his hind legs, thus stretching his swollen tail. His shell was then snapped back, presumably because of relaxation of the leg muscles. In one case, the two shells did not come together until after having been separated for two minutes and five seconds. The second means of separation (head withdrawal, leg extension) was effected by the male withdrawing his head and front parts into his shell, shutting his eyes in the process, extending his hind legs, and consequently separating the two shells. The shells came together when the male extended his head and withdrew his hind legs. The difference between the first and second pattern lies in the fact that in the latter there is a direct relationship between the withdrawal of the front parts and extension of the hind parts, as anyone who had persistently tapped a turtle on the snout knows.

The female did not play a completely passive role. She jerked her body strongly, moving it in its entirety, and caused the male's body to shake. She repeated this seven times after intervals of approximately fifteen seconds. She also dragged the male after her, while walking with some difficulty in a small circle. This walking difficulty was due to the male's hind legs, which prevented her from utilising her own.

The male often rolled from side to side on the rear portion of his carapace (side to side roll) by pushing with his feet against the female. The effect on the female was a sudden start forward plus initial walking movements with her front feet, which ceased almost immediately. The male also rolled to the side, and jerked back to the vertical position; the effects on the female were the same.

At 6.20 p.m., the male withdrew his tail from the female's cloaca, and turned over on his carapace, in the process.

By 9.00 p.m. the male's penis was no longer external.

At 10.45 p.m. both turtles were found lying side by side.

On 9/15/55, the male *Terrapene carolina bauri* became very active in its quarters. It snapped at the young female *Terrapene carolina bauri,* and among other things, caught her leg with his jaws, turned her over and snapped at her shell. The immature female measured only three inches in length. The male also snapped at the shell of a female *Terrapene carolina carolina,* mounted the shell of the female *Terrapene carolina triunguis,* and snapped at her anterior parts. The female withdrew within her shell and closed it. On the following day the male was found on his carapace, his hind foot caught by the female's shell, evidence of an unsuccessful mating attempt.

On 8/25/56, the turtles had been removed from their quarters and temporarily placed in a large sink. It was found that the male *Terrapene carolina bauri* had successfully mounted a female *Terrapene carolina carolina* without,, however, obtaining coitus.

The male *Terrapene carolina bauri* and female *Terrapene carolina triunguis* were again found in coitus at 8.25 a.m. on 6/15/57. They were in their permanent quarters which contained the same cage companions. The male repeated most of the coital movements observed on 9/6/55 besides introducing the following variations. The first consisted of a combination of side rolling, and shell separation—by means of the head withdrawal. The male withdrew his head while rolling to the side (head withdrawal and side roll), the shells separated, he rolled back to the vertical position, extended his head, and the shells reunited. In a variant of this, the head was withdrawn, and the shells separated before the male rolled to the side (head withdrawal, side roll). Another variation consisted of a withdrawal of the head after reaching the side (side roll, head withdrawal).

A gentle backward and forward motion occurred which might be a weaker form of the leg extension. This was very likely since the male was in poor physical condition and showed a general decline in vigour as compared to the pairing on 9/6/55. Rolling also occurred from the vertical to the side position (vertical to side roll).

At 9.45 a.m., the male pulled his tail from the female's cloaca. He did this by pushing hard against the female with his hind legs while violently moving his front ones in the air, as if trying to push off on something. He pulled his tail out almost immediately, and turned over in the act.

At 10.15 a.m., the male's penis was no longer external.

The female *Terrapene c. triunguis* laid at least eight eggs during her period in captivity, but none of these hatched. The male *T. C. bauri* was her only male contact during this time.

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THE CAVE SALAMANDER

(*HYDROMANTES GISTEL*)

By

E. Elkan

We divide the Amphibians into the tailed (Urodela, Caudata) and the tailless (Batrachia anura, Acaudata). The salamanders, which make up the greater part of the tailed amphibians, receive, on the whole, little attention because they are only active at night when they cannot easily be watched; their movements are slow and very few of them are as attractively coloured as tropical fish. All the same, and despite their specialization, they represent a most interesting link somewhere between the fish and the reptiles. Living, as they do, half in and half out of the water, they have their own physiological problems and deserve more of our attention than they have so far received.

Starting with the humble inhabitant of our ponds and lakes, often pursued and fortunately rarely caught by little boys, we soon learn that our "common" newt is by no means everywhere as common as it is here, that many countries are without newts of any kind and that others, like the American continent, are inhabited by a multitude of salamandrine species, including many with anatomical details differing very much from those of *Triturus vulgaris.*

Among these, a most characteristic feature which has been of much help in classifying the tailed amphibians, is the arrangement of their teeth. Here again the Urodeles occupy a position midway between the fish and the reptiles whose teeth are arranged in single rows along the edges of the upper and lower jaws. Whereas in the lower animals teeth may appear anywhere in the mouth, they begin to concentrate in certain regions in the amphibians, until they either disappear altogether, as in some toads, or concentrate in the familiar maxillary and mandibular regions. These single rows are already present in salamanders but there are, in these animals, rows or patches of teeth in several regions on the roof of the mouth, the palate. Palatal teeth appear either in the form of a long S-shaped curve on the pre-vomer (*Salamandra, Triturus*) or in short transverse rows on the vomer—another of the palatal bones—itself. Finally, there exists a large group of salamanders which in addition to these vomerine teeth have two large oblong patches of teeth further back over the para-sphenoid bone. These are the "plethodontid" salamanders (from the Greek "pletho" to be full or complete, and "odous—odontos" a tooth) (Fig. 1). Of these there are, in the New World, about 170 species but this figure is not final, new species being from time to time discovered. Besides the characteristic distribution of their teeth they have two other characteristics which distinguish them from all other salamanders. The first, an inconspicuous one, is a little groove which runs from the external opening of the nose to the upper lip, the naso-labial groove. This groove may help to drain water from the nose.

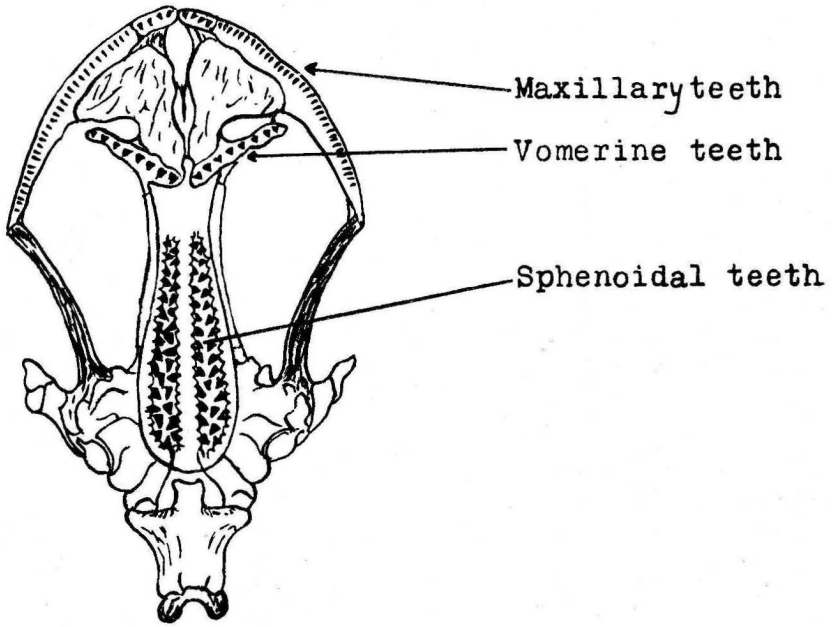

Fig. 1.
Ventral view of the skull of a plethodont, lungless salamander (after Noble).

The most striking peculiarity of the plethodont salamanders however is the complete absence of lungs in the species. We are prepared to find lungs in all land vertebrates and regard them as organs essential for gas exchange in all those animals which are too large and whose skin is too impermeable to allow for the spontaneous diffusion of gases. It may be assumed that, like all other salamanders, the ancestors of the Plethodonts were also equipped with lungs. In the cold mountain streams where they lived, however, and where the water was very well oxygenated, lungs were not only not very essential for breathing, they were even of a disadvantage to the animals because, when filled with air, they increased the buoyancy, making it more difficult for the animal to maintain a foothold at the bottom.

Even when eventually these salamanders left the water, they found it quite possible to breathe without lungs so long as they remained in localities of sufficient moisture, and so it has come about that today we find nearly 200 species of land vertebrates with either reduced lungs or no lungs at all. They lead a retiring and sluggish life under the bark of fallen trees or in holes in the ground in the neighbourhood of water and are largely nocturnal in their activity.

Their breathing, i.e., the exchange of oxygen for carbon dioxide, is largely effected by the skin. It has also been maintained that the rapid vibrating motion which these animals execute with the floor of the mouth (gular vibrations) serve the same purpose. Although some oxygen must, no doubt, in this way be absorbed through the mucous lining of the mouth, anatomical studies show no special adaptation of this lining for the purpose of breathing. It is therefore thought that the gular vibrations, which in some species attain the rate of 200 per minute, serve the ventilation of the nose cavity. The nasal cavity is, in these animals an important and well developed structure. Its importance for the life of the animal can be deduced from the development of the olfactory part of the brain which supplies the nose with nerves. To an animal of such retiring habits the sense of hearing is unimportant since worms and slugs can hardly be spotted by the noise they might make. The eyes and the nose remain as main contacts with the outer world. Both, as shown in the plate, are well developed.

The American lungless salamanders are not all equally common. Some are indeed very rare, and one of the rarest is the Mount Lyell Salamander (*Hydromantes platycephalus*). It has been found only at the head of Lyell Canon in the Yosemite National Park of California at an altitude of 10,800 feet. The reason why this rare and obscure amphibian deserves our attention lies not so much in its habits and its anatomy as in the fact that, of all the American lungless salamanders, it is the only one to have a European relative. One species of the genus *Hydromantes, H. italicus,* lives in Northern and Central Italy, another, *Hydromantes genei,* on the Isle of Sardinia (see Map). They live under stones and in moist caves, quite unbeknown to the majority of the Italians. To catch them, one must go out at night with a torch when the little salamanders crawl about on the surface, looking—or smelling—for food. During the day they retire to hiding places too far underground for pursuit.

Their colour is, on the dorsal side, brown in the fore part of the body down to the mid-thoracic level. From then onwards the brown changes more and more to dark orange, the tail being entirely orange. The whole ventral side is dark grey and densely covered with small, almost white unpigmented spots. Their total length (nose to tail) varies between 5 and 9 cm, the snout is square and the naso-labial groove can just be seen with a good hand-lens.

Dr. B. Lanza of the Florence Institute of Zoology, who has studied *Hydromantes* extensively in the field, describes their distribution as follows (see map) : The mainland species, first described and named by the German naturalist Gistel in 1848 and finally named *italicus* by Dunn in 1926, follows the course of the main Italian mountain range from the Maritime Alps through the province of Liguria (i.e., the district of Genoa), along the border between the provinces of Emilia and Tuscany where the population of *Hydromantes* is highest, to outposts as far East as the neighbourhood of the Adriatic coast and as far South as the Abbruzzi mountains (see Map). Considering the sluggishness and the retiring habit of the species, it is not surprising to learn that local variations have established themselves. Dr. Lanza named the Western type *Hydromantes italicus gormani,* another type,

confined to the neighbourhood of Spezia, *Hydromantes italicus ambrosii*. Since the exploration of the habitats of *Hydromantes* in Italy has as yet not been completed, it is quite possible that other varieties may, in time, be discovered. One of these, *Hydromantes genei*, has been known since 1838 when Schlegel discovered it on the Island of Sardinia. It shares this island with another lungless salamander, *Euproctus platycephalus* Grav. Yet another species of *Euproctus* (*montanus*) occurs on the island of Corsica. Since Corsica is nearer the mainland than Sardinia one might expect *H. italicus* to occur here too, but there is no record of its having been found on Corsica.

Like its American relative the Italian *Hydromantes* does not depend on a hot climate. It has been found in localities of between 3° and 17° C. If surface moisture and temperature are to its liking, it emerges from the holes and crevasses which it usually inhabits, but this does not seem to happen very often. Most of its time is spent underground, particularly in the countless caves of the region, a habit which has given it the popular name of "Cave Salamander". It lives on any small worm or insect it can catch. The feeding habit very much resembles that of the chameleon on a smaller scale because, like the larger reptile, *Hydromantes* has a remarkably mobile tongue which can, with great speed, be thrown out at the victim. The tip of the tongue carries a pad, covered with mucus producing glands (Fig. 2). To this, the small insects stick and are speedily carried back to the mouth. The tongue can be protruded for 10-12 mm and to allow for this, the skin covering the tongue-stalk is, when at rest, thrown into corrugated folds, much after the manner of an accordion (see Plate). When retracted, the whole apparatus is accommodated in a separate sheath in the floor of the mouth.

Gaps still exist in our knowledge of the reproductive life of *Hydromantes*. The presence of extensive glandular areas around the cloaca of the male indicates that, like other salamanders, it produces a spermatophore which would then be taken up by the female. The process has, however, not yet been observed. Of the female it is known that she produces live young. Their birth does not seem to be confined to any particular season and, surprisingly enough, no pregnant female has ever been found. It must be assumed that the pregnant females retire to inaccessible places underground and it must be left to the zeal—and luck— of future naturalists to complete our knowledge of this little known and interesting amphibian.

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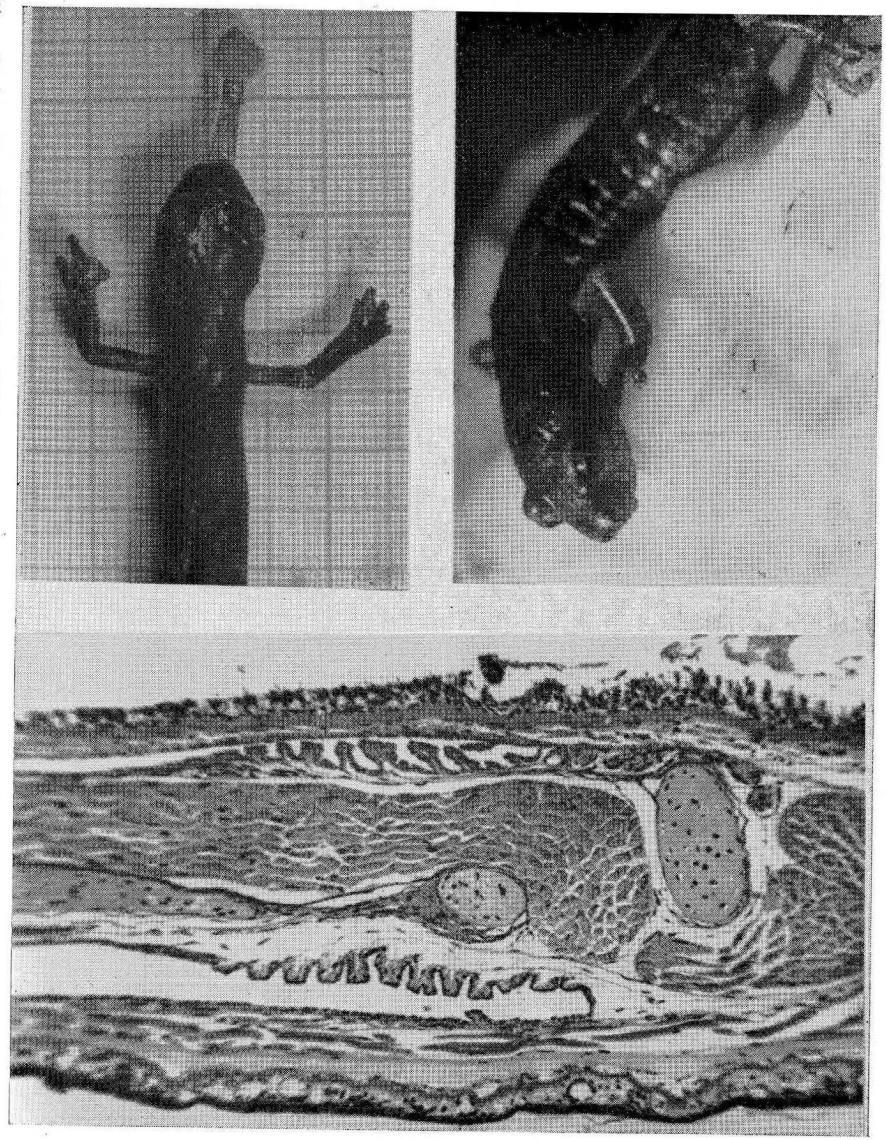


Hydromantes italicus. Note the size of the extended tongue in the top left figure, photographed against background of 1 cm. graph paper, and, on the top right, the blunt snout, the large eyes and the intercostal grooves. The bottom figure shows a longitudinal section through the base of the tongue stalk. Note the accordion-like arrangement of the epithelium covering the tongue stalk. These folds are completely smoothed out when the tongue is extended.

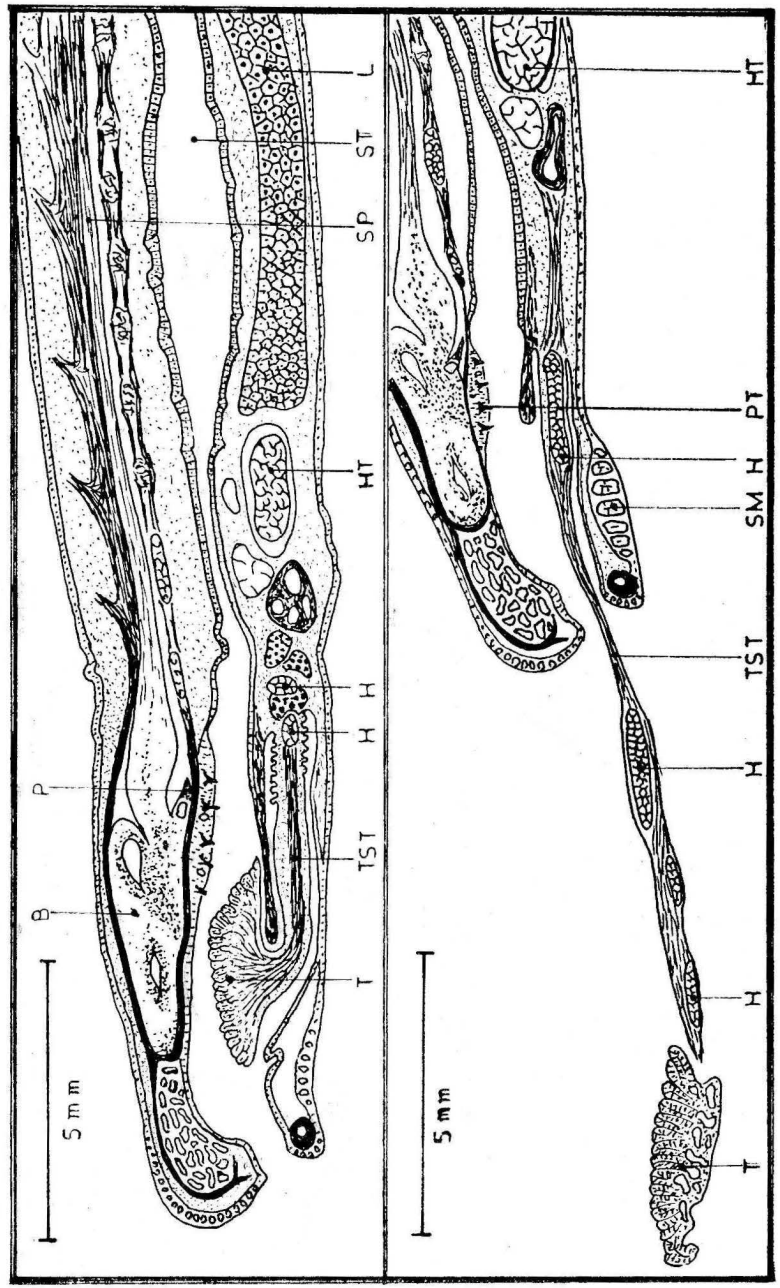


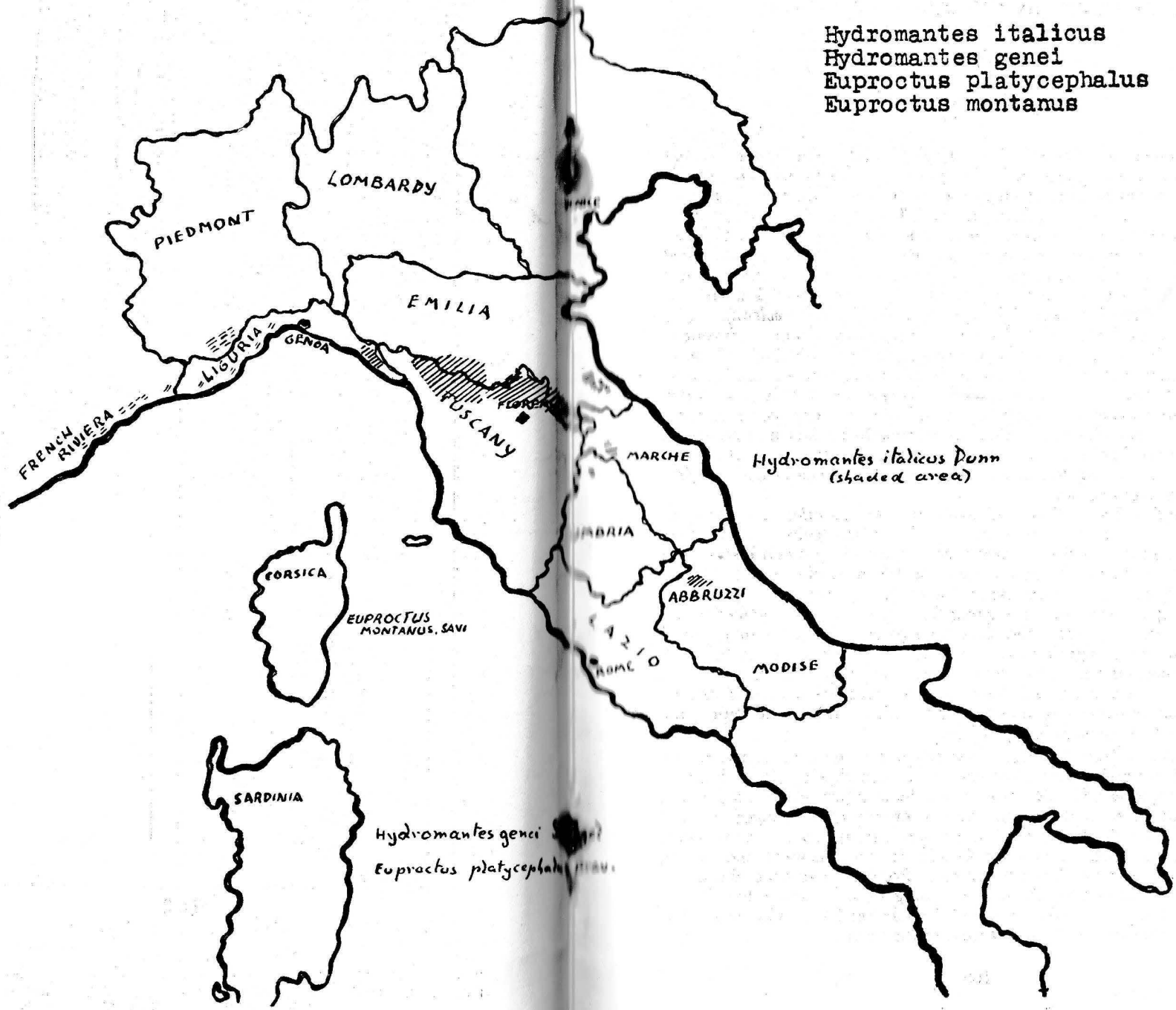
Fig. 2

HYDROMANTES ITALICUS
with retracted and extended tongue.
(*Camera lucida*)

B, Brain. H, Hyoid bone, cross sections. HT, Heart. L, Liver. P, Pituitary gland. PT, Palatal teeth. SM, Submental glands. SP, Spinal cord. ST, Stomach. T, Body of Tongue. TST, Tongue stalk.

DISTRIBUTION of

Hydromantes italicus
Hydromantes genei
Euproctus platycephalus
Euproctus montanus



USE OF HORNS BY *CHAMAELEO JACKSONI*

By

ROBERT BUSTARD

During the summer of 1956 I had a couple of adult male Three-Horned Chameleons (*Chamaeleo jacksoni*) in the chameleon greenhouse. In this, as in some other species of horned chameleons, the horns are much less well developed in the female than in the male. These chameleons were living peacefully with about one hundred others which were largely dwarf species such as *Microsaura pumila* and *Chamaeleo bitaeniata elloti*. They showed no interest in each other and at no time were they observed fighting, indeed they appeared oblivious of each other's presence. It is well known that many species of chameleon will fight (e.g., *Chamaeleo chamæleon*).

It should be explained that chameleons invariably acquire a favourite perch to which they return each evening to sleep and on which they bask in the sun. Although naturally they leave this to forage during the day the consistency with which they return to it is remarkable. This perch they will defend against invaders. This question of home territory occurs in many groups in the Animal Kingdom. The chameleons had taken up perches on the dead tree branches in the greenhouse, and since other vegetation was not yet very far advanced, to move along a branch one chameleon had frequently to climb over another.

The small S. African Dwarf Chameleons (*M. pumila*), although not fighters like *Ch. chameleon,* usually resent other chameleons trying to pass them and make lunges at the opponent, accompanied by much hissing and a general display of fury. The result is that (a) the other chameleon retreats, (b) attacks and is repulsed, (c) attacks and wins, or (d) attacks and either falls or jumps from the branch in the ensuing fight. Actually the chameleon on whose home range (i.e., perch) the fight takes place wins in the majority of cases, as it seems to be fighting more fiercely. This applies even to much larger chameleons and I have frequently seen a ten inch chameleon hesitate to try to pass an irate dwarf (*M. pumila*) which was less than half its size, which was swinging backwards and forwards with its mouth wide open, the orange interior of which was clearly visible.

On the 12th of June I noticed that the horns could be of use to the chameleons. I noticed a Three-horned Chameleon slowly approaching an irate Dwarf Chameleon (in *M. pumila* the females are much bolder and more bad-tempered than the males), and when the dwarf lunged at it, it merely kept its head down and the horns saved it from attack. As the dwarf swung back (to prepare for another attack), it came forward and gained ground slowly causing the dwarf to retreat. From time to time, the dwarf was surprised by the horned chameleon raising its head and biting it, but quickly lowering it again before the dwarf could retaliate. This was interesting, but by no means conclusive es a use of the horns.

The next case took place on the 18th June. At about 8.30 a.m. when the temp. was about 70-75° F., and the chameleons were basking in the morning sun, I placed one of the Three-horned Chameleons on the perch of the other, facing the "owner" and about six inches away from it. There was an instantaneous reaction! The one to whom the perch belonged came forward and met the specimen which I had introduced. They interlocked their horns and pushed. (Here it should be pointed out that the specimen introduced not being on its "home ground" had no apparent desire to fight, but retreat was impossible. It obviously had not time to turn round and in so doing it would have left itself in a very vulnerable position. I was later to witness an alternative line of action.)

In the following account the owner of the branch is referred to as chameleon "A" and the specimen I had introduced as "B". After a minute chameleon A succeeded in lifting chameleon B bodily off the branch (by this time it had been pushed about six inches along the branch) and they were held together by the horns. After about half a minute B fell to the ground, having got its horns free from those of A. On being replaced, they glared at each other with mouths agape and then "charged", both now being annoyed. They never tried to bite each other.

Later when they had again locked horns to battle it was noticed that A pushed B to a position such that B could retreat no farther, and further pushing from A caused the head to bend at right angles to the body under the strain. While they were both annoyed numerous experiments were carried out. B appeared to show definite fear when placed on A's territory and obviously did not again voluntarily trespass on to it. In fact it often avoided doing battle by throwing itself off the branch, out of reach of A.

When they were put on the lawn together they again locked horns and pushed and when B tried to make off A pursued it and hit it. This annoyed B which then turned on A. They seem to have little interest in butting each other on the flanks with the horns (doubtless ineffective as they cannot get up much speed nor do they have much weight behind them unless "anchored" on a branch when they have leverage and can push or swing forward a few inches suddenly). When fighting on the lawn they always bit each other.

The above notes are interesting in view of the fact that most present-day authorities either avoid the issue or are of the opinion that the horns are not used for fighting and are merely adornments (Schmidt & Inger 1957), and because I can find no one who has observed such action although several have tried (Durrell 1953).

The reason why some people have failed to get horned chameleons to fight is because the experiments they have designed have been, in my opinion, basically wrong. They have, almost without exception, put two chameleons together on a branch where both were strangers and where the overriding desire was to escape. Had they introduced one on to the perch of the other they would possibly have achieved the response which I have described.

I may add that after this incident and others like it evoked by me, they

were never observed fighting, nor were they ever observed together, as chameleons are, of course, solitary creatures. Possibly the apparent agressive behaviour of B, brought about by me, fired off the conflict and that under normal conditions this would not take place unless two males met by chance or perhaps during the mating season. The interlocked horns and pushing is reminiscent of stags.

These observations show that the horns of *Chameleo jacksoni* can be of use and are in fact used in fighting. The immediate manner in which my male *Ch. jacksoni* interlocked horns suggested that this was no chance occurrence but the natural response to the circumstances. It would be interesting to have the results of similar experiments on other species of horned chameleons.

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PARTIAL NEOTENY IN AN AUSTRALIAN FROG

By

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These notes are directly inspired by a paper in this Journal by R. Bushnell on the breeding of amphibia, in which that author refers to delayed metamorphosis of frogs under the heading "Notes of Doubt".

I believe delayed metamorphosis is quite a common phenomena with Australian Frogs. In the "notes of doubt" referred to the question is postulated. Does this occur under natural conditions? A little thought should convince us that under natural conditions it would be impossible to prove or disprove this, as it is only by controlled breeding that accurate observations can be made, as in a stream or pond practical difficulties are insuperable.

We are all familiar with the fact that the growth of tadpoles in their initial stages can be stimulated by favourable conditions and abundance of food. We may assume that the same phenomena occurs in a state of nature, particularly in running streams where tadpoles may be transported to different conditions. The only real question is how far does this reaction to varying conditions affect metamorphosis?

Delayed metamorphosis may amount to temporary or partial neoteny, unless as in the case of the Axolotl, paedogenesis takes place, in which event, of course, it becomes permanent or total neoteny.

In January, 1956, I collected six very large tadpoles from a swiftly moving stream at Blackheath in the Blue Mountains, New South Wales.

They were the largest tadpoles I had ever seen, appearing to be about three inches long. Three of the tadpoles died in transit and the remaining three were placed in an ordinary aquarium. One metamorphosed the last week in Jan. 1956 and was identified as *Mixophyes fasciolatus* of the family Leptodactylidae, our largest Australian frog. Another tadpole metamorphosed the following week but the third tadpole is still a tadpole at the time of writing these notes (20th November, 1957), i.e., over a year and nine months since the first one metamorphosed. The surviving tadpole does not appear to have grown much if at all. Naturally not anticipating anything of this nature I took no measurements and in fact had it been a tadpole of one of our commoner frogs I would never have even bothered to keep it. As a matter of interest this neotenous tadpole has always been kept in fairly dark surroundings largely because when it failed to metamorphose it was placed on one side in my garage. The garage has no windows and although usually left open, may be closed for days at a time. Nevertheless this cannot be said to be a factor in its neoteny in the first instance because it was one of three tadpoles taken from identical surroundings and kept by me in the same aquarium. Darkness has been put forward as a possible cause of the origin of neotenous forms (Deuchar, 1957).

Observations I have made with tadpoles of a more common Leptodactylid frog, perhaps the second largest of this family, *Limnodynastes dorsalis*, indicate that in addition to varying growth rates the tadpoles (a) may or may not metamorphose at the same size and (b) may or may not assume the typical dorsal stripes prior to metamorphosis and (c) may vary in colour depending upon the receptacle in which they are kept. Furthermore, of three receptacles in which I placed tadpoles of *Limnodynastes dorsalis* from the same brood, the tadpoles metamorphosed, first from the receptacle with the least light and speaking generally the least favourable conditions. So far as it is possible at this stage to generalize without exhaustive controlled and detailed experimental work for which unfortunately I have neither the time nor the facilities, it does seem also that metamorphosis was more speedily reached in the shallowest receptacle and most delayed under more favourable conditions.

I am inclined to think that provided a certain minimum size is reached (and this process can be speeded up by copious feeding on concentrated fish food) tadpoles living under the unfavourable conditions will as a rule metamorphose before tadpoles living under more favourable conditions, which may take their time and metamorphose as larger frogs. This, of course, does not explain individual cases, such as the one I have just cited, but it may well be that more favourable conditions act as a stimulus to individuals with a latent tendency to neoteny. Although total neoteny is unknown in frogs, I have no doubt that under suitable conditions many individuals will retain their juvenile form indefinitely.

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REVIEWS

RATTLESNAKES: Their Habits, Life Histories, and Influence on Mankind. LAURENCE M. KLAUBER. 2 vol., 1,476 pp. with numerous illustrations (maps, diagrams, and photographs). University of California Press, Berkeley and Los Angeles; and Cambridge University Press. 1956. Price: $17.50.

This most impressive, and indeed formidable, work has been compiled over a period of some ten years, by the foremost living authority on the subject, Dr. Laurence M. Klauber, with the obsessional care and thoroughness which herpetologists have come to associate with his investigations and writings. The late Dr. Karl P. Schmidt, the eminent herpetologist and Curator of Zoology at the Chicago Natural History Museum, accurately described the author's career as "the most conspicuous illustration of the herpetological amateur turned professional in America ... He pioneered in methods of statistical study of variation in snakes, a natural turn of interest on account of his mathematical training as an engineer ... His contribution to systematics in the fauna of the American Southwest consists in reviewing genus after genus in terms so much more exact than in any earlier work as to be beyond comparison."*

The present work is an extensive and comprehensive monograph of the two genera of the Crotalidae (or Crotalinae), *Crotalus* and *Sistrurus*, which comprise the Rattlesnakes. It is, in fact, the first monograph on these two genera to appear since that by H. K. Gloyd (*Spec. Publ. Chicago Acad. Sci.*, 1940, No. 4, 270 pp.). Its general scope may perhaps best be described in the author's own words: "In a way, this book is an encyclopaedia of the rattlesnake; in it both the rattlesnake's reactions to its environment and man's reaction to rattlesnakes have been surveyed. Among other objectives, I have sought to disentangle rattlesnakes as they are from rattlesnakes as people imagine them to be ... This book is written to assemble and survey our present knowledge of rattlesnake habits and life histories. It is intended for reference rather than as a popular natural history of the rattlers, being perhaps too extensive and detailed for the latter purpose. But as it includes numbers of field observations from varied sources, it is hoped that it may aid in the correction of some dubious accounts long current in the popular natural histories; and, further, that it may encourage renewed investigations and observations respecting those phases of rattlesnake life now imperfectly understood or unknown."

In fact, the work covers the palaeontology, taxonomy, anatomy, physiology, ethology, ecology, and toxicology of these two genera; and it provides, in addition, a most interesting anthropological survey of the myths, folklore and folk-medicine relating to rattlesnakes, and, in particular, of the significance of these creatures in the religion and beliefs of various, principally North and Central, American Indian tribes—which is, of course, but one aspect of the psychologically important and fundamental theme of serpent

* Cf. especially, the several valuable statistical studies by Klauber which appeared in *Occ.Pap.S.Diego Soc.nat.Hist.*, 1936-1940, and in *Bull.zool.Soc.S.Diego*, 1941-1952.

symbolism, age-old and worldwide in its prevalence and thus deeply rooted in the collective unconscious.

It is impossible to do justice to a work of this scope and size in a brief review. Without prejudice, however, to the subject matter of this book which is not here specifically mentioned, it may be stated that the work includes a survey of the author's important earlier studies of correlative statistical data concerning the morphology of rattlesnakes, and of the structure, function and development of their characteristic and specialized appendage, the "rattle". Not only are there excellent diagrams, graphs, tables, and distributional maps of the geographical races, but also a very good series of photographs of various subspecies of *Crotalus* and *Sistrurus* by L. C. Kobler, who also contributes some most interesting notes (p. 1029) on his technique in photographing the snakes for the purpose of illustrating their respective characteristics.

The principal subject for criticism is the author's inclusion throughout the already lengthy text, of extracts of personal communications from various correspondents, beginning with such phrases as: "I have noted", "I once saw", "I know of cases", "I can recall", etc. These observations, and the fact that they are inserted in small type in the general text, are unnecessarily cumbersome, and tedious, if not indeed irritating, to read: they might perhaps with advantage have been summarized and incorporated by the author in the main text.

In conclusion, it may be said that Dr. Klauber's *magnum opus* is invaluable as a careful, detailed and authoritative reference work on all that is known, up to the present time, about these two most interesting genera of snakes. The bibliography is truly comprehensive, and extends to 141 pages.

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AUSTRALIAN TREE FROGS OF THE GENUS HYLA. STEPHEN J. COPLAND. From the proceedings of the Linnean Society of New South Wales, Volume LXXXII Part 1, 1957 (for sale separately by the Linnean Society Science House, Gloucester Street, Sydney, at a provisional cost of 12/-). Printed by Australasian Medical Publishing Co. Ltd., Sydney.

The author's synopsis best describes the scope of this excellent monograph as follows: "All 44 known continental species and subspecies of the genus *Hyla* are dealt with in a purely systematic way, but an attempt has been made to indicate at least interesting and important notes on ecology, colour in life, breeding habits and other matters not directly bearing on the present approach. A standard description of each frog is given to facilitate comparison. It was thought essential to include original descriptions to serve as

courts of appeal, especially as so many type specimens are unavailable overseas. Variation in nearly 3,000 frogs has been studied and contributions of other authors have been discussed. Fairly comprehensive lists of locality records are included as a basis for the more accurate study of geographical distribution. Short diagnoses have been added to the key to simplify identification. Eight new specific and subspecific names have been given."

In 108 closely printed quarto pages the author has provided a comprehensive and systematic reference to all Australian Hylids. The bibliography alone contains 146 references. Although the author adopts the systematic approach his ecological notes dealing with distribution of species are of extreme value. It is indeed an important contribution to Australian Herpetology and is clearly the result of many years of painstaking work. It will provide a basis for much future investigation and study of individual species.

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