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THE CARE OF YOUNG RED-EARED TERRAPINS (*PSEUDEMYS SCRIPTA ELEGANS*) IN THE LABORATORY

By B. B. Boycott and M. W. Robins,
University College London.

The object of this article is to describe the care of red-eared terrapins under laboratory conditions. Since these terrapins are extensively imported from North America as pets it may be of more general use. It probably contains little unknown to American herpetologists, but with the exception of I. & A. Noël-Hume (1955) and Lester (1957) there appear to be no articles on the keeping of these animals generally available in Great Britain. It is limited to four years' experience and is probably by no means the best possible procedure. Kaplan (1957 a & b) in N. America has written a comprehensive review on the care and diseases of turtles and with Young in 1960 described a method of anaesthesia.

Carr (1952) has discussed the systematics of the genus *Pseudemys*, to the *scripta* group of which the red-eared terrapin belongs as the subspecies *elegans*.†

HABITAT AND DIET IN THE WILD

Pseudemys scripta elegans (Wied.) lives at the edge of large bodies of quiet water such as lakes, drainage ditches, and the oxbows of rivers. It may also be found in shallow prairie ponds. Not much is known of its diet in the wild. It is usually thought to be carnivorous with a tendency to scavenging and the occasional intake of vegetable food (Carr 1952). However, there is evidence (Marchand 1942) that this is only true of juveniles (see however p. 207). Comparative stomach contents showed that older red-eared terrapins may eat a greater proportion of plant material, such as *Lemna*, *Spirodela* and *Wolffia*, than animal matter.

LABORATORY ACCOMMODATION

Aquarium tanks 2 x 1 x 1 ft. have been used. Six or more of the smaller animals can be kept in such tanks, but as they grow larger three animals is the maximum for a tank. It is possibly best not to keep them singly. If this is done they may stop feeding for quite long periods. There has been no trouble due to fighting with this species, although such may occur among other species (Kaplan 1957a). Red-eared terrapins are among the more aquatic of terrapins but they frequently come out to bask on rocks, floating logs, etc. The tanks were provided, therefore, with water about 4 inches deep and with a stone for the animals to crawl out on. It is not necessary to put gravel in the bottom of the tank. The tanks were covered with plate glass supported on corks as a protection against dust.

The general activity and feeding of *Pseudemys* is related to temperature (Cagle 1946). Kept at about 30°C, these animals are among the more active of the Chelonia. For this reason they have been found suitable for training experiments (Boycott & Guillery 1962). The optimum temperature range for these terrapins to remain active in the wild has been suggested to be between 18 and 30°C (Cagle 1946). We have noted no deleterious effects on the animals due to keeping them at an average temperature of 30°C for periods as long as 18 months, as Kaplan (1957a) has sometimes found. In the laboratory, at temperatures below about 18°C, they become less active and feed only erratically if at all at temperatures below about 15°C. A thermostat controlling a 200 watt strip heater under the length of each tank was adequate for keeping the temperature at 30 ± 3°C. The heaters were placed about 4 or 5 inches under each tank and shielded from draughts. This system was preferred to having heaters in the tanks, which was inconvenient during cleaning.

Ideally these terrapins should be kept in slowly running water in order to keep the tanks free from faeces and food debris (Kaplan 1957a). This is impracticable on a large scale in most laboratories, especially when the water has to be kept warm. Nor with fifty or so animals to feed each day is it convenient to have a special feeding tank as suggested by various authors (e.g., Kaplan 1957a, Lester 1957). With the diet we have adopted and regularly cleaning out the tanks every two to three days we have not, so far, been troubled by infections or unduly dirty tanks.

DIET

The ideal diet would probably be insects, earthworms, small fish and molluscs, and pondweeds. Individuals have certainly been kept successfully in this way. Under laboratory conditions these foods are expensive and sometimes unobtainable in sufficient quantities. We have, therefore, adopted the following régime.

(1) MEAT

Chopped lambs' or calves' heart has proved most convenient since this was easily freed from excess blood, fat and connective tissue. Meats such as ox heart or steak are not so easily chopped up and the larger pieces were torn up by the fore-limbs, thus fouling the tanks. Lambs' and calves' hearts can be chopped up sufficiently small for the terrapins to swallow a whole piece at a time. Animal fat was not readily eaten by the animals kept, even when mixed into the meat.

Heart by itself is not an adequate diet, so on alternate days chopped liver was given instead. Although these animals will take food on dry land, they always submerge in order to swallow it. Chopped liver tends to dissolve in water, but if pieces are pared off a block of deep frozen liver the small lumps are usually eaten before they have begun to dissolve. It is best to arrange the cleaning schedule so that the tanks are cleaned an hour or two after a meal of liver.

(2) INSECT FOOD

Mealworms can be obtained commercially at most times of the year. Each terrapin received on the average about two mealworms a day, sometimes given as a single meal twice a week, sometimes each day.

(3) VEGETABLE

There seems to be almost no limit to the amount of lettuce eaten by healthy animals, even hatchlings. Two or three leaves for every six animals were given each day. The animals kept here did not appear to eat cabbage although they tore pieces off the leaves.

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†"A red-eared terrapin is sometimes found in dealers' stocks in this country which differs from this species in the shape of the red mark in the ear region and in general colouring. It probably comes from S. Mexico and Colombia and may be *P. scripta ornata*."

(4) VITAMINS A AND D can be provided by feeding the animals with herring, or mixing cod liver oil with the meat (Lester 1947), but these tend to make the tanks messy and smelly. Two or three drops of halibut liver oil mixed with enough meat for six animals is more convenient.

(5) CALCIUM

Growing terrapins require very large amounts of calcium. Even in hard tap water insufficient calcium is ingested to provide material for their shells and bones. This has been pointed out by many authors. Table 1 shows the weight of the carapace and plastron as a percentage of the total body weight. The figures are on the average slightly higher than the 28% mentioned by Kaplan (1958).

Loveridge (1947) recommended the placement of plaster of Paris lumps in the tanks. This has proved satisfactory and the terrapins were often observed to bite off and swallow pieces. In order to make quite sure of an adequate calcium supply, particularly for small or weak animals, finely ground bonemeal was mixed in with the meat as well.

Table 1

Animal	Plastron length (mm.)	Total weight (g.)	Shell weight (g.)	Shell weight/ body weight %
150	67	86	25	29
151	62	62	25	40
152	73	91	32	35
153	66	64	28	44
154	64	64	26	41
155	68	87	32	37
156	80	131	42	32
157	67	85	28	33
158	58	47	20	43
159	70	107	31	29

The shell weight represents the weight of the carapace and plastron with all the flesh and moveable skeleton removed.

(6) ULTRAVIOLET LIGHT

The well known basking habit of red-eared terrapins suggested that they need ultraviolet light for proper growth. They were, therefore, exposed to weak ultraviolet light for ten minutes a day from a Philips TLU 20 watt/12 tubular lamp placed about 20 inches above them.

(7) QUANTITIES OF FOOD

Red-eared terrapins can starve for long periods, including hatchlings, who may or may not feed off a reserve of yolk (Cagle 1946). The maximum quantities of food that can be eaten by animals kept warm have not been determined. About 1 to 2 grammes of meat, for each animal, mixed with bone meal and halibut liver oil seemed to be sufficient for one meal. Greater quantities at one meal were left on the bottom. But the animals would feed an hour or two later, presumably when their stomachs were empty.

AGE, GROWTH AND HEALTH

Determination of the exact age of juveniles is difficult, especially without field experience and knowledge of where and how the animals were collected. Some of our animals were received when they had plastron lengths between 25 and 35 mm., the egg-caruncle still present and an incompletely healed umbilicus. These animals may have recently left the nest, been taken from the nest by collectors or overwintered in the nest (Cagle 1944). Others were about the same size but without egg-caruncles and a firmer umbilicus. Their age might well have been anything from a few weeks to six months after hatching. They formed the majority of the animals kept. Older animals with plastron lengths up to 70 and 100 mm. have been kept. Estimation of the age of such animals is also difficult, particularly as the exact location from which they were collected was unknown (Cagle 1946, 1948), but judging from Cagle's data they were not older than their fourth or fifth season.

Until the terrapins were looked after as outlined above, they almost all became sick after about two or three months in the laboratory. Their eyes closed and became swollen, the shell was soft and the animals became lethargic and ceased to feed. Kaplan (1957a) has attributed these symptoms to an inadequate diet and this has been our experience. Antibiotics, such as penicillin and chloromycetin, had a temporary palliative effect. In the two years since the animals have been looked after in the way described, we have had no trouble of this kind, although out of a batch of two dozen or so red-eared terrapins one or two may be runts that feed reluctantly if at all, and die in about six weeks.

Table 2 †

Animal No.	Plastron length (mm.) 9/1/60	Plastron length (mm.) 17/5/60	Total weight (g.) 9/1/60	Total weight (g.) 17/5/60	% increase plastron length	% increase in weight
171 t ...	82	90	117	145	9.8	23.9
172 t ...	87	95	151	184	9.2	21.8
173 t ...	73	75	183	105	2.7	26.5
174 ...	73	73	105	106	0	1.0
175 t ...	63	80	65	107	26.9	64.5
176 ...	51	60	34	63	17.6	85.4
177 ...	51	63	45	85	23.5	88.9
178 t ...	61	103	62	77	68.9	24.2
179 t ...	66	77	78	113	16.6	44.8
180 t ...	54	68	47	81	25.9	72.5
181 ...	59	64	56	74	8.5	32.2
183 t ...	67	70	72	80	4.5	11.1
184 t ...	61	70	61	90	14.7	47.5
185 t ...	58	61	57	89	5.2	56.0
186 ...	62	62	62	64	0	3.2
187 ...	62	72	68	89	16.1	30.9
188 t ...	60	88	59	72	46.5	22.1
189 t ...	52	63	48	78	21.2	62.5
190 ...	68	75	80	102	10.3	27.5

Animals marked t were used in training experiments

† Since this table was drafted we have obtained measurements on hatchlings kept in the laboratory over a comparable period. The percentage increase in plastron length was similar but the percentage increase in weight was often of the order of 100 to 200%

It is difficult to give a positive measure of the effect of the diet described. Table 2 shows that even under constant laboratory conditions there is a wide variation in growth over a four month period as measured by increase in weight and plastron length. Cagle (1946) has found similar variation in the less constant conditions of the wild. Much of this he proved to be related to detailed ecological differences. Animals 174 and 186 did not grow appreciably although they ate all right; while 178 and 188 grew remarkably in plastron length although with a surprisingly small increase in density. Others did not increase in length so much as in weight. Some of these differences may have been due to differences in fat deposition, some due to changes in unmeasured parameters of the shell. The table includes males and females, another source of variation (Cagle 1946, 1948).

The table is some slight evidence that the conditions under which the animals were kept were favourable to them, and this is supported by the fact that none of them became ill or ceased to feed. Much more elaborate collection of data will be necessary to measure future improvements in the care of the animals.

ACKNOWLEDGMENTS

We are most grateful to Drs. F. R. Cagle of Tulane University, L. T. Evans of the Jeffrey Centre, New Hampshire, and T. R. Forbes of Yale University, for their help when we started work with these animals, and to the Zoological Society of London. The animals were purchased with a grant from the Department of Scientific and Industrial Research.

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THE OCCIPITAL CREST AND ANTERIOR SPINAL NERVES IN THE LARVAL URODELE *SALAMANDRA MACULOSA*

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INTRODUCTION

The possession by *Cryptobranchus japonicus* and *Cryptobranchus (Menopoma) alleghaniensis* of a hypoglossal (spino-occipital) foramen and its concomitant hypoglossal (spino-occipital nerve) in the occipital crest was once considered to be unique among living amphibia (see de Beer, 1937). Recently, however, *Hynobius nebulosus* and *Hynobius retardatus* have been shown to possess these structures (Fox 1957, 1959) and this present work describes similar anatomical features in two specimens of *Salamandra maculosa*, which genus thus joins the other two in providing examples of a primitive organisation in the hind region of the urodele head.

MATERIAL AND METHODS

A collection of six specimens of *Salamandra maculosa* 21 mm., 23 mm. (a), 23 mm. (b), 24 mm., 25 mm. and 26 mm. long (nose-to-cloacal length 11.14 mm., 12.33 mm., 12.75 mm., 13.23 mm., 13.66 mm. and 13.72 mm. respectively) was investigated. All specimens were killed in Smith's fixative, embedded in paraffin wax, sectioned transversely at 10 microns and stained in Ehrlich's haematoxylin and aqueous eosin.

MORPHOLOGICAL DESCRIPTION

On each side of the head in all specimens spinal nerve III, which emerges between neural arches II and III, consists of a ganglion (about 250-400μ long, 300-450μ high and 100-150μ wide), a dorsal and a ventral root. Spinal nerve II emerges between neural arches I and II and is similar but slightly smaller than spinal nerve III. Spinal nerve I emerges between the occipital arch and neural arch and consists of a single ventral root only, except on the right side of the 23 mm. (a) and the 24 mm. specimens and both sides of the 23 mm. (b) specimen, where the ventral root has a paired origin at its insertion in the nerve cord. A small ganglion to spinal nerve I is described in *Salamandra atra* but it disappears by the 13.5 mm. stage (Froriep 1917). This is the transient nerve suboccipitalis which probably has no functional importance in the adult (Francis 1934). The occipital crest is situated in front of the neural arches. There are three occipital segments in the urodele skull but the first metotic somite disappears (de Beer 1937) as shown in the larvae of axolotls (Goodrich 1911) and *Salamandra atra* (Froriep 1917), and the first myotome is derived from the second metotic somite. The first cartilaginous occipital arch is never developed, but when a hypoglossal foramen is present it marks the boundary between a pre-occipital (2nd occipital) arch, which is situated between head segments 5 and 6 and an occipital (3rd occipital) arch, situated between head segments 6 and 7. An occipital arch is present in all the *Salamandra* specimens.

Furthermore, on the right side of the 21 mm. specimen a fine cleft-like hypoglossal foramen barely 10 microns long, separates the occipital from the preoccipital arch. It transmits a delicate ventral hypoglossal nerve (Plate 1, figs. 4, 5). The preoccipital arch region in front of the hypoglossal foramen is about 60 microns long and correspondingly thin in transverse view. The occipital crest on both sides of the head of the 24 mm. specimen possesses a well developed hypoglossal foramen 50 microns long on the left and 90 microns long on the right side. The cartilaginous preoccipital arch region in front of the hypoglossal foramen is about 60 microns long as in the 21 mm. *Salamandra* specimen, but it is contiguous with a short ossified region 50 microns long which marks the posterior margin of the foramen metotica. Both hypoglossal foramina transmit a slender hypoglossal nerve, each one having its origin in a single ventral root from the hind brain and terminating in the myotome of the third occipital segment (Plate 1, figs. 1, 2, 3). The occipital regions of *Cryptobranchus japonicus, Hynobius nebulosus, Hynobius retardatus* and *Salamandra maculosa* are similar in appearance. Transverse views through their hypoglossal foramina can be compared and their similarity confirmed (see Plate 2, fig. 10, Fox 1954; Plate 1, figs. 1 and 2, Fox 1957; Plate 7, fig. 51, Fox 1959).

DISCUSSION

The urodele occipital crest on each side of the head is composed of cartilaginous preoccipital and occipital arches firmly fused together and its dual nature is revealed when a small hypoglossal foramen is recognised. In two *Salamandra* specimens a delicate hypoglossal nerve emerges through a hypoglossal foramen as in *Cryptobranchus japonicus* (Fox 1954). *Hynobius nebulosus* and *Hynobius retardatus* possess identical structures (Fox 1957, 1959); furthermore, in some specimens of *Hynobius nebulosus* the hypoglossal (spino-occipital) nerve consists of a dorsal and a ventral root and a ganglion. It is in fact a typical spinal nerve, and analysis of the arrangement of the occipital crest elements (and their concomitant nerve) lends support to the established view of homology between them and the neural arches (de Beer 1937). The structure and arrangement of the occipital crest arches, hypoglossal foramen and hypoglossal nerve in the *Salamandra* specimens described are presumably atypical of the genus (see Stadtmüller 1924). Nevertheless, the existence of the foramen and related nerve in *Salamandra* would encourage a cautious prediction that the same structures can and sometimes do occur in other urodele genera which normally do not possess them.

SUMMARY

1. Two larval specimens of *Salamandra maculosa* 21 mm. and 24 mm. long were found to possess a hypoglossal (spino-occipital) foramen in the occipital crest of the chondrocranium. A hypoglossal (spino-occipital) nerve of the 3rd occipital segment originates by a ventral root from the hind brain, emerges through the hypoglossal foramen and innervates the myotome of the 3rd occipital segment.

2. *Salamandra, Cryptobranchus* and *Hynobius* are the only living amphibia which so far have been shown to possess a single pair of hypoglossal foramina in the occipital crest.

EXPLANATION OF THE PLATE

Photomicrographs of transverse sections at 10 microns through the occipital crest region of 21 mm. and 24 mm. specimens of *Salamandra maculosa.*

Fig. 1—24 mm. specimen. Section through the preoccipital arch, 3.85 mm. from the tip of the snout; about 30 microns in front of the hypoglossal foramen and hypoglossal nerve (left hand side) and 60 microns in front on the right.

Fig. 2—24 mm. specimen. Section through the hypoglossal foramen and hypoglossal nerve (left hand side); 3.88 mm. from the tip of the snout.

Fig. 3—24 mm. specimen. Section through the hypoglossal foramen and hypoglossal nerve (right hand side); 3.94 mm. from the tip of the snout.

Fig. 4—21 mm. specimen. Section through part of the hypoglossal foramen in the occipital crest; 2.68 mm. from the tip of the snout.

Fig. 5—21 mm. specimen. Section through the hypoglossal foramen and hypoglossal nerve; 2.69 mm. from the tip of the snout.

aud.c., auditory capsule; for.h., hypoglossal (spino-occipital) foramen; ga.IX., glossopharyngeal ganglion; ga.X, vagus ganglion; myot., myotome; n.IX, glossopharyngeal nerve; n.c., nerve cord; not., notochord; phx., pharynx; pre-occ., pre-occipital arch; occ.a., occipital arch; occ.c., occipital crest; v.r.h.n., ventral root of hypoglossal (spino-occipital) nerve.

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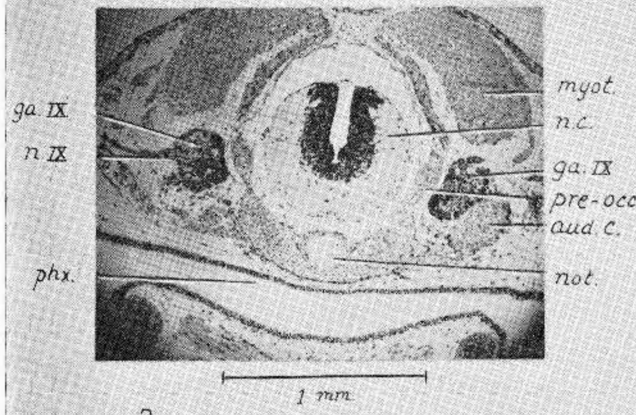

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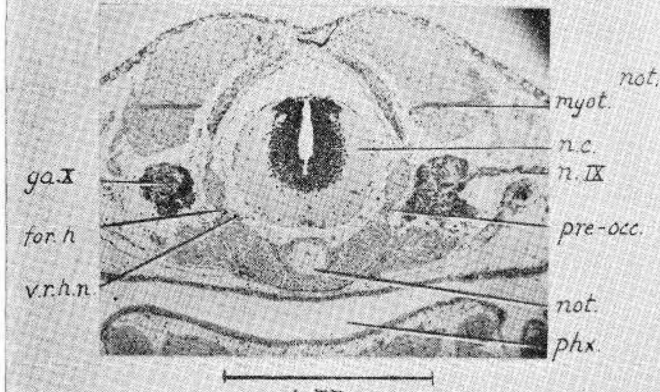

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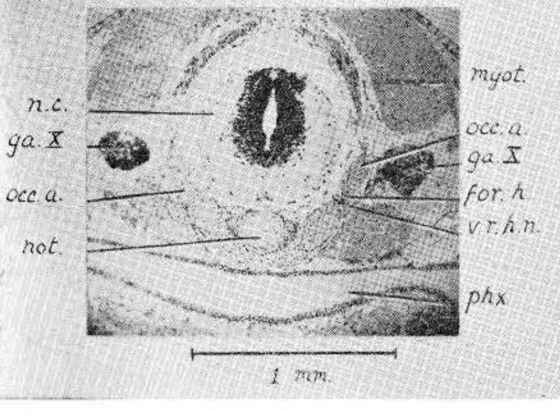

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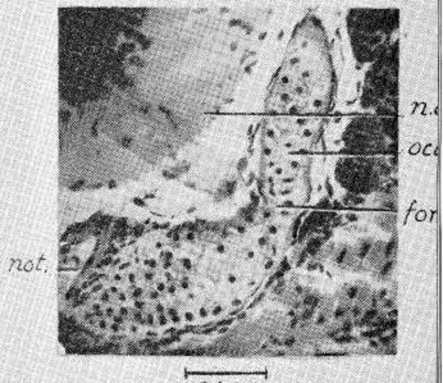

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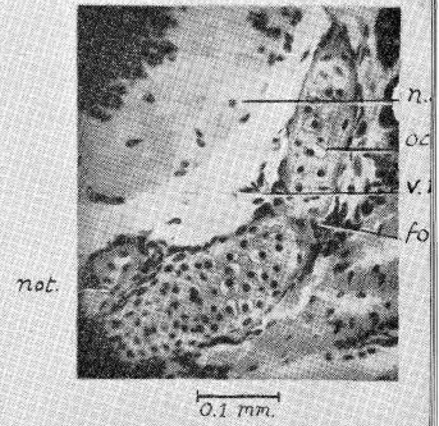

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I should like to thank Mr. C. Atherton for his assistance in preparing the photomicrographs.

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EDITORIAL NOTE

A further comment on apparent failure of tooth replacement in monitor lizards, by A. d‘A Bellairs and A. E. W. Miles, will appear in the next issue‘ Vol. 3, No. 1.

Vol. 95, Sect. 16 A of The Zoological Record on Amphibia for 1957 is now available.

ON TWO CASES OF ANOMALY OF THE EXTERNAL JUGULAR VEINS IN THE INDIAN FROG *RANA TIGRINA* (DAUD.)

By C. L. Talesara,

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Several anomalies in the venous system of different species of frogs have been reported (Vaidyanathan 1949; Soule 1950; Rosine and Brande 1955). However, two interesting cases of anomaly of the external jugular veins in the Indian frog *Rana tigrina* (Daud.) hitherto unrecorded, came to my notice during dissections. In the first case a conspicuous anastomosis between the two external jugulars of the right and the left sides was present while the superior vena cava of the right side was much reduced in comparison with the left vena cava which was normal (Fig. 1A). This suggests that with the anastomosis the major flow of blood to the sinus venosus from the right side of the head was through the left external jugular and there was a considerably less flow through the right superior vena cava owing to its extreme reduction in size.

In the second case, too, the anastomosis between the external jugulars of the right and left sides was present but the superior vena cava of the right hand side was totally absent. In this case the flow of blood from the right side of the head to the sinus venosus was entirely through the left external jugular (Fig. 1B).

The two cases of anomaly observed seem to be related to each other and probably show a trend towards adopting a single left pathway consisting of an enlarged external jugular vein for returning the blood to the sinus venosus, at least in the event of such an anastomosis taking place.

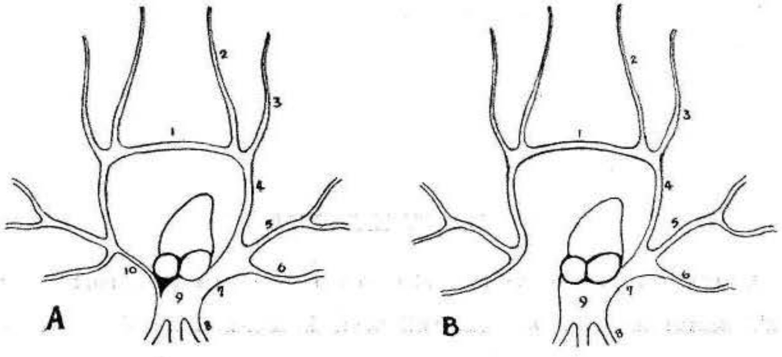

FIG. 1

Fig. A—showing the anastomosis between the external jugular veins of the right and the left sides and the reduced vena cava of the right side.

Fig. B—showing the complete absence of the right superior vena cava.

Fig. 1—anastomosis between the external jugular veins; 2—lingual; 3—mandibular; 4—external jugular; 5—innominate; 6—subclavian; 7—left superior vena cava; 8—hepatic; 9—sinus venosus; 10—the reduced right superior vena cava.

In the heart of the *Rana tigrina* it has been described by George (1958) that the major outflow of blood from the conus arteriosus is through a common pathway consisting of the right systemic, the right carotid and the left carotid, which open together with the left systemic separated by the extension of systemico-carotid septum unlike conditions in the other frogs studied. This separation of blood in the heart of the Indian frog has been considered a condition nearer to what exists in the reptilian heart (George and Shah 1955). It appears, therefore, that with a greater outflow of blood on the right side in the event of an anastomosis between the two jugular veins, the greater inflow tends to be on the left side.

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THE OCCURRENCE OF A PERICARDIAL EXTENSION OF THE LUNG MUSCLE IN SOME TURTLES

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While studying the morphology of the respiratory muscles in a pleurodire, *Podocnemys unifilis*, a sheath of striated muscle on the dorso-lateral side of the pericardium was observed. Since there is no mention in literature of the occurrence of such a muscle over the pericardium in any vertebrate, it was thought desirable to examine this muscle sheath in some other pleurodires and cryptodires and the present report is the outcome of that investigation.

Owen (1866), while describing the *diaphragmaticus* muscle in *Emys europea*, made a casual mention of a small slip of this muscle being attached to the wall of the lung. George and Shah (1954, '55, '58 and '59), who made a detailed study of the myology of some Indian chelonians, described a striated muscle sheath, the *muscularis striatum pulmonale* around the lung. It was shown by them (1958 and 1959) that this muscle completely covered the lung in *Lissemys*, and partially in *Geoemyda*, while it was totally absent in *Testudo* and *Trionyx*.

In *Podocnemys unifilis*, the *muscularis striatum pulmonale* muscle covers the lung only partially. The anterior portion of the medial part of the muscle sheath arises from the body of the third thoracic vertebra. This part of the muscle adheres to the anterior part of the medial side of the lung without its fibres terminating there: these proceed forward towards the dorso-lateral side of the pericardium. There, too, the muscle adheres to the pericardium and terminates on it at the level of the auricles without covering the region of the ventricles. Some more specimens of the same species and also some specimens of the other species of the same genus, viz., *Podocnemys lewyana* and *Podocnemys expansa* were examined. It was found that in all these forms studied, the muscle sheath had the same disposition. On the other hand, in a number of forms belonging to the pleurodiran genera, viz., *Chelodina, Pelusios, Emydura, Hydromedusa* and *Pelomedusa* and also all the fifty forms belonging to various genera of the cryptodiran group which were examined did not possess such an extension of the *muscularis striatum pulmonale* over the pericardium.

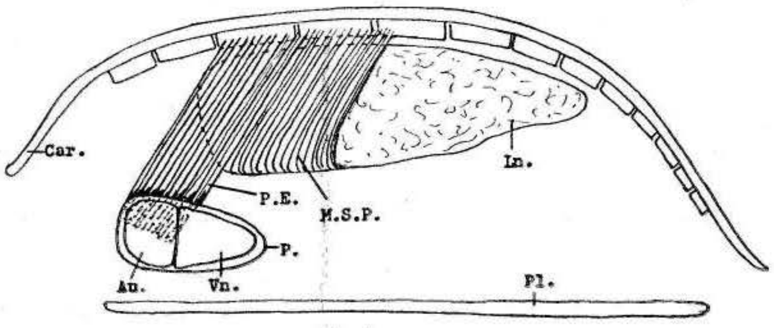

Fig. 1

Fig. 1—Diagrammatic sketch showing the disposition of the pericardial extension of the *muscularis striatum pulmonale* of the right side in *Podocnemys unifilis.*

Au., Auricle; Car., Carapace; Ln., lung of the right side; M.S.P., posterior part of the medial portion of the *muscularis striatum pulmonale;* P., pericardium; Pl., plastron; P.E., pericardial extension of the *muscularis striatum pulmonale.*

From the present observations, it appears that the pericardial extension of the *muscularis striatum pulmonale* is a characteristic feature of the genus *Podocnemys.* The question arises whether the extension is a primitive feature or a secondary acquisition. If the suggestions of Williams and McDowell (1952) and George and Shah (1955) that the Lissemydinae are a primitive group is accepted, it follows that this character in question which is absent in *Lissemys,* is a secondary acquisition in the members of the genus *Podocnemys.* However, the functional significance of such an extension of the muscle sheath over the pericardium remains to be explained. It is not possible to suggest a definite function for it at this stage. Nevertheless, it appears that the presence of such a muscle slip over the pericardium is suggestive of the possibility that when the lungs contract through the action of the lung muscle sheath, the contraction takes place in a wave action toward the heart with the pericardial extension of the muscle facilitating a powerful contraction of the auricles as well. Such an action would promote complete emptying of the lungs as well as the auricles.

ACKNOWLEDGMENT

I am extremely grateful to Professor A. S. Romer of the Museum of Comparative Zoology at Harvard for very kindly giving me the opportunity of examining the various specimens of turtles in his laboratory and for his valuable advice and encouragement. I am also grateful to Dr. Williams for his constant help. It is a pleasure to record my indebtedness to the U.S. Government for the grant of a Fulbright and Smith-Mundt scholarship which made this work possible.

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BIRTH OF THE LIZARD *SCELOPORUS CYANOGENYS* IN THE VIVARIUM

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The iguanid genus *Sceloporus* is represented by some 102 recognised forms, including sub-species (see Smith 1946). The *torquatus* or *poinsettii* group to which the Blue Scaly Lizard (*S. cyanogenys*) belongs is the largest group in the genus, containing twenty-two forms. Distinctive features of this group include large size and a conspicuous neck collar. So far as is known, all members of the group give birth to live young, though certain other members of the genus lay eggs (see Carpenter 1960 a, b). Smith gives the range of *S. cyanogenys* as "Southern Texas along the Rio Grande from Devil's River to Starr County, southward in Mexico to central Tamaulipas and central Nuevo León".

In March, 1959, I received adult specimens of *S. cyanogenys* from the U.S.A. They were housed in large metal vivaria furnished with sand, rocks, dry moss and pieces of bark, and the temperature was kept at 75—80°F during the day. They fed well, preferring bluebottles to gentles or mealworms.

On June 12th two young were seen in a vivarium where six adults were housed. Two dead young enclosed in their embryonic membranes were also found. The suspected gravid female was isolated, and gave birth to a further eleven young on June 14th. The measurements of the live young in mms. are given in the following table.

total length	head & body	tail
70	30	40
72	31	41
73	32	41
74	33	41
70	32	38
73	32	41
74	32	44
70	31	39
70	31	39
66	29	37
71	32	39
64	30	34
70	31	39
Similar measurements of 3 adults		
254	120	134
245	120	125
270	135	135 (part missing)

The young were born within their embryonic membranes, which they ruptured by stretching, sometimes assisted by side to side movements of the head. Some of them seemed to have difficulty in breaking the umbilical cord from its point of attachment in the belly region. One specimen was observed to free itself completely from its membranes in about a minute, but others took considerably longer.

An interesting feature was the appearance of a number of yellowish yolky looking masses, some 8 x 6 mms. in size, in the vivarium. About a dozen of these were found in March soon after the lizards arrived, and it is not known whether these were produced by a female other than that which later gave birth to the young. Three more of these masses were also passed by the gravid female during the period when the young were being born; it is possible that these masses were dead embryos with their yolk-sacs.

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A preliminary note on herpetological data obtained from natives in the Central Highlands of New Guinea.

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Introduction:

New Guinea in the South Pacific is one of the few countries in the world where the opportunities for original field work in herpetology are boundless, for the fauna and flora of vast tracts of land have yet to be sampled.

With the notable exceptions of the expeditions of the American Museum of Natural History, and the pioneering activities of Miss Cheesman of the British Museum (Natural History), the majority of the zoological expeditions to New Guinea have concentrated on examining the animals found in the tropical coastal belts, and the surrounding islands. Very few collectors have visited the sub-tropical highlands, and the scope in these regions of rugged mountains and fertile valleys is therefore virtually unlimited. Many highland species are known solely from the type specimens, whilst biological data is at present limited to collectors' notes.

During a six-month visit last year to Nondugl in the Central Highlands, I found that the natives who lived in nearby districts had an intimate knowledge of many species of reptiles and amphibians. This paper records the nature and extent of these observations.

Nomenclature:

Every species of amphibian and reptile has a specific name in the native dialects, but the dialects are so numerous that the names are only of value in relatively small sub-areas.

The name generally describes a salient feature of the species' habitus, habitat or habits. An example of this is a species of the Microhylid genus *Cophixalus,* which is known in the Middle Wahgi Dialect as "De-boor-boor." Here, the name describes the habitat in which the frog is most commonly found. *"De"* means wood, and *"boor"* is translated as "rotten" or, in Melanesian Pidgin English which is also spoken in the Wahgi Valley, "stinking." The repetition of the word "boor" adds extra emphasis to the condition of the wood, i.e., "extremely rotten wood", and it was under sodden, rotting logs that this species was found to occur in large numbers.

Many of the names recorded have yet to be translated, as in the case of *Cophixalus shellyi* Zweifel which is known as *"Doolkaglan."* This species has been known from only three specimens, the holotype being collected thirty-five miles south-east of Nondugl by the Rev. O. Shelly S.V.D. in 1956. I was fortunate enough to obtain a specimen of this species and, once the native name had been established, it was a relatively easy matter to obtain a large series by simply asking the natives to look for *"Doolkaglan."*

Biological Notes:

The biological data recorded ranged from habitat descriptions to the duration of the stages in the metamorphosis of many species. The validity of the statements was checked by comparison with personal observations.

As a direct result of information obtained from natives, all of the *Cophixalus* spp. in the area were found to lay their eggs away from water beneath moss, logs, rotting leaves, etc. There are however species of other genera that select similar sites, and the identification of spawn is not possible from knowledge of habitat alone. Although the natives were unable to identify the spawn of all species, they were aware of some of the macroscopic peculiarities that enabled them to associate some spawn with particular ones. *Asterophrys wilhelmana* lays less than sixty eggs either singly or in small groups, and each egg has an independent layer of albumen. On the other hand the eggs of *Cophixalus parkeri* are laid in the form of a chain, each egg being connected to its immediate neighbours by an albuminous cord at least two millimetres in diameter. In some other species of *Cophixalus* the diameter of the cord is less than one millimetre.

Many natives were familiar with the calls of frogs, and were able to associate particular calls with the species that made them.

The information about lizards and snakes was equally extensive, although there was less certainty about the nomenclature. This was probably due to the fact that these creatures were not found as frequently as frogs. Hunting for animals was carried out in the dense moss forests where frogs predominated, whilst less attention was paid to the deforested lower ground where most of the lizards and snakes occurred. The habits of the occasional species that did occur in the mountains were well known, and extended to such details as the duration of the incubation of snake eggs.

Practical Application of Data:

In the case of the small species it is difficult to find any utilitarian purpose behind the knowledge the natives have acquired, but this does not apply to the larger species of frogs, snakes and lizards which are eaten indiscriminately, and specimens of many species were tasted by the writer. Examples of those most frequently consumed are *Rana grisea, Chondrophython viridis* (an epicurean delight) and *Goniocephalus sp.* Snakes and lizards are cooked in hot ashes, whilst frogs are boiled in sections of bamboo stems. Potions made from frogs were said to have been used for medicinal purposes, but details of their preparation and application could not be obtained.

It is proposed to include a complete account of native herpetological data in a future paper on the biology of the herpetofauna of the Central Highlands.

I wish to express my thanks to the Rev. J. Dunn S.V.D. of Nondugl who translated many of the native names.

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