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THE ROLE OF AMPHIBIA IN THE DISPERSAL OF BIVALVE MOLLUSCS

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It has long been known to malacologists that bivalve molluscs colonize all kinds of water masses like cattle ponds, springs and even dew ponds not in direct continuity by water with a main drainage system. Their means of dispersal are varied and may be accomplished by flooding (in low-lying areas) and in others due to transport on water plants, attached to aquatic beetles, the feet of birds and of domestic animals (Kew, 1893). In the Unionacea the larvæ (*glochidia*) become parasitic on the gills of fish for a time and so can be transported some distance, and may even colonize pools during floods.

Amphibia, too, play a part, even if it is not a very significant one compared with other dispersal agencies. I was surprised to find no mention of it in Dr. Malcolm Smith's admirable book (*British Amphibians & Reptiles,* 1951). Nor does there appear to be any mention of this subject in herpetological literature although that on Mollusca contains a number of records.

(*a*) Dispersal of Adult Mussels.

Let us consider the dispersal of the adult first. Molluscs, particular of the genus *Sphærium* (small bivalves usually no larger than a pea), have often been found clamped on to the digits of several species of British Amphibia and it has been generally assumed that they can be transported from pond to pond in this way. *Sphærium corneum* (Linnæus) the species most frequently found attached to newts, frogs and toads, lives in the surface of the mud and it is an easy matter for it to become attached to any small animal (be it beetle, amphibian or bird) by accident. *Sphærium,* like other bivalves, lives by ciliary feeding, and to do this, it must spend most of its time with its valves gaping; its immediate reaction to any foreign object thrust between the valves is to close them and to keep them closed indefinitely.

Most of the following records (all except one refer to *S. corneum*) are quoted by Kew (p.69 et seq.), but as his book is now scarce, I have summarized them below; the names of the amphibia are given as cited by the various authors.

Newts.

The earliest record is that of Knapp (1829, p.316) who records *Sphærium* attached to the "common newt (*lacerta aquaticus*)" as follows:—"I have seen the boys in the spring of the year draw it up . . . having a small shell-fish (*tellina cornea*) attached to one or all of its feet; the toes of the newt

having been accidentally introduced into its gaping shell in its progress on the mud at the bottom of the pool."

Standen is the only author to give any indication of the species of amphibia involved.

It is perhaps hardly necessary to mention that the frequency with which bivalves become attached to the feet of aquatic animals will bear a close relationship to the density of the bivalves on the bottom. This is evident from the note written by Peers (1865).

Observer	*Frequency*	*Species*	*Locality*
*D. F. Heynemann (1870, p.130)	1 (with *Pisidium*)		
R. W. Goulding (1885, p.238)	1		Louth, Lincolnshire
Mr. Heathcote	2		Farington, Lancashire
W. Jeffrey	"Occasionally"		Not stated
L. E. Adams	"Many instances"		Ponds in South of England
R. Standen (1885, p.281)	1 (with 4 shells)		Goosnargh
R. Standen	"Each year for many years prior to 1890"	*Molge vulgaris* / *Molge cristata*	Lancashire
R. Standen, 1890	3	*Molge vulgaris*	Lancashire
	1 (with 4 shells)	*Molge cristata*	Lancashire
Mr. Norgate	"Frequently"		In aquaria
J. Ray Hardy	"Many instances"		? Cheshire

*Attached to the lower jaw of a newt.

Two further records are of special interest as they show that newts can leave the water even when encumbered and indicate the possibility of transportation from pond to pond.

Mr. J. Ray Hardy found a newt with a *Sphærium* shell on one of its fore feet at the foot of a wall at Dunham Massey, Cheshire, at a distance of about 10 yards from a small pool. In another instance Mr. Joseph Henshall found two shells on the toes of a newt "midway between two ponds about one hundred and fifty paces apart" (Kew, p.77).

FROGS.

The species in each record was probably the Common Frog (*Rana temporaria temporaria*); all were noted prior to 1893.**

Observer	*Frequency*	*Locality*
*J. T. Riches (1877, p.93)	1	?
†W. D. Crick	1	Northampton (Darwin 1882, p.529)
R. W. Goulding (1885, p.239)	1	Louth, Lincolnshire
R. Standen (1885, p.281)	often	Lancashire
R. Standen	1	Drinkwater Park, Nr. Prestwich
S. S. Pearce	1	Thames, London
Mr. Hudson	1	Redcar
J. Ray Hardy	several	? Cheshire
Mr. Woodthorpe	5—6	Alford, Lincolnshire

*Alongside a canal. †Near a pond.

**Since this note was written I have seen that Elton (*Animal Ecology*, p.155) records finding *Sphærium* on the hind limbs of a frog.

TOADS

No indication of species given.

Observer	*Frequency*	*Locality*
R. C. Douglas (1851, p.3210)	1	? Forebridge, Stafford
J. Peers (1865, p.96-97)	a number	Warrington
R. Standen (1885, p.281)		Lancashire
H. Wallis Kew (1893, p.75)	1	Hampstead Heath, London
H. Wallis Kew (1903, p.263)	5	Tetney, Lincolnshire

It has already been mentioned that bivalves may keep their hold indefinitely and Darwin (1882, p.530) informs us that the bivalves may remain for several days until the crippled toe is completely severed. He adds that encumbered newts in aquaria swim about in a very restless manner (*vide infra*).

Most bodies of water that are inhabitable contain *Sphærium* or *Pisidium* and even new habitats such as dew ponds, bomb-craters and abandoned gun-sites quickly acquire an aquatic fauna which includes representatives of one or both these genera. The evidence so far considered allows of the possibility of their transportation by Amphibia (among other agencies), but are the habits of Amphibia of such a nature as to favour dispersal from pond to pond?

In general (if I interpret Dr. Malcolm Smith's summary of our knowledge correctly), our endemic species do not as a rule wander regularly from pond to pond. Newts appear to use the same breeding places year after year, seldom wandering far, although they have on occasion been found some distance away. Having travelled some distance their poor sense of direction might lead them to another pond, and Henshall's record indicates that a newt carrying a shell could reach a second pond by chance. Although it seems established that newts are not great travellers, it is nevertheless surprising how they manage to find their way into new pools. Of the 43 bomb-crater pools examined by Warwick (1949) at Marlow, eight contained the Smooth Newt (*Triturus vulgaris vulgaris*). Whether this species wandered into these ponds or was carried during floods cannot be established. The restlessness of newts encumbered with bivalves has already been mentioned and it may be that under these conditions they may behave abnormally and seek new pools.

Neither the Common Frog (*Rana temporaria temporaria*) nor the Common Toad (*Bufo bufo bufo*) seem to wander from pool to pool.* Indeed, they have marked preferences for particular pools in which to breed and in the former for hibernating, so that they can be of little importance as far as dispersal of molluscs is concerned.

The Edible Frog (*Rana esculenta*) may be a good dispersal agent because of its habit of frequently migrating from pond to pond. In Britain, as an introduced species, it has a restricted distribution, but in Europe it may be responsible for some dispersal of bivalves.

On the evidence presented, newts and the Edible Frog appear to be the most likely carriers of bivalves. Successful dispersal is possibly quite rare in nature and much more information is required, not only of the frequency with which molluscs are picked up, but also of the movements of the Amphibia themselves.

(*b*) DISPERSAL OF LARVAL MUSSELS.

Fish are usually the hosts of the glochidia of large bivalves of the Unionacea, each species of mussel having one or more species of fish on which it is an obligatory parasite at this larval stage.

Wide dispersal in a river system and to low-lying ponds during floods is achieved as a result of this association. There is no doubt also that the stocking of ponds, reservoirs and ornamental lakes with fish has resulted in the inadvertent introduction of mussels as well.

However, only a small percentage of life histories are known and there is now some evidence (admittedly scanty) that amphibia, too, act as hosts. Howard (1951) gives an account of the glochidia of *Simpsoniconcha ambigua* Say which are parasitic on the salamander *Necturus maculosus* Rafinesque in North America, and suggests that the latter is a distributing agent for young mussels. Earlier, in 1901, Faussek at St. Petersburg demonstrated that it was possible to successfully infect the Axolotl (*Siredon*) and the Austrian cave salamander (*Proteus*) with glochidia of *Anodonta*. More recently, Seshaiya (1941) succeeded in rearing young mussels of *Lamellidens* from glochidia which he induced to encyst in very young tadpoles of *Rhacophorus;* his experiments with tadpoles of *Rana,* as were those of Faussek with *Rana* and *Pelobates,* were abortive; this is usual when the host is not a normal one for the species.

On this slender evidence little can be said on the importance of Amphibia in the dispersal of glochidia. It is, however, a subject worthy of more attention, because only a small percentage of the life histories of the Unionacea are well known, and it may well be that amphibia play a much greater part as obligatory hosts than at present realized.

I am indebted to Dr. H. W. Parker and to Dr. Malcolm Smith for discussion of some of the points raised.

*But see Savage (1935) for evidence that a certain amount of pond to pond migration takes place.

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PAIRING OF MALE *BUFO BUFO* WITH FEMALE *RANA TEMPORARIA* IN CAPTIVITY, FOLLOWED BY INFERTILE SPAWNING

By R. H. AHRENFELDT

It has long been known that pairing sometimes occurs between Salientia belonging to different species or even different genera. As examples of the latter type of mating which have frequently been observed, Boulenger (1897-98) mentions pairing between *Rana temporaria* and *Bufo bufo, R. temporaria* and *Pelobates fuscus, Pelodytes punctatus* and *Hyla arborea.* He observes that male *Bufo bufo* may be found clasping frogs or toads of other species, and that *Rana temporaria* males often "make mistakes" and clasp female toads or *Pelobates.* According to Rostand (1934), in natural conditions female *B. bufo* frequently mate with male *R. temporaria,* and males of the former species with females of the latter. Malcolm Smith (1951) also states that, in exceptional years when frogs (*R. temporaria*) and toads (*B. bufo*) are breeding at the same time, he has often found mixed couples.

On genetic grounds, it would be surprising if such inter-generic crossings were to prove fertile, or, at least, if the fertilized eggs were to develop normally to full maturity. Boulenger (1897-98) refers to the experiments of Born, who succeeded in obtaining a few embryos, which did not develop beyond the hatching period, from eggs of *Rana esculenta* fertilized by *Bufo viridis.* However, Boulenger doubts the validity of a case mentioned by Héron-Royer, where the spawn of a *Pelobates fuscus* which had been found pairing with a male *R. temporaria,* was stated to have developed quite normally and to have produced larvæ indistinguishable from those of *R. temporaria;* two of the larvæ survived, and transformed into normal specimens of *R. temporaria.* According to Malcolm Smith (1951), the failure to obtain hybrids between many species of Salientia by artificial fertilization is, no doubt, due to the great diversity in size, shape and structure, shown

by the spermatozoa, not only in different genera, but sometimes even in closely related species of the same genus. Rostand (1934) carried out experimental crossings between *Bufo bufo* and Salientia of other genera. He found that when ovules of *B. bufo* are placed in contact with spermatozoa of *R. temporaria,* all the eggs develop regularly until the blastular stage, after which they all degenerate. On the other hand, when ovules of *R. temporaria* are placed in contact with spermatozoa of *B. bufo,* fertilization does not take place, and the spermatozoa do not even enter the ovule.

Two cases of pairing between a male *B. bufo* and a female *R. temporaria* in captivity have recently been observed by the writer, and it is felt that a brief description may be of interest because of the opportunity which was thus provided to follow the fate of the spawn, and also because of various details of behaviour which were noted at the time.

In the locality where these specimens were captured—North-east Hampshire—frogs were first seen mating, and frog spawn was first seen, on 13th March, 1952 (73 days from beginning of year), the external air-temperature being 0.5°C. Toads in this district first emerged from hibernation on 6th March, and were first seen mating also on 13th March. A large number of toads, and some frogs (which are less common locally), were captured during the following days, and were all placed in the same cage. By 19th March, the clasp reflex was well marked in all of the male toads in captivity. On 27th March, the freak snow-fall commenced, and deep snowdrifts soon blocked all the lanes locally; and some snow still remained on 7th April, in spite of a fairly rapid thaw. No frogs were seen mating in the district, after 19th March.

In the early afternoon of 13th April, a small male *B. bufo* was seen mating with a much larger female *R. temporaria* which was obviously loaded with eggs; presumably, the frog had been captured before she was able to find a male frog with which to mate. She had then apparently had to wait until a male toad, having by then developed the very strong clasp reflex characteristic of this species, climbed on to her back, in order to rid herself of her eggs.

This pair was placed in a separate cage. About 6 p.m., the female frog was observed making a repeated squeaking-croaking noise, and contracting the body wall and the cloaca, presumably in an attempt to expel the eggs. This behaviour occurred intermittently. The clasp of the male toad was characteristic of his species, and did not extend beyond the axillæ of the female frog, as compared with the grasp in *Rana,* which extends round the ventral surface of the body. The hold of the small male *Bufo* was obviously precarious, partly, no doubt, because of the different method adopted by this species in grasping the female, due to the shortness of the front limbs (cf. M. Smith, 1951); but apparently, partly also because of the relatively smooth, slippery back of the frog. In fact, the toad skidded off the frog's back, but immediately climbed on again. Once more, he lost his foothold

and skidded off, and this time he made no immediate attempt to resume his position; within half an hour, however, he had again climbed on to the frog's back. By 8 p.m. that evening, the frog had begun to lay a few eggs. In contrast to the usual procedure in the frog, where the eggs are expelled suddenly, the process of oviposition was, in this case, lengthy, intermittent and laborious (although the toad now remained firmly in position), possibly because of the male's inability to assist the female adequately in some way in the ejection of the eggs, or because he failed to provide some stimulus normally contributed by the male frog; it is also interesting to note, however, that, unlike the frog, the toad expels her eggs slowly (cf. M. Smith, 1951).

Although the pair subsequently remained in amplexus, it was not until about 9.30 p.m. the following night (14th April) that a further collection of eggs was deposited. By 10.30 p.m., some more eggs had been ejected. By midday, next day (15th April), a large mass of frog spawn had been deposited, but oviposition was not completed until 4.30 p.m. (i.e., 44½ hours after commencement of laying). At that time, the pair separated, but, by the following morning, had resumed the copulatory position which they maintained at least until 21st April. (Unfortunately, it was not possible to keep this pair under observation after this date, but, on the writer's return 10 days later, they were found to have separated permanently.)

A second pair, consisting also of a male *B. bufo* and a female *R. temporaria* captured and kept in similar circumstances, was first seen in amplexus in an almost identical (though even less stable) position to that adopted by the first pair, about midday on 15th April. At this time, a number of *Bufo* couples had formed, in the same cage. This pair was also placed in a separate cage. About 5 p.m., the male toad had slipped off the back of the female frog, and attempted immediately, but unsuccessfully, to climb back. This pair had not resumed the copulatory position by 22nd April, but were again in amplexus within the next week or so—(unfortunately, the exact date is not known)—and a small amount of frog spawn was produced; they had separated permanently by 2nd May (and possibly, some days earlier).

The spawn produced by both of these female *R. temporaria* was typical in appearance. Kept under the usual conditions, however, in both cases it failed to develop, and, examined under magnification, none of the eggs showed the slightest evidence of segmentation. The eggs subsequently degenerated. These findings are in accordance with the results obtained experimentally by Rostand (1934).

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COUNTERMEASURES FOR DIFFICULTIES OBSERVED DURING THE BREEDING OF *XENOPUS LÆVIS* IN CAPTIVITY

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It is common knowledge that *Xenopus lævis* in captivity requires injections of chorionic gonadotrophin to induce amplexus and oviposition. (Bles 1905; Elkan 1937, 1947; Landgrebe & Purser 1941; Parkes 1947). Once the larvæ have developed into free swimming tadpoles they require infinite attention to be maintained in health. Their food requirements and methods of segregation have been described by Schwabacher (1951). This communication is a description of the routine employed at Watford, which has kept the aquaria free of fungal growth and has eliminated the occurrence of hydrops in tadpoles and toads.

(*a*) Fungal growth. *Saprolegnia ferax* soon attacks infertile eggs; hence it is necessary to remove plants from the tanks three days after oviposition. The small tadpoles travel along the bases and walls of the aquaria in search of micro-organisms. Any fungus imbibed proliferates within the alimentary canal and when voided is again taken up by mouth. The fungus, if not removed, interferes with growth. The tadpoles become albinoid and finally succumb. pl. 1A demonstrates a tadpole swallowing its own excreta, a cord of *S. ferax*.

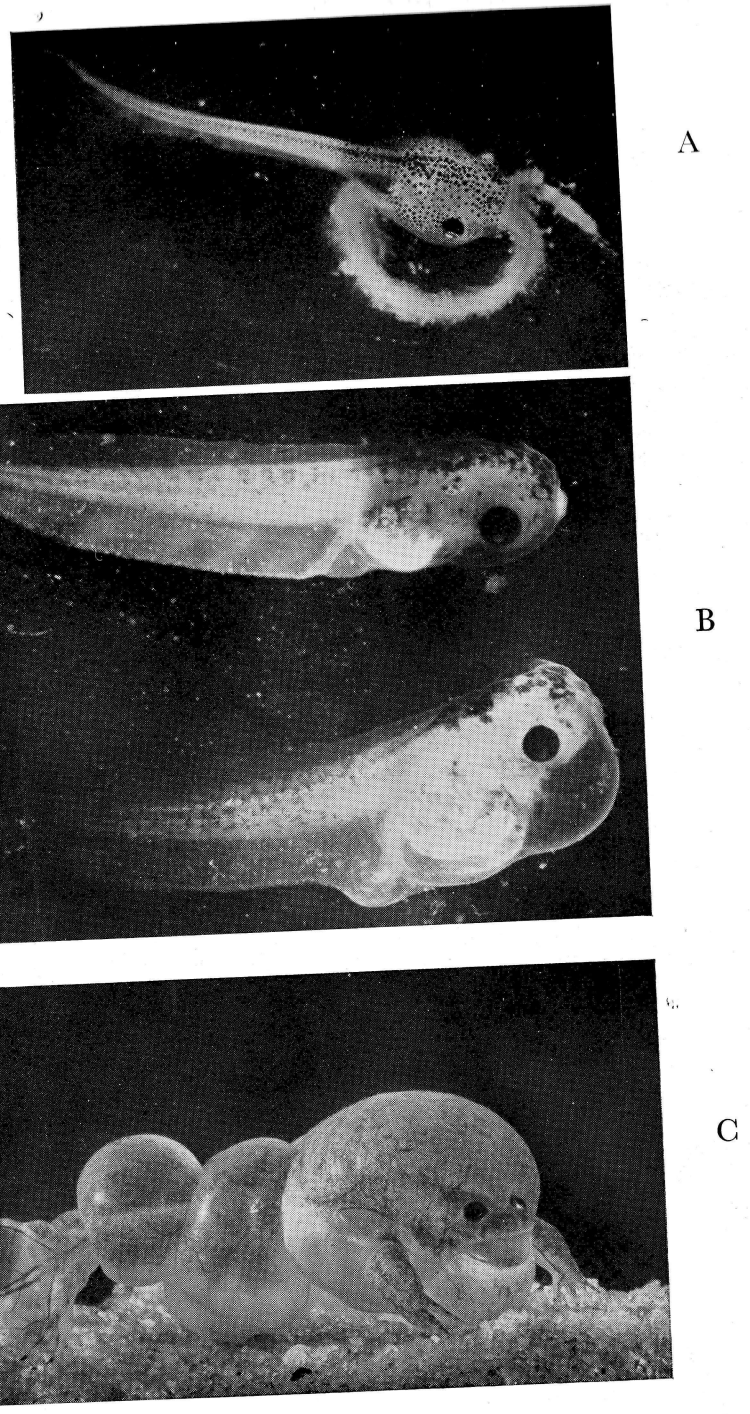
The following description of cleansing the tanks is a routine procedure on six days of the week. First thing in the morning all surfaces of the aquarium are brushed. Freed particles are allowed to sediment and are then removed by suction pump. Water is syphoned away to the depth of one inch. The glass sides are wiped with a cloth wrung out in 10 per cent. Teepol. A Y-piece, connecting hot and cold tap, ensures the mingling of the water conveyed into the aquarium at 24°C. The saline content of water is adjusted to 0.3 per cent. (see below) and the animals are fed. Late in the afternoon surplus food is removed and the tank saline is changed for the second time. The aquarium is left without food during the night.

(*b*) Hydrops in tadpoles and toads. The minute quantities of mineral salts in tap water (0.0083 mg. % NaCl) appear to be adequate to maintain health provided the water is exchanged *daily*. If the water is not exchanged and thereby the salt replaced, there is a metabolic imbalance whereby a large percentage of tadpoles and later toads become hydropsical. The condition can be recognised after 72 hours (pl. 1B). These tadpoles may metamorphose (pl. 1C) but none of the young toads reach maturity. They die either because one of their lymph sacs bursts or because they are unable to reach the surface of the water for air.

A. A tadpole swallowing its excreta, a cord of the fungus Saprolegnia ferox.

B. Dorso-lateral view of 3-day-old tadpoles. Upper: a normal tadpole. Lower: a tadpole with hydrops well established.

C. A young toad showing hydrops of dorsal, ventral, femoral, & tibial lymph sacs.



A

B

C

PLATE I

The sodium chloride content of adult *Xenopus* blood varies between 384, and 432 mg. %. Brackish water flown to London from S. Africa contained 300 mg. %. Following oviposition crude salt (Watson's Water Softeners, Letchmore Heath) is added to the tank to maintain isotonic conditions.

By adhering to rigorous cleaning procedures, by maintaining tank water isotonic to that of *Xenopus*' blood and by adjusting the diet according to development, it has been possible to rear 75% of tadpoles through to metamorphosis.

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NOTES

EARLY BREEDING OF THE COMMON LIZARD (*LACERTA VIVIPARA*)

During the early part of April, 1952, several specimens of the Viviparous Lizard were caught in the vicinity of Market Rasen in North Lincolnshire. Among them were two gravid females. The first had the typical brown coloration above with lateral bands of cream on each side and cream below. The second, which was found basking on the branch of a small fir tree, matched the colour of the foliage perfectly, being of a brilliant green ground colour above with longitudinal bands of darker green; the underside was pale green. The lizards were placed in a vivarium with other smaller females and one male, all of which had been taken in the same locality. They soon became tame, feeding on small earthworms, centipedes and Greenfly, etc.

On the morning of May 28th the first female was observed burrowing in the sand beneath a loose piece of moss. Several hours later she was seen whilst feeding and it was obvious by the reduction in her size that she had deposited her young. The moss was carefully lifted and underneath in a hollowed out depression in the sand were eight "eggs". They were in an upright position and formed a cluster, glossy in appearance and slate blue in colour. The moss was then put back into its original position and the lizard returning to it disappeared beneath and a considerable amount of movement was seen to go on. A little later she reappeared and from that time took no more interest in her "eggs". On lifting the moss it was then seen that she had almost completely buried them, only the tips being visible.

Tweny-four hours later five of the "eggs" hatched. The youngsters were active at once, running about the cage, climbing over the rocks and beneath the moss. Although there was plenty of food for them they were not seen

to eat for 24 hours; after that they fed voraciously upon Greenfly. They measured at birth about 46 mm. in length the tail being 24 mm. In colour they were dark green above speckled with bronze, giving them when they basked in the sun, the appearance of having been lightly brushed with gold. The remaining three "eggs" did not hatch and were removed after 48 hours. They had a somewhat shrivelled appearance and fully formed lizards could be seen through the membrane.

Of the five living young one was eaten by a full grown lizard and as this individual seemed bent on devouring the rest of the family she was removed. None of the other adults paid any attention to the young ones.

Dr. Malcolm Smith in his book, *"The British Amphibians and Reptiles"*, states that emergence of the young from the egg membranes may take place immediately after birth or not for some days. The earliest birth of which he has a record is June 22nd; the earlier date now recorded is no doubt connected with an unusually warm spell early in the spring. The gestation period for *L. vivipara* is three months, so far as is known, and presumably mating took place at the beginning of March which this year was unusually warm. The weather report of the Cleethorpe Meteorological Office for that period is as follows :—

	Temperature F°			
Date	*Max.*	*Min.*	*Rainfall*	*Sunshine*
February 28th	46	29	trace	—
February 29th	52	35	trace	1.8 hours
March 1st	51	35	—	0.1 „
March 2nd	56	41	—	1.3 „
March 3rd	57	46	—	0.7 „
March 4th	53	42	0.15 ins.	3.0 „
March 5th	53	42	trace	0.5 „
March 6th	50	34	0.53 ins.	1.0 „
March 7th	52	42	0.28 ins.	—

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NOTES ON THE VIPERINE SNAKE (*NATRIX MAURA*)

In 1951, in company with Mr. Peter Hopkins, I spent fourteen days' holiday in the foothills of the Spanish Pyrenees, in the immediate vicinity of the village of Vera de Bidasoa, on the banks of the river Bidasoa. *Natrix maura* (termed *Natrix viperina* by many authors) was abundant in the district and the following observations on its life history may be of interest.

The river is flanked by belts of varied country each one covering approximately 1,000 by 50 yards and extending for about three miles on each side. The belts consist of (1) wooded areas; (2) green meadows; (3) areas of mixed vegetation of low shrub vines, ferns and creepers; (4) rock areas. Of these four habitats the snakes were found only in the rock areas.

Each area was searched thoroughly daily at different hours, thus removing the possibility that the position of the sun did not in any way affect their habits. They sought cover during the mid-day heat. The rocks had numerous small holes and fissures which gave the snakes excellent hiding places; they were usually sunning themselves at short distances from the holes. A snake when disturbed from a particular spot would usually be found to return to it later. No method of marking was employed to identify the individuals, but they could usually be recognised by their different markings and in some cases by the scars of old injuries. In very few instances was a second snake found at the spot where one had been previously captured.

This preference for rock habitats has not been recorded before for *N. maura*. The cryptic coloration of the snake fitted in well with its surroundings and would thus give it protection from predators. Dr. David Lack of the Edward Grey Institute of Ornithology informs me that the Short-toad Eagle (*Circœtus gallicus*) which feeds largely upon reptiles occurs in this area. Another reason may be that the rocks would retain the heat during the night when outside the temperature dropped rapidly.

On several occasions the snakes were observed swimming in mid-stream and diving at intervals, presumably to catch fish. Fish and frogs appear to form the staple diet of this species. Stomach contents were noted in several occasions when regurgitation of the meal took place in a freshly caught specimen. Regurgitation could also be induced by drawing the fingers lightly along the body towards the head thus forcing the food into the mouth. This operation did not appear to have any ill effects upon the snakes, for they fed again soon afterwards.

During the return to England thirty-two eggs were laid in a travel case and most of these together with eight others that were laid afterwards were successfully hatched. The eggs were placed between layers of sterile moss and absorbent tissue and placed in an incubator tank which was kept at approximately 95°F. The moss was lightly sprinkled with water for the first few days but the addition of a glass lid made this unnecessary afterwards. The temperature was maintained by a gas heater and did not vary more than 1 or 2 degrees above or below 95* the whole time. It was realised that this temperature for the eggs was higher than that which they would have had under normal conditions but there was no alternative method of heating and as the results proved it had no detrimental effects upon the embryo.

The eggs were laid between July 24th and 30th and hatched between September 6th and 14th, thus giving an incubation period of about 46 days. The emergence of the young took 12 or 13 hours after the first cutting of the shell. The young when born measured about 5 inches in length. In colour they were cream to light grey with lighter and darker grey markings, very unlike the olive-brown chestnut markings of the adults.

*Fowls' eggs are incubated at about 100°F.

Sloughing took place about a week after hatching and almost immediately afterwards the young snakes began to feed, taking whole or chopped worms, *Discoglossus pictus* tadpoles and Guppies (*Lebistes reticulatus*).

The anal secretion of this snake can be quite as disagreeable as that of the Grass Snake but is not emitted so constantly. It was discharged occasionally by the adults when first caught. It was also emitted by the young. It was first noticed in them when they were about three weeks old but the habit was abandoned after a few weeks handling.

The only other snakes seen in the valley of the Bidasoa was a species of *Natrix,* presumably *N.n. astreptophora,* the only form found in Spain. One was seen in a mixed vegetation area, the other in a meadow.

KENNETH BLACKWELL.

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REVIEWS AND COMMENTS

HANDBOOK OF TURTLES

By Archie Carr

Comstock Publishing Associates, Ithaca, New York :
London, Constable & Co. Ltd., price 60/-

Herpetologists, ecologists, conservationists and people who eat turtles in America are fortunate in having so many different species of chelonians in that region : they are also fortunate in having Professor Carr to write about them. His "Handbook of Turtles" is the latest in the series of Handbooks of American natural history and covers the turtles of the U.S.A., Canada and the Mexican province of Baja California. As its predecessors in the series, this book is divided into two sections; the first is an introduction to chelonian zoology and the second is a systematic account.

The introduction takes up no more than forty-six pages of the five hundred and forty page book. In the first chapter Professor Carr gives us a brief glimpse of chelonian evolution. In the space of four pages we learn that the first turtles probably arose between the Carboniferous and the Triassic and having arisen remained much the same and merely sat back in their shells and meditated while evolution proceeded to heights of Archosaurian and mammalian frenzy and a "mob of irresponsible and shifty eyed little shrews swarmed down out of the trees to chip at stones, fidget around fires and build atom bombs".

Having been thus rushed through two geological eras the reader is plunged into a series of short chapters on turtle form and function, turtle economics, and even turtle ethnology. No doubt the physiologist or anatomist would like to see more in their particular fields but the author has at

least been fair in keeping all these introductory chapters the same length.

The closing chapters of the introduction deal with turtle terminology. In endeavouring to clarify the terminology of turtle structures the author has proposed a new nomenclature for the elements of the horny and the bony shells. He has succeeded in completely separating the terminology of the two shells but in doing so has introduced many new terms. In using the keys in the systematic section of the book the reader will have constant recourse to this chapter until the new terms are memorised.

Following the introduction is the systematic section and here the high standard set by the previous "Handbooks" is well maintained. The keys are very easy to use, the accounts are profusely illustrated and there are maps to illustrate the ranges of the species discussed. The vernacular names used by the author may confuse the English reader. It is appreciated that to an American the reptiles known here as "terrapins" are "turtles". A handbook of turtles may thus be expected to include all those chelonians adapted to an aquatic life, but the reader may be somewhat mystified when the author writes of "land turtles".

Following the descriptions of the species are sections on the habits of each species and subspecies. In compiling these sections Professor Carr has freely quoted from other sources but a large part consists of his own observations collected over many years. The notes on the feeding of the Alligator Snapper deserve repetition. Quoting Allen and Neill Professor Carr says :—

> "The young turtles would lie between rocks in a corner of the aquarium and open their mouths widely. The muscular base of the lure would then pull down, first on one side, then on the other, imparting a wriggling motion to the two portions of the appendage. Sometimes the turtles would "fish" for hours without success but often a *Mollienesia* or a *Gambusia* would swim into the open jaws and bite at the "bait".The turtle's jaws would immediately snap shut on the fish, which was next manipulated into position and then swallowed whole."

This is merely a single instance from a whole host of facts which turn what could be a rather dull systematic account into a book which may be read through from cover to cover without a loss in interest.

In addition to the sections on habits there are, where applicable sections on turtle economics which will prove useful to the conservationist. The value of turtles as food may not be appreciated here; we are, therefore, all the more interested to learn how much turtle populations are affected by food markets. Some of the chapters on the uses of the sea turtles will not make good reading. How much the Hawksbill has to suffer for the sake of its tortoiseshell is revealed in a quotation from a nineteenth century author who witnessed the removal of the shell by Mosquito Indians in Nicaragua.

> "Had the poor turtles the power of shrieking they would have made that barren island a very hell with their cries of torture."

The author has suggested ways in which the tortoiseshell might be removed with a minimum of discomfort to the turtle; even so the reader will hope that plastics may soon replace tortoiseshell in commerce.

Professor Carr's "Handbook of Turtles" will be a valuable asset to any herpetologist's bookshelves; one hopes that the publication of this book and its predecessors in the series may inspire the publication of similar handbooks for different parts of the world.

J.I.M.

PHENOLOGICAL REPORTS

The results of the phenological reports on the British amphibians for the year 1952 will be published in the next number of this journal.

Additions and Corrections to List of Members, published May, 1952

CORRIGENDA

EASTWOOD, D. T. Address changed to: 6 South Lodge Avenue, Mitcham, Surrey.
HOWLETT, R. P. For *Maybrook* read *Mabrouk*.
LANTZ, Louis A. Address changed to: c/o M. C. Rynest, 109 Obergrundstrasse, Lucerne, Switzerland.
LEADLEY-BROWN, Mrs. Alison. Address changed to: Greenhill, Lympstone, nr. Exmouth, Devon.
RICHARDS, Miss Jean. For *30* read *36*.
STEPANEK, Dr. Address changed to: Narodni Museum, Vaclavski Namest, Prague II.
TYLER, Gurney. Address changed to: The Abode, Main Road, Icklesham, Sussex.
WILLIAMS, Miss Margaret. Delete *North*, for *N.2* read *N.12*.

ADDENDA

DENMARK, Stanley, 41 Chantry Road, London, S.W.9 1952
FISHER, 21 Lynwood Avenue, Slough, Bucks 1952
GREIG, Alistair, 113 Colson Road, Loughton, Essex 1952
HALL, R. C., 77 & 81 High Street, Stoke-on-Trent, Staffs 1952
HERRMANN, Carl, 221 East 12th Street, New York 3, N.Y., U.S.A. . . . 1952
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