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PARASITES FROM REPTILES IN KENYA, WITH NOTES ON THEIR SIGNIFICANCE AND CONTROL

By

* J. E. Cooper,
Veterinary Research Laboratory,
P.O. Kabete,
Kenya

SUMMARY

The author lists parasitic Protozoa, Nematoda, Cestoda, Trematoda, Pentastomida and Acarina from Kenya reptiles (mainly snakes) during a period of 2½ years. Attention is drawn to the potential pathogenicity of some parasites, especially in captive reptiles, and their control is discussed. The need for further investigations into reptilian parasites is emphasised.

INTRODUCTION

A large number of endo- and ecto-parasites has been recorded from reptiles (Reichenbach-Klinke and Elkan, 1965). Some can by themselves cause disease, particularly in herpetological collections; others (e.g. mites) either transmit bacterial infections or cause damage which predisposes to them. Some reptilian parasites can infect, and on occasion cause disease in other animals, including man. Certain reptilian parasites have unusual life cycles about which little is known, as for example certain Nematoda which are free-living in the absence of a suitable host and which can also enter a reptile by skin or buccal cavity. Partly on account of this, reptiles are now increasingly used for laboratory work on parasites, particularly for studies on their life cycles (Sprent, 1970).

Scattered information on Kenya reptilian parasites exists in a number of journals. Helminth parasites of African vertebrates are listed, together with their recorded hosts, by Ogambo-Ongoma and Canaris (1967). The Journal of the East African Natural History Society and National Museum includes papers on Nematodes (Schmidt and Canaris, 1968) and Cestodes (Hudson, 1933), both of which mention reptilian parasites. Kenya ticks are extensively covered by Hoogstraal (1956) and Yeoman and Walker (1967) and blood Protozoa of East African reptiles by Hoare (1932) and Ball (1967). There has been no attempt however to collate the different groups of parasites of East African reptiles other than Pitman's (1938) classical work on the snakes of Uganda in which a number of endo- and ecto-parasites is listed. Pitman also includes the considerable data on reptile parasites amassed by A. Loveridge in his herpetological publications between 1916 and 1937. The personal note-books of the late C. J. P. Ionides (at present in the care of Mr. J. H. E. Leakey) list a number of parasites from snakes. It is hoped that data from these valuable note-books will be abstracted and published in due course.

MATERIALS AND METHODS

Parasites are listed from Kenya reptiles (especially snakes) during 1970, 1971 and the first six months of 1972. The reptiles came mainly from the Nairobi Snake Park and parasites were removed from snakes either at clinical or *post-mortem* examination (see Cooper and Nares, 1971). The paper covers nearly 300 examinations but not all of these reptiles were examined parasitologically and routine examination for some parasites (e.g. blood Protozoa) has only recently commenced. A few parasites came from other sources in Kenya, in particular Mr. J. H. E. Leakey's snake farm at Baringo.

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It is of limited value merely to list the parasites; therefore notes are appended on the veterinary significance of them, with comments on control or treatment .

Parasites and hosts are listed in Table I. Numbers in brackets refer to the number of specimens from which the particular parasite was identified.

The names of the African reptiles listed follow Loveridge (1957). For non-African species the authority is given.

Protozoa

Blood-borne Sporozoans (Fig. I) are common in reptiles (Wenyon, 1926); Hoare (1932) and Ball (1967) extensively investigated East African species. These parasites can be pathogenic but no evidence was found by the author. As a routine part of clinical examination, however, blood smears were taken from anaemic reptiles (by cardiac puncture) and stained with Giemsa but

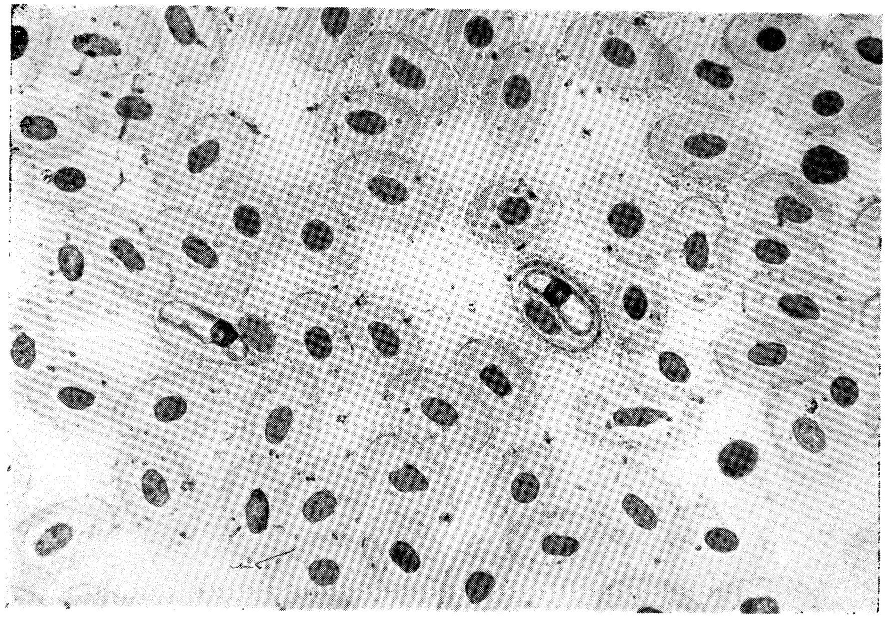

FIG 1

none showed blood Protozoa. Blood Protozoa are transmitted by mosquitoes, sandflies, ticks and leeches and it is important that such vectors are controlled in herpetological collections. Flagellate blood Protozoa (e.g. *Trypanosoma* spp.) have not been found by the author in Kenya reptiles.

A number of other Protozoa was found in wet smears of faeces and in intestinal contents. These included ciliate, flagellate and amoeboid species but no further identification was possible and they are not considered pathogenic. Entamoebiasis due to *Entamoeba invadens* Rodhain is an important disease of snakes in the U.S.A. (Page, 1966) and Europe (Hill, 1953) but it has not been identified as a cause of disease in Kenya.

Nematoda

Many freshly-caught snakes harbour nematodes with little or no evidence of pathogenicity. In captivity, however, nematode parasites build up in

numbers and may cause disease, especially in reptiles which refuse to feed during their first few weeks in captivity. In addition, a cage or pit may rapidly become infected so that an incoming reptile is exposed to its own and other parasites from its environment. Some parasites (e.g. *Kalicephalus* spp.) multiply on the ground in the absence of a host and therefore destocking will do little to clear the pit of infection. Small cages with wooden or concrete floors can be scrubbed or fumigated but this is not practicable in pits containing earth and vegetation. Control must therefore be based on the use of an anthelmintic drug and thiabendazole (Merck, Sharp and Dohme: "Thibenzole") is used with good results at the Nairobi Snake Park. The drug is given orally (see Cooper, 1971). Snakes in the collection are dosed on arrival and thereafter at 6 week intervals.

Disease due to *Kalicephalus* spp. occurs in a number of Kenyan snakes, though some snakes harbour large numbers of worms with no obvious ill-effects (Cooper, 1971). Affected snakes show inflammation of the upper alimentary tract, the worms being attached to the mucosa. They frequently result in erosions of the area with a subsequent build-up of cellular debris. In some cases the debris extends up the "oesophagus" and protrudes into the buccal cavity, causing anorexia and often resulting in "mouth-rot" (necrotic stomatitis). *Kalicephalus* infestation can be diagnosed if debris is examined microscopically; eggs and newly emerged larvae are visible within the dead cellular material.

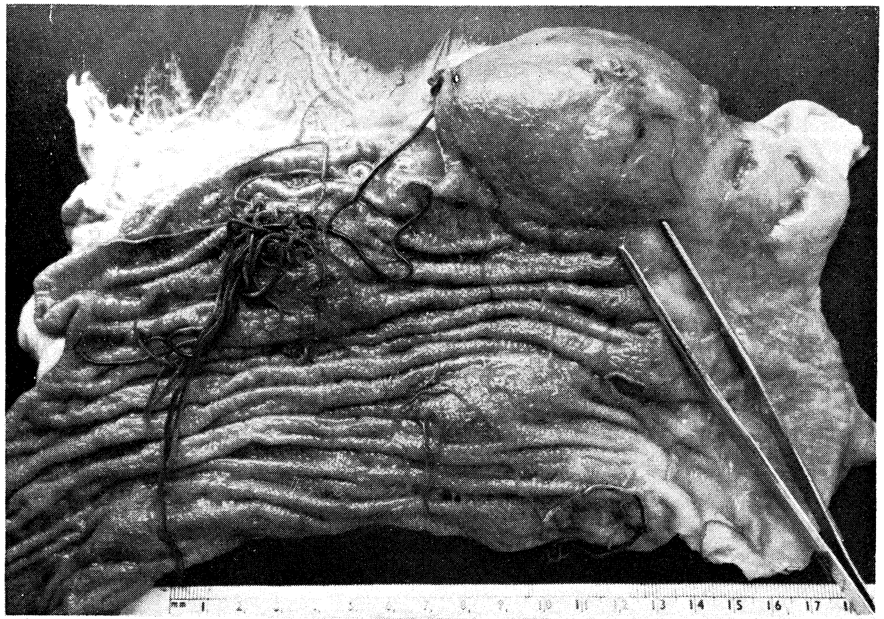

Fig 2

Ophidascaris spp. are common parasites of large pythons in many parts of the world and considerable research has been carried out into their biology (Sprent, 1970). In Kenya they do not appear to be lethal; one large *Python sebae* (which died of a bacterial septicaemia) had large numbers of these worms embodied in an ulcer in the lower intestine adjacent to which was a "tumour", 10 x 5.5 cm, which contained the necrotic remains of dead worms (Fig. 2).

Probably all species of Nematode can, in large numbers, cause loss of condition in reptiles and, possibly, predispose to other diseases. It is advisable, therefore, for all captive reptiles to be dosed with thiabendazole, either routinely or if worms are passed *per os* or *per rectum.* Faecal examination for eggs is a useful aid to diagnosis but cloacal swabs can be disappointing as urates frequently predominate and eggs may not be seen (Cooper & Nares, 1971).

Other Nematode parasites have been found coiled in the sub-cutaneous and peritoneal areas of snakes. They are probably in the Order Filaroidea. They do not appear to be pathogenic. Parasitic cysts in the intestinal wall and body cavity of a number of species of snakes also await identification.

Cestoda

Cestodes are not usually considered highly pathogenic although in large numbers they probably will result in loss of condition. A *Python sebae* showed hyperaemia and erosion of the midgut associated with large numbers of *Bothridium pithonis* and *Ophidascaris* spp. but it was not clear which (if either) of them was responsible. Cestode infestation is usually diagnosed when proglottides occur in faeces, or cestode eggs (with hooks) are seen on microscopical examination by salt flotation methods. No routine treatment is carried out but in the event of a high parasite burden the drug niclosamide (Baywood: " Mansonil "), which appears to be non-toxic to snakes, is used orally.

A full list of cestodes from East African reptiles is given by Hudson (1933) and Mettrick (1963) describes seven species from Rhodesian and Zambian reptiles.

Trematoda

Although Trematodes usually are only found in the gut or respiratory tract *post mortem,* large numbers were found in the buccal cavity of recently captured live bush vipers (*Atheris* spp.). The flukes appear as small black specks. They originate from the respiratory and alimentary tracts but do not appear to be pathogenic and no treatment is carried out other than manual removal with a moistened swab.

Pentastomida

Although pentastomes resemble segmented worms (Fig. 3), they are in fact primitive arthropods. Little is known of their life cycle in reptiles (but see Fain, 1961).

Pentastomes do not appear to be pathogenic to Kenyan reptiles and are not treated by the author. It is possible, however, that they can cause lung damage predisposing to pneumonia or bacterial septicaemia. Eggs of some species, if swallowed, can invade the tissues of mammals, including man, and cause inflammatory lesions of the mesenteric lymph nodes and other organs. Tribes in certain parts of Africa, including the Bamba and Bakonjo in Uganda (Pitman, 1938), eat snakes and if not thoroughly cooked pentastome eggs may survive and infect man. Transmission to man could also possibly occur if adequate hygiene is not practised with captive reptiles.

Acarina

Specimens in Table I were adults unless otherwise stated. Acarina suck blood and transmit a number of diseases. In the case of the mite *Ophionyssus natricis* (Gervais), transmission of certain Enterobacteriaceae responsible for epizootics of a highly septicaemic disease (Camin, 1948) can occur. The same mite can cause skin lesions in humans (Privora and Samsinak, 1958). Mites

were seen on only a few snakes in Kenya after this survey was completed, *Ophionyssus natricis* was identified from *Psammophis s. sibilans Dispholidus typus* and *Python sebae* from Baringo. One reason for the relative dearth of ecto-parasites on snakes at the Nairobi Snake Park is that all new arrivals are routinely sprayed with a dilute solution of trichlorphon (Bayer: " Neguvon ") (Lehmann, 1969). Probably very few mites or ticks survive this treatment.

Large numbers of ticks may be found on free-living snakes, especially *P. sebae.* On arrival in captivity, if spraying is not possible, parasites should be removed manually, ensuring that the mouth parts of each tick are completely removed.

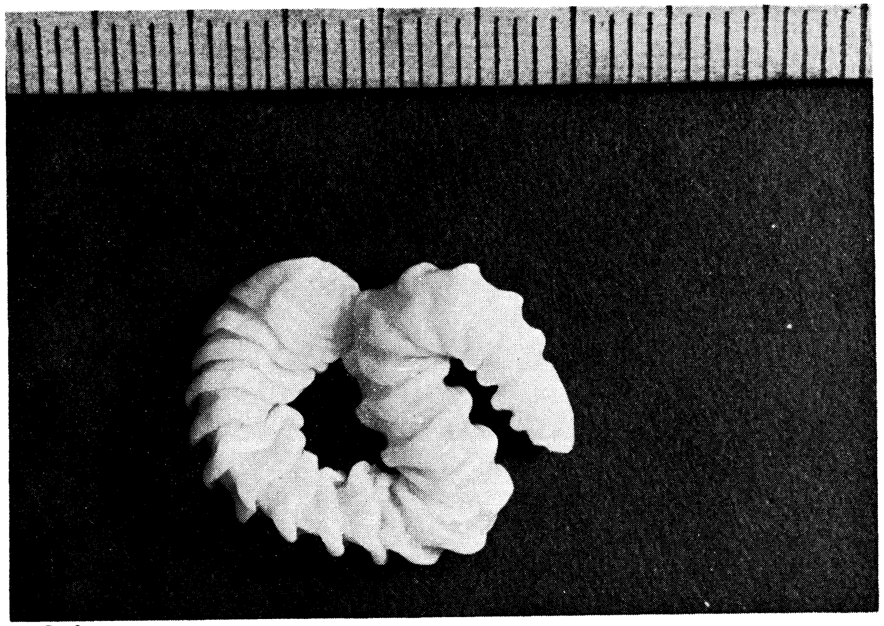

FIG 3

DISCUSSION

Several endo- and ecto-parasites can cause disease in Kenya reptiles, especially if their numbers build up in captivity or if the host is unhealthy. In free-living reptiles they probably play only a minor role. In captivity the aim should be to reduce parasite numbers as much as possible, especially in sick snakes or those in poor condition. Routine oral dosing with thiabendazole and spraying with trichlorphon will go a long way towards reducing the parasite burden.

The study of parasites of reptiles has been neglected in comparison with that of mammals and much needs to be learned of their life cycles and significance in terms of disease. The veterinary surgeon can contribute by examining all reptile material, especially less common species, for parasites and by submitting them for identification.

ACKNOWLEDGEMENTS

I am grateful to: Mr. G. C. Backhurst for identifying ticks and helpful suggestions; Captain C. R. S. Pitman who kindly read and commented on this paper; Messrs. S. Prudhoe and M. T. Harris who identified many nematodes and Dr. D. E. Deakins the pentastomes. Fig. 1 was photographed by Mr. J. A. Spence and Figs. 2 & 3 by Mr. G. C. Backhurst.

Thanks are due to Mr. J. H. E. Leakey for permission to record specimens found on his snakes at Baringo, to the staff of the Nairobi Snake Park for their co-operation and to my wife for her help in checking records. Dr. E. Elkan gave valuable advice on many occasions. This paper is published with the permission of the Director of Veterinary Services, Kenya.

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TABLE I

Parasite	*Host*	
	English name	*Scientific name*
PROTOZOA		
Family Haemogregarinidae	Brown mamba	*Dendroaspis polylepis* (2)
	Common African python	*Python sebae* (2)
	Gray beaked-snake	*Scaphiophis albopunctatus albopunctatus*
NEMATODA		
Kalicephalus sp.	Eastern Jameson's mamba	*Dendroaspis jamesoni kaimosae* (4)
	Brown mamba	*Dendroaspis polylepis* (4)
	Blanding's tree-snake	*Boiga blandingii*
	Hissing sand-snake	*Psammophis sibilans sibilans* (2)
	Israeli sand-snake	*Malpolon monspessulana* (Hermann)
	Nose-horned viper	*Bitis nasicornis* (5)
	Central African gaboon viper	*Bitis gabonica gabonica* (2)
	Gray beaked-snake	*Scaphiophis albopunctatus albopunctatus* (2)
	Common spitting cobra	*Naja nigricollis nigricollis* (2)
	Black-and-white cobra	*Naja melanoleuca* (3)
	Common house snake	*Boaedon fuliginosus fuliginosus*
K. colubri Ortlepp	Black-and-white cobra	*N. melanoleuca*
	Nose-horned viper	*B. nasicornis*
K. simus Ortlepp	Black-and-white cobra	*N. melanoleuca* (2)
	Hissing sand-snake	*P. sibilans sibilans*
Abbreviata? affinis (Gedoelst)	Hissing sand-snake	*P. sibilans sibilans* (2)
A. paradoxa von Linstow	Hissing sand-snake	*P. sibilans sibilans*
Polydelphis attenuata (Molin)	Puff adder	*Bitis arietans arietans* (2)
Ophidascaris sp.	Common African python	*Python sebae* (4)
O. filaria (Dujardin)	Common African python	*P. sebae*
Tanqua tiara (Linstow)	Eastern savanna-monitor	*Varanus exanthematicus microstictus*
Dujardinascaris tasmani (Ortlepp)	Nile crocodile	*Crocodylus niloticus*
CESTODA		
Bothridium pithonis Blainville	Common African python	*Python sebae*
Proteocephalus sp.	Black-and-white cobra	*Naja melanoleuca*
TREMATODA		
Ochetosoma ellipticum (Pratt)	American King snake	*Lampropeltis getulus hoolbrooki* Stegnegon
O. elongatum	American King snake	*L. getulus hoolbrooki*
	" Grass Snake "	*Natrix* sp. (ex India)
O. septicum MacCullum	American cotton-mouth	*Agkistrodon piscivorus piscivorus* (Lacepede)
Mesocoelium monodi Dollfus	Green bush viper	*Atheris squamiger*
	Boomslang	*Dispholidus typus*
	Spotted woodsnake	*Philothamnus semivariegatus semivariegatus*
Mesocoelium sp.	Bush viper	*Atheris* sp. (at least 6)
PENTASTOMIDA		
Armillifer? grandis Sambon	Nose-horned viper	*Bitis nasicornis*
Raillietiella? boulengeri Sambon	Nose-horned viper	*B. nasicornis*
R? orientalis Sambon	" Grass snake "	*Natrix* sp. (ex India)
ACARINA		
Amblyomma falsomarmoreum Tonelli-Rondelli	Eastern leopard tortoise	*Testudo pardalis babcocki* (3)

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A. sparsum Neumann	Common African python	*Python sebae* (3)
	Eastern Jameson's mamba	*Dendroaspis jamesoni kaimosae* (2)
	Eastern leopard tortoise	*T. pardalis babcocki* (3)
	Nile monitor	*Varanus niloticus niloticus*
Aponomma exornatum (Koch)	Common African python	*P. sebae*
A. flavomaculatum (Lucas)	Common African python	*P. sebae* (6)
	Nile monitor	*V. niloticus niloticus*
A. latum (Koch)	Eastern Jameson's mamba	*D. jamesoni kaimosae* (many)
	Brown mamba	*Dendroaspis polylepis* (many)
	North Eastern green snake	*Philothamnus irregularis battersbyi*
Aponomma sp.	Hissing sand-snake	*Psammophis sibilans sibilans*
	Common African python	*P. sebae*
Rhipicephalus sp. (3 larvae)	Eastern Jameson's mamba	*D. jamesoni kaimosae*

FIGURE 1.
Blood smear of African python (*Python sebae*) stained with Giemsa to show two erythrocytes containing blood Protozoa of the Family Haemogregarinidae.

FIGURE 2.
Portion of the intestinal tract of an African python (*P. sebae*) showing *Ophidascaris* worms associated with a " tumour ".

FIGURE 3.
Pentastome (unidentified) from a rhinoceros-horned viper (*Bitis nasicornis*).

LIZARDS AND SNAKES FROM THE NORTHERN DISTRICT OF PAPUA, NEW GUINEA

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INTRODUCTION

The lizards and snakes listed in this paper were all collected between March 1972 and August 1973, below 750m altitude within 75 km of Popondetta (148° 14′ E, 8° 45′ S), in the Northern District of Papua New Guinea. Fig. 1 shows the positions of collecting localities and the location of Popondetta, in relation to the whole of the island of New Guinea.

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The collecting area is bounded to the west by the Wharton Mountain Range, which rises to 3,000m, and is dominated by the dormant but smoking Mt. Lamington volcano (2,400m), the long extinct Hydrographer volcanic system (3,000m) and the igneous Ajule Kajale Range (2,700m). Most of the area is extremely rugged and strongly dissected by cold, clear, fast flowing mountain streams and rivers. To the North East of Mt. Lamington a large fan shaped outwash plain slopes gently to the sea. There are four lakes among the northern foothills of the Hydrographers Range, the largest of which is 1.5 km long and 1 km wide.

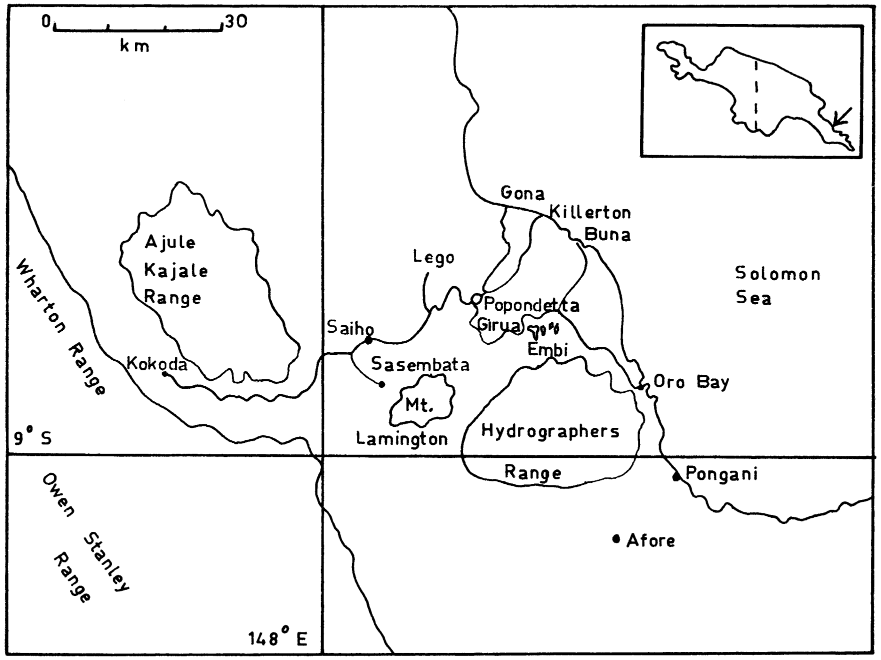

Fig 1. Map of the Popondetta area in the Northern District of Papua New Guinea showing roads and mountains.

A great deal of the original semi-deciduous rainforest is still standing, particularly on mountain slopes and in poorly drained areas. On the more accessible parts of the volcanic outwash plain and in the Kokoda Valley there is a patchwork of food garden clearings, various stages of secondary forest regrowth, cocoa, coffee and rubber plantations, and grasslands maintained by annual fires.

Popondetta has an average annual rainfall of 2,425 mm. Fig. 2 shows the distribution of rainfall and sunshine in monthly means. June, July and August of each year are usually relatively dry, but it is rare for no rain to fall in these months. During the collecting period, however, the most severe drought for 50 years was experienced between June and October 1972. Daily maximum and minimum temperatures are 32°C and 22°C respectively ±2°C throughout the year and humidity is always high.

More detailed information on the geology, vegetation and climate of the area can be found in Haantjens (1964).

With the exception of man there are no large mammals indigenous to the island of New Guinea. In the collecting area wallabies (*Macropodidae*) and bandicoots (*Peramelidae*) were occasionally seen in grasslands, especially at night, and possums (*Phalangeridae*), marsupial mice (*Dasyuridae*) and true rats and mice (*Muridae*) were quite common in forest and plantations.

The bird fauna of New Guinea is very large. Two birds of prey, the whistling kite (*Milvus migrans*) and the brahminy kite (*Haliastur indus*), were present in numbers around Popondetta, and both were seen to eat various reptiles and amphibia.

Amphibians *Gymnophiona* and *Caudata* are absent from New Guinea, but *Anura* are particularly abundant. Species common in the collecting area were:

Bufo marinus—mainly near human habitations; introduced in about 1960 to try to control crop pests.

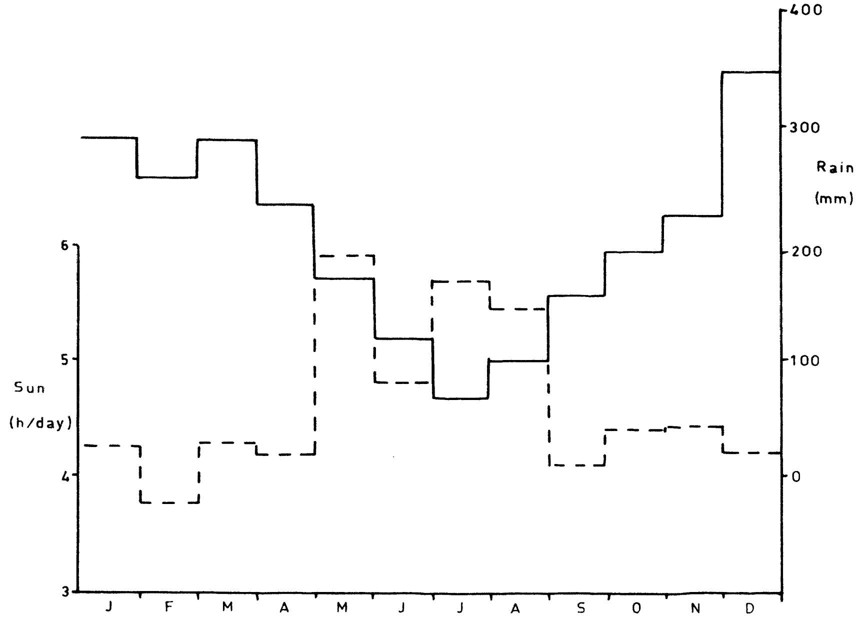

Fig 2. Monthly mean mm of rainfall (——) and hours of sunshine daily (– – –) at Popondetta.

Rana papua—usually found close to streams and lakes.
Sphenophryne schlagenhaufeni—found in the undergrowth in forest.
Litoria nasuta—a grassland frog.

In addition to lizards and snakes, other reptiles in the area were:

Crocodylus porosus—in coastal swamps and Embi Lakes; the largest predator in New Guinea; heavily exploited by the skin trade.
Emydura (*Elseya*) *novaeguineae*—a sidenecked freshwater turtle found in the slow moving lower reaches of rivers.

LIST OF LIZARDS AND SNAKES TAKEN

When a species was first collected, or when there was some doubt about the identity of a specimen, the specimen concerned was assigned an accession

number and sent to Mr. F. Parker, Wildlife Section, D.A.S.F., Konedobu, Papua New Guinea, for identification. Subsequent specimens of known species were measured, dissected and so on, and then discarded. All specimens with accession numbers have now been lodged in the collections of the Museum of Comparative Zoology, Harvard.

In the following list, measurements (and scale counts for snakes) have been given only for the largest specimen of each species taken. Full data for every specimen collected including stomach contents and numbers of eggs or foetuses in females, can be obtained from the author.

Measurements are in the form snout to vent + tail mm; where a tail was incomplete its measurement is followed by a +. For snakes the ventral + anal (S single, D divided) + subcaudal (S single, D double) and / the mid-body dorsal (K keeled, N not keeled) scale counts are given. A — signifies that data was not recorded.

LACERTILIA

VARANIDAE

Varanus indicus (Daudin)
10 Jun 72 Lego Male 340+380+mm
4 specimens.

Two recent hatchings and two adults successfully kept in captivity for 8 months fed voraciously on scrambled egg, chopped meat and various small lizards.

Varanus prasinus prasinus (Schlegel)
4 Jan 73 Popondetta Male 300+560+mm
3 specimens.

This species, bright emerald green speckled with black, was seen climbing in forest trees and in the canopy of cocoa plantations at mid-morning on a few occasions.

GEKKONIDAE

Cyrtodactylus louisiadensis (de Vis)
14 Sep 72 Sangara Female 87+95mm
1 specimen.

Black and white in broad transverse bands dorsally, white ventrally.

Cyrtodactylus pelagicus (Girard)
30 May 73 Agenahambo Female 69+82mm
5 specimens.

Dark brown with dermal tubercles dorsally. Active on the forest floor at night, hides in and under rotten logs by day.

Gehyra oceanica (Lesson)
4 Sep 73 Sangara Female 115+73+mm
1 specimen.

Gekko vittatus (Houttuyn)
5 Aug 73 Popondetta Male 110+85+mm
4 specimens.

Found in plantation houses. Adults olive with a white vertebral stripe, immatures have the tail barred with black and white. Nocturnal.

Hemidactylus frenatus (Duméril and Bibron)

Abundant on the windows of every occupied house. Bustard (1970) gives an account of its activity cycle under controlled conditions and on a verandah at Popondetta.

AGAMIDAE

Goniocephalus dilophus (Duméril and Bibron)
5 Apr 72 Popondetta Male 126+190+mm
1 specimen.

Dull green/brown with a large dewlap and a low heavily serrated crest from the back of the head to the base of the tail.

Goniocephalus modestus (Meyer)
8 May 73 Agenahambo Male 98+260mm
1 specimen.

Small dorsal crest behind head, small dewlap, dark emerald green dorsally except top of head, waist, hind legs and tail dark brown. Taken in primary forest starting to climb a tree.

Goniocephalus sp.
4 Apr 73 Popondetta Male 180+555+mm
14 specimens.

A dull mottled grey and brown lizard common in town gardens but seldom seen because very arboreal. Runs very fast over the ground on hind legs only. Several entered a cataleptic state when caged and refused all food. Nuchal crest and dewlap in adults, and adult males have a large crest at the base of the whip-like tail. Appears to be a new species.

SCINCIDAE

Carlia fusca luctuosa (Peters and Doria)
13 Dec 72 Sangara Male 60+35+mm
18 specimens.

A small brown skink particularly common on the ground in cocoa plantations and occasionally found in town gardens.

Carlia novaeguineae (Meyer)
13 Dec 72 Sangara Female 37+46mm
21 specimens.

A very small brown lizard common on the ground in cocoa plantations and on the edges of forest.

Dasia smaragdinum perviridis (Barbour)
14 Dec 72 Popondetta Female 112+75+mm
3 specimens.

A handsome emerald green lizard. Some specimens have the abdomen, hind legs and tail olive brown. Very arboreal, taken on freshly felled forest trees and in cocoa and coconut plantations. Adapts well to captivity.

Emoia cyanogaster (Lesson)
21 Mar 73 Popondetta Male 100+140+mm
3 specimens.

Dull olive to metallic brown. Very arboreal and only occasionally seen in cocoa plantations and secondary forest. Very shy in captivity.

Emoia caeruleocauda (de Vis)
3 Aug 73 Lego Female 43+66mm
3 specimens.

Longitudinal brown and cream stripes on body, tail irridescent blue. Rarely seen on the ground in cocoa plantations.

Emoia kordoana (Meyer)
12 Oct 72 Popondetta Male 60+130mm
9 specimens.

A dull green/brown arboreal species moderately abundant in cocoa plantations.

Emoia mivarti (Boulenger)
3 Jul 73 Girua Female 52+65+mm
37 specimens.

The most abundant lizard in cocoa plantations where it is active among the dead leaves on the ground. Longitudinally striped with cream and dark brown.

A brown and black skink found on the ground in forest and plantations.

Emoia pallidiceps pallidiceps (de Vis)
11 Oct 72 Popondetta Male 63+52+mm
9 specimens.

Emoia submetallica popei (Brown)
4 Apr 73 Lego Female 58+79mm
4 specimens.

Shiny golden to dark brown above; from forest floor.

Emoia tropidolepis (Boulenger)
17 Jul 73 Sangara Male 71+85+mm
3 specimens.

Eugongylus rufescens (Shaw)
Jun 72 Popondetta Male 147+175+mm
3 specimens.

Heavy body and tail, reduced legs which are folded along body when moving fast. Dark brown dorsally. Found under rubbish in town gardens, fed on assorted insects and small lizards in captivity.

Lipinia noctua noctua (Lesson)
3 Aug 73 Lego Female 41+55mm
7 specimens.

A male and female from Embi Lakes were marbled brown and white all over, while all other specimens seen were dark brown with two indistinct white stripes dorsally on the body, and had a bright red tail.

Lipinia virens virens (Peters)
12 Oct 72 Popondetta Female 52+67mm
11 specimens.

A light olive green, arboreal lizard common in cocoa plantations close to Popondetta. Lamellae under the toes enable it to cling to vertical glass.

Lipinia longiceps (Boulenger)
21 Nov 72 Sangara Male 33+39mm
2 specimens.

A rarely seen, little, arboreal skink. White and brown longitudinally striped body and a red tail.

Scincella semoni (Oudemans)
30 Jan 73 Popondetta Female 57+57+mm
2 specimens.

White and brown marbled skink.

Scincella subnitens (Boettger)
10 Nov 72 Popondetta — 24+10+mm
1 specimen.

From a cocoa plantation.

Sphenomorphus forbesii (Boulenger)
12 Oct 72 Popondetta Male 38+51mm
1 specimen.

From a cocoa plantation.

Sphenomorphus jobiensis (Meyer)
13 Dec 72 Sangara Male 92+102+mm
6 specimens.

A heavy bodied, black and brown barred skink common on the ground in forest and cocoa plantations.

Sphenomorphus muelleri (Schlegel)
18 Sep 72 Sasembata Male 170+72+mm
1 specimen.

A large burrowing skink, brown dorsally merging into red/brown on the tail and with a black lateral band. Found by a bulldozer operator.

Sphenomorphus pratti (Boulenger)
28 Mar 72 Popondetta Male 85+92mm

1 specimen.

Elongated dark brown skink with slightly reduced legs.

Sphenomorphus schodei (Vogt)
3 Jul 73 Girua Male 68 + 100 + mm
8 specimens.

Small, dark brown mottled with grey skink, with reduced legs. Often taken in a pitfall trap in a town garden, and in cocoa plantations.

Sphenomorphus schultzei (Vogt)
1 Aug 73 Sasembata Male 39 + 42 + mm
1 specimen.

Sphenomorphus stickeli (Loveridge)
1 Aug 73 Lego Male 71 + 88 + mm
2 specimens.

Like a very small version of *S. jobiensis,* found on the forest floor.

Sphenomorphus sp.
20 Sep 72 Sasembata Female 33 + 46
2 specimens.

Tiliqua gigas (Schneider)
25 Sep 72 Popondetta Female 500mm total
2 specimens.

The female had been killed by a car and five of its 6 ready to be born young were dead, but one survived and was kept for three months. It fed on scrambled egg and insects, and grew from 106 + 56mm to 165 + 100mm before being released.

SERPENTES

TYPHLOPIDAE

Typhlops braminus (Daudin)
1 Aug 73 Lego — 142 + 6mm —
1 specimen.

Typhlops depressiceps (Sternfeld)
24 Apr 73 Afore — 228 + 5mm —
1 specimen.

BOIDAE

Chondropython viridis (Schlegel)
12 Dec 72 Popondetta Female 1400 + 250mm —
13 specimens.

Specimens up to and including 570 + 117mm in length showed typical immature colouration, being bright yellow with red and white markings. All larger specimens were green with some white flecks dorsally. All were found crossing roads at night, or were brought in by farmers.

Liasis albertisi (Peters and Doria)
2 Jul 73 Girua Male 2010 + 300mm 269 + SA + 70D/54N
6 specimens.

Dark grey dorsally, beautifully irridescent in certain lights, off white ventrally. Found crossing roads at night; very sluggish but powerful.

Liasis papuanus (Peters and Doria)
2 Aug 73 Girua Female 2910+372mm 372 + SA + 87D/65N
1 specimen.

Python amethistinus (Schneider)
7 May 73 Popondetta Female 2380 + 460mm
5 specimens.

Occasionally found crossing roads at night.

Candoia aspera (Gunther)
4 Jan 73 Popondetta Male 473 + 42mm 135 + SA + 16S/33K
1 specimen.

A dark grey/brown snake with an unusual mode of progression described in Bustard (1969). *Eugonglylus rufescens* in stomach.

Candoia carinata (Schneider)
29 Nov 72 Lego Female 760 + 74 + mm 182 + SA + 25S + /34K
13 specimens.

The majority of the specimens were dark brown dorsally with an even darker zig-zag vertebral line, the underside being irregularly speckled with white, red/brown and black. Occasionally a light orange/brown colour form was seen which appeared to be an adult with juvenile colouration. This species was found under logs in cocoa plantations in the day and crossing roads at night. Viviparous. A skink and a rat found in stomachs.

COLUBRIDAE

Dendrelaphis punctulatus (Gray)
22 Dec 72 Popondetta Female 895 + 420mm 190 + DA + 141D/13N
1 specimen.

Anterior dorsal grey, posterior dorsal brown, ventrally yellow.

Dendrelaphis calligaster (Gunther)
26 Apr 73 Popondetta Female 663 + 363mm 178 + DA + 147D/13N
4 specimens.

Olive with white flecks on dorsal neck scales, head brown above with a black line along upper jaw, white ventrally. Found in herbaceous borders in town gardens during the day.

Stegonotus cucullatus (Duméril, Bibron and Duméril)
19 Jul 73 Popondetta — 1283+296mm 200 + SA + 76D/17N
11 specimens.

Dark grey dorsally, light grey ventrally. Found at night in forest, cocoa plantations and crossing roads. Frogs and skink found in stomachs.

Boiga irregularis (Merrem)
28 Jul 73 Popondetta Female 1515 + 384mm 257 + SA + 111D/23N
11 specimens.

The commonest form was light yellow/brown with darker markings, but a grey form with dark grey markings was occasionally seen. Taken from a freshly felled forest tree, crossing roads at night, and twice in grassland. Lizards and a rat found in stomachs.

Amphiesma mairii multiscutellata (Brongersma)
11 Jul 73 Popondetta Female 445+176mm 146 + DA + 81D/15K
3 specimens.

Light brown with black specks dorsally, cream ventrally.

ELAPIDAE

Toxicocalumus loriae (Boulenger)
10 Aug 72 Popondetta Female 369 + 41mm 196+SA+30D/15N
2 specimens.

Aspidomorphus lineaticollis (Werner)
26 Jul 73 Lego — 360 + damaged — /15N
1 specimen.

Aspidomorphus muelleri (Schlegel)
12 Sep 72 Popondetta Female 416 + 65mm 167 + DA + 36D/15N
3 specimens.

Micropheehis ikaheka (Lesson)
11 May 73 Popondetta Female 1110 + 157mm 182 + DA + 38D/15N
1 specimen.

DISCUSSION

A total of 35 lizard and 17 snake species were collected in the area. This compares with 36 species of lizards taken between 500-1000m in the Karimui-Bomai area in the Chimbu District of Papua New Guinea, and 37 species of lizards taken between 100-500m in the Ningerum-Kiunga area of the Western District of Papua New Guinea by Mr. F. Parker (personal communication). Leston and Hughes (1968) suggest that the upper limit for the number of snake species in a tropical forest locality is about 40, while Lloyd, Inger and King (1968) took 47 species of snake in 20 square miles of rain-forest in Sarawak. It seems likely then that there are a further 5 to 10 species of lizard and at least 20 species of snake yet to be collected in the lowlands of the Popondetta area.

It is noteworthy that several of the species taken are not known to occur south of the Owen Stanley mountain range, for example *Dasia smaragdinum*, *Leiolopisma noctua* and *Lipinia virens* (Parker—pers. comm.). Presumably some barrier such as the Musa River and its associated swamps has stopped these species from following the coastal lowlands around the south-eastern tip of Papua to the south-west coast.

A further point of interest is that there appear to be no reptiles in the collection area which can be described as purely grassland dwellers. This contrasts with the situation in other groups such as birds, mammals and insects which all have species only found in grassland. It appears that the greater powers of dispersal possessed by these groups have enabled their " grassland forms " to reach the relatively small and isolated grasslands of the Northern District, while reptiles such as *Physignathus temporalis* present in the savannah around Port Moresby have not been able to do so. In addition, it seems that either the grasslands are too young for " forest reptiles " to have had time to evolve forms capable of living in them, or if the grasslands are old on an evolutionary time scale, then none of the " forest reptiles " had the ability to produce grassland forms.

The data on the presence of eggs in females were insufficient for a detailed analysis of oviposition periods to be made. The only point which emerged was that the lizards in general did not appear to have a clearly defined egg-laying season.

ACKNOWLEDGEMENTS

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THE USE OF CAROTENES TO INDUCE CHANGES IN THE PIGMENTATION OF *BOMBINA ORIENTALIS* AND *BOMBINA VARIEGATA*

By

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INTRODUCTION

In the summer of 1972 a pair of *Bombina orientalis* received among others from Dr. Nace, Department of Zoology, Michigan University, were induced to breed by injecting the female with amphibian pituitary. This treatment was necessary as *Bombina orientalis* is similar to *Bombina bombina*, being considerably more difficult to breed naturally under laboratory conditions than other Discoglossidae such as *Bombina variegata* and *Discoglossus pictus*. The male had well developed nuptial pads and was croaking and most eager to assume amplexus; the female, though plump, showed no inclination to spawn.

The abdomens of all the males, originally caught in the wild in Korea, were a bright orangey-red colour; the abdomens of the females, which had been bred and raised in laboratory conditions, were all yellow; a somewhat lighter shade of yellow than normally found in *Bombina variegata*. According to Nace this yellow colouring is normal in laboratory-reared specimens and is thought to be determined by nutrimental factors operating in the latter part of larval or early post metamorphic life (Nace and Ryuzaki, 1971).

It was believed that the red pigmentation was due to carotenes in the diet and the tadpoles had vegetable matter such as tomato and carrot included in their food. They only ate small quantities, however, and it made no difference to their colouring.

Some of the newly metamorphosed toads were separated into two batches, with a dozen in each batch. All were fed on the same diet used for other species of reared *Discoglossidae*, i.e. *Drosophila*, *Tubifex*, larvae of two species of small beetles and newly hatched stick insects. Batch 1 was maintained in a vivarium in an unheated room with only natural light, where the temperature varied between 34°F (1°C) and 75°F (24°C). Batch 2 was maintained in a heated vivarium with strong artificial light with the temperature 75°F (24°C).

At the end of six months the specimens in the second batch were approximately three times the size of those in the first batch, about ⅓ normal adult size. They had very pale cream coloured undersides in contrast to the first batch which were a custard coloured yellow.

After ten months the second batch were half adult size and still the same colour. The members of the first batch were still approximately one-third the size of the second batch, some showing an orange colouration, which was most pronounced on the feet and hands, becoming fainter in intensity as it spread along the limbs and over the abdomen.

In order to test whether lack of carotenes in the diet was responsible for the absence of red pigmentation one member of the second batch of young *Bombina orientalis*, one year old, was force-fed every three days for a period of four weeks with a small piece of the orange part of a scallop. A gradual colour change was observed and a pronounced chrome yellowy orange colour became apparent on its underside. However, despite such regular feeding this colour did not become more marked and the diet was terminated. The chrome yellowy orange colour was still bright and apparent some months afterwards.

Meanwhile a third batch of 6 tadpoles had metamorphosed and was maintained in an unshaded greenhouse in which the temperature fluctuated with the incidence of direct sunlight. In these considerably brighter conditions the young toads gradually assumed the dorsal colouration of wild adults and they varied widely in patterning and in the proportion of bright green. Their diet was similar to that of the others except that they also received aphids and mealy-bugs. Soon the ventral colouration became a brighter yellow, deepening to orange and then to reddish-orange, particularly in two of the smaller specimens. The coloration was assumed to have been derived from the mealy-bugs, some species of which when squashed were reddish in colour.

It was unfortunate that late winter sunshine caused overheating and the death of all but two of the *Bombina orientalis* and the two reddest ones were among the casualties. However, the experience gained supported our belief that the ventral colouring was derived from ingested materials and that carotene was probably involved. Carotene is widespread in plants and all the aphids and mealy-bugs given to the young toads had fed directly from the sap of living plants. It also seemed likely that more than one type of pigment was involved in the coloration of wild specimens since only deep yellow appeared to be obtainable from cultured foods and the concentrated carotene of the scallop.

A search for information about carotene showed that research had led to the commercial synthesis of certain carotenoid pigments as additives to feeding stuffs used for poultry and trout rearing. We contacted the international pharmaceutical firm of Hoffmann-La Roche of Switzerland through their British company Roche Products, Ltd., who showed interest in our efforts and provided literature concerned with the application of their products to poultry and fish and also to ornamental birds such as Flamingoes and Scarlet Ibis in zoos, which were enabled to regain or retain the red colouring otherwise lost following the first moult in captivity.

This fairly wide application, however, had not hitherto included research involving amphibians and we were pleased to find them sufficiently interested to provide us with a sample of their additive *Carophyll-Red* to try out on our *Bombina orientalis.* Beta-carotene, as found in green plants, we learnt was incapable of producing red pigment and this also applied to the other yellow carotenoid in *Carophyll-Yellow. Carophyll-Red,* however, contains the carotenoid *Canthaxanthin,* one of the substances occurring naturally in the small aquatic crustaceans which form a major constituent in the diet of wild flamingoes and rainbow trout; they could well occur at the shallow edges of the waters where *Bombina* species could take them.

The sample *Carophyll-Red* was divided between us with the intention of administering it as a 10% constituent of a pill made from a vitamin/mineral powder. This proved time consuming and difficult to administer to the very small *Bombina.* Also vitamin A competes for absorbtion with any of the carotenes. No great progress therefore was made along these lines.

Tadpoles can take floating food particles by swimming upside down and it was found that particles of the vitamin/mineral powder (" Vionate ") were likewise ingested when dusted onto the water surface. *Carophyll-Red,* floated similarly on the water surface, proved attractive to *Discoglossus pictus* tadpoles. After half an hour practically all the pigment granules had disappeared from the water surface and all the tadpoles appeared red underneath, where the gut showed through the belly skin. Thus *Discoglossus* tadpoles eat the Carophyll granules; this fact had to be considered in relation to the partly grown *Bombina orientalis* which require live food. It was then decided to feed the latter on the pigment fed tadpoles maintained in shallow water.

The two survivors of the third batch of *Bombina* were used. The level of their swimming water was reduced to a $\frac{1}{4}$ inch and six Carophyll-primed *Discoglossus* tadpoles were introduced. Next morning they had disappeared but the *Bombina* still had yellow bellies. More tadpoles were introduced periodically and the *Bombina* examined daily. By the third day there was a definite orange tinge in their undersides and by the end of one week the colouring was the same as that in some of the wild adults in the next tank. It intensified very slightly afterwards and then stabilised; nor did it lessen after subsequent periods without any " boosting " of *Carophyll-Red.*

It seems probable that these two specimens are the first to have been raised under " laboratory " conditions from eggs to full coloration. It is also a natural coloration since *Canthaxanthin* is a carotenoid pigment occurring naturally in aquatic crustaceans which are known to occur in aquatic habitats of *B. bombina* and probably of *B. orientalis.* It is reasonable to expect them to be equally available to *B. variegata.* Young *B. variegata* were subjected to the same experiment but showed no departure from the natural yellow belly colour. Thus while both species are capable of exhibiting yellow pigment there may well be a genetic difference which allows only *B. orientalis* (of the two species studied) to further utilise red pigment and transform its belly colour to bright orange-red.

It may be of additional interest to report a further brief experiment with *B. variegata.* When half-grown the youngsters' yellow was noticeably paler than their parents' though still quite bright. The same pigment experiment was repeated but this time using *Carophyll-Yellow* and, after only three days, the yellow belly colour improved noticeably and became equal in hue to that of the parents. Nor did it apparently fade after several ensuing weeks without boost.

SUMMARY

1) When *Bombina orientalis* was raised from spawn in laboratory aquaria it failed to achieve its normal (wild) belly coloration, the best being yellow instead of orange-red.

2) When the commercial carotenoid pigment *Carophyll-Red* was included in the diet of partly grown *B. orientalis* normal coloration was achieved.

3) A successful administration of the pigment is possible by feeding it first to tadpoles (*Discoglossus pictus*) and then feeding them to *Bombina* in very shallow water.

4) In similar experimental conditions *B. variegata* retains its natural yellow belly colour demonstrating at least one genetic difference from *B. orientalis.* However, when *Carophyll-Yellow* is substituted for *Carophyll-Red,* pale bellied *B. variegata* achieve full depth and brightness of wild specimens.

ADDENDUM

Discoglossus pictus is an excellent source of live food in tadpole form since the adults are easily maintained in captivity, settle down readily and breed spontaneously and repeatedly through spring and summer. The two pairs maintained by one of the authors to date have produced 14 fertile spawnings in 15 weeks, each spawning of up to 300 eggs. However, it was found that the Carophyll products carry the active principle in a gelatine matrix. It was thus relatively simple to dissolve the " powder " in very warm water and mix the cooled solution into a quantity of white-worm (*Enchytraeus albus*), which was readily taken, together with the pigment, by both species. The amount of *Carophyll required* is very small and only sufficient water was used to ensure a solution. This method might appeal to others wishing to repeat the experiments.

It seems probable that in *B. orientalis* full coloration is a two stage process involving both yellow and red pigments and that if the yellow is lacking it will detract from the effectiveness of the red. Certainly a single adult male possessing a pale cream-coloured belly managed to achieve merely a salmon coloured underside when dosed with *Carophyll-Red* only.

Experiments are now taking place to study the effects of feeding *Carophyll-Yellow* to tadpoles of *B. orientalis* and it is encouraging to see that, by the time the tail is absorbed, there is a very noticeable yellow pigmentation of the underside of the hands and feet. It is hoped to maintain this pigmentation by feeding them with fruit-flies raised on a medium including *Carophyll-Yellow*. The red pigment can be added later, at the white-worm stage, if the young *Bombina* are then showing a good yellow base colour.

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INTESTINAL CILIATES OF TORTOISES

By

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Little has been written on intestinal ciliate protozoans of terrestrial tortoises (*Testudinidae*). Chagas (1911) described *Balantidium testudinis* from *Testudo graeca*; also later found in *Geochelone radiata* and *Geochelone sulcata* by Wenyon (1926) and *Chersina angulata* by Fantham (1932). Geiman and Wichterman (1937) described *Nyctotherus kyphodes* and *Nyctotherus teleacus* from *Geochelone elephantopus elephantopus, Geochelone e. hoodensis* and *Geochelone gigantea elephantina*. These authors also described the amoeba, *Endamoeba insolata* from these tortoises and found *Balantidium testudinis* and a small *Trichomonas* flagellate. Carini (1938) reported *Nyctatherus* from *Geochelone denticulata*. Telford (1971) remarked that the non-pathogenic genera *Nyctotherus* and *Balantidium* are commonly found in the large intestine of herbivorous turtles.

A *Kinixys belliana* owned by the junior author stopped feeding and eventually died. On autopsy a number of stomach lesions were found. Microscopic examination revealed protozoans closely resembling *Nyctotherus kyphodes* and unidentified fungi. Since *Nyctotherus* are usually found in large intestines and are considered nonpathogenic, it is not known if they caused the lesions, or migrated up the alimentary tract after the tortoise stopped feeding and, being opportunistic, then invaded already formed lesions.

Subsequent examinations of fecal smears from several *Geochelone carbonaria* and *Geochelone elegans* also revealed *Nyctotherus kyphodes* and another unidentified *Nyctotherus*. Dr. Sam R. Telford, Jr. (University of Florida, U.S.A.) has informed us that he found *Nyctotherus* in Florida *Gopherus p. polyphemus*. These four tortoises represent new host records for *Nyctotherus*. Mode of transmission of the protozoans is unknown. Since *Kinixys* and the two species of *Geochelone* are from widely separated areas of the world, it is unlikely that *Nyctotherus kyphodes* is native to all three tortoises. They were purchased from different pet dealers at different times and were possibly infected through ingestion of food or drinking water contaminated with feces of other tortoises (after purchase they were kept separate). Corliss (1961) reported that cockroaches may serve as hosts and tortoises may have ingested roaches or food or water contaminated by them at the pet stores.

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COMMENTS ON THE REPRODUCTION OF POPE'S PIT-VIPER (*TRIMERESURUS POPEORUM*) SMITH

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Fitch (1970) laments the lack of information concerning the reproductive cycles of snakes and includes data on only six of the 32 species of *Trimeresurus* (not including *T. popeorum*). A Pope's Pit-viper, *T. Popeorum* (57 cm length) from Bangkok, Thailand, was received at Max Allen's Zoological Gardens (M.A.Z.G.), Eldon, Missouri; 29 April 1969 and maintained in isolation from other snakes. This snake gave birth to six young on 26 June 1970, but unfortunately did not resume feeding and died 17 October 1970. It is preserved as M.A.Z.G. 1986. There is no indication of hermaphroditism or intersexuality as in *Bothrops insularis* (Hoge, et.al., 1959). These data suggest delayed fertilisation or possibly parthenogenesis.

Because *T. popeorum* is primarily distinguished from *T. stejnegeri* by differences in hemipenes (Campden-Main, 1970); i.e., males are well known, parthenogenesis is not immediately suspect.

Delayed fertilisation is known from a variety of reptiles (Fox, 1956; Cuellar, 1966) including snakes (mainly colubrids). The viperine *Causus rhombeatus* is known to utilise delayed fertilisation (Woodward, 1933) and *Vipera aspis* and *V. berus* are suspect (Volsoe, 1944; Rollinat, 1946). Apparently *T. popeorum* may be added to this list.

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A DOUBLE-HEADED GRASS SNAKE, *NATRIX NATRIX HELVETICUS*, FOUND AT LADOCK, TRURO, CORNWALL

By

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Double-headed snakes have frequently been reported and they are not particularly rare. Up to 1933 80 cases have been reported from various parts of the world, 33 of them belonging to the genus *Natrix* and 19 of the latter being of the species *natrix* (see Cunningham, 1937).

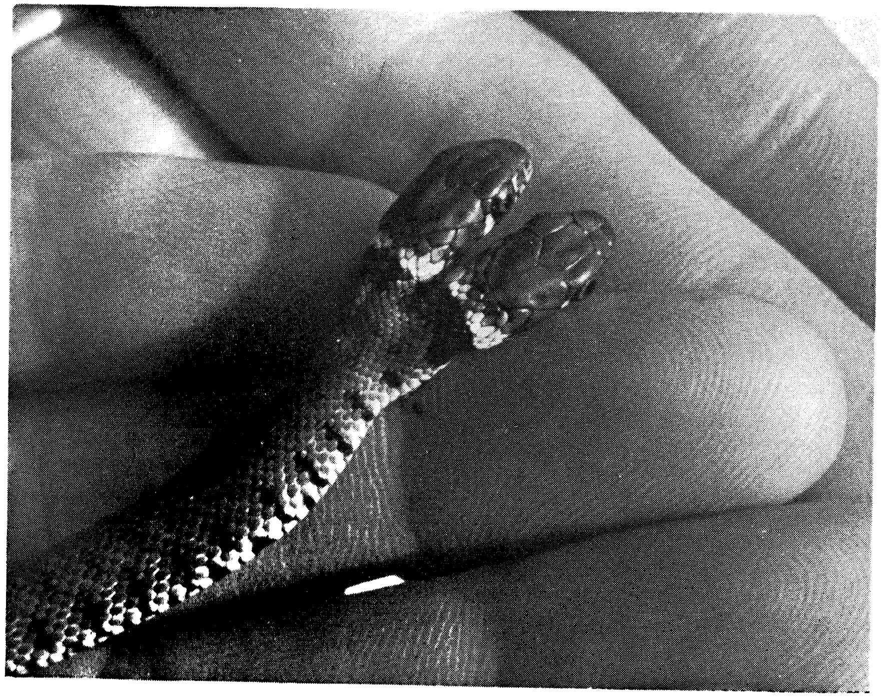
This present snake is only the second double-headed one recorded in Britain; the other occurrence involved an Adder, *Vipera berus*, found in 1853 (or 1854) also in Cornwall.

The snake (see Figure) was found by two pupils of Truro Girls Grammar School, the Misses Joyce and Susan Clayton, in their garden on 29 September 1972. Its two heads joined the body in the shape of a letter Y. The overall length of the snake was 5 inches. It may be assumed that it was born only a few weeks prior to its discovery. The schoolgirls housed it in a large coffee jar, into which was introduced small earthworms and slugs. Presumably they were eaten by the snake as they were not found the next morning and it was impossible for them to escape from the jar.

The snake was eventually featured on a television programme and then sent to the Zoological Gardens in London. Here the snake did not feed voluntarily but had to be force-fed with small guppies. The snake was held behind one of its heads whose mouth was forced open by one of the guppies

held in a pair of forceps. Although the keepers tried to feed both heads on numerous occasions, only the right one accepted food. It was maintained in a small cage containing a dish of water and a piece of cork bark, under which it passed most of its time. The cage furniture was kept to a minimum in order to reduce the chances of damage to the paired heads by any extraneous objects. It was noticeable that the snake showed some confused behaviour for often the two heads appeared to wish to go in different directions. However, clearly the right was dominant. The snake died on 29 November 1972 and is now preserved and with Professor A. d'A. Bellairs in the Department of Anatomy, St. Mary's Hospital Medical School, Paddington, London.

Whatever the cause of the double-heading it is certainly a "developmental accident", comparable with certain types of Siamese twinning seen in man and other animals. Doubtless in the vast majority of cases of such developmental abnormalities, the embryos do not survive or they succumb soon after hatching. The surprising feature of the double-headed snake is that it survived at all.



ACKNOWLEDGEMENTS

The author is most grateful to the Misses Clayton for their written account of the snake when in their possession; to Mr. D. Ball, Zoological Gardens, London and Professor A. d'A. Bellairs for kind advice and the loan of relevant literature on the subject.

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OLIVER HOOK—NATURALIST (1893-1973)

The death of Oliver Hook in the autumn of 1973 removed an outstanding figure from the diminishing ranks of all-round amateur naturalists. Reared in the Surrey heathlands before they became almost an annexe of London, he rapidly familiarised himself with the rich fauna and flora of that area. He was aided in this by the parallel enthusiasm of his younger brother Raymond and both were encouraged by their father, Bryan Hook, a Royal Academician, who was an eminent painter of, among other things, natural history subjects. Raymond Hook emigrated to Kenya before the First World War and he and Oliver kept up a life-long correspondence about animals and plants until Raymond's death a few years ago. Oliver's interests remained focussed on the British fauna and flora.

However, it was not until after the Second World War that an early retirement and settlement in the New Forest gave full rein to the energy and enthusiasm that Oliver devoted to natural history.

At Brockenhurst and, later, at Lyndhurst he accumulated on a card-index and map system of his own devising a vast amount of information about the distribution of the animals and plants of the New Forest, and any passing naturalist was assured of a warm welcome and ready access to this storehouse of facts.

As a zoologist Oliver Hook was interested in and knowledgeable about all groups of animals, though he was most keen on the terrestrial vertebrate. The snakes of the New Forest received his attention in collaboration with Dr. Carl Edelstam of Stockholm; deer were perennially intriguing to him and he gathered much information about mice and voles, particularly in relation to forestry practices, which were one of his more practical enthusiasms; but above all, he was devoted to seas.

The focus of his interest centred on the grey seal (*Halichoerus grypus*) and, in tracing its distribution and breeding habits, he organised himself into some of the more remote corners of the Atlantic—to many of the off-lying British islands, Iceland, Spitsbergen, Greenland and the Canadian Arctic, endeavours that would have taxed far younger men.

Latterly, he was fired to investigate the anomalous situation in the Baltic where grey seals breed in the early spring upon the ice before it breaks up and, in conjunction with Dr. A. G. Johnels, he organised, while in his seventies, a series of trips by aeroplane and ice-breakers back and forth across the ice of the Baltic. The results of these expeditions were published in the Proceedings of the Royal Society, series B (1972).

During this time, with his customary vigour, Oliver Hook took up cinematography and produced many valuable colour films recording his travels and the wild life he had encountered. These films and accompanying talks made him in great demand as a lecturer to natural history and other societies. One of them, which I was privileged to help him make, recorded a visit to Uganda and Kenya in 1957 before these places had become a Mecca for ecologists and tourists. I was concerned with the rats and mice that inhabited the forested areas and I shall always remember gratefully the ardour with which Oliver flung himself into laying trap-lines, handling the animals caught and making study specimens, beautifully done despite his predilection for using an aged pocket knife which he had treasured for years, instead of a scalpel. I was particularly pleased that we were able to publish two joint papers resulting from this expedition, one in the Journal of Mammalogy, the other in the Proceedings of the Zoological Society.

Many societies admitted Oliver Hook to their membership and benefited by his active support. His influence in local societies will be the subject of a separate appreciation. National bodies to which he belonged included the Zoological Society, the Linnaean Society and the Mammal Society. It was in connection with the last that I was more closely associated with Oliver. We were two of a small group of people who met at the Zoo in 1953 and decided to launch the Mammal Society. Since then he served on its Council and as its Publications Officer, giving freely of his time and wisdom and, in the latter office, of shelf space in his house. He was a foundation member also of the British Herpetological Society (1947) and in 1950 devised and led a Society outing to the New Forest. In the last few years he had been a valued member of the Society's Conservation Committee and, at the time of his death, a copy of a report which he proposed to make in person at their next meeting was already in the post.

Great Britain is justly envied for its natural history societies, which thrive on a mixture of amateurs and professionals. Should we ever run short of Oliver Hooks, such societies may as well disband themselves.

H. N. Southern.
13 March 1974.

LETTER TO THE EDITOR

I was interested to read the letter from Dr. Elkan in the *Br. J. Herpet. 5,* **429**, June 1974, criticising wasteful research into the eating habits of the frog.

The populations of all our indigenous herpetofauna have fallen dramatically in recent years due to loss of habitat, pond drainage and clearance of heathland, water pollution, commercial collecting etc., until most species are "locally extinct". In an effort to conserve our herpetofauna many of us undertake home breeding and reintroduction of these animals to the wild, but what is the point of doing this when our efforts are thwarted by research involving the destruction of those creatures we are trying to conserve?

In the same issue of the *Journal* we learn that 24 frogs were used in an experiment to determine the effects of DDT, the conclusion being that "there is a likelihood of British frogs being poisoned in the field". Could there possibly have been any doubt that DDT will eventually poison our frogs when in America it had been shown that large populations of frogs were decimated as a result of spraying the swamps with DDT to eradicate the mosquito. What was the function of these experiments except to repeat, in essence, experiments previously performed in 1947, 1964, 1968, 1969 . . . ?

The British Herpetological Society maintains that "the solution to herpetological conservation lies in practical field work backed by comprehensive educational studies". Since some 200,000 frogs and countless newts, toads and reptiles are used each year in our schools and centres of higher education would it not be better to withhold money from any research project which does not carry out practical field work. Such work could involve the contruction of new ponds, and renovation of old ones (a project now sponsored by the Ford Motor Company) and a widespread publicity campaign urging people not to remove spawn from ponds, nor smash reptile eggs and irrationally kill harmless snakes and slow-worms.

School science teachers and the public examination boards should be asked to amend their biology and zoology courses. Too often . . . "lightly anaesthatise and pith a frog" is the standard beginning to physiological experiments, for the usual method of demonstrating muscle action is to use the gastrocnemius muscle of the frog and the frog has long been the typical dissection animal

Some examination boards have withdrawn the frog from the syllabus but schools are still encouraged to use frogs in experiments which have dubious value, since models or simple theory can cover the point in question.

Schools could also discourage their pupils from keeping spawn and tadpoles in jam jars and other unsuitable sites. It is amazing that when the few tadpoles survive metamorphosis the pupils seem to have so little time to return them to their natural environment.

These measures are surely only the minimum we could do to conserve our wildlife. If research projects involving large numbers of our herpetofauna were suspended wild populations might then remain steady; certainly if we do not act now then in the future, when the demand on the land for housing and roads is greater, we may find our " common " species becoming extinct. Today it is the Natterjack toad, Great Crested Newt and Sand Lizard; tomorrow it will be *Rana temporaria, Triturus vulgaris* and *Bufo bufo.*

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BOOK REVIEW

Frye, Frederic L. (1973) *Husbandry, Medicine & Surgery in captive reptiles.* VM Publishing Inc., 144 North Nettleton, Bonner Springs, Kansas 66012, U.S.A. 28 x 22 cm. Pp. 140. Ill. in colour. Price not mentioned.

The fact that few veterinary surgeons know much about the pathology and the therapeutics of lower vertebrates seems to percolate through to the publishers. The present slim volume, written by a Vet and published by a veterinary publishing house, is obviously addressed to the veterinary fraternity, not to the general public, which would hardly know what to make of it. The chapter headings alone are somewhat confusing: Husbandry, Medicine, Surgery & Pathology, Epilogue, Glossary, Index.

The author, as demonstrated by the dust-cover list of his degree attainments and past appointments, has obviously a great deal of experience in the field of Reptilian husbandry, but his book covers only a small part of the field. His bibliography is almost wholly confined to American publications and far too much space is occupied by bad illustrations. Most of the x-ray findings, reproduced in blue and the 12 pages devoted to electrocardiographs could have been better occupied by more detailed text. To start the Index with the letter " A ", the word " Amoeba ", does not occur at all. The legend for Fig. 7 has the word " tricolithous ", which could not be found in three scientific dictionaries; the condition shown in Fig. 25 is not " Blepharitis or Conjunctivitis " but Avitaminosis A and to call a tumour, caused by an encysted worm, a " Pseudoneoplasm " is an innovation few would care to accept.

Some of the pictures and much of the text should be useful for a Vet practising in an area where Reptiles, particularly Chelonians frequently appear at the Surgery. If the book could be enlarged by at least another hundred pages and supplied with better—not necessarily more—pictures, it might eventually find its way to the shelves of the Surgeries of those for whom it was written.

E. ELKAN.

Provisional Atlas of the Amphibians and Reptiles of the British Isles. Edited by Henry R. Arnold, Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, England. 1973. Price 25p.

This atlas is the first of a series which is intended to cover the smaller groups of animals. It describes *Triturus cristatus, T. vulgaris, T. helveticus, Bufo bufo, B. calamita, Rana temporaria, R. esculenta, R. ridibunda, Anguis fragilis, Lacerta vivipara, L. agilis, Natrix natrix, Coronella austriaca* and *Vipera berus.*

H.F.

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