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THE NATTERJACK TOAD (*BUFO CALAMITA*) IN THE BRITISH ISLES; A STUDY OF PAST AND PRESENT STATUS

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(*Received* 16/10/74)

INTRODUCTION

Within recorded times, the natterjack toad has always been the least common of the British Amphibia. Nevertheless, at the beginning of this century *Bufo calamita* was widely distributed on suitable habitats throughout England, north Wales, south Scotland and south-west Ireland (Taylor, 1948; 1963); the species was local rather than rare. Suitable habitat included coastal sand dunes and marshes, and inland heaths.

It has been apparent for some time that many areas where natterjacks were recorded 40 or more years ago no longer support them (Beebee, 1973). Indications of serious declines are also apparent if the recent distribution surveys are compared (Taylor, 1948; 1963; Arnold, 1973). By 1970, *Bufo calamita* was recognised as an endangered species in Britain by the Conservation Committee and the Nature Conservancy. The present investigation is an attempt to quantify the declines, determine the current distribution and population sizes of *B. calamita* colonies, discover reasons for the decreases and to recommend a conservation programme.

METHODS

Information relating to past and present distribution was obtained by: (1) personally visiting all relevant areas as many times as possible, usually during the breeding season. Other Conservation Committee members (especially K. F. Corbett and J. Griffin) assisted; (2) interviewing local inhabitants; over 100 inhabitants of past and present natterjack sites were consulted; (3) contacting local naturalists, Naturalists' Trust recorders and Nature Conservancy wardens (particularly important sources of information) and (4) examination of literature records. Despite the use of these sources of information, it is always possible that a few remnant populations may have escaped notice. If such colonies persist, however, they are certainly too small to make significant differences to the overall situation.

Data relating to possible causes of declines were obtained from the above sources, and from the Meteorological Office (Bracknell) and the Meteorological Service (Dublin); drainage information was from the Southport Council, West Lancashire Water Board, Lancashire River Authority and the River Crossens Drainage Board. Habitat information was also obtained by examination of old Ordinance Survey maps.

Populations were estimated only in very general terms; the ease with which adults could be found hiding in daytime and the numbers of males calling in late evening were noted. Presence and abundance of spawn and tadpoles were recorded. Final estimates were then made by comparison with an area where natterjack populations still exist and have been extensively investigated. Habitat quality was judged by: (1) total extent; (2) abundance of suitable freshwater pools; (3) state of terrestrial vegetation; (4) public pressure; (5) agricultural interference; and (6) potential threats.

RESULTS

The fates of natterjacks in various parts of the country were considered separately.

1. South-west region

Apart from dubious records from Devon and Cornwall, where no breeding colonies have ever been reported, *B. calamita* was an inhabitant of certain heaths and dunes in Dorset and S. W. Hampshire. Colonies at Bloxworth (Dorset), Holmsley Heath and Beaulieu (New Forest) and Hengistbury Head had all disappeared by 1950. Considering the large areas of heathland available in this area, records are few and natterjacks may never have been common here despite the apparent suitability of the habitat. It is certainly no longer indigenous to the south-west.

2. South-east region

Natterjacks were formerly very widely distributed on the heathlands of the south-east, especially in Surrey and N. E. Hampshire. The toads disappeared from the London area soon after the turn of the century (Smith, 1954); they were recorded from Putney heath, Wimbledon, Streatham and Mitcham commons, Coombe Hill and Blackheath. Some of the few Kent records are dubious, especially from Dover, Maidstone and Canterbury and the only area where *B. calamita* persisted until fairly recent times was Dartford. Natterjacks are certainly absent from Kent today. Similarly, Berkshire records are vague and unsatisfactory and the species is now absent there. In Surrey and Hampshire, *Bufo calamita* has been recorded from Wisley, Ripley, Send, Woking, Horsell, Chobham, Bisley, Bagshot, Worplesdon, Shalford, Blackheath, Godstone, Thursley, Hankley, Frensham, Farnham, Woolmer, Shortheath, Kingsley, Oakhanger, Bordon and Selbourne. In most of these areas natterjacks persisted until the 1930s, but since then the declines have been dramatic. By the mid 1950s only five sites were occupied; by the mid 1960s only one, last recorded in 1972. To all intents and purposes *Bufo calamita* is now extinct in south-east England.

3. Wales

Natterjacks were once present on the coastal dunes of north Wales; the species was recorded from both sides of the Conway estuary and of the Clwyd estuary (Kinmel Bay and Rhyll) and eastwards towards the Point of Air (Gronant dunes and Talacre Warren). *B. calamita* has now departed from these places; the last survivors were in the Kinmel Bay area around 1945. Natterjacks are now extinct in Wales.

4. Central England

Old records from Shropshire and Hertfordshire are unreliable. The species is certainly now absent from central England.

5. East Anglia

This area was, until recently, a stronghold of the natterjack. Large colonies existed in S. W. Cambridgeshire and adjacent Bedfordshire (Gamlingay, Tadlow and Sandy). In Suffolk, heaths at Alderton, Bawdsey, Aldeburgh, Coldfair Green, Walberswick, Southwold, Wangford Wood, Easton Warren, Tostock, Wortham and Lothingland had natterjacks. Norfolk colonies were equally extensive, at Gorleston, Yarmouth north denes, Caister, Hemsby, Winterton, Horsey, Cley, Holkham, Hunstanton, Wootton, Roydon, Syderstone, Reedham, Beeston and Sherringham, St. Faiths, Framlingham Earl and Thorpe. A recent record from the Brecklands was probably misidentified. From almost all of these places, natterjacks have disappeared since the 1930s. The huge colonies at Lothingland and Reedham were last recorded around 1960 and now only four definite sites remain, where the toad populations are a fraction of their former size. The species is extinct in Cambridgeshire, Bedfordshire and almost certainly in Suffolk. The total remaining East Anglian population (of adults) is estimated at less than 2,000.

6. North-east England

Natterjacks have been recorded from Yorkshire and Lincolnshire. However no colonies have ever been known in Yorkshire and the records were probably misidentifications or referred to escapes from captivity. Reports from unsuitable areas of habitat have come from several other counties throughout Britain (Devon, Lake District, Northumberland, Scotland); where investigation was possible the above factors seem to be responsible.

In Lincolnshire, natterjacks inhabited the coastal dunes from Gibralter Point to North Somercotes. They are now absent from all but one very small area of dunes, where a vestigial population of perhaps 100 adults persists.

7. North-west England

This region is the last remaining stronghold of the English natterjack. *Bufo calamita* has been recorded from virtually all the coastal sand dunes and marshes between Cheshire and the Solway and on many of these the species is still found. However, declines have occurred; at Millom, a large colony was totally destroyed by permanent flooding in 1970. At Ulverston, the habitat was developed as an industrial estate. On the dunes of S. W. Lancashire, eight square miles of the most extensive and optimal natterjack habitat in Britain, the recent declines have been vast (Corbett & Beebee, 1975). From the hundreds of thousands present in the 1930s (Hardy, 1939; R. Wagstaffe, *in. litt.*), only a few thousand remain. Natterjacks still occur at a further 11 geographically isolated sites in the north-west, though in most cases areas of habitat and toad populations are small. The largest, in Cumbria, extends over 1½ square miles and supports a few thousand natterjacks.

8. Scotland

The most northerly British records, from Inverkip and the Isle of Arran, are of dubious origin; natterjacks are certainly absent today (Gibson, 1969). Colonies persist on the Scottish Solway (M. Boyd, *in litt.*), though *Bufo calamita* is now apparently absent east of Annan and west of the river Nith. The habitat between Annan and Dumfries is low grazing "Merse", and there is no evidence that natterjacks have declined there in recent times.

9. Eire

The current status of the natterjack in Eire has been investigated recently (Gresson & O'Dubhda, 1971; 1974) and observations of K. Corbett and the author are in agreement. Records from the west Waterville peninsular (Coomakista and Cahirdaniel) were probably inaccurate, and *B. calamita* is now absent. Natterjacks disappeared from Valentia harbour (Ballycarbery) around 1945. The distribution of the toads around Castlemaine harbour has decreased dramatically and they now persist only in a few small areas between Cromane and Glenbeigh and on Inch dunes. The well known colony at Rossbeigh dunes (Smith, 1954) has gone. The largest remaining natterjack population in Eire is the recently discovered one on the north side of the Dingle peninsular near Castlegregory (Gresson & O'Dubhda, 1971).

In the United Kingdom natterjacks are now restricted to 20 geographically isolated sites. The total adult population is estimated to be less than 30,000; smallest colonies number less than 50, the largest no more than 5,000. Clearly a vast decline of both habitat and population has occurred and the natterjack is now a seriously endangered species. 30,000 is a precariously low number for animals such as amphibians which rely on large congregations of breeding adults and a few specific breeding sites for success.

Overall declines are summarised in *Table 1*, which shows how the number of recorded Natterjack sites (on heathland and sand dunes in the U.K.) has changed since 1900. Most of these sites are vague and refer to very general areas, but the trend is clear. Sites on dunes have decreased in number by 55%, and on heathland by more than 95%. Overall decrease is over 80%. Only reliable colony records are included.

TABLE 1
Changes in numbers of natterjack sites

Type of site	Year 1900	1930	1945	1955	1965	1974
HEATHLAND	62	42	26	17	4	2
DUNE AND MERSE	45	35	29	28	24	18
TOTAL	107	77	55	45	28	20

Table 2 shows that the areas of habitat occupied by natterjacks (within the rather large margin of error implicit in such calculations), have fallen in a manner which corresponds remarkably well with the decrease in recordings shown in Table 1.

TABLE 2
Changes in areas of habitat (acres)

Type of Habitat	Year 1900	1930	1960	1974
HEATHLAND	113,000	80,000	7,000	600
DUNE AND MERSE	33,000	29,000	19,000	15,000
TOTAL	146,000	109,000	26,000	15,600

Heath habitat has decreased by over 99%, dune habitat by 55% and the total by 90%.

Reasons for the declines

1. NATURAL CAUSES

Certain factors beyond the direct control of Man were examined as possible causes of the declines. No evidence suggests that any change in numbers of predators or availability of prey have been responsible; predators specific to *Bufo calamita* are not known, and the habitat is such that invertebrate prey is least likely to be affected by pesticides.

Increased competition with *Bufo bufo* has certainly occurred at many natterjack sites. This is probably due to the reduction of shade and cover on the sandy terrain to which the natterjack is better adapted. The high summer temperatures reached in sandy areas probably tend to exclude *B. bufo*, whereas the burrowing ability of *B. calamita* ovecomes such thermal problems. In minimally disturbed areas clear dividing lines between the species are apparent, but where various types of development have occurred *B. bufo* has frequently encroached. Most of the old southern heathland natterjack sites are now occupied by common toads.

There is no evidence that disease has affected wild natterjack populations in Britain or elsewhere.

Various weather factors were examined, including temperatures likely to be critical during the breeding period and larval development. No changes were observed (since 1930) to correlate with the natterjack declines. The possible effects of changing rainfall patterns on dune slack levels were also investigated. ("Slacks" refer to the shallow freshwater pools which form in many dune systems). Although winter rainfall has tended to decline since the 1930s, it has become an important factor in most places only since 1970, and then usually only as a secondary aggravation to basic drainage problems discussed below. In S.W. Lancashire, where slacks have been drying out for several decades, rainfall has continued to increase since 1916. Conversely, rainfall in S.W. Ireland has followed the national trend and may have contributed to the loss of slacks there.

Natural succession (i.e. accumulation of organic detritus) as a cause of the infilling of ponds is not a major problem in sandy habitats. Heathland soil is poor in nutrients, plant growth in ponds is restricted and the deposition of organic detritus slow. Very few heath pools have been lost in recent times

from this process. Dune slacks are richer in minerals due to their proximity to the sea but the ephemeral nature of the pools also retards the accumulation of organic material. Slacks are gradually destroyed by inblown sand and other factors, but in accreting dune systems freshwater pools are usually maintained somewhere within the system.

2. HUMAN INTERFERENCE

Inland heaths. The vast majority of natterjack habitat in S.W., S.E. England and East Anglia was on lower greensand heath. Destruction of this habitat over the last 100 years has now almost reached completion. Only a tiny fraction has escaped development as road or housing sites, afforestation, agricultural reclamation and military devastation. Heaths which remain have often become amenity areas, with consequent high public pressure and increased frequency of fires. These factors account for virtually every case of natterjack decline on heathland: in the few areas where relatively unspoilt heath remains, the terrain has been fragmented by the above developments. Natterjack populations became isolated around single breeding centres and succumbed to local catastrophes without chance of repopulation from other sites. Breeding sites on heathland have often remained intact; Frensham ponds are little changed except for the enormous public pressure. However, subtle changes of marshland drainage dykes in East Anglia following the introduction of mechanical clearance in the late 1930s (including steeper sides and deeper water), were sufficient to render them unusable by the adjacent heathland natterjack colonies.

Coastal dunes have also suffered from development. Natterjacks disappeared from north Wales following the despoliations of the holiday industry, a process which is now occuring in S.W. Lancashire. Dunes are favourite sites for golf courses, which although not totally incompatible with natterjacks have influenced the declines where drainage has been involved (e.g. Gibralter Point).

A serious threat to dune natterjacks is improved drainage of both dunes and adjacent agricultural areas. In S.W. Lancashire dune streams are now piped and no longer supplement the water table. Many dune systems back on to low-lying grazing marshes, which often contain natterjack breeding sites. Mechanical clearance of dykes increased their efficiency, the water table fell and soil shrinkage lowered the land surface level. The dykes were then deepened further, and the cycle continued over several decades. The result has been a continuous lowering of the water table, which either eliminated breeding water directly or reduced the level in the adjacent dunes, causing breeding slacks to dry out. In S.W. Lancashire, improved drainage of adjacent marshes lowered the water table by 4 feet in 10 years. Drainage of sandy fields has also been a major cause of the decline of the Irish natterjacks.

3. GENERAL FACTORS

Pollution has been of minor significance to natterjacks, although at least 2 breeding sites have been contaminated by sewage. Collection, both professional and amateur, has been significant in some places; at Frensham it was probably the decisive factor. The larger dealers no longer sell British natterjacks but some smaller concerns still do so and they abstract specimens at a time when the species can least afford the losses.

DISCUSSION

The natterjack toad has undergone a dramatic decline in Britain and concern is certainly justified (Beebee, 1973; Prestt *et al*, 1974). The species faces the probability of extinction on heathland in the immediate future. Its status in many sand dune habitats is also precarious and few remaining sites support anything approaching the populations of 40 years ago. The majority are under threat of one sort or another and although there is no imminent prospect of total extinction, the possibility is not far distant.

Bufo calamita is a particularly interesting member of the British Amphibia. It is unique in being the only species on the edge of its range and restricted to particular specialised habitats; for this reason it lends itself to the study of limiting factors in its ecological environment (Mathias, 1971). It is also unique among British herpeto-fauna in that it has not yet been specifically dealt with in this journal. It is hoped, therefore, that this neglect is over and that studies on ecological and other aspects of the natterjack toad will continue apace.

It is realised that a work of this nature is open to criticism on the basis of the vast scope of the field of study. The possibility that a few sites could have been missed was stated earlier, though it is believed that any additional data will clarify further, though not significantly alter, the picture presented on the status of the natterjack in the present work.

Any further information on natterjack toad colonies would be welcomed by the Conservation Committee of the British Herpetological Society.

Conservation

A number of measures are urged to protect the surviving natterjack populations.

(1) The continuation and intensification of research into the ecological requirements of the species should be encouraged.

(2) Commercial sale of *B. calamita* should be made illegal. Any form of collection and keeping natterjacks in captivity should be strongly discouraged. The wild populations can in most cases not withstand much more abstraction of this kind.

(3) Remaining sites must be rigorously protected. Of the 20 known localities, 6 are in, or partly in, Sites of Special Scientific Interest (S.S.S.I.s); 5 are on local nature reserves and 5 are on, or partly on, National Nature Reserves (N.N.R.s). However, 2 sites are on both S.S.S.I.s and N.N.R.s, leaving 6 sites totally unprotected and the largest site (S.W. Lancashire) is mainly unprotected. All natterjack sites should be on nature reserves with the possible exception of two very small colonies which should be S.S.S.I.s.

(4) Specific conservation measures are required at particular sites. Reintroductions are planned for certain heathland habitats now considered safe and suitable; excavation of breeding slacks is required at several dune sites. These and other activities will be pursued by the Conservation Committee in liaison with local naturalists' trusts and the Nature Conservancy Council.

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REFERENCES

ARNOLD, H. Ed. (1973). Provisional Atlas of the Amphibians and Reptiles of the British Isles. Biological Records Centre, Abbots Ripton.

BEEBEE, T. C. J. (1973). Observations concerning the decline of the British Amphibia. *Biological Conservation* 5, 20-24.

CORBETT, K. F. & BEEBEE, T. J. C. (1975). The disappearing Natterjack. *Oryx* 13, 47-49. south-west Lancashire. *Oryx* (In press).

GIBSON, J. A. (1969). The reptiles and amphibians of the Island of Arran. *Trans. Buteshire Nat. Hist. Soc.* 17, 69-72.

GRESSON, R. A. & O'DUBHDA, S. (1971). Natterjack toads *Bufo calamita* Laur. at Castlegregory and Fermoyle, Co. Kerry. *Ir. Nat. J.* 17, 9-11.

GRESSON, R. A. & O'DUBHDA, S. (1974). The distribution of the Natterjack Toad *Bufo calamita* Laur. in Ireland. *Ir. Nat. J.* 18, 97-103.

HARDY, E. (1939). A rare toad (Natterjack). *Field* 174, 415.

MATHIAS, J. H. (1971). A study of the ecology of *Bufo bufo* and *Bufo calamita* on the Ainsdale Nature Reserve between 1968 and 1970. Ph.D. Thesis, University of Manchester.

PRESTT, I., COOKE, A. S. & CORBETT, K. F. (1974). British Amphibians and Reptiles. Ed. D. L. Hawksworth. *Systematics Association Special Volume* 6, 229-254.

SMITH, M. A. (1954). *The British Amphibians and Reptiles*, 2nd edn. Collins, London.

TAYLOR, R. H. R. (1948). The distribution of reptiles and amphibia in the British Isles, with notes on species recently introduced. *Br. J. Herpet.* 1, 1-38.

TAYLOR, R. H. R. (1963). The distribution of amphibians and reptiles in England and Wales, Scotland and Ireland and the Channel Islands: a revised survey. *Br. J. Herpet.* 3, 95-115.

THE SAND LIZARD IN NORTH-EAST ENGLAND

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INTRODUCTION

This work attempts to define the known distribution and establish the present faunal status of the Sand Lizard *Lacerta agilis* in north-eastern England, from the Scottish border to the north shore of the Wash, east of the Pennine watershedding between Irish Sea and North Sea streams. It is based on a field investigation and review of the literature, mainly between 1966 and 1973. Only some of the more important reports are considered. The work followed and partly overlapped investigations in the north-west (Simms, 1969). Furthermore, some localities were repeatedly mentioned in reports, and these have had most attention. Lizards cannot always be located even in restricted habitats, except by repeated visits and close search in appropriate conditions. The author is conscious that some localities, notably Spurn, Gibraltar Point, Donna Nook and Teesmouth have not had the attention they need: but these are all places regularly visited by active naturalists and before very long can be expected to yield any secrets they yet hold.

Since the publication by Simms (1969) there have been " unhappy developments " in the name of " conservation ". Reptiles have been removed from some good localities for ill-considered breeding or re-stocking experiments which generally seem to have failed. It is hoped that any Sand Lizards remaining in the north-east, whatever their origin, will not be interfered with unnecessarily. As in the previous paper this account is imprecise as to locality, and the notes on which it is based will not be " available ". This is a critical review of reports; both published as " records ", and unpublished, which have come to my notice.

This account was compiled before the recent revision of County and other boundaries: here the " old " boundaries still apply in every case.

North-East England

Northumberland

Taylor's (1963) record for the coast of Beadnell, Seahouses, in 1963, in my opinion, derives from a reliable source and there are good sight records of *Lacerta agilis* from this part of the Northumberland coast in a few subsequent years. My own research there (since 1966) has been unsuccessful, except to reveal large numbers of *L. vivipara* rather vulnerable to increasing public pressure. Correspondence with D. Bowes (pers. comm.) and further visits by both of us have led to the conclusion that this population, if it survives, is of introduced origin and derives from individuals released at Bamburgh in 1962. There is no evidence known to me of breeding at this locality; nor of any specimens in vivaria or preserved collections. The Northumberland coast is still relatively little-worked by naturalists and does not have a markedly cooler or more cloudy summer than further south in north-east England. We are still far from knowing the critical climatological or population factors for survival of the species, which has a wide Continental range.

Durham County

Calvert (1884) clearly does not distinguish between *Lacerta vivipara* and *L agilis* when, under the latter name, he states (p. 137) that it is " common on the sand banks of the coast and near the moor edges in the west, but it appears to be rare in the intervening districts ". The same may be said of other Durham reports within my notice. In the east the dene country has several current stations for *L. vivipara,* and greenish individuals occur. " Green " viviparous lizards, at a casual glance, are particularly likely to be

mistaken for Sand Lizards, as are the heavily maculate (and especially the ocellate) straw-yellow specimens, which help make up the variable populations of this species (Simms 1971d p. 103). On the Magnesian Limestone and further west in the Pennine valleys of Tees, Wear and Derwent there are several stations for the commoner species. Recent reports of " Sand Lizard " from naturalists near Crook and Seaton Carew (various pers. comm.) have been satisfactorily referred to *Lacerta vivipara.* There are no extensive spreads of typical north-British *agilis* habitats (Simms, in prep.) anywhere in the county, but there have been escapes of captive Sand Lizards and of other European species, in urban Tees-side and elsewhere, which could have led to reports or might yet do so.

Northumberland and Durham are still little known for their reptiles and *Lacerta agilis* is not the only species to have uncertain status there. The coastal sandy habitat has been relatively little disturbed in some parts of the region compared with, say, south-west Lancashire.

Yorkshire, North Riding

There appear to be no reports of Sand Lizards for vice-counties 62 or 65, (Watsonian system), before the two English *Lacerta* were generally recognised as distinct species during the last third of the nineteenth century. Typical of many uncritical applications of the name *Lacerta agilis* is that of Wolstenholme (1883) describing Strensall Common: " The small lizards *Lacerta agilis* very common ". No doubt the trivial name contributed to the confusion: *vivipara* is certainly more *agile* than *agilis*! There have been several reports of *Lacerta agilis* from the South Gare at Teesmouth during the past 20 years. Few only need be taken seriously but the possibility of their presence remains. Repeated visits have shown this worker only *Lacerta vivipara.* " Sand Lizard " is a vernacular name still applied to the " dry eft " (*L. vivipara*) of the coastal sand and boulder-clay of Redcar and Marske, and the name is also known in the morainic central Vale of York and in the Vale of Pickering. At one farm near Malton I was shown Common (Smooth) Newts *Triturus vulgaris* as " Sand Lizards " by a farmer quite familiar with most vertebrates.

Yorkshire, East Riding and West Riding (part)

Here the best case for *Lacerta agilis,* as a member of the north-eastern fauna, can be made. Taylor (1963) mentions the 1959 sight record at Spurn Point by Waterston. This was the starting-point of my investigation. Waterston would not be mistaken but it is surprising that a small peninsula, so often regularly visited by naturalists over a long period, has yielded so very few good records. Of the several reports, very few were from experienced observers until the capture of a female *L. agilis* in October, 1970 (Simms, 1971a, b and c). The 1946 record for Spurn (Y.N.U. Annual Report, and Taylor) cannot be substantiated but the situation is confused perhaps by the possibility of repeated introduction.

In 1949 17 lizards (9 gravid females) from Dorset were released on sandy land around the Dunscroft district near Doncaster (Bunting 1950). There is no sign of them today, but no guarantee that others have not been released in other localities. The gross morphology and pigmentation of the 1970 Spurn specimen accords more with forms typical of Dorset or the western fringes of the continent than with the rather distinctive Lancashire populations (Simms, in prep.). In June 1969 at Sherburn (Vale of Pickering) J. Radley and I heard accounts of large, brightly-coloured lizards seen there and at Willerby nearby, by an elderly labourer from time to time over the past 20 years, who was " certain " they matched illustrations of *L. agilis* (Simms (1971d) and Smith (1951). We were, however, unable to examine specimens.

Clarke and Roebuck (1881) dismiss reports of the Sand Lizard for Yorkshire, whilst allowing those from Durham and Northumberland to stand. In their *Supplement* (*Naturalist* 1884) they maintained their opinion for Yorkshire and reduced the Northumbrian occurrence to the status of " myth "!

Derbyshire, North and Nottinghamshire, North

No reports worthy of serious attention are known.

Lincolnshire, Lindsey

Taylor's (1963) records refer to "dunes near Sutton-on-Sea, Huttoft Island". I have found Common Lizards at the former site, none at the latter. These are known locally as "Sand Lizards". (Mackenzie Thorpe and others, pers. comm.). The dunes inland of Donna Nook have figured in verbal reports but these are unsubstantiated. The Common Lizard occurs. Investigations were extended in 1972 to the Hemsby Sand dunes and elsewhere in Norfolk (on the advice of R. H. Clark); *L. vivipara* but no *L. agilis* were found.

SUMMARY

Records of the Sand Lizard (*Lacerta agilis*) in north-eastern England now substantiated are known only from Northumberland and Yorkshire coasts; in both cases almost certainly the result of attempted introduction. No preserved specimens from the region are known in any public or private collection: the 1970 Spurn individual was released where captured after being taken to York for photography and examination. Smith (1951, map p. 192) does not acknowledge the occurrence of the species anywhere in the region treated here "at the present time". If "naturalists" persist in the ill-documented transfer of herpetofauna from place to place we can perhaps look to further revision and an even less natural distribution.

ACKNOWLEDGEMENTS

I should like to thank various colleagues at the British Museum (Natural History) and the British Herpetological Society. Natural History staff at the Doncaster and Hancock Museums have been helpful.

Many naturalists sent me casual or serious reports and drew my attention to records I missed. Several members of the British Herpetological Society responded to requests for information. I am particularly glad to have seen details upon which R. H. R. Taylor's (1963) distribution summary was made. For this I am indebted to Mrs. J. M. Weingott and Dr. J. F. D. Frazer. Unpublished sources to which I referred included Charles Procter, Reginald Wagstaffe (the Yorkshire Museum 1940–1949), Tony Tynan, Keith Corbett, A. Roger Waterston, Colin Howes, William Bunting, Ronald Clark, Nick Arnold and Andrew Allen. Weekend members of my Selby evening classes (University of Hull) have also helped. Some of the fieldwork has been conducted from the Yorkshire Museum, York, whose Director and Committee have consistently encouraged such work.

APPENDIX. NOMENCLATURE.

Linnaeus (*Systema Natura* Ed. 10, 1758) did not have the Sand Lizard solely in mind when he first used the binomial *Lacerta agilis*. Notoriously, his genus Lacerta included, at various times, both newts and crocodiles as well as lizards! In view of this the correct full scientific name for the Sand Lizard might read *Lacerta agilis* L. (partim).

Synonyms of *Lacerta agilis* which are fairly frequently used in the other literature include:

Lacerta (di) Linneo	C. L. Bonaparte
Seps argus	Laurenti 1768
Lacerta stirpium	Daudin 1882 = *arenicola* Daudin
Lacerta anguiformis	Sheppard 1804

REFERENCES

BERWICKSHIRE "NATURALISTS" CLUB. *Hist. records* 1919-31.
BOULENGER, G. A. (1917). On the variation of the Common Lizard. *Lacerta vivipara. J. Zool. Res.* **2**.
BUNTING, W. (1950). Animal and Plant Introduction in the Thorne District. *Br. J. Herpet.* **1**, No. 3.
CALVERT, R. (1884). *Geology and Natural History of the County of Durham.* Bishop Auckland.
CLARK, W. E. & ROEBUCK, W. D. (1881). *Handbook of the Vertebrate Fauna of Yorkshire.* P. xii. Brown, Hull.
COWARD, T. A. (1901). The Sand Lizard in the North of England, *Zoologist*, 4th Ser., **5**, 355-57.
EVANS, A. H. (1911). *A vertebrate fauna of the Tweed area including Farne.* **XI**, 121.
FAWCETT, T. W. (1900). Reptiles and Amphibians of the County of Durham. *Naturalist*, p. 36.
GILL, L. E. (1905). On the Reptiles and Batrachians. *Vic. Co. Hist. Durham.*
GRABHAM, O. (1907). On the Reptiles and Batrachians. *Vic. Co. Hist. Yorkshire.*
GRIFFITHS, T. S. (1960). In *South Yorkshire Times.* 13.6.60.
HANCOCK MUSEUM, Newcastle-upon-Tyne. Records. (Personal examination 1971).
LEIGHTON, G. (1903). *British Lizards.* Morton, Edinburgh.
HOWES, C. A. (1973). Reptiles and Amphibians in South East Yorkshire. *Naturalist*, **(927)**, 121-32.
MERTENS, R. & WERMUTH, H. (1960). *Die Amphibien und Reptilien Europas* Frankfurt.
MILLER, S. H. & SKERTCHLY, S. B. J. (1878). *Fenland Past and Present.*
RIMINGTON, E. (1956). In: *Natural History of the Scarborough District.* Vol. 2.
SIMMS, C. (1969). The Sand Lizard in Northwest Britain. *Naturalist* **(911)**, 119-22.
SIMMS, C. (1971a). Annual Report 1970 (Reptiles). Yorkshire Naturalists Union (Nat. **916**).
SIMMS, C. (1971b). In: *Yorkshire Gazette and Herald*, April 30, 1971. p. 9.
SIMMS, C. (1971c). In: *Yorkshire Philosophical Society Annual Report*, York.
SIMMS, C. (1971d). *Lives of British Lizards.* Goose, Cambridge.
SIMMS, C. (in prep.). Geomorphological factors in reptile distribution.
SIMMS, C. (in prep.). An analysis of the morphology of populations of *Lacerta agilis* L. in Northern England.
SMITH, M. A. (1951). *The British Amphibians and Reptiles.* Collins, London.
SOUTHWELL, T. (1871). The Mammals and Reptilia of Norfolk. *Zoologist*, 2751-60.
SOUTHWELL, T. (1901). On the Reptiles and Batrachians. *Vic. Co. Hist. Norfolk.*
TAYLOR, R. H. R. (1963). And an earlier paper on the same lines (1948): The distribution of reptiles and amphibians in England and Wales. *Br. J. Herpet.* **3**, No. 5.
WOLSTENHOLME, C. D. (1883). Addenda to Y.N.U. notice, Meeting at Strensall Common. M.S. in author's possession.
YORKSHIRE NATURALISTS' UNION. Annual Reports.

NOTES ON NECROTIC STOMATITIS IN SNAKES

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(*Received* 3/1/75)

INTRODUCTION

Necrotic stomatitis is one of the most dangerous diseases affecting snakes, being difficult to cure and almost invariably terminating fatally if left untreated. Little information appears to be available, at least regarding the disease in Southern African snakes, and much of what little I have seen seems to be somewhat contradictory—the pathogenic organisms have been variously identified as *Salmonella, Pseudomonas, Aeromonas* and *Pasteurella* spp. (Vogel, 1964; Wallach, 1969; Manning, 1972; Cooper, 1973).

METHODS AND MATERIALS

The following notes are based on studies of the disease as it occurs in the snakes of Southern Africa, the most commonly affected species being:

Python sebae; Boaedon f. fuliginosus; Pseudaspis cana; Crotaphopeltis h. hotamboeia; Psammophis s. sibilans; Naja haje annulifera and *N. nivea; Dendroaspis p. polylepis; Causus rhombeatus* and *Bitis a. arietans.*

The majority of cases studied were donated by many amateur herpetologists in Rhodesia and South Africa over a period of about eight years. A long series of therapeutic trials was carried out in the Salisbury Snake Park in 1966 and 1967, and shorter trials were made privately since then. The Port Elizabeth Museum and Snake Park kindly provided many cases for *post-mortem* examination in 1974.

Oral swabs from diseased snakes were plated out using standard methods, and a small number of healthy snakes were deliberately infected with bacterial cultures in attempts to assess their pathogenic potentials on snakes under physiological and physical stress.

Approximately 2,000 snakes were clinically examined and treated, and about 1,000 *post-mortem* examinations were performed, including those on snakes specially killed in all stages of the disease.

POSSIBLE CAUSES OF NECROTIC STOMATITIS

Necrotic stomatitis occurs only infrequently in snakes that are living under natural conditions; I have never seen the disease in wild snakes, although Cooper (1973) recorded instances of this. The disease manifests itself in captive snakes when the environment is altered and the snake is unhealthy. Such factors include unhygienic conditions which encourage its appearance and rapid spread in cages and pits, dietary deficiencies, physical, psychological and physiological disturbances, generally in combination.

The exact nature of the dietary deficiencies are imperfectly known, but Vitamin B complex injections are of considerable value in treatment of the disease and if these vitamins are fed regularly to captive snakes, they tend to reduce the frequency of infection in those that are often milked. In advanced cases lack of proteins and mineral salts make the snake particularly susceptible to secondary complications.

Physical disturbances include any injury, especially to the lips, gums and teeth. These may normally be of little consequence but if the snake is unhealthy, infections tend to occur more readily. A large series of Puff Adders (*Bitis a. arietans*) from the Port Elizabeth Snake Park in South Africa provided excellent *post-mortem* material of necrotic stomatitis resulting from traumata caused by excessive milking; other species from the same Park that were not milked rarely showed evidence of necrotic stomatitis on examination after death.

Physiological and psychological disturbances appear to be closely related. In many cases excessive tension or excitability tended to cause hypersecretion of liquids in the mouth and stomach with consequent increase in numbers of potentially harmful bacteria. This occurred most frequently in the Horned Viper (*Bitis caudalis*), a most irascible little snake that rarely lives long in captivity. Dissection of specimens from the Bulawayo area of Rhodesia invariably showed evidence of hypersecretion of juices in the stomach after a few weeks in captivity, and increased bacterial counts in oral swabs, *Pseudomonas* and *Pasteurella* being particularly prominent. A larger series of *B. caudalis* from the Northern Transvaal, donated by the Port Elizabeth Museum, confirmed this picture in almost every detail, but bacterial cultures were not made from this material. This pattern occurred most frequently in the Puff Adder (*Bitis a. arietans*) the Black Mamba (*Dendroaspis p. polylepis*) and the Cobras (*Naja* spp.)—the most easily irritated species involved in the study, and three of the most susceptible species in our region apart from the rather rarer Horned Viper.

Although different workers have isolated other bacteria as the cause of necrotic stomatitis in snakes, I found that *P. haemolytica* was probably the most frequent in cultures from oral lesions, and the only form which would readily cause the disease when introduced into a small scratch made in gum tissue of healthy snakes. It is quite possible that bacteria occurring normally in the mouth may become pathogenic under suitable conditions, as outlined above.

PATHOLOGY OF NECROTIC STOMATITIS

Assuming that for some or all of the above reasons, a snake has a disturbed gastric condition and an excessive secretion of saliva, it will often collect in the mouth, especially in the folds along the gums and anterior trachea to stagnate with consequent increase in the amount of cellular debris. There is a corresponding increase in the oral bacterial populations, especially in an empty tooth socket. It is then a simple matter for bacteria to invade the tissues and cause a local infection of the gum, or even penetrate bone marrow of the jaws and cause osteomyelitis as a secondary complication.

In the earliest stages of the disease there is a slight inflammation at the focus of infection. The infected area ulcerates and characteristic caseous masses begin to form.

The lymphatic and blood vessels become considerably inflamed and as the infection spreads they collapse and degenerate, contributing to the increasingly rapid spread of necrosis. The salivary glands also tend to be severely damaged relatively early. The line of demarcation between necrotic and healthy tissue is often quite sharp in the gums and around the trachea, but retropharyngeally the infected tissues become much more diffuse. In time the whole throat and neck may degenerate into a soft, flabby oedematous mass.

Caseous matter collects in the nasal passages. At first it is soft and usually mixed with mucus, but it tends to become hard and compacted.

The respiratory system is particularly susceptible to secondary complications. In many advanced cases aspiration tracheitis was well established and there were frequently haemorrhagic lesions in the lung tissue.

TREATMENT OF NECROTIC STOMATITIS

Treatment has often proved to be difficult and unsatisfactory. Part of the problem involves the correct treatment of the more important secondary complications.

Osteomyelitis and pneumonitis are relatively simple to treat if suitable drugs are available, but lack of food proved a major problem, especially with the larger species.

Because of the poor physical condition of more advanced cases, conventional force-feeding was out of the question. When necessary snakes were lightly sedated by intraperitoneal injection of small doses of Sagatal (pentobarbitone sodium) diluted to 20mg/ml with apyrogenic water. A broad canula was passed down the oesophagus and very finely divided meat mixed with calcium and vitamin tablets, was squeezed into the stomach. With care this procedure minimises trauma and the chances of carrying diseased tissue into the stomach.

Complete removal of necrotic and diseased tissue is essential for successful treatment of the disease. In earlier stages of minor infections irrigation of the area with saline solution or with sulphadimidine sodium solution is often sufficient, but in more advanced stages curetting was essential. A 1mm MacHardy curette is most suitable for small snakes, and a small Sims double curette may be used for pythons and larger cobras.

The use of sulphonamides was abandoned rather early in the therapeutic trials, because of potentially harmful intestinal and neurological side effects. However, sulphanilamide was moderately effective in treating small snakes if applied topically in the early stages of the disease. Sulphadimidine sodium solution (33.3% W/V) was used in treating larger snakes, especially pythons, with reasonable satisfactory results. An initial dose of 2ml per 4,5kg (and *pro rata*), followed by a maintenance dose of 1ml per 4,5kg (and *pro rata*) injected intramuscularly every day, proved to be the most suitable.

A combination of penicillin and streptomycin generally gave the best results, not only in curing stomatitis, but in clearing up secondary infections also. In most of the trials "Strypen" Injection (May & Baker Ltd) was injected both intramuscularly and subcutaneously in two or more sites. For reasons of convenience dosages were regulated according to length rather than weight, approximately 0,5ml per 50cm body length. Heavier snakes, such as puff adders and pythons, were given slightly larger doses. Small snakes treated every second day and large ones every day, received a maximum of six doses of "Strypen". In the majority of cases recovery was rapid and uneventful.

In 1974 a number of cases were treated with "Oxycline" (Panvet (Pty.) Ltd.) and "Norivite 12" (Noristan Products), with remarkable success.

"Oxycline" is a 125mg/ml oxytetracycline solution, injectable subcutaneously, intramuscularly or intravenously, at a dose level of 1ml per 50kg. body weight. It is effective against a wide range of bacteria, and the free choice of routes and negligible trauma caused by the tiny doses required for snakes makes it one of the most suitable drugs I have used.

"Norivite" is an injectable solution of Vitamin B 12 containing 1,000mcg cyanocobalamin per ml. A dosage level of about 0,05ml per metre body length is the optimum dose for general treatment.

Both drugs are best administered with a tuberculin syringe and the finest possible needle, the appropriate dosage given intramuscularly or subcutaneously once daily for three to seven days.

PRODUCTS MENTIONED IN THE TEXT

Sagatal: pentobarbitone sodium, May & Baker (S.A.) (Pty.) Ltd.

Sulphanilamide and *sulphadimidine sodium solution*: May Baker (S.A.) (Pty.) Ltd.

"Strypen" Injection: May & Baker (S.A.) (Pty.) Ltd.

"Oxycline": Oxytetracycline solution, Panvet (Pty.) Ltd.

"Norivite 12": Vitamin B 12 Noristan Products.

REFERENCES

COOPER, J. E. (1973). Treatment of necrotic stomatitis at the Nairobi Snake Park. International Zoo Yearbook **13**, 268-69.
WALLACH, J. D. (1969). Medical care of reptiles. *J. Am. vet. med. Ass.* **155**, 1017-34.
VOGEL, Z. (1963). *Reptiles and Amphibians; their care and behaviour*. London: Studio Vista.
MANNING, G. (1972). *Pers. comm.*

THE MICRO-ANATOMY OF THE SKIN OF *OPHISAURUS APODUS* PALLAS (ANGUIDAE, SAURIA)

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(*Received* 28/11/74)

Ophisaurus and the better known slow worm (*Anguis fragilis*) are representatives of the family of Anguidae. Also known as the glass snake it is mainly found in Southern Russia and the Balkans. Due to severe sclerification of the skin the whole animal has acquired a high degree of rigidity. Hence the popular German name of "Panzerechse" (armed lizard). In its country of main distribution it is known as the "Scheltopusik", a name, derived according to Brehm (1914), from the Russian "Shjoltopusik" = yellow-belly.

In conformity with the other Anguidae the limbs are rudimentary. Their remnants can only be demonstrated by dissection. Adult specimens reach a length of 1m.

A study of the skin of this lizard reveals some interesting facts. The entire animal is scaled and each scale is reinforced by bony osteoderms, which partly overlap each other and constitute a most efficient exoskeleton. In fact, the splinting effect of these scale bones is so great as to inhibit the glass snake from curling up into a tight ball after the manner of snakes.

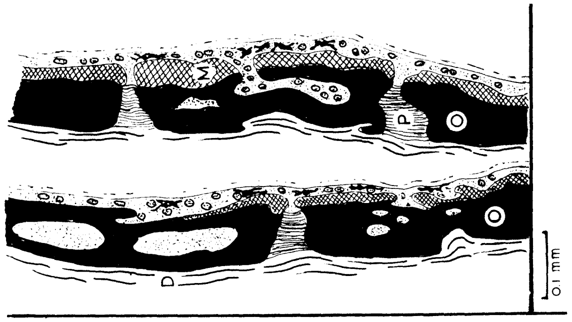

Fig. 1. Transverse sections through the skin of *Sphenomorphus richardsoni*, an Australian skink, showing osteoderms and pseudo-joints between the osteodermal segments—D,dermis; M,external (alcianophil) layer of osteoderms; O,Osteoderm; P, Pseudo-joint.

The distribution of these osteoderms, which occur in many reptiles, has been catalogued by Bellairs (1969). They are particularly developed in the skinks, where each bony plate is subdivided into a number of segments, joined to one another by fibrous sutures (Fig. 1). Tilak and Rastooi (1964) referred to these sutures as "canals". Serial sections through the skin of skinks show, however, that the sutures consist entirely of collagenous fibres which enter the adjacent bone on either side after the manner of Sharpey's (1843) fibres. Insofar as these sutures allow the various parts of the osteoderms to bend against each other and thereby add a moderate degree of flexibility to the skin, they may be referred to as "pseudo-joints" seeing that no joint space and no joint capsule exist. Their designation as "canals" however must be rejected. In *Tarentola*, where the osteoderms are small, more widely spaced and connected by broader sutures of collagenous fibres, the bony segmentation is absent.

In *Ophisaurus* each osteoderm is a rigid whole, not subdivided into segments. If a piece of skin is treated according to the first stages of Spalte-

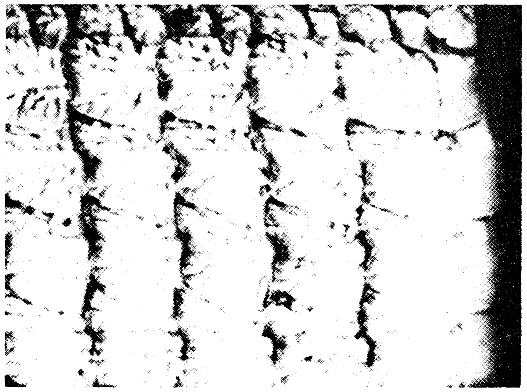

Fig. 2. Surface of the skin of *Ophisaurus apodus* after removal of the epidermis, showing the keeled, corrugated osteoderms *in situ.*

holz's (1840) method (bleaching and gentle maceration in potassium hydroxide and drying) we obtain the picture shown in Fig. 2. The surface of the osteoderm is divided into a smooth, smaller part covered by the next scale and a larger exposed part which is deeply corrugated.

If the preparation is stained with Alizarine and cleared, it can be seen that the whole body of the osteoderm is traversed by a system of canals. Both Alizarine and treatment after Tripp and McKay (1972) show that calcification of the bone is particularly heavy along the walls of these canals.

Two different systems of canals can be distinguished: the system in the smooth, covered part is self-contained and has only one narrow exit which

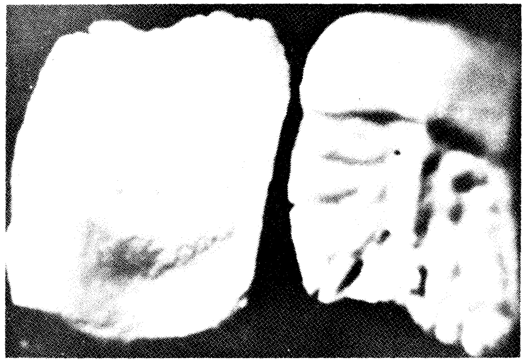

Fig. 3. External and internal surface of osteoderms of *Ophisaurus apodus.* The external view (right) shows the corrugated exposed part below and the smooth, non-exposed part above. *In situ* the smooth part is covered by the adjoining scale. The internal aspect (left) shows the two entry pores to the Haversian canal system x = 20.

connects it with the second system in the corrugated part of the osteoderm. In this part we find a radiating system of channels, all connected with one or two ports of entry situated at the centre of the internal surface of the bone (Figs. 3, 4).

Serial sections show the true nature and the micro-anatomy of these canals. Each canal is lined by endosteal cells and contains at least one, sometimes several capillary blood vessels which run along the centre of the canal and are anchored to the walls by fine threads. In short, we are here dealing with typical Haversian canals which traverse the laminated bone and maintain its oxygenation.

Their function however goes further than that. Along the edge of the osteoderm the radiating channels come to the surface and the Haversian capillaries emerging from these orifices spread in the subepidermal part of the dermis. Since the sutures which connect the osteoderms contain no blood vessels, the region of the dermis which overlies the osteoderms and the epi-

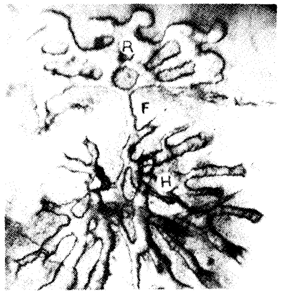

Fig. 4. Dorsal osteoderm of *Ophisaurus apodus* cleared and stained with alizarine to show the Haversian canal system which consists of the main radiating channels (H), the " reservoir " (R) and the communicating canal (F).

dermis would, without this Haversian system, have no blood supply at all. No branches of these vessels were seen to enter the epidermis which may rely on gas exchange with the air (Fig. 5).

The first canal system, which is entirely enclosed in the smooth, covered part of the osteoderm, has no radiating branches and does not communicate

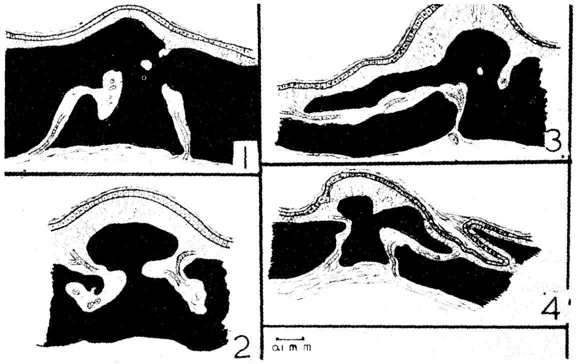

Fig. 5. Transverse sections through four osteoderms of *Ophisaurus apodus* showing the ports of entry and the exits of capillary blood vessels, also, their course through the Haversian canals.

1 Entry of capillaries from the subcutis into the Haversian system.
2 Exit of capillaries from the Haversian system to the external layer of the dermis and the epidermis.
3 and 4 Complete course of Haversian canals through the osteoderm. Each canal contains one or several capillaries.

FIGURE 6.
Ophisaurus apodus. Transverse section through the "reservoir" of an osteoderm, showing the haematopoetic bone marrow and two capillaries filled with erythrocytes.

with the surface. The capillaries in this system are wider than those in the other system and are always filled to capacity with erythrocytes. The remaining space (Fig. 6) within the bone is filled with bone marrow, and it appears that this part of the canal system is more engaged in haematopoesis than in oxygenation. This would also explain the fact that this "blind" part of the system has only one communication with the main Haversian system and no outlet to the surface.

One further peculiarity of the anguid skin might be mentioned here. Elkan (1968) showed that in amphibian skin mucopolysaccharides play an important part in the protection of the animal against desiccation. The deposits of sulphated mucopolysaccharides, where they exist, are found in the dermis and can be demonstrated in many anurans and reptiles. It is worth noticing, however, that where osteoderms are embedded in the dermis, mucopolysaccharides appear exclusively in the external, superficial layer of the bone. In the case of the anguid osteoderms only the exposed, uncovered part of the bone is impregnated with mucopolysaccharides, a fact which can easily be demonstrated by staining sections after Steedman (1950) with Alcian Blue. This selective appearance of a hygroscopic substance, in the uncovered part of the osteoderm suggests that here, as in so many amphibians, these substances, which are highly hygroscopic, contribute to the defence of the lizard against desiccation.

SUMMARY

The osteoderms of *Ophisaurus apodus*, while protecting the lizard against injury, also protect it against desiccation.

They have a complicated system of Haversian canals which traverse the laminated bone. One part of this system serves as a locus for haematopoesis, the other for the distribution of capillary blood vessels which oxygenate the dermis. Mucopolysaccharides, deposited in the external layer of the osteoderms, reinforce the protection against desiccation.

ACKNOWLEDGEMENTS

I wish to thank Dr. M. Bennett and the Management Committee of Mt. Vernon Hospital, Northwood for permission to carry out this investigation in their laboratory, also Mr. R. A. Baltrock of Porthgwyn, N. Wales who kindly supplied the material on which the paper is based.

REFERENCES

BELLAIRS, A. (1969). *The Life of Reptiles.* Weidenfield & Nicolson, London.
BREHM'S (1914). Tierleben, Lurche und Kriechtiere. II, 113-15 4th edn. Bibliogr. Inst. Leipzig.
ELKAN, E. (1968). Mucopolysaccharides in the Anuran Defence against desiccation. *J. Zool.* 155, 19-53.
SHARPEY, W. (1843). Bone or osseous tissue. In: Quain's Anatomy II. p. 148-53.
SPALTEHOLZ, W. (1950). *Über das Durchsichtigmachen von menschlichen und tierischen Präparaten.* 2nd edn. Leipzig.
STEEDMAN, H. F. (1950). Alcian Blue 8G, a new stain for mucin. *Q. J. micr. Sci.* **91**, 477-79.
TILAK, R. & RASTOOI, S. C. (1964). Dermal scutes in Sauria (Reptilia). *Proc. Zool. Soc. Calcutta* 17, 163-91.
TRIPP, E. J. & MacKAY, E. H. (1972). Silver staining of bone prior to decalcification for quantitative determination of osteoid in sections. *Stain tech.* **47**, No. 3, 129-36.

A CONTRIBUTION TO THE HERPETOLOGY OF JAMMU AND KASHMIR

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(*Received* 20/1/75)

INTRODUCTION

Information concerning the herpetology of Jammu and Kashmir is scanty. The only publications dealing with the herpetofauna are those by Gunther (1864), Theobald (1872), Murray (1884), Boulenger (1890) and Smith (1943). The recent study in west Pakistan by Minton (1966) is concerned only with some regions of Jammu and Kashmir.

The herpetofauna of this state is derived from three major faunal regions, viz. Palearctic, Ethopian and Oriental. Several species are endemic in this area.

Probably the great majority of amphibians and snakes found in the state of Jammu and Kashmir are represented in the collection. It is felt, therefore, that this work will serve as a guide for further herpetological investigations.

Several species are recorded in this area for the first time. But a definitive herpetology of the state should await further exploration based upon larger series of collections from all over the state.

GEOGRAPHY OF POONCH VALLEY

The district of Poonch situated about 70 miles S.W. of Srinagar is a natural valley surrounded by lofty mountains, the high peaks of which remain snowbound for at least seven months in a year. The altitudinal ranges of the valley of Poonch vary from 3,000ft (900mts) to 6,000ft (1,800mts) the town of Poonch being situated at an elevation of 960mts. There are no marked differences in climate from the valley of Kashmir, which has a salubrious temperate climate throughout the year.

The collections were taken mainly from bushes, forested areas, ruined buildings, marshy edges of hilly streams in Poonch town and its vicinity, within a radius of 40–50kms.

AMPHIBIA

Family: RANIDAE

Rana cyanophlyctis (Schneider)

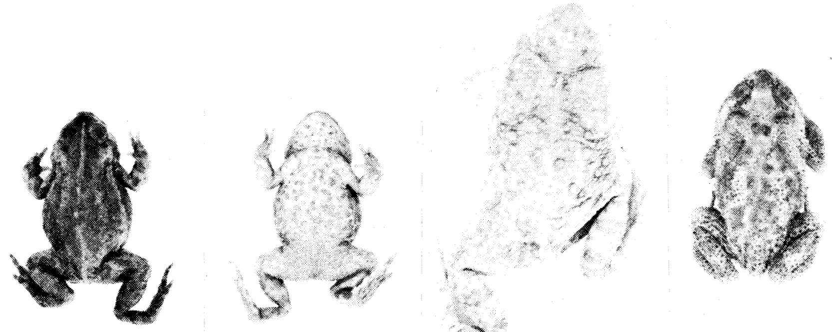
Three specimens (65–75mm) from the edges of hilly streams and amid bushes.

The commonest water frog in India (up to 6,000ft in Himalayas), Thailand, Nepal, Sri Lanka, Iran, Southern Arabia, Pakistan and Afghanistan.

Rana tigrina (Daudin)

Two adults (75–77mm long) near bushes in a tank. The mid-dorsal streak is very thin in contrast to the thick stripe commonly found in forms elsewhere in India.

Recorded from the Nepal Valley, most of the Indian subcontinent, Sri Lanka, W. Pakistan, Taiwan and Southern China.



1 2 3 4

FIGURE 1: Dorsal view of *Bufo viridis*.
FIGURE 2: Ventral view of *Bufo viridis*.
FIGURE 3: Dorsal view of *Bufo andersoni*.
FIGURE 4: Dorsal view of *Bufo melanostictus*.

Family: BUFONIDAE (Figs. 1-4)

Bufo andersoni (Boulenger)

Four specimens (43-65mm) from grassy ditches in Rajouri.

Distinguished from allied species, *B. olivaceus* by their warty dorsum and reniform parotid glands.

Three specimens from Poonch nearly black, the adult specimen from Rajouri greyish. The dorsum of all specimens is warty.

Recorded from U.P., Bihar, Rajasthan and Andhra in India, Pakistan, Nepal and Arabia.

Bufo melanostictus Scheneider

One adult (53mm) from a road-side bush in Poonch.

Bufo vidris (Laurenti)

Seven specimens from several damp localities in Rajouri, Poonch and Bhaderwah. The dark blotches on the dorsum are more pronounced in three specimens (41–54mm); probably females.

This palearctic toad is endemic to Kashmir.

Recorded extensively from Germany eastward to Mongolia and central Siberia and south to Tibet, Iran, Israel, Egypt and Morocco.

Family: RHACOPHORIDAE

Rhacophorus maculatus (Gray)

One specimen (53mm) from a small bush in a garden of Poonch.

Recorded from India and Sri Lanka.

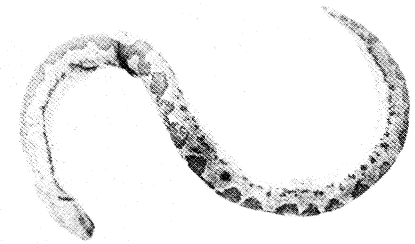
REPTILIA: SERPENTES

Family: TYPHLOPIDAE

Typhlops porrectus (Stoliczka)

Two specimens (65–84mm) from stones near footpaths in Poonch. Dorsal colour, almost black.

Recorded from India, upper Burma and Pakistan.



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Family: BOIDAE

Eryx conicus (Schneider)

One juvenile specimen (255mm) from sandy soil in a ruined building of Poonch (Fig. 5).

Recorded from Bihar and Orissa Westward through India, Sri Lanka and west Pakistan (Sind).

Eryx johni (Russel)

An adult specimen (760mm) from loose soil underneath huge boulders in a dilapidated building in Poonch. Specimen buff coloured with sooty bands on its body.

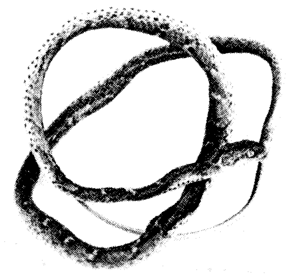
Reported from Rajasthan, U.P., eastern Punjab (India), Afghanistan, Iran and W. Pakistan.

Family: COLUBRIDAE

Amphiesma stolata (Linn)

Eight specimens (195–530mm) from watery sources around edges of muddy pools in and around Poonch.

Recorded from the whole of India, Sri Lanka, Sind and N.W.F.P. in Pakistan, southern China, Hainan and Indo-China.



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Boiga trigonata (Schneider)

Three examples (315–550mm) from scrubby jungle near Poonch (Fig. 6).

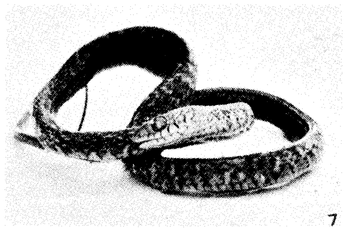
Recorded from the whole of the Indian peninsula, Sri Lanka (Uva province), Baluchistan and N.W.F.P. (Pakistan) and Transcaspia.

Boiga multifasciata (Blyth)

Two examples (310–880mm) from scrubby jungle around a dilapidated building in Rajouri town.

Dorsum greyish brown above speckled with black oblique bars meeting one another on the vertebral line forming A-shaped marks. A distinct white spot is present in the apex of all these bars. The head has a large longitudinal stripe on the nape followed by two more on the sides of the mouth.

Recorded from both the eastern and western Himalayas.



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Coluber rhodorachis (Jan)

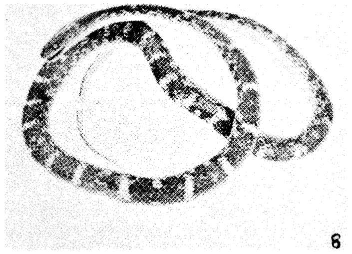
Three specimens (430–490mm) from residential places and rocky situations around Poonch. The dorsum of all specimens is brownish covered by spots arranged in a chessboard pattern (Fig. 7).

Recorded from Egypt, Arabia, Somaliland, Transcaspia and Sind (Pakistan).

Fowlea piscator (Schneider)

Three examples (520–680mm) from marshy areas and aquatic bushes in and around Poonch. Two adults from muddy banks found hibernating during December-January 1971. Both the checkered and small blotched varieties were represented.

Recorded from Borneo and Taiwan westward across the mainland and islands of south Asia to the Indus drainage.



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Lycodon travancoricus (Beddome)

One juvenile specimen (175mm) from cultivated land near a canal in Poonch (Fig. 8).

Dark purplish colour and faint yellow cross bars establish its identity.

Smith (1943) gives its range as Western Ghats as far north as Matheran (Bombay) and reports that Wall records it from South Arcot (Tamil Nadu), Vizag (Andhra) and Jabalpur (M.P.). Minton (1966) refers to a single specimen from West Pakistan.

Records of this species extending its known range up to Kashmir are significant.

Lycodon striatus bicolor (Nikolsky)

A single specimen (210mm) from a scrubby area in a ruined building off Poonch.

Differs from its nominate race, *L. striatus* in having a distinct, narrow light collar at nape.

Recorded from upland Baluchistan and Wazirstan (Pakistan).

Ptyas mucosus (Linn.)

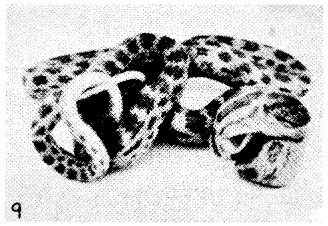
A specimen (1,440mm) from thick jungle around Poonch.

Recorded from all over India, Sri Lanka, Pakistan, Afghanistan, Burma, Malay peninsula, Java and southern China.

Sphalerosophis articeps (Fishcher)

A single specimen (1,270mm) from ruins of a dilapidated tomb. Appears to be the first record for the state.

Recorded so far from Gilgit, W. Punjab and Baluchistan (Pakistan), E. Punjab, U.P., and Kutch (Gujrat) in India.



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Sphalerosophis arenarius (Boulenger)

Two specimens, a juvenile and a large adult (680–1,020mm) from old ruined buildings in Poonch (Fig. 9).

Recorded from Rajasthan, N.W. India, and Karachi (W. Pakistan).

Smith (1943) referred to only three specimens. This is the first record from J. & K.

Trachischium fuscum (Blyth)

A single specimen (282mm) from under stones in a forested area off Poonch.

Reported from Gilgit, Loharganj, Garwhal in the west and Darjeeling and Assam in the east.

Family: ELAPIDAE

Bungarus caeruleus (Schneider)

A specimen (730mm) from a suburban garden in Poonch.

Recorded from West Bengal through India, Sri Lanka and Pakistan.

Naja naja oxiana (Eichwald)

A juvenile specimen (820mm) from an inhabited area in Poonch.

Recognised by the dark transverse bars on the dorsum and its narrow head without the spectacle markings.

Recorded from Transcaspia and Turkmenistan east across most of Afghanistan, N.W.F.P., N.W. Baluchistan in Pakistan and Kashmir and Punjab (India).

Family: VIPERIDAE

Agkistrodon himalayanus (Gunther)

A single specimen (470mm) from a rocky cliff off Poonch.

Restricted to Western Himalayas.

10

Echis carinatus (Schneider)

A large specimen (625mm) from under big boulders in a ruined building. Greyish brown in colour (Fig. 10).

Recorded from northern Africa southward to Ghana and Kenya, through the Middle East from Arabia northward into southern provinces of Russian Asia, and eastward through the drier parts of India to northern Sri Lanka.

Vipera russeli (Shaw)

Two specimens, a juvenile and an adult (233–920mm) from forested areas in and around Poonch (Fig. 11).

Recorded from Indus valley to Kashmir, Bangladesh and southward through most of the Indian peninsula and Sri Lanka.

11

ABSTRACT: The study is based on the material collected from various parts of the Poonch Valley, Jammu and Kashmir over a period of three years during 1971–73. Six species in 3 genera of amphibians and 19 species in 15 genera of snakes were recorded.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, Calcutta-12, Drs. A. G. K. Menon, Deputy Director and K. C. Jayaramakrishnan, Superintending Zoologist S.R. Station, Z.S.I., Madras and the Principal, Govt. Degree College, Poonch for facilities and encouragement.

Thanks are also due to Mrs. Tejkumari Kaul, Post-graduate Dept. of Zoology, Univ. of Kashmir, Shri S. Vijayaraghavan, Photographer and Shri C. Sripathy Rao, Field Collector, S.R. Station, Z.S.I., Madras.

FIGURE 5: Dorso-lateral view of *Eryx conicus*.
FIGURE 6: Dorso-lateral view of *Boiga trigonata*.
FIGURE 7: Dorso-lateral view of *Coluber rhodorachis*.
FIGURE 8: Dorso-lateral view of *Lycodon travancoricus*.
FIGURE 9: Dorso-lateral view of *Sphalerosophis arenarius*.
FIGURE 10: Dorsal view of *Echis carinatus*.
FIGURE 11: Dorsal view of *Vipera russeli*.

REFERENCES

BOULENGER, G. A. (1890). *The Fauna of British India including Ceylon and Burma. Reptilia and Batrachia.* Taylor & Francis, London.

GUNTHER, Albert (1864). *The Reptiles of British India.* London.

MINTON, Sherman A., Jr. (1966). A contribution to the Herpetology of West Pakistan. *Bull. Amer. Mus. Nat. Hist.* **134**, 27-184.

MURRAY, J. A. (1884). *The Vertebrate Zoology of Sind, Bombay.*

SMITH, M. A. (1943). *The Fauna of British India including Ceylon and Burma. Reptilia and Amphibia.* London, **3**, Serpentes.

THEOBALD, W. (1876). *Descriptive catalogue of the Reptiles of British India.* Calcutta.

SUBTUNIC LEYDIG CELLS IN THE TESTES OF *AGAMA TUBERCULATA* (GRAY)

By

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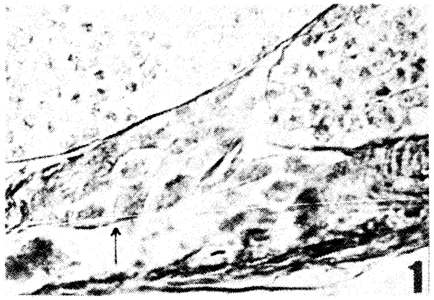
(*Received* 7/10/74)

In their studies on the reproductive cycle of *Cnemidophorus tigris*, Goldberg and Lowe (1966) reported subtunic Leydig cells in the testis. Lowe and Goldberg (1966) also showed these cells in the subtunic of 16 other species of this genus and also in *Ameive undulata*. Both genera belong to the family Teiidae.

In the present work testes from 196 specimens of *Agama tuberculata*, collected over a period of two years, were examined histologically. Material was fixed in Smith's fixative and sectioned at 6–8um. The Leydig cells are small and occur in groups of 4–20, in the recesses between the tunica albuginea and the outer surfaces of the seminiferous tubules (Fig. 1). Elsewhere a thin band of these cells, 2–5 cells thick, is interposed between the outer tunic and the seminiferous tubules.



ONTOGENETIC VARIATIONS

30 Adult males (larger than 70mm snout-vent length, S.V.L.), were examined. In transverse section the thickness of the Leydig cell band (in terms of the number of cells) varies slightly with change in lizard snout-vent length (S.V.L.). Lizards between 70 and 110mm S.V.L. show bands 2–4 cells wide; in lizards of greater size the width of the band averages about five cells. In an adult male 118mm S.V.L., the average width of the band was six cells. This variation continues throughout adulthood and though the slope of the graph is slight (Fig. 2; $b = 2.744$) a positive and a fairly high degree of correlation ($r = +0.812$) is detectable. These data reveal a gradual though small increase in thickness of the Leydig cell band with increase in size of the adult lizard.

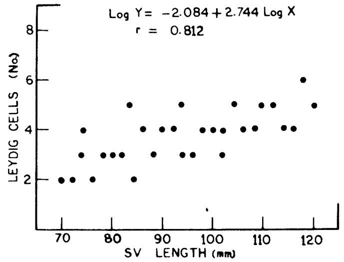
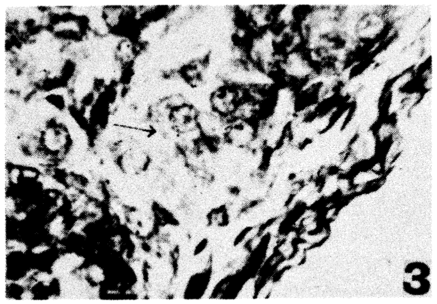


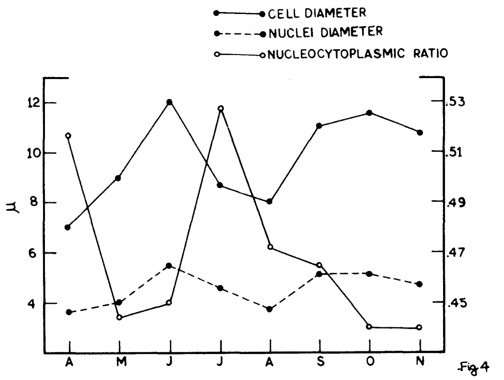
Fig 2.

SEASONAL VARIATION

When lizards just emerge from hibernation in April, Leydig cells are aggregated in 2–5 layers, each cell averaging in diameter about 7um (range 5.6–9um). In May and June these cells are not closely packed together (Fig. 3) and they increase in diameter from 9–12um to reach 12um in June



(Table I). During July and August when the subtunica is 2–5 cells thick, the overall cell size falls to diameters averaging 8.7um. From September to just before hibernation, in December, the overall Leydig cell size increases to about 11.6um in diameter. Thus the cells show two seasonal peaks, one in June, the other in October (Fig. 4).



NUCLEO-CYTOPLASMIC RATIO VARIATION

There is a marked seasonal periodicity in the nucleo-cytoplasmic ratio. It is maximal in July, which is almost the end of the breeding season and a second high peak occurs in April. However, during the latter month, nuclear and cellular diameters are the lowest recorded for the year. There is a relationship between the size of the circum-testicular band of Leydig cells and the seasonal cycle in the lizard testes. The peaks in the nucleo-cytoplasmic ratio appear to lie at each end of the reproductively active period, which in the present form extends from May to July (Fig. 4).

Interstitial Leydig cells are best developed and are of maximum size in June and October. At these times they are highly granular.

CONCLUSIONS

The subtunic cells of *Agama tuberculata* show a striking resemblance to those in reptile species described by Goldberg and Lowe (1966) and Lowe and Goldberg (1966). These reptiles are the only vertebrates to show this feature. The occurrence of a sub-tunic band of Leydig cells in *Agama tuberculata* and

teiid lizards (Goldberg *et al*, 1966) strongly supports the belief of a close phylogenetic relationship between agamid and teiid lizards (Hebard & Charipper, 1955; Gorman, 1970).

REFERENCES

GOLDBERG, S. R. & LOWE, C. H. (1966). The reproductive cycle of the western whiptail lizard (*Cnemidophorus tigris*) in southern Arizona. *J. Morph.* **188**, 543-48.
GORMAN, G. C. (1970). Chromosomes and the systematics of the family Teiidae (Sauria: Reptilia). *Copeia* No. 2, 230-45.
HEBARD, W. B. & CHARIPPER, H. A. (1955). A comparative study of the morphology and histochemistry of the reptilian adrenal gland. *Zoologica* N.Y., **40**, 101-23.
LOWE, C. H. & GOLDBERG, S. R. (1966). Variation in the circumtesticular Leydig cell tunic of Teiid lizards (*Cnemidophorus* and *Ameiva*). *J. Morph.* **119**, 277-82.

TABLE I: Data on Leydig cells: measurement in microns

Month	Cell diameter mean	Cell diameter range	Nuclear diameter mean	Nuclear diameter range	Nucleo-cytoplasmic ratio
April	7.0	(5.6–9.0)	3.62	(2.8–4.8)	0.517
May	9.0	(8.0–11.2)	4.0	(3.0–4.9)	0.444
June	12.0	(8.8–16.0)	5.45	(4.0–6.4)	0.454
July	8.7	(6.6–10.4)	4.6	(4.0–5.6)	0.528
August	8.0	(7.6–10.4)	3.78	(3.2–4.8)	0.472
September	11.1	(8.2–14.0)	5.16	(4.0–6.4)	0.465
October	11.6	(8.0–14.2)	5.11	(4.0–6.4)	0.440
November	10.8	(8.0–14.0)	4.76	(4.0–5.6)	0.440

LEGEND TO THE FIGURES

Fig. 1. Testis of *Agama tuberculata*, showing a subtunic band of Leydig cells (arrow).

Fig. 2. Regression of mean number of Leydig cells (band thickness) on S.V.L. in a random sample of 30 adult males of *A. tuberculata*. The high correlation coefficient ($r = +0.812$) associated with low regression coefficient ($b = +2.744$) reveals a slight variable increase in the thickness of the Leydig cell band with increase in the adult lizard S.V.L.

Fig. 3. Testis of *Agama tuberculata* showing a subtunic band. Note loosely packed cells beneath tunica albuginea (arrow).

Fig. 4. Subtunic cell diameters, nuclei diameters and nucleocytoplasmic ratio; by month, in *Agama tuberculata*.

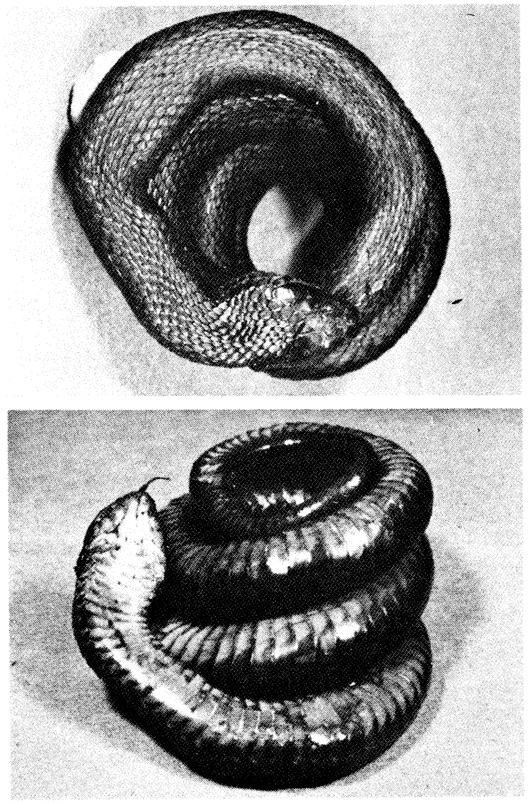
A BLACK GRASS SNAKE

By
G. HALFPENNY AND A. D'A. BELLAIRS
City Museum and Art Gallery, Broad Street, Hanley, Stoke-on-Trent
and St. Mary's Hospital Medical School, London.

In May 1975 a black snake approximately 829mm in total length was brought to the City Museum and Art Gallery, Stoke-on-Trent by a local school teacher; it had been killed on waste land near a housing estate in North Staffordshire. It was identified as a female grass snake (*Natrix natrix helvetica*. The dorsal surface is completely black (see Plate). Most of the ventral scales are bluish across the width of the belly, but black at their margins on either side. The chin shields and a median area of the throat as far back as the 6th ventral are whitish in colour, and the normal yellow collar is represented by a whitish band which is confined to the ventro-lateral surface of each side of the lower jaw. No marked abnormality of the scale pattern was observed.

Melanism in *Natrix natrix* is known in some parts of mainland Europe, but does not appear to have been previously recorded in Britain (Smith, 1973; R. S. Thorpe, personal communication). This specimen is more uniformly dark than other melanistic individuals in the British Museum collection from south Brittany, eastern Europe and Asia Minor. The occurrence of black adders is well known (Smith, 1973; Plate XIII) but it cannot now be assumed with certainty that every black snake found in Britain is either an adder or some escaped foreign form.

We are grateful to Dr. E. N. Arnold for his help in the examination of specimens in the British Museum (Natural History).



Black grass snake (*Natrix natrix helvetica*). The specimen is preserved in the City Museum and Art Gallery, Stoke-on-Trent (No. 16/NH/1975).

REFERENCES

SMITH, M. (1973). *The British Amphibians and Reptiles*. Collins, London (5th edn.).

CONSERVATION AND THE BIOLOGIST

By
H. Fox
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(*Received* 24/11/75)

During the past few years letters have appeared in the *British Journal of Herpetology* which bitterly complain about the indiscriminate destruction of wild life, particularly herpetological forms (see E. Hazelwood, 1971, vol. 4, No. 9. 237-8; E. Elkan, 1974, vol. 5, No. 2. 429; K. Pearce, 1974, vol. 5, No. 3. 455) with replies and comments (see A. Cooke, 1975, vol. 5, No. 4. 475 and C. Gans,

1975, vol. 5, No. 4. 475). Recently a long-serving member of the British Society of Herpetology, Mr. Robert Lowes of Magburaka, Sierra Leone, West Africa, reiterated the feelings of many naturalists who deplore the slaughter of wild specimens. An excerpt of a first letter, reproduced practically *verbatim*, stated: "On reading some of the articles in the journal for June (1975), I am sickened by the slaughter of so many animals for unnecessary experiments that seem to be indulged in out of childish curiosity, or perhaps for the satisfaction of the perpetrator seeing his name in print. I could have told Mr. Subba Rao, without killing 36 lizards, that *Calotes versicolor* fed on all the creatures he so carefully tabulates, simply by watching them. But that is the difference between a naturalist and a zoologist. The academic mind is interested only in the laboratory and has no sympathy with the living organism."

The member then tendered his resignation from the Society. This passionate animosity against the professional zoologist, who would appear to spend his time needlessly destroying wildlife for trivial reasons, is commonly found among naturalists. In my opinion, therefore, it seemed that a case should be made for the "professional" and likewise for the British Society of Herpetology and its journal. Where do they stand, for the *raison d'être* of the Society is to further the well-being of native and European herpetological forms. I therefore wrote to Mr. Lowes and part of the letter stated:

"The journal and the Society are not necessarily in agreement with the views expressed in the "Letter to the Editor", or with the results of published papers, or in many cases with the methods used. We do not set ourselves up as judges in these circumstances. I doubt whether any scientific journal does. Its hallmark is scientific credibility. Of course, if the methods described in submitted papers were so reprehensible, they would be condemned by all biologists and our referees would comment accordingly. In most cases, however, the procedures described are the usual standard practices, acceptable by biologists.

"I do indeed completely agree with you that our Society, through the pages of the journal, should encourage the maintenance and protection of natural fauna. Most biologists who investigate them may well sacrifice relatively small numbers in the short term, so that in the long term their researches would assist the preservation of species. All biologists have a vested interest in survival of wildlife. In fact the main cause of species' decline in all countries is not due to the activities of biologists killing or capturing specimens for research purposes. It is due to the creeping urbanisation of modern society and commercial interests, of varied kinds, encroaching on their habitats and thus destroying or endangering their food resources and breeding areas. This is certainly true for British amphibians. One could also quote the hunting of whales and elephants and the wholesale killing of turtles and the removal of their eggs as further examples of such commercial practices.

"The journal publishes papers on fauna preservation (see the recent one on *Triturus cristatus* by Beebee (vol. 5, No. 5, 1975). This work on behalf of the Conservation Committee offers valuable advice on how to arrest its regrettable decline; mainly due to the loss of breeding sites, as in the case of other amphibians (anurans). A paper by the same worker is concerned with the decline of the Natterjack toad. Others such as A. Cooke, J. F. D. Frazer and C. Simms are likewise concerned with population studies on amphibians and reptiles and ways to prevent their decline. Such results are published in the journal, which thus mirrors the views of the Society and reflects the concern about the very problems you mention. The unnecessary destruction of wildlife is deprecated and we support all methods to assist their preservation, especially those herpetological forms. There are many ways of doing this, however; one way is to learn as much about faunal ecology, structure, function and breeding habits etc., and thus use the knowledge so gained to educate society (and governments) on ways of preserving their habitats and thus the species."

A further reply was received from Mr. Lowes. He wrote:

"I do feel very strongly about the wasteful destruction of wildlife which is going on so needlessly all over the world. I agree with you that most of it is caused by commercial interests and the spreading of human urbanisation and settlement into previously untouched habitats. Excessive hunting, mostly by expatriots who ought to know better, is another reason in countries like this. Uncontrolled burning of the bush in the dry season for farming when thousands of acres are carelessly set ablaze must destroy many slow moving reptiles like chamaeleons and tortoises and also frogs. I have often seen the charred remains of snakes after such holocausts.

"It is for such reasons as these that it is disturbing to find that the very people who ought to be concerned about this loss, the biologists, are themselves often so wasteful in using animals in research projects. I understand, of course, the great need and value of genuine research by true scientists but there are too many people, it seems, who indulge in pretty useless experiments which are inexcusably wasteful of life as well as causing suffering of some sort or other to the unfortunate victims. The killing of the *Calotes* lizards described recently in the journal, merely to discover the contents of the stomach, was surely without any scientific value. Careful observation in the field would have shown the nature of the food taken by the animals. One sometimes feels that biology has become a sort of intellectual game in which the dead organism is the only matter of interest and the living creature is ignored. This is an exaggeration but I think there is some truth in it.

"The use of frogs for dissection in school biology during all the years it has been going on, must have accounted for many millions of frogs and surely ought to be discontinued in this supposedly enlightened age, except for those students going on to medical school, or specialising in biology. I am happy to be reassured that the Society supports the preservation of herpetofauna and is not averse to conservation."

It should therefore be stressed again that responsible zoologists do not —or should not—wantonly destroy fauna. Yet I doubt whether any sane individual could become a biologist if he or she disliked animals; at least they would respect them. The biological research worker is basically concerned with "finding out". He seeks a rational explanation of how animals live; how they grow, move, reproduce and also die. Paramedical research doubtless is strictly concerned with promoting the health and well-being of the human race, though not I would think, at the expense of natural fauna unless they endangered the very existence of man. Thus poisonous snakes need to be contained but not destroyed. Indeed the disparate and colourful animals living today provide aesthetic pleasures for mankind. It would be stupidly tragic if future generations saw most of their wild animals in books because the fools of yesteryear misguidedly destroyed them.

Society should be discouraged from demanding crocodile shoes and bags, however fashionable, and leopard skin coats. Indeed synthetic materials are equally as good and less expensive. Indiscriminate whaling should stop. Yet commercial interests do have a rational reason for their activities; usually material gain. Those who hunt and kill for pleasure doubtless need a psychiatrist and eventually such practices will be socially unacceptable.

I am happy to conclude that Mr. Lowes reconsidered his decision to leave the Society and has decided to stay. The Society has need of members like him.

I am grateful to our correspondent for permission to publish extracts of his letters.

NOTES ON FEVERISH LIZARDS AND *PSEUDOMONAS AERUGINES*

By E. Elkan
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(*Received* 5/11/75)

Bacteriologists and herpetologists have one common enemy which may kill their patients or wipe out whole collections of amphibians or reptiles. The enemy is a bacterium, *Pseudomonas aerugines*, known in human medicine as *Bacillus pyocyaneus*. It is 2-4μm long, Gram negative, has one polar flagellum and is obligate aerobe. (3). In cultures it produces a bluish-green pigment, pyocyanin which arrests the growth of other microorganisms.

How seriously surgeons and bacteriologists take the threat posed by this bacillus may be deduced from the fact that not only long lists of articles but recently two whole textbooks dealing exclusively with *Pseudomonas* have been published. (1, 2, 5, 6). This bacillus attracts particular attention because it is resistant to all but very few antibiotic drugs now in use. Even with the few remaining drugs which have an effect on this bacillus it is not always possible to save a patient once septicaemia has set in. In common with so many other bacilli and fungi *Pseudomonas*, which may be found anywhere, is harmless so long as it remains on the surface; it becomes dangerous, even lethal, in cases where the skin is destroyed as in burns or other accidents. This is one reason why lower vertebrates, particularly amphibians, should never be kept in crowded conditions where they may fight in competing for food. The smallest breach of the skin may serve as an entry for the bacillus which quickly spreads through the tissue and overnight may produce "red leg" disease which can kill every animal in the tank.

Luckily *Pseudomonas* is easily killed by desiccation; it needs moisture to multiply and for this reason it is not as dangerous to reptiles as to amphibians. Even so it is by no means rare to discover *Pseudomonas* as the cause of death following a violent inflammation of the mouth, the lungs or the intestines.

The only antibiotics likely to be of use in such cases are Gentamycin, Carbenicillin and Polymyxin B and E. For the disinfection of polluted tanks Chloroxylenol ("Dettol") or potassium permanganate may be used. Detergents do not improve their efficiency much. So far 24 different strains of *Pseudomonas* have been described, one of them even living on plants. Readers requiring further details about this intensely studied bacillus should refer to the publications mentioned below.

American authors (4, 7, 8) have recently used a similar bacillus, *Aeromonas*, in experiments on lizards which may lead to a review of an important chapter of general pathology. They injected a number of lizards (*Dipsosaurus dorsalis*) with known quantities of the bacillus and then placed them into a cage giving them a choice of a heat gradient gradually rising from 30°C to 50°C. The first set of tests with killed bacteria showed that the lizards chose a temperature 2° higher than that normally preferred. A second set of tests with live bacteria, killed all the lizards injected, but those kept at a higher temperature survived longer than others kept at lower temperatures.

Even the highest temperatures to which the lizards exposed themselves could not possibly have killed the bacteria circulating in their bloodstream. To kill such bacteria in a moist environment 60°C at least, preferably 100-120°C as used in autoclaves, are needed. Yet, if lizards voluntarily expose themselves to heat 2°C higher than normal, one would assume they feel some benefit from this choice.

In higher vertebrates leucocytes produce antibodies to neutralise bacterial toxins and it is quite possible that an increased temperature enhances their activity. If this is so then fever, although it cannot directly kill bacteria, may yet be a beneficial reaction by the body and, as the American author rightly suggest, it may be of very doubtful value to dose men or animals with drugs known to lower the temperature. On this point textbooks on medicine, physiology and therapy are alarmingly silent and extended examination of the value of fever seems much overdue.

REFERENCES

BROWN, M. R. W. (Ed.) (1975). *Resistance of Pseudomonas aeruginosa*. J. Wiley, London.
CLARKE, P. H. & RICHMOND, M H. (Ed.) (1975). *Genetics and Biochemistry of Pseudomonas*. J. Wiley, London.
HARE, R. (1967). *An Outline of Bacteriology and Immunity*. Longmans, Green & Co., London.
KLUGER, M. J., RINGLER, D. H. & ANVER, M. R. (1975). Fever and Survival. *Science* 188, 165-68.
LOWBURY, E. J. L. & JONES, R. J. (1975). Treatment and Prophylaxis for *Pseudomonas* infections. In: BROWN (l.c.).
MELLING, J. & BROWN, M. R. W. (1975). The effect of the bacterial environment on Resistance. In: BROWN (l.c.).
VAUGHN, L. K., BERNHEIM, Harry A. & KLUGER, M. J. (1974). Fever in the lizard *Dipsosaurus dorsalis*. *Nature* 252, 473-74.
WATTS, G. (1975). Lizards in a Fever. *World Medicine*. May 21st, 81-83.

LETTERS TO THE EDITOR

In a recent paper in the British Journal of Herpetology (Vol. 5, No. 3, 1974) P. M. Room called attention to the occurrence of the microhylid frog *Sphenophryne achlaugenhaufeni* in the northern province of Papua, New Guinea.

Since the only other reference to this species in the eastern part of New Guinea had proved erroneous (R. G. Zweifel, *Am. Mus. Novit.* No. 1766, 1956 and Menzies & Tyler, *Trans. Roy. Soc. S. Australia*, *95*, 1971), I thought it desirable that the identity of the Room specimens be checked.

Re-examination shows them to be *Cophixalus cheesmanae*, which is a common species along the northern coast of the eastern part of Papua, New Guinea. The specimens are in the Museum of Comparative Zoology at Harvard University and are numbered 87254 from Kokoda and 87255 from Saiho.

I am grateful to Dr. R. G. Zweiful who carried out the re-examination.

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BOOK REVIEWS

Conant, R. (1975). *A Field Guide to Reptiles and Amphibians of Eastern and Central North America.* Peterson Field Guide Series, no. 12, Houghton Mifflin Press. pp. 429. Fig. 353. Maps 311. Phot. 646. Price $8.50.

Herpetologists visiting North America have eagerly awaited a new edition of Conant's field guide. Although works upon the herpetofauna of individual states abound, this is the sole volume serviceable across the entire east of the continent. However the 1958 edition had passed out of date in numerous respects, and suffered from a number of faults.

Coverage now extends further to the west, eliminating the awkward geographical gap between this volume and Stebbins' *Field Guide to Western Reptiles and Amphibians.* Several recently discovered and introduced species are included. Distribution maps have been redrawn in the light of new records. Nomenclature has been updated. Revised data on dimensions are given, and European users will be delighted to find that metric measurements now accompany the feet and inches, rectifying one of the most serious lacunae of the 1st edition.

The guide satisfied initial requirements of a field work: it fitted into my anorak pocket, and was sufficiently robust to survive three months of rough field study. During a lightweight expedition it provided adequate identifications, in the forced absence of more detailed supplementary works. The descriptions

are concise, emphasising key features for identification, line sketches illustrate these features simply and clearly. Excepting the monochromes, the photographs are admirable: most field specimens could be identified just by leafing through the plates. Ecological data are necessarily scant, but with distribution maps furnish a useful background. A good bibliography highlights local guides. Prose can be evocative and cultured; savour "large choruses sound like a sty full of hogs at feeding time", for example, or warts arranged "like Belgian blocks on an old fashioned street".

Conant's guide is essential to any herpetologist in Eastern North America. A compact mine of information, utterly without frills, it fulfils its role as a working book that should always be in the pocket, never on bookshelf or coffee table.

Andrew Allen.

Mintoff, Eli C. (1975). *A Laboratory Guide to Frog Anatomy* VII + Pp 91. Pergamon Press Ltd. £2.00 ($4.50).

This new manual on *Rana pipiens* and *R. catesbeiana* (generally similar anatomically except for size) will be of use to students wishing to dissect and study the gross anatomy of the adult frog during their zoological course. All the different systems are described and illustrated by hand-drawn, black and white figures. Histological aspects are not considered.

The descriptions would seem to be adequate for those students supplied with *R. temporaria*, though it is hoped that the general "free-for-all dissections" by students below the seniors at universities and medical schools will ultimately be abolished. Adequate instruction at junior level can be provided by the instructor using single anaesthetised frogs and requisite illustrations.

In this regard this book will be of value.

H. Fox.

Deuchar, Elizabeth M. *Xenopus: The South African clawed frog.* XI + 246. John Wiley & Sons. £12.00.

This work which presumably derives from a major review on *Xenopus* (Deuchar, 1972), is initially concerned with the external features, ecology and anatomy. Thereafter there are chapters on aspects of its physiology, reproduction and embryology. The value of *Xenopus* embryos in fundamental experiments on tissue interaction, such as induction, organ interaction, regeneration and biochemical features of ontogeny are emphasised in the detailed descriptions of succeeding chapters. Some of the halftone illustrations are pretty awful for a book of this price, though the line drawings are adequate. There is a comprehensive and useful bibliography.

The work will be of value especially to workers engaged in embryological research and who wish to exploit amphibians, for *Xenopus* is widely used in this field. The book is expensive but it should certainly be available from any worthwhile biological library.

Deuchar, E. M. (1972). *Xenopus laevis* and developmental biology. *Biol. Rev.* 47, 37-112.

H. Fox.