F R O N T I S P I E C E.

Part of G. R. Leighton's Collection of Large Adders.

THE

REPTILIA

of the

MONNOW VALLEY.

Being a

THESIS

for the Degree of M.D. of Edinburgh University,

by

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Grosmont,

Pontrilas,

HEREFORDSHIRE.

"It is the bright day, that brings forth the adder."

Julius Caesar,
Act II. Sc.1.

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LIST OF PHOTOGRAPHS.

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C O N T E N T S.

I. INTRODUCTORY.

In choosing a subject for his Thesis, the graduate whose lot is cast in a country practice, finds himself in a very different position from that of the man who is holding hospital appointments in a town, or is even engaged in town practice. In both latter cases there is generally a wealth of material, medical and surgical, to fall back upon; and though it may be difficult to find some subject that has not been done already so well as to discourage one's attempting to better it, still it is always possible to follow up a particular disease, or operation, or treatment, throughout a large series of cases, and to find some valuable suggestions if not conclusions therefrom, from which our profession at large may derive benefit. So one finds that the best thesis work must invariably be done by graduates who have not entered upon general practice for themselves, but are still in touch with a large hospital, either on the staff or as attendants on post-graduate courses. But all of us do not have these opportunities, and the graduate whose lot takes him somewhat early to/

to general practice in a country district, finds that if his ambition to convert the M.B. into M.D. is to be attained and his thesis to be of any value at all, a somewhat different class of subject must necessarily engage his attention. The country districts have their own special medical problems, most of them sanitary questions, e.g., water supplies, drainage schemes, and the like, which though important enough for the locality to which they refer, are of little interest to science as a whole: since the general principles on which they depend are very much the same for similar places. Questions of the Public Health of country places are likely to be better done by <u>county</u> medical officers of health, than by those of us whose office of M.O.H. is limited to two or three square miles from our own doors. But there is one kind of science that the country practitioner can investigate, which his brother in the city is cut off from, and which our University of Edinburgh has wisely included in those subjects eligible for Theses. I mean the science of <u>Natural History</u>. Here indeed the country doctor, if his tastes and study have led him in that direction, has a unique opportunity. His training has peculiarly fitted him to undertake investigations in Natural History, his anatomical and physiological knowledge, no less than his/

his educated faculty of accurate and systematic observation, all contribute to his fitness for the task. And, indeed, one has only to read the various publications on different sections of animal life to find how very much these sciences owe to country medical men. Birds, mammals, butterflies and insects have all had their literature largely written by country practitioners. Some natural orders have been so very fully and carefully worked at, that little remains to be done (as far as Great Britain is concerned) except to verify and confirm the results of the investigations of other observers. But there are one or two natural orders in our British Fauna, which, for various reasons, have been very much neglected, or at any rate, comparatively untouched. Of these classes the Reptilia seems to me to have been particularly uninvestigated, as far as the natural habitats of its members go, and more particularly the order Ophidia, our British snakes. And it is not difficult to see why this should have been so. To a large number of people, even those interested in other animals, snakes are very repulsive, especially the poisonous species. But still more, I think, has this neglect of natural observation been due to the great difficulty attached to it. I have been very much struck in reading the/

the various books on our Reptiles, with the fact that comparatively little of the author's work has been done at first hand, out of doors. The laboratory side of the question, structure of organs, and so forth, is very elaborately set forth in some books, but of the habits of life of our snakes in their natural habitats very little is to be found that bears the stamp of accurate and original observation. One can easily understand why this should be so, more especially if one has tried oneself to do it. I know of no subject in Natural Science requiring such patience, as that of observing our snakes, and more especially our adders. Specimens are not to be found at any given time, or in every field; and it is only during the few summer months that observation is it all practicable. So, it seemed to me, that finding my lot cast in a district where the Ophidia (or one of them) abound, it would be better worth while to attempt to work out some of the little known features of that order, than to merely criticise the more strictly medical work of others, for my Thesis. Of course, my own tastes fitted in with this idea. For five years, now, I have devoted all my spare time from professional work, to the study of the Ophidia of this locality, and if the results seem all too small in comparison/

comparison with the time and labour expended, it is because (as I have said) the difficulties of observation in this case are perhaps greater than in any other branch of our Fauna that could be mentioned. In any case, such as they are, those results are here collected together, as far as I have investigated. I see a very great deal yet to be done, and indeed feel as if I had but touched the fringe of the matter, but I think there is quite sufficient new material to justify my putting it together in the form of a Thesis. I would just explain here that I have given no systematic account of the Order and of its members, such as may be found in any book on British reptiles, but simply stated the course of investigation I have myself pursued and the facts that have come under my own observation. When I have quoted others, it has been to compare their statements with my own observations. Lastly, I would add that last year (1899) I felt that my work would be more interesting and of greater value to others if I could illustrate specimens taken, and I consequently took up photography as a means of illustration. The photos in this Thesis I have done myself from specimens in my own collection, most of which I still have. The correspondence I have appended on the subject of the adder-mother swallowing/

ing her young, is only a part of that in my possession. I give it, not because of any particular scientific value attached to it, but simply because it has come from various districts, and has an interest of its own, as showing the very widespread belief in that hitherto unproved phenomenon. I have no doubt that my writing may appear somewhat disjointed, but that is inevitable when one can at most only get an hour or two at a time for one's subject. The principle I have adopted has been to make a note <u>at the time</u> of everything I have seen and done, and to endeavour to write that out more fully the same night while the occurrence has been quite fresh in my memory. The pursuit has been a great delight to me, and if I have added anything to our knowledge of the British Reptiles, I am more than satisfied.

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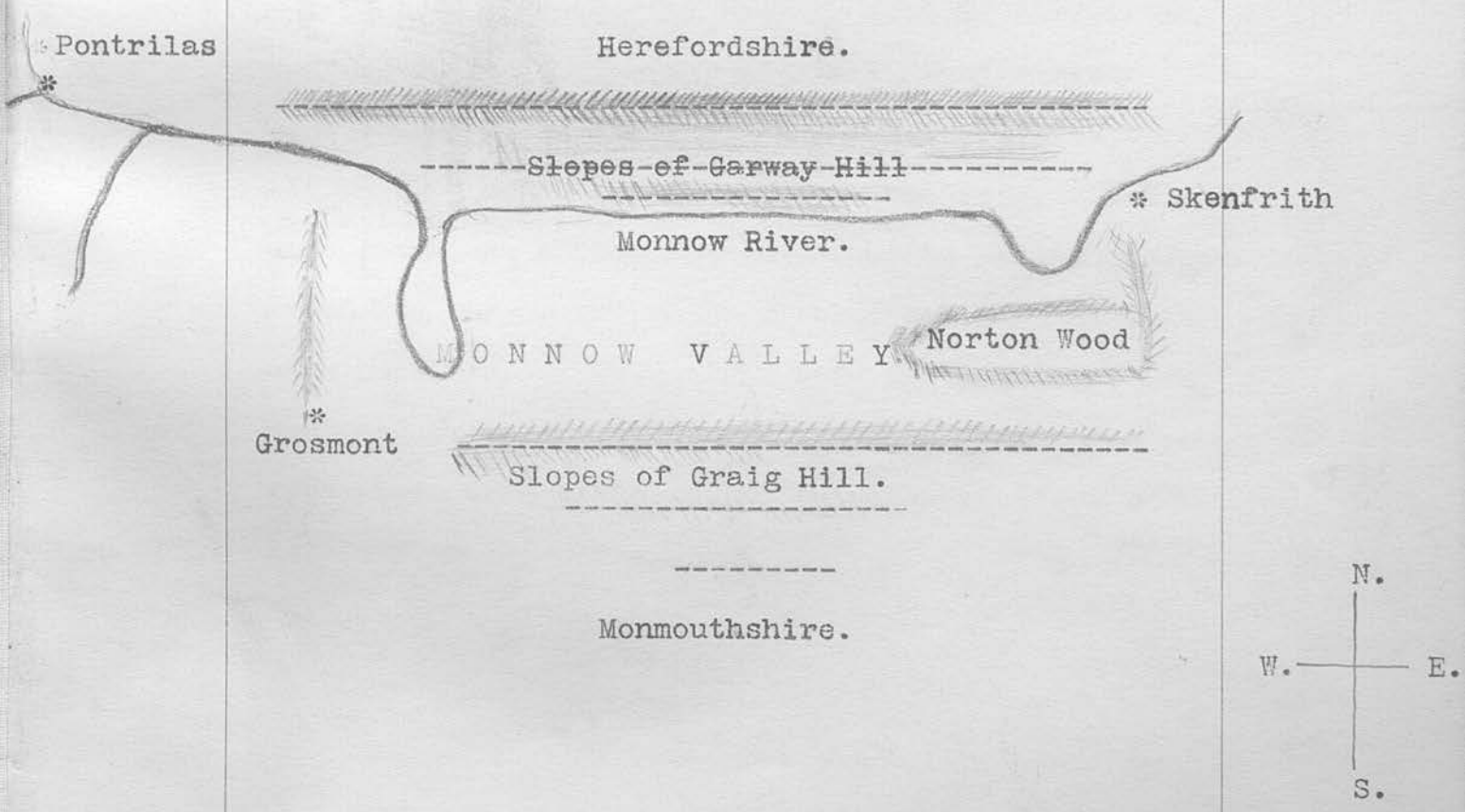
II. THE AREA DEALT WITH

1895 to 1899- For the first four years I was here I confined my attention to my immediate locality, and only this year (1900) have I worked up the surrounding districts. This first area may be described as that part of the Monnow Valley between Pontrilas and Skenfrith, a distance of 8 miles long. The river Monnow at Pontrilas, where it is joined by the Doyer, turns at a right angle to enter the exquisitely beautiful valley formed by the Graig Mountain and Garway Hill. For the whole of this length the Monnow forms the boundary between Herefordshire and Monmouthshire, the former being on the North and the latter on the South bank. It is a most interesting locality from many points of view, historically, from its scenery, and (as I have to consider it here) from its fauna. The change of character in the configuration of the landscape is striking in its suddenness. The visitor approaching this district from the Hereford side, leaves in a moment all the flat agricultural land or gentle ploughed undulations and finds himself transferred into a land of mountains and valleys. It is a typical transition from South England to Wales, all in a moment. Herefordshire ends abruptly here in its highest point/

point Garway Hill (1200 feet) gradually reached from the north side, but with a precipitous descent to the Monnow river on its south side. Across the river the steep sides of the Graig mountain rise at once from the roadside, and the traveller feels that to get out of the valley he must go <u>through</u> it. Curiously enough, both ends of the valley are also closed by hills, though not of such altitude. The whole valley area may thus be likened to an oblong box, the two sides of which (8 miles in length) are very high in the centre and the two ends (half a mile to 1 mile across) about half the height of the sides. Diagrammatically, one might represent the valley thus:



The above diagram is not drawn to scale but simply meant to shew how the Monnow valley here is like an oblong box.

The slopes of both sides of the valley are covered with alternating thick woods and bracken, the only difference being that the Graig is wooded to the summit, while the upper third of Garway Hill is bracken. It is necessary to appreciate these characteristics in order to follow the distribution here of the Ophidia, as I shall shew later on. But enough has been said to demonstrate that we have in this part of the Monnow Valley a specially secluded spot. There are only a few farms between the two ends of the valley, and no bridge or road across anywhere. The Hereford side is divided between the Kentchurch and Glenmonnow estates; the Monmouth sides between the Blackbrooke and Hilston estates, all being thickly preserved with pheasants. The most important point, I think, to note is the absence of pools, marshy ground or small streams. As I have said, my investigations were for some time restricted to this valley, and I shall now proceed to recount in detail the characteristics of the Reptilia in this area.

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III. FIRST IMPRESSIONS.

I entered on my residence at Grosmont in November, 1895, and consequently my first four months were winter months. The reptiles were, of course, hibernating, but I began my investigations by questioning my patients as to their prevalence, etc. I very soon found that there was something specially interesting about the valley from the ophidian point of view. My questions were answered in a curiously uniform manner, which arrested my attention from the outset. Landlords and tenants, farmers and gamekeepers, labourers and poachers, all said the same thing in almost the same words. The universal statement was: "There's no snakes here, Sir, only adders." (I don't know whether this is a popular distinction everywhere between the grass-snake and the adder, but I notice M. C. Cooke and some other popular writers speak of snakes as opposed to adders; I suppose in deference to this popular nomenclature.) At the time (1895) I had not heard the distinction used before and after hearing the statement from a large number of people, the conclusion I came to was that the adder was the only snake found in the valley and that fairly commonly. (I should here state that I had never before lived in a district where/

where I could investigate for myself reptiles, and my knowledge of them was entirely theoretical, from reading and museum study. I think this part of my work is of some interest, inasmuch as it has taught me how one may come to quite wrong conclusions by merely trusting to theoretical considerations.)

The next line of questioning I followed up was the enquiry as to the ordinary length of the reptile that all these people referred to. Here again I was struck with the great uniformity in the replies. "About two feet or a little more" was the usual answer I got, with occasional statements of someone who had killed one "as long as my arm and as thick as my wrist-" Now, I confess that I was rather nonplussed at this unexpected result. I had always understood that the British adder was about 18 inches long, rarely more, never much more, and that the red-viper (so-called) was about 10 inches. But these people all assured me that they very seldom saw one <u>less than two feet long</u>. The next point was that I never heard of any snake from them of more than about 30 inches and knowing that many people are ignorant of the distinctions of our snakes, I yet could hardly believe these here to be grass-snakes, or I should have heard of some at least 3 feet or 4 feet long. The idea occurred to me that it was just possible that the smooth snake might be more common here,/

here, and I reflected that its usual length would be about that given, viz. 24 inches. Still, I could hardly believe it could be so common as this local reptile evidently was, and so I went on through the winter, eagerly looking for the Spring, when I could begin my now practical investigations. The conclusion I came to in my own mind from the information I got was:— that only one kind of snake was found in the valley, that its average length was about 2 feet, that it could hardly be the adder, that it was most unlikely to be the smooth snake, that it was rather numerous here, that it would probably turn out to be the ordinary grass snake, and that in any case the matter was worth looking carefully into. Whatever the correct interpretation of the facts should turn out to be, I could see that in any case the distribution of the Ophidia in this part of the Monnow valley was somewhat peculiar. Thus I awaited the spring months, my mind open to believe in any of the possible solutions, and yet I was hardly prepared for what I found.

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IV.

WORK IN 1896.

I now come to my first summer's practical work. I began by finding out from the gamekeepers, woodmen and farmers the places that were reputed to hold this common reptile, and early in May I spent all the time I could spare in searching the likely spots. On May 16th I came across the first reptile I had seen here, and it turned to be an adder. I soon found others and in a few weeks I had taken eight - all adders. But what about the measurements? Had my informants been exaggerating when they all spoke of 2 feet and upwards or not? I may as well give at once the measurements of these first eight that I took, because in the first place, the list includes both the <u>largest</u> and the <u>smallest</u> that I have come across up to the present time (1900 August) and in the second place, the average length of these eight is the same as I have found taken over a very large series of adders.

No.1.	Female.	$26\frac{1}{2}$ inches.	
No.2.	"	$26\frac{3}{4}$ "	
No.3.	Male	23 "	
No.4.	Female	$28\frac{1}{2}$ "	(the largest)
No.5.	Male	$25\frac{1}{2}$ "	
No.6.	Male	$21\frac{1}{4}$ "	
No.7.	"	$19\frac{3}{4}$ "	(the smallest)
No.8.	"	$22\frac{1}{2}$ "	

The average of this series is just over $24\frac{1}{2}$ inches, which is practically just what I had been told/

told was the case. This series were taken in various parts of the valley and by the end of the month of July I had taken about twenty specimens of the Ophidia group, every one of them adders, the average length working out at 24½ inches. But what about other members of the class Reptilia? I did not find a single specimen of the grass snake nor a smooth snake. Of the order Lacertilia I had noticed the blindworm to be common and to grow to a large size; a few specimens of the common lizard and none of the sand lizard. So that the result of that summer's investigations was that I found the Reptilia to be represented thus in the Monnow Valley:

Reptilia	Lacertilia	1. Angius Fragilis ..common.
		2. Common Lizard ....a few.
		3. Sand Lizard .....absent.
	Ophidia	1. Tropidonotus natrix .....absent.
		2. Pelias Berus .....common.
		3. Coronolla Laevis..absent.

I give this result now because four years' subsequent experience proves it to be correct.

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V. W O R K I N 1897 - 98 - 99 - 00.

During the summer months of these four years I took altogether nearly 150 adders in the area I am writing of. I never came across another as small as 19¾ inches, nor one as large as 28½ inches. The great majority were between 22 and 26 inches, the average length keeping at slightly above 24½ inches. Only once did I find a grass-snake and that was on 21st September 1898, on the drive through Kentchurch Park, at the entrance to the valley. This was a small specimen 24 inches long (which I still have in my collection preserved). So that to sum up I have conclusively shewn that:--

1. The only representative of the Order Ophidia in this part of the Monnow valley is Pelias Berus, the common Adder or Viper.

2. That the average length of the Adder in this locality reaches the large figure of 24½ inches.

3. That the grass snake Tropidonotus Natrix does not breed in the valley.

4. That the order Lacertilia is represented by two of the three British members, Angius Fragilis (blindworm) which average 13 inches, and a few of the Lacerta vivipara (common lizard), the sand lizard being absent.

This/

This concludes my results of the first point investigated, viz., what members of the class Reptilia were represented here and the length of the one Ophidian found? This done, one naturally wanted to endeavour to find out what were the causes which had produced this peculiar distribution, and which still marked off this valley as a special area in itself, as far as the Ophidia are concerned. I have thought much on this point and find it not altogether easy to quite satisfactorily account for all the facts, but I think one may see at any rate some of the factors that have played and are playing important parts in the problem.

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VI.

DISTRIBUTION OF THE OPHIDIA IN THE MONNOW VALLEY.

In trying to account for the peculiar distribution of the Ophidia in this district, one is immediately struck with the obvious part played by natural boundaries. By natural boundaries I mean hills, river, woods, and rough uncultivated land. The Monnow valley outside its natural walls is bounded more or less on every side by flat or undulating cultivated land. The approach from the Hereford side, i.e. the north, is comparatively flat, from the Ross side (N.E.) more undulating, but still highly cultivated; from the Abergavenny side (S.W. also we have undulating land, and the same applies in the Monmouth direction (S.E.) Suddenly one finds Garway Hill (1200 feet) and the Graig (1600 feet) confronting one. This is especially marked in coming from Hereford. The cyclist - who of all persons notices the difference in road levels - experiences a beautifully easy road from Hereford to Pontrilas, and then without warning, should he leave the main road and turn to the left into the Monnow Valley, he is at once struck with the fact that cycling has become a toil, and two miles further on is compelled to give it up, and push his machine up/

up the precipitous approach to Grosmont village. True, from here the road drops down to the valley again and keeps near the river, but the steep ridge of Garway on the one hand, and Graig on the other, hem him in like the walls of a prison. And so it is until the traveller emerges at the other end of the valley, when the undulating country once more appears.

It is easy to trace the effect this has had on the distribution of the reptiles. This is an agricultural district and, generally speaking, the flatter the land, the higher the cultivation, and the thicker the population. Conversely, the more mountainous the country, the less one sees of the plough (grazing land taking the place of crops) and the sparser the population. Here also on these mountain slopes are the thickest woods, the highest bracken, and the largest rocks. To mention these is to catalogue the requirements (as far as environment is concerned) of the snake group. Obviously, as civilisation advanced around these mountain passes, the wilder forms of animal life would retreat before it, and make their last stand in the lonely valley, and on the all but deserted mountain sides. It often reminds me of the habitat of the rattle-snakes on "The Mountain" described so beautifully by O. W. Holmes/

Holmes in "Elsie Venner". So one would be prepared to find a priori the Ophidia presenting special features here, as in fact they do. One does not wonder any longer that the adder should average 24½ inches in length, when one reflects that this unobtrusive reptile has here every opportunity of developing to full maturity, with a minimum risk of being interfered with. Besides, the woods and bracken are plentifully supplied with a favourite article of diet, viz. mice.

But this does not explain the entire absence of the grass or ringed snake (Tropidonotus natrix) in the valley. I confess that the predominance of the adder puzzled me extremely for a long time, and I do not know that I can satisfactorily account for it now. But I think one can see some circumstances bearing on the point. In considering a question of the distribution of a species, one naturally thinks at once of the food supply, amongst other factors, and it was not until I realised the rarity here of some of the favourite articles of diet of the grass snake, that I came to what I believe is the correct solution of this question. I found in course of time , that the lizards and newts and frogs were by no means common in this valley - that is, compared with other places around. The reason is simply this - there/

- there is no marshy or damp ground. The river is flanked by two steep mountain sides, there are no bogs or marshes on the banks, the mountains rise up practically from the bank. Now the grass snake is fond of a damp country; a land of ponds and sluggish streams is more to its taste than a mountainous torrent, because the former supplies its food. I do not say that there are no frogs and toads, etc., here, but there is not the supply that there is in districts around. Hence it is quite natural to find that the grass snake avoids the scorching hill-side of Garway, for the more sheltered and undulating land of Llantilio Crossenny. The adder has no such great partiality for marshy land, and is quite satisfied to be able to glide down to the river for young water-voles, and return to the hot slopes above, or the sheltering woods, as the season may require. This seems to me to be the main factor in this curious distribution of the Ophidia. Whether it accounts for the entire absence of the grass-snake or not, I cannot say, but it is at any rate an important factor in that absence.

There is another point worth considering. The grass snake deposits her eggs in manure heaps, or piles of rubbish, or some such place. In this valley suitable spots for leaving the eggs to develop would be/

be few and far between. Unless they hatched out in the late summer (which is not always the case) they would be exposed to the severe winter on the bare slopes, or too sheltered in the thick woods for the sun to hatch them out when spring came. This, too, no doubt, has a bearing on the point and goes to make up the conclusion that the Monnow Valley suits the peculiar habits of the adder in food and breeding, but not those of the grass-snake. That it suits the adder there is no manner of doubt. Never have I seen such adders as Garway and Graig hold, and others are astounded when they see my specimens. What giants there may be waiting still, I know not; for my humbler patients often assure me that they have seen much larger ones than any in my collection. A very favourite way of describing the size is to say "as long as my arm and as thick as my wrist, Sir." I have not found these monsters, but I have never seen elsewhere adders such as are found here. Of that one solitary little grass-snake that I found on the drive on Kentchurch Park, I do not know what to think. What was he doing there, and how came he there? I have always had the suspicion that the egg must have been brought in some cartload of stuff from a distance, and being fortunately deposited in some suitable spot, in course of time developed. From the/

the length of this snake (it was only 24½ inches) and the date I saw it (September) I should say this was an instance of an egg hatching out in the spring. Whatever be the true explanation, there remains the specimen, the one solitary grass-snake I have ever seen in the valley, and considering the large family the grass-snake has, I do not think it is possible for this one to have been one of two or three dozen hatched out in the same place, or one would almost certainly have seen more of them since.

July 1900.

I am told that at Welsh Newton Common and Llangrove, places 4 to 8 miles from the east of the slope of Garway Hill, there are numbers of both kinds of snakes, adders and grass-snakes, which is just what I should expect, as there the land is more undulating, and better watered; and instead of thick woods, one there finds gorse and scrub.

I hope soon to investigate this part of the district (during the next few months, perhaps) and will note the results later on.

II. The Lacertilia:

A few words will dispose of the distribution of this group as far as the Monnow Valley is concerned. They occur in order of frequency as follows:-

Most common:	Angius fragilis or Blindworm.
Next:	Common lizard; but not frequent.
Absent:	Sand lizard.

Of/

Of these, the blindworm is the only one seen at all frequently, and these grow to a large size, 15 to 17 inches being often recorded in my notes. The Common lizard (Lacerta vivipara) is seen but very rarely, and the sand-lizard not at all, as one would expect, as the latter is an inhabitant of the plains.

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VII. THE NUMBER OF YOUNG ADDERS IN AN AVERAGE LITTER.

As I proceeded with my observations on our local adders, it was more and more borne in upon me, how many questions there were about their natural life which were not very satisfactorily or definitely settled, and I was much struck in reading the various books which deal with our British reptiles, to note the widely divergent statements made concerning some of these habits of life. For instance, one would have thought that authors would have been able to say with some degree of concurrence, how many young ones the adder mother usually brings forth at one birth. Instead of a unanimity of opinion, however, one finds the most varying statements, so varying indeed, as to at once suggest to one's mind that the authors themselves really knew very little about it, but one quoted one authority and one another. I think the explanation of this, at any rate in some books on Natural History, is that the author includes the Reptiles in his book, because otherwise the book would be obviously incomplete as a description of British vertebrates, or British Fauna, etc., without having had his own attention particularly drawn to the Reptilia. Indeed, as far as I know, no well-known/

known writer on British Natural History has paid much personal attention to this group, with the exception, perhaps, of Miss C. Hopley, and she carefully avoids reckoning the adder among her favourite objects of study; keeping more to the harmless species. Whatever the reason, the result is, as I have said, widely differing statements are made. For instance, Dr Stradling gives the number of young adders at a birth as varying between 15 and 40: M. C. Cooke at 10 to 20: the one estimate being practically double that of the other: while both are so vague as to at once suggest that the question for them was a very open one. Statements of this sort are, no doubt, copied from one book to another without any steps being taken to verify them and so, if originally inaccurate an error is perpetuated unconsciously. Now, I am not in a position to say what Dr Stradling's authority is for giving the number 40. (Unfortunately one cannot now get into communication with this observer, owing to a sad malady) Consequently, I cannot say whether he ever saw an adder with 40 young ones or not. All I do say is that my experience has not been the same, and personally doubt very much the accuracy of his statement. I have often heard people say that they have killed adders with about twenty young ones around, or even 30. But when questioned/

questioned, I found that these figures were a hasty estimate on the part of the observer, and one cannot place any reliance whatever on this kind of haphazard evidence. There is only one way to get reliable figures on this question, and that is to kill and dissect a series of gravid female adders, shortly before the time of parturition. This condition in the adder is to be found in the month of July, the young usually being born at the end of July or in August. At this time the embryos are well developed and can be handled and counted. They measure from two to three inches in length, according to the nearness to maturity and every embryo that is to be born can be counted. This is the method I adopted to settle the question of prolificness and my results were as follows:-- After dissecting 23 gravid female adders in the months of July and early August, I found the average number of well developed embryos to be 13 per female adder. The lowest number I have observed was 7, the largest number 20, but in most of the dissections there were 10, 11, 12, 13, 14, or 15. Such a dissection as this I did this week (July 30th, 1900). The specimen was a large female 26½ inches long. I made a mesial incision over the situation of the ovary, and carried that down to the cloaca. The skin was turned out on both sides, and the oviducts full of eggs carefully separated/

separated from the other contents of the abdominal cavity, the upper and lower ends of the oviducts being secured with twine, then severed from their connections and bodily lifted out. This dissection if done carefully shows the blood supply very beautifully and the embryos can be seen distinctly, curled up in various shapes in the eggs. In this particular case, there were /3 eggs. Frequently one finds an egg contains more than one embryo, as in this case when the /3 eggs contained 20 embryos. (A photo of this dissection is appended). Now I quite admit, that if one were to dissect 230 gravid female adders in this way instead of 23 as I have done, one might possible find the average to be slightly different, but I should not anticipate a very different result from mine. At any rate, I have ~~a~~ specific data for my conclusion and every dissection I make only confirms it. It is not a haphazard estimate, but a definitely worked out resulting figure. The family does vary in number, but I do not believe it is so large as some authors give it, and in this district I find the average number of young adders to be 13 at a birth. The adder brings forth her young alive, fully developed, not as the grass-snake does, simply depositing a number of immature eggs, which develop outside the mother/

mother. I cannot help thinking that it is the large family of the grass-snake (4 dozen eggs have been recorded) that has led to that of the adder being exaggerated. From what I have seen I could hardly think the adder-mother could carry 40 young to the stage her family is born at: at any rate, I have never seen more than 20, and only once as many as that. This question of the number of young in the adder family, bears upon the belief in the mother swallowing the young for protection. I refer to this later on (under "The Adder Swallowing Theory") but would just say here, that one could not have any belief in that theory unless it could be shewn that the capacity of the oesophagus (or wherever the young go to) were such as to admit of an ordinary sized family being contained therein. As far as I am concerned, I have no definite opinion at present (July 1900) one way or the other. I have merely mentioned it here, because the size of the family has a bearing upon it. A naturalist friend of mine, I remember, once said to me that he thought it rather a large order for an adder to swallow 40 young ones, in which remark I quite concurred. But it is just possible that an adder never had 40 young ones, and I think it worth mentioning here in this connection. My conclusion then on this point at present is:-

<u>The average number of young at a birth is 13</u>.

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VIII.

A DAY'S WORK.

Of course whatever work I have been able to do at this subject has been in the intervals of practice, or rather I have fitted both together. For instance, I had a very interesting day on August 13th. 1900, which is typical of many I have had, so I propose to describe it in detail.

At 9 a.m. I was called out to a confinement at a hamlet called Monmouth Cap. Arrived at the case, I found I would have to wait an hour or so; consequently, I told my man to drive to Pontrilas in the interval and find out from a man who was on the look-out for adders for me, if he had anything to report. At this time I was paying several men to keep an eye on some female adders that were about to have young. On his return my coachman informed me that my scout had just captured a large blindworm alive, and killed a female adder. Having seen my human patient out of her difficulties I drove home with my reptilian spoil. I found on examination that the blindworm was a female in young 14 inches long, but that the captor had broken off 3 inches of her tail, which however, he put in the box. She seemed quite lively, all the same, so I put her into the same compartment with another blindworm I was watching/

watching. I then measured the female adder. She was a fine specimen, 24½ inches long and evidently just about due to bring forth. I put her in spirits of wine for dissection later and then started to drive to Skenfrith - the other end of the Monnow Valley. Finishing my professional work there I thought I might as well take the opportunity and go on to Llangrove (a place out of the valley, mentioned before), and make some enquiries there. After a hasty meal at the village inn we drove on 4 miles. On approaching Pembridge Castle I noticed a very rough patch of gorse and bracken covered ground, in the midst of a somewhat highly cultivated farm. I enquired from a man cutting hedges on the road if he had ever seen adders there. He at once pointed to this patch and said he had killed three there himself. I sent my trap on to the farm to put up and went to explore the gorse. It looked a most likely place, but though I looked for some time I found none. Presently, my man joined me with a little boy, the latter having been sent by his father to shew me where one had gone in a hedge an hour before. We went to the spot but to no purpose. Walking towards the farm we passed the postman's cottage and he informed me that he saw a large adder in his garden on Saturday(two days before). I searched the garden, but to no purpose. The postman referred me to his next/

next neighbour who said that at 2 p.m. this very day (it was now 3 p.m.) he saw a snake, 4 feet long, just by some ripe barley a short distance off. He shewed me the spot, but we found nothing. In all these three cases the observers had been unprepared and had no weapons in their hands. But I had heard quite enough to convince me that the locality deserved a more careful investigation. Before leaving I arranged with an agent to go to a neighbouring wood in a day or two, as he said he knew a spot much frequented by adders and where his men had killed five recently. I thanked him for his kindness in offering to escort me, and promised to come as soon as I could get a day off. On the way home I called on one or two of my scouts, but they had nothing to report; and we arrived home at 6 p.m. , having driven about 23 miles. True, I had got no adders, but I think I got some valuable information for future investigations. One has many blank days in Reptile hunting in England, but I have generally got some experience, one way or another, on a day of this kind, such as finding new haunts as above. Arrived home I thought the daylight was just good enough to photograph the adder I got in the morning, so I took her out of her spirits and got a good picture. I then had some tea. My blindworms next demanded attention and I visited them. To my great astonishment and interest, I found/

found that while I had been away the large blindworm with the broken tail had had a premature labour and three embryo blindworms were in the box. The mother seemed all right, so I removed the embryos and preserved them. I got a few worms and slugs for the old blindworms, and then decided to open the large adder, which I knew was just near her time. I thought I could feel young ones through the skin, so I inserted a probe pointer bistoury into the cloaca and carefully slit her up from below. As I expected the young adders were almost born. Three of them had left the eggs and were loose in the belly, all from the eggs of the right oviduct. They dropped out on the dissecting dish and I measured them at once and found them to be $5\frac{1}{2}$, 5, and $5\frac{1}{4}$, inches long respectively. The daylight was **failing** now, so I carefully dissected out the other embryos in their eggs, tied the oviducts at both ends as usual and lifted them out. There were ten young ones altogether and the dissection shews them most beautifully lying in the eggs. I hope to get a good photograph of them in the morning. Thus I work in my reptile investigations with my daily round, taking advantage of a call to an outlying part, to make enquiries from my patients and to get them to send me any specimens they kill.

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IX. COLOUR VARIATION IN ADDERS.

I touch on this subject of the varying colours of Adders with considerable diffidence, because, for all I know, there may have been monographs upon it before, giving some explanations. If there are such extant I have not yet seen them, so that in what follows I have been in no way influenced by the writings of others. It is another example of the barrenness of our Reptilian literature, and one which some day I hope to return to in much greater detail and after longer study of the subject.

In a communication I had from G. A. Boulenger (British Museum) he says "I have a very large series of these (i.e. adders) here and an extensive series of notes on their variations", but I fancy he is referring to their size rather than colour. In any case I have not had any opportunity since taking up this subject of seeing the Adder collection at South Kensington, though I hope to do so some day and to compare my notes with Boulenger's.

No one can study adders in their natural conditions for long, without being very much struck with the great variations they present in colour. I am not now referring to specific markings, but to the general hue of the adder. Unfortunately, photo-

graphy/

graphy gives no idea of this variation, I mean by the ordinary processes; colour photography of course would, but at present I have not that at command. Water colours would be the best, but they are not a success in everybody's hands. Nevertheless I think I must attempt to give some efforts of my own in water colours to exemplify some of my own specimens.

I often think that no description is more difficult to put into words than that of an indefinite colour or tint; but we must endeavour to do so. In my collection I have specimens which may be said to vary from pale grey to very dark brown, passing through every intermediate shade, and mostly having an olive-green tint as part of all the shades. (In this chapter I am not referring at all to the small red variety of viper.) This general greenish background to the markings, shades off from a bright yellow in some to a dark greenish-brown in other specimens. However inadequately one can describe the colours, everyone who has looked at a series of adders must have noticed the variation, and the important thing to investigate is the factors concerned in the production of this variation in hue. This question of colour variation arises in a consideration of almost all species of animals and there are certain factors which are recognised as playing their respective/

respective parts in its production. Among these factors are:

1. Climate.
2. Locality (i.e. nature of ground, etc.)
3. Sex.
4. Age.
5. Heredity.

1. Climate: This may be ignored as far as this thesis is concerned because my series of Adders are all from the South West of Great Britain. (Herefordshire, Monmouthshire, and the adjoining counties to the sea.) The climate over this area cannot, I think, be supposed to vary sufficiently to produce any effect in the direction we are now considering.

2. Locality: Now at first sight this factor seems to play an important part. It is natural to suppose that adders will vary in colour to adapt themselves to their surroundings, as many animals do. One might naturally suppose that the adder in a light, sandy soil, would be lighter in colour than that of the dark woodland and black rock. The analogy of fish at once occurs to one's mind. I know nothing of fish myself, but I have read and heard others on their varying tints. A correspondent of mine who/

who lives at Newcastle-Emlyn, South Wales, where adders are very common (and where I hope to catch some next week) in one of his letters to me says:-- "The varying colours (i.e. of adders) are, I think, due to the actual spot they frequent, to which they get adapted like trout. For instance, on open slopes facing the south they (vipers) get a reddish tinge like parched grass. In the "Tivy", trout vary in tint within a distance of a few yards. For instance one taken in a deep rocky pool would be a deep green on the head and back; and one taken a few yards away in a shallow stream would be a light gravelly-golden tint."

Now my correspondent is a good fisherman and observer, and doubtless all fishermen will agree that what he says of the trout in the Tivy is true of trout elsewhere. Whether he is correct in attributing the variation of trout colourings entirely to their habitat, I leave it to authorities on fish to say. But having noticed this in trout, he very naturally concludes that the case of the Adder is analogous. Now, one must always remember in science that analogy is not proof. Forgetfulness of this has led to many an error. Analogy may be good for illustration purposes, but it can never in itself be proof. In this case of trout and adder I believe the analogy is misleading. It is/

is a very tempting one, nevertheless, for I believe adders do, like trout, keep very much to one spot. But the crucial test is this:- If the varying colours of adders are due to the actual spot they frequent, then all the adders in a given spot should be of the same variety of colour. Instead of this, however, I have adders of every degree of variation taken from the southern slopes of Garway Hill, and also the same variation taken from the northern slopes of the Graig. Now these two hills, facing each other, the river Monnow coming between, have opposite aspects, and as I pointed out in the geographical part of my thesis, the Graig is more wooded, while on Garway bracken predominates. I do not mean to say that I could pick out an identical series of adders from both localities, because no two are alike, <u>even in the same locality</u>, which is the very point at issue. But I do say that adders of every variety of colouring are taken in both localities. Curiously enough, this same correspondent shortly afterwards sent me three adders from Newcastle-Emlyn. One was particularly light, one exceptionally dark, and one a medium shade. I do not know the nature of the ground there (that is one of the things I am going to see next week) but I think I can account for the variations without that (see later). Roughly speaking, one finds the same/

same great variety of colouring for miles round here, the Hereford adders, the Monmouthshire adders, and those of Breconshire Black Mountains, i.e. those on cultivated undulating ground, wooded mountains and bare arid slopes, all shew the same variety. It would be utterly impossible to accurately describe the nature of the locality from an adder's colour, at least, such is my conclusion from my own collection. I am inclined to go further and say that while the factor of locality may be a very or all-important one in fish (or some fish), it has but little to do with the varied colouring of our adders. The proof of my contention is found, I think, in the examination of one locality such as I have given much time to in the Monnow Valley, where instead of uniformity one finds infinite variety of colouring. So then in my view one must look further than locality or environment, to account for the wonderful variety of colours one finds in British Adders.

3. Sex: Having considered briefly the possible effect of climate and locality in the production of colour variation, and having found little or no explanation in them, I would now draw attention to sex and then age in this variation. In these two factors are to be found, I believe, the most/

most important modifying influences. First as to Sex. This is a point very apt to be overlooked by a casual or non-anatomical observer obviously, because except in the case of a female big with young, the observer would often not find out what sex any particular adder was. A certain amount of special education would be necessary to ascertain the sex, that is, the observer must be able to recognise the internal organs when seen, which I am quite satisfied many field naturalists cannot do, in snakes at any rate. Now in this matter of adder-colouring, I have found that sex plays a very definite part. I have often had an adder brought or sent to me with the remark or message "It is a beautifully marked specimen." When such is the case I almost invariably find the adder to be a male. That is to say, speaking generally, one finds that the male colours are far more brilliant than the female. There are light coloured males and light-coloured females, but the former are brighter than the latter. Also there are dark males and dark females, but the males are blacker than the females. More definitely still, one finds a brilliant yellow background, with the zigzag back-line almost black, in the male, but I have never seen that striking contrast of colouring nearly so well marked in a female. The general colouring of the female tends to/

to dull shades, that of the male to sharp colours. Olive green body and brown markings are characteristic of the female; while yellowish body and blacker markings appertain to the male. Such, at least, is my experience, as anyone can see in my collection. Here again analogy is suggested. It is almost a rule in nature (except in the genus Homo perhaps) that the male is the more attractive, in birds above all. Thus it is a choice of analogies. In neither instance is the analogy to be regarded as proof, but one analogy may be misleading and the other correct. It is curious that in the Amphibia and Aves - one group on either side nearly related to the Reptilia - this particular attractiveness in the male should be so marked. I find that female adders are much more common than males, and it is in such cases that one usually finds the males of a species to be more attractive. This is so generally known and recognised that I need do no more than refer to it and point out its bearing on Adder-colouring. But its full bearing can only be appreciated when considered in connection with the other factor remaining, viz., Age.

4. Age: This is a very difficult factor to estimate, for who is going to say the exact age of any given specimen? Certainly I cannot do so to my own satisfaction, but yet I fancy I can tell an old/

old adder from a young one. The difficulty is after the full growth is attained. But assuming that one has decided that an adder is a young one, say from its size, how does this bear on the colouring. I find that the younger the adder the more well-defined are the colours; by that I mean, that black and yellow, green and brown, are seen more distinctly as separate colours. So if one had decided that a given adder is an old one, say by its size, looseness of skin round the throat, or other signs, this also is found to have its counterpart in the colour. My firm conclusion is that the older the adder the less defined are the colours, and the more blending is there of shades. Also the markings are less distinct. In an old female there is a tendency to a general greenish-brown all over the body, and I have one old female 26½ inches long, in which this general brownish-green colour has almost absorbed the zig-zag dark line, so that the markings are almost obliterated. I think anyone who has observed many adders in nature will agree in this general statement, that the old adders are much duller in colour than the young ones; the young males being the brightest of all, the old females the dullest of all. Thus, as I said, age with sex must be considered the two most prominent factors in determining the varying colours of adders.

Adders/

Adders of the same age and sex in the same locality might be nearly identical: but adders of different age, and sex, in the same locality will be found to be different in colouring. Of the three factors I attribute the least influence to locality.

5. Heredity. Of the other factors mentioned, I can say nothing of heredity, because I have never compared the young of an adder with the mother , where the former are full grown: nor could one do do this except in captivity, when the results might be misleading.

All these considerations are factors in the case of other animals, but there is one other point in connection with the Reptilia specially; viz. sloughing. Has casting the slough any effect on the variation of colour? Strictly speaking, I thi think not. That is the colours are not different after sloughing. But it does affect the brilliancy of them . The brightest coloured of all adders is a young male which has just cast his spring slough. So in the female the green is brighter and less dull just after the slough is cast. In one specimen I got, this was most marked. The slough was partially cast and the green colour was beautifully seen in a bright shade where the slough was cast, a duller shade showing where the old/

old covering still remained. It really comes to this that the slough which is to be cast off prevents us seeing the true colour underneath.

These, then, are the conclusions I have come to from my own observation. Possibly a perusal of the opinions of others might modify my own, but at the present moment (July 22nd, 1900) I have not read anything seeking to account for the colour variation in adders, except the opinion of the correspondent, I quoted above. My inmost idea is that colour markings are the truest tests of the age of an adder, and I always fancy I know when I am dealing with an old one directly I see the reptile. This may, of course, be a delusion on my part, but there is something in the general appearance of some adders which gives me the impression of old age, and it is chiefly, I think, in the colouring.

-------ooOoo-------

X. DO ADDERS SWALLOW THEIR YOUNG?

There is a very widespread belief among the inhabitants of districts where adders are fairly common, that the female will take her young into the gullet for protection. In the absence of an ocular demonstration I do not wish to assume a positive attitude on this much-debated question. At the same time I think one cannot refuse to give due weight to any evidence, for or against, that may be forthcoming. To be content to say, "I don't believe such a ridiculous idea" is to my mind a very unscientific attitude to take up, when one thinks for a moment of the innumerable facts in nature quite as curious. I merely wish to point out here, how difficult this question is of absolute proof to those who are justly sceptical.

In the first place, adders are not often seen at all, even if one is looking for them in places they are known to frequent. I have gone to such places repeatedly and never seen a single adder. They will always move away quickly if they can, and it is almost certain that unless one happens to go within three or four feet of an adder, the reptile will slip away unnoticed. So, as I say, it is not common to see adders at all. Still less common is it to see them with their young.

Secondly/

Secondly, even if it be true that the female does swallow her offspring, this could only occur when the young are very small; for a few days after birth, that is. This time would be about the end of August or in September. The young certainly do not stay with the mother long after birth. That being so, the only chance of seeing this natural curiosity would be during these few days in each year. Now, I would ask, how many people in England and Scotland see an adder at all in any given week? Certainly very few. Of those few, nine-tenths would not stop to see what the adder was doing or about to do, but would leave that precise spot as rapidly as possible. Of the rest, some would kill the reptile at once, but in most cases, the adder would elude observation. So that one is forced to admit the extreme difficulty of proving an affirmative.

As far as the adder is concerned, I am quite satisfied that the feat would present no anatomical difficulty, if she wished to do it and the young ones understood the process. The oesophagus is extremely dilatable. The adder has no difficulty in swallowing a frog or a water-vole whole, the bulk of which would be quite as great as that of the young adders.

Lastly,/

Lastly, I have met a good many people (statements from some of whom are appended) in this district, who say they have seen this occurrence, have subsequently killed the adder, opened it and found the young inside. Why they should make these detailed statements if not true, is not quite obvious. Personally, I have never yet (June 1900) seen this phenonenon, but unfortunately I have not been able to spare the time from professional work, just when one would be likely to have the chance of observing it, if it ever happens. There is one other consideration, which I have never seen put forward, but which seems to me to have a bearing on the point. It is this: I have never yet found anyone who has seen an adder with young ones, where the swallowing process was not seen. In other words, every person I have met who ever saw an adder with young ones about her, also says he saw them swallowed. That, to my mind, is, to say the least of it, significant. Personally, I have never seen the young adders with the mother at all.

I think the above considerations will prove that it falls to the lot of very few to see an adder with young, and that one must admit that actual proof - though it would be very welcome - must of necessity be very difficult to obtain.

The Adder-Swallowing Theory from an Anatomical Point of View.

.....

The main objections of scientific naturalists to the belief that the Adder mother swallows her young, are the following:--

First: that no adder has been dissected by a competent authority with the young found in the gullet.

Second: that the cubic capacity of the gullet is not sufficient to hold all the young ones in a litter.

Third: Some hold that there is no adquate reason for the pheneomenon, i.e., that the young could have a better chance of escape if they were not thus swallowed.

Of these objections, the second is by far the most pressing to my mind, for if it could be shewn that the gullet of the adder is not capacious enough to hold the average number of young, then, indeed, one could not have much belief in the occurrence. It is this point I wish to deal with at present. One must settle:

1st/

1st- What is the average number of young at a birth?

2nd. Is the anatomical structure of the gullet adapted for the reception of the young?

3rd. Is the capacity of the gullet sufficient?

These are practical questions, only capable of decision by dissection of a sufficient number of adult female adders. Take these questions seriatim.

1st. The average number of young at a birth.

Various authorities give different figures. Dr Stradling puts the litter at anything from 15 to 40; M.C.Cooke at 10 to 20. My own experience leads me to doubt very seriously whether adders ever have 40 young at a birth. I have now dissected a large number of gravid female adders and have never seen anything like approaching this number. The following is a description of a dissection done this week, one of three I got on the same day.

Dissection of Gravid Female.

On Monday, July 23rd, I dissected a large gravid female adder, for the purpose of counting the number of young that had developed. A mesial section was made from the position of the ovaries to the cloaca and the skin turned outwards. Both oviducts were full of eggs. The upper and lower ends/

ends of the oviducts were tied with string and the other organs gently separated. Both oviducts were then lifted out of the body cavity. The dissection shewed the blood-supply very beautifully and the young were evidently only a day or two from birth. I took a photo of the full oviducts, as one cannot often get an adder at this stage. The right oviduct contained seven and the left six, eggs (An egg often contains two embryos.) The specimen was such a perfect one that I thought I would preserve it in toto to harden, so as to observe later the precise position of the embryo in the egg. This being so I could not be quite certain as to their number, but I think it is 19 or 20. The average of this series of dissections works out at thirteen young per litter. In this case there were 13 eggs, containing the 19 embryos. Possibly a larger series of dissections might give slightly different results, but I do not think the difference would be likely to be great. To be on the safe side (as far as the question of capacity is concerned) let us consider the average to be 15.

2nd: The Anatomical Fitness of the Gullet.
This is soon disposed of, as the adder's gullet is, of course, adapted to its food. There is no difficulty whatever for a mouse, a young water-vole, or a blind-worm to pass into the gullet, and it is quite/

quite easy to press them out again, if they are contained therein. (A short time ago I killed an adder which appeared very full in the throat, and on gentle pressure I got out two young water-voles. The mechanism of the jaws is indeed peculiarly fitted for the passage of bulky articles of food.)

3rd. The cubic capacity of the Oesophagus. (Gullet)

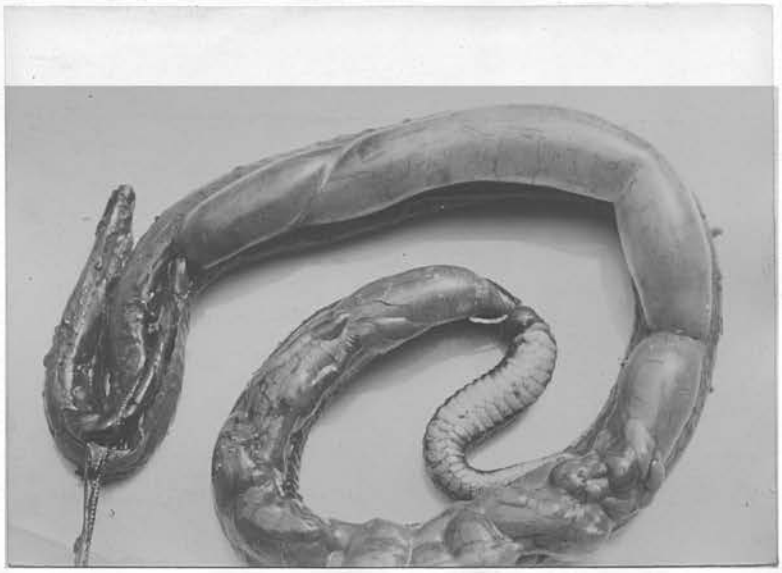
This is a crucial point. If the adder does swallow her young, it is to be presumed that there must be room in every average sized adder's gullet for an average sized family. The capacity of the gullet can be estimated by the simple process of dilating it to its fullest extent with air through a blow-pipe. I did this in the presence of a naturalist last week. His comment was "There is room for 20 young ones; but for 40, I think not." The average length of the gullet is 9 inches, and the average diameter when distended is 1 inch, the average circumference, 3½ inches. Young adders can curl themselves up in a remarkable way, and I have no hesitation in saying that the capacity of the oesophagus is sufficient to held the young.

My conclusion is that, theoretically considered, there is no anatomical reason why the Adder-swallowing Theory should not be true.

The/

The third objection I alluded to, viz., that there is no need for the process, is a mere matter of opinion. Very curious instances could be given of the expression of maternal instincts in nature.

It only remains then for the first objection to be removed, viz., that a competent authority should have the opportunity of dissecting an adder which has been observed to swallow the young. Until this has been done, scientific naturalists will continue to regard the question as one capable of proof if true, but hitherto unproved. The following photograph illustrates the capacity of the oesophagus when dilated by a blow-pipe.



This photograph appeared in "The Zoologist" for September, 1900.

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I now append copies of a few of the numerous letters I have received at one time or another from people in various parts of the country, who say they have seen the swallowing process. I make no comment on the letters themselves, as it is difficult to do so without appearing to doubt the good faith of the writers. I constantly receive letters of this sort, occasionally very indignant ones, from correspondents who seem to think that nothing more than their word is needed to settle the controversy. One man quaintly says: "What appears to me to be satisfactory evidence is that I have seen it myself."! Nothing could be more satisfactory as far as he is concerned; but for myself, I prefer to regard it as an open question, hoping some day to have more direct evidence at first hand.

COPY.

Mill Farm,
Welsh Newton,
Monmouth,
July 23rd, 1900.

Sir,

I see you are seeking information through our local papers, asking do Adders swallow their young. I think I can honestly say they do. I will write you an incident I once saw with an adder.

I was walking by the side of a small brook and I came in contact with an adder. Of course the first thing I did was to kill it. To my surprise there were three small adders close by, from 3 to 4 inches long. I smashed them up and turned my attention to the old one, where I could see protruding from the mouth the tail of a little adder. I got it out ; it was the same size as the other three. With the aid of two small sharp sticks I tore open the old adder and found two more of the same size inside. I should say the little ones all belonged to one lot. This happened quite 20 years ago. I never saw such a thing before or since, though I have killed several since. I have killed two this season.

Yours truly,

(Signed) JAMES DAVIES.

COPY.

30 Queen Anne's Gate,
L o n d o n,

July 2nd, 1900.

Dear Sir,

I can quite understand your desire for information re adders. I came across one on Ascot Heath many years ago; it was attempting to cross the road out of some furze and heather. I don't know if it was not wanton mischief on my part to try and kill it - however, I made for it with my stick. It made a hissing noise and to my surprise seven small - its own offspring, no dount - ran to it and were demolished. This exceeded my comprehension. I succeeded in killing it and from legendary remembrance I put one foot on its tail and with the other I pushed up the body of the viper and the whole seven fled out. I succeeded in killing four of these little ones, the others escaped in the heather. I am quite convinced they do swallow them, and I grieve I did not attempt the further elucidation, to me a mystery.

Yours faithfully,

(Signed) R. SLANN.

Statement by letter from JOHN WENT, 1 Park Cres., Barry, near Cardiff, July 3rd, 1900.

Sir,

Seeing a few lines in the "Hereford Times" of Saturday last about adders swallowing their young, I for one have seen it, and I will tell you where. It was not far from where you are living. About ½ a mile from Pontrilas Station there is a farm called Penlan, just above the distillery works. Three hundred yards from the barn at that farm, there used to be some rough brambles, just outside the Benath Wood. There was another person with me, but I have forgotten who it was at present. Anyhow, the old adder was a large one, very dark. I was very near putting my foot on her. She at once jumped right at me and threw a lot of something out of her mouth on my clothes. I retreated back some paces to look for a stick or stone and I returned back and then she "blowed" at me again. I saw two or three young ones go down her throat about 4 or 5 inches long and I noticed that they were very dark and about the size of a worm. I was at that time one of the underkeepers at Kentchurch for Colonel Scudamore. I can't say quite certainly as to the date, but I think it is 35 or 36 years ago. We killed the adder at the time. We saw one of the little ones come out of her mouth and it got away in the brambles, but the others were smashed to bits with the old one. You can rely on this to be true.

I remain,

Sir,

Yours obediently,

(Signed) JOHN WENT.

P.S. Please excuse this scribble.

Statement by Mr Thomas Morgan, Tresemmey, Grosmont, June, 1900.

Some years back I saw an adder killed and opened with 13 young ones in her throat. We were reaping a field of beans in July and my brother was carrying the men's dinner up to the field. On his way up he heard an adder hiss close to him and a moment or two afterwards saw the brute a few feet off. It was a very large one, I should say nearly 30 inches long. We killed it and found it very full about the throat and so, knowing they swallowed their young ones, we cut her open and found, as I say, 13 young ones about the length of my little finger in her.

Statement by Leonard Davies, High Meadow, Kentchurch, June 3rd, 1898.

Some years ago I was walking in company with my younger brother from our cottage towards the Park. We were going to help to gather the cut fern, which would be in July. About a yard off the path I saw an adder coiled up in the grass in the sun. When I stopped three or four feet off she lifted up her head, put out her tongue and hissed at us. I then saw six young ones which I had not noticed before, wriggle up to her. She put her head flat on the surface of the ground and opened her mouth, when all six went in. The young ones were about 3½ inches long. As soon as they were inside her, the mother at once disappeared under a stone. I could shew you the very spot on Garway Hill where this occurred.

Statement by Mr Benjamin, Farmer, Old Gardens, Garway Hill, June 1899.

Seven or eight years ago I killed a large adder which I had just seen swallowing its young in a field at Demesne Farm, Garway. I forget how many little ones we found in her, five or six, I think. I have also killed on Garway Hill a smaller, reddish snake, the only one of its kind I ever saw.

---------oo0oo----------

Statement by George (& W.) Jackson, Bootmaker, Grosmont, July 1900-

The moat round Grosmont Castle used to swarm with adders before it was cleaned out and tidied up and I once saw an adder swallow her young there, just where that heap of loose stones is now, by the entrance. I was with my brother, Walter, who also saw it. She disappeared under the stones very quickly and we did not see her again.

Statement by Mr Prothero, Pontrilas (Gamekeeper to W. Steward, Esq., Pontrilas) July 17th, 1898.

A few years ago I disturbed an adder in a field near Mr Husband's house. She gave a repeated hissing noise, so I knew there were young about, as they never hiss more than once unless they have young ones with them; the repeated hissing is to call the young. She then put her lower jaw on the ground and I saw a number of young ones swallowed. I killed the adder which measured 22 inches in length, and found eleven young ones, about 2½ inches long, inside her.

---------oooOooo----------

Statement by Mr Wm. Moore, Postman, Garway, Nr.Ross.

July, 1900.

I remember seeing an adder swallow twelve young ones in a potatoe field on the Northgate Estate near here. I was out walking with the shoemaker and old Mr. Badham when it happened. We killed the old adder and cut her open and found 13 young ones in her.

Statement by Mr Sims, Tremadoe, Garway, July 1900.

My little boy and I were going up Garway Hill one autumn and he called out to me to come back (I was in front), as an old adder's young ones were jumping down her throat. I ran back to where he was, but she got away.

--------oooOooo--------

Statement by William Symonds, Labourer, Houldalbert, Grosmont. July 6th, 1900.

About this time four years ago, I saw an adder on a grass bank on the roadside near the Pool Farm, Grosmont, lying curled up. She hissed at me but did not move and I saw a lot of small ones go down her throat. Directly they were inside she moved off, but there was no cover for her to get into and I killed her. I took out my knife and cut her open and found fifteen little ones. Some time afterwards Mr Gladwyn, butcher, told me he had found my knife on the roadside just where I cut the adder open. He gave me back the knife which I had lost. I knew I had lost the knife, but did not remember I had left it there.

Statement by Mrs Eliza Jones, Grosmont, July 5th, 1900.

About 25 years ago when I lived in Penalt, near Monmouth, I was coming home one afternoon when I saw an adder on the roadside by the hedge, It hissed like a goose, and then some little ones went down her throat, five altogether I saw. Three came from one side and two from the other. She made for the hedge as soon as they were inside her and I did not see here again.

Copy.

27 Lawford Road,
Kentish Town,

July 12th, 1900.

Dear Sir,

In answer to your question with regard to snakes swallowing their young, I am aware it is a common opinion that snakes hide their young in this manner, but I candidly believe it never happened. I have had many kinds of vipers with young ones and have tried several methods of frightening them, but have never seen the event take place, or any action to cause me to believe it even possible. I have forwarded a pamphlet which will interest you, but which I should like returned.

Yours truly,

(Signed) J. TYRELL,
Reptile Keeper,
Zoological Gardens.

F. G. Aflado, Esq.

----------oooo0oooo----------

(Mr Aflado kindly sent me the above letter from Tyrell and allowed me to keep a copy of it. I cannot see that it is of much value, as to what an/

an adder would do in a state of nature. An adder kept in captivity and having young born in a cage knows perfectly well that she cannot get away and also that her young are safe from injury. The keeper must be a very familiar figure to the caged reptile and I do not think it would be safe to conclude, that because he has been unable to frighten a captive adder into swallowing her young in a cage, that therefore it never occurs in nature. I hold no brief for the swallowing theory, but I consider such evidence as unscientific, and any conclusion drawn from it to be wrong. Nothing short of the kind of proof I have indicated previously will ever settle this question, but all evidence is welcome, whichever side it is on. Hence I thought it would be as well to give the foregoing letters on the subject.)

* * * * * *

XI. SINGULAR FIND OF LARGE ADDERS.

One of the haunts of the adder in the Monnow Valley is in the Norton wood on Hilston Estate This is a long wood some 2½ miles in extent, covering the summit and sides of a sort of peninsula into the valley. At one point this peninsula turns at a right angle and runs up here to a rocky steep promontory. This is just by the Norton Inn. Although only a quarter of a mile off the main road, the promontory itself is a very lonely spot, and except when the wood is shot (two or three times in Winter) I do not suppose anyone ever walks through this part of it. Consequently I thought I should not fail to find adders here, nor did I , and I have known the place for some years as a happy hunting ground. I purposely have not visited the spot this summer, because I wanted to be sure of getting some female adders at the end of July for dissection, and I thought by leaving them quiet till that time I should better attain my object. On Saturday last I instructed a "scout" of mine to take a stroll up to the wood in the afternoon and report to me. This morning (July 23rd) he came to me looking uncommonly pleased. His cottage lies between the wood and the road, not more than 150 yards from the edge of the wood. He reported that yesterday afternoon/

noon (Sunday, July 22nd) he walked quietly up the "ride" through the wood and killed four adders before he had gone 200 yards! He produced them with evident pride and they were a picture. I have never before had four in succession so large. I measured them with great care, with the following result:--

No.1. Female in young, 26 9/16 inches.

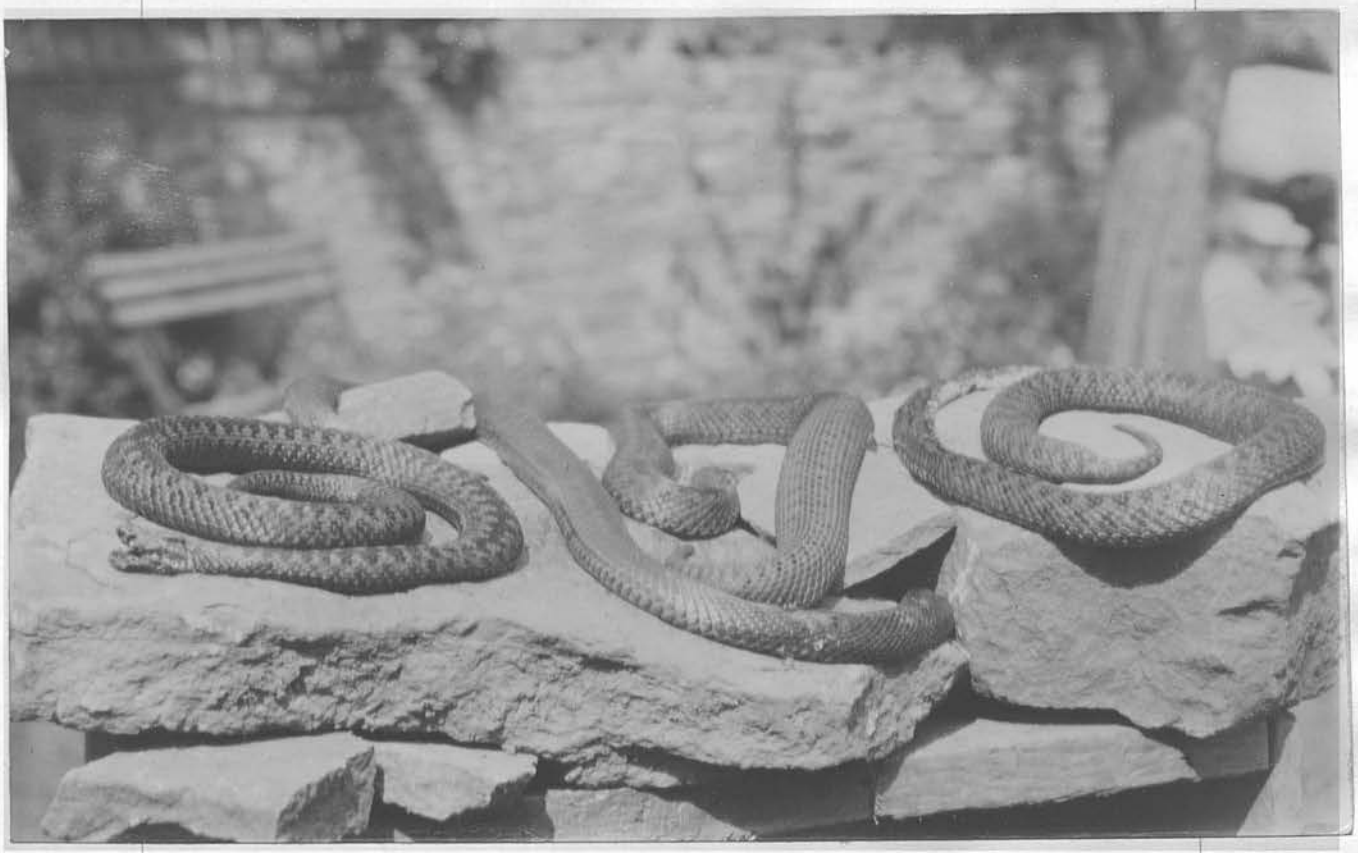
No.2. Female in young, 25½ inches.

No.3. Male, Beautifully marked, 24¼ inches.

No.4. Female in young, 26¼ inches.

Average for the four, 25 5/8 inches.

No.4. is the one from which the photograph of the full oviducts is taken. I also took the four in a group, and I here reproduce them. The one male is easily distinguished from the females, by the indications I mentioned under the head of "Colour Variation".



XII. THE NAKED EYE EMBRYOLOGY OF THE ADDER.

I now come to the point which I specially set myself to investigate this last summer (1900): viz., the development of the adder. I wished to obtain, if possible, a succession of female adders shewing the embryos at their different stages of development, and these from my own district. Only a person who has attempted this can realise the time and patience required for anything like success, and I think that, considering I had my professional work to do as well, I must account myself fairly fortunate.

I knew from former observation that the process of fecundation takes place soon after the adders begin to get about, in the warm spring days. In this district, one may see them on an early May day, sometimes in pairs (a male and a female) or more often three or four together. In the latter case one usually sees one male and the rest females. I have seen as many as seven, all lying together. (It will be remembered that I stated the proportion of males to females to be one to three or four.)

If then a female adder be taken a little later than this, what is the condition? My first specimen this year of a female in young was on May 16th. The/

The mother was 26½ inches in length. The eggs were seen at intervals in the oviducts (six in each oviduct) and were of the following size and shape:

Figure I.

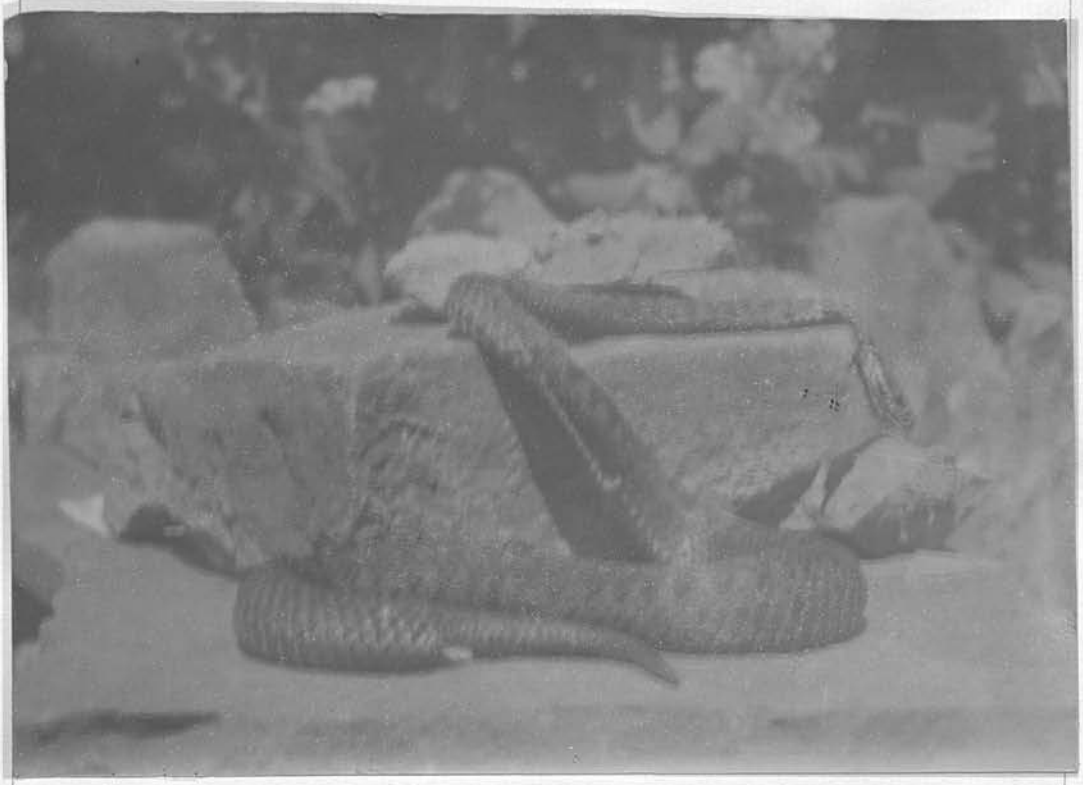
On section they appeared to the naked eye to be all yolk, inside the thin wall of membrane. The weight of each was 90 grains.

The next female in young I got on June 14th, near Pontrilas. She was 21½ inches in length and shewed very markedly the prominent full ovaries, which is well seen in the photograph I here reproduce:

She contained eleven embryos, and the eggs were seen to have altered their shape somewhat, being more rounded than before: thus:--

The young at this stage, on being taken out of the egg were seen to be well formed about the head and might be thus shewn:--

I did not get another female in young till the 10th of July when development had greatly advanced. The embryos could now be easily handled and proved to be seven in number. I took a photo of the mother, but the light was very poor and the result not a success. Still it shews very well the prominence of the ovaries in marked contrast to the thinness of the throat. This specimen contained the fewest embryos of any I have yet dissected, there being, as I say, only seven.



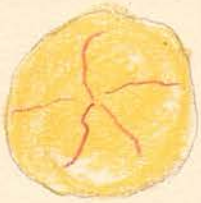
Taken out of the eggs the embryos were found to be from two inches to two and a half inches long. The eyes were very large and prominent and the whole head very bird-like in general appearance. The mouth was well formed. The body was about the thickness of a worm, white in colour and the abdominal wall not united in the middle line.

I next got a female in young on July 23rd, in fact, three on that date. These are the three referred to under the head of "Singular Find of Large/

Large Adders". The largest was 26 9/16 inches and is here shewn with a male taken at the same time and place. The difference in size, shape, and depth of colour markings are well seen in the photograph.

This female contained ten embryos. The main difference from the embryos of June 14th (two and a half weeks before) was in length. They were now just over three inches long and slightly thicker than before. The anterior abdominal wall was still unclosed. When I took the oviducts and eggs out, the dissection shewed the blood supply so beautifully/

beautifully that I photographed them before dissecting them, but unfortunately the negative got broken. However, I got an even better one later. The size of the eggs now was markedly larger and quite round.



The embryos were this size.

The other two females taken on this date I have still preserved undissected for future observation.

At this time of the year - the end of July - the development goes on most rapidly. The adder-mother lies out in the sun in the hottest spots available, no doubt that the heat may be utilised to further the process going on within her. Hence one/

one would expect to find that a week or two at this stage would make a great difference in the embryo, and so it does. By the second week in August, the appearance is quite different from what we have seen hitherto. I got a specimen at this time (August 13th) and was surprised to see the remarkable change. When taken out of the egg the embryos looked like young adders for the first time. There were 10 in the female and they measured 5 inches in length. The belly was now completely united anteriorly. The colour on the ventral surface was still white, but the division where each scale is to appear is evident. The general body colour shades off into grey on the back and the markings now shew distinctly. The zigzag line is well marked and an extra line of grey patches is evident opposite each point of the zigzag. The general appearance may be best judged, perhaps, by a drawing.

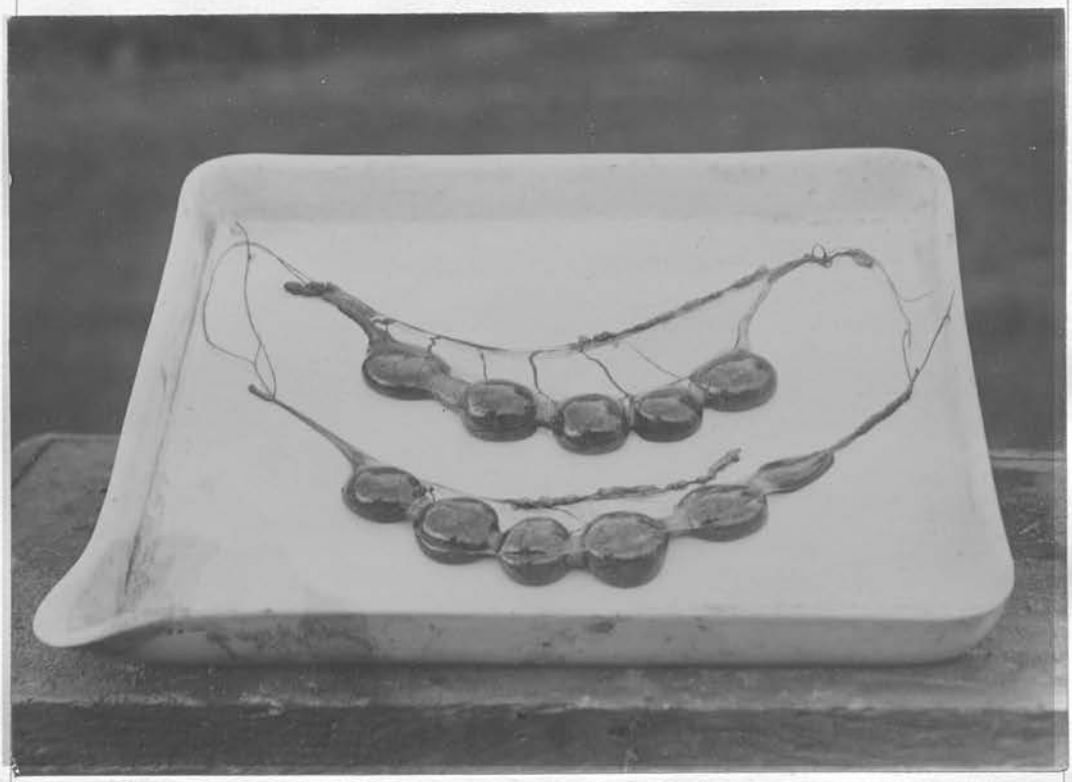
Side view.

Back view.

I reproduce here a photograph of several of this litter (The figures are inches)

There is one very interesting detail about the embryonic appearance of this stage, in connection with the development of the colour markings. It is this. At the posterior part of the head, where subsequently the dark V-shaped patch appears, is now a white V. That is to say, the pigment here has not yet been deposited, though the zigzag marking is complete all along the back. I had never observed this before, but have noticed it in other embryos since. The dark V seems to be the last colour marking to develop, as it is the most characteristic. These embryos were attached to the egg by an umbilical vessel. It was the photo of these, in situ, that/

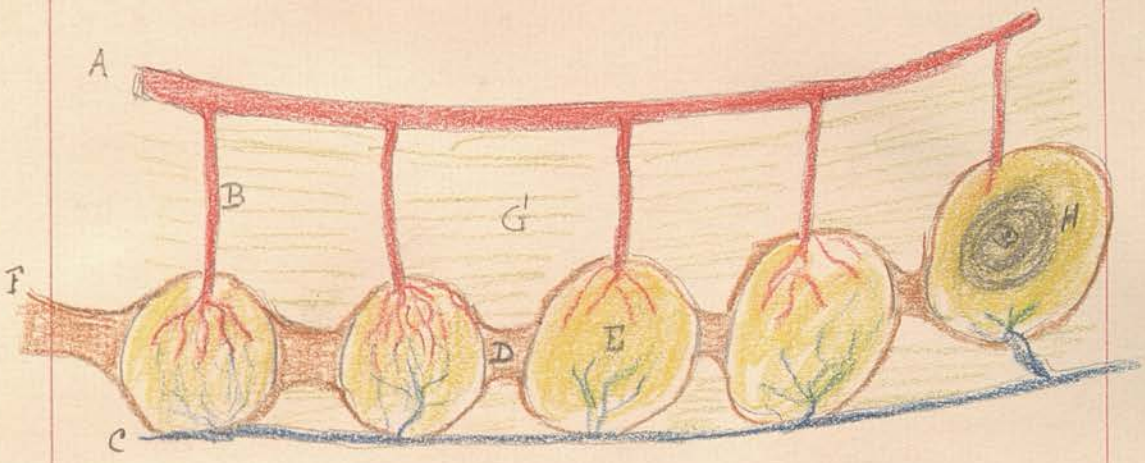
that gave the illustration of the blood supply so beautifully, which I previously referred to: and I now reproduce it (Photo No.7) The photo shews my usual method of dissection. The oviducts being exposed at both ends are there ligatured. A little gentle manipulation is all that is required to separate them and their contents from the other abdominal contents. They can then be lifted out bodily on to a dish as here shewn.



The upper is the left oviduct with five eggs. The lower is the right oviduct with six eggs. The embryos can be made out in the photo curled up in spiral form in the egg. The left oviduct in the photo (upper) shews the blood supply best. There is/

is one large main artery running along the free edge of a well marked mesentery; which artery gives off a large branch to each egg. This branch breaks up into a number of smaller ones on reaching the egg and forms a network of vessels all over the egg surface. These again unite with one large vessel on the oviduct end of the mesentery. The mesentery (or fold of peritoneum) itself is a double layer, which splits and encloses the eggs and oviduct. This is the typical arrangement, but often one sees two or more branches from the main artery going to one egg. Reproduced diagrammatically (but of natural size) the appearance would be seen as in the next diagram: perhaps easier to follow than the photo. I should add before leaving this interesting photograph that the oviduct is well seen as a broad band between each egg, expanding to cover each egg in succession and finally becoming much smaller at the cloacal end, i.e. to the left of the photograph.

Diagram of Blood Supply.

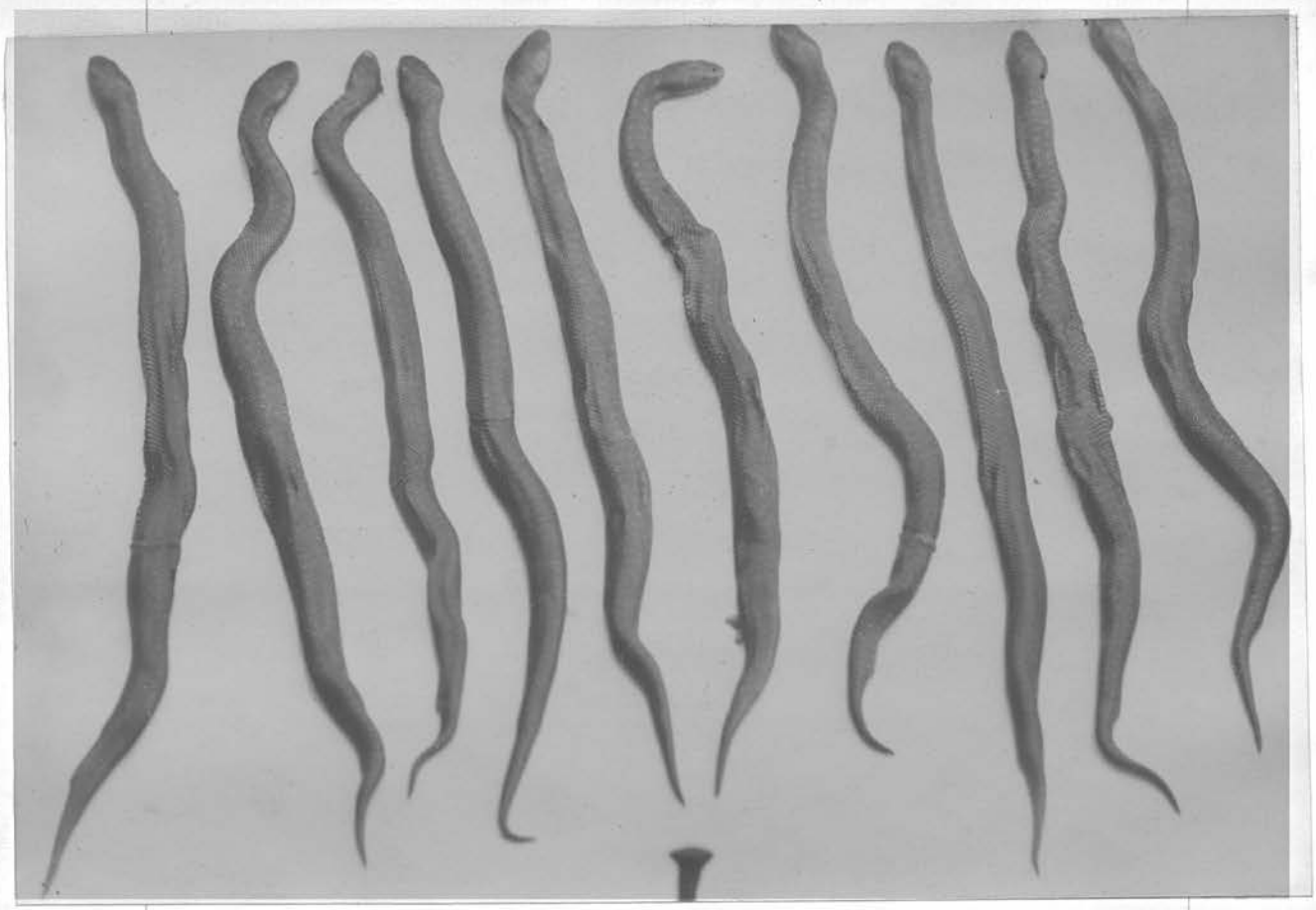


A. = Main Artery.
B. = Branch to Egg.
C. = Main Vein.
D. = Oviduct between Egg.
E. = Egg containing embryo.
F. = Cloacal end of oviduct.
G. = Mesenteric membrane.
H. = Embryo curled in egg.

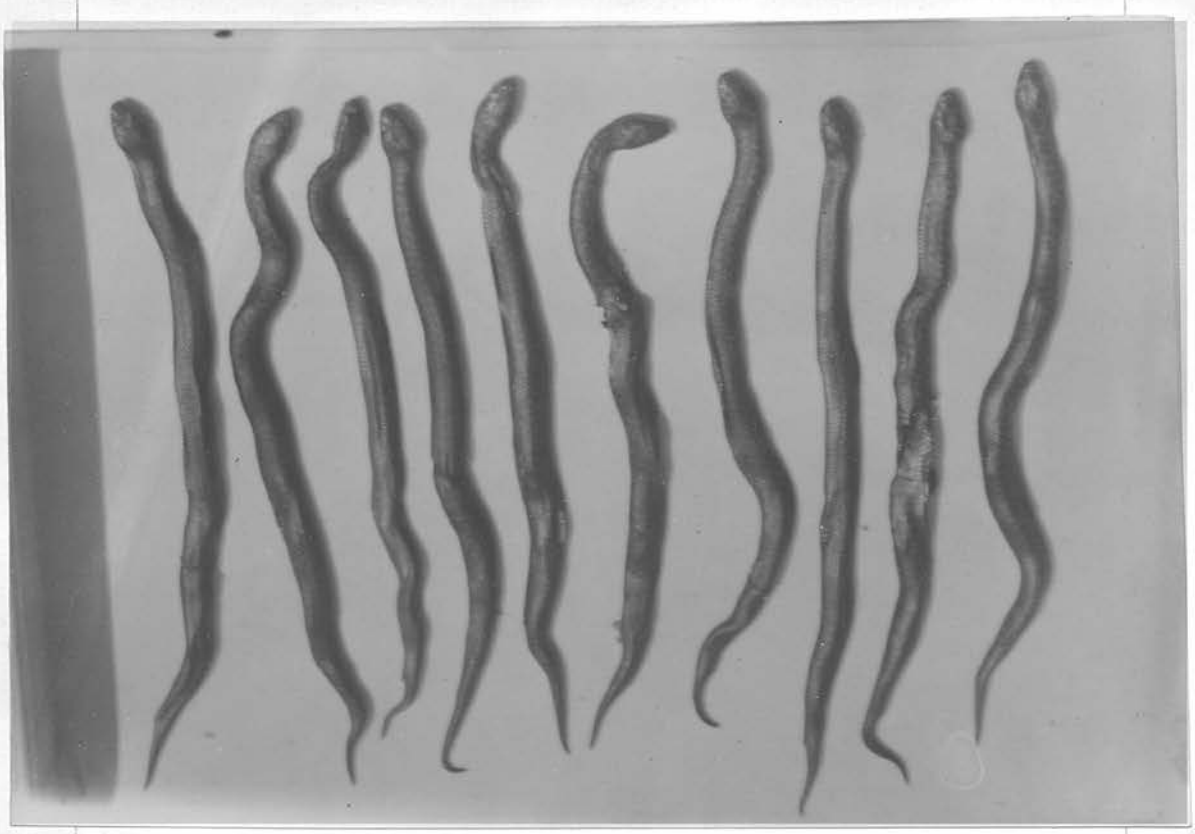
At this stage the embryo by no means fills the egg, there is still a large quantity of yolk matter left, the embryo lying, as it were, on the surface. I had just reached this most interesting stage last summer (1900) and was hoping to get a few more specimens of later development, when the weather changed here from warm, dry summer, to very cold, wet weather, with easterly winds. This was a great disappointment. The adders retired into the woods and bracken and not one was seen about for three weeks. It was then September and I almost despaired of getting any more before the young were born. However, one fine sunny afternoon (on September 4th, 1900) I was/

was fortunate enough to capture on the Graig Hill, in a favourite spot for adders, a female very big with young and which proved a specimen which, as far as my experience goes, is unique. She measured 25½ in. in length, and was so heavy in young that she moved with difficulty and I captured her with the greatest ease. Arrived home with her, I photographed her in her jar at once with the following result:-

I could feel the young adders through the abdominal wall quite distinctly and knew that they must have arrived at full time. I made the dissection next morning with great care and found a most interesting condition of affairs. (I use a blunt pointed bistoury for this dissection.) Inserting the knife in the cloaca for about one inch, I slit this up. An embryo adder at once presented itself to view. Proceeding very carefully so as not to disturb the position of the relative parts, I slit up the abdomen and saw two more young adders. Turning back the abdominal wall I was surprised to find that these three young ones were lying loose in the cloaca. I gently lifted them out on to a dish and went on till I had exposed the whole of the oviducts. These I tied and lifted out in the usual way described before. I then counted the litter, which I found to number fourteen. But what amazed me was the size of the young. I carefully uncoiled one and measured it. It proved to be 7 inches long; then another, 7½ inches; then one just 8 inches. I found the whole fourteen varied from 7 to 8 inches in length. When exposed and uncoiled they looked perfectly developed and no one would have supposed they were embryos. I arranged ten of them in a row on a plate and photographed them. Here they are:



The picture so fascinated me that I took a second one in case anything should happen to the first negative. Both turned out well, so I give the second as well.



Of course, the great interest of this specimen is that the young were on the point of being born alive. Another hour or two would probably have seen fourteen young adders playing about on that spot. They certainly look quite able to take care of themselves. As I said, three were already loose in the cloaca and shewed the membrane ruptured where they made their exit. This was a new point. It appears to me from this specimen that the young do not pass along the whole length of the oviduct and make their exit at the cloacal end, but rupture the egg in situ. There was no trace of yolk left now,/

now, nothing but the young adder coiled up in a remarkably small space with the membrane covering it. Once uncoiled and exposed, it seemed impossible that the litter of fourteen could have got into so small a space. It seems then that each embryo ruptures the egg membrane when mature, escapes into the cloaca and thence is expelled by the common opening. This was the last specimen I saw this season. As far as I can tell these young adders are perfectly fully developed. The colour markings are complete, the teeth are present, and the fangs quite ready for use. One interesting point I noticed when arranging them to be photographed, viz. that they were casting a very delicate slough already, before birth. It was peeling off backwards and can be seen in the photo in one or two of the adders as a ring round the belly. The mother of this litter was casting her slough at the time also and shews the process very well in her bottle.

This completes the series of embryos I got in the summer of 1900 and considering the cold weather in August I think it is fairly satisfactory. I have preserved all the specimens referred to and hope in the future to carry out a microscopical examination of these in detail. My great regret is that country practice leaves one so little time and means for pure science.

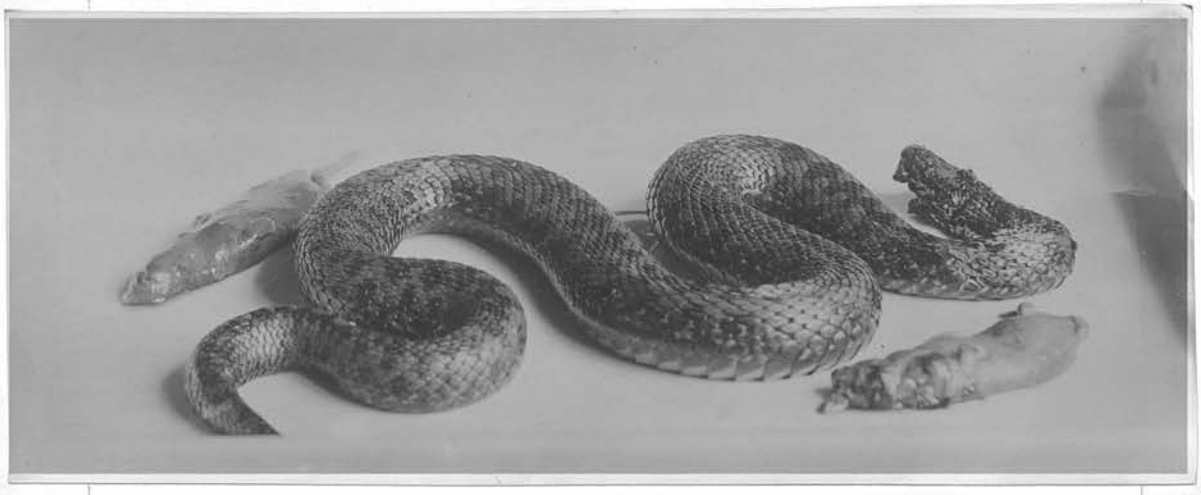
* * * * * * *

XIII. THE FOOD OF ADDERS.

One of the parts of reptile literature which seems specially defective is that dealing with their food and its digestion; and particularly difficult is it to get authority for the statements that are made. There are only two methods of investigation that seem to me of any real value, namely, actual observation out of doors, and dissection of the stomach of freshly killed adders. The former is almost impossible to carry out and one has to rely mainly on the contents of the stomach. I have referred to this question of food previously, when dealing with the problem of the absence of the grass-snake from the Monnow Valley. In this chapter I wish to give some examples of what has come under my own notice in this direction.

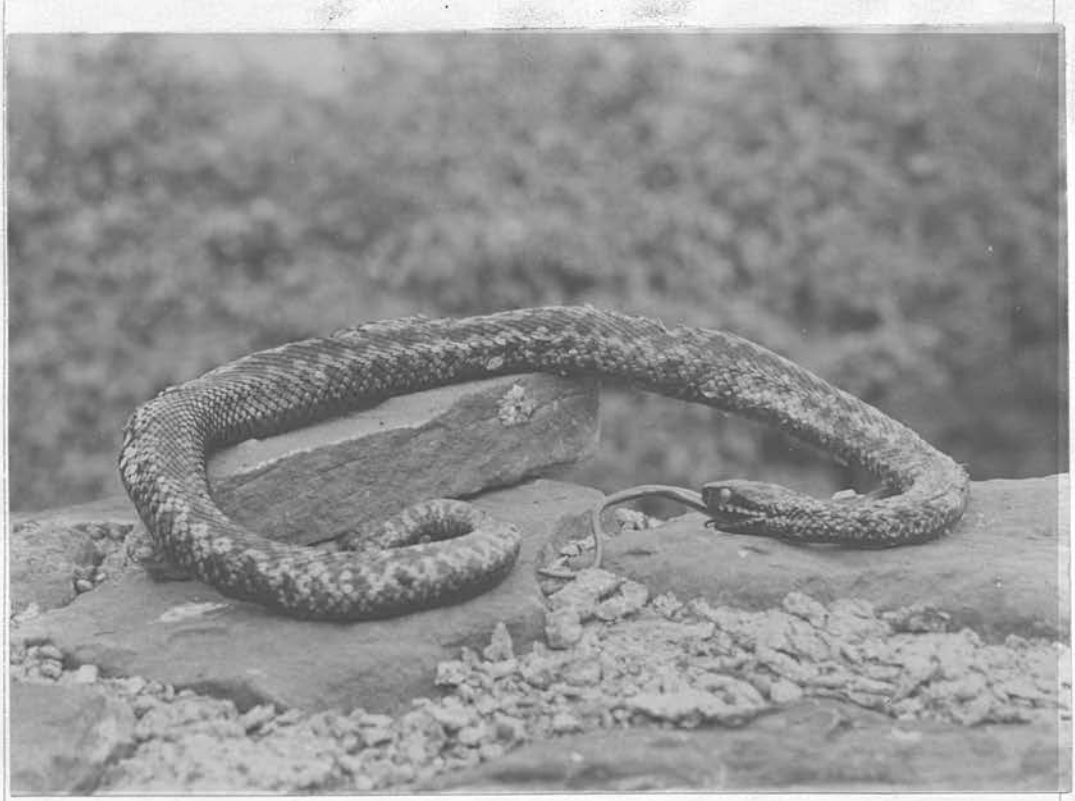
The first thing that I observe is that in the great majority of adder stomachs I have opened, absolutely nothing at all is found. That means, in other words, that the adder does not feed continuously, but at more or less long intervals. In my own district I have found singularly little variety in the food. It seems to consist mainly of the small rodents, mice and water-voles particularly. I once took an adder at Skenfrith just on the/

the bank of the Monnow river. The throat region looked very full and without any difficulty I expressed a young water-vole. On opening the stomach I found another, partially digested. The first was quite unharmed and evidently just swallowed; the second, I fancy, had been swallowed a day previously, and the adder had returned for another course of the same dish. Curiously enough, this summer I took an adder which shewed exactly the same condition, except that in this case I was able to express both by a little continuous manipulation. I photographed this specimen with the water-voles and here reproduce it. The adder is a male, 24 inches long.



It will be noticed that the water-vole on the right hand side is quite undigested while that on the left shews at the head end the process of digestion/

digestion partly advanced. This proves that the adder can retain food in its oesophagus undigested till required to be passed on into the stomach; and accounts for the fact that frogs and toads have been rescued alive from the inside of an adder. Though generally described as having been in the stomach, probably they were really in the oesophagus. Obviously also this bears on the swallowing theory, and probably the young adders could remain alive some little time in the oseophagus: it would certainly be most interesting and curious to find them there. In this district, as I before stated, there are comparatively few frogs and the blindworm is the only common lizard. The latter is very common, and I have no doubt that the adders feed largely on them. I got a very interesting specimen in a quarry near my house this summer. I was looking really for a pregnant blindworm, as I wanted to keep her in captivity to observe the parturition. I had known this quarry for some years as a resort of adders and blindworms. (The quarry is no longer used and is overgrown with bramble.) I turned over a large flat stone, some two feet square, and was most surprised to find underneath it a large male adder in the very act of swallowing a blindworm. Here he is as I slew him and photographed him on the spot.



The adder is a male 25½ inches long and one of the most beautifully marked in my collection. The blindworm is evidently a young one, and about four inches of it is projecting from the mouth of the adder. I left it <u>in situ</u> and have it still preserved just as I took it. The smaller and softer articles of food generally credited to adders, such as birds' eggs, insects, etc., are of course so quickly digested that one is hardly able to recognise them. I have one specimen which looks like a small black rat, but it is a good deal digested and I could not be certain about it. On our hills mice and blindworms are certainly the main dietary and water-voles on the river banks. I am inclined/

inclined to think that the adder gets into a "run" or burrow made by the mice in the leaves which lie on the ground and there waits for the mouse; as I have several times seen an adder disappear down one of these "runs" in the bracken and woods. Ant eggs are eaten freely also.

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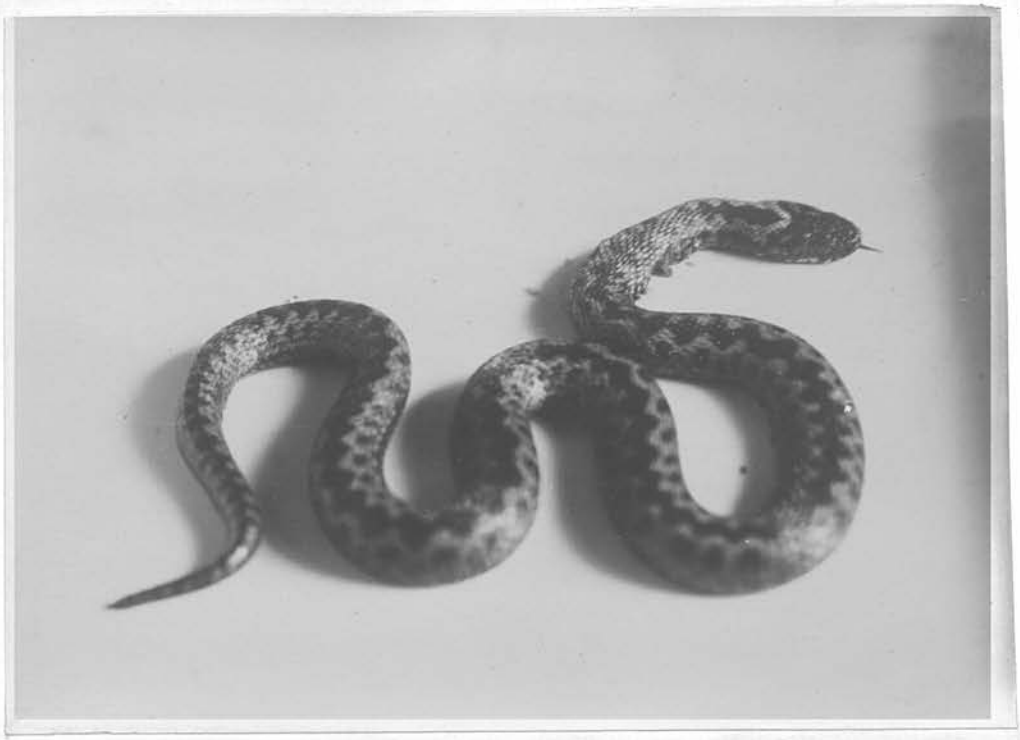
XIV.

VARIOUS PHOTOGRAPHS.

I now propose to reproduce a few of the more interesting photographs in my collection, which do not fall under any particular heading, but simply illustrate the size, shape, markings or other individual peculiarity, or point of interest. I trust they will be judged not from the standpoint of the professional photographer, but from that of the naturalist. Snakes are very difficult animals to photograph satisfactorily, but I believe I have, at any rate, photographed as many and as various specimens as have been done before. My only regret is that I did not take up photography earlier, as I missed much in my first few years here, which would have been of interest to reproduce. My main object has been to shew the point of interest in each photograph rather than produce a highly artistic picture. The only one which has been published so far (October 1900) is the one of the gullet before referred to. Others have been promised for illustrating articles later.

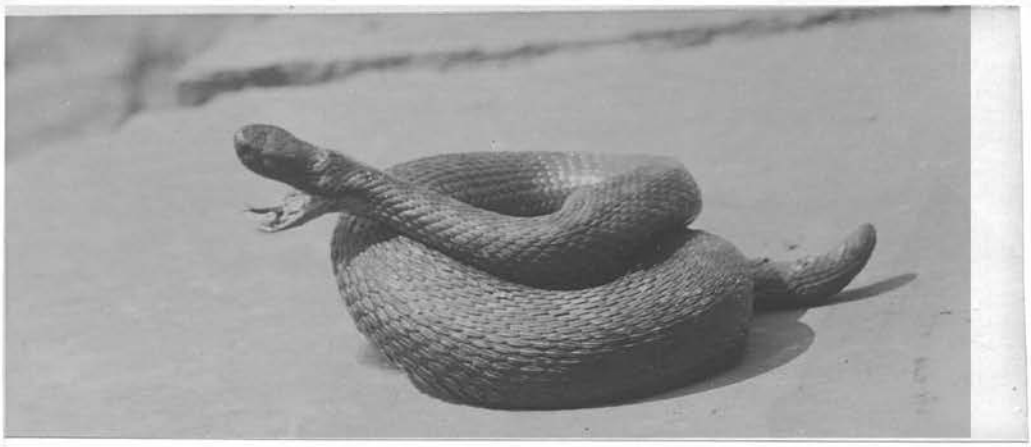
These are the two largest adders in my collection, both females, measuring 28½ and 26¾ inches respectively. The former, captured close to my house in October 1898, is the largest I have been able to get any authentic record of. G. A. Boulenger (British Museum) has no British specimen of this large size and says he very seldom hears of an adder measuring as much as 26 inches. I have half a dozen over 26 inches long.



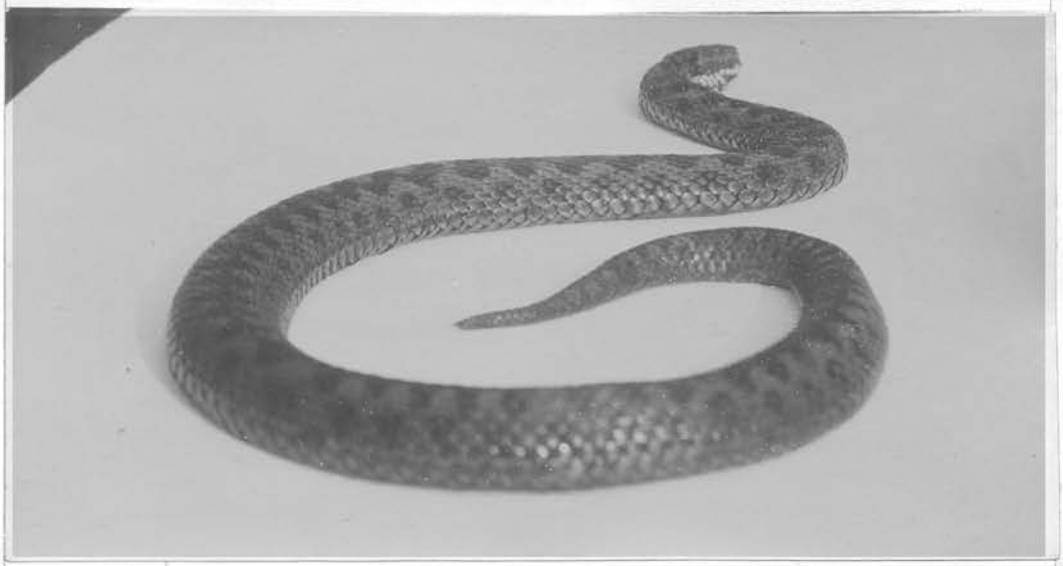
I consider this photograph in some respects the best reptilian photo I ever took. It is a young male adder 19¾ inches long, caught in May, 1899, just after casting his slough. The markings are the most beautiful I have ever seen in their brilliancy, the skin being of a bright gold colour and the patches very black. It is also interesting as being the smallest adder I have seen in this district, though still larger than the usual figure given, viz 18 inches.

This photo, with the next, I once offered to "The Field", but the editor declined them more or less politely.

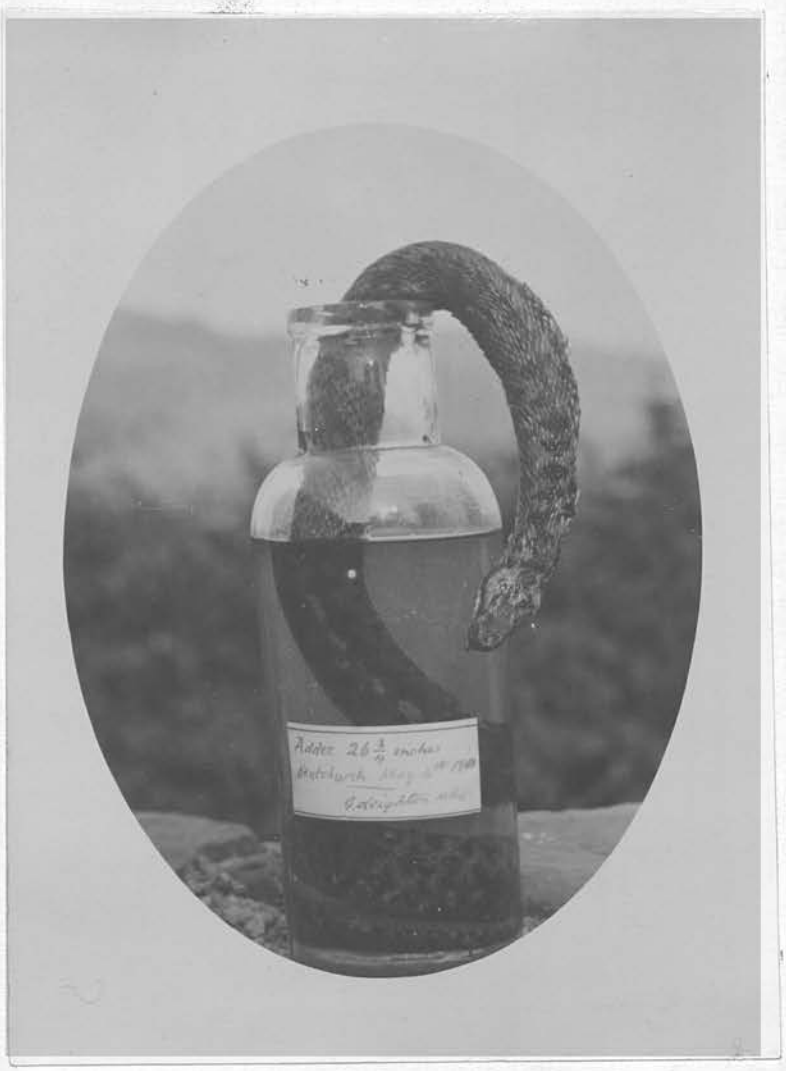
F. G. Aflalo, F.Z.S., considers this the best photo I have. It is a male adder, 26½ inches long, the largest <u>male</u> I have seen. The focus of the photo is so accurate that the forked tongue is beautifully seen to the very tip, and even the shadow is quite distinct. This photo shews the arrangement of the scales, particularly well. The age of the snake is evident from the flattened character of the body generally. Contrast this with the oval shape of the last (No.14) which is a young male and the difference is at once seen and is instructive.



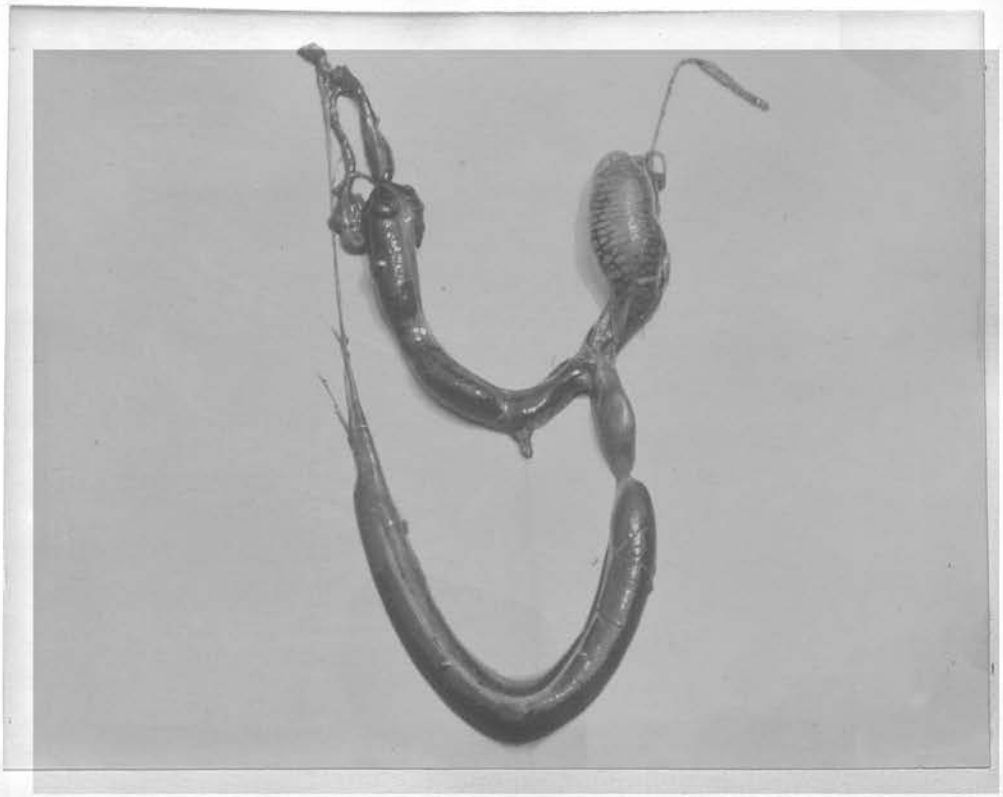
This is an old female 26½ inches long. It is an example of what I mentioned under "Colour Variation" of the markings almost disappearing in some old specimens. The V-shaped marking and the zig-zag marking just behind the head are visible, but the rest of the body shews no markings at all. The jaw is wide open, as in yawning, and shews the tongue and muscular sheath. The scales, too, are well seen.



This is a male adder, 24½ inches long which I captured on Ewyas Harold Common on August 19th, 1900. It shews what I have often drawn attention to, the much greater brilliancy of the markings in the male than in the female. It also shews very well the curious yellow marking round the lower jaw and the row of black patches opposite each point of the zigzag line along the side of the body.

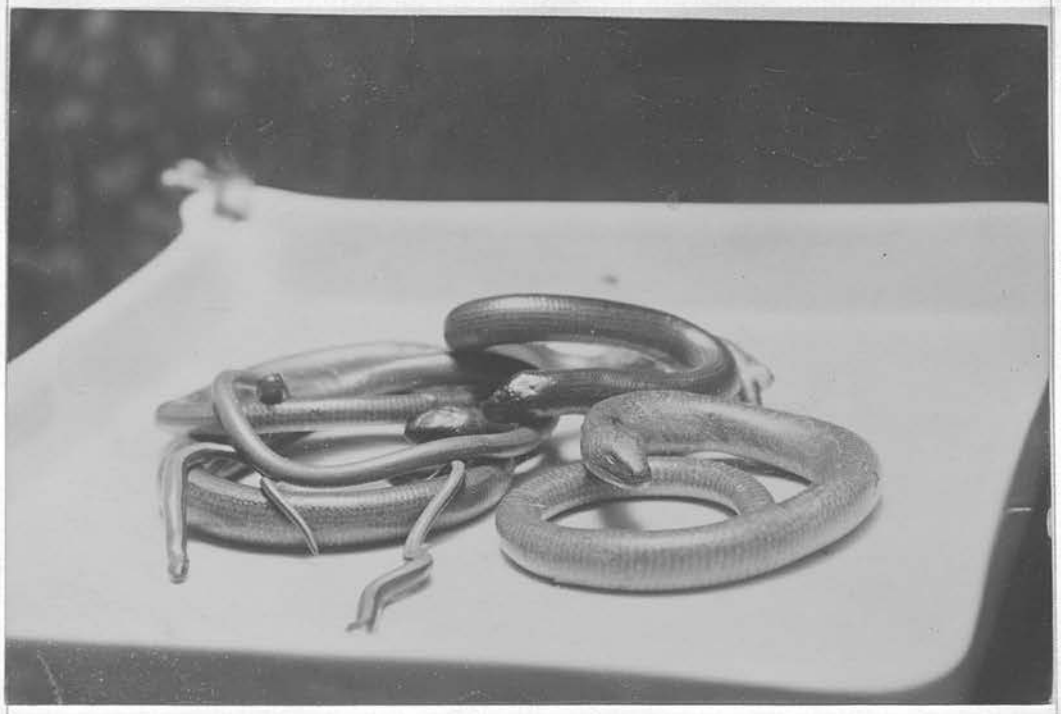


This is my second largest specimen, a female $26\frac{3}{4}$ inches; taken in a wood at Kentchurch on May 4th, 1900. She was crawling over a heap of dead brushwood, under which in all probability she had been hibernating. This was the first adder I saw this spring (1900).



This is a dissection which shews the heart, lungs and liver of an adder removed from the body. The liver is curled in a semi-circle to bring the whole of it into view. The lungs shew the capillaries full of blood, spread out over the air sac. (It has been inflated to distend it.) The right lung, as usual, was developed, not the left.

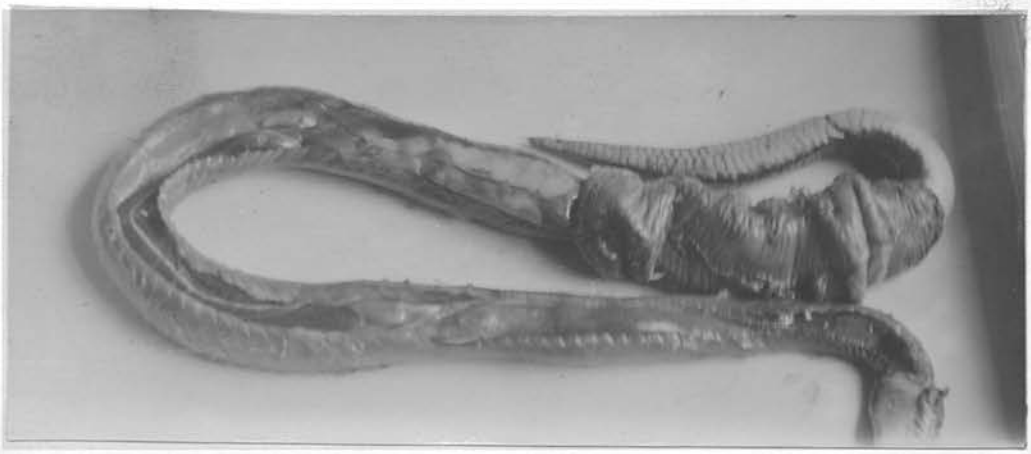
This is a photo of the only specimen of the grass-snake, Tropidonotus Natrix, that I ever saw in this valley. I have referred to it previously. The photo is not a good one, but shews the yellow collar well. The snake is 24½ inches long and was caught on Kentchurch Drive in September 1898-



There are seven blindworms in this photo. I found them all in one heap of stones and put them together in a heap to photograph them. They are all sizes and ages. One young one was crawling out of focus as the photo was taken. The large one in the front right hand corner was a fine specimen, 17 inches long, and comes out very well. All were alive, of course. It is curious that the other lizards should be so rare, and Angius Fragilis so common. I hope next summer to do more work at this reptile than I have had time for yet.

The large one shows the knob where the rudimentary limb is under the skin.

This illustrates the method I formerly employed in catching adders. The instrument is simply an iron prong. I have since devised a far more satisfactory instrument which does not harm the adder in any way.



This is a dissection made by dividing the skin round the neck and skinning the adder as one would an eèl. It shows the position of the lung, heart, liver and the fat over the intestines in situ. The trachea is also visible: and the points of the ribs. The following is a slightly different view.

This, the last of the photos I now reproduce, explains itself. I was dissecting the oviduct of a female adder when a friend took me at work, with the above result. There were 11 embryos in this particular dissection.

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C O N C L U S I O N.

I have now indicated the main lines of my own investigations during the last five summers in the valley of the Monnow river. I think I have said enough to prove the great interest of this locality from an Ophidian point of view. I have purposely left out entirely all that may be found in our ordinary books on British reptiles, such as they are. I have not touched on Anatomy, or scarcely, because this has been done thoroughly by others in laboratories, and can be read in our larger textbooks. For this reason I have left out a detailed description of the poison apparatus, and have tried to confine myself to the Monnow Valley. I have a large mass of material in my collection which goes beyond this limited area, and it is my hope that I may be able to afford time and money to publish the whole in book form. There are many lines of investigation still to be worked up in our snakes, such as the comparison of adders in various parts of the country, the power of the poison on different animals and on themselves, the question of parental relationship in adders, their length of life, the feeding of the young - and many other questions, all more or less obscure at present. The great difficulty is the great amount of time required/

required to investigate snakes in a state of nature. I had intended this autumn (1900) to go down to Caermarthenshire (South Wales) and to do some reptile work there, but professional work interfered. From correspondence I receive from that part, I believe one would be well repaid for a journey there, and the comparison with my own locality would be most interesting. I should also like to study the small red viper in Devonshire, or some other place where it is common. I think this viper ought surely to be regarded as a separate species. It is very rare here; but I have one specimen which I caught on the summit of the Graig Hill. It measures 10 inches in length; and I am not aware that one had ever been seen here before. This small red kind deserves more attention than has been bestowed upon it. I hope, too, to prepare a set of microscopical preparations of the various reptile organs which ought to throw some light on the processes of digestion and fecundity. But one must set a defined limit to a thesis, so I thought it better to confine myself, for this purpose, to the peculiar reptile characteristics of the Monnow Valley.

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