

6. Observations on the Incubation of the Indian Python (*Python molurus*), with special regard to the alleged Increase of Temperature during that process. By W. A. FORBES, B.A., Prosector to the Society.

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The first exact observations of the incubation of their eggs by the females of the constricting Serpents included in the genus *Python* were made, forty years ago, by M. Valenciennes in the Jardin des Plantes at Paris, his account having been published in the 13th volume of the 'Comptes Rendus' for 1841¹. In this case the species observed was *Python bivittatus*: a female, about 10 feet long, which had been in company with a male of the same species of rather smaller size, and with which she had been seen several times *in copulâ*, laid at the beginning of May fifteen eggs, round which she coiled herself up, and so remained for fifty-six days, when eight of the eggs hatched, producing young snakes about half a metre in length. During the period of incubation Valenciennes observed a marked increase of temperature in the female, highest at the commencement of incubation and gradually diminishing thence till its close. His observations on the temperature are recorded in a table appended to the memoir already cited; and to them I shall have further occasion to refer in the sequel.

In the year 1862, a large female *Python sebae* laid a number of eggs, and also incubated on them, in this Society's Gardens, as described by Mr. Sclater at length². The period of incubation lasted 82 days; at the end of that time the eggs were removed, as none had hatched, and they were evidently decomposing. On examination five or six were found with embryos inside, one of these being eleven inches in length. A few observations on the temperature of the female were taken, that of the male in the same compartment being taken at the same time. In every case, the female was found to be several degrees warmer than the male, the difference ranging between 2°·8 F. and 12°·4 F. when the surface temperature was recorded, and between 6°·8 F. and 20°·0 F. when that between the folds of the animals was measured.

During the past summer we have again had an opportunity of observing the incubation of a Python in the Society's Gardens. A female *Python molurus*, about 12 feet long, which had been living in company with two somewhat smaller males (one of this species, the other being a *Python bivittatus*), deposited during the night of June 5th-6th a number of eggs, about twenty. Round these she coiled herself up, in the same way as already observed by Valenciennes and Mr. Sclater, the eggs being nearly entirely concealed from view by her folds. In this position she remained for six weeks, without once eating, and with only one break in her

¹ *Tom. cit.* pp. 126-133.

² P. Z. S. 1862, pp. 365-368.

incubation, in the early part of July, when she left her eggs for a few hours, returning to them again however and coiling herself up as before, though now the regularity of her folds was not so great as it had been previously. On July 18th (that is, after a period of forty-three days from the date of laying), as the eggs were evidently decomposing, they were removed; and their state on examination was found to be very similar to that observed by Mr. Sclater on the previous occasion. Several of those examined showed no traces of having been impregnated; at least, no signs of any development inside remained; one or two, however, contained embryos, one of which was about 11 inches long, and had its scales well developed.

From the discrepancies existing between the observations of Valenciennes and those made here previously on the temperature of the incubating Pythoness, it seemed highly desirable to utilize the opportunity afforded by this last instance for a further and more extensive series of observations on the phenomenon in question. Mr. Zambra, of the well-known firm of Negretti and Zambra, who had himself taken part in the observations made in 1862, was kind enough to give me his most valuable aid and assistance in this investigation. He not only supplied us with excellent self-registering thermometers of the newest pattern and most delicate make, but was also kind enough to attend regularly—often, I fear, at considerable inconvenience to himself—to superintend and take the necessary readings. With the assistance of Mr. Bartlett, Mr. Clarence Bartlett, and the keeper of the reptiles, J. Tyrrell, Mr. Zambra and I were thus enabled to take a very considerable number of observations on the point in question, with instruments of a more accurate kind than had been available for our predecessors. Our first observations were taken on June 14th, about nine days after the eggs were laid; and they were continued thence without intermission, at intervals of two or three days, till the eggs were removed on July 18th. The readings were always taken about the same time of day, from 12 to 2 o'clock, in order to avoid any differences that might be due to the diurnal variation of temperature. Following Mr. Sclater's example, we took a double series of observations, one set on the incubating female, another on the male of the same species, which, after it had been removed from the female when the eggs were laid, was kept in the cage next to that of the female under conditions practically identical. The temperature of the Snakes was ascertained, first by placing the thermometer on the surface of their bodies, and then by placing it between the folds of their coils. In each case their bodies were covered by the blankets under which they usually rest; and, as far as possible, the different readings, of which we usually took three in each set, were obtained in as many different places in the coils, one towards the centre, the others more towards the outside. The temperature of the air was taken by suspending a thermometer a little way above the floor of the cages; that of the gravel in the cages by burying the bulb of the thermometer in the gravel, in the same position in each cage, and over the hot-water pipes which run beneath the floors of the cages.

The observations are given *in extenso*, as we took them, in Table I. (p. 964). In Table II. (p. 967) I have given the average temperatures of the two Snakes, as deduced from these observations, as well as the difference for each set of readings in the temperature in the two sexes. In the diagrams (figs. 1 and 2, p. 963) I have recorded these averages in a graphic form, the upper line marking the average temperature *between* the folds and the middle line the average *on* the folds, whilst the lowest one indicates the temperature of the air in the respective cages. This last curve is nearly identical in the two cases, that in the male's cage averaging, however, a trifle higher. Although this is the case, it will nevertheless be observed that *both* the temperature-curves of the female are higher than the corresponding ones for the male, especially the upper one. All four are clearly influenced by the variations in the external medium, the maxima temperatures of the snakes' bodies being attained when the air is hottest or nearly so.

Not only are the temperature-curves of the female higher, but, as shown by their less amount of angularity, the temperature of the female continues more constant throughout the time observed. This, no doubt, may in part be due to the fact of the female being in a condition of repose throughout, with no variations produced by exercise, the assimilation of food, or other causes.

Taking the averages of the first four columns of Table II., we get respectively $82^{\circ}\cdot98$ F. and $86^{\circ}\cdot03$ F. as the temperature of the male, and $84^{\circ}\cdot38$ F. and $89^{\circ}\cdot07$ F. as that of the female, according to whether the temperature is taken on the surface or between the folds. These figures give a difference of $1^{\circ}\cdot4$ F. and a little over $3^{\circ}\cdot0$ F., the difference being in each case in favour of the female.

The *maxima* readings obtained were, as may be seen from Table I., $89^{\circ}\cdot6$ F. (July 4) and $89^{\circ}\cdot8$ (July 15) for the male (surface and folds), and $89^{\circ}\cdot8$ F. (July 15) and $92^{\circ}\cdot8$ F. (July 1) for the female. The maximum observed by Valenciennes was $41^{\circ}\cdot5$ C. ($106^{\circ}\cdot7$ F.), or nearly 14° higher than the highest I observed.

The greatest difference between the temperature of the air and that of the surface of the two Snakes was $8^{\circ}\cdot3$ F. (on June 16th) in the case of the male, and $9^{\circ}\cdot6$ F. (on June 18th) in the case of the female. The greatest differences between the air and the coils were also observed on the same days, and amounted to $11^{\circ}\cdot6$ F. in the case of the male, $16^{\circ}\cdot7$ F. in the female. Valenciennes found on one occasion the difference, as measured between the coils, as much as $21^{\circ}\cdot5$ C. (between $18^{\circ}\cdot0$ C. and $39^{\circ}\cdot5$ C.) or $38^{\circ}\cdot7$ F., a difference enormously greater than any we observed.

It would seem therefore that, if his observations are to be relied on, throughout the case recorded by Valenciennes the female developed a far greater amount of heat than ours did, though she was kept in a cage that was apparently considerably colder¹. As in this

¹ The extreme temperatures of the air recorded by Valenciennes—who took his observations when the cages were coldest, *i. e.* before the fresh hot water was put in—are 17° C. and 23° C. ($62^{\circ}\cdot6$ F. and $73^{\circ}\cdot4$ F.) respectively. The temperature of the two cages in which our animals were kept was only on three occasions less than the highest in Valenciennes' series.

Fig. 1.
Male.

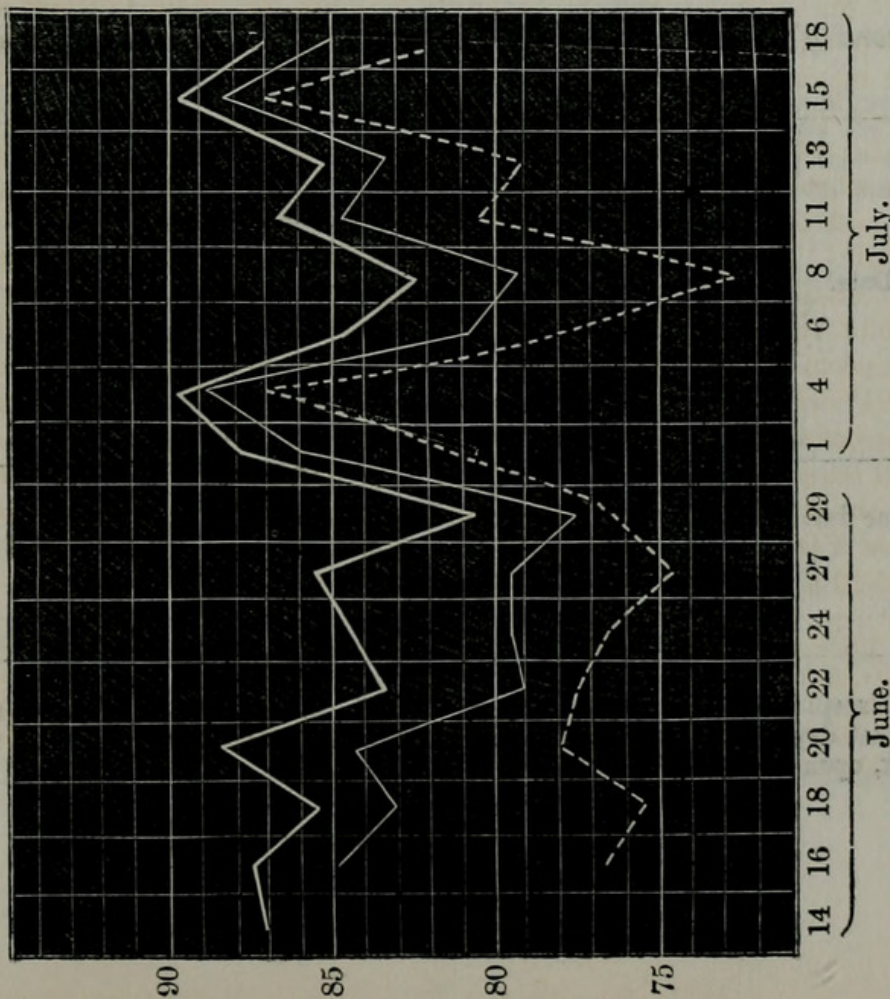


Fig. 2.
Female.

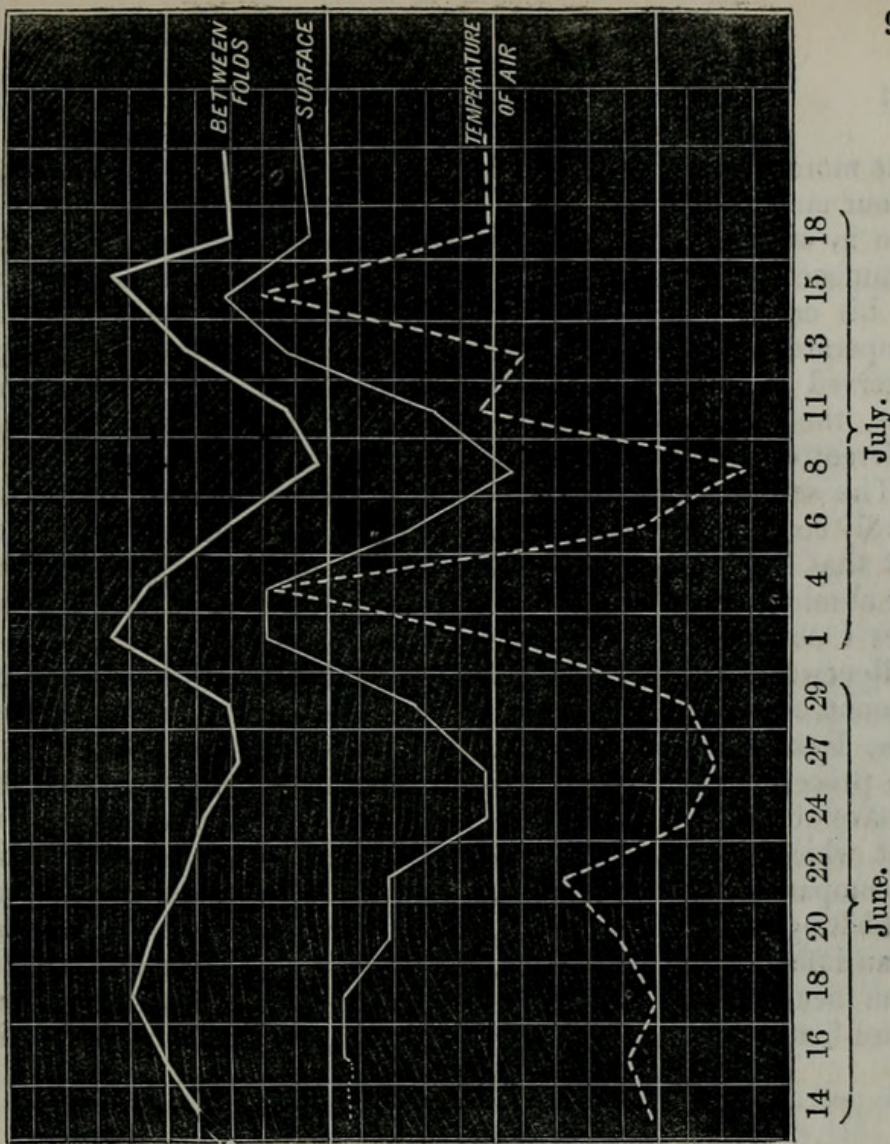


Diagram showing the temperature-curves of the male (fig. 1) and female (fig. 2) (incubating) Pythons. The top line indicates the temperature of the Snakes' bodies between their folds, the middle line that on the surface, the lowest line that of the air of the cages in which they were.

case more than half the eggs hatched out, it may be that the failure of our animal to do the same was due to the lack of heat. There is also in our case none of that steady fall in temperature, from the commencement to the close of incubation, observed by Valenciennes. In his case, at the commencement of incubation the female had a temperature of $41^{\circ}5$ C. ($106^{\circ}7$ F.) between the folds (the highest observed at all), falling at the end to 28° C. ($82^{\circ}4$ F.). In our case, the maximum temperature was very nearly obtained on three different occasions.

The second set of observations, those made here in 1862, are hardly complete enough to allow of much comparison; but throughout that series the differences between the sexes are greater, though the absolute temperatures are considerably lower¹ than the average ones I obtained.

Renewed observations will be required to satisfactorily settle the amount of the increase of temperature—a fact of which there can now, I think, be no doubt—which is produced in these reptiles by the process of incubation. The average difference of 3° F. which I have obtained is, it may be observed, very nearly identical with that which occurs in the case of the temperature of fever-patients as compared with the normal. And as the increase of heat in an incubating bird is essentially of the same nature as that produced by an inflammation of a tissue, and such is also presumably the case in an incubating reptile, the nearness of the results thus arrived at is, in itself, an argument in favour of the correctness of my observations.

TABLE I.

Record of Observations on the Temperature of the incubating (Female) and non-incubating (Male) Pythons.

Date.	Air in cage.	Air under blanket.	Gravel of cage.	Male on folds.	Male between folds.	Female on folds.	Female between folds.	Remarks.
June 14...	♂ 75.0	° 77.2	° 82.5	84.8	86.9 86.7 87.6	°	89.5 88.5 88.9 88.7	

¹ Except in the case of one reading of 96° F., taken on the female, which was on that day 20° F. warmer than the male. This observation, however, is, I think, open to doubt.

TABLE I. (continued).

Date.	Air in cage.	Air under blanket.	Gravel of cage.	Male on folds.	Male between folds.	Female on folds.	Female between folds.	Remarks.
June 16...	♂ 76.6 ♀ 75.7	° 78.7	° 83.3	86.7 83.5 84.6	88.1 87.1 87.5 86.7	83.6 86.9 83.3	90.8 88.8 90.3	An observation taken on the tail of the male gave 82° 3. Two on another male on the tree in cage gave 76° 7 (each time).
" 18...	♂ 75.5 ♀ 75.0	79.6 81.3	84.5 83.8	82.6 83.5 83.6	86.3 83.8 86.5	84.4 85.4* 84.0	91.3 90.0 91.7	The male had fed the previous night. * Tail.
" 20...	♂ 78.0 ♀ 76.2	77.2 76.4	86.3 83.5	84.0 84.5 84.5	87.9 88.0 89.6 88.4 88.4	85.0 82.9 82.7	88.6* 92.7† 91.3 92.0 87.2	* The blanket over here was wet. † Tail.
" 22...	♂ 77.4 ♀ 77.8	79.1 82.3	84.7 84.0	77.3 79.8 80.1 78.6	84.5 82.8 83.8	80.9 83.4 85.9	88.9 89.7 89.9	The temperature of an egg, on the exposed surface, was 88° 3 (two observations).
" 24...	♂ 76.3 ♀ 74.4	73.7 73.9	83.5 79.5	79.2 78.6 80.7	84.4 84.4 84.3	78.3 80.6 81.8	88.7 89.3 88.0	Temperature of an egg 88° 1.
" 27...	♂ 74.6 ♀ 73.4	75.4 76.2	83.8 82.0	81.0 77.7 79.4	85.6 84.4 86.6	82.4 81.2 77.6	87.9 88.6 88.0 87.2	
" 29...	♂ 76.6 ♀ 74.0	79.8 78.2	83.0 82.2	78.6 76.9 77.0 77.7	79.3 80.4 82.2	83.0 83.6 81.0 82.8	88.0 89.0 87.5	

TABLE I. (continued).

Date.	Air in cage.	Air under blanket.	Gravel of cage.	Male on folds.	Male between folds.	Female on folds.	Female between folds.	Remarks.
July 1...	♂ 80.8	° 81.5	° 85.4	87.0 85.2	88.0 85.5	88.4 85.8	90.8 91.5	
	♀ 79.5	80.0	86.2	87.0 84.6	89.6 88.4	87.6 85.8	92.8 90.8	
" 4...	♂ 87.0	86.6	90.6	88.2 88.6	89.2 89.6	86.2 85.6	90.0 90.0	
	♀ 86.6	82.4	89.0	89.6	89.8 91.1	88.8	90.8 90.8	
" 6...	♂ 78.8	82.6	89.2	81.4 81.0	82.6 87.0	80.2 83.7	90.0 90.0	
	♀ 76.2	81.5	87.2	80.4	84.0 85.0	85.2 81.5	83.8† 88.7	† On neck.
" 8...	♂ 72.8	77.2	84.0	79.8 79.3	83.0 83.2	78.6 79.6	85.0 86.2	
	♀ 72.3	76.2	82.0	79.0	80.4 83.4	79.4	85.4	
" 11...	... ♂ 80.3	... 83.0	... 85.2	84.3 84.4	86.6 85.8	80.8 81.7	86.8 85.5	Two observations on a male that had been in the water gave 80°·4 and 79°·8, between the folds.
	♀ 80.2	79.0 80.3	84.8	85.6	86.8 86.6	83.3	87.1	
" 13...	♂ 79.3	80.7	85.1	83.4 83.3	85.5 85.9	85.4 86.2	88.7 89.6	The eggs are all exposed. ‡ A male that had been in the water gave 82°·1 between the folds.
	♀ 79.2	83.3	83.8	84.3	85.1	87.1	89.0 89.7	
" 15...	♂ 87.1	87.7	90.3‡	87.7 88.7	89.8§ 88.6	86.8 87.8	90.9 91.2	§ Only one observation, the male being very restless. A Boa (♂) in the same cage gave also 89°·8 as its temperature between the folds.
	♀ 87.1	86.0	89.4	88.6		89.8	92.2 91.7	
" 18...	♂ 82.2	86.0	89.2	85.1 84.5	88.0 87.4	86.2 85.7	88.0 86.6	
	♀ 80.0	82.8	86.8	85.4	86.2	84.3	88.8	

TABLE II.

Showing the Averages of the Observations recorded in Table I., and the Differences in Temperature between the two sexes.

Date.	Male.		Female.		Difference.	
	On surface.	Between folds.	On surface.	Between folds.	On surface.	Between folds.
June 14.....	°	87.1	°	88.9	°	1.8
„ 16.....	84.9	87.4	84.6	90.0	.3	2.6
„ 18.....	83.2	85.5	84.6	91.0	1.4	5.5
„ 20.....	84.3	88.5	83.5	90.4	.8	1.9
„ 22.....	79.0	83.7	83.4	89.5	4.4	5.8
„ 24.....	79.5	84.4	80.2	88.7	.7	4.3
„ 27.....	79.4	85.5	80.4	87.9	1.0	2.4
„ 29.....	77.6	80.6	82.6	88.2	5.0	7.6
July 1.....	86.0	87.9	86.9	91.5	.9	3.6
„ 4.....	88.8	89.9	86.9	90.4	1.9	.5
„ 6.....	80.9	84.7	82.7	88.1	1.8	3.4
„ 8.....	79.4	82.5	79.2	85.5	.2	3.0
„ 11.....	84.8	86.5	81.9	86.5	2.9	
„ 13.....	83.7	85.5	86.2	89.3	2.5	3.8
„ 15.....	88.3	89.8	88.2	91.5	.1	1.7
„ 18.....	85.0	87.1	85.4	87.8	.4	.7
Average.....	82.98	86.03	84.38	89.07		

N.B. The figures in black type point out when the difference of temperature is in favour of the male. Such cases, it is to be observed, only occur when the surface-temperature is observed.

December 13, 1881.

Prof. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie during the month of November 1881:—

The total number of registered additions to the Society's Menagerie during the month of November was 136, of which 46 were by birth, 36 by presentation, 33 by purchase, 15 were received on deposit, and 6 in exchange. The total number of departures during the same period, by death and removals, was 101.

The most remarkable additions during the month of November were as follows:—

1. Forty-six young Nose-horned Vipers (*Vipera nasicornis*), procured alive by a large female of this Serpent acquired on the 1st of

October last. But few of them long survived their birth; but the large number of young produced on one occasion by this venomous Snake is remarkable, and worthy of record.

2. A Vinaceous Amazon (*Chrysotis vinacea*), purchased November 30, being of a species new to the Society's collection.

Mr. Sclater exhibited two skins of a Rail obtained from Macquarie Island, south of New Zealand, and transmitted to him by Sir George Grey, K.C.B., F.Z.S. The skins were in bad condition and hardly suitable for exact determination, but appeared to belong to the species lately described by Captain Hutton as *Rallus macquariensis* (Ibis, 1879, p. 454).

Mr. Sclater proposed to deposit these specimens in the British Museum.

Mr. Henry Seebohm, F.Z.S., exhibited a specimen of the Rusty Grackle (*Scolecophagus ferrugineus*), which had been shot on the 4th of October last, by a workman engaged as a wheelwright, within a mile of Cardiff, on the grassy flats between the sea and the mountains which are known there as "moors." It had been brought a few hours after being killed to Mr. Robert Drane, F.L.S., by the man who shot it, and who was in the habit of bringing to that gentleman any rare bird that he happened to meet with. It had been shot on the wing; and the plumage was in such a perfect condition, that the idea of its having escaped from a cage seemed untenable. Mr. Drane had known the man some time as an intelligent though uninformed workman, fond of birds, and believed perfectly in his bona fides. This bird had never before been recorded as a British one. It was said to breed in the arctic regions of the American continent up to the limit of forest-growth from Labrador to Alaska. The example obtained at Cardiff appeared to be an adult male in autumn plumage.

Mr. Seebohm also exhibited a specimen of Pallas's Great Grey Shrike (*Lanius major*), which had been shot in the April of the present year, by a gamekeeper, twenty miles west of Cardiff, and sent in the flesh to a bird-preserver in that town, who had shown it to Mr. Drane before skinning it, and in whose possession it had remained. This species was known to breed from North Scandinavia eastwards throughout Siberia, but had not been recorded before from the British Islands.

The following papers were read:—



Forbes, W. A. 1881. "Obsevation on the Incubation of the Indian Python (Python molurus), with special regard to the alleged Increase of Temperature during that process." *Proceedings of the Zoological Society of London* 1881, 960–968. <https://doi.org/10.1111/j.1096-3642.1881.tb01353.x>.

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