

are very similar to many of the articles found in the mounds in such position as to lead to the supposition that they were placed there by the builders of the mounds.

ON LECONTE'S TERRAPINS, *EMYS CONCINNA* AND *E. FLORIDANA*. By O. P. HAY.

ON THE BREEDING HABITS, EGGS, AND YOUNG OF CERTAIN SNAKES. By O. P. HAY.

Notwithstanding the deep impression which serpents have made on the human mind, as shown in literature and in popular conversation, it is surprising how little accurate information has been accumulated concerning some of their habits. The densest ignorance, the result of inattention and general lack of interest, prevails with regard to some of the most interesting matters connected with the life-history of snakes; while on the other hand, many of the popular notions about the powers of these animals are either wholly false or are gross exaggerations of the truth. The breeding habits of our snakes, even of the most common species, belong among the things about which little is known. Even our biologists have given but little attention to this subject, while unscientific people simply recognize the fact that nests of snake eggs are occasionally met with. For instance, who would not suppose that all the essential facts are known concerning the reproduction of the common black-racer, *Bascanion constrictor*? Nevertheless, where have we been told when it lays its eggs, how many there are of them, how they are concealed, and when they hatch?

Some snakes are known to lay eggs which after a period produce young. Other snakes are known to retain the eggs within the body until the young have attained sufficient size and strength to care for themselves after birth. Still other species are supposed sometimes to lay eggs, at other times to bring forth living young,* or to produce some eggs and some living young at the same time.† There are, indeed, oviparous snakes and snakes which are ovoviviparous, and there is a conspicuous difference in their eggs. The eggs of the oviparous species are furnished with a thick, tough, flexible covering, or "shell," while the eggs of the species which produce living

* Proc. A. A. A. S., 1873, p. 185.

† Proc. Phil. Acad. Sci., 1887, p. 121.

young have coverings which are very thin and delicate. Now, should such eggs as the latter be laid any considerable period before the young are ready to be excluded, the thin envelopes would surely be torn during the writhings of the embryo. That some of the eggs may be only partially developed at the time when the embryos of other eggs are ready to be ushered into the world, and that all may be expelled together, is possible; but this is not the normal course of things and may not be well for the immature young. Normally the coverings of such eggs are ruptured before birth or immediately afterwards. On the other hand, it is quite probable that the eggs of the oviparous species are laid a considerable period before they are hatched. The tough coverings of such eggs protect them from attacks and injuries from without, and at the same time resist the movements of the young snake within. So far as we know, these eggs are deposited in the earth, in piles of decaying vegetable matter, and similar places.

A very curious structure deserves mention here. This is the "egg-tooth," a small tooth fixed to the united premaxillary bones and projecting forward slightly beyond the edge of the upper lip. It is present only in the embryo, and is shed very shortly after the escape of the young snake from the egg. In the ovoviviparous species, the tooth may apparently be shed before the young are born. The tooth is employed by the little snake in ripping open the tough egg-covering in its efforts to escape from its prison. It would appear to be of little service to the young which are mature when born, since the egg-coverings are so very tender; nevertheless, I have found the tooth present in all of the ovoviviparous species whose young I have had opportunity to study. This tooth, as found in the black-racer, was described as long ago as 1857, by Dr. Weinland;* but Müller had observed it even earlier.

The Crotalidæ, including the rattlesnake, the copperhead, and the water-moccasin, all, so far as I am able to discover, bring forth living young. The number produced at each birth is small as compared with the number of young sent into the world by some other species.

As to the breeding habits of the copperhead, *Aghkistrodon contortrix*, we have the statement of Dr. J. A. Allen † that in Massachusetts five out of seven females caught in the latter part of July contained slightly developed embryos, while of six killed in September, the oviducts of each contained from seven to nine young, each of which had a length of six inches. As to

* Proc. Essex Institute, Vol. II, p. 28, pl. I.

† Proc. Bost. Soc. Nat. Hist., 1868, Vol. XII, p. 179.

the time of the pairing of the sexes, I have knowledge of only one observation. My friend, Rev. A. M. Hall, brought me from Western Pennsylvania two specimens of this species, which he took while pairing, on the 28th of August. Unfortunately, the female was disposed of before my investigation of this subject was begun. This observation and those of Dr. Allen, when considered together, seem to indicate a period of gestation of nearly a year.

The breeding habits of the water-moccasin, *Agkistrodon piscivorus*, are no doubt much like those of the copperhead. A female 26 inches long (U. S. Nat. Mus., No. 17968), which was taken on the Arkansas bank of the Mississippi river, just opposite Memphis, in the latter days of June, contains seven eggs, four of which are in the left oviduct. Usually the larger number of eggs in snakes is found in the right oviduct. The eggs of this specimen are about the size of the yolk of a hen's egg. In each is an embryo not larger than a common pea.

The breeding habits of *Crotalus* do not appear to be well known. Prof. Putnam* dissected a female which he says contained in the oviducts eight fully formed eggs, besides a number of smaller ones, which he supposed belonged to a later brood. It is more probable that all the eggs were really in the ovaries. A female rattlesnake, 39 inches long (U. S. Nat. Mus., No. 17959), was brought to me from Western Pennsylvania by Mr. Hall. In this I find nine eggs, four of which are in the left oviduct. The eggs will average nearly an inch and a half in long, and an inch in short, diameter. In one of them I find an embryo about 3 inches long. The egg-coverings are extremely thin. The mother snake was captured some time in August, probably before the 15th. At what time of year the sexes unite I find nothing on record. Prof. S. W. Williston, who has had abundant opportunities for making observations on *C. confluentus*, states† that the sexes pair in May. Nor do I know how large the young are at the time of their birth. M. Palisot Beauvois, as quoted by Dr. Goode,‡ says that he saw five young run into the mouth of a mother snake, and that these young were about the size of a goose quill. The young are undoubtedly much larger than this statement makes them. There is apparently as strong a tendency in observers to minify the size of the young of snakes as there is to magnify the size of the adults.

* Amer. Nat., Vol. II, p. 133.

† Amer. Nat., Vol. XII, p. 207.

‡ Proc. A. A. A. S., 1873, p. 183.

I have been enabled to make some observations on *Sistrurus catenatus* Raf. (*Crotalus tergeminus* Say.). In the American Naturalist for March, 1887, pp. 211-218, I published some notes on the breeding habits and young of this species. About September 1, two females, which had been kept in confinement, brought forth young, one six, the other seven. The young were not seen by myself at the time of birth, but on the 1st of January they were at least 10 inches long. From a female sent me from Paris, Ill., I have taken an almost fully developed embryo (U. S. Nat. Mus., No. 17947). It measures $7\frac{1}{2}$ inches in length, and this is probably nearly the length which it would have been when born. A considerable amount of the yolk was still spread over and among the coils of the little snake; but, when its body was opened, a large mass of the yolk was seen to have been received within its walls. This would be sufficient to maintain life and growth until the little reptile could provide for its own necessities. The fang is developed, and the egg-tooth is present, although it does not seem to be directed so much forward as in other species. In the oviduct, lying alongside of the embryo just described, was another egg which contained an embryo only about 4 inches in length. It was so deeply immersed in the yolk that its presence was not suspected until the yolk was cut partially away. Nevertheless this immature little snake exhibits quite distinctly the pattern of coloration found in the adults. In contact with this egg was another in which no indications of an embryo were to be found. The more immature young were probably lying farther forward in the animal, but of this I am not now certain. Should all these eggs be expelled from the mother's body at the same time, it would seem that the least developed young must perish. A female (U. S. Nat. Mus., No. 17950) of this species taken in Hamilton county, Ind., contained eight eggs, and these had not yet left the ovaries. Three of the eggs were in the left ovary. The eggs were an inch long by half an inch in the short diameter. Prof. Putnam mentions* a specimen of *Sistrurus miliarius* which contained fourteen eggs. This appears to be a larger number than is usually found in the Croc'olidæ.

The species of the genus *Eutainia* are probably all ovoviviparous. Dr. Goode, as already cited, says that there is some reason to believe that some of them are in some instances oviparous, in others ovoviviparous. Dr. C. C. Abbott † says that the eggs of the garter-snake, *E. sirtalis*, and of the rib-

* Amer. Nat., Vol. II, p. 134.

† Rambles, &c., p. 295.

bon snake, *E. saurita*, are deposited in the loose sandy soil of the recently plowed fields. He has found none earlier than May 9; and once he found a complement of seventeen within a day or two of hatching. He farther states that he has never come across a young snake less than four inches in length, except in the case of the hog nosed snake *Heterodon platirhinos*. I am convinced that there is some error of observation here. I shall present evidence that the species of *Eutainia* bring forth living young, and that too rather late in the summer and in autumn. It seems improbable that a snake should usually be ovoviviparous, and again, at rare times, should lay eggs furnished with coverings suitable for protecting the developing embryos. If, notwithstanding all this, the *Eutainias* do lay spring eggs, I shall be extremely glad to receive a batch of them.

Dr. H. C. Bumpus, in his interesting account of the snakes,[§] says that the eggs of *Eutainia sirtalis* and of *E. saurita* are sometimes found about out-buildings, and in hatching give birth to little fellows having enormous eyes and a spotted body, the longitudinal bands of the adults only being gained after several sloughings of the skin. The source of the information here detailed is not given; but almost certainly the eggs of some other species have been mistaken for those of *Eutainia*. Young of both the species, especially those of *saurita*, taken by myself from the oviducts of the female and with a considerable portion of the yolk still unabsorbed, have the stripes perfectly distinct.

As to *E. sirtalis*, Prof. F. W. Putnam † states that a female taken July 22, contained forty-two nearly developed young. Each of these was 5½ inches long. The mother snake was 35 inches long. Dr. J. Schneck, of Mt. Carmel, Ill., writes ‡ that seventy-eight were taken from a female. He implies that he saw this done. C. Few Seiss says‡ that the sexes of this species copulate in early spring and produce from thirteen to eighty young. That he has seen the latter number from a single snake he does not say. Drs. Coues and Yarrow refer|| to the habits of *Eutainia sirtalis parietalis*, as observed by them in Montana during the month of August. "At this season all the female individuals observed were gravid with nearly matured embryos. Like others of the genus, this species is ovoviviparous, the young being some 6 inches in length when born." In a specimen of *E.*

§ Riverside Natural History, Vol. III, p. 371.

† Amer. Nat., Vol. II, p. 134.

‡ Amer. Nat., Vol. XVI, p. 1008.

§ Scientific Amer., Vol. LXIII, p. 105.

|| Bulletins U. S. Geol. & Geo. Survey, Vol. IV, p. 277.

sirtalis (U. S. Nat. Mus., No. 17960), captured near the city of Indianapolis by Dr. Alex. Jameson about August 1, I find thirty-nine partially developed young. Of these, twenty-five are in the right uterus. The young measure 6 inches in length. There is a considerable amount of yolk still remaining attached to these young, a fact which indicates that they will increase in size before birth. An examination of the mouth of some of these little snakes shows that the egg-tooth is present. The membrane which surrounds each egg is quite thin. The female bearing this lot of young is 33 inches in length. Another female (U. S. Nat. Mus., No. 17961), from Paris, Ill., of nearly the same size, contained about thirty-five young snakes, these being packed together so densely in the mother's body that it was difficult to determine the number accurately without removing them. They are each 7 inches long, and are evidently just ready to be expelled. An examination of about half a dozen of them failed to reveal the presence of the egg-tooth, which has therefore been shed. Nor could I determine with certainty that any egg-covering was present. The yolk of the egg, also, is wholly consumed. On opening these young snakes I find little or none of the yolk within the body. In this respect they contrast strongly with the young of the rattlesnakes. The young garter-snakes must from the first depend on their own activities for support. This accords well with the report of Mr. C. Few Seiss, that the young of a female kept in confinement began to feed shortly after birth, struggling vigorously with one another for the earthworms thrown them. At what time during the summer the Paris, Ill., specimen was captured I do not know. Seiss' statement that the sexes of *E. sirtalis* pair in the early spring has already been mentioned. Drs. Coues and Yarrow (*op. cit.*, p. 278) tell us that the females of the closely related species, *E. radix*, are pregnant in July and August, bringing forth as many as thirty to forty young; and that they are found *in coitu* in September and October. Can it be that snakes copulate twice in the year, as Agassiz says* some turtles do, and as Gage has recently found† to be the habit of the newt, *Diemyctylus*? Observations on this point are to be desired.

The ribbon-snake, *E. saurita*, appears to be wholly similar in its breeding habits to its relative just considered, although it probably does not bring forth so many young at each birth. Prof. Putnam informs‡ us that a female, taken in Massachusetts on July 13, had nine eggs, each three-

* Contributions, Vol. II, p. 491.

† Amer. Nat., Vol. XXV, p. 1091.

‡ Amer. Nat., Vol. II, p. 134.

fourths inch long and containing an embryo $2\frac{1}{2}$ inches in length. Another, taken July 31, contained but four eggs, and these are ready to be burst by the young. The eggs containing the coiled embryos were then an inch and a quarter long, while the extended young had a length of $5\frac{1}{2}$ inches. Dr. Goode has quoted* a note from Herman Strecker, of Reading, Pa., who states that some years previously he had found and caged a female of this species which soon produced thirty or more young ones. He supposed that the little snakes had been hidden in the mother's stomach. There is possibly some confusion here with *E. sirtalis*, judging merely from the number of the young. Prof. S. I. Smith, of the Sheffield Scientific School, is quoted † by Dr. Goode as having seen two young snakes, each 3 or 4 inches long, run down the mother's throat. The statement is no doubt incorrect, so far as regards the size of the young.

In a female (U. S. Nat. Mus., No. 17965) of the variety *faireyi*, taken probably in Mississippi, I find nine eggs, the hindermost three of which are in the left oviduct. The eggs are about three quarters of an inch long and a third of an inch in the short diameter. The development of the embryo had just begun. In a female (U. S. Nat. Mus., No. 17952) of *faireyi*, 28 inches long, taken at Veedersburg, Ind., are twelve ovarian eggs of the same size as those just mentioned. The hinder four are in the left ovary. At what time of the year the two specimens last described were killed, I do not know. In a specimen of *faireyi*, 40 inches long (U. S. Nat. Mus., No. 17958), captured at Vicksburg, Miss., about the 4th of July, there are twenty young snakes, each close to 9 inches in length. The hindermost nine of these are in the left oviduct. All were evidently ready to be expelled. They did not appear to be contained in any egg-covering, and the egg tooth was not found in any of the three which were examined. Not only is this date not so early as that given by Dr. Abbott for the finding of the eggs of this species in New Jersey, we must take into account the difference in the climate, and especially the difference in the size of the young snakes.

The species of the related genus *Tropidonotus* are also ovoviviparous. *T. sipedon*, our water-snake, is the commonest species of the genus in the eastern United States. It is extremely variable and reaches a large size. Prof. Putnam has a note regarding the breeding habits of this species. ‡ He states that twenty two of the young belonging to one family were

*Proc. A. A. A. S., 1873, p. 18.

†Proc. A. A. A. S., 1873, p. —.

‡Amer. Nat., Vol. II, p. 134.

found. Each of them was 8 inches long. Dr. Heilprin mentions* a large specimen from which thirty-three young were taken. These were in different stages of development. Some of the larger ones had absorbed all the yolk, while to others a considerable mass of this was attached. In a specimen (U. S. Nat. Mus., No. 17962) from some point in northern Indiana I find sixteen eggs, eight in each oviduct. The young are $7\frac{1}{2}$ inches long, and each is provided with a well-developed egg-tooth. This is curved upward like a short horn, and tapers gradually to near the point, where it rounds off rapidly. The egg-membranes are thin. I have some reasons for believing that the larger specimens of this species will be found to produce a considerably larger number of young than the above observations indicate.

I have met with no statements regarding the breeding habits of either *Tropidonotus grahamii* or *T. leberis*, except that made by Miss Hopley,† to the effect that a specimen of the last-mentioned species in the Zoölogical Gardens produced in August five young and at the same time some eggs. What the state of development of these eggs was, and what became of them, we are not informed. I have a female specimen (No. 26) taken somewhere in Indiana, and in this I find eight eggs, of which three are in the left oviduct. There are no signs of beginning development. A gravid female (U. S. Nat. Mus., No. 17970), captured on July 15, and sent me by Mr. W. O. Wallace, of Wabash, Ind., is 24 inches long. There are eight eggs, two of which are in the left oviduct. The eggs are of different shapes, on account of pressure. A considerable amount of yolk is still present, an indication that the embryos are not yet completely developed. A measurement of one of these shows it to be $6\frac{1}{2}$ inches long. The longitudinal bands of the upper surface are sufficiently well displayed to enable one easily to determine the species, but the longitudinal brown ventral bands are not seen. I find no indications of the presence of the egg-tooth, although it is probably present.

Some years ago I killed a specimen of a female of *T. grahamii* in Bureau County, Ill. Of the specimen the skin and a few eggs (U. S. Nat. Mus., No. 17954) were preserved. The time of capture was about the middle of July or later. The mother snake was of such a rusty color that the species to which she belonged could not then be determined. One of the eggs measures an inch and a half in long diameter by three-quarters trans-

Proc. Phil. Acad. Sci., 1887, p. 121.

† Snakes, etc., Miss C. C. Hopley, p. 437.

versely. A considerable mass of yolk is present, into one side of which an embryo snake is sunken. This embryo is 7 inches long; and, although thus immature, has its scales and its colors so perfect that there is no difficulty in assigning it to the proper species. The embryo is surrounded by a very thin egg-covering. No indications of the presence of the egg-tooth were seen until a series of sections through the snout were examined, when it appeared.

Tropidonotus kirtlandi is a rather common snake in central Indiana. One specimen (U. S. Nat. Mus., No. 17957) taken at Irvington contains three eggs in each ovary. Each egg is a little less than half an inch in length. Another specimen (U. S. Nat. Mus., No. 17953) from Winchester, Randolph county, has eight eggs in the ovaries. Each egg is seven-sixteenths of an inch in length. This species is in all probability ovoviviparous.

The species of *Storeria* are stated by Dr. Goode* to be oviparous; but Prof. Cope† regards them as ovoviviparous, and he is quite certainly correct in his conclusion. One female of *Storeria dekayi* sent me from Winchester, Ind., contains thirteen eggs, five of which are in the left ovary, the remainder in the right. The eggs have apparently not attained their full ovarian size. Another specimen (U. S. Nat. Mus., No. 17966) of this species, taken by Dr. D. S. Jordan, at Cumberland Gap, Tenn., about midsummer, is a foot long, and has in it eleven eggs, the hindermost three of which are in the left oviduct. Each egg is about three-eighths of an inch in length by one-quarter in short diameter. Another specimen (U. S. Nat. Mus., No. 17967), which was taken at Irvington, contains eight eggs in the oviducts, each including a very immature embryo an inch and a half in length. The eggs are about half an inch long. The membranes are extremely thin.

I find a few notes on the breeding habits of *Heterodon platirhinos*, the hog-nosed snake, viper, or spreading adder, as it is popularly known. Some of these contain statements which, to me, appear exaggerated. Dr. J. Schneck, of Mount Carmel, Ill., reports‡ that eighty-seven "young spotted spreading adders" were taken from the body of a wounded female. The author of the note did not see this done, but got his information from persons who did see it. I am strongly inclined to believe that the reptile was a *Tropidonotus sipedon*. Another writer§ in Pennsylvania gives an account of over one hundred young snakes issuing from a wound in the side of a female

*Proc. A. A. S., 1873, p. 181.

†Proc. Phila. Acad. Sci., 1874, p. 116.

‡Amer. Nat., Vol. XVI, p. 1008.

§Amer. Nat., Vol. III, p. 555.

spreading adder. These young were each from 6 to 8 inches in length, and all were active and blowing vigorously. Neither did the author of this note see the escape of the snakes, although he did see sixty-three of the young in alcohol. There may easily have been an error in the determination of the species to which these young snakes belonged. One who has examined the eggs of this species can not easily believe that so many young snakes could, with such readiness, escape from a wound in the mother's side. Moreover, these snakes deposit their eggs in the earth some time before the young are ready to lead an independent existence.

Dr. Bumpus (*op. cit.*, p. 364) states that a female *Heterodon* in the National Museum brought forth one hundred and eleven young; but Dr. Bumpus kindly informs me that he did not himself observe this.

Prof. F. W. Cragin reports* the finding, on September 10, of twenty-two eggs of this species. They were buried in the sand at East Hampton, Long Island. Two of the eggs, which he had in his possession, hatched four days afterwards. Troost appears to have dissected a black specimen, in which he found twenty-five eggs. Dr. C. C. Abbott says† that he has frequently in May found the eggs of the hog-nosed snake in considerable numbers, a few inches below the surface of the ground; and in early July he once found a family of 17 very small, and apparently just hatched, young. These resented all interference, snapped, hissed, and flattened their heads precisely as an older snake would do. The size of the young is not given, but in another place (*op. cit.* p. p. 295) he implies that they were less than 4 inches in length. I think that this species, like most other species, produce their young rather later in the season; but I see no reason for not believing that some individuals may bear their eggs over the winter and lay them in the spring.

A female (U. S. Nat. Mus., No. 17951), sent me from Veedersburg, Fountain county, Ind., contained fifteen eggs, the posterior four of which lay in the left oviduct. I could discover no signs of embryos. Each egg was covered by a thick, tough, yellowish coat, inside of which was a thinner and more delicate membrane.

Through the kindness of Dr. L. Stejneger, curator of the department of reptiles in the National Museum, I have been enabled to make some observations on the eggs and living young of this *Heterodon*. On the 31st day of last August, there were brought into the laboratory of the Department, from

*Amer. Nat., Vol. XIII, p. 710.

†Rambles, etc., p. 289.

some point in Maryland not far from Washington, a lot of twenty-seven eggs, which the finder said were the eggs of the copperhead. It was reported that the eggs were thrown up out of the ground by the plow, and that the mother snake was near by and had resented the disturbing of her treasures. She had been killed, but had not been sent along with the eggs. Since it was supposed that the copperhead produces living young, the occupants of the laboratory were anxious to learn if this opinion were erroneous. Accordingly one of the eggs was opened, and in it was found a young hog nosed snake, fully developed, and ready to assist himself on the stage of action. This *Heterodon* quite closely resembles the copperhead, and most people are not accustomed to make nice distinctions among snakes. This close resemblance may account for some of the statements of the large number of young produced by the copperheads.*

The eggs referred to were between an inch and a quarter and an inch and a half long, and about seven-eighths inch in short diameter. The egg covering was thick, tough, and flexible, resembling a piece of parchment. There is little if any deposit of lime in it. Of these eggs, some were found to have hatched during the night of September 6. Others, which were buried somewhat deeper in some clay, escaped from the eggs later; but all were out by the afternoon of the 8th. The length of such as were measured varied between 7 and 8 inches. From the moment of escape from the egg all were quite active, and manifested many of the characteristics of the adults. Some of the little fellows were quite saucy, and would make a pretense of striking at the approaching finger; but their efforts in that line were rather feeble. A faint hiss was sometimes uttered, but that may not have been voluntary. One would sometimes flatten its head and body and rear up with the anterior third of its length free from the ground. If one did not know well their inoffensive natures, one would be excused for fearing to handle them. An extremely singular habit possessed by the adults is that of feigning death. On being struck or teased they will roll over and over, as if in the intensest agony, and then throw themselves on the back and lie there as if dead. Out of some fifteen of the young experimented with, I succeeded in getting only two or three to go through with this performance, but these did it to perfection. On being lightly struck a few times, they would turn over on the back, writhe about a while, and then lie perfectly still. If turned right side up, they would again turn on the back. If left undisturbed for a little while they would turn over and

* Amer. Nat., Vol. XVII, p. 1235.

creep slyly away. The others of the young would not act in this way, however much they were teased. It would be interesting to know whether all the adults possess this odd habit, or only a portion of them.

The cuticle of the young *Heterodons* is shed very shortly after their escape from the egg-coverings. Within a few minutes after one had left its prison the skin was observed to be broken about the head. It had left the egg at half-past 1 and by 4 o'clock the skin was pushed back half the length of the body. The next morning the skin was wholly shed, revealing the brighter colors of the new skin. While getting rid of the cuticle the little reptile kept crawling over the clay and among the roots of grass.

The opportunity was embraced to observe the use which is made of the egg-tooth. The tooth itself is easily seen in the just-hatched snake. Its lateral borders are more nearly parallel than those of the tooth of *Bascanion* figured by Weinland. Seen from the side, the anterior or upper outline is concave, the posterior outline convex. Thus, the tooth projects forward and is turned slightly up. The anterior face is also concave from side to side, so that there is, on each side, a distinct cutting edge. The tip is cut off square. The tooth appears to have a ligamentous attachment, and may be lifted a little, but not much depressed. It seems quite evident that the tooth is first engaged in the egg-covering and then made to do its work by a forward push of the head. An examination of the covering, after the snake has left it, gives ample proof that it has been cut and not merely torn. The edges are as smooth as if they had been slashed with a razor. A long slit is sometimes made as if by a single effort. In other cases, several attempts appear to have been made before the covering has been open enough for the snake to get out. In one or two cases, a tooth has not been inserted deeply enough, and the only result was a scratch on the inside of the covering. The egg tooth having performed its office becomes loose and drops out. This occurs usually within twenty-four hours.

When the slit has been successfully made, the little snake may sometimes be seen pushing its head carefully out as if to survey the surroundings. Should there be any movement, the head will be quickly withdrawn.

I have been able to collect some facts concerning the pairing of the sexes of *Heterodon platirhinos*. Prof. U. O. Cox, of Mankato, Minn., informs me that he found two individuals uniting some time in May. A second male was entwined with the two other snakes. The latter were separated with difficulty. The male intromittent organs are described as being of an oval form, an inch long and over a half inch thick.

Two observers have seen black specimens, formerly called *H. niger*, pairing with the spotted individuals. Prof. W. S. Blatchley⁶ found a black and a spotted one copulating on April 19. He speaks in a letter to me of the intermittent organs as being as large as a walnut, and covered with spines. Mr. E. R. Quick, of Brookville, Ind., an accurate observer of nature, writes me that he once found a black viper pairing with a spotted one. The time, he thinks, was late in June. The time of gestation of this species is not known. It may continue from spring until autumn. Possibly the late-pairing individuals may retain their eggs until the next spring. Nor do we know how long the eggs are laid before they are ready to hatch. These matters are known concerning very few of our snakes, and a wide field is offered for work and observation.

Of the *Colubers*, I have been able to make observations on *C. obsoletus* alone. It is likely that others have observed and written on the subject, but I have not met with their statements. Dr. G. B. Goode reckons[†] this species among those which are ovoviviparous, but I am inclined to question this. My son, W. P. Hay, captured two of these snakes, near Indianapolis, while they were in sexual union. This was on June 19. The male (U. S. Nat. Mus., No. 17948) was 5 feet 5 inches long, the female (U. S. Nat. Mus., No. 17949) 6 feet 3 inches. When they were separated, the intromittent organs of the male were everted some 3 inches. A dissection shows that the hollow portion of the organ extends behind the vent 3 inches, while the retractor muscles form a cord which extends back nearly to the tip of the tail. At the base of the evertible portion, near the vent, the inner surface, which when the organ is everted becomes the outer surface, is furnished with numerous plications. Near the middle of the organ are found many hooked papillæ, some of them large and horny. The remainder of the organ has the surface raised up into numerous anastomosing folds, so that under the microscope it reminds one of the reticulum of the ox's stomach. On opening the female I find in her sixteen eggs. Of these eggs, four lie about the middle of the animal's body, while the other twelve occupy a much more anterior position; the one farthest forward being within 8 inches of the tip of the snake's snout, the hindermost one only 9 inches farther back. Several of these eggs are lying apparently loose in the body cavity. It might be supposed that they had just left the ovary and were about to enter the oviduct; but they are surrounded each

⁶Jour. Cincinnati Soc. Nat. Hist., 1891, p. 33.

[†]Proc. A. A. S. 1873, p. 185.

with a covering nearly as thick and tough as that of the egg of the *Heterodon*. Could these eggs have been in the oviducts and then squeezed out into the body cavity during the time of being entwined with the male? The thickness of the egg covering makes it appear to me highly probable that the eggs are destined to be laid before the young will be mature enough for independent existence.* †

Some years ago, in midsummer, I found a number of the eggs of the house snake which had been deposited in a pile of stable manure. This was in Bureau county, Ill. No record was kept of the number of the eggs, but a few of them (U. S. Nat. Mus., No. 17955) were preserved in alcohol. When found, the eggs were glued together into one mass. Each egg is 2 inches long and nearly an inch and a quarter in the short diameter. On the outside is found a thick, leathery, yellow covering, beneath which is a much thinner coat. From one of these eggs I have taken a young snake which measures $10\frac{3}{4}$ inches in length. Attached to this embryo is a considerable mass of yolk, a condition which indicates that the embryo is not ready for hatching. Nevertheless, all the generic and specific characters are well shown. There is a well-developed egg-tooth. The intromittent organs are everted in the specimen examined. Each consists of a rather slender and twisted basal stalk, at the end of which is the swollen glans. This is acorn-shaped at the base, but terminates, at the distal end, in two blunt lobes. The base of the glans is densely spinose, the remainder reticulately papillose. The seminal groove winds around the basal stalk and terminates at the tip of one of the terminal lobes, the larger one.

Concerning the breeding habits of the black-racer, *Bascanion constrictor*, I find little in print. It is well known that the young differ markedly from the adults, being decidedly spotted. Dr. Weinland, as already stated,

*Since the above has gone to press, I have had the opportunity, April 29, of dissecting a recently captured female, the length of which was 4 feet 4 inches. The ovaries lie in the region situated about two thirds the distance from the head to the vent. Each oviduct ends close to the corresponding ovary. It seems evident, therefore, that at least some of the eggs of the specimen described above are really lying loose in the body cavity. In the specimen dissected, the ovarian eggs are very immature, none of them exceeding about a quarter of an inch in length. It may be of some interest to add that this female had the anterior three-fourths of the body ornamented with blotches of a decided red color, the red occupying both the surfaces of the scales and the skin between them. The blotches were separated by scales which were partly yellow. Soon after death a great part of the red disappeared. The stomach contained eight wild mice, six of them young.

† I am able to state that *Coluber obsoletus* is oviparous. Mr. Thomas Marron, of the National Museum, early in April, 1889, collected a number of snake eggs in a hollow stump near the Potomac river. They were opened and found to contain fully developed young of this species, (U. S. Nat. Mus., No. 15334).—Leonhard Stejneger.

described the egg-tooth. In one female, taken near Indianapolis, I find nineteen eggs, seven of which lie in the left ovary. These eggs are quite immature.

Some alcoholic eggs (U. S. Nat. Mus., No. 17956) of this species from an unknown locality furnish some points. They are of the usual elongated oval form, an inch and a half long and close to an inch in short diameter. The outer covering is thick and tough, and it is furnished with numerous hard points, as if of deposits of lime salts. Within the egg is a young racer $10\frac{1}{2}$ inches long and evidently nearly ready to come forth. The intromittent organs of this specimen are somewhat flattened, broad at the extremity, and with prominent terminal angles. The organ begins to expand from its base. It is furnished plentifully with spines. When the sexes unite, when the eggs are laid, how concealed, and when they hatch, are some of the things which we need to learn.

I have examined a specimen (U. S. Nat. Mus., No. 17969) of *Haldea striatula* from some point in Arkansas. It is $9\frac{1}{2}$ inches long and contains five eggs, each with a young *Haldea* in it. Only the hindermost egg is in the left oviduct. This is a little over an inch long, but the others are only a little more than three-quarters. The short diameter of the egg is about a quarter of an inch. The embryos are far from mature, being only $2\frac{3}{4}$ inches long when extended. They have a considerable mass of yolk still attached to them. The egg-coverings are very thin. This circumstance causes me to conclude that the young are brought forth alive. A series of sections through the snout of an embryo reveals the presence of the usual egg-tooth.

SOME OBSERVATIONS ON THE TURTLES OF THE GENUS *MALACLEMYS*. By O. P. HAY.

Of the turtles belonging to the genus *Malaclemys* there are now recognized five species, two new ones having been described within recent years by Dr. G. Baur. The genus is a very distinct one, and is distinguished from *Chrysemys* especially by the extremely broad and flat crushing surfaces of both upper and lower jaws. As a result of the provision made for the support of these wide, horny, masticatory plates, the internal nares are thrown far back, so as to lie behind the level of the eyes. In the Catalogue