Counties (Clark, 1905, 110), Huron County (Ruthven, 1911a, 267) and Cheboygan County (Ruthven, 1911, 115). Specimens from the following localities have been examined: Ann Arbor, Washtenaw County, Au Sable River, Oscoda County, Brighton, Livingston County, Higgins Lake, Roscommon County, Grayling, Crawford County, Traverse City, Grand Traverse County, Bad Axe and Sand Point, Huron County, Manistee, Manistee County, Douglas Lake, Cheboygan County, Brown Lake, Dickinson County, Alma, Gratiot County, Eaton County, Mackinac County, and Dr. F. N. Notestein informs me that he saw specimens in Otsego County in 1911.

DIADOPHIS PUNCTATA (Linnaeus).

RINGNECKED SNAKE.

Coluber punctatus, Sager, 1839, 302.

Diadophis punctatus, Clark, 1902, 193; 1905, 110. Notestein, 1905, 119. Smith, 1879, 7. Ruthven, 1906, 111; 1911, 114. Miles, 1861, 233. Cope, 1900, 751-753.

Description: A small snake that attains a length of about a foot or eighteen inches. Head flat and broad, low on the sides. Eye small. Two nasal plates.

The scutellation is described as follows: Dorsal scale rows 15, the scales smooth. Supralabials usually 8, often 7; infralabials 8. Oculars 2-2, temporals 1-1. Ventrals 141-161, subcaudals 36-56. Anal plate divided. In the three specimens examined by us (from Ann Arbor, Olivet and Oakland County) the scutellation is: dorsals 15 throughout the length of the body, supralabials 7-8, 7-7, 8-7, infralabials 8-8, 7-7 in two, oculars 2-2 in two, 2-1 in one, temporals 1-1 on each side, ventrals 144, 148, 159, subcaudals 57, 50, ?.

The writer has seen but one live specimen of this snake in Michigan. Hay (1892a, 493) describes the coloration as follows: "The color above varies in the subspecies, or varieties, from olive through gray to blue-black; below from yellowish white to orange and red, with more or fewer dark spots. There is usually a light ring around the neck, close to the head.

"The form in Indiana is the typical *punctatus.* The color above is a bluish black or a dark ash, with a wash of bronzy that extends down to the lowest rows of scales. Below, the color is orange or deep red, somewhat palest in front. On the outer ends of each of the ventrals there is a small black spot, and these are involved in the color of the dorsal scales. Near the middle line of the ventrals may be two rows of dark spots, or the spots on the ventrals may unite to form transverse bars. The ring around the neck is orange, edged with black. It is one or two scales in width. Upper labials yellow."

Habits and Habitat: But little has been recorded on the habits of this snake. By far the best account is that of Ditmars (1907, 335). "The Ringnecked snake is a secretive species, hiding under the loose, rotting bark of fallen trees, among loose rocks or under flat stones. It is seldom seen abroad and if it ventures from its lairs, usually prowls at night. In the North the writer has collected large numbers of these pretty snakes by turning over flat stones. He remembers a particular stone, about the size of an ordinary platter, lying near the edge of heavy timber, in Sullivan County, New York, that appeared to be a favorite hiding place for snakes of this species. In his daily trips to the woods, this stone was always turned over, and generally to disclose a ring-necked snake, snugly coiled beneath it. Many specimens were taken at this spot. They had apparently prowled about the clearing at night and on their way back to the thicket, and its hiding places, had discovered the shelving stone.

"In the South, large numbers of these reptiles were collected by stripping the bark from fallen trees. To find fifty or more specimens during a half-days hunt for various reptiles that select such hiding places, was not unusual. The Ringnecked Snakes were most frequently found under the bark of trees infested by ants; often the working streams of these insects would pass but a fraction of an inch from the spot where the reptile lay coiled. In one instance, while pursuing some entomological investigations during the early spring, the writer exhumed one of these snakes while digging through a large and thickly populated ant hill."

The Oakland County specimen (see below) was found under the bark of a decaying stump.

It has been said to feed on the following forms: snakes, lizards, amphibians, insects and earthworms. Specific records are as follows: green snake, *Liopeltis vernalis,* and red-bellied snakes, *Storeria occipitomaculata* (Ditmars, 1907, 336); frog, *Engystoma carolinense* (Cope, 1900, 753); beetles and earthworms, (Atkinson, 1901, 148); insects (beetles and undetermined fragments), salamander, *Plethodon cinereus,* and undetermined remains (Surface, 1906, 173).

The ringnecked snake is oviparous. The following account of the breeding habits is from Surface (1906, 172). "The latent gonads or undeveloped eggs are one-fourth inch in length and commence to

develop in May, when they reach a length of one-half inch, and by the middle of June they are practically developed or over one inch long. They are laid from the middle of June to July or August and each is covered with a thin opaque shell, white and leathery, and

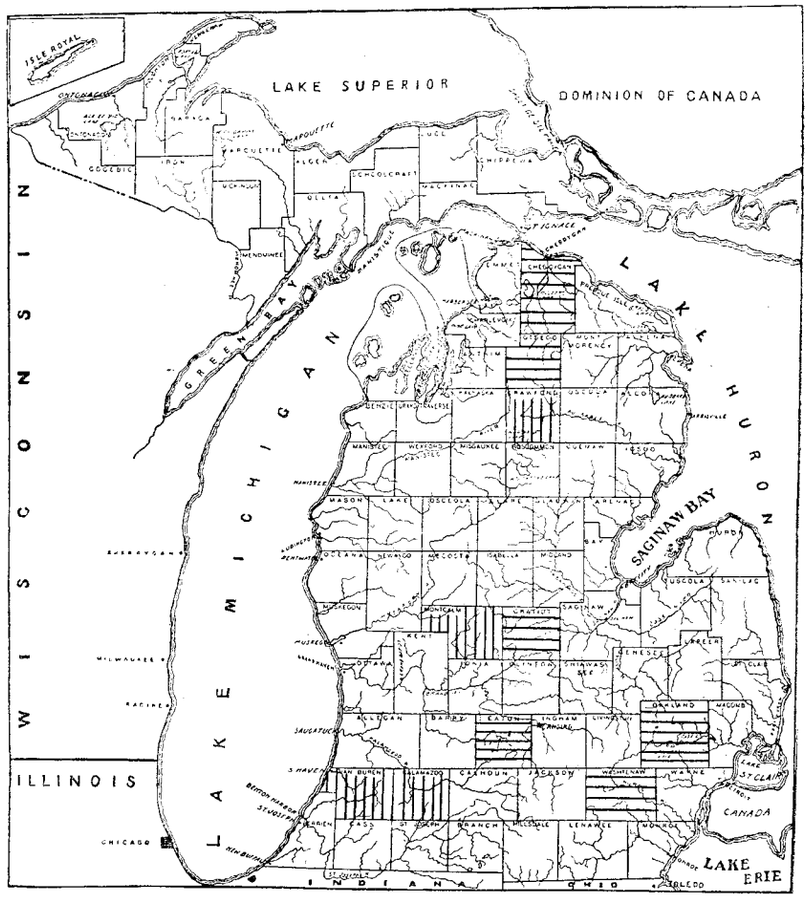


Fig. 38. Distribution of *Diadophis punctata*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

very irregular in shape and size. They hatch in September and October, and the young are about four inches in length at the time of hatching."

Range: The ringnecked snake is evidently rare in the state. The species has been reported from Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Grayling (Cope, 1900,

753), Eaton County (Clark, 1902, 193), Olivet, Kalamazoo, Montcalm and Van Buren Counties (Clark, 1905, 110), Marquette (Ruthven, 1906, 111), Pine Lake, Oakland County (Ruthven, 1911, 114), but there is great probability that some of these records refer to young specimens of *Storeria*. The Marquette record is particularly open to question and has not been recorded upon the map. We have seen specimens from: Ann Arbor, Washtenaw County (a single specimen taken many years ago and now in the Museum), Pine Lake, Oakland County, Olivet, Eaton County, Alma, Gratiot County, and Douglas Lake, Cheboygan County, and Dr. F. N. Notestein informs the writer that he saw the species in numbers in Otsego County in 1911.

BASCANION CONSTRICTOR (Linnaeus).

BLUE RACER.

(Pl. X.)

Coluber constrictor, Sager, 1839, 302.
Bascanion constrictor constrictor, Notestein, 1905, 119. Clark, 1905, 110. Smith, 1879, 7.
Bascanion foxii, Baird and Girard, 1853, 96. Miles, 1861, 233.
Zamenis constrictor, Clark, 1902, 193; 1903, 172-173.
Bascanion constrictor foxi, Smith, 1879, 7.
Bascanion constrictor, Baird and Girard, 1853, 93-94. Whittaker, 1905, 100-102. Miles, 1861, 233. Cope, 1900, 791-797. Hankinson, 1908, 236. Thompson, 1911, 107.

Description: A large snake that often attains a length of about six feet. Head somewhat flattened from the nape, but profile curving downward anterior to the eye, high on the sides and sides concave in front of eye. Nostril and eye large.

Dorsal scale rows 17-15 in every specimen examined. Supralabials 7, frequently 8; infralabials 8 or 9. Oculars 1-2, generally a small plate under the preocular. Temporals usually two in the first row. Ventrals 175-192; subcaudals 88-92. Anal plate divided.

Michigan specimens when adult usually uniformly dull bluish green above, rarely darker than dark olive, becoming black only on the temporal region and more or less brownish toward the end of the muzzle. Color of ventral surface nearly always greenish or bluish white, although frequently tinged with yellow.

The young differ so markedly from the adults that a superficial examination would seem to indicate that they belong to a different species, and as a matter of fact they are frequently confused with

the milk snake (*Lampropeltis doliatus triangulus*). Specimens less than one and one-half feet in length may be described as follows: ground color dark olive, this color belonging mostly to the centers of the scales, the edges being paler. A row of large blotches on the back, extending about to the fourth row of scales, about 3 to 4 scales long, and separated on the median line by about the length of half a scale. These spots with dark brown to black margins, the centers, in some cases at least, light brownish olive. Exterior to the dorsal blotches, on the first four rows of dorsal scales, numerous small and irregular black spots. Top and sides of head, and the pale ventral surface also marked with numerous small, black spots.

Habits and Habitat: The blue-racer is most frequently found in dry, open situations, generally near or in thickets. It also frequents hedge rows, and stone walls. It is a good climber and is not infrequently found several feet from the ground in bushes and twenty or thirty feet up in trees (Plate X). It is extremely graceful and agile as are all of the members of the genus, and very frequently eludes a would be captor. It will fight furiously when cornered or captured, but its small teeth can do little more than puncture the skin. As every herptologist knows, the blue-racer is not venomous (as popularly supposed), but entirely harmless, so that even the largest specimens may be handled with impunity. Indeed they make rather interesting pets, and soon cease to resent handling. The senseless slaughter of this beautiful snake is as much a disgrace to any civilized community as is the similar destruction of song birds, and an all too common occurrence in southern Michigan. Large and conspicuous, the adults often fall prey to the ignorance and superstition of people who should know better. The writer recalls an instance when a farmer showed him with great satisfaction six splendid specimens not one of them under five feet, which he had killed in a brush pile, under the impression that he was greatly benefiting the community by ridding it of six very dangerous animals.

The food of the blue-racer consists of small mammals, birds, bird eggs, other reptiles, amphibians and possibly insects. Exact records of stomach examinations or direct observations of the food habits are few. The principle food seems to be small mammals, and birds probably occupy a second place. Surface (1906, 170) states that in the Pennsylvania specimens examined by him the meadow mouse (*Microtus pennsylvanicus*) formed a large percent of the stomach contents. He sums up the results of an examination of a series of stomachs as follows: insects 25%; snakes (garter snakes,

green snake, water snake) 15%; field mice 22%; bird eggs (robin) 8%; rabbits 4%; voles 4%; frogs (green frog, wood frog) 7½%; birds 4%; mammals unidentified 7%; larvae of Royal Moth 3½%. Atkinson (1901, 147) records a weasel in the stomach of a Pennsylvania specimen.

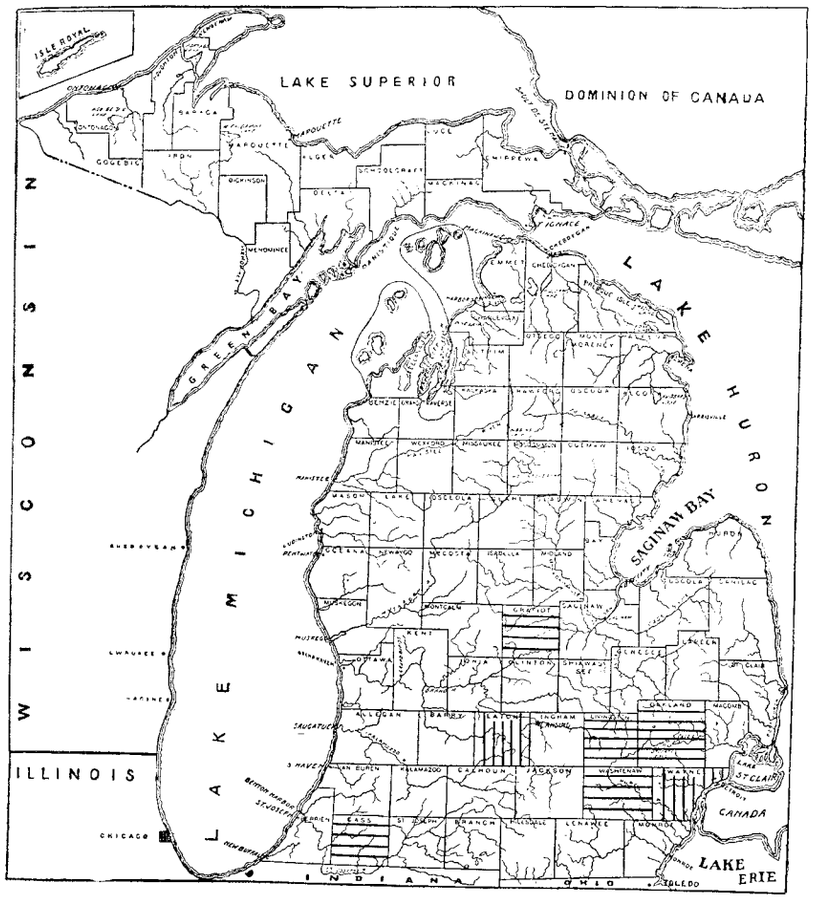


Fig. 39. Distribution of *Bascanion constrictor*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

The writer has never been able to induce captive specimens of this snake to eat toads or frogs but that they prey on these forms to some extent is proved by the observations of Surface. It will probably be found, however, that amphibians form a very minor part of the food. Also as regards insects it is doubtful if the blue-racer preys on any of these directly except possibly the large

lepidopterous larvae. That snakes are eaten is shown by the observations of Cragin (1878, 820-821), Verrill (1869, 158-159), Coues (1878, 269), Ditmars (1907, 282), Surface (1906, 168), and Putnam (1868, 136); and it is interesting to note that in the instance observed by Verrill it was a copper-head that was eaten, while the specimen observed by Coues killed and devoured a rattle-snake. This suggests that the species is, like the king-snake, immune to the poison of these venomous serpents.

Early writers supposed that this snake was a constrictor, a fact denied by some later writers. The truth is about mid-way between these views. In capturing small prey it simply seizes the animal in the mouth as do garter snakes, or at most after seizing the prey partly holds it by covering it with a portion of its body. This is exactly the same as does the king snake (*Lampropeltis getulus*), which is commonly said to be a constrictor. It is true of both species that when a snake is captured the captor winds a coil or two about the captive and thus secures it until swallowed. When a king snake captures a large mammal (e. g., a rat) it constricts it until dead, and it is possible that the blue racer does likewise.

Range: The species has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193; 1903, 172, 173; Whittaker, 1905, 100-102), "Oceana and Muskegon to Arenac, Saginaw and St. Clair Counties and southward" (Clark, 1905, 110), Grosse Isle (Cope, 1900, 795, 797; Baird and Girard, 1853, 93-94), Walnut Lake, Oakland County (Hankinson, 1908, 236), and Cass County (Thompson, 1911, 107). We have examined specimens from various parts of Washtenaw County, from Walnut Lake, Oakland County, Alma, Gratiot County, Cass County, and the photographs (Pl. X) were made near Hamburg, Livingston County.

LAMPROPELTIS DOLIATUS TRIANGULUS (Boie).

MILK SNAKE.

Coluber eximius, Sager, 1839, 302.
Ophibolus eximius, Miles, 1861, 233.
Ophibolus triangulus, Smith, 1879, 6.
Osceola doliata triangula, Clark, 1902, 194, and 1904, 173.
Lampropeltis doliatus triangulus, Clark, 1905, 110. Notestein, 1905, 118-119. Hankinson, 1908, 236. Ruthven, 1911, 115, 1911a, 267-268.
Ophibolus doliatus triangulus, Thompson, 1911, 107.

Description: A medium sized snake, attaining a length of about

three feet. Body of nearly the same diameter from the head to the tail. Head relatively small, broad and flat, as compared with the usual form as exhibited, for instance, in the garter snakes. The sides of the head are low in the milk snake so that the nasals, loreal and oculars are also low, and the whole head is short, and the eye small. Cephalic plates normal in number and form. Rostral normal. Temporals usually 2 in the first row. A single loreal. Nasals two, the nostril between them.

Dorsal scale formula usually 21-19-17; scales smooth and with two pits. Supralabials 7; infralabials usually 9, occasionally 7 or 8. Oculars 1-2. Temporals usually 2. Ventrals 195-204; subcaudals 42-51. Anal plate entire.

Ground color brownish ash or brownish yellow. Five series of dorsal blotches of which those of the median row are much the largest, broader than long and involve twelve to fifteen rows across the back. They are chestnut brown (inclining to red in the young) to olive brown in color, and bordered with black. On the sides, involving the second to fifth rows, and alternating with the vertebral series, a row of smaller circular brownish spots, and below and alternating with these another series of small black spots that involves the edges of the ventral plates and the first one to three dorsal scale rows. Belly white blotched with small squares of black. Tail crossed by half rings of black. A dark band across the posterior half of the prefrontals another from the eye to the corner of the mouth. On the nape a large spot of the ground color usually surrounded by extensions of the first dorsal blotch, these extensions uniting again on the parietals in a blotch that includes a V or heart-shaped spot of the ground color; but there are many variations from this arrangement.

Habits and Habitat: The milk snake is a rather common snake in southern Michigan, although not as frequently seen as some of the other species. Its apparent rarity is due to its secretiveness. It lives principally in and under fallen logs in the woods, but is found commonly about barns and outbuildings, probably in search of food. The name is a misnomer and originated in the popular idea that these snakes suck cows or steal milk from pans in the dairies. It is hardly necessary to state that this is an absolute fallacy. The food, as shown by examinations of stomach contents and by direct observations, is as follows: slugs, unidentifiable invertebrates, red-bellied snake (*Storeria occipitomaculata*), DeKays snake (*Storeria dekayi*), unidentifiable bird, robins eggs, unidentified mammals, jumping mouse, unidentifiable mouse, meadow mouse, *Microtus* sp?, white footed mouse, house mouse (Surface, 1906,

179-180); "Young of other snakes, besides such lizards as the blue-tailed and the swift, which it hunts at night as these creatures take refuge in the crevices of bark on fallen trees. The writer dissected a specimen that had been killed in a barn, in Sullivan

Fig. 40. Distribution of *Lampropeltis doliatus triangulus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

County, N. Y. The stomach contained five very young rats" (Ditmars, 1907, 344); *Natrix leberis* (Queen snake) and mice (Atkinson, 1901, 150); mice *Arvicola riparia,* (Cope, 1900, 886); garter snake (Merriam, 1878); *Eumeces quinquilineatus* L. (Blue-tailed skink) and the mouse *Peromyscus bairdii* (Ruthven, 1911a, 268).

Range: The species has been reported from: Michigan (Sager,

1839, 302; Miles, 1861, p. 233), Ann Arbor (Smith, 1879, p. 6), Eaton County (Clark, 1902, p. 194), Ann Arbor, Kalamazoo and Olivet, and Antrim, Barry, Montcalm, Kent, Ottawa and Van Buren Counties (Clark, 1905, p. 110), Douglas Lake, Cheboygan County (Ruthven, 1911, 115), Oakland County (Hankinson, 1908, p. 236), Stony Island and the sand region of Huron County (Ruthven, 1911a, 267-268), Cass County (Thompson, 1911, 107). The writer has examined specimens from the following localities: Ann Arbor, Washtenaw County; Brighton, Livingston County; Jackson, Jackson County; Pontiac and Walnut Lake, Oakland County; Shelby, Oceana County; Charity Island, Saginaw Bay, Stony Island and the sand region of Huron County, Douglas Lake, Cheboygan County, Alma, Gratiot County, Osceola County, Cass County.

THAMNOPHIS SAURITUS (Linnaeus).

RIBBON SNAKE.

(Pl. VI.)

Coluber saurita, Sager, 1839, 302.

Eutaenia sauritus, Miles, 1861, 233. Notestein, 1905, 114. Smith, 1879, 6.

Thamnophis saurita, Clark, 1902, 194; 1905, 109. Ruthven, 1906, 112; 1908, 112-119; 1911a, 269.

Thamnophis faireyi, Kirsch, 1895, 333.

Description: A slender, long-tailed snake, attaining a length of two to two and one-half feet. Head small, distinct from neck, rather high on the sides, slightly concave in preocular region. Cephalic plates normal; two nasals; one loreal. Nostrils lateral, between nasals.

Dorsal scale rows 19-17. Supralabials usually 7, occasionally 6 or 8; infralabials 10, occasionally 9 or 11. Oculars 1-3, occasionally 1-2; temporals 1 in the first row, and 2 in the second. Ventrals 157-169; subcaudals 87-112. Anal single.

The ground color above is usually chocolate brown, varying from light olive-brown to black. There are three light yellowish stripes —a dorsal (on the median and halves of adjacent rows) and two laterals (on the third and fourth rows)—all three of which are usually brightly colored, the dorsal generally tinged with orange, the laterals with green. The lateral black spots generally found on the skin in the garter snakes are seldom distinct, but are not always entirely fused. The ground color of the head is like that of the dorsal surface. There is usually a small pair of bright yellow spots

on the suture of the parietals, and another large yellow spot on the preoculars. The labials are generally nearly white and without black markings. The belly is pale greenish and ventral spots are usually wanting.

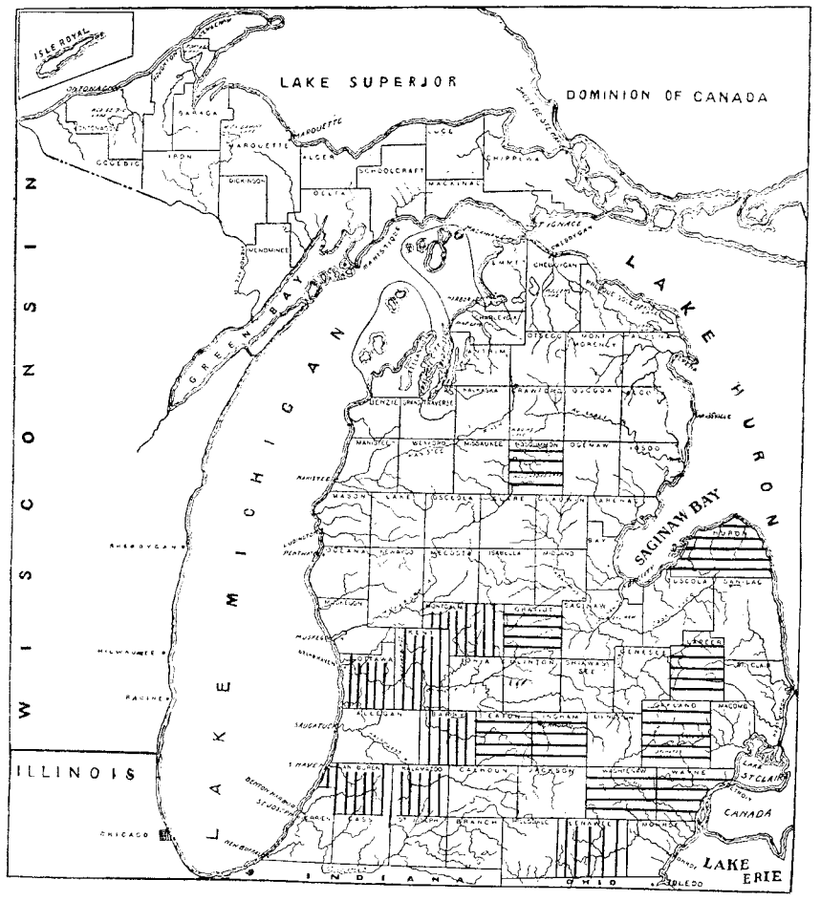


Fig. 41. Distribution of *Thamnophis sauritus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Habits and Habitat: Ruthven (1908, p. 112) describes the habits of this form as follows: "Like the other members of the group, *sauritus* seems to be more than ordinarily aquatic in its habits, but apparently less so than either *proximus* or *sackeni*. In Michigan we have generally found it about the margin of ponds and streams in damp woods. It is somewhat of a climber, and is occasionally

found in bushes, several feet from the ground. When pursued it glides through the pools and herbage at an astonishing rate, and does not hesitate to take to water and conceal itself among the water plants, but it generally remains near the surface, and we have never observed it dive to the bottom like a natricid snake. There are numerous short notes in the literature, to the effect that *sauritus* prefers damp situations.

"Ditmars (1907, 217-219) states that it feeds on salamanders, tadpoles, frogs, and fish, but, like *sackeni*, refuses earthworms. Two other writers, Atkinson (1901, 151) and Surface (1906, 142-143), record insects in stomachs examined. The latter gives the following as making up the stomach contents of Pennsylvania specimens: Earthworms, spiders, insect fragments, ants, *Plethodon cinereus, Spelerpes bilineatus, Hyla versicolor*. It should be noted that the insects may have been contained in the stomachs of the frogs and salamanders. The number of young is comparatively small; we have counted the embryos in a few specimens, and they seem to average about a dozen."

Range: The eastern ribbon snake is not very common in Michigan, at least it is rarely taken by collectors. It has thus far only been found in the southern peninsula. The specimen from Roscommon County, listed below, is the most northern record. A specimen has been recorded from Isle Royale in the museum catalog (Ruthven, 1906, 112), but this record is very doubtful and has not been indicated on the map. It has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Hudson, Lenawee County (Kirsch, 1895, 333), Ann Arbor (Smith, 1879, 6), Eaton County (Clark, 1902, 194), Ann Arbor, Olivet, and Barry, Kalamazoo, Kent, Montcalm, Ottawa and Van Buren Counties (Clark, 1905, 109), Roscommon, Gratiot, Eaton, Washtenaw, Lapeer, Ingham Counties (Ruthven, 1908, 112), the sand region of Huron County from Sand Point to Port Austin (Ruthven, 1911a, 269). Specimens from the following localities have been examined: various parts of Washtenaw County, Pontiac and Walnut Lake, Oakland County, Detroit, Wayne County, Alma, Gratiot County, Eaton County, Lapeer County, and Lansing, Ingham County.

THAMNOPHIS BUTLERII (Cope).

BUTLER GARTER SNAKE.

Eutainia brachystoma, Clark, 1903a, 1904, 194.
Eutaenia butleri, Notestein, 114.
Thamnophis butleri, Clark, 1905, 109. Ruthven, 1904, 289-299; 1909a, 116; 1908, 87-96; 1911a, 268-269. Whittaker, 1905.

Description: A small rather thick-bodied snake attaining a length of about twelve inches. Head small and usually not very distinct from neck, somewhat elevated behind, and sloping quickly down to the point of the snout. Muzzle short. Sides of head moderately high, concave in preocular region. Eye small. Cephalic plates normal; two nasals and one loreal. Nostril lateral, between the nasals.

Dorsal scales usually 19-17, occasionally 17-19-17 or 17-19-17-15. Supralabials 6 or 7, rarely 8, average between 6 and 7; infralabials 6, 7, 8, 9, or 10, average between 8 and 9. Temporals 1 in first row and 1 large or 1 large and 1 small in second row. Ventrals 134-146 (males), 132-140 (females), subcaudals 61-66 (males), 49-58 (females). Anal plate single.

Ground color above some shade of dark olive brown, with three (a dorsal and two lateral) bright yellow or greenish yellow stripes. The dorsal stripe is usually on the median and halves of the adjacent rows, and the laterals upon the third and more or less of the second and fourth rows. The color of the first and adjacent half of the second rows of scales is generally not lighter than the ground color above. There are two rows of black spots on the skin—encroaching on the scales along the stripes in specimens light enough to show them—but these often lose their identity by fusing irregularly. Belly pale greenish, the only markings being a small black spot at either end of each ventral scute.

Habits and Habitat: The following account of the habits of this snake is taken from the monograph of the genus by the writer (Ruthven, 1908, 89-91): "In southern Michigan I have only taken it in the immediate vicinity of water, either about the margin of swampy places or on the banks of streams. This may be a coincidence, but it is in accord with all of the specimens collected throughout the range which have habitat data. I have found them most frequently by overturning boards, etc., in such places, although they are also found crawling about in the long grass and herbage.

"It is in disposition a rather sluggish snake, seldom attempts to defend itself, and when surprised is usually easily captured. The ease with which they are captured is in part due to their inability to escape, owing to the extreme awkwardness of their movements on land. When moving slowly this is scarcely noticeable, but when they attempt to move rapidly to escape capture their efforts are peculiarly odd and ineffective. The movements consist in throwing the body in long curves in a manner closely analogous to the wiggling motion by which garter-snakes swim in deep water, and which results in much movement and muscular effort, but very little progress. This movement may be greatly augmented by putting the snake on a smooth surface, but it is not entirely due to the nature of the surface, as it can scarcely make any headway on a surface where *sirtalis* will glide away with comparative ease. This is one of the most striking characteristics of *butleri* and was first noticed by Reddick (1895, 261), who comments upon it in the following words: 'It is short and chubby, and its movement is very characteristic of it. It does not have the gliding movement of *E. saurita* nor the swift and active movement of the *Natrix sipedon,* but seems rather to exert a large amount of force to do little crawling. The movement is so characteristic that I believe anyone having once seen the peculiar way in which it tries to hurry itself away would ever after be able to recognize it at a distance.'

"Fortunately no doubt attaches to the species which Mr. Reddick had, for the specimen upon which this observation was based has been examined, and it is unquestionably a *butleri.* The movement seems to be very similar to the method of locomotion described for the so-called *atrata* specimens of *ordinoides* by Ditmars (1907, 227).

"Observations upon the food habits of *butleri* are but fragmentary. As announced in 1904, it is fond of earthworms and small frogs, but I have since found that in captivity it apparently prefers small fish. As a rule it is impossible to get them to take either worms or frogs if dead, but it is apparently a matter of unconcern to them whether the fish be alive or dead, as they will greedily eat specimens of the latter which have begun to decompose. Young individuals four or five days old will eat as many as three or four small minnows successively.

"Females taken in July are usually pregnant, and the number of young is apparently small. In the specimens examined the number of embryos is about twelve to fifteen. One specimen which was taken in late July, 1905, and kept in captivity gave birth during the first part of August to ten young. The members of this brood were not all born on the same date, but appeared at different times

between August 7 and 20, a difference of thirteen days. This is an unusual occurrence among the garter-snakes, and is undoubtedly abnormal, for, as far as we have observed, it has been invariably the rule that the entire brood appeared within a few hours at most.

Fig. 42. Distribution of *Thamnophis butlerii*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

We have seen but one other specimen give birth to young, and there were four in this brood. The young when but a few days old will struggle eagerly with earthworms or minnows, capturing the latter in a small dish of water or taking them from the fingers. For the first three or four days they are very secretive and can be seen only by overturning the moss and stones in the cage, except when they

come out to feed. They have not been observed to feed during the first three days, but after this they will come out freely to gorge themselves on fish, returning again beneath the stones when satisfied. One of these young snakes was kept for three months, in which time it attained to the respectable length of 150 mm."

An additional observation on the food-habits was made in 1908, when several leeches were taken from the stomach of a specimen taken under a stone on the shore of Stony Island, Huron County (Ruthven, 1911a, 268). In nature the form probably subsists largely on such weak food.

Range: Thamnophis butlerii is rather common in southern Michigan as far north as the tier of counties represented by Eaton, Oakland and Ingham. A few specimens taken by the State Biological Survey on the south side of Saginaw Bay (Rush Lake and Stony Island, Huron County) in 1908 represent the most northern record, and they were apparently rare in that region (Ruthven 1909a, 116; 1911a, 268). It has been reported from Olivet, Eaton County (Clark, 1903a, 83-88), Brighton, Livingston County, Washtenaw County, Eaton County (Ruthven, 1904), Pontiac, Oakland County (Ruthven, 1908, 92), and Ann Arbor and Chelsea, Washtenaw County (Clark, 1905, 109).

THAMNOPHIS SIRTALIS (Linnaeus).*

GARTER SNAKE.

(Pl. XII.)

Coluber sirtalis, Sager, 1839, 302.

Thamnophis sirtalis, Clark, 1905, 109; 1902, 194. Kirsch, 1895, 333. Ruthven, 1909, 332-333; 1908, 176-186; 1911, 115; 1911a, 268. Hankinson, 1908, 236. Thompson, 1911, 106.

Eutaenia sirtalis sirtalis, Notestein, 1905, 115. Ruthven, 1904a, 189-191. Cope, 1900, 1069-1074.

Thamnophis sirtalis sirtalis, Ruthven, 1906, 31, 34, 36, 49, 50, 111. Sperry, 1903, 175-179.

Eutaenia sirtalis ordinatus, Notestein, 1905, 115.

Eutaenia sirtalis parietalis, Notestein, 1905, 115. Smith, 1879, 6.

Thamnophis sirtalis parietalis, Ruthven, 1906, 49, 50, 53, 111-112. Clark, 1902, 194. Sperry, 1903, 175-179.

*Although recorded from the state the western subspecies *T. s. parietalis* does not occur within our limits. Nevertheless some Isle Royale specimens have the interspaces between lateral spots generally suffused with red, showing a strong tendency toward the western variety (Cf. Ruthven, 1906, 111-112.)

Description: A medium sized snake attaining a length of one and a half to two or three feet. Head generally well elevated behind, elongate, high and straight on sides, concave in preocular region. Cephalic plates normal. Two nasals and one loreal; nostril lateral and between the two nasals.

Dorsal scales 19-17, supralabials 7, occasionally 8, much more rarely 6; infralabials 10, occasionally 8, 9 or 11. A single preocular and usually 3 postoculars. A single anterior temporal. Ventral plates 144-168; subcaudals 54-84. Anal plate single.

The coloration consists of three light stripes on a darker ground, the lateral stripes on the second and third rows, the dorsal on the median and halves of the adjacent rows. The first row of scales much lighter than the ground color above, usually greenish or yellowish, at least the upper half. The color between the stripes may be uniformly black or brown, or olivaceous with two rows of alternating, usually poorly defined, black spots. Regardless of the color of the scales between the stripes, however, there may nearly always be seen, on stretching the skin, two rows of prominent black spots separated by pale interspaces. Along the lateral stripes the interspaces may occasionally be red. The stripes may be yellowish, greenish or bluish, and the laterals when greenish or bluish frequently blend with the first row. The dorsal stripe sometimes wanting. The ventral surface usually pale and free from prominent markings, except for a black spot on each end of the ventrals.

Habits and Habitat: Ruthven (1908, 177-179) has summarized the habits of this species as follows: "The experience of the writer indicates that it is quite generally distributed in the Eastern forest region, for while it is found most commonly in the vicinity of water, it is not uncommon in the clearings, woods, and thickets on the neighboring hills.

"The food consists principally of frogs, toads, salamanders, earthworms, and various insects. Whether or not it feeds to any great extent upon tadpoles and fish is undetermined. Garman (1892, 268) states that they eat these animals, and I have observed them to "capture fish in captivity, but since in the wild state they are not particularly aquatic, the truth of the matter is probably that they capture these forms when they encounter them in small pools, but that this is comparatively seldom. The number and kinds of insects eaten is also a questionable point. It is true that many species are found in the stomachs examined, but, as Surface (1906, 149) says, many of these are 'taken inside of the toads and other batrachians which the garter-snake had eaten.' However, both adults and young are very fond of earthworms. As other garter-snakes, *sirtalis* apparently does not refuse dead food. Mr. N. A. Wood, of the University of Michigan, reported to the writer, on May 18, 1907, that he saw a specimen of this species swallowing a yellow warbler, which he had observed lying dead in the same place on the preceding day. In the latter part of October, 1907, the writer discovered an individual at Portage Lake, Washtenaw County, Michigan, busily engaged in an attempt to swallow the dried remains of a large green frog (*Rana clamitans*).

"The breeding habits have been commented upon several times, but are as yet only incompletely known. In southern Michigan copulation takes place in April, and at this time it is reported on good authority that these snakes often collect in groups, probably owing to the procreative impulse. I have not witnessed this nor can I find any observations on the act of copulation. The latter I have seen but once, and then but imperfectly. It took place on April 21, 1906, between two specimens in captivity. The male in this case lay at full length beside the female, and evidently attempted to excite her by gently rubbing her neck with his snout. He finally threw a fold of his tail across hers, and turning his ventral surface against her side began spasmodic contractions of the abdominal muscles, which were continued from twenty to thirty minutes. Unfortunately the snakes were then disturbed and the observations ceased. They indicate, however, that there may be some interesting courtship reactions to be observed in these snakes.

"The period of parturition extends from the latter part of July to about the middle of September. Both of these dates are only approximate, as definite observations are wanting. The number of young is very variable, the average range in number being probably about 10-30, while as many as 78 have been recorded in a single brood, which is not at all an unusual number, since *parietalis* may have, according to our observations, as many as 73. After birth the young remain for a short time about the mother, but this time is probably limited to a few hours at most. In captivity there is little tendency discernable to stay near the mother, and although we have several times seen a mother and her brood in a wild state, in every case noted, when the mother became alarmed, or for some other reason moved away, the young scattered in all directions, and it is improbable that they ever came together again. The quickness and completeness with which the little snakes disappear when alarmed may partly explain the fable that this snake swallows its young.

"Ditmars (1907, 235-236) gives the following interesting account of the hibernating habits:

'The favorite situations in which to pass the cold months are in soft soil on a slope that faces the south. Here the reptiles burrow down a yard or more. Rocky situations are often selected, and among the clefts and fissures, one opening into another, the snakes are enabled to retire to a considerable depth from the surface.

'It is in the fall that these snakes congregate in large numbers on ground that is suitable for the winter's sleep. Here they sun themselves during the middle of the day, retiring into clefts and burrows during chilly autumn nights. As the nights become colder, their basking periods during the day are shortened, and finally, after the first severe frost, they remain below the ground for the winter. Instinct seemingly attracts them to these places of hibernation, for such spots are usually poor feeding grounds and have been devoid of snakes during the summer months. In spring, the breeding time, the reptiles remain in numbers until the weather has become well settled and the danger of needing good shelter from the cold spells has passed. Then they scatter into the ravines, the thickets, along streams and brooks, until the scene that has abounded with sinuous, crawling life is deserted.'

"This account harmonizes very well with the writer's observations in southern Michigan. In the latter region they are found in the autumn on sunny hillsides in the immediate neighborhood of holes, into which they hasten when alarmed, but that they dig these holes themselves yet remains to be proven, nor after the beginning of the period of hibernation do they necessarily 'remain below the ground for the winter,' for if periods of marked moderation in the temperature occur they will come out in December, January, or February. Thus, on January 22, 1906, which was a warm day (60° F.) in a period of very moderate temperature, a collector for the University of Michigan Museum reported seeing a large garter-snake near Grass Lake, Washtenaw County, Michigan, which was undoubtedly this species."

Range: The species has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 6), Hudson and Manitou Beach, Lenawee County (Kirsch, 1895, 333), Grosse Isle and Port Huron (Cope, 1900, 1073), Eaton County (Clark, 1902, 194), Porcupine Mountains, Ontonagon County (Ruthven, 1904, 189, 191), Ann Arbor, Olivet, and Antrim, Barry, Kalamazoo, Kent, Mackinac, Montcalm, Ottawa and Van Buren Counties (Clark, 1905, 109), Bessemer, Gogebic County, Isle Royale, Keweenaw County, Limestone Mountain, Baraga County, Marquette, Marquette County, Porcupine Mountains, Ontonagon County (Ruthven, 1906, 111-112), Washtenaw County, Kent County, Grosse Isle, Wayne County, Livingston County, Eaton County, Oakland

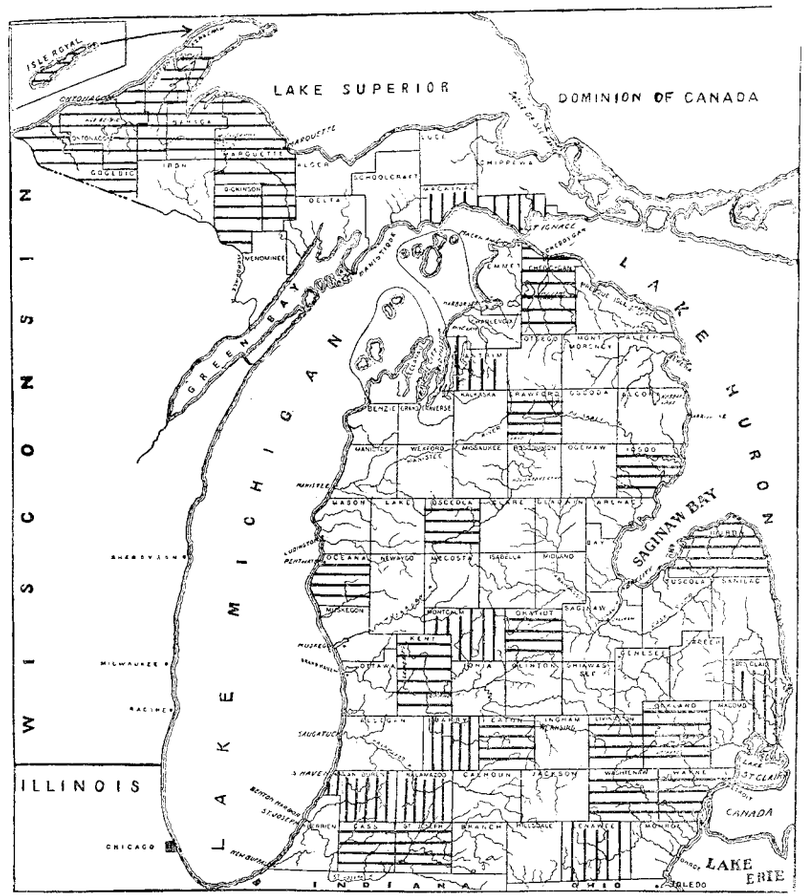


Fig. 43. Distribution of *Thamnophis sirtalis*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

County, Oceana County, Crawford County, Iosco County, Gratiot County, Isle Royale, Lake Superior, Ontonagon County, Gogebic County, Houghton County, Baraga County, Marquette County (Ruthven, 1908, 181), Walnut Lake, Oakland County (Hankinson, 1908, 236), sand region of Huron County (Ruthven, 1911a, 268), Douglas Lake, Cheboygan County (Ruthven, 1911, 115), and Cass

County (Thompson, 1911, 6). Specimens from the following localities have been examined: Alma, Gratiot County, Washtenaw County, Au Sable River, Crawford County, south branch of Au Sable River, Iosco County, Bessemer, Gogebic County, Walnut Lake, Pontiac and Birmingham, Oakland County, Brighton, Iosco, Livingston County, Denton, Wayne County, Isle Royale, Keweenaw County, Limestone Mountain, Baraga County, Marquette, Marquette County, Porcupine Mountains, Ontonagon County, Shelby, Oceana County, Winona, Houghton County, Eaton County, Kent County, Grosse Isle, Wayne County, Douglas Lake, Cheboygan County, Brown Lake, Dickinson County, Charity Island, Saginaw Bay, sand region from Sand Point to Port Austin, Huron County, Cass County, Osceola County, and Dr. A. S. Pearse observed specimens in St. Joseph County in the spring of 1909.

SISTRURUS CATENATUS (Rafinesque).

RATTLESNAKE, MASSAUGER.

(Pl. XI b.)

Crotalus tergiminus, Sager, 1839, 302.
Caudisona tergimina, Gibbs, 1900, 12-13.
Sistrurus catenatus, Clark, 1902, 194, 1905, 110. Stejneger, 1893, 413. Ruthven, 1911a, 270-271. Thompson, 1911, 107.
Sistrurus catenatus catenatus, Notestein, 1905, 120. Cope, 1900, 1146-1149.
Crotalophorus tergeminus, Baird and Girard, 1853, 14-15. Smith, 1879, 6.
Crotalophorus kirtlandi, Holbrook, 1842, III, 32.
Crotalophorus tergeminus kirtlandi, Smith, 1879, 6. Miles, 1861, 233.

Description: A short thick-bodied snake attaining a length of two and one-half or three feet. Head broad and decidedly triangular in shape, being much swollen through the back part, and terminating in a blunt snout. Generally a slight concavity in the frontal region. Cephalic plates normal in arrangement, but parietal plates small, which together with the broad head and a rather well defined canthus rostralis makes the area covered by the cephalic plates broadly oval in outline. Sides of head high and without or with only a slight concavity in the loreal region. Eye small, situated high up on head, with an elliptical pupil, and over-hung by the supraoculars. A deep pit in the loreal region. Temporal region occupied by four or five rows of smooth scales. Tail terminating in a rattle.

Dorsal scale rows usually 25-23-21-19, frequently 23-21-(19). Supralabials 11-13 in number, separated from the orbit by a row of small scales that is continuous with the postoculars; infralabials usually about 11 to 14. Two preoculars, elongated anteriorly, the upper meeting the posterior nasal scute. Loreal small and trapezoidal in form. Ventrals 134-147; subcaudals 22-30, undivided. Anal plate single.

Ground color above grayish or ash, relieved by several series of deep brown blotches that form cross bands on the tail. Spots of the dorsal series large, and transversely and irregularly oblong in form. Below and alternating with the vertebral row a row of small rounded spots, and below these a series of large blotches transversely oblong and extending to the second row of scales, and alternating with these another series of small spots on the first and second scale rows. Spots of all of the series, with the exception of the row of small rounded blotches exterior to the vertebral series, margined with an inner black and an outer pale yellow line. Dorsal blotches occasionally divided or fused with the upper row of lateral spots. A pair of elongated spots similar to the other dorsal spots in color extend from the cephalic plates to the neck, and another on either side extends backward from the orbit. Inferior yellow margin of the latter well developed between the eye and the angle of the mouth forming a narrow yellow band. Two diverging yellow lines from the pit to the lip. Head dark brown, as the dorsal blotches, but with a light brownish band between the eyes and occasionally light marks on the posterior head plates. Color underneath black irregularly broken up with pale yellow.

Habits and Habitat: The rattle snake, or massauger, as it is generally known, is the only poisonous snake in Michigan; a statement which when generally known should stop the wholesale destruction of the harmless snakes practiced by most persons who come in contact with them. Needless to say this snake should be avoided as it is distinctly venomous, but on the other hand most of the current stories about it must be discredited for it is doubtful if its bite is sufficiently noxious to kill a healthy adult. It is a sluggish snake, slow to bite, and usually gives warning with its rattle before striking. It is thus little to be feared.

It prefers the vicinity of swamps, although not aquatic in its habits, and is becoming yearly more rare in this region. Its extinction is probably due to several causes chief of which is the draining of swamps and the killing of great numbers by farmers. An excellent general account of the habits of the species is given by Hay (1887).

Very few observations have been made on the food habits of this snake. Taylor (1892, 357) writes on the subject as follows: "The contents of the stomachs of this species shows that its food is almost wholly made up of mice and animals of that class. Aside from well known venomous qualities this snake has no bad habits and is decidedly useful. It is said that rats and mice will very soon disappear when the presence of this reptile is known. In at least one instance we have known this statement to be true. It was noticed that rats which a few days previous had been extremely numerous in a certain cellar had wholly disappeared. Within a few days more the mystery was solved by finding a huge rattler in the doorway. These facts fully account for the frequent finding of rattlers around old cellars, buildings, etc., where they go to hunt for their choice food." Ditmars (1907, 438) states that his captive specimens "would take young birds, mice and frogs, and, like the copperhead snake, different kinds of food according to the seasons, a trait probably developed by necessity while in the wild state."

Our observations on the food habits of the species differ from those of Taylor in that frogs form the bulk of the stomach contents in the specimens we have examined. We have also found in two instances snakes (one a rattlesnake) in stomachs examined, and in one case it was evident that the snake eaten had been dead for a considerable time before it was eaten (Ruthven, 1911a, 270).

The young are brought into the world alive, i. e., the eggs are not laid. There are, according to Hay, usually about six young in a brood, and they are about six inches long.

Many erroneous opinions are current concerning this snake. Among these are that the number of rattles indicates the age of an individual, one rattle being added each year. The researches on the growth of the rattle all agree that each ring represents the epidermis shed from the enlarged portion of the tail, in a manner analogous to the general shedding of the skin, the new ring being added at the base each time, thus pushing the string outward. There is some disagreement among observers as to whether or not the two processes always take place at the same time, but the fact is well established that the shedding of the epidermis from the terminal enlargement of the tail and the consequent formation of rattles, like the general shedding of the epidermis, takes place every few (two-five) months, so that several rattles are usually added each year. The reason that so few rings are generally present at one time is that the terminal ones are easily and frequently lost. The number of buttons even on the largest individuals is rarely

more than eight or nine, and the long strings occasionally exhibited as curiosities are in most instances formed by the joining together of several strings.

Another popular fallacy regarding these snakes is that the ex-

Fig. 44. Distribution of *Sistrurus catenatus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

traction of the fangs renders them harmless. It is true that it does so for a time, but, as is well known to scientists, new fangs soon replace the old ones when the latter are broken off or shed. This is in fact a wise provision of nature, since the long fangs are occasionally broken off by the struggles of the prey.

The writer will not take space to describe further the character-

istics of this snake. A most excellent account may be found in Stejneger's "The Poisonous Snakes of North America" (1893, 413).

Range: The species has been reported from: Michigan (Sager, 1839, 302; Holbrook, 1842, III, 32; Miles, 1861, 233; Stejneger, 1893, 413, Grosse Isle (Baird and Girard, 1853, 14, 15), Ann Arbor (Smith, 1879, 6), New Buffalo, Berrien County (Cope, 1900, 1149), Eaton County (Clark, 1902, 194), Benzonia to Au Sable River (Clark, 1905, 110), Cass County (Thompson, 1911, 107), and Huron County (Ruthven, 1911a, 270-271). We have seen specimens from Alma, Gratiot County, Au Sable River, Oscoda County, Pontiac, Oakland County, various localities in Washtenaw County, Charity Island, Saginaw Bay, Cass County, Stony Island, North Island and Sand Point, Huron County.

ORDER TESTUDINATA. (TURTLES).

As indicated by the key (p. 77) the members of this order are quadrupedal, cuirassed forms with a rounded or longitudinal anal opening. The shell in our species is, with the single exception of the soft-shelled turtle, covered with large dermal plates. Siebenrock (1909) divides the order into four superfamilies only two of which have representatives in Michigan. It is sufficient for our purposes to diagnose the genera and species.

Key to the Genera and Species of Michigan Turtles.

a¹. Carapace covered by leathery skin, and without horny epidermal plates ..... *Platypeltis spinifera,* p. 129.

a². Carapace rigid and covered with horny epidermal plates.

b¹. Plastron narrow, not nearly filling the opening of the carapace.

c¹. Bridge long and narrow. Tail long and furnished above with a median row of large horny tubercles. Marginal scutes 25.... *Chelydra serpentina,* p. 133.

c². Bridge short and rather wide. Tail in males with a terminal nail, and without a median dorsal row of tubercles. Marginal scutes 23..... ..... *Kinosternon odoratum,* p. 137.

b². Plastron nearly or quite filling the opening of the carapace. Marginal plates 25.

c¹. Parts of plastron immovably attached to each other and to the carapace.

d¹. Carapace smoothly rounded, i. e., with no median dorsal keel.

e¹. A sharp tooth on either side of the notch at the symphysis of the upper jaws. Carapace without round, bright orange spots, *Chrysemys.*

f¹. Vertebral and costal scutes unicolored except for a yellow margin. A relatively small plastral blotch along the median line..... *C. cinerea,* p. 141.

f². Vertebral and costal scutes marked with irregular pale-yellow lines. A large blotch covering most of the plastron ..... *C. bellii,* p. 143.

e². No teeth bounding the notch at the anterior end of the upper jaws. Carapace marked with numerous, round, bright orange spots. ..... *Clemmys guttata,* p. 147.

d². Carapace with a strong median keel..... ..... *Graptemys geographica,* p. 150.

c². Plastron with a transverse hinge, and movably attached to the carapace.

d¹. Upper jaw notched in front. Carapace long and depressed..... *Emydoidea blandingii,* p. 153.

d². Upper jaw produced downward at the symphysis to form a hook. Carapace short and high.... ..... *Terrapene carolina,* p. 155.

PLATYPELTIS SPINIFERA (LeSueur).

SOFT-SHELLED TURTLE.

(Pls. VII, XI a)

Aspidonectes spinifer, Smith, 1879, 7. Clark, 1902, 193; 1905, 110. Miles, 1861, 233. Agassiz, 1857, 404-405.
Trionyx spiniferus, Thompson, 1911, 107.

Description: Body broad and very flat. Carapace and plastron not covered with epidermal plates, but by a soft and leathery skin, the margins of the carapace bending freely at the edges. Head tapering to the snout which is much produced and flexible. Nostrils separated by a septum, and each with a papilla projecting into it from the septum. A low obtuse keel along the middle of the back. A series of spines along the anterior edge of the carapace, in the adults; the entire upper surface of the carapace covered with small tubercles. Feet broad and fully webbed.

Color of carapace olive or light brown, the margin yellow. Near the margin is a narrow, broken line of black. In young specimens there are on the carapace numerous spots somewhat darker than the ground color and each surrounded by a broad, black ring. These spots become smaller and entirely black toward the margin of the carapace, and are obscure in old individuals. Plastron immaculate white or pale yellow. Limbs olive spotted with black. A pair of black lines on the snout, each of which at the base of the latter become two diverging black lines separated by yellow, and pass through the eye onto the neck.

Habits and Habitat: In southern Michigan the soft-shelled turtle occurs rather commonly in the rivers and lakes which have a soft muddy bottom. They are not commonly seen, as they seldom leave the water, and owing to the fact that the color of the carapace harmonizes well with the color of the bottom. When surpised, they are rapid swimmers and easily elude capture. The larger individuals should be handled with care as the lip-like folds of skin cover sharp-edged mandibles that are capable of inflicting considerable injury.

Newman's (1906, 126 *et seq.*) observations on the habits of the soft-shelled turtle at Lake Maxinkuckee, Indiana, are the most comprehensive that have been made and are largely the basis of the following very brief account.

They appear early in April (or in the latter part of March), from their hibernation, and soon begin to feed actively. In food habits it "is voracious and carnivorous, feeding principally upon crayfish and the larvae of large insects. From the vantage ground of a high bank it was possible on still days to observe individuals as they captured their prey. They crawl or swim along the bottom, thrusting their snout under stones and into masses of aquatic vegetation, occasionally snapping up a crayfish or larvae that they have succeeded in dislodging. They do not tear up their food, but swallow it whole, using the fore-feet to assist in forcing it down.

"The stomachs of three specimens, opened during the latter part of June, contained the following:

1. A large female contained nine medium sized crayfish, only slightly digested.
2. A medium sized female contained four crayfish and twenty-two dragon-fly larvae.
3. A large male contained nine dragon-fly larvae and a few plant buds, probably taken by accident when snapping up larvae."

Surface (1908, 123) has recorded the following observations on the food habits: "Unfortunately, only two of the Soft-shelled Turtles available for examination contained food, although a greater number were examined and found to be empty. Of these neither had eaten any vegetable matter, but both contained Crayfish, which are common inhabitants of streams they frequent, and are doubtless among the chief elements of their food. In devouring Crayfish (or Crawfish), any creature is objectionable from the fact that it is one of the most important foods of the carnivorous fishes. Hay asserts that 'it feeds on such fishes and reptiles as it can secure.'

"One Soft-shelled Turtle was found to contain fragments of beetles so broken as to be beyond recognition, but indicating the possibility of these creatures feeding upon insects which may be found floating on the water or in damp places frequented by such turtles.

"We take this opportunity to record the fact that we have found the Soft-shelled Turtle feeding upon grains of corn obtained in or near the ponds which they inhabit. A specimen examined by us in Ohio some years ago contained both yellow and red field corn, or Indian corn, to the extent of almost as much corn as would be produced upon two average ears of this plant."

Mating must take place during April or May (Newman) and the nesting period extends from about the middle of June to the middle of July. Newman states that "The character of the soil seems to be immaterial so long as it is near the water's edge. Nests were found in clay so hard packed that one could scarcely break it with the fingers. One nest was made in a rock pile, the eggs being dropped into crevices between the rocks, and sand packed around them. Several nests were made among the smaller roots of a tree growing on the sandy beach, the eggs being deposited between and under the roots in a very irregular fashion. The majority of nests, however, were found in the soft beach sand over six feet from the water."

The same writer briefly describes the nest building as follows: "A warm sunshiny day. Place: the 'old road' about ten feet from the water's edge and concealed from view on one side by tall grass. A large female Aspidonectes has just escaped from the grass and is commencing to make a nest. No time is lost in selecting a spot. She scratches out footholds for the forefeet and begins to excavate with the hindfeet, using right and left alternately with a circular gouging movement. As the hole becomes deeper it is generally necessary for her to give a more nearly perpendicular thrust with the hindfeet.

"In less than forty minutes the nest is completed and she has commenced to lay her eggs, letting the tail down into the narrow hole as far as possible. After depositing several eggs she arranges them with the hindfeet and then rakes in some earth previously wet

Fig. 45. Distribution of *Platypeltis spinifera*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

up with water from the accessory bladders. The earth is gently packed in before any more eggs are laid. The remainder of the eggs are deposited and the hole is filled up with earth and tramped down quite firmly with the knuckles of the hind feet, right and left feet being used alternately. This treading movement continues for some minutes and seems to be quite thorough. Al-

though not in any way disturbed, the tortoise left without attempting to cover up the traces of scratching feet, and anyone who is familiar with the appearance of a tortoise nest would have no difficulty in detecting this one. At 12:25 she turned and started for the water but was captured with a landing net. The nest was examined and found to be flask-shaped with a narrow neck only an inch and a half in diameter. The depth of the nest was a trifle over six inches and the diameter at the bottom about three inches. The nest contained eighteen rather large spherical eggs of a delicate pink color and with a very thin brittle shell."

After the breeding season is over they spend their time in the water, and as the cold weather comes on, bury themselves in the mud and sand of the bottom where they remain until the following spring.

The soft shelled turtle is highly valued as food, the flesh being delicate and of excellent flavor. Individuals attain a large size, and are rather readily shot or caught with a hook and line.

Range: The species has been reported from: Michigan (Agassiz, 1857, 404-405); "Southern half of the Lower Peninsula. It is frequently met with as far north as Genesee County, and in the streams of the eastern as well as the western slope of the state" (Miles, 1861, p. 233), Ann Arbor (Smith, 1879, p. 7), Eaton County (Clark, 1902, p. 193); Ann Arbor, Brookfield, Olivet; and Allegan, Kalamazoo, Montcalm and Van Buren Counties (Clark, 1905, p. 110), and Cass County (Thompson, 1911, 107). The writer has seen specimens from: Ann Arbor and Portage Lake, Washtenaw County, White Pigeon, St. Joseph County, Cass County, Kalamazoo County and Allegan County.

CHELYDRA SERPENTINA (Linnaeus).

SNAPPING TURTLE.

(Pl. VI.)

Chelydra serpentina, Sager, 1839, 301. Smith, 1879, 7. Clark, 1902, 193; 1905, 110. Kirsch, 1895, 333. Miles, 1861, 232. Hankinson, 1908, 236. Thompson, 1911, 107. Ruthven, 1911a, 271.

Description: Carapace rigid, covered with horny plates, broadly oval in outline, rather depressed and serrated behind. There are three moderate keels on the carapace, one median and two lateral, very prominent in the young, less so in old individuals, the keels tuberculated, the tubercles with radiating edges. Plastron small,

leaving most of the body exposed, bridge narrow. Tail long and tapering. Under surface covered with large scales, the upper surface furnished with a row of large horny tubercles; other smaller tubercles on the upper surface of the tail. Head large and flattened above, and with rather conspicuous bony ridges; snout rather pointed; both jaws terminating in a hook. Large, transverse, sharp-edged scales on the anterior part of the fore leg. Skin wrinkled and covered with prominent warts.

The color of the carapace may be very dark olive, brown or black. Upper parts of head, neck, limbs and tail brown or black, the tips of the warts and various lines on the head frequently yellow or brown. Plastron and under surface generally mostly dull yellow.

Habits and Habitat: This is the largest turtle native to Michigan. True (1893, 153) gives the maximum weight as twenty or thirty pounds. It is extremely pugnacious in disposition, and uses its sharp and powerful jaws upon slight provocation. Large individuals are to be handled carefully, as their powerful, keen-edged jaws are capable of inflicting a severe injury.

Snapping turtles prefer the quiet water habitats, such as lakes, ponds and the pools of sluggish streams. They frequently lie partly embedded in the mud of the bottom, snapping at their prey as it comes within reach; in this habitat they are rendered more inconspicuous by the mat of algae that often grows on the shell. According to Newman (1906, 150), they may also stalk their prey. They are carnivorous, and, according to Garman (1893, 245), "their food consists of all manner of small animals, such as fishes, frogs, reptiles, and young water birds." Hay (1892a, 558) states that "a large specimen that I dissected had in its intestine the feathers and partially digested bones of a full grown robin. The wing and tail feathers filled up the intestine. Its excrement contained the remains of a crayfish."

Numerous other authors mention the food of this turtle but the observations of Surface, who has published the following table, are the most exact.

FOOD CHART OF SNAPPING TURTLE (*C. serpentina*).*

(Number with food, 19).

	No.	Per cent.
Vegetation	5	26
Algae (low water plants)	2	10.5
Seeds, undetermined	1	5.2
Leaves, undetermined	2	10.5
Apple seeds	1	5.2
Skunk Cabbage (*Symplocarpus foetida*) leaves	1	5.2
Grass	3	15.7
Animal Matter	19	100
Mollusca (Snails and Slugs)	7	36.8
Snails (*Helix*)	4	21.1
Pond Snails	2	10.5
Slugs	1	5.2
Crustacea, *Cambarus* sp. (Crayfish)	12	63.1
Insecta	9	47.3
Undetermined Insects	2	10.5
Hemiptera (Bugs)	1	5.2
Corisidae, *Corisa* sp. (Water Bugs)	1	5.2
Pentatomidae (Stink Bugs)	1	5.2
Diptera (Flies)	3	15.7
Larvae	2	10.5
Stratiomyiid (Fly) Larva	1	5.2
Coleoptera (Beetles)	7	36.8
Undetermined	5	26.3
Water Beetle larva	1	5.2
Hydrophilidae, Water Scavengers	1	5.2
Dytiscidae, Diving beetles	1	5.2
Gyrinidiae, Whirligig Beetles	1	5.2
Vertebrata (Vertebrates)	7	36.8
Undetermined species (Fish)	2	10.5
Pisces (fishes)	2	10.5
Undetermined fish	1	5.2
Catostomidae (Suckers)	1	5.2
Batrachia (Frogs, etc.), *Rana* sp.	1	5.2
Ophidia (Serpents)	2	10.5
Aves (Birds)	1	5.2
Mammalia (Mammals)	4	21.1
Undetermined	1	5.2
Muridae (Mice)	2	10.5
Leporidae (Rabbits), *Lepus* sp	1	5.2

*From Surface (1908, 128-129.)

Captive specimens will feed upon pieces of meat or the bodies of mammals and birds. They grasp the food, pull it under the water, and swallow it, or, if too large, tear it to pieces by seizing it firmly in the mouth and clawing it with the forefeet.

On land a snapping turtle is a curious sight, as it walks with the body well elevated on the legs. If brought to bay at this time they do not retire into their shells, but, raising themselves still higher on their limbs, open their jaws and lunge forward at the offender with a force that often destroys their equilibrium and causes them to fall forward.

Newman (1906, 150-151) records the following notes on the breeding habits: "Only in one instance have I observed the female Chelydra during the nesting process. On this occasion the nest was more than half completed when I first caught sight of her. Although she stopped work and showed signs of preparing for a retreat, she concluded the filling-in process in a somewhat slovenly

manner and then retreated. The filling-in process was the same as that observed for Graptemys and Aspidonectes.

"The nest was in gravelly sand on the side of a railway embankment, separating the lake from a swamp. An examination of the

Fig. 46. Distribution of *Chelydra serpentina*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

nest revealed a broad funnel shaped depression, about a foot in diameter, at the apex of which a tunnel, about four inches in diameter, led diagonally into a wider expansion of irregular shape and about a foot beneath the general ground surface. The tunnel was obstructed by a stout stick and was consequently turned somewhat to one side. In the expansion and communicating tunnel

were thirty-three eggs scattered irregularly in a double layer. On the whole it was a decidedly untidy and primitive sort of nest.

"At about the same time of the month (June 15) several half-finished nests were found in the same railway embankment and all had the same general characteristics as the one described. I am told by the engineers on the railroad that the females are often seen at work and that they leave precipitately on the approach of the early train.

"The eggs are spherical with one hemisphere white and the other pinkish. The shell is very tough, so that the eggs, if thrown on hard ground, will rebound several inches without breaking. The eggs laid on June fifteenth hatched during the last week in August."

The flesh of the snapping turtle is usually esteemed as food by the people in localities where the species is found. True (1893, 154) states that "The snapping turtle is regularly seen in spring in the markets of Washington, dressed for cooking, that is, having the under part of the shell and the entrails removed." The eggs are also often eaten.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Miles, 1861, 232), Ann Arbor (Smith, 1879, 7), Hudson and St. Joseph River (Kirsch, 1895, 333), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Barry, Kalamazoo, Kent, Montcalm, Ottawa, St. Joseph and Van Buren Counties (Clark, 1905, 110), Walnut Lake, Oakland County (Hankinson, 1908, 236), Huron County (Ruthven, 1911a, 271), and Cass County (Thompson, 1911, 107).

Specimens have been examined from Washtenaw County, Oakland County, Brown Lake and the falls of the Sturgeon, Dickinson County, Alma, Gratiot County, Charity Islands, Saginaw Bay, Cass County, in Turtle Bay (Sand Point) and in lower part of Pigeon River in Huron County, and Kalamazoo County.

KINOSTERNON ODORATUM (Daudin).

MUSK TURTLE.

(Pl. VII.)

Emys pennsylvanica, Sager, 1859, 301.
Aromochelys odoratus, Smith, 1879, 7. Clark, 1902, 193, 1905, 110. Miles, 1861, 232. Hankinson, 1908, 236. Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates, rather

narrowly oval in outline, and considerably arched. Young specimens have a prominent keel, but this becomes obscure with age. Plastron very narrow and short, not nearly filling the opening of the carapace, rounded anteriorly, emarginate posteriorly, the anterior part slightly movable on a transverse hinge between the pectoral and abdominal scutes. All of the plastral scutes in the adults separated by areas of skin. Head large; snout tapering and conical. Skin soft and everywhere provided with fleshy papillae, those on the neck in rows, and two to four elongated ones on the chin and two on the anterior part of the throat. Several long curved scales on the anterior side of the foreleg near the foot, and several on the heel.

The color of the carapace in young specimens is dull olive or brown; in old specimens it is blackish brown. The plastron varies from dark yellow to brownish black. Skin dark greenish olive to dark olive brown, marbled with light olive or yellowish olive. Two yellowish lines extend backward from the snout, one passing below and the other above the eye and ear.

Habits and Habitat: The musk turtle is quite aquatic in habits, being found most commonly on the bottom in ponds and lakes. The carapace is very often covered with a thick growth of algae, so that it is difficult to detect when lying in a patch of aquatic vegetation.

Hay (1892a, 562) states that "They lay their eggs on shores in holes that they have dug in the sand with their hind feet. The eggs are from three to five in number, of an elongated elliptical shape, a little more than an inch long, and have a hard, smooth shell." Newman (1906, 147-148) records the following notes on the breeding habits: "On only one occasion did I have the good fortune to observe Aromochelys in the process of nesting. When I first encountered the little tortoise she was digging in some soft soil, using all four feet and her snout. On my approach she abandoned her work and wandered about for fully an hour trying different places. Finally she selected for nesting a decayed stump that had rotted down level with the ground. She dug with fore-feet and hind-feet a shallow hole about two inches wide and of about the same depth, and deposited two eggs therein. After covering these eggs with the excavated debris, she went her way. The form and workmanship of this little nest were of an inferior order as compared with those of other species of tortoise I have observed.

"Specimens were captured on land with eggs in the oviducts, ready to be laid, on the following dates: June 11, 16, 20, 22, 23,

and 25. In no case did I find more than three eggs in the oviducts. These were elliptical in form and nearly as large as the eggs of Chrysemys. The shell is hard and of a china-like consistency, brittle but capable of withstanding considerable pressure."

Fig. 47. Distribution of *Kinosternon odoratum*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

The same writer (1906, 146-147) records the following notes on the food habits: "I have caught them at dusk, crawling about in the grass and have seen them catching and eating slugs" (p. 147); "They are the scavengers of the lake, feeding on all sorts of material, from dead molluscs to kitchen refuse. They refuse nothing that could be construed as edible. If food is placed in the midst of

a group, they fight over it like so many puppies over a rag, pulling and jerking to the best of their ability." "Their appetite is insatiable and indiscriminate. On one occasion I put a living rat in an aquarium containing several musk tortoises. Almost immediately three of them seized it by the feet and pulled it under, thus drowning it. Before it had ceased to struggle they proceeded to disembowl it and succeeded in making a fairly good skeleton of it in a few hours" (p. 147).

Surface (1908, 138) has tabulated the food found in the stomachs of a number of specimens as follows:

	No.	Per cent.
Mollusca	2	50
Snails	2	50
Insecta	3	75
Orthoptera (Crickets, Grasshoppers)	1	25
Gryllus pennsylvanicus	1	25
Lepidoptera, (Moths, etc.)	2	50
Larvae	2	50
Coleoptera, (Beetles)	2	50
Undetermined fragments	1	25
Carabidae—Undet., (Ground Beetles)	1	25

When captured the musk turtles emit a strong odor (not especially disagreeable), open their jaws widely, and hiss, but they seldom bite and then with little effect.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Miles, 1861, 232; Smith, 1879, 7), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Barry, Kalamazoo, Montcalm and Van Buren Counties (Clark, 1905, 110), Cass County (Thompson, 1911, 107), and Walnut Lake, Oakland County (Hankinson, 1908, 236). The writer has seen specimens from the following localities: Washtenaw County, Walnut Lake, Oakland County, Cass County, and Miss Crystal Thompson saw one in the Kalamazoo River, Calhoun County, in September, 1911.

CHRYSEMYS CINEREA (Bonnaterre).

WESTERN PAINTED TURTLE.

(Pl. VII.)

Emys picta, Sager, 1839, 301.

Chrysemys marginata, Agassiz, 1857, 439. Smith, 1879, 7. Clark, 1902, 193; 1905, 110. Miles, 1861, 233. Hankinson, 1908, 236-237.

Chrysemys cinerea, Ruthven, 1911, 115; 1911a, 271. Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates, broad and depressed, flaring considerably posteriorly, and without trace of keel. Plastron broad and flat, immovably attached to the carapace and not hinged. Head moderate in size; upper jaw with a distinct notch in front, and a sharp tooth on either side of the notch.

Carapace dark olive, brown or black. The scutes narrowly margined with dull yellow. Marginal plates prominently marked with red as follows: on the upper surface narrow cresentric bands often surrounding (especially anteriorly) a wider vertical band that is median in position and an extension of a similarly situated band on the lower surface. The last named band is the principal mark on the lower surface and is there surrounded, on the inner end and on the sides, by the black ground color. There may be other light marks on the lower surface, but these are rarely prominent; the most conspicuous and perhaps frequent one is a spot or short band in the black areas between the central bands. (Cf. description of *C. bellii.*) Plastron yellowish with a large central patch of dusky, which is, however, never as large as in *C. bellii* (Figs. 50-51). Head black striped with yellow; neck and limbs striped with red.

Habits and Habitat: This is the common turtle of southern Michigan. It may be seen along most of the streams or about the borders of ponds and lakes. If the habitat is approached cautiously they may be seen basking on logs, muskrat houses, etc., but they are easily alarmed, and quickly scramble off into the water and bury themselves in the mud and vegetation of the bottom. If undisturbed they soon come to the surface again and thrust their pointed black snouts out of the water.

Hay (1892a, 572) states that the food "probably consists of insects, tadpoles and other feeble small animals." Newman (1906, 144) writes that he has observed individuals "feeding on dead fish,

dead clams, decaying tortoises, worms, meat, and aquatic insects. They even capture the soft and defenseless young of *Aspidonectes* [*Platypeltis*]." The same writer describes the egg-laying as follows: "The method of nest-making is essentially like that de-

Fig. 48. Distribution of *Chrysemys cinerea*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

scribed for Graptemys, but the flask-like enlargement is much less pronounced. This may be due to the smaller number of eggs laid and the consequent economy of space. The nesting season is about the same as for Graptemys and the choice of nesting places about the same. They lay only four to eight eggs that are strikingly like those of Graptemys in color, shape and character of shell. In size, however, they are somewhat smaller.

"Like Graptemys, the broods are sometimes belated in hatching, so that a forced hibernation of embryos results. Many just-hatched young were found during the months of May and June."

Range: The species has been reported from: Michigan (Sager, 1839, 301; Agassiz, 1857, 439; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193), Porcupine Mountains, Ontonagon County (Ruthven, 1904, 191), Ann Arbor, Marquette, Olivet, Porcupine Mountains (Clark, 1905, 110), Stony and North Islands and Sand Point, Pigeon River, Rush Lake, Huron County (Ruthven, 1911a, 271), Marquette, Porcupine Mountains, Ontonagon County (Ruthven, 1906, 112), Douglas Lake, Cheboygan County (Ruthven, 1911, 115), Cass County (Thompson, 1911, 107), Walnut Lake, Oakland County (Hankinson, 1908, 236-237). The northern peninsula records probably all refer to *C. bellii* and are not recorded on the map. The writer has seen specimens from Washtenaw Oceana County, St. Joseph County, Monroe and Douglas Lakes, Cheboygan County, Cass County, Alma, Gratiot County, Stony and North Islands, Sand Point, Pigeon River at Caseville, and Rush Lake, Huron County, Allegan County, Kalamazoo County, Calhoun County, and Mr. N. A. Wood observed specimens on Charity Island in 1910.

CHRYSEMYS BELLII Gray.

BELL'S TURTLE.

Chrysemys bellii, Ruthven, 1909, 117.
Chrysemys marginata bellii, Ruthven, 1910, 59.
Chrysemys marginata, Ruthven, 1904a, 191; 1906, 34-112.

Description: Structural characters as in *C. cinerea* from which it differs in attaining a somewhat larger size (large individuals reaching a length of six to eight inches as compared with five to six inches in cinerea) and in color markings. The yellow borders to the dorsal shields are generally narrow or wanting but are occasionally as wide as in cinerea. Costal and vertebral scutes marked with faint, irregular light lines. The prominent markings on the marginals are: above; a median and two lateral pale vertical bands, the median continued on the lower surface and there extended on the outer and inner margins to restrict the intervening black area to a spot with a pale center. These markings may be yellow or red. The dusky markings on the plastron always form a much larger blotch than in *C. cinerea* (Figs. 50-51). This blotch covers a large part of the plastral surface and send out extensions along the sutures.

Habits and Habitat: The habits of this species are probably very similar to those of *C. cinera.* It is found in similar habitats.

Range. *C. bellii* has been found thus far only in the western part of the northern peninsula. It is a western form that ranges

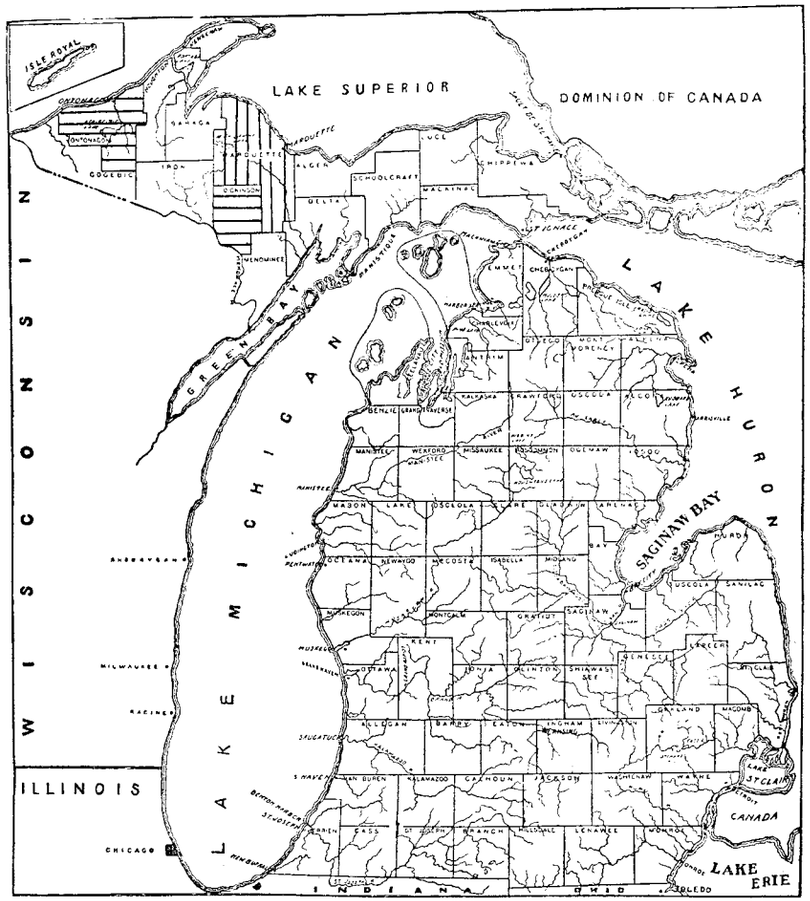


Fig. 49. Distribution of *Chrysemys bellii.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

westward to Oregon. The Michigan localities are: Porcupine Mountains, Ontonagon County, Brown Lake, Norway and Iron Mountain, Dickinson County (Ruthven, 1909, 117; 1910, 59). The Marquette record for *cinerea* (Ruthven, 1906, 112) is probably this form and is so indicated on the map.

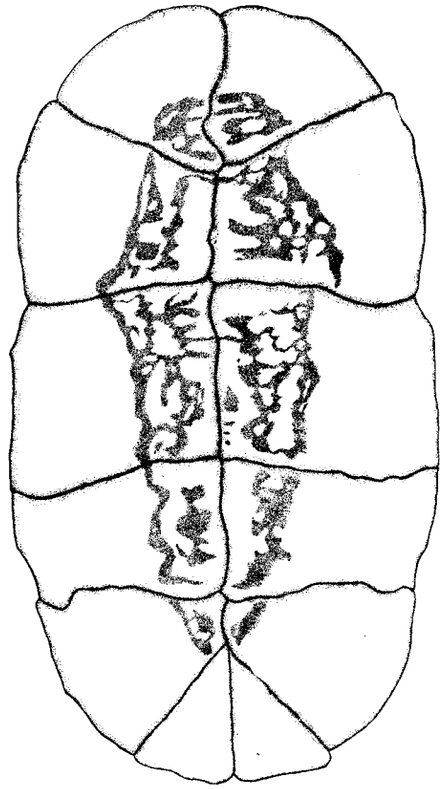


Fig. 50. Plastron of *Chrysemys cinerea.*

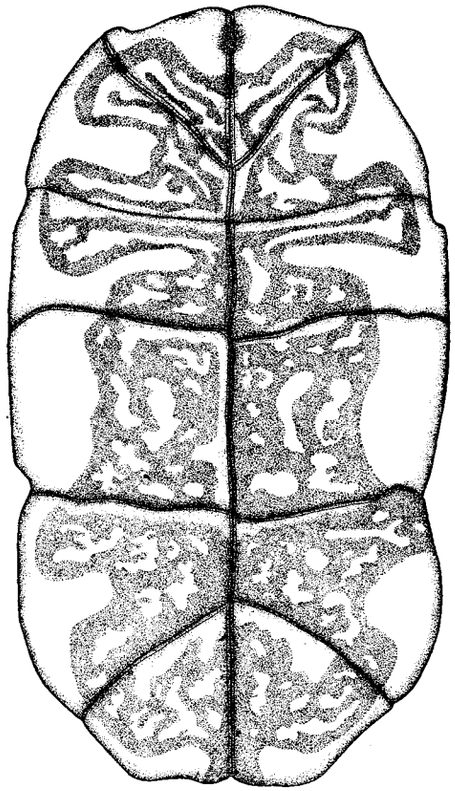


Fig. 51. Plastron of *Chrysemys bellii.*

CLEMMYS GUTTATA (Schneider).

SPECKLED TORTOISE.

(Pl. VII.)

Emys guttata, Sager, 1839, 301.
Nanemys guttatus, Smith, 1879, 7. Miles, 1861, 233.
Clemmys guttatus, Clark, 1902, 193; 1905, 110. Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates, oval in outline and widest behind the middle. Carapace without a keel. Plastron large, without a transverse hinge, and immovably joined to the carapace. Head of moderate size; snout not projecting; upper jaw notched in front.

Carapace black or dark reddish brown with one to several round, bright orange spots on each scute. The plastron is reddish orange and black, the black being limited to large blotches on the ends of the scutes. The head and the upper surface of neck and limbs are black (often washed with red) with orange spots, the under surfaces orange yellow, the throat marbled with darker.

Habits and Habitat: We have no notes on the habits of this turtle in Michigan. Ditmars (1907, 51) has recorded the following observations: "The writer has found many specimens along brooks that here and there spread into thick, grassy spots. It is in this water-grass that the turtles delight to hide, after feeding. The species always feeds under water and, in fact, appears to be unable to swallow unless the head is submerged. The food consists largely of dead fish and the larvae of aquatic insects. Captive specimens will eat the tender leaves of lettuce if these be thrown upon the surface of their tank. It therefore appears probable that they feed upon various water plants as well, while in a wild condition." Holbrook's account differs in some respects from the above. He says (1842, I, 83). "It lives in ponds, brooks and rivers, feeding on such animals as it can seize, as tadpoles, young frogs, etc. It takes to the land frequently in search of food, devouring earthworms, crickets, grasshoppers, etc." Hay (1892a, 577) states that it is less aquatic than most of our turtles but "seems to delight in being in the neighborhood of swamps and sluggish streams, and probably spends the greater part of its time in the water."

The same writer also says "Their food is said to consist of tadpoles, young frogs and other weak animals. On land they devour earthworms, crickets and grasshoppers." Surface (1908, 166-167) has summarized his examination of the stomachs of 27 specimens as follows:

	No.	Per cent.
Vegetation	3	11.1
Undetermined leaves	1	3.7
Undetermined seeds	1	3.7
Gramineae—Grass	2	7.4
Animal matter	27	100
Annulata, (Worms)	1	3.7
Mollusca	3	11.1
Snails	2	7.4
Slugs	1	3.7
Crustacea	8	29.6
Undetermined spp	6	22.6
Gammarus sp., (Fresh Water Shrimps)	1	3.7
Cambarus sp., (Crayfish)	1	3.7
Myriapoda, (Millipedes, etc.)	1	3.7
Arachnida, (Spiders)	2	7.4
Insecta, (Insects)	27	100
Undetermined fragments	11	40.8
Ephemerida, (Mayflies)	2	7.4
Plecoptera—Perlidae, (Stone Flies)	3	11.1
Odonata, (Dragon Flies)	9	33.3
Nymphs	8	29.6
Agrionidae, (Damsel Flies)	1	3.7
Hemiptera, (Bugs)	3	11.1
Capsidae, (Water Bugs)	1	3.7
Notonectidae, (Back Swimmers)	1	3.7
Belostomidae	1	3.7
Zaitha fumina	1	3.7
Neuroptera—Sialidae	2	7.4
Lepidoptera	3	11.1
Undetermined Moth larvae	2	7.4
Noctuidae, (Cutworms)	1	3.7
Coleoptera	20	74.0
Undetermined Beetle fragments	13	48.1
Carabidae, (Ground Beetles)	2	7.4
Dytiscidae, (Diving Beetles)	2	7.4
Chrysomelidae, (Leaf Beetles)	3	11.1
Undetermined	2	7.4
Donacia sp	1	3.7
Scarabaeidae.		
Lachnosterna, (June Bugs)	1	3.7
Euphoria inda, (Flower Beetles)	1	3.7
Macrodactylus subspinosus, (Rose Bugs)	2	7.4
Rhynchophora, (Snout Beetles)	1	3.7
Diptera, (Flies).		
Undetermined flies	10	37
Tipulidae, (Crane Flies)	2	7.4
Chironomidae, (Midges)	1	3.7
Scatophagidae	1	3.7
Hymenoptera, (Ants, etc.)		
Tenthredinidae	1	3.7
Ichneumonidae	1	3.7
Brachonidae	1	3.7
Ants	1	3.7

"Their eggs are few in number; never according to Agassiz, exceeding three or four. They are about an inch and a quarter long, and three-quarters in the shorter diameter. The eggs are laid about the 20th of June, in a perpendicular hole dug by the use of the hind legs. After the eggs are deposited the dirt is pushed back over the opening so as to conceal it entirely." (Hay, 1892a, 577-578).

Range: The species has been reported from: Michigan (Sager, 1839, 301), Genesee County, Oakland County, Saginaw Bay (Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Barry, Kalamazoo and Van Buren Counties (Clark, 1905, 110), and Cass County (Thompson,

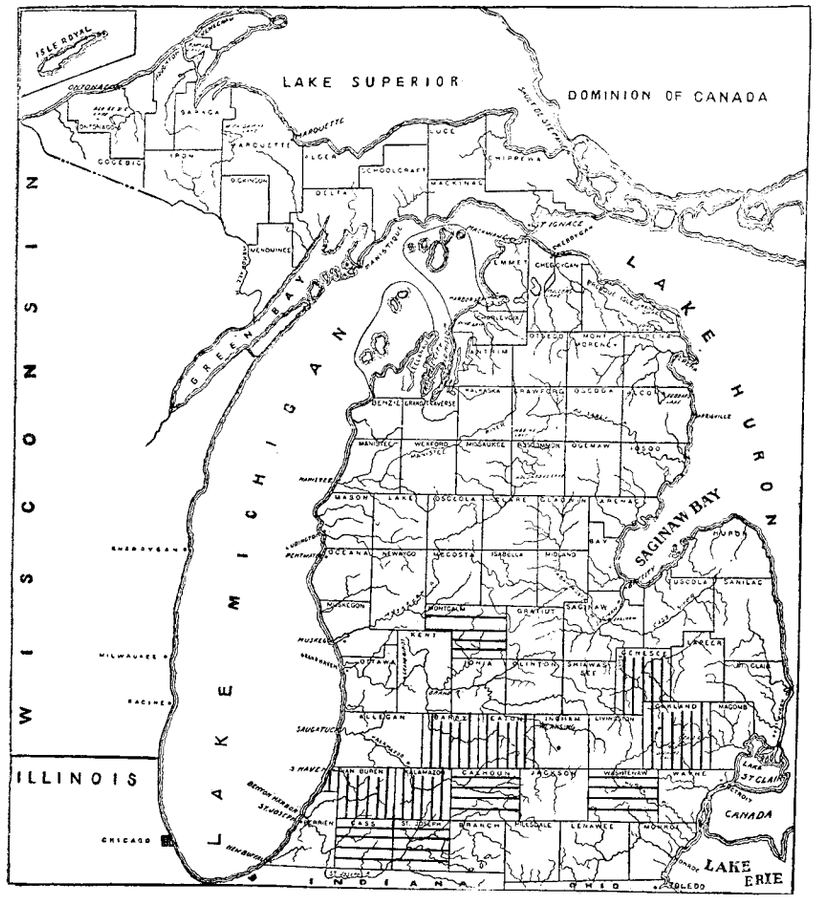


Fig. 52. Distribution of *Clemmys guttata*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

1911, 107). The specimens the writer has seen are from the following localities: Ann Arbor and Manchester, Washtenaw County; Cass County, Calhoun County, St. Joseph County and Montcalm County.

GRAPTEMYS GEOGRAPHICA (La Sueur).

MAP TURTLE.

(Pl. VI.)

Emys geographica, Sager, 1839, 301.
Graptemys geographica, Agassiz, 1857, 436. Clark, 1902, 193, 1905, 110. Smith, 1879, 7. Miles, 1861, 232.

Description: Carapace rigid, covered with horny plates, depressed and with a distinct, slightly tuberculated keel (much more distinct in the young). Carapace feebly serrated behind. Plastron large, nearly filling the opening of the carapace, immovably united to it, not hinged, and distinctly notched behind. Snout not projecting. Cutting edge of upper jaw somewhat sinuous.

Color of carapace dark olive, covered with a network of greenish-yellow lines (occasionally uniformly dark brown above). Head, neck, limbs and tail dark green to black with numerous longitudinal lines of greenish yellow. A triangular yellow spot behind each eye. Under side of marginal plates pale greenish or yellowish with large blotches consisting of concentric lines of olive and black or brown. Plastron yellow, with brownish bands (frequently absent in old individuals) along the sutures of the scutes.

Habits and Habitat: The map turtle is markedly aquatic, seldom, except during the breeding season, being found on land. In southern Michigan it occurs both in lakes and rivers, but is much more common in the former. According to the observations of Garmen (1891, 237), Hay (1892a, 576), and Newman (1906, 140) its food consists principally of molluscs, and very largely of the heavy shelled forms of the family Viviparidae. The young feed on the thiner shelled ones. Newman writes as follows: "Two methods of feeding prevail. The favorite method seems to be to capture the mollusc when the foot and gills are well out of the shell, to bite off the soft parts and leave the hard shell. To do this the final closure of the jaws must be quite sudden. If they fail to secure the body of the snail in this way they adopt the crushing method. The hard shell is easily crushed between the broad flat jaws and the broken pieces of shell are picked out with the aid of the claws. When in search of food they prowl about the bottom, often underneath the dense vegetation. The heavy growth of Chara or Nitella is tunneled in every direction with the passageways made by foraging Graptemys."

Hay (1892a, 576) states that "After a number had been kept for a few days in a tub there were found in it a large number of the opercles of such molluscs; and in the intestines of one were the remains of a crayfish, some fish scales, and what appeared to be the cases of some kind of caddisworm. Its broad masticatory surfaces are well fitted for crushing the shells of molluscs." In captivity Ditmars (1907, 44) found that it would eat "chopped fish, meat and mealworms, also earthworms and various softbodied grubs, dragging all its food into the water and devouring it beneath the surface."

A specimen examined by Surface (1908, 141) had only crawfish remains in the stomach.

The breeding habits of Indiana specimens have been rather fully reported by Newman (1906, 140-142): "Graptemys begins to lay very early in June, somewhat earlier than other species observed. The females are apt to wander some distance from the water for nesting, seeming to prefer soft, plowed soil or clear, dry sand away from the beaches. They wander about for hours in search of a suitable place for nesting. One specimen started five nests before she was satisfied with the condition of the soil. Two were rejected on account of the presence of stones and one because the sand caved in too readily. The other two appeared to me to be suitable in every way and I was unable to explain why she abandoned them.

"If one expects to see the first stages of nest-making it behooves him to be astir before sunrise. Over half of the females found nesting were encountered before eight o'clock. They work slowly and seem to prefer the quiet hours of the day, probably because they are less likely to be disturbed.

"Apart from the slowness and deliberateness of their movements, they work much after the fashion adopted by Aspidonectes, except that they never work the fore-feet so as to secure foothold.

"The nests are of somewhat smaller dimensions and the flask-shaped expansion is more symmetrically placed, scarcely more bulged on one side than the other. Two layers of eggs are deposited in the flasklike expansion but the last two or three eggs are placed in the narrow neck, the uppermost egg being sometimes only about two inches from the surface.

"It is difficult to frighten them away after they have once decided upon a nesting place. When surprised they stop work but soon resume it and continue it to the end, even while the observer is in plain view. The nest of Graptemys is a finished product, all traces of nest-making being obliterated. This is accomplished by dragging the smooth plastron back and forth across the small area that had been disturbed by nesting.

"The eggs are ellipsoidal in shape, of a dull white color, and have a rather soft easily indented shell. The number laid by one female at one time varies from eleven to fourteen.

"The eggs hatch, as a rule, late in August or early in September,

Fig. 53. Distribution of *Graptemys geographica*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

the young burrowing to the surface through the sand. When they emerge they are covered with sand that adheres for some time. Their instinct directs them unerringly toward the water and they frequently have to travel almost incredible distances before reaching the lake or a tributary stream. On two occasions I have found recently hatched Graptemys, at a distance of about a quarter of

a mile from the water, traveling steadily and in an approximately correct direction toward the lake. At the observed rate of progress they would reach the lake in about two days.

"For some time I was greatly puzzled by the frequent discovery of newly hatched Graptemys during the months of May and June. Farmers in the vicinity frequently plowed up nests of eggs that were nearly ready to hatch.

"These facts have been explained by the observation of occasional specimens nesting during the latter part of July. Eggs laid at that time would have only about five or six weeks of steadily warm weather, in which to develop, and would be retarded by the chilling of the ground in October. Thus the well advanced embryos must pass the winter in a condition of dormancy analogous to that observed in hibernating adults.

"On no occasion have I caught a female nesting whose carapace length was less than nineteen centimeters and whose age was less than fourteen years—according to the age record afforded by the annual growth ring on the scutes."

Hay (1892a, 576) has found sixteen eggs in a large female.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Agassiz, 1857, 436; Miles, 1861, 232), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1904, 193), Olivet, and Barry, Kalamazoo, Kent, Montcalm, Ottawa and Van Buren Counties (Clark, 1905, 110). The specimens examined are from: Washtenaw County, Brighton, Livingston County, Pawpaw, Van Buren County, St. Joseph County, Allegan County, Calhoun County, and Kalamazoo County.

EMYDOIDEA BLANDINGII (Holbrook).

BLANDING'S TURTLE.

(Pl. VII.)

Emys meleagris, Agassiz, 1857, 442. Smith, 1879, 7. Miles, 1861, 233.

Emydoidea blandingi, Clark, 1902, 193, 1905, 110. Hankinson, 1908, 236. Ruthven, 1911a, 271.

Emys blandingii, Thompson, 1911, 107.

Description: Carapace rigid, covered with horny plates; elongated oval in outline, and rather high and convex but not as much so as in the box turtle (*Terrapene carolina*). Plastron large, closing the opening of the carapace and attached to it by a ligament. Plastron divided into two movable lobes, the hinge line between the

abdominal and pectoral scutes. Head broad, snout not projecting and the upper jaw notched in front. The lower jaw with a hooked tip.

The ground color of the carapace is usually black with numerous

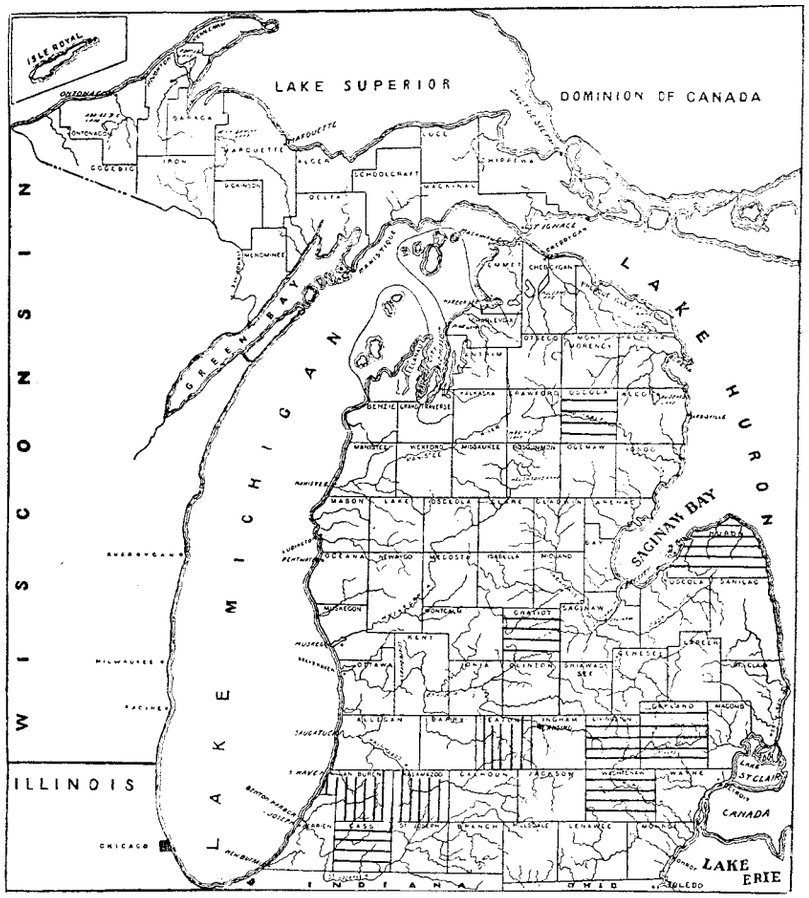


Fig. 54. Distribution of *Emydoidea blandingii*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

round or irregularly elongated, pale yellow or light brown spots.

In old individuals the lighter markings may predominate toward the margins of the carapace restricting the black to small irregular blotches. Plastron pale yellow to light brown, the outer end of each scute occupied by a large black or brown blotch. Head and neck black or brown above with numerous small yellowish or olive

spots; the muzzle and sides of the head predominatingly olive. Chin and throat immaculate yellow. Legs olive or light brown with mottlings of black or dark brown.

Habits and Habitat: Little has been recorded on the habits of the Blanding turtle. Ditmars (1907, 57) writes on the subject as follows: "Although fully as agile in the water—in swimming, diving and remaining a considerable time beneath the surface—as the typical pond and river turtles and terrapin, this species often evinces a desire to wander about on land, and while it seldom ventures from wet, marshy areas, prowls about through the undergrowth in search of tender shoots, berries and insect larvae, a character quite in opposition to the feeding habits of the strictly aquatic turtles and terrapins, which are unable to feed unless under the water. Blanding's Turtle feeds with equal readiness upon the ground, or under water. Captive specimens are very fond of lettuce; they also feed voraciously upon earthworms, small fishes, tadpoles and young frogs, actively pursuing these creatures in the water and seizing them by a sudden dart of the head. Well fattened specimens are unable to employ the hinged plastron to but a slight extent and with such individuals the rear lobe is quite useless in covering the hind limbs which bulge from the shell in helpless fashion."

Range: The species has been reported from: Michigan (Agassiz, 1857, 442; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Eaton County (Clark, 1902, 193), Ann Arbor, Olivet, and Kalamazoo and Van Buren Counties (Clark, 1905, 110), Sand Point and Stony Island, Huron County (Ruthven, 1911a, 271), Walnut Lake, Oakland County (Hankinson, 1908, 236), and Cass County (Thompson, 1911, 107). The writer has seen specimens from: Washtenaw County, Au Sable River, Oscoda County, Brighton, Livingston County, Walnut Lake, Oakland County, Cass County, Alma, Gratiot County, Sand Point and Stony Island, Huron County, and Mr. N. A. Wood reports seeing one in the pond on Charity Island.

TERRAPENE CAROLINA (Linnaeus).

BOX TURTLE.

(Pl. VII.)

Cistudo clausa, Sager, 1839, 301. Smith, 1879, 7.
Cistuda virginea, Agassiz, 1857, 445.
Terrapene carolina, Clark, 1902, 193; 1905, 110. Thompson, 1911, 107.

Description: Carapace rigid and covered with horny plates, broadly oval in outline, high, very convex, and solid. Plastron,

large, closing the opening of the carapace with which it is united by a ligament. Plastron divided into two movable lobes, the hinge line between the abdominal and pectoral scutes. Snout not projecting; the upper jaw drawn down in front to form a beak, the lower jaw turned upward at the tip.

The colors of the carapace are yellow and brown or black. The arrangement is very variable and either the lighter or darker colors may predominate. The head, neck, limbs and tail are brown, spotted with yellow. The plastron is also very variable in coloration. It may be uniformly brown or black, and the brown or black may be spotted with yellow, or the yellow may be the predominating color and the brown or black reduced to irregular blotches.

Habits and Habitat: The box turtle differs from other Michigan turtles in being strictly terrestial. No notes are available on the habitats preferred by the species in Michigan, but Ditmars (1907, 61) makes the general statement that it is "most abundant in situations where open, grassy spots alternate in sparse thickets. The food consists largely of vegetable matter and berries, though the larvae of insects are eaten as well as earthworms and slugs. During the periods when blackberries ripen many specimens show unmistakable evidence of feasting by their stained mandibles and forefeet."

Holbrook (1842, I, 34) states that it feeds on "insects, crickets, etc., and according to Leconte, on fungous plants, as the Clavaria, etc. When in confinement and it can easily be domesticated, it eats readily whatever is offered, as bread, potatoes, apples, etc." Surface (1908, 175-176) has examined stomachs of 40 specimens and tabulated the results as follows:

	No.	Per cent.
Vegetation	25	62.5
Cryptogams, (Flowerless Plants)	7	17.5
Fungi.		
Undetermined fungi	1	2.5
Basidiomycetes	1	2.5
Mushrooms	4	10
Bryophyta, Moss	1	2.5
Phanerogams, (Flowering Plants).		
Undet	4	10
Roots	2	5
Buds	1	2.5
Leaves	5	12.5
Berries	3	7.5
Seeds	1	2.5
Podophyllum petatum (May Apple)	1	2.5
Vitis labrusca (Grapes)	1	2.5
Prunus sp. (Cherry) seeds	1	2.5
Rubus sp. (Blackberry)	3	7.5
Pyrus sp. (Apple)	2	5
Osmorhiza sp.	1	2.5
Pyrola rotundifolia	1	2.5
Physalis sp. (Ground Cherry)	3	7.5
Gramineae, grass	8	20
Bird's Wheat Moss	1	2.5
Animal matter	32	80
Annulata (Earthworms)	2	5
Mollusca (Mollusks)	15	37.5
Snails	14	35
Slugs	2	5
Crustacea (*Cambarus* sp.)	1	2.5
Myriapoda (Millipedes)	8	20
Insects (Insecta)	24	60
Undetermined insects	7	17.5
Orthoptera (Grasshoppers, etc.)	7	17.5
Acridiidae	1	2.5
Melanoplus femur-rubrum (Red-legged G)	2	5
Gryllidae (Crickets)	1	2.5
Gryllus pennsylvanicus (Cricket)	2	5
Locustidae (Long Horned Grasshoppers)	1	2.5
Hemiptera Pentatomidae (Stink Bugs)	1	2.5
Lepidoptera (Moths)	9	22.5
Larvae (Caterpillars)	7	17.5
Pupae (Chrysalids)	1	2.5
Notodontidae—*Datana ministra*	1	2.5
Noctuidae, larvae (Cut worms)	3	7.5
Diptera (Flies)	1	2.5
Coleoptera (Beetles, etc.)	10	25
Undetermined beetles	7	17.5
Larvae of Beetles	2	5
Carabidae (Ground Beetles).		
Undetermined ground beetles	2	5
Carabus limbatus	1	2.5
Pterostichus lucublandus	1	2.5
Harpalus caliginosus	1	2.5
Hymenoptera (Ants, etc.)	1	2.5
Vertebrata (Back-boned Animals).		
Mammalia, Muridae (Mice)	1	2.5

The eggs are covered by a thin shell, and are deposited in loose soil. According to Hay (1892a, 581), they number from four to six and are laid about the latter part of June or after.

In winter they burrow into the soil to hibernate, and Ditmars (1907, 62) records one that was found in January, buried to a depth of about two feet.

Range: The species has been reported from: Michigan (Sager, 1839, 301; Agassiz, 1857, 445), Ann Arbor (Smith, 1879, 7), Eaton and Montcalm Counties (Clark, 1902, 193), Barry, Kalamazoo,

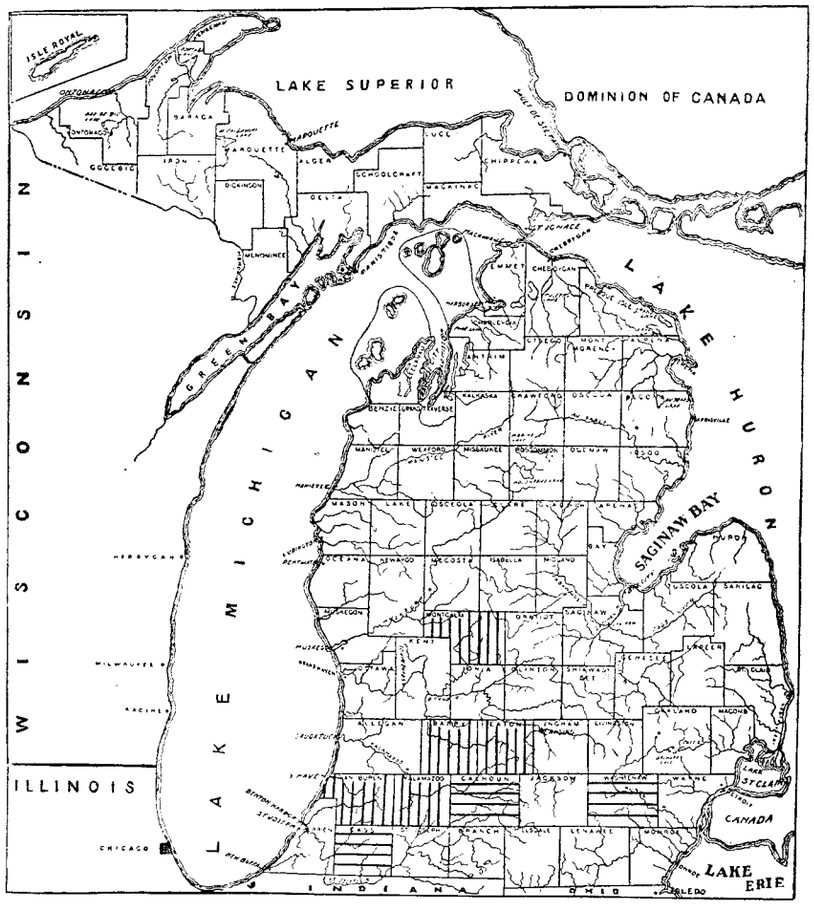


Fig. 55. Distribution of *Terrapene carolina*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Montcalm and Van Buren Counties (Clark, 1905, 110), and Cass County (Thompson, 1911, 107). The writer has examined specimens from Battle Creek, Calhoun County, Manchester, Washtenaw County, and Cass County.

GLOSSARY.

Abdominal plates. The antepenultimate pair of large scales on the plastron in turtles. (See Fig. 25.)

Alveolar surface. The masticatory surface of the jaws in turtles.

Anal plate. The large scale just in front of the anus in snakes. (See Fig. 23.) The posterior plates on the plastron of a turtle. (Fig. 25.)

Azygous scale. Occurring singly, i. e., unpaired. Applied to the small plate on the median line of the snout in *Heterodon platyrhinus*.

Bridge. The part of the shell which joins the carapace and plastron in turtles.

Canthus rostralis. The ridge from the eye to the tip of the snout that separates the top of the muzzle from the side.

Carapace. The upper shell in turtles. (See Fig. 24.)

Cephalic plates. The large scales on the top of the head in snakes. (See Fig. 22.)

Costal plates. The row of large scales between the marginal and vertebral series on the carapace in turtles. (See Fig. 24.)

Dorsal scales. The scales on the upper surface of the body in snakes. (See Fig. 23.)

Emarginate. Obtusely notched.

Femoral plates. The penultimate pair of scales on the plastron in turtles. (See Fig. 25.)

Frontal. The single large scale on the top of the head, and between the supraoculars, in snakes. (See Fig. 22.)

Gular plate. In turtles, the first plate or pair of plates on the plastron. (See Fig. 25.)

Hinge. A transverse joint in the plastron in some turtles.

Humeral plates. The second pair of scales on the plastron in turtles. (See Fig. 25.)

Internasal plates. The two large scales on top of the head, and between the nasals, in snakes. (See Fig. 22.)

Keel. A ridge.

Labial plates. See upper labials and lower labials.

Loreal plate. The scale on the side of the head, between the nasals and preocular, in snakes. (See Fig. 21.)

Lower labial plates. The row of scales along the margin of the lower jaw in snakes. (See Fig. 21.)

Marginal plates. The scales about the margin of the carapace in turtles. (See Fig. 24.)

Nasal plate or plates. The first one or two plates on the side of the head in snakes. (See Fig. 21.) See also prenasal and postnasal.

Nuchal plate. The small plate in the marginal series at the anterior end of the carapace in turtles. (See Fig. 24.)

Ocular plates. See preocular and postocular plates.

Parietal plates. The pair of large scales on the top of the head, back of the frontal and supraocular plates, in snakes. (See Fig. 22.)

Pectoral plates. The third pair of scutes on the plastron in turtles.

Pit. The opening on the side of the head, between the eye and nostril, in the rattlesnake.

Plastron. The lower shell in turtles. (See Fig. 25.)

Plate. A large scale. Synonymous with scute.

Postnasal plate. The posterior nasal scale, when there are two, in snakes. (See Fig. 21.)

Postocular plates. The series of scales just behind the orbit in snakes. (See Fig. 21.)

Prefrontal plates. The pair of large scales on the top of the head, just in front of the frontal and supraoculars, in snakes. (See Fig. 22.)

Prenasal plate. The anterior nasal scale, when there are two, in snakes. (See Fig. 21.)

Preocular plate or plates. The scale or scales just in front of the orbit in snakes. (See Fig. 21.)

Rattle. The dermal structure on the tail in rattlesnakes.

Rostral plate. The large scale on the end of the snout in snakes.

Scales. Thin horny outgrowths of the skin which overlap to form a more or less complete investment in reptiles. When large known also as plates and scutes.

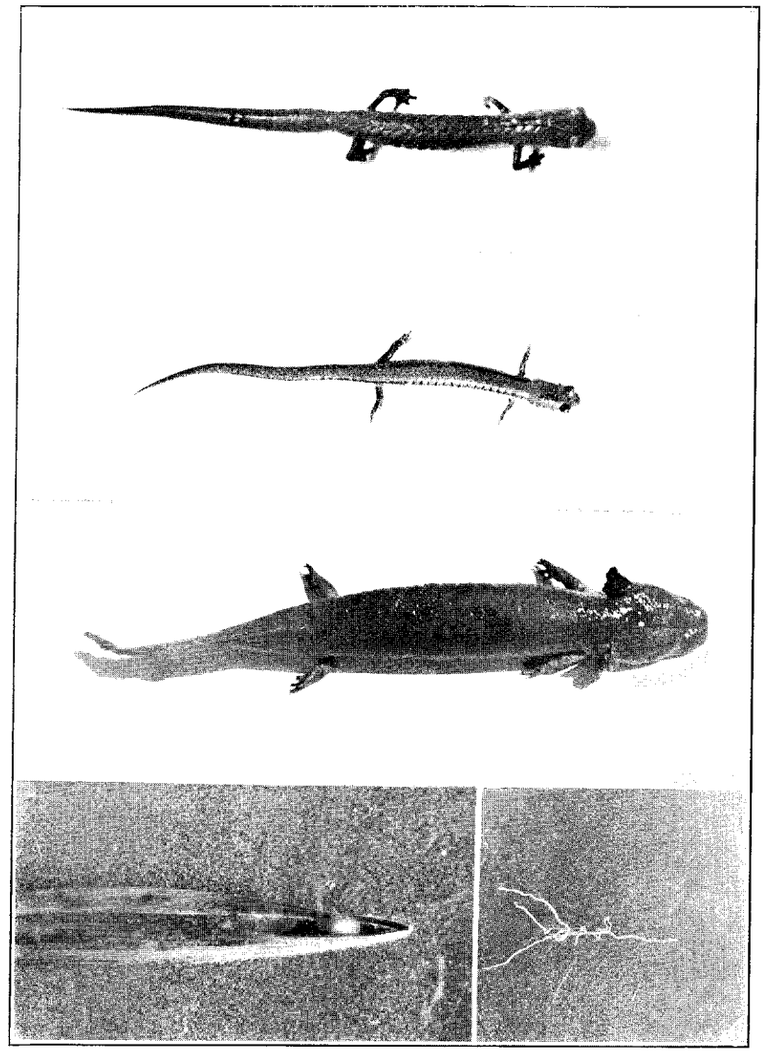
Scale pits. Tiny pores at the apex of the scales in some snakes.

Scute. A large scale. Synonymous with plate.

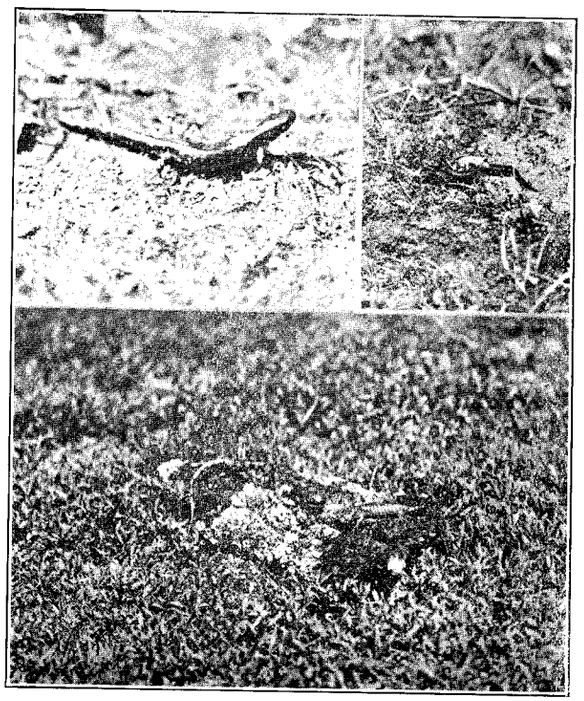
Subcaudal plates. The large scales on the ventral surface of the tail in snakes. (See Fig. 23.)

Supraocular plate. The large scale above each eye in snakes. (See Fig. 22.)

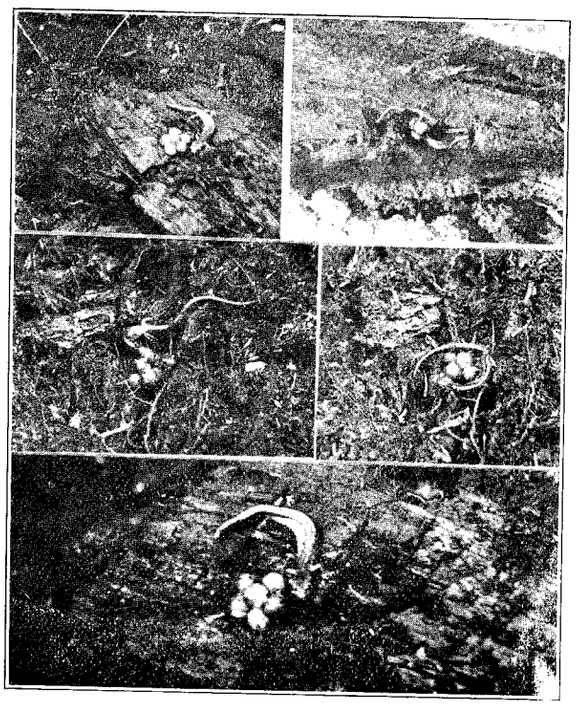
Temporal plates. The scales on the side of the head, behind the postoculars, in snakes. (See Fig. 21.)



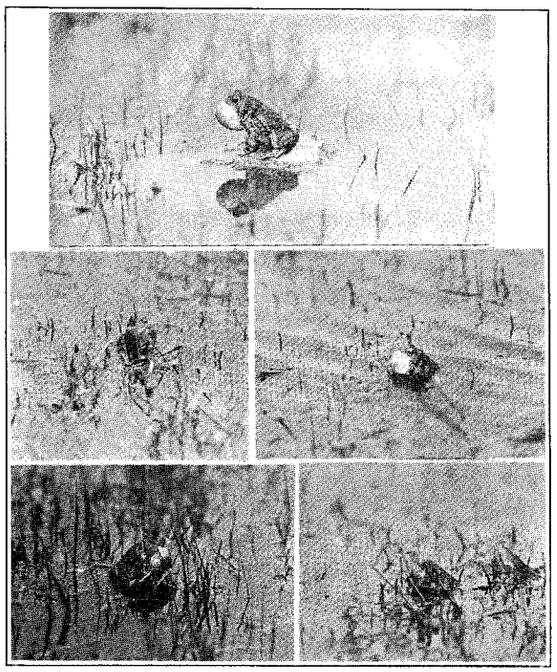
HEMIDACTYLIUM SCUTATUM.
PLETHODON ERYTHRONOTUS.
NECTURUS MACULOSUS.
EGGS OF *DIEMICTYLUS VIRIDESCENS.*



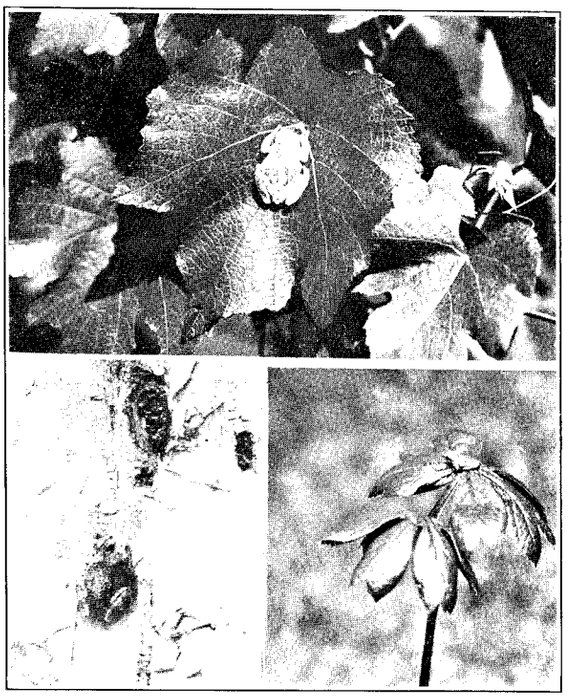
A. *AMBYSTOMA JEFFERSONIANUM, DIEMICTYLUS VIRIDESCENS, AMBYSTOMA TIGRINUM* AND *A. PUNCTATUM.*



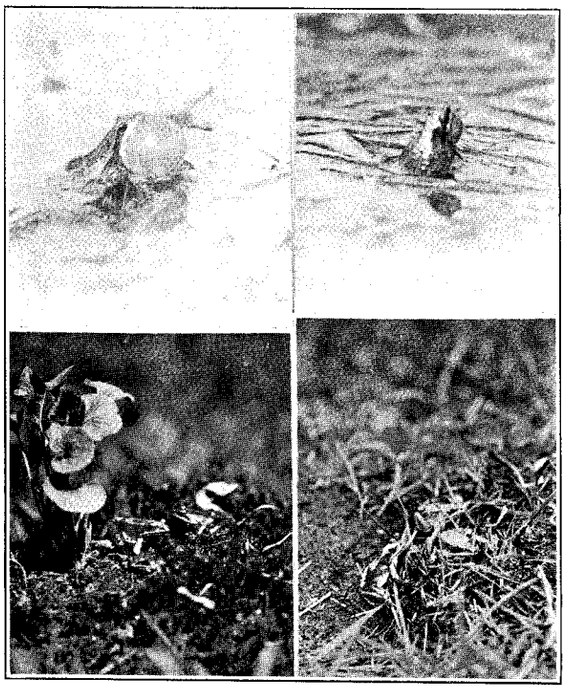
B. *PLETHODON ERYTHRONOTUS* AND EGGS.



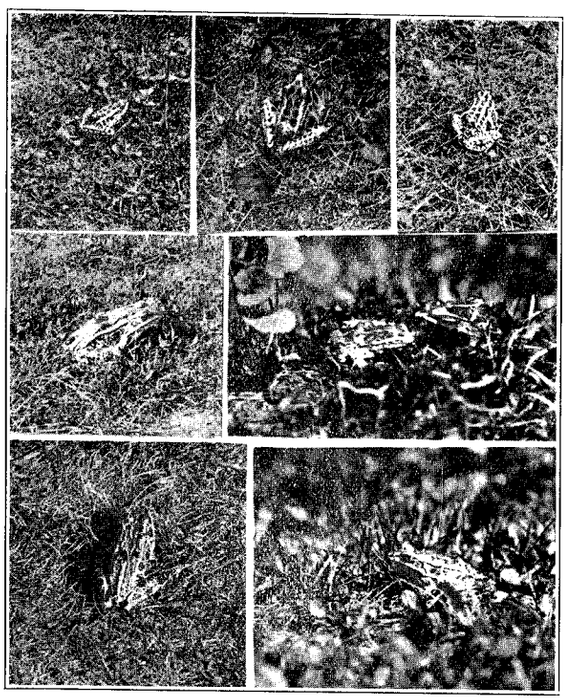
A. *BUFO AMERICANUS*. PHOTO TAKEN WHILE THE TOADS WERE SINGING; NOTE THE EXTENDED VOCAL POUCH AND CHARACTERISTIC ATTITUDES.



B. *HYLA VERSICOLOR*.
HYLA VERSICOLOR. *HYLA PICKERINGII*.



A. *CHOROPHILUS NIGRITUS.* (PHOTO BY J. E. REIGHARD.)
RANA CANTABRIGENSIS.



B. *RANA PALUSTRIS.* (TOP ROW.)
RANA PIPIENS.

Upper labials. The series of scales along the margin of the upper jaw in snakes. (See Fig. 21.)

Ventral plates. The large scales on the ventral surface of the body in snakes. (See Fig. 23.)

Vertebral plates. The median dorsal series of scutes on the carapace in turtles. (See Fig. 24.)

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A. WOODS OF CHARITY ISLAND. HABITAT OF *LAMPROPELTIS DOLIATUS TRIANGULUS*.

B. DECAYING LOG IN WOODS AT PORT AUSTIN. BREEDING PLACE OF *PLETHODON ERYTHRONOTUS*.

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A. POND NEAR GEDDES, WASHTENAW COUNTY. HABITAT OF *RANA PALUSTRIS* AND *R. CLAMITANS*.

B. UNDERGROWTH IN WOODS NEAR PORT AUSTIN. HABITAT OF *PLETHODON ERYTHRONOTUS*.

MEMORANDA TOWARDS A BIBLIOGRAPHY OF THE ARCHAEOLOGY OF MICHIGAN.

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American Antiquarian, Vol. 1, 1878, p. 8, mentions an embankment in Branch County.

American Antiquarian, Vol. XI, No. 4, 1889, p. 249, refers to Saginaw Grave.

American Association for the Advancement of Science, Proceedings, Vol. XXIV, 1875, pp. 311, 316-322, mentions mound in Wayne County.

American Association for the Advancement of Science, Proceedings, Vol. XXV, 1876, p. 324, mentions mound in Wayne County.

American Association for the Advancement of Science, Proceedings, Vol. XXVI, 1877, pp. 336-337, mentions mound in Wayne County.

ANDERSON, (ABEL). Smithsonian Report for 1879, p. 434, reports mounds in Newaygo County; p. 434, reports mounds in Ottawa County.

ARMSTRONG, (BENJ. G.). *Early Life among the Indians.* Press of A. W. Bowron, Ashland, Wisconsin, 1892, p. 150.

BALDWIN. *Ancient America,* p. 43-45, mentions copper mines in Ontonagon County.

BARNES, (CHAS. E.). Smithsonian Report, 1879, p. 434.

BEAUCHAMP, (WM. M.). *A History of the New York Iroquois,* Bulletin 78 (Archaeology 9) of the New York State Museum, p. 396, refers to Sansond's map of 1656; p. 398, refers to Crenoxins' map of 1660, and, p. 400, refers to Caronellis' map of 1688.

——— *Indian Nations of the Great Lakes,* American Antiquarian, Nov. 1895, Vol. XVII, No. 6.

Berrien County. See United States National Museum Report, 1886, p. 107.

BLOIS, (JOHN T.). Gazetteer of the State of Michigan, 1838-1840 (copyrighted 1838), p. 165, mentions mounds in Lenawee County; p. 168, mentions sites in Calhoun County; pp. 168-170, mentions sites in Macomb County; pp. 173-177, mentions garden beds.

BOYLE, (DAVID). Archaeological Report, Ontario, 1901, pp. 32-35, mentions matter for comparison with Ogemaw County enclosures.

———— Archaeological Report, Ontario, 1903, Toronto, 1904, p. 91, mentions perforated skulls from Canada similar to those of Michigan.

BRADY, (SAMUEL). Smithsonian Report for 1879, p. 434, reports that he is exploring copper mines on Isle Royale.

Branch County. See United States National Museum Report 1889, p. 118.

BROWER, (J. V.). *Kathio, Memoir of Explorations in the Basin of the Mississippi,* St. Paul, Minn., 1901, page opposite Plate II mentions copper.

CANFIELD, (——). *Sketches of Sauk County, Wisconsin,* American Antiquarian, 1890, refers to garden beds.

CARSON, (H. H.). American Antiquarian, Vol. IX, No. 4, July 1887, p. 237, mentions village sites in Clinton County; p. 238, mentions mounds, effigy mounds and garden beds in Saginaw County, and, pp. 237 and 238, mentions sites in Shiawassee County.

CATHERWOOD, (MARY HARTWELL). *The White Islander* (Indians), Century Magazine, Sept. 1893.

CHARLEVOIX, (SAGARD). *Voyage au grand pays des Hurons.*

COFFINBERRY, (W. L.) and STRONG, (E. A.). Proceedings of the American Association for the Advancement of Science, Vol. XXIV, 1875, pp. 293-297, describes mounds in Kent County.

CONANT, (A. J.). *Foot Prints of Vanished Races in the Mississippi Valley,* p. 65, refers to garden beds. Barnes, says p. 181, of Nadaillac.

Copper Mine in Michigan, Records of the Past, Vol. II, Part 7, July 1903, p. 223.

Copper. See Brower, Detroit, Moore, Palmer, Short, Whittlesey, Wisconsin Archaeologist, Vol. II, No. 1, Oct. 1902, p. 23.

MOSS COVERED STUMPS IN CADY'S WOODS SOUTH OF ANN ARBOR. HABITAT OF *HEMIDACTYLIUM SCUTATUM.*

COPWAY, (G.). *The Traditional History and Characteristic Sketches of the Ojibway Nation,* London, 1850.

Courier, see Saginaw.

DAN, (JOHN E.). Smithsonian Report 1879, p. 434, reports that he has in preparation a manuscript on forts and mounds of Macomb County.

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DODGE, (BYRON E.). American Archaeologist, Nov. 1898, Vol. II, Part 11, p. 299, refers to shell-heap on Flint River near Richfield, Genesee County.

———— American Archaeologist, March 1898, Vol. I, Part 3, p. 78, refers to supposed bridge across Flint River, Sec. 15, Genesee Tp., Genesee County.

Detroit Evening News.

Detroit Free Press, August 2, 1903, mentions copper.

Detroit Free Press, July 8, 1900, mentions Bert Marsh's Collection.

Detroit Free Press, May 1, 1901, refers to grave in Wayne County.

ELSWORTH, Epworth Assembly Quarterly, IV, 1897, p. 7, refers to a site in Mason County.

EVERTS, (L. H.). *History of Calhoun County,* 1877, p. 11, mentions sites in Calhoun County.

———— *History of St. Joseph County, Michigan,* 1877, p. 11, mentions sites in St. Joseph County.

EVERTS and ABBOTT. *History of Kalamazoo County,* Philadelphia, 1880, mentions sites in Kalamazoo County; p. 65, mentions garden beds; p. 68, cuts of garden beds on W. B. Cobbs' Farm at Schoolcraft, also one at Galesburgh and one in Kalamazoo, probably the one in the Park west of the mound.

FARMER, (SILAS). *History of Detroit and Michigan,* 1884, p. 321, mentions mounds in Wayne County.

FISHER, (A. W.). *Cache of Leaf-shaped Relics,* Popular Science News, February, 1901, Vol. XXXV, No. 2, p. 38.

FOSTER, (J. W.). *Prehistoric Races of the United States of America,* p. 265, p. 266, mentions copper mines in Ontonagon County; p. 155, mentions garden beds.

FOSTER and WHITNEY's Report, 1850, p. 162, mentions mines in Keweenaw County; pp. 161-162, notices copper mines in Keweenaw County; pp. 159-161, describes and figures copper mines in Ontonagon County, and, p. 161, mentions mounds in Ontonagon County.

FOWLER, (S. W.). Smithsonian Report, 1879, p. 434, mentions shell-heaps and sites in Manistee County.

FOWKE, (GERARD). Copy of Fowke's Report on Michigan. A carefully compared copy made with permission of Professor Thomas from a copy made by Rev. Wm. M. Beauchamp, of Syracuse, N. Y., for his use while assisting in preparing the Thomas Catalogue.

——— Mr. Gerard Fowke of Chillicothe, Ohio, made a reconnaissance of Michigan for the Bureau of American Ethnology.

GALATIAN, (A. B.). See I. M. Thomas.

GIBBS, (MORRIS). *Origin of Mounds*, Popular Science, March, 1899, p. 59.

GILLMAN, (HENRY). Smithsonian Report, 1874, pp. 369, 370, describes mines in Keweenaw County.

——— Appleton's Journal, Vol. X, 1873, p. 173, describes mines in Keweenaw County.

——— 6th Report of the Peabody Museum, pp. 13-19, describes and figures mounds in St. Clair County.

——— Smithsonian Report, 1873, pp. 380-382, describes and figures mounds in Emmett County; pp. 378, 379, describes mounds in Iosco County; pp. 387-390, describes and figures pits in Keweenaw County; p. 380, mentions with plat mound in Mackinac County; pp. 382-384, describes with plat and figures mounds in Manitou County; p. 380, mentions mound in Presque Isle County; pp. 370-374, describes and figures mound in St. Clair County; pp. 367-368, describes and figures mound in Wayne County; pp. 364-365, partly describes with map mound in Wayne County.

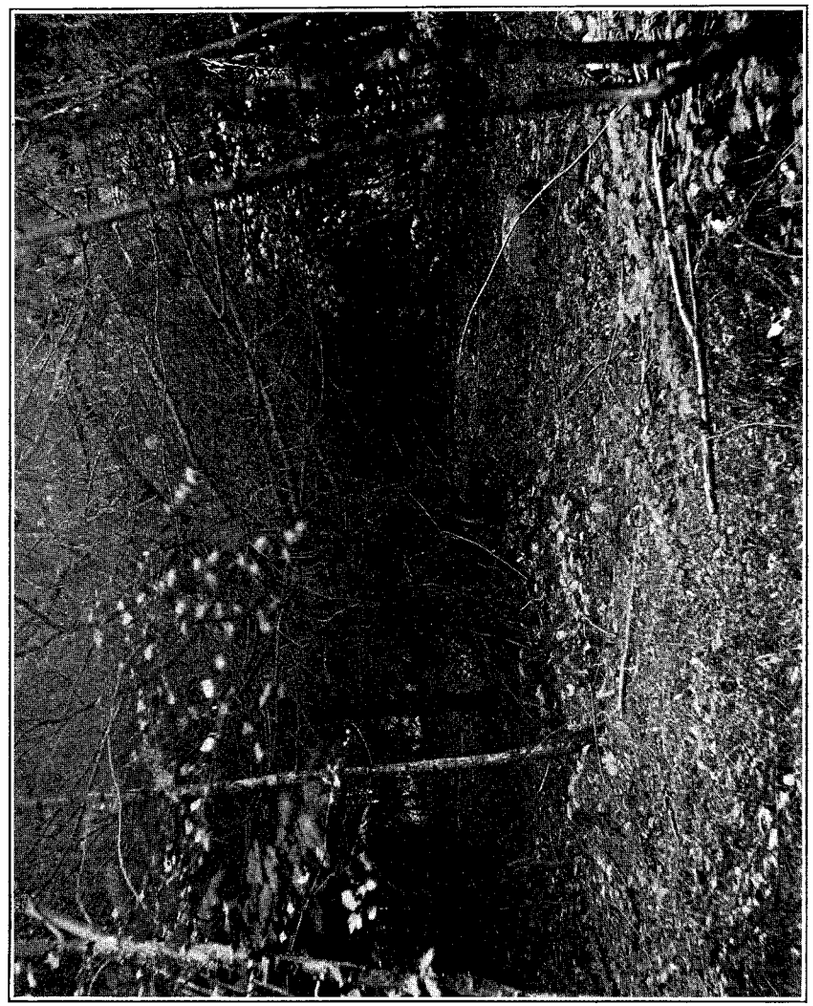
——— *The Mound-Builders and Platycnemism in Michigan,* Smithsonian Report 1873, Government Printing Office, 1874, pp. 364-390, Figs. 1-12, some being maps.

——— Also reprint 1877.

——— *Certain Characteristics Pertaining to Ancient Man in Michigan,* Smithsonian Report 1875, Government Printing Office, 1876, pp. 234-245, Figs. 1-13.

——— Also reprint 1877.

——— *The Ancient Men of the Great Lakes.* Abstract from Proceedings of the American Association for the Advancement of Science, Vol. XXIV, Salem, 1876, pp. 316-331, Figs. 1-7. Read August 16, 1875, at Detroit meeting.



GENERAL VIEW IN WOODS NEAR PORT AUSTIN. HABITAT OF *PLETHODON ERYTHRONOTUS.*

——— *Perforation of the Humerous conjoined with Platycnemism,* American Naturalist, Vol. IX, No. 7, 1875, pp. 427-428.

Grand Rapids. The Evening Press, February 20, 1904, refers to sites in Kent County.

Handbook of the American Indians, Bulletin 30 of the Bureau of Ethnology, pp. 149-150, refers to Saginaw County; p. 139, refers to Manitou County; p. 58, refers to Saginaw County; p. 535, mentions piece of hafted celt from Michigan; p. 345, refers to copper from Michigan.

HAUPTMAN. (See Science.)

HAVARD, (DR. V.). *The French Half Breeds of the Northwest,* Smithsonian Report, 1879, pp. 309-327; p. 318, mentions Michigan.

HAVEN, (——). *Archaeology of the United States,* contains report of Verandrier who explored this region before 1748.

HILLS, (LESLIE W.). American Archaeolgist, March 1898, p. 77, refers to a cache in Berrien County.

HINSDALE, (W. B.). Washtenaw Times, Ann Arbor, June 23, 1901, mounds in Washtenaw County.

History of Kalamazoo County.

HOLMES, (WM. H.). *Aboriginal Copper Mines of Isle Royale,* Lake Superior, American Anthropologist, N. S., Vol. 3, 1901, pp. 684-696, Plates XXIII-XXIV, Fig. 73.

History of Saginaw County, Michigan; together with sketches of its cities, villages and townships, educational, religious, civic, military, and political history; portraits of prominent persons, and biographies of representative citizens. History of Michigan, embracing accounts of the pre-historic races, aborigines, French, English and American conquests, and a general review of its civil, political and military history. Illustrated. Chicago, Chas. C. Chapman & Co., 1881, pp. 960. P. 268, refers to Rifle River in Ogemaw County; p. 287, refers to sites in Iosco County.

HODGMAN, (F.). *The Old Fort,* written for the Michigan Pioneer and Historical Society, June 5, 1902. Refers to fort in Kalamazoo County.

HOUGHTON, (JACOB). *Ancient Copper Mines of Lake Superior,* mentions mines in Ontonagon County.

HUBBARD, (BELA). American Antiquarian, Vol. I, 1878, pp. 4-9, partly describes and figures garden beds in Kalamazoo

County; p. 7, partly describes rectangular and circular embankments in Kalamazoo County; p. 4 and Fig. 4, mentions garden beds in St. Joseph County.

——— *Memorials of a Half Century,* 1887, Copyrighted G. P. Putnam Sons, p. 185, mentions L'Arbe Croche Village Site in Emmett Co.; p. 203, describes, with cut, sites in Macomb County.

——— *Ancient Garden Beds of Michigan,* Pioneer Collections of the State of Michigan, Vol. II, 1877-78, pp. 21-27 and maps pp. 28-35, partly describes and figures garden beds in Kalamazoo County.

HUBBARD, (LUCIUS). Smithsonian Report, 1879, pp. 434-435, mentions mounds in Berrien County.

Huron, see Miner.

JENISON, (O. A.). Smithsonian Report, 1879, p. 435.

JENKS, (ALBERT ERNEST). *The Wild Rice Gatherers of the Upper Lakes,* 19th Report of the Bureau of Ethnology, Part 2, p. 1050, refers to Saginaw County and Bay County.

JENNINGS, (H. S.). The Michigan Academy of Science, Science N. S. XIII, No. 329, April 19, 1901, p. 616, refers to papers by Harlan I. Smith on "An Archaeological Survey of Michigan: The Antiquities of Michigan, Their Value and Impending Loss."

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JONES, (PETER). *History of the Ojibway Indians,* 1861.

KELTON, (DWIGHT H.). *Annals of Fort Mackinac,* Copyrighted 1892.

KINZIE, (MRS. JOHN H.). *"Wau-Bun the Early Day in the Northwest."* New York, 1856.

KOHL, (J. G). *"Kitchi-Gami Wanderings Round Lake Superior."* London, 1860.

LA HONTON. *New Voyages,* Vol. I, p. 93, 1703, refers under the names Otontagans and Ottawas of Talon, to Otontagan, an Ottawa band living before 1680 on Manitoulin Island and driven out by the Iroquois.

LAPHAM, (I. A.). *Antiquities of Wisconsin,* p. 74, mentions copper mines in Ontonagon County and garden beds.

LARMOUR, (J. J.). Smithsonian Report 1880, p. 444, mentions mounds in Calhoun County.

LATHROP, (J. H.). *Prehistoric Mines of Lake Superior,* American Antiquarian, Vol. XXIII, No. 4, July and August 1901.

——— Also printed in Northwest Magazine, Feb. 1901.

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——— Also reprint in Papers Relating to Anthropology from the Smithsonian Report for 1884, Washington, Government Printing Office, 1885, pp. 11-13, with two maps.

——— *Ancient Mounds in Clinton County, Michigan,* Annual Report of the Smithsonian Institution, 1884, Washington, Government Printing Office, 1885, pp. 839-848, describes and figures mounds; pp. 840-841, describes and figures mounds on a flat in Shiawassee County.

——— Also reprint in No. 620 Papers Relating to Anthropology from the Smithsonian Report for 1884, Washington, Government Printing Office 1885.

——— Address Traverse City, Michigan.

LEESON, (M. A.). *History of Macomb County, Michigan,* 1882, mentions sites in Macomb County.

MANKTELOW, (CHAS. W.). The American Archaeologist, April 1898, p. 105, and the American Archaeologist, December 1898, p. 323, reports mounds or earthworks near Boone and Cadillac, Wexford County.

——— *Prehistoric Remains in Northern Michigan,* Popular Science News, Nov. 1902, p. 289.

——— Address Cadillac, Michigan.

MASON, (OTIS T.). *Papers Relating to Anthropology,* 1884, pp. 4-10, mentions mounds in Clinton County; pp. 11-13, mentions enclosures in Ogemaw County; pp. 1-4, mentions mounds in Shiawassee County.

——— United States National Museum Report 1902, p. 385, refers to Angwassag, Saginaw County.

MCCORMICK, (W. K.). *Mounds and Mound Builders of the Saginaw Valley,* Michigan Pioneer Collection, Vol. IV, 1881, Lansing, W. S. George & Co., 1883, p. 382, mentions sites in Bay County and refers to Ogemaw County; p. 379, mentions enclosures in Ogemaw County, and describes mounds in Genesee County; p. 380, mentions mounds and earthworks in Saginaw County.

MacLean, (Jno. P.). *Mound Builders,* pp. 76-77, mentions copper mines in Ontonagon County.

Mallory, (Isaac). *History of Baptist Indian Missions,* 1840, p. 366, mentions mound in Wayne County.

Middleton, (James D.). The Smithsonian Report, 1889, footnote on p. 47 in appendix I, refers to his work in Michigan.

Miner, The Michigan, Nov. 1, 1901. *The Lake Huron Region.* An early geographical Sketch of Lake Huron with accompanying map of interest. Saginaw, Michigan.

——— Vol. VI, No. 2, January 1902, p. 12, mentions copper.

Moore, (Charles). *The Ontonagon Copper Boulder in the United States National Museum,* United States National Museum Report for 1895, pp. 1021-1030, with two plates, Washington, Government Printing Office, 1897.

——— Also reprint.

Moorehead, (Warren K.). *Prehistoric Implements,* Cincinnati, 1900, pp. 23 and 307, mentions a cache.

Morse, (Jedidiah). Report to the Secretary of War of the United States on Indian Affairs, 1822, Appendix, p. 19, refers to Saganau.

Muir, Michigan, (Ionia County). *Story of a Fort Near Muir, Michigan,* Detroit News, Feb. 25, 1893.

——— Also reprint in the Archaeologist, Vol. I, No. 4, pp. 65-67.

Nadaillac. *Prehistoric America,* p. 81, refers to garden beds.

New York Times, January 9, 1908, mentions discovery of a copper axe at Presque Isle, Presque Isle County.

——— March 23, 1902, mentions copper found at Lake Gogebic.

——— August 10, 1902, refers to perforated skulls found near Arkona, Ontario, similar to those found in Michigan.

Oakes, (H. E.). *The Garden Beds of Michigan Modeled.* American Antiquarian, Vol. XVIII, No. 6, November 1896, p. 323.

Packard, (R. L.). *Pre-Columbian Copper Mining in North America,* Smithsonian Report for 1892, Washington, Government Printing Office, 1893, pp. 175 and 178, refers to Marquette.

——— Also reprint, p. 919.

——— *Pre-Columbian Copper Mining in North America,* American Antiquarian, March, 1893, Vol. XV, No. 2, pp. 67-78, continued in American Antiquarian, May, 1893, Vol. XV, No. 3, pp. 152-164.

Palmer, (Friend). *Early Days in Detroit,* p. 247, mentions copper.

Peabody Museum, Harvard University, 10th Annual Report, 1877 (Reports II) p. 20, refers to photograph, 11054, of stone ornament found in Fruitport, Michigan, presented by W. L. Coffinberry of Grand Rapids, Michigan.

——— 16th and 17th Annual Reports, 1884, (Report III), p. 202, articles 29476-29521 from mound on Devil River, collected by Henry Gillman and presented by Stephen Salisbury.

——— 19th Annual Report, 1886, p. 505, 38225, perforated crania, mound on River Rouge presented by Bela Hubbard. P. 508, articles from mound at Grand Rapids presented by W. L. Coffinberry.

Peck, (William Ira). The Evening News, Detroit, Dec. 7, 1901, refers to fort in Ogemaw County.

Peet, (Stephen D.). American Antiquarian, Vol. VII, 1885, pp. 23-28, describes and figures garden beds in Kalamazoo County.

——— *Emblematic Mounds,* Vol. II, p. 131, refers to garden beds.

Perforated, see Saginaw.

Pioneer Collections, Vol. II, 1877-78, p. 45, mentions sites in Manitou County.

Popular Science, March 1899, p. 59.

Popular Science Monthly, 1881, p. 601, mentions copper.

Post, (H. D.). Michigan Pioneer Collections, Vol. III, 1879-80, p. 296, mentions sites in Allegan County.

Riley, (Henry H.). Michigan Pioneer Collections, Vol. III, 1879-80, p. 14, refers to mounds discovered by Gillman in St. Clair County.

Royce. Map 1st. Report of the Bureau of American Ethnology, 1881, refers to Pocagons Village (Pocagon).

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——— January 29, 1903, mentions mound in Genesee County.

——— March 14, 1903, refers to perforated skull from Bay County in American Museum of Natural History.

———— Nov. 1, 1905, Nov. 11, 1905, Dec. 17, 1905, and Dec. 30, 1905, refers to graves at Bridgeport, Saginaw County.

———— May, 1907, mentions graves at Bridgeport, Saginaw County.

Saginaw Evening News, June 1, 1888, refers to Saginaw Grave.

———— December 31, 1902, mentions Edinger collection.

———— September 23, 1909, mentions a grave in Berrien County.

SAUR, (WM. C). *Illustrated Atlas of Kalamazoo County, Michigan,* with Early and Present History, Detroit, Mich., 1890, p. 79, refers to garden beds.

SCHOOLCRAFT, (HENRY R.). *Historical and Statistical Information respecting the History, Conditions and Prospects of the Indian Tribes of the United States,* Lippincott, Grambo & Company, 1851-1857, Vol. I, pp. 50-54-60 with plates VI and VII, refer to garden beds in the Grand River Valley.

Science, February 21, 1902, p. 309, refers to Hauptman Earthwork in Ogemaw County.

SHORT, (——). North Americans of Antiquity, pp. 89-92, mentions copper mines in Ontonagon County.

SMITH, (HARLAN I.). *The Antiquities of Michigan Their Value and Impending Loss.* John F. Elby & Co., Detroit, Michigan. A reprint of a syndicated article which appeared in the Detroit Evening News and the Detroit Free Press.

———— *Prehistoric Michigan,* Popular Science News, May, 1901, pp. 110-111.

———— Also reprint.

———— *An Archaeological Survey of Michigan,* Third Report of the Michigan Academy of Science, 1901, pp. 35-37.

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———— *Archaeological Survey of Michigan.* Presented before the Michigan Academy of Science at its seventh annual meeting, Ann Arbor, March 28, 1901, pp. 198-200.

———— American Anthropologist, N. S., Vol. III, January-March, 1901. This paper with slight changes the same as "An Archaeological Survey of Michigan."

———— Also reprint.

———— *In Primitive Times.* Saginaw Evening News, April 9th, 1894.

———— *The Saginaw Valley Collection,* The culture of the people once inhabiting a limited area near Saginaw, Michigan, as illustrated by material in the Anthropological Department of the American Museum of Natural History. Illustrated, 2 maps, 24 pp. Supplement to American Museum Journal, Vol. I, No. 12, November-December, 1901. A popular account.

———— *Anthropological Matters in Michigan,* read at the 43rd Meeting of A. A. A. S. at Brooklyn, N. Y., 1894.

———— *Relics of an Early Race,* Detroit Free Press, October 21, 1894, refers to sites in Saginaw and Kalamazoo Counties.

———— *Study of Man,* Detroit Free Press, Nov. 12, 1893.

———— *Legendary Invasion of the Saginaw Valley,* American Antiquarian, Chicago, Vol. XIII, No. 6, Nov. 1891, pp. 339-340.

———— Reprinted under the title—*The Invasion of Saginaw Valley.* A legend of northern Michigan as told by an Indian, Detroit Free Press, Sunday, January 3, 1892, p. 11, column 4, also in daily issue of Saginaw Courier-Herald, January 7th, and in the weekly issue of the same January 14, 1892.

———— *The Archaeology of the Saginaw Valley as illustrated at the World's Columbian Exposition.*

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———— Also reprint.

———— *The Development of Michigan Archaeology.* Presented at the first meeting of the Michigan Academy of Science, Dec. 26, 1894. The Inlander, VI, 8, May, 1896, part II.

———— Also reprint.

———— Partial Reprint in Preservation of Local Archaeological Evidences, Report of the Museums Association of the United Kingdom. Brighton Meeting for 1899.

———— Also reprint, 1900.

———— Also reprint Sci. Am.

——— *Work in Anthropology at the University of Michigan for 1892*, University Record, Feb. 1894, pp. 98-100.
——— Reprint Courier Presses, Ann Arbor, 1894.
——— Also reprint Detroit Free Press.
——— *An Earthwork Discovered in Michigan*, Science, 1901, p. 991, refers to Hauptman Earthwork in Ogemaw County.
——— Science, 1901, p. 228, refers to Hauptman Earthwork in Ogemaw County.
——— *Primitive Remains in the Saginaw Valley, Michigan, The Ayres Mound*, The Archaeologist, Vol. 1, No. 3, March, 1893, pp. 51-53.
——— *Caches of the Saginaw Valley, Michigan*, Proceedings Am. Ass. for the Advancement of Science, Vol. XLII, 1894, pp. 300-303.
——— Also separate.
——— See also same article revised and extended in The Antiquarian, Columbus, Ohio, Vol. I, Pt. 2, Feb., 1897, pp. 30-33.
——— *Summary of the Archaeology of the Saginaw Valley, Michigan, I*, American Anthropologist, N. S. Vol. 3, No. 2, April-June, 1901, pp. 286-293.
——— Also separate.
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——— Also separate.
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——— *Anthropological Work at the University of Michigan*, Memoir of the International Congress of Anthropology, Chicago, 1894.
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SMITH, (EMILE). Wrote in German on Michigan Copper and also translated into English.
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——— 1892, p. 50, refers to Holmes' exploration of copper mines on Isle Royale.
SQUIER, (E. G.). *Aboriginal Monuments of New York*, p. 184, mentions copper mines in Ontonagon County.

STARR, (FREDERICK). American Antiquarian.
STEVENS, (EDWARD T.). *Flint Chips*, p. 540, refers to garden beds.
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——— Dr. G. Archie Stockwell of Port Huron, Michigan, at the time of Mr. Fowke's reconnaissance, while hunting extensively in various parts of the state, had been watchful for mounds or other remains. He desired to make a systematic survey of Huron County and had collected many data regarding Michigan Archaeology which he freely offered to place at the disposal of science. In 1894 Dr. Stockwell removed to Detroit, Michigan.
STRONG, (E. A.). See Coffinberry.
SWINEFORD, (——). *History and Review of the Mineral Resources of Lake Superior*, mentions copper mines in Ontonagon County.
TALON. Refers to Ottawas (Otontagan).
TEED, (DELMAR E.). American Archaeologist, April 1898, note p. 105, assisted Chas. E. Manktelow explore mounds near Boon and Cadillac, Michigan.
——— Address Cadillac, Michigan.
THOMAS, (CYRUS). 12th Report of the Bureau of Ethnology, pp. 550 and p. 33, refers to garden beds, describes enclosures in Ogemaw County.
——— *Catalogue of Prehistoric Earth-Works East of the Rocky Mountains*, pp. 106-116, Plate X, and Archaeological map of Michigan. Washington, Government Printing Office, 1891.
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THOMAS, (——). *Kalamazoo Directory and Business Advertisements, 1867-1868, together with History of Kalamazoo*, Kalamazoo, 1867, p. 7, refers to garden beds.
Tippecanoe Treaty (1832). U. S. Indian Treaty 701, 1873, refers to Pocagon's village (Pocagon).

University. *Wants University to Search for Prehistoric Remains.* Ann Arbor Argus Democrat, Ann Arbor, Michigan, February 27, 1903.

VERANDRIER. (See Haven.)

WARD, (HENRY L.). *A Remarkable Ceremonial Object from Michigan,* Bulletin of the Wisconsin Natural History Society, Vol. IV, N. S., No. 4, October, 1906, pp. 160-161.

Washington Treaty 1836. U. S. Indian Treaty, 1873, p. 607, refers to sites in Manitou County.

Washtenaw Times, June 26, 1901, refers to graves in Washtenaw County.

Wayerman, Walkins & Co. *History of Cass County,* 1882, mentions sites in Cass County.

Wayne County. *Find of Indian Skeletons,* American Antiquarian, November-December, 1894, Vol. XVI, No. 6, p. 383.

West Branch Herald Times, June 14, 1901, refers to wall around Rifle Lake. Possibly a natural ice push.

Western Gazetteer or Emigrant's Directory, 1817, p. 170, mentions sites in Wayne County.

WHITNEY. See Foster.

WHITTLESEY, (CHARLES). *Ancient Mines on the Shores of Lake Superior,* Contribution to Knowledge, 1863, pp. 17-20, describes and figures copper mines in Ontonagon County.

WILSON, (THOMAS). *Arrow Points, Spearheads and Knives of Prehistoric Times.* United States National Museum, 1897. P. 980, refers to caches in Saginaw County and in Huron County. Frontispiece represents a hafted celt from Genesee County.

———— Report of the United States National Museum, 1892, part 1, p. 980, refers to cache from Chippewa County.

WILSON, (DANIEL). *Prehistoric Man.* Vol. I, p. 278, refers to copper mining.

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