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THE HERPETOLOGY OF MICHIGAN

BY

ALEXANDER G. RUTHVEN,
CRYSTAL THOMPSON AND HELEN THOMPSON

MEMORANDA TOWARDS A BIBLIOGRAPHY OF THE ARCHAEOLOGY OF MICHIGAN

BY

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1912.

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LETTER OF TRANSMITTAL.

To the Honorable the Board of Geological and Biological Survey of the State of Michigan:

Governor Chase S. Osborn, President.
Hon. D. M. Ferry, Jr. Vice President.
Hon. L. L. Wright, Secretary.

Gentlemen:—I beg to present herewith as a part of the report for 1911 of the Board of Geological and Biological Survey, Publication No. 10, being a contribution to the biological survey of the state authorized by Act No. 250 of the Session of 1905.

Very respectfully,
R. C. ALLEN,
Director.

Ann Arbor, Mich., October 1, 1911.

R. C. Allen, State Geologist, Lansing, Michigan:

Sir:—I transmit herewith a report upon the amphibians and reptiles of Michigan, prepared under my direction, to form a part of the series of monographs on Michigan forms that the biological division proposes to issue, and a bibliography of Michigan archæology compiled by Mr. Harlan I. Smith of the Victoria Memorial Museum. According to our plan for the series, the papers in this report attempt to summarize our present knowledge of the subjects treated and in such a way that the results may be used by teachers and local naturalists and archæologists.

Respectfully,
ALEXANDER G. RUTHVEN,
Chief Naturalist.

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THE HERPETOLOGY OF MICHIGAN.

GENERAL INTRODUCTION.

BY ALEXANDER G. RUTHVEN.

In view of the geographical situation of Michigan, it might be expected that its reptile and amphibian faunas would by this time be at least as well known as those of other states east of the Mississippi River. As it is our knowledge of the status of these groups in the state is astonishingly meager. It is true that all of the species known to occur in the state are well known to herpetologists, as they are, without exception, forms that occur commonly elsewhere in eastern North America, but of the actual number of forms that occur within our limits and the distribution, habits and variations of these we have as yet most inadequate data. Furthermore, there are practically no general works on the amphibians and reptiles of the state for the use of students and other persons interested in natural history.

Recognizing the need of a summary of the herpetology of Michigan the survey set aside out of the appropriation for 1907, $250.00 for the preparation of a work on the reptiles of Michigan and out of the appropriation for 1911, $200.00 for the preparation of a report on the amphibians of the state. The writer took personal charge of the reptile work, and with the appropriation engaged Miss Frances Dunbar, assistant in zoology in the University of Michigan, to assist him. The second appropriation was given to Miss Crystal Thompson and Miss Helen Thompson, who have had charge of the amphibian work under the direction of the writer.

In the pursuit of the work two ideas have been kept in mind: first, to make the results of genuine scientific value as a summary of our knowledge of the status of the groups in the state, and, second, to present the results in such form that they may be readily grasped by students and teachers and used as a reference work in the schools of the state. In order to place Michigan herpetology on a firm basis only those species are included (a) of which the writers have examined specimens[1] from authentic Michigan local-

[1] All specimens referred to in this report are in the University of Michigan Museum of Natural History unless otherwise stated.

ities, or (b) of which specimens have been examined by competent authorities, or (c) that have been reported to us by reliable observers who could unmistakably describe them. We have rigidly excluded all records by persons who possibly did not know the forms in question. It is believed, therefore, that the work is reliable as far as it goes, and, altho it is of course incomplete, for there are large areas in the state from which no or only a few records have been obtained, we trust that it will serve as a basis for future work and as an incentive to further investigation. It should be added that all descriptions of species are based on Michigan specimens unless otherwise stated.

January 1, 1912.

THE AMPHIBIANS OF MICHIGAN.

BY CRYSTAL THOMPSON AND HELEN THOMPSON.

INTRODUCTION.

One of the greatest difficulties encountered by the general student when he attempts the study of Michigan amphibians is the lack of a general work on the subject. Many papers have been published, but these are principally local lists and are so widely scattered that they are not generally available. The general books on the group are quite adequate for the determination of species, but they do not, as a rule, give the correct distribution of the forms in the state, so that, aside from the disadvantage of having to deal with many more forms in the keys than we have within our limits, the further objection to their use is that one can scarcely tell from them what species to expect in any region.

It is the purpose of this paper to present in a concise and convenient form the present knowledge of the amphibian fauna of Michigan. The work is necessarily far from complete because of the lack of data from many parts of the state, but it is hoped that it will prove of assistance to students. It should also serve to arouse an interest in this group of vertebrates that will result in the accumulation of data on the intrastate distribution of the species, particularly as an effort has been made to show just how much information is at hand for each section.

LITERATURE.

The published papers that deal either entirely with Michigan amphibians, or that include definite records for Michigan are as follows:

1. Sager, Abram. Report to the State Geologist. Senate Doc., State of Michigan, 1839, 294-305. Includes a catalogue of the amphibians of the state. The following species are listed: *Bufo musicus* (*americanus*), *Hyla versicolor, Rana clamitans, Rana halecina* (*pipiens*), *Rana palustris, Rana sylvatica, Rana gryllus* (*Acris gryllus*), *Salamandra symetrica* (*Diemictylus viridescens*),

Salamandra cinera (*Plethodon erythronotus*), *Menobranches lateralis* (*Necturus maculosus*).

2. Holbrook, John Edwards. North American Herpetology, Vol. IV, 1842. Holbrook states, on the authority of Dr. Kirtland, that *Rana sylvatica* is common in the woods of Michigan.

3. Miles, M. A Catalogue of the Mammals, Birds, Reptiles and Molluscs of Michigan. First Biennial Report of the Geological Survey of Michigan, 1861. This, as the name implies, is merely a catalogue of the species supposed to occur in Michigan. The list of amphibians includes: *Bufo americanus, Acris crepitans* (*gryllus*), *Hyla versicolor, Hyla pickeringii, Helocaetes triseriatus* (*Chorophilus nigritus*), *Rana catesbeana, Rana fontinalis* (*clamitans*), *Rana pipiens, Rana palustris, Rana sylvatica, Ambystoma punctatum, Ambystoma luridum* (*tigrinum*), *Ambystoma laterale* (*jeffersonianum*), *Diemictylus viridescens, Plethodon cinereus, Necturus lateralis* (*maculosus*). There are a few footnote references to localities.

4. Milner, James W. Report on the Fisheries of the Great Lakes. Report of the U. S. Fish Commission, 1872-3. Milner reports *Necturus* from Grand Haven, Ecorse and the Detroit River.

5. Smith, W. H. The Tailed Amphibians, including the Caecilians; A Thesis presented to the Faculty of Michigan University, 1877. Descriptions are written of the specimens in the University of Michigan Museum. In no case is the specific locality given.

6. Smith, W. H. Catalogue of the Reptilia and Amphibia of Michigan. Supplement to Science News, 1879. Under Amphibia Smith lists: *Rana halecina* (*pipiens*), *Rana palustris, Rana temporaria* var. *sylvatica, Rana clamitans, Rana catesbyana, Bufo lentiginosus, Hyla versicolor, Hyla pickeringii, Chorophilus triseriatus, Acris gryllus* var. *crepitans, Plethodon erythronotus, Plethodon erythronotus* var. *cinereus, Notophthalmus viridescens* (*Diemictylus viridescens*), *Ambystoma punctatum, Ambystoma opacum, Ambystoma tigrinum, Ambystoma jeffersonianum* and *Menobranchus lateralis* (*Necturus maculosus*). The species known to occur at Ann Arbor are starred.

7. Smith, W. H. Report on the Amphibians and Reptiles of Ohio. Report of the Geological Survey of Ohio, Vol. IV, 1882. Mentions *Plethodon erythronotus, Ambystoma tigrinum* and *Ambystoma opacum* as coming from Ann Arbor.

8. Cope, E. D. Batrachia of North America. Bulletin 34, U. S. National Museum, 1889. Specimens of *Necturus maculosus, Ambystoma tigrinum, Plethodon cinereus, Plethodon glutinosus, Rana clamitans* and *Rana palustris* are listed from Michigan.

9. Kirsch, Philip H. A Report on the Investigations in the Maumee River Basin during the summer of 1893. Bulletin U. S. Fish Commission, Vol. XIV, 1894. In the list of amphibians observed in the Maumee River Basin, *Rana sylvatica* and *Rana clamitans* are recorded from near Hudson, Mich.

10. Clark, H. L. Notes on the Batrachians and Reptiles of Eaton County. Fourth Ann. Report Michigan Academy of Science, 1902. This list includes the species found in Eaton County by the writer and those reported to him by reliable observers.

11. Ruthven, Alexander G. Notes on the Molluscs, Reptiles and Amphibans of Ontonagon County, Michigan. Sixth Ann. Report Michigan Academy of Science, 1904. Records the amphibians collected by the writer in Ontonagon County.

12. Ruthven, Alexander G. The Cold-Blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan. Ann. Report of the Geological Survey of Michigan, 1905. The list of amphibians includes all of the data "available to the author on the occurrence of these animals in the Northern Peninsula."

13. Clark, H. L. A Preliminary List of the Amphibia and Reptilia of Michigan. Seventh Ann. Report Michigan Academy of Science, 1905. A list of amphibians whose presence in the state "is vouched for by at least one of the writers" (M. Gibbs, F. N. Notestein, H. L. Clark), together with the localities from which records were obtained. It includes in the bona fide list; *Necturus maculosus, Ambystoma maculatum* (*punctatum*), *Ambystoma tigrinum, Ambystoma jeffersonianum, Hemidactylium scutatum, Plethodon cinereus* and *P. cinereus erythonotus, Plethodon glutinosus, Diemictylus viridescens, Bufo lentiginosus americanus, Acris gryllus, Chorophilus nigritus triseriatus, Hyla versicolor, Hyla pickeringii, Rana pipiens, Rana clamitans, Rana palustris, Rana sylvatica* and *Rana sylvatica cantabrigensis, Rana septentrionalis* and *Rana catesbeana*. Unfortunately the sources of the individual records are not given.

14. Smith, Bertram G. The Breeding Habits of *Ambystoma punctatum* Linn. American Naturalist, Vol. XLI, 1907. Work on the breeding habits of *Ambystoma punctatum* was conducted at the University of Michigan and the material upon which the work was based was collected in the vicinity of Ann Arbor.

15. Hankinson, T. L. A Biological Survey of Walnut Lake, Michigan. Report Geological Survey of Michigan, 1908. A list of the amphibians found at Walnut Lake, Oakland County, during the spring and summer of 1906.

16. Ruthven, Alexander G. The Cold-Blooded Vertebrates of Isle Royale. Report Geological Survey of Michigan, 1909. A summary of the amphibian fauna of Isle Royale, based largely upon the results of the University of Michigan Museum expeditions to the island in 1904 and 1905.

17. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians. Eleventh Ann. Report Michigan Academy of Science, 1909. This paper places on record some miscellaneous data upon the amphibians of Michigan. The writer refers the Michigan wood frogs to *Rana cantabrigensis* rather than *Rana sylvatica*.

[1]18. Smith, Bertram G. The Nests and Larvae of *Necturus*. Biological Bulletin, Vol. XX, 1911. A larval specimen taken from the Detroit River, Nov. 24, 1906, is described.

METHODS OF STUDY.

The amphibians are a group of animals that will furnish many interesting problems to Michigan students. In the first place, while most observers of nature know something of their habits and considerable has been published on the subject, there is still much to be done upon the species to be found within our limits. Added to this is the fact that the species are not difficult to observe in the field after one becomes familiar with their haunts.

In taking up the systematic study of amphibians, it is desirable first to become familiar with the general characters of the group. The best method of doing this is to dissect a specimen, following the directions in some manual on the subject. The anatomy is treated in most vertebrate zoologies. The Frog Book, by Mary C. Dickerson, gives an excellent account of the characters used in the classification of the tailless forms, but unfortunately there is nothing at present available on the tailed amphibians. Other books which will prove helpful are, The Batrachians and Reptiles of the State of Indiana, by O. P. Hay, A Manual of the Vertebrate Animals of the Northern United States, by David Starr Jordan, and The Batrachia of North America, by E. D. Cope, although the latter is at present difficult to obtain and is for the most part technical and rather difficult for the beginner.

The external characters are sufficient for the identification of the Michigan species and are alone used in this work. The points to be considered in the identification are:—first, presence or absence of a tail in the adult state. This at once separates the two orders found in this region, the Salientia (tailless forms) and Caudata

[1] Since this bibliography was compiled two papers have been published, Thompson, 1911, and Ruthven, 1911a, containing records from Cass and Huron counties.

(tailed forms). In identifying the Salientia the following characters are used,—general external appearance, proportionate length of head and body, proportionate length of hind limb and body, presence or absence of parotid glands, presence or absence of lateral glandular folds, teeth, presence or absence of disks on fingers and

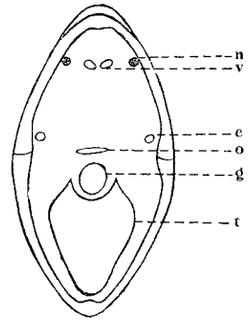

Fig. 1. Diagram of Mouth of Frog to Show Position of Teeth.
n, Internal nares; *v*, Vomerine teeth; *e*, Eustachian tubes; *o*, Oesophagus; *g*, Glottis; *t*, Tongue,

toes, ground color and pattern. The characters used in the identification of the Caudata are,—general external appearance, proportionate length of body and tail, shape of tail, number of costal grooves, number of toes on the hind feet, character and position of teeth (Fig. 2), ground color and pattern.

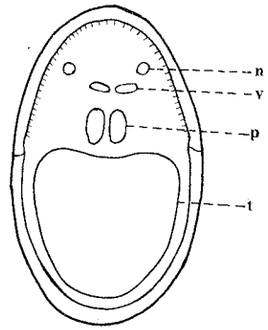

Fig. 2. Diagram of Mouth of Salamander to show Position of Teeth.
n, Internal nares; *v*, Vomerine teeth; *p*, Paresphenoid teeth; *t*, Tongue.

Teachers may outline laboratory and field work from the following suggestions. The collecting and identifying of species should precede or go along with the study of habits. The spring is the best time to observe the species in the field, for this is the breeding

season and the associated habits are most interesting. Particular points to be noted are,—time of appearance in the spring, habitat, food habits, time of breeding, characteristic notes of the different species, method of fertilizing the eggs, nature of egg masses, time of hatching of eggs, habits and metamorphosis of larvae.

METHODS OF COLLECTING AND PRESERVING SPECIMENS.

Collecting: Since most of the species come to the streams or ponds to breed in the spring this is the best season for collecting. They may also be collected during the entire summer and fall, but as most of the species leave the ponds after breeding and become more solitary, they are much more difficult to find. However, during the summer many frogs will be found along the borders of ponds and lakes, along the banks of streams, near springs, and in marshes, woods and fields. The toad and the tree frogs as a rule retreat from the water after the breeding season is past.

The Caudata, or tailed amphibians, with the exception of *Hemidactylium scutatum, Plethodon erythronotus* and *Necturus maculosus,* may be found in the spring in small ponds where they have gone to breed. At other times during the year they, with *Hemidactylium scutatum* and *Plethodon erythronotus,* are to be found under logs, moss, and in and around decaying stumps and logs in the woods. Some may also be found, before entering the water in the spring, under logs and stumps in woody places. *Necturus maculosus* may be caught at all seasons of the year in the larger lakes and streams. *Plethodon erythronotus* never enters the water. It may be found under the bark of decayed logs and similar places. *Hemidactylium scutatum,* so far as is known, does not enter the water. It may be collected, during the spring at least, under loose moss and in old stumps in low, wet woods. The two year old form of *Diemictylus viridescens* may be found in decaying logs with the other species, but younger and older forms occur in the ponds at all seasons.

Amphibians may be readily caught with the hands or by means of a net. The best net to use is a long handled dip net of small mesh and deep enough to prevent the escape of frogs after they are caught. The net is useful in collecting frogs or toads when in the water, or for scooping them out of the mud at the bottom of ponds. A 22 caliber rifle shooting cartridges loaded with dust shot (No. 14), or a 28 gauge shot gun loaded with light loads of powder

and dust shot, are very effective means of collecting large series of frogs.

The tailed amphibians are rather slow in their movements, and when on land they can be readily picked up by hand. When observed in the open water they may be easily caught in the dip net. Digging up with the net the leaves and mud from the bottom of ponds in woody places will usually result in the finding of several specimens.

Specimens may be carried from the field in a minnow pail in which there is enough water to keep them moist. When it is necessary to keep several collections separate, the animals may be placed in cheesecloth bags with some wet moss. Small specimens should be kept separate from the large ones so that the former may not be injured.

Keeping Live Material: It is often desirable to keep amphibians alive in the laboratory and the following suggestions may be found useful. Toads and frogs may be kept in large glass jars, covered over the top with netting and containing some moss and a small amount of water. Flies and earthworms placed in the jars will be eaten readily. The frogs should be sorted according to size and those of approximately the same size placed in the same jar, otherwise the large individuals will eat the smaller ones.

The small tailed amphibians which are terrestial in habit, *Hemidactylium scutatum* and *Plethodon erythronotus,* may be kept in bacteria dishes with a little damp moss. If the moss is renewed frequently they will find sufficient numbers of insects and larvae in it to keep them in good condition. The Ambystomas and *Diemyctilus viridescens* should be kept in dishes containing moss, bark and dead leaves with some water at one side, so that they may enter it at will. They will eat insects, worms and small pieces of meat if offered to them. Small tadpoles placed in the water will furnish food for *Diemyctilus viridescens.*

The aquatic forms will need a larger supply of water. *Necturus* should be kept in a tank containing running water to the depth of two or three inches. There should be some floating plants or other objects under which they may partially conceal themselves. Raw beef cut in small pieces and presented on the end of a fine wire will sometimes be taken as food. If this method of feeding is not successful, small frogs and fish may be eaten if placed in the tank. *Necturus* will remain in good condition for a few weeks without food.

Preservation of Specimens: Amphibians which are to be per-

manently preserved should be properly killed and put up in a preserving fluid, for a poorly preserved specimen is usually worse than none. The best method of killing is to drown the animals. This can easily be done by placing them in small cheesecloth bags and immersing them in water so that no air can reach them. The air should be excluded from the bag by gently kneading it in the hands while under water. The amphibians will drown within twelve hours.

After killing, the specimens should be placed in 4% formalin for at least a week to harden. The formalin must be allowed to enter the body cavity or otherwise the internal organs will decompose before the preservative can penetrate to them. This is best accomplished by injecting the formalin into the body cavity, by means of a hypodermic syringe, but if this is not convenient, the abdomen may be slit open with a pair of scissors. When thoroughly hardened, the specimens should be transferred to from 55% to 60% alcohol for permanent storage. It is important that the alcohol be of this strength, for stronger solutions will shrivel them and weaker will not properly preserve them. Each specimen should be provided with a tag tied rather loosely about the body just in front of the hind legs. This label should give the locality, date, name of collector and habitat unless a catalog is kept, in which case a number may be placed on the label and in the notebook with the habitat data.

DESCRIPTION OF SPECIES.

KEY TO MICHIGAN AMPHIBIA.

a¹. Tailed throughout life. *Caudata.*

b¹. External gills persistent in adult. *Proteidae.*

c¹. Body lizard-like. Limbs four, equally developed. External gills. Color brown, spotted with black. Four toes on each foot. . . . . *Necturus maculosus*, p. 23.

b². Adult without external gills. Limbs well developed. Eyelids present. *Mutabilia.*

c¹. No parasphenoid teeth; vomero-palatine teeth in parallel or posteriorly diverging series that do not extend posteriorly over the parasphenoid. Body lizard-like. Costal grooves distinct. Tail compressed. *Ambystomidae.*

d¹. Costal grooves 12. Back dark brown with large irregular yellow spots. Body and head stout. Plantar tubercles well developed . . . . . *Ambystoma tigrinum*, p. 26.

d². Costal grooves 11. Body and head broad. Back black with series of bright yellow spots on each side of vertebral column. No plantar tubercles. Transverse line of teeth in three parts, central separated from the lateral by a slight interval; central patch usually straight but may curve forward in the middle. *Ambystoma punctatum*, p. 28.

d³. Costal grooves 12. Back bluish black, uniform or with pale blue spots. Head and body slender. No plantar tubercles. Teeth in four patches, the two central in a nearly straight line. . . . . *Ambystoma jeffersonianum*, p. 30.

c². Parasphenoid teeth present. Body cylindrical. Tail round, tapering to tip. *Plethodontidae.*

d¹. Color brownish black, usually with a broad red or ashy dorsal band. Body slender. Inner toes rudimentary. Costal grooves 16 to 19. . . . . *Plethodon erythronotus*, p. 32.

d². Color light brown spotted with dark, a lighter stripe down the back. Under surface yellowish white with dark inky spots. Body slender. Four toes on each foot. Tail very long, separated from the body by a distinct depression. Costal grooves 13. . . . . *Hemidactylium scutatum*, p. 34.

c³. Parasphenoid teeth absent. Vomero-palatine teeth in transverse or posteriorly diverging series extending posteriorily over the parasphenoid. Tail compressed. Outer and inner toes on hind foot rudimentary. *Salamandridae.*

d¹. Costal grooves indistinct. Color varying from olive green to reddish brown above. ....*Diemictylus viridescens,* p. 36.

a². Tail absent in adult. Body short and broad. Hind limbs adapted for leaping. *Salientia.*

b¹. No maxillary teeth. Parotid glands present. Skin warty. *Bufonidae.*

c¹. Parotids oval. Cranial crests divergent behind.....*Bufo americanus,* p. 39.

b². Maxillary teeth present. Parotid glands lacking. Fingers and toes enlarged at ends to form adhesive disks. *Hylidae.*

c¹. Disks large. Color green, gray or brown with irregular dark blotches. Irregular dark star-shaped blotch on upper part of back. .....*Hyla versicolor,* p. 41.

c². Disks medium. Oblique dark cross on back. Dark mark between eyes. Limbs barred. .....*Hyla pickeringii,* p. 43.

c³. Disks small. Color variable with three oblique blotches on sides. Dark triangular spot between eyes. Light line from eye to arm.....*Acris gryllus,* p. 45.

c⁴. Disks small, scarcely discernable. Color changeable. Three longitudinal dark stripes on back. Dark line from eye to arm. .....*Chorophilus nigritus,* p. 47.

b³. Maxillary teeth present. Parotid glands lacking. No adhesive disks. *Ranidae.*

c¹. Lateral folds large. Color green with two irregular rows of rounded dark spots edged with lighter color on back. Legs barred or spotted.....*Rana pipiens,* p. 49.

c². Color brown with two irregular rows of oblong square blotches of dark brown on the back, the spots without edgings of lighter color.....*Rana palustris,* p. 51.

c³. Lateral folds conspicuous. Color brownish green with small dark spots. Legs spotted or barred with dark. Web broad leaving last two joints of fourth toe free. ....*Rana clamitans,* p. 53.

c⁴. Lateral folds present. Ground color variable. Arms and legs barred. A black patch in ear region. Length of hind limb to heel equals distance from anus to some point in front of eye....*Rana cantabrigensis,* p. 55.

c⁵. No lateral folds. Color light olive brown with blotches of darker color. Legs spotted or branded.....*Rana septentrionalis,* p. 57.

c⁶. No lateral folds. Color greenish brown with darker spots. Fold of skin from eye to arm curving behind ear. Hind feet webbed, leaving last joint of fourth toe free..... .....*Rana catesbeana,* p. 59.

NECTURUS MACULOSUS Rafinesque.

MUD PUPPY.

(Pl. I.)

Description: Body elongate, thick and cylindrical. Head broad, flat and depressed. Muzzle rounded; mouth large, upper lip overhanging lower. Eyes small, situated near front of head; nostrils at end of snout. Three bushy external gills on each side of neck. Gular fold prominent, fourteen costal furrows and a dorsal groove. Limbs small but well developed, digits four in number. Tail greatly compressed. Skin very smooth and slimy. Two series of teeth in almost parallel rows. Premaxillary series short, forming an angle anteriorly. Vomero-palatine series longer, extending from the angle of the premaxillaries to the angle of the jaw.

Ground color varies from dark to ashy brown above, paler below. Upper surface usually mottled with darker color and with small light spots. Gills bright red. In young specimens a dark lateral band is sometimes found.

Measurements: Specimen No. 41723.

Total length	.243
Length of head and body	.155
Width of head	.034

Habits and Habitat: *Necturus maculosus* is wholly aquatic and is rather dull and sluggish during the day time. It usually rests on the bottom with the gills spread out and may sometimes be seen crawling slowly about. When disturbed, the gills are contracted close to the sides and the animal swims rapidly away by means of the large, flat, paddle-like tail. The fact that it is frequently taken throughout the winter would seem to indicate the absence of a hibernating period.

At night the Necturus, which is extremely voracious, swims about in search of its food, which consists mainly of small crustacea, worms, fish and their eggs, and insects. In captivity it will sometimes eat small pieces of meat, but only when it has been for some time without food. It is frequently caught on hooks or in nets by fishermen, who commonly regard it as very poisonous. This fallacy is no doubt due to the coat of slime which is emitted when the animal is irritated. Adult specimens can also inflict a rather painful bite with their sharp, strong teeth, and it is hard to dislodge them when they have secured a good hold. The flesh is reported excellent by those who have eaten it.

Very little is known of the breeding habits of Necturus. The animals are usually found in pairs in the autumn, and it is possible that this is the mating season. Hay (1892a, p. 12) states that eggs were taken from the Detroit River about the middle of July, while according to Eycleshymer (1906, p. 133), who has studied their habits in the small lakes of Wisconsin, "the best time for collecting is during the middle and latter parts of the month of May." The nest is much like that of a fish, consisting of a small excavation in the sand under some sheltering object, such as a log, board or stone. The eggs are found attached to this shelter "by the slender stalks of the gelatinous envelopes" (Smith, 1911, p. 191), and cover a surface of from six to twelve inches in diameter. Smith (1911) found the average number of eggs in a nest to be sixty-six. They are about the size of a pea, and lack the pigment which is characteristic of the eggs of most amphibians. Further details of development have not been worked out.

Distribution: Eastern United States, mostly north and west of

the Alleghanies, abundant in the Great Lake region. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Dickinson, Cheboygan, Huron, Livingston, Washte-

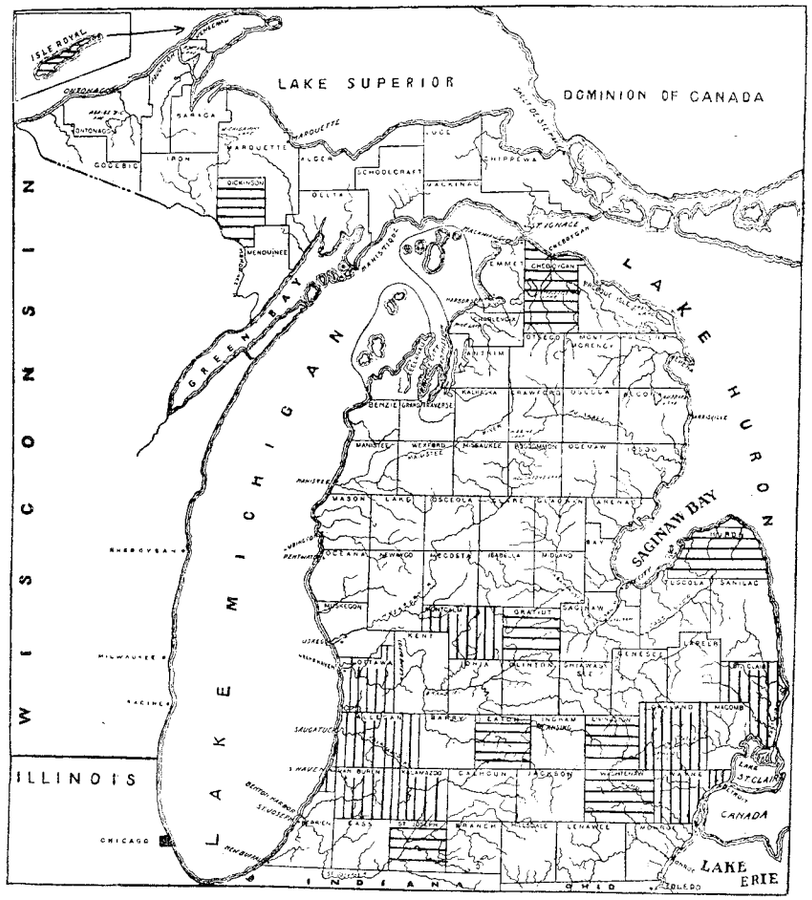

Fig. 3. Distribution of *Necturus maculosus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

naw and St. Joseph Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Keweenaw (Isle Royale). Wayne and Oakland Counties (Cope, 1889); Wayne, St. Clair, Allegan, Kalamazoo, Eaton, Montcalm and Van Buren Counties (Gibbs, Notestein and Clark, 1905); Ottawa County (Milner, 1874); Keweenaw County (Isle Royale) (Ruthven,

1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879); Ottawa and Wayne Counties (Milner, 1874).

AMBYSTOMA TIGRINUM (Green).

TIGER SALAMANDER.

(Pl. II a.)

Description: Body large and thick. Head flat and not as broad as body in adult specimens. Eyes prominent, nares small. Parotid region much swollen. Gular fold prominent, extending upward on sides of neck. Also a groove running from corner of mouth to eye. Twelve costal furrows and a distinct dorsal groove. Limbs stout; toes depressed, tapering from a broad base to the tips which are hardened and horny in appearance. Two distinct plantar tubercles. Tail long and compressed, equal in length to distance from snout to groin. Skin smooth and glossy, and covered with mucous pores which are not as prominent as in *Ambystoma punctatum*. Vomero-palatine teeth in a straight or slightly curving series across roof of mouth. Tongue large and fleshy, free on sides and attached at ends.

Ground color brownish black above, lighter beneath. Bright yellow spots scattered irregularly over entire surface of body. These spots may be few or many in number and are sometimes confluent to form more or less definite stripes.

Measurements: Specimen No. 36030.

Total length	.205
Length of head and body	.100
Width of head	.026

Habits and Habitat: This species, as a rule, spends most of the year under stones, logs, in decaying stumps and in holes or burrows made by other animals. However, it has been known to remain in the water during the summer. It is voracious and carnivorous, eating worms, insects and at times small frogs. According to Metzdorff (Gadow, 1901, p. 113), the breeding season of *Ambystoma tigrinum* is from April to June and occasionally in December. Smith (1882, p. 721) states that "they have been observed in great numbers in the 'Cathole,' at Ann Arbor, Michigan, swimming vigorously on March 10th, and their eggs were found a few days later." The male enters the water and deposits spermatophores, which are

taken up into the cloaca of the female. The eggs are usually laid the day after fertilization, in masses containing from six to ten, and are attached to stems or leaves of water plants. The larvae emerge after an interval of about two weeks. The latter were

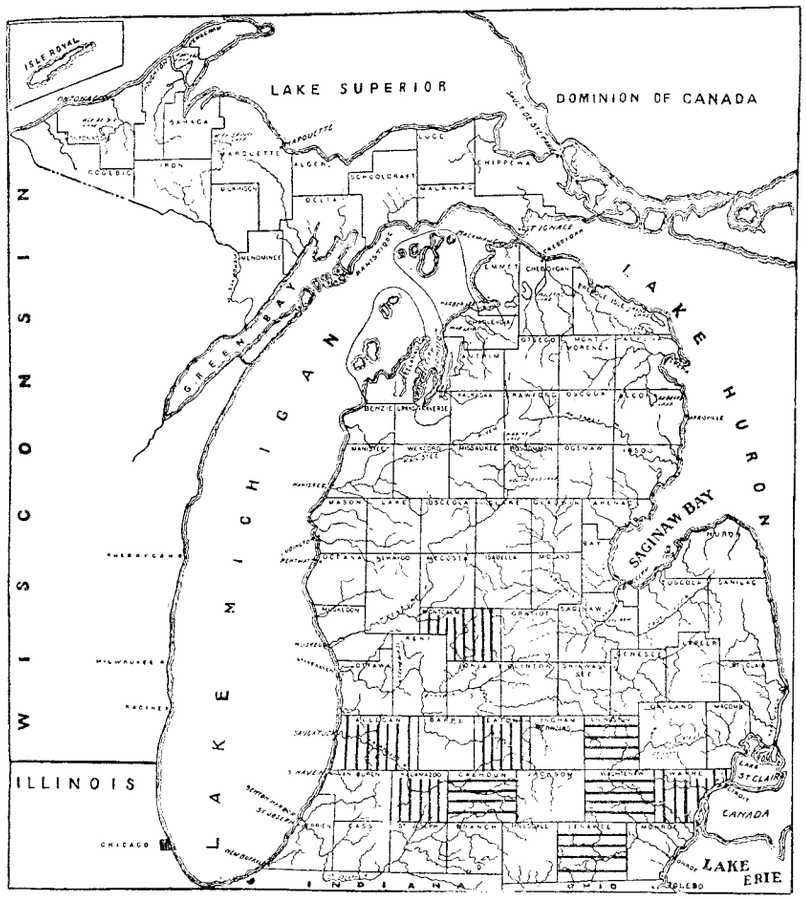

Fig. 4. Distribution of *Ambystoma tigrinum*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

formerly supposed to be a distinct species, "Axolotl", due to the fact that metamorphosis may be delayed and breeding take place during the larval stage. Under normal conditions, however, the adult form is reached in about one hundred days after hatching.

Distribution: Northeast to Minnesota and south. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Calhoun, Washtenaw, Lenawee and Livingston Counties. Reported from Wayne and Washtenaw Counties (Cope, 1889); Montcalm, Washtenaw, Kalamazoo, Eaton and Allegan Counties (Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1879; Smith, 1882).

AMBYSTOMA PUNCTATUM (Linnaeus).

SPOTTED SALAMANDER.

(Pl. II a.)

Description: Body short and stout. Head broad and slightly rounded, with parotid region greatly swollen. Eyes prominent, nares small. Gular fold prominent, connected by a ridge with another slight fold behind the eye. Eleven costal furrows and a slight dorsal groove. Limbs moderately developed; toes slightly depressed; plantar tubercles indistinct. Tail compressed, with a well marked indentation along each side. Skin smooth and glossy, surface pitted with mucous pores which are most prominent in the parotid region and on the tail. Transverse line of teeth in three patches, the central separated from laterals by slight interval at inner edges of posterior nares. Central patch may curve forward in the middle.

Ground color blue black or black with large yellow blotches arranged in a more or less irregular row on each side of vertebral column. Legs also spotted. Under surface paler than upper.

Measurements: Specimen No. 35787.

Total length	.145
Length of head and body	.081
Width of head	.0165

Habits and Habitat: Ambystoma punctatum is nocturnal in its habits and is found under logs and stones in damp, woody places. It resembles *Ambystoma tigrinum* in its food habits. When in the water the animal swims rapidly by means of the broad, flat tail. Like the other members of the genus, this species goes to the water to deposit its eggs. This migration to the ponds takes place in March or April. The males enter the ponds and deposit spermatophores on sticks and leaves just at the surface of the water. These spermatophores are small, white, mushroom-like bodies, the cap-shaped tops containing the sperm. Several are usually deposited in one place and fertilization probably takes place in the same manner as in *Ambystoma tigrinum*. After fertilization the eggs are laid in oval masses, the whole mass being embedded in gelatine. They are attached to some support in the water, either grass stems or small sticks. When hatched the young larvae are about half an

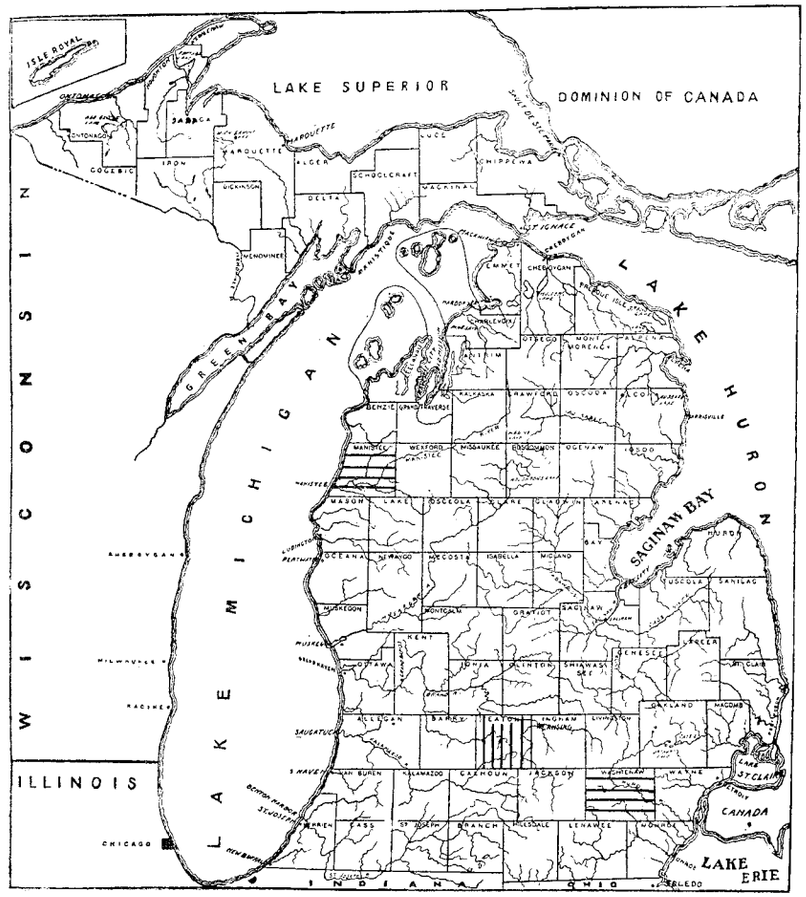

Fig. 5. Distribution of *Ambystoma punctatum*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

inch in length and metamorphosis does not occur until a length of about two inches has been reached.

Distribution: Nova Scotia to Nebraska, south to Georgia. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Manistee and Washtenaw Counties. Reported from Eaton County (Clark,

1902; Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1907; Smith, 1879).

AMBYSTOMA JEFFERSONIANUM (Green).

JEFFERSON'S SALAMANDER.

(Pl. II a.)

Description: Body long and slender. Head elongate and flat; eyes large and prominent; nares small, situated at end of snout; mouth large. Gular fold distinct, rising on sides of neck. Another fold extends across the throat from a point just behind the corner of the mouth and is met by a groove running from the corner of the eye. Twelve costal furrows and a dorsal groove. Limbs well developed; toes long, slender and much depressed; no plantar tubercles. Tail compressed and somewhat shorter than body. Skin smooth and covered with numerous pores which may be clearly seen under a lens. Teeth in four patches, the two central extending to the inner nares, where they are met by the two lateral patches which form the posterior border of the inner nares. Tongue large and thick.

Ground color bluish or brownish black above, paler below. Surface with or without pale blue spots.

Measurements: Specimen No. 37926.

Total length	.118
Length of head and body	.070
Width of head	.010

Habits and Habitat: *Ambystoma jeffersonianum* is secretive, and during the day is found in damp, dark places. It is usually found under logs and stones. It is extremely active, and, according to Gadow (1901, p. 111), a good climber, "easily escaping out of high-walled bell-glasses."

Little has been done on the breeding habits of this salamander. Smith (1911a, p. 19) states that the early spawning season "suggests the possibility of an autumnal fertilization." Hahn (1908, pp. 550-552) has taken the eggs in late segmentation stages on Feb. 28, at Mitchell, Ind., while Smith (1911a, p. 17) found the first eggs on April 5, at Syracuse, New York. They are laid in small grape-like masses that are usually hung on a leaf or stick. Piersol (1910) has found the number of eggs in a single mass to be about twenty. The hatching probably takes place in from thirteen to

eighteen days and transformation occurs some time during July or August.

This species resembles *Plethodon glutinosus,* which has been reported from Kent (Gibbs, Notestein and Clark, 1905), Wayne (Cope, 1889) and Marquette (Ruthven, 1906) Counties. However,

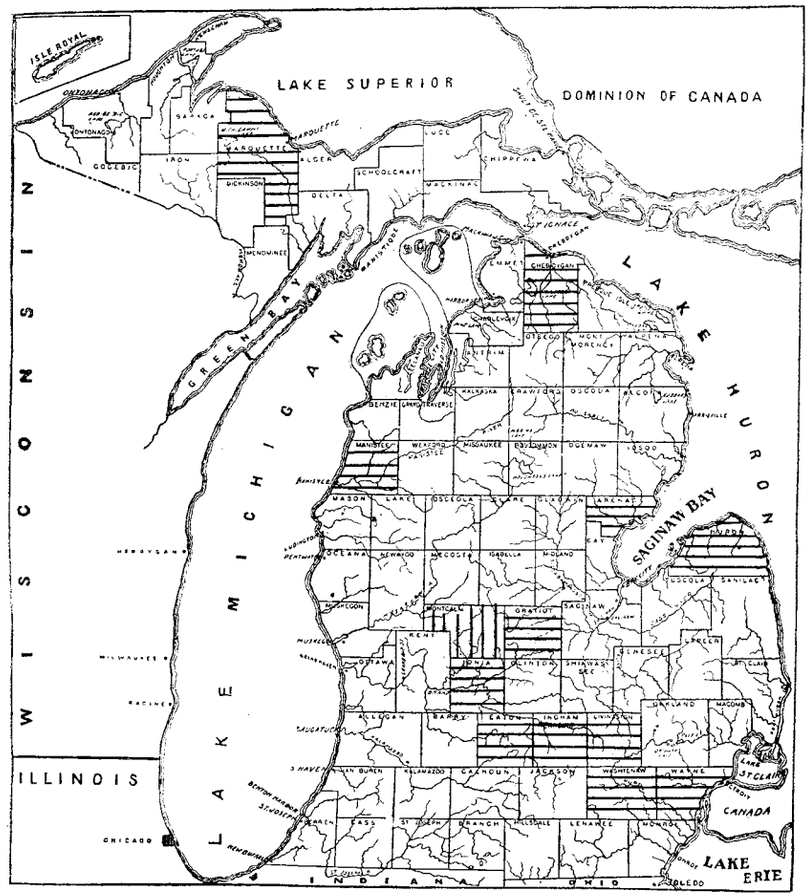

Fig. 6. Distribution of *Ambystoma jeffersonianum.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

the specimens listed from Wayne and Marquette Counties are in the University Museum and have been re-identified as *Ambystoma jeffersonianum.* The two species may be distinguished by the fact that the parasphenoid teeth are present in *Plethodon glutinosus* and absent in *Ambystoma jeffersonianum.* We have not seen specimens of the former from the state.

Distribution: Pennsylvania to Virginia and north to Canada. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Marquette, Cheboygan, Manistee, Arenac (Charity Island), Huron, Ionia, Ingham, Livingston, Wayne and Washtenaw Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Eaton County (Clark, 1902); Eaton and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Washtenaw County (Smith, 1879); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a).

PLETHODON ERYTHRONOTUS (Green).

RED-BACKED SALAMANDER.

(Pls. I, IIb.)

Description: Body long, slender and cylindrical. Head small; mouth very large, upper jaw slightly protruding; eyes large; nares small and situated laterally. Gular fold prominent, reaching up to the dorsal stripe and met there by a groove running from the corner of the eye. This groove is in turn bisected by a groove extending upward from the corner of the mouth. Costal folds distinct; the number varying from sixteen to nineteen. A distinct dorsal groove. Limbs extremely slender, inner toes rudimentary. Tail cylindrical. Vomero-palatine teeth extending backward in two converging rows. Parasphenoid teeth in two patches behind the nares.

Color brownish black on sides, usually with a broad ashy or red dorsal stripe which is mottled with brown. Under surface yellowish, also mottled with a darker color.

Measurements: Specimen No. 35804.

Total length	.089
Length of head and body	.045
Width of head	.005

Habits and Habitat: The red-backed salamander is entirely terrestrial in its habits. It is usually found under rocks and in decaying logs in moist, woody places and occasionally on low shrubs and plants. It is very active, the adult disappearing rapidly and hiding under leaves and moss when disturbed, unless accompanied by its young. The food consists mainly of insects, larvae, small snails and worms, which are caught by means of the projectile tongue.

The eggs are found in grape-like bunches of from six to eleven attached to the under surface of stones or the bark of decaying trees and are brooded by the female. They are laid, according to Hahn (1908), in May, but have not been found at Ann Arbor until June (Smith, 1882). The writers took eggs in a late stage of development at Port Austin, Huron County, Aug. 5, 1911. The larvae, which are at first provided with branchiae, are usually found with the parents and are apparently fed by them. When young the animal is very light in color, growing darker with age.

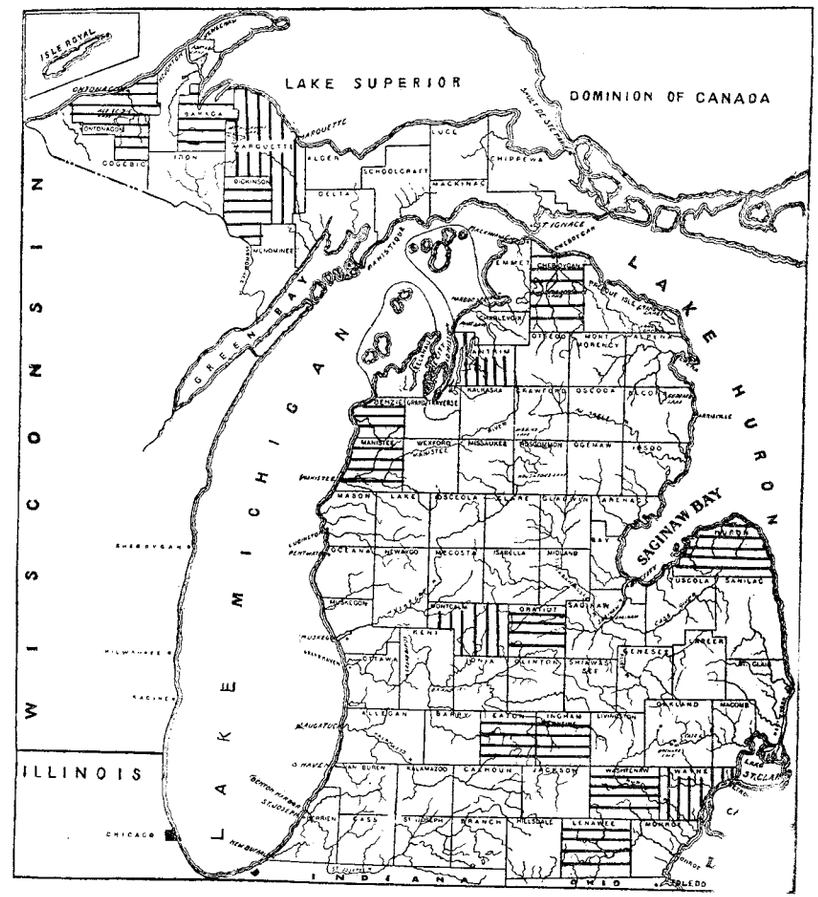

Fig. 7. Distribution of *Plethodon erythronotus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Prof. Cope (1889) recognizes two sub-species of Plethodon, *P.*

cinereus and *P. cinereus* var. *erythronotus*, which have both been reported from Michigan. There are no apparent differences in structure, proportions and general character between these two forms. The distinction is entirely one of color, *erythronotus* having a red dorsal stripe, *cinereus* an ashy one. Also, the writers have found the two varieties in the same region, and not infrequently in one log. Without doubt the differences in color are only individual.

Distribution: Eastern United States. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Ontonagon, Baraga, Dickinson, Cheboygan, Benzie, Manistee, Huron, Ingham, Washtenaw and Lenawee Counties. The writers have also examined specimens from Gratiot and Eaton Counties. Reported from Eaton County (Clark, 1902); Wayne County (Cope, 1889); Eaton, Montcalm and Antrim Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Ontonagon, Baraga and Marquette Counties (Ruthven, 1906); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879; Smith, 1882).

HEMIDACTYLIUM SCUTATUM (Schlegel).

FOUR-TOED SALAMANDER.

(Pl. I.)

Description: Body short and cylindrical. Head broad, muzzle blunt, upper jaw projecting over lower. Eyes large. Gular fold distinct but not prominent, and rising on the sides of the neck. Another depression extending from the eye to the gular fold. Skin with slight depressions that give it a scuted appearance. Thirteen distinct but not prominent costal grooves. A dorsal groove and a slight depression extending along the sides from limb to limb. This lateral depression forks anteriorly and sends out a branch to the middle of the head between the eyes. Limbs very slender but well developed. Toes four in number, the inner toe and inner and outer fingers rudimentary; third toe the longest. Tail very long, separated from body by a distinct depression, slightly compressed, large at base and tapering gradually to a point. Vomero-palatine teeth in two series just behind internal nares. Parasphenoidal patches distinctly separated. Tongue attached anteriorly, and slightly free posteriorly.

Ground color dark brown, spotted with darker color, and becoming dark gray on the sides. Limbs, snout and tail lighter in color than back, and blotched with dark above. Small light spot on shoulder just above arm.

Measurements: Specimen No. 4240.

Total length	.067
Length of head and body	.031
Width of head	.005

Habits and Habitat: The four-toed salamander is a rare species

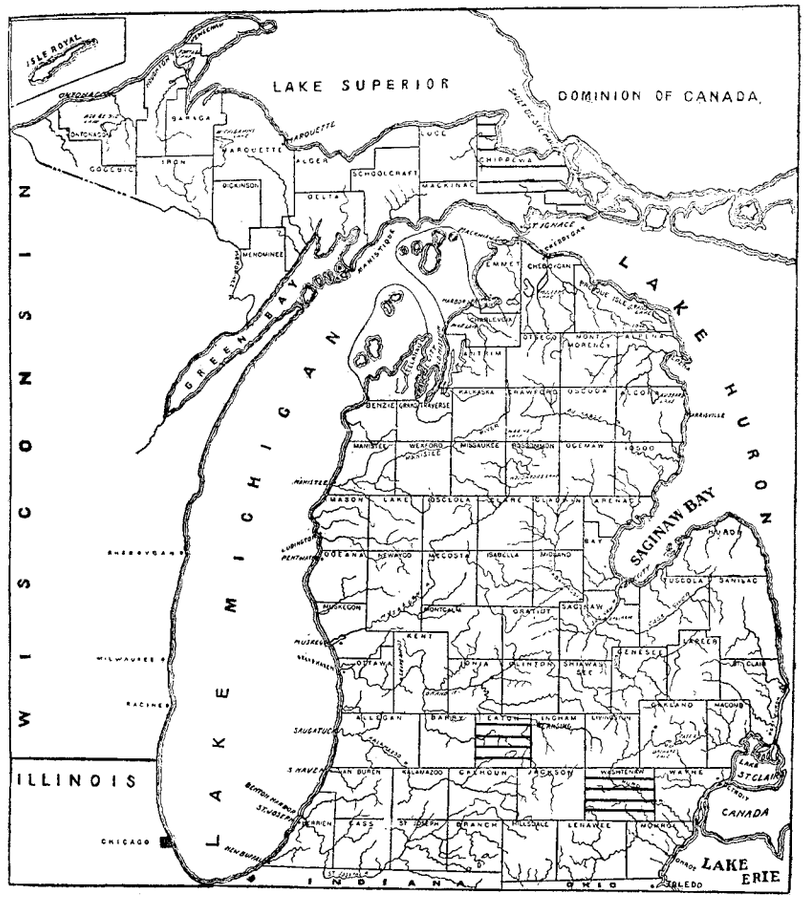

Fig. 8. Distribution of *Hemidactylium scutatum*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

in Michigan, having been found in only three counties in the state. Clark (1902) reports five specimens, which have been examined by the writers, from Eaton County as follows: "A single specimen of this uncommon salamander was collected May 13, 1901. It was found in the earth on the roots of a violet, which had been pulled up. So far as I can learn, it has not previously been collected in

Michigan. Four other specimens, two males and two females, were taken together in April, 1902, under a log. The females were fully twice as large as the males." There are at present three live specimens in the University of Michigan Museum. One of these was taken in a woods about five miles south of Ann Arbor during the summer of 1910, and was presented to the Museum by Miss Jessie Phelps. The other two specimens were taken by the writers in the same woods in April, 1911. A single specimen was collected by N. A. Wood at White Fish Point, Chippewa County in August, 1912.

Very little is known of the habits of this salamander. Smith (1882, p. 723) states that "it has been found in April under old logs and rails in open woods, at some distance from the water, and was very quick and lively in its movements." The woods in which the Washtenaw County specimens were taken is low and damp. One was found under loose moss and one was just inside the bark of a rotten stump. The movements are lively and erratic, the animal sometimes jumping for some distance. The food probably consists of insects and worms, the writers have observed it to eat small flies in captivity. The eggs are laid under moss or bark, and the salamander, at least in the adult condition, avoids the water. Individuals sometimes emit a sharp squeal when annoyed.

Distribution: From Massachusetts and Canada westward to Illinois and south to Georgia. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Washtenaw and Chippewa Counties. Reported from Eaton County (Clark, 1902; Gibbs, Notestein and Clark, 1905); Washtenaw County (Ruthven, 1911).

DIEMICTYLUS VIRIDESCENS Rafinesque.

GREEN NEWT.

(Pls. I, II a.)

Description: Body slender and slightly compressed. Muzzle rounded; upper jaw extending a little beyond the lower; eyes large; exterior nares close together. Limbs slender, anterior about half the size of the posterior. First finger and first and fifth toes rudimentary. Tail much compressed and as long, if not longer, than the head and body. Skin finely wrinkled; costal grooves indistinct. On either side of the head below the eye there may be a row of four pits, but these are frequently lacking. Vomero-palatine teeth in two longitudinal rows which converge close to the internal

nares. Tongue attached posteriorly and anteriorly but free on the sides.

Ground color varies from reddish brown to olive green above; lower surface pale yellow. Body covered with small black spots especially noticeable on the lower surface because of the lighter ground color. On either side of the vertebral line a row of small red spots, each having a black border.

Measurements: Specimen No. 37937.

Total length	.100
Length of head and body	.048
Width of head	.008

Habits and Habitat: This newt is aquatic in its habits, the adult spending most of its time in the water. It frequents places with a soft bottom and hides under leaves and water plants. In large ponds it is usually found in the more sheltered places. It is carnivorous in food habit and extremely voracious. The food consists chiefly of water insects, small molluscs, worms and tadpoles. When kept in captivity the animal becomes very tame and will readily eat small pieces of meat, worms and small tadpoles. It sometimes emits a sharp squeak when disturbed. The breeding season extends from April to June. During this season the genital openings of the male become swollen, and transverse horny plates appear on the posterior surface of the hind limbs and on the under side of the tips of the toes. A spotted crest also appears along the upper and lower sides of the tail. The male deposits spermatophores similar to those of *Ambystoma punctatum* except that they are fewer in number. In order to insure the fertilization of the eggs there is a preliminary "Liebes spiel". The eggs are laid singly between the leaves of water plants or in other like situations. According to Jordan (1893), the egg laying season for one individual lasts about seven or eight weeks. The young larvae hatch after a period of about thirty days. After the gills are absorbed, the young animal leaves the water and the color changes to a dark red. This stage was formerly considered a distinct species and called *D. miniatus;* careful observation, however, has shown that, after the first two or three years of its life, the animal returns to the water and assumes the adult viridescent coloration.

Distribution: Eastern United States, abundant north and northeast. (Jordan, 1899.)

Michigan: Specimens in the University Museum from Houghton,

Fig. 9. Distribution of *Diemictylus viridescens*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

Marquette, Cheboygan, Huron, Arenac (Charity Island), Ionia and Washtenaw Counties. The writers have also examined specimens from Eaton County. Reported from Eaton County (Clark, 1902; Gibbs, Notestein and Clark, 1905); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879).

BUFO AMERICANUS Le Conte.

AMERICAN TOAD.

(Pl. IIIa.)

Description: Body short and depressed. Head very broad, upper jaw protruding slightly and notched in the center. Eyes large. Parotid glands large and kidney shaped. Fronto-parietal crests extend back between the eyes and are joined at right angles by the post-orbital crests which extend back of the eyes to a point above the ears. Skin conspicuously warty above; under surface granulated. Toes partly webbed. Two dark-colored metatarsal tubercles, the outer small, the inner with a cutting edge. Jaws without teeth.

Ground color varies from grayish to brownish black, with large irrgular spots of dark brown which show more plainly on the specimens which are lighter in color. There is frequently a light vertebral stripe. Under surface a dusky lemon color, sometimes with smaller irregular blotches of dark brown. Throat of male black.

Measurements: Specimen No. 30114.

Length of head and body	.0845
Length of hind limb to heel	.0565
Width of head	.032

Habits and Habitat: The common American toad is our best known amphibian. This is due to its abundance and to the fact that it is common in gardens and around houses so that it is frequently seen. It appears with the first warm spring days and is found in shaded places until fall, when it burrows into the ground and hibernates until spring. It is nocturnal in habit, coming out in the dusk of evening to search for food, which consists mostly of insects and their larvae. During the day it sits in its burrow, which it makes by backing into the soft earth or dense vegetation, and sleeps. It is so protectively colored that it is usually very hard to distinguish from the clods of earth or the background of partially shaded vegetation in its usual haunts.

The popular belief that toads are poisonous is erroneous. On the contrary they are very beneficial to man, since about 88% of their food consists of garden pests. They may at times, especially when roughly handled, excrete a colorless, odorless and harmless fluid from the skin, which makes them somewhat moist. There is also an excretion from the parotid gland region, and this is slightly

poisonous if taken internally. The latter affects the mucous membrane of the mouth and protects the toad when seized by dogs and other enemies.

The breeding season lasts from April to July. The first specimen observed by the writers in 1911 was found on the evening of April

Fig. 10. Distribution of *Bufo americanus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

26, and the next day large numbers were seen on their way to the ponds. The males seem to outnumber the females and struggle together for their possession. When disturbed, the male utters a peculiar chirping sound somewhat like the scolding of a chicken. The song consists of a sweet high trill that is bird-like in its quality.

The eggs are laid in the water in two very long strands each consisting of a row of eggs embedded in a gelatinous mass. They hatch in about four days, and the larvae remain in the water until the final metamorphosis which occurs in July. The toad does not start breeding until it is about four years old, and it may live for many years. Miss Dickerson tells of one that lived for thirty-six years and then was killed by an accident.

Distribution: Eastern North America, west to Arizona and Mexico. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Baraga, Ontonagon, Dickinson, Cheboygan, Crawford, Oceana, Arenac (Charity Island), Huron, Ingham, Washtenaw, Barry, Allegan and Cass Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Ontonagon County (Cope, 1889); Eaton, Kalamazoo, Washtenaw and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Ontonagon County (Ruthven, 1904a); Keweenaw (Isle Royale), Ontonagon, Baraga and Marquette Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

HYLA VERSICOLOR Le Conte.

COMMON TREE FROG.

(Pl. III b.)

Description: Form toad like. Muzzle blunt in outline. Eyes prominent. Toes webbed nearly to tips; fingers and toes with large adhesive disks. Upper surface of body slightly warty. Lower surface granulated. A large fold of skin across the chest. Vomeropalatine teeth in two patches just behind internal nares. Tongue very large and fleshy, slightly notched behind.

Ground color gray, green or brown with irregular dark blotches. A large irregular dark star on upper part of back. Limbs barred with dark brown. A dark ear patch and a light spot under the eye. Under parts pale yellow, brighter posteriorly. Throat sometimes mottled with darker. Concealed leg surfaces vermiculated with brown.

Measurements: Specimen No. 30805.

Length of head and body	.044
Length of hind limb to heel	.0375
Width of head	.0165

Habits and Habitat: The common tree frog, or tree toad as it is frequently called, is the most familiar of our Hylidae. It lives for the most part in trees, bushes and vines. It is not confined to the woods alone but lives also in orchards and in the vines around

Fig. 11. Distribution of *Hyla versicolor.*
Horizontal ruling, specimens examined; verical ruling, reports only.

houses. The large size of the disks on the fingers and toes allow it to cling to smooth vertical surfaces and enable it to catch and hold to branches when it climbs from place to place among the trees and bushes. It is more active toward night when it is searching for food. The latter consists of insects and larvae, found on the tree in whose leafy branches it makes its home. In the winter it

hibernates in hollows of trees or in the moss at their roots. This species has the power of changing its color, although the change is not rapid. There is a range of colors from very light yellow and green to dark brown and green. The color, under ordinary circumstances, corresponds with that of the object on which the frog is resting. The eggs are laid in May, in small groups or singly. They are attached to water plants or grass stems and hatch in about forty-eight hours. After hatching, the development is rapid, the final metamorphosis taking place in about seven weeks.

Distribution: Canada, south to Texas and Kansas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Dickinson, Cheboygan, Oceana, Huron, Livingston, Oakland, Washtenaw, Wayne and Cass Counties. Reported from Eaton County (Clark, 1902); Washtenaw and Wayne Counties (Cope, 1889); Eaton, Montcalm, Kent, Ottawa, Barry and Van Buren Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Marquette County (Ruthven, 1906); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

HYLA PICKERINGII Holbrook.

SPRING PEEPER.

(Pl. III b.)

Description: Body short and stout. Muzzle pointed, upper jaw extending beyond lower. Ears small. Feet moderately webbed, disks relatively large. Under surface granulated. A fold of skin across the chest. Vomero-palatine teeth in two patches behind internal nares. Tongue large, slightly notched, and free behind.

Ground color varies from light to dark brown. A dark V between the eyes and a large oblique dark cross on the back. Limbs indefinitely barred with darker. A dark band from the snout through the eye to the side. Under surface pale yellow, granulated, darker posteriorly. Usually darker blotches on throat and chest.

Measurements: Specimen No. 37906.

Length of head and body	.021
Length of hind limb to heel	.0155
Width of head	.0065

Habits and Habitat: The spring peeper is the smallest of the Hylidae. During the summer it may be found among fallen leaves

and moss in damp places, the color being admirably adapted for concealment in such situations. Its search for food, which consists mainly of small insects and worms, may frequently take it to gardens and orchards, and it has even been found in greenhouses.

Fig. 12. Distribution of *Hyla pickeringii*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

During the winter months it hibernates under the moss and leaves or in hollow trees. The breeding season begins early and lasts until May. The frogs sing in chorus and their bird-like call is one of the most familiar sounds of spring. The male croaks when hidden under moss or grass. The eggs are laid in April, usually singly, though occasionally in small masses, and are attached to water

plants. They are very small, "so small that they look like tiny plant seeds" (Dickerson, 1906, p. 145). The time of development varies from six to twelve days according to the temperature, and metamorphosis takes place in about two months after hatching, the little tadpoles usually leaving the water before the transformation is completed.

Distribution: Eastern North America, Canada to South Carolina. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Dickinson, Houghton, Baraga, Huron, Washtenaw, Cass and St. Joseph Counties. Reported from Eaton County (Clark, 1902); Wayne and Washtenaw Counties (Cope, 1889); Van Buren, Eaton, Kalamazoo, Antrim and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Ontonagon, Baraga, and Houghton Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

ACRIS GRYLLUS Le Conte.

CRICKET FROG.

Description: Form frog like. Muzzle very long and pointed. Disks on fingers and toes small, scarcely noticeable. Toes webbed almost to tips. Sole tubercles moderate in size. Skin above with numerous conspicuous smooth warts. Under surface slightly granulated posteriorly. A fold of skin across the chest. Vomerine teeth in two patches between internal nares. Tongue attached in front and along mid-line.

Ground color variable, usually brown or green with a dark triangular mark between the eyes. Three oblique blotches on the sides. Limbs barred or spotted with dark. A light line from eye to arm. Upper lip light spotted with darker. Concealed surface of femur with a longitudinal dark stripe. Under surface yellowish white, throat mottled with darker. Coloration of male may be so dark that markings do not show.

Measurements: Specimen No. 30473.

Length of head and body	.024
Length of hind limb to heel	.025
Width of head	.0085

Habits and Habitat: The cricket frog is a tree frog that is en-

tirely terrestrial in its habits. It is unable to climb trees because of the extreme smallness of the disks on its fingers and toes, and its agility and ability to accomplish rapid changes in coloration are probably its principal protection from enemies. It is usually found

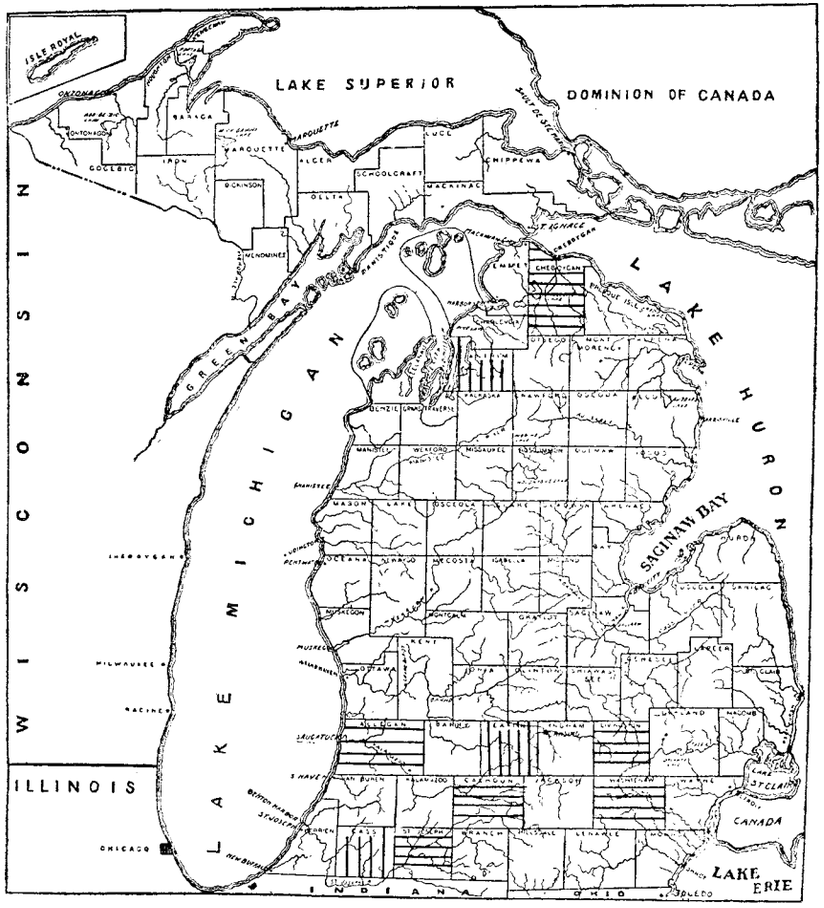

Fig. 13. Distribution of *Acris gryllus*.
Horizontal ruling, specimens examined: vertical ruling, reports only.

in large numbers along the banks of streams or ponds. When disturbed it jumps into the water with a series of high leaps and buries itself in the mud, from which it soon emerges. This species hibernates during the cold weather but soon becomes active again during warm periods. The food consists of small insects. These frogs sing in chorus during the months of April and May and the

isolated call may be heard all summer. The song resembles the chirping of a cricket, hence the common name, cricket frog. The eggs are laid in April or May. The development is rather slower than that of the rest of the Hylidae. Miss Dickerson has found the tadpoles in the water in August and thinks that metamorphosis takes place in September.

Distribution: New York to Florida, west to Texas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Cheboygan, Livingston, Washtenaw, Calhoun, Allegan and St. Joseph Counties. Reported from Eaton County (Clark, 1902); Antrim and Eaton Counties (Gibbs, Notestein and Clark, 1905); Cass County (Thompson, 1911).

CHOROPHILUS NIGRITUS (Le Conte).

SWAMP TREE FROG.

(Pl. IV a.)

Description: Body frog like. Head long and pointed; upper jaw protruding. Eyes prominent. Toes slightly webbed; disks small, hardly noticeable. A conspicuous fold across chest. Skin granulated on back and lower surface. Vomero-palatine teeth near the posterior part of internal nares. Tongue medium in size.

Ground color changeable, varying from light to dark brown. A dark stripe begins at the snout and runs back through the eye to the posterior part of the body. Upper lip with a light stripe and bordered with dark. Usually three dark longitudinal stripes on the back; center stripe on the vertebral line and sometimes forking posteriorly and behind the eyes. Limbs indistinctly barred or spotted. Under surface yellowish white. Throat of male yellow.

Measurements: Specimen No. 37921.

Length of head and body	.017
Length of hind limb to heel	.015
Width of head	.006

Habits and Habitat: The swamp tree frog is found in marshes and damp places throughout the summer and fall. During this time it is solitary and its call is rarely heard. It is also seldom seen because of the small size and protective coloration. When disturbed it disappears in the water, but it is a very poor swimmer

and soon comes back to land. This species is probably, like *Acris gryllus,* unable to climb trees because of the small size of the disks on the fingers and toes. The food consists of small insects. It comes from its hibernation early. The song is very loud. When

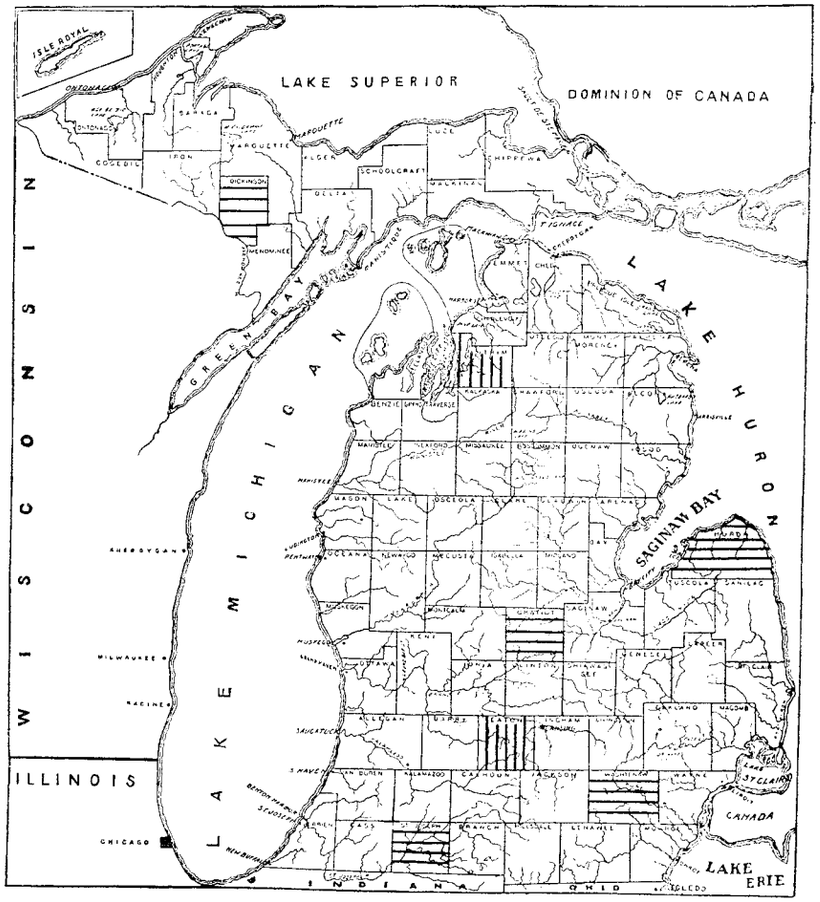

Fig. 14. Distribution of *Chorophilus n gritus.*
Horizontal ruling, specimens examined: vertical ruling, reports only.

croaking, the male sits upright in the water, supporting himself with grass, leaves or twigs, and sings with the head and vocal pouch out of the water. When disturbed, he sits perfectly still and does not resume his song until the source of alarm has passed. The eggs are laid in March or April in small masses containing from five to twenty, and are attached to water plants. The devolopment

is rapid, the eggs hatching in about two weeks. Metamorphosis is completed early in June.

Distribution: Entire United States and north in Canada to the Hudson Bay region. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Dickinson, Huron, Washtenaw and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Antrim and Eaton Counties (Gibbs, Notestein and Clark, 1905); Huron County (Ruthven, 1911a).

RANA PIPIENS Shreber.

LEOPARD FROG.

(Pl. IV b.)

Description: Body long and slender. Head long and pointed at the snout. Lateral folds prominent; there may be several smaller folds between them. Skin smooth above; under surface of thighs slightly granular. A glandular fold extending from corner of mouth over the shoulder. Legs long and very powerful; feet partly webbed, webs deeply indented. Tubercles under joints of toes prominent. Vomerine teeth in two patches between internal nares.

Ground color green, gray or brown above. Lateral folds lighter; between them two irregular rows of rounded dark spots edged with lighter. Several rows of smaller rounded spots below lateral folds. Under surface yellowish white, frequently with dark spots across pectoral region. A dark line extending from muzzle to shoulder through eye; light lines above and below the darker line make the latter more noticeable. Upper surfaces of limbs transversely barred or blotched with darker. Concealed surface of femur vermiculated with brown.

Measurements: Specimen No. 37869.

Length of head and body	.087
Length of hind limb to heel	.077
Width of head	.022

Habits and Habitat: The leopard frog is the best known of the Ranidae, because of its great numbers and its habit of travelling away from the ponds into the fields in search of food. Its green coloring probably serves as a protection from its enemies. The leopard frog also possesses the power of changing the ground color to a limited degree to suit the surroundings. When kept in the lab-

oratory in a dish containing moss, brown specimens turn green in a few days. The food consists of worms, insects and small frogs. It becomes very tame in captivity and may be easily handled. Like the rest of the Ranidae, the species hibernates during the cold weather

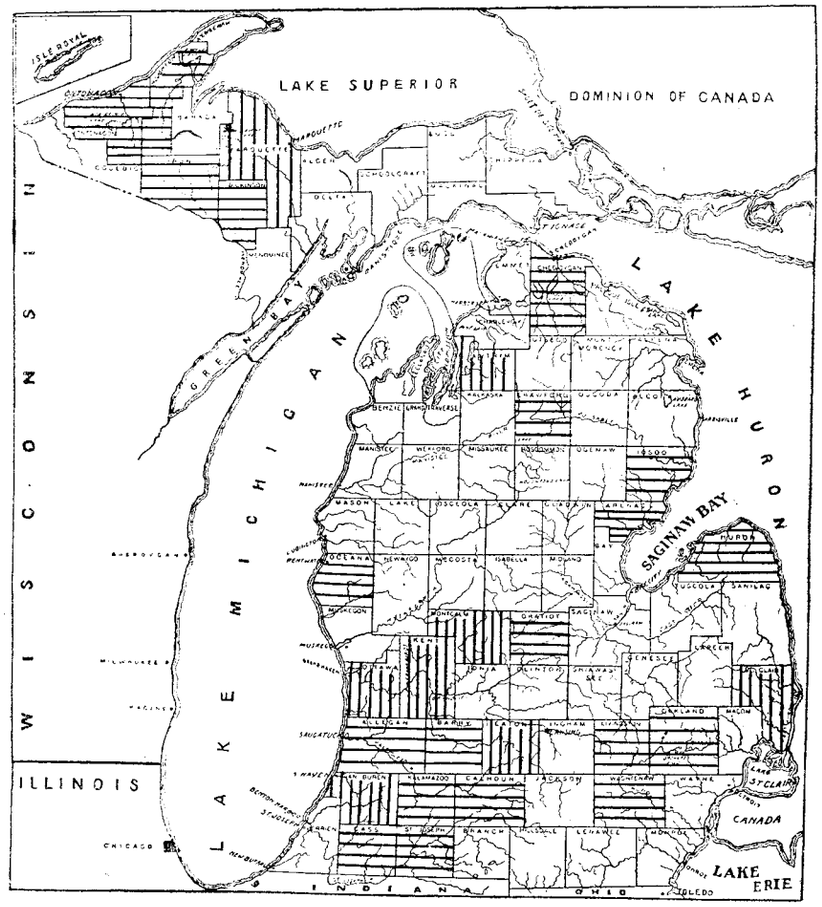

Fig. 15. Distribution of *Rana pipiens*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

in the mud and under stones, but, according to Hay (1892a, p. 66), its note may be heard "during the warmer days of midwinter," and it is often seen at such times.

This frog is one of the first to appear in the spring, the breeding season being in March and April. When it first appears it is almost black in color, but soon becomes lighter. The eggs are laid in

the shallow water of ponds in large masses which may float freely in the water but are usually attached to sticks or plants. Hankinson (1908) found unsegmented eggs, which had evidently been recently deposited, in Oakland County, April 8, 1907. The time of hatching varies according to temperature, but under ordinary conditions the tadpole will appear in about ten days. The metamorphosis is completed in July or August and it is for this reason that this species is more apt to be raised than *Rana catesbeana* by dealers. Its legs are esteemed as an article of food, and it is also reared or collected in considerable numbers to supply biological laboratories.

Distribution: Common in North America, east of Sierra Nevada Mountains. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Houghton, Ontonagon, Iron, Dickinson, Cheboygan, Crawford, Iosco, Arenac (Charity Island), Huron, Oceana, Barry, Oakland, Livingston, Washtenaw, Allegan, Calhoun, Kalamazoo, Cass and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); St. Clair County (Cope, 1889); Eaton, Van Buren, St. Joseph, Montcalm, Kent, Ottawa, Antrim, Kalamazoo and Barry Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Ontonagon County (Ruthven, 1904a); Ontonagon, Houghton and Marquette Counties (Ruthven, 1906); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

RANA PALUSTRIS Le Conte.

PICKEREL FROG.

(Pl. IV b.)

Description: Body slender. Lateral fold very broad but not elevated. Skin more or less smooth. Under surface of thighs slightly granular. Eyes prominent. Glandular fold from eye to shoulder. No external vocal pouch.

Ground color always some shade of brown, with two rows of more or less square spots of dark brown between the lateral folds, and two rows of smaller brown spots beneath. Lateral folds lighter than ground color. Under surface white anteriorly, bright yellow posteriorly. The yellow may extend along the sides and out under the fore arms. A conspicuous light line from eye to shoulder. Upper surface of limbs barred with brown. Jaws marked as in *R. pipiens*. A brown spot on the snout and one above each eye.

Measurements: Specimen No. 41911.

Length of head and body	.070
Length of hind limb to heel	.061
Width of head	.019

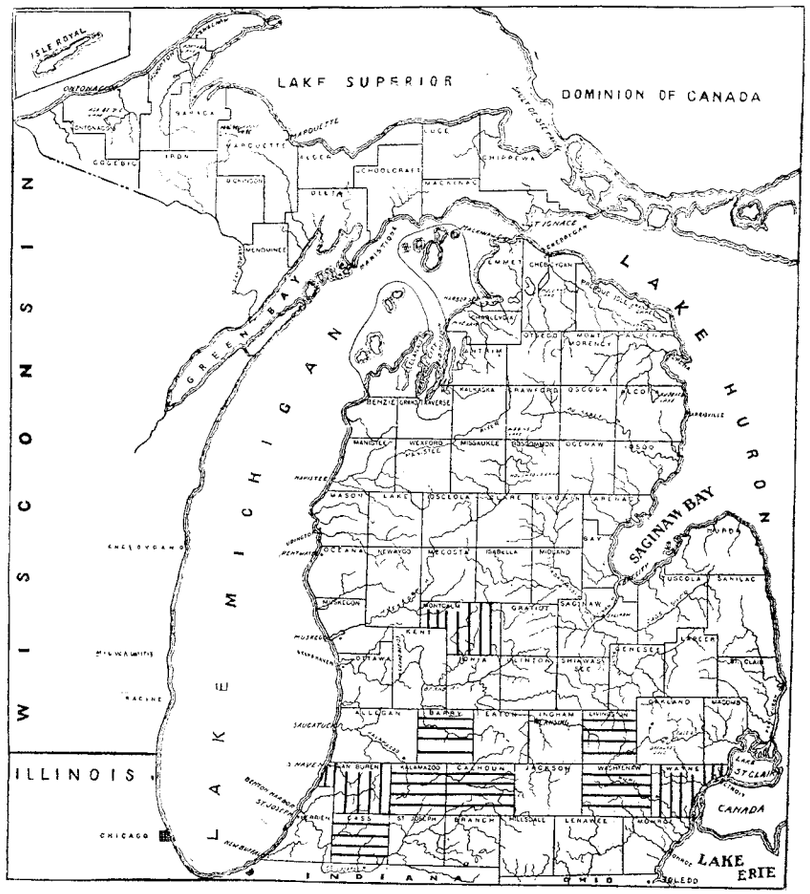

Fig. 16. Distribution of *Rana palustris*.
Horizontal ruling, specimens examined: vertical ruling, reports only.

Habits and Habitat: In habits *Rana palustris* closely resembles *Rana pipiens*. It lives along streams, ditches, about cold springs and ponds, and is very hard to capture because of its great agility and its protective coloration. When resting on a pile of dried leaves, such as is often found along the banks of streams or ponds,

it is almost impossible to distinguish the frog from its surroundings. When frightened it makes several long leaps in quick succession. The food probably consist of insects, small crustacea and snails. The common name "pickerel frog" is due to the fact that the species is frequently used as bait in pickerel fishing. It is of no food value because of the disagreeable odor.

The breeding season of *Rana palustris* is April and May. The croaking of the males is said to resemble the sound made by the tearing of coarse cloth. The eggs are laid during May and the early development is rapid. The metamorphosis usually takes place in July or August, but under adverse conditions transformation may be delayed until the next year.

Distribution: Eastern North America, north to Hudson's Bay and west to the Great Plains. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Washtenaw, Barry, Calhoun, Kalamazoo, Livingston and Cass Counties. Reported from Wayne County (Cope, 1889); Wayne, Kalamazoo, Montcalm and Van Buren Counties (Gibbs, Notestein and Clark, 1905); Ontonagon County (Ruthven, 1904a); Washtenaw County (Smith, 1879); Cass County (Thompson, 1911).

This species has been reported from Michigan by several writers, but until this year there were, with the exception of one from Livingston County, no specimens in the University Museum. The writers have found it to be rather common in the vicinity of Ann Arbor, and have taken it in Kalamazoo and Calhoun Counties and in large numbers in Cass County (Thompson, 1911), and have received two specimens collected by Miss Jessie McNall in Barry County, so that the species is without doubt quite common throughout the southern part of the southern peninsula. The Ontonagon record is erroneous and the other records need to be verified for the species is easily confused with *R. pipiens*.

RANA CLAMITANS Latreille.

GREEN FROG.

(Pl. V.)

Description: Body stout. Head thick, muzzle pointed. Eyes large and close together. Skin of back rough. Back of femur granulated. Lateral folds conspicuous. Toes broadly webbed, leaving last two joints of fourth toe free. Tubercles on joints of toes and inner sole tubercles distinct. Ear of male larger than eye. Vomerine teeth in two patches between or behind the internal nares.

Ground color variable, usually brownish green with small dark spots. Head and shoulders bright green. Sometimes a light band, widening anteriorly, from shoulder to jaw. Limbs barred with darker. Posterior part of femur finely vermiculated with brown. Under surface yellowish white, throat of female spotted.

Measurements: Specimen No. 36827.

Length of head and body	.079
Length of hind limb to heel	.062
Width of head	.028

Habits and Habitat: The green frog is thoroughly aquatic in its habits, never travelling far from the water. It may be found along the edge of small streams, pools and cold springs. It is rather solitary and timid, when frightened disappearing quickly in the water. It is very much like the bullfrog in appearance and habits, but may be readily distinguished by the lateral folds and the smaller webs on the feet. The food consists of insect larvae, small crustaceans, small frogs and insects. It comes early from hibernation. The song, which is low pitched and explosive in character, is usually heard in March. The eggs are laid in April, in large masses supported in the water by twigs or water plants. The early development is rapid, but metamorphosis is delayed till the second summer and sometimes the third. Hay (1892a) states that the tadpoles are vegetarians and never carnivorous.

Distribution: Common throughout eastern North America, including Canada and Florida. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Baraga, Ontonagon, Houghton, Dickinson, Cheboygan, Crawford, Alcona, Iosco, Arenac (Charity Island), Huron, Oceana, Barry, Livingston, Oakland, Wayne, Washtenaw, Cass and St. Joseph Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); St. Clair and Wayne Counties (Cope, 1889); Eaton, Van Buren, Antrim, Kalamazoo and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Oakland County (Hankinson, 1908); Lenawee County (Kirsch, 1895); Baraga and Ontonagon Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Cass County (Thompson, 1911).

Fig. 17. Distribution of *Rana clamitans*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

RANA CANTABRIGENSIS Baird.

WOOD FROG.

(Pl. IV a.)

Description: Body slender, muzzle pointed. Upper surface slightly granulated; posterior surface of femur granular. Lateral folds conspicuous. Toes long and slender, webbed almost to the tip. Inner sole tubercle present. Vomerine teeth in two patches between or behind internal nares.

Ground color varies from light to reddish and dark brown. Tri-

angular dark spot back of eye covering ear. Light line along upper jaw reaching to shoulder. Limbs barred. Sides may be obscurely spotted with dark. Concealed surface of femur vermiculated. Under surface yellowish white, sometimes mottled with dark.

Fig. 18. Distribution of *Rana cantabrigensis.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

Measurements:. Specimen No. 34243.

Length of head and body	.039
Length of hind limb to heel	.032
Width of head	.014

Habits and Habitat: The northern wood frog, *Rana cantabrigensis,* is one of the most terrestrial of our frogs and is usually found in thick, wooded places, among dead leaves or moss. It is very difficult to see because of the protective coloration, the dark brown or grayish coloring blending into the surroundings to such an extent that one may almost step on individuals before seeing them, and the black ear patch and the light line along the side of the head also seem to be protective. When disturbed the frog is very active, leaping quickly away. It becomes very tame in captivity. The wood frog is among the first of the Ranidae to come out in the spring. The hoarse clacking song of the males may be heard during the latter part of March and early in April. The male has no external vocal pouch, but the throat and the parts of the body over the lungs expand. Unlike the males of other species, he floats or swims in the water while croaking. The eggs are laid in ponds, either in the woods or fields, in masses which are usually attached to water plants. They are very small and are surrounded by a gelatinous envelope. The time of development varies greatly according to temperature. Eggs brought into the laboratory hatch in four days, but the development of those left in the ponds is much slower. Metamorphosis usually takes place some time during May or June. The young tadpoles are very carnivorous, living mostly on decaying animal matter in the ponds.

Distribution: Northern. "Reported from Illinois, Michigan, Wisconsin and Minnesota northward to Great Slave Lake on the west and St. James Bay on the east." (Dickerson, 1906, p. 212.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Baraga, Dickinson, Mackinac, Cheboygan, Iosco, Huron, Livingston and Washtenaw Counties. The writers have also examined specimens from Gratiot County. Reported from Eaton County (Clark, 1902); Eaton, Kalamazoo, Antrim, Van Buren and Montcalm Counties (Gibbs, Notestein and Clark, 1905); Lenawee County (Kirsch, 1895); Ontonagon County (Ruthven, 1904a); Keweenaw (Isle Royale), Baraga and Ontonagon Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a).

RANA SEPTENTRIONALIS Baird.

NORTHERN FROG.

Description: Body stout. Head rounded, narrow in front. Eyes large and close together. Skin smooth, slightly granulated on sides and posterior part of femur. Feet fully webbed. Inner sole tuber-

cle large with cutting edge. Vomerine teeth in two patches just behind internal nares.

Ground color light olive brown, usually with large dark brown blotches. Upper surface of jaw from snout to eye lighter in color.

Fig. 19. Distribution of *Rana septentrionalis*,
Horizontal ruling, specimens examined; vertical ruling, reports only.

Large irregular blotches or bands on limbs. Under surface light yellow. Concealed surface of femur strongly vermiculated with brown.

Measurements: Specimen No. 40275.

Length of head and body	.062
Length of hind limb to heel	.051
Width of head	.020

Habits and Habitat: The northern or mink frog is distinctly aquatic. It has been said not to frequent lakes or ponds, but in the Northern Peninsula Ruthven (1910) has found it more characteristic of the inland lakes than of the streams. When frightened, it stays for a long time under water. It is solitary in habits, and never strays far from the shores of the rivers and lakes. The food consists of water insects and small fish. The eggs of this frog are laid in June and July, and are attached to water plants. Two years are required for the full development and metamorphosis (Dickerson, 1906, p. 225). When annoyed it gives off a strong musky odor, somewhat resembling that of the mink, and because of this odor it is frequently called the "mink frog."

Distribution: Adirondack Mountains to Minnesota and Ontario. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Keweenaw (Isle Royale), Ontonagon, Houghton and Dickinson Counties. Reported from Ontonagon and Marquette Counties (Ruthven, 1906); Keweenaw County (Isle Royale) (Ruthven, 1909); Dickinson County (Ruthven, 1910).

RANA CATESBEANA Shaw.

COMMON BULLFROG.

Description: Body large and stout, head broad. Eyes large and prominent. Ear of male larger than eye. Glandular fold from eye to arm, curving behind ear. No lateral folds. Back and under surface slightly granular. Feet webbed, leaving last joint of fourth toe free. Inner sole tubercle distinct.

Ground color greenish brown, sometimes spotted with darker. Limbs spotted or barred. Under surface yellowish white, usually mottled with darker.

Measurements: Specimen No. 40913.

Length of head and body	.130
Length of hind limb to heel	.098
Width of head	.047

Habits and Habitat: Rana catesbeana, the common bullfrog, is the largest of our frogs. It does not always follow, however, that the individual *R. catesbeana* is larger than the individual *R. clamitans* or *R. pipiens*, since the size depends upon the food and environment. The bullfrog is aquatic in its habits, being found during the summer in large ponds or lakes, usually those with mud bottoms

and with deep as well as shallow water. It is a powerful swimmer, due to the fact that the toes are fully webbed and the hind limbs are long and well developed. The food consists of fish, young turtles, young water birds, frogs, small snakes and insects.

Fig. 20. Distribution of *Rana catesbeana*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

The bullfrog is solitary in habit except during the breeding season and even then it sings alone and not in chorus. The song consists of a deep bass note that resembles the roaring of a bull; from this it gets the common name, the bullfrog. It is late in coming from its hibernation quarters, the eggs being laid in May or early June. Metamorphosis does not take place until the second

year and may be delayed until the third if the environment is unfavorable. This species is of great economic importance because of its value as food, the legs being considered a great delicacy by many people. The frog may be caught in the day time on a hook and line baited with a bit of red flannel. They are frequently hunted at night with lanterns, the light blinding them so that they may be easily speared by the hunter.

Distribution: East of the Rocky Mountains, including Florida and Texas. (Dickerson, 1906.)

Michigan: Specimens in the University Museum from Cheboygan, Iosco, Huron, Livingston, Washtenaw and Cass Counties. Reported from Eaton County (Clark, 1902); Eaton, Kalamazoo, Van Buren, Antrim, Montcalm, Kent, Ottawa, Barry and St. Joseph Counties (Gibbs, Notestein and Clark, 1905); *Ontonagon County (Ruthven, 1904a); Cheboygan County (Ruthven, 1911); Huron County (Ruthven, 1911a); Washtenaw County (Smith, 1879); Cass County (Thompson, 1911).

GLOSSARY.

Angle of the jaw.—Point of articulation of the two jaws.

Anus.—External opening of the intestine.

Branchiae.—External branched gills.

Caudal fin.—The tail fin.

Compressed.—Flattened from side to side.

Costal grooves.—Grooves on the sides of the body, indicating the position of the ribs.

Cranial crests.—Bony ridges extending back between the eyes.

Depressed.—Flattened from above downward.

Disks.—The enlarged and adhesive pads on the ends of the fingers and toes.

Dorsal groove.—A depression along the back.

Femur.—The upper or proximal bone of the leg.

Fronto-parietal crests.—Crests in front of, and between the eyes.

Genital openings.—External openings of the genital ducts.

Gills.—Organs for breathing the air contained in water.

Glandular.—Swollen and gland like.

Gular fold.—A transverse fold of skin across the throat.

Hibernate.—To refrain from an active condition, to remain in a torpid state over winter.

**Rana catesbeana* has been reported from Ontonagon County by Ruthven (1904a) but the specimens were later identified by Stejneger as somewhat anomalous specimens of *Rana clamitans* (Ruthven, 1906).

Lateral folds.—Gland like folds extending along the sides of the back.

Maxillary.—The bone of the upper jaw, back of the premaxillary. It forms the greater part of the upper jaw and may bear teeth.

Maxillary teeth.—Teeth borne on the maxillary bone.

Metamorphosis.—Change from the larval to the adult condition.

Metarsal tubercles.—Tubercles on the toes.

Mucous membrane.—Membrane lining the mouth.

Nares.—Nostrils; the external openings are called external nares, the internal openings internal nares.

Palatine.—A pair of bones just behind the vomers and extending transversely across the skull.

Parasphenoid.—The large broad bone in the roof of the mouth which forms the floor of the brain case.

Parasphenoid teeth.—Teeth borne on the parasphenoid bone.

Parotid glands.—Elevated glandular bodies found back of the eye in toads.

Pectoral.—Pertaining to the shoulder or breast.

Plantar tubercles.—Tubercles on the palm.

Postorbital crests.—Bony crests extending behind the eye.

Premaxillary.—The two bones, one on either side, in front of the maxillaries. They unite to form the anterior angle of the upper jaw.

Premaxillary teeth.—Teeth borne on the premaxillary bone.

Protective coloration.—Coloration of such a character that it serves to conceal the animal in the natural surroundings.

Rudimentary.—Not well developed. Degenerate.

Scuted.—Having scutes or scales.

Segmentation.—The cleavage of the eggs which takes place after fertilization.

Sole tubercles.—Small callous like projections on the sole of the foot.

Spawning.—The act of depositing the eggs.

Sperm.—The male sex element.

Spermatophores.—Small mushroom like bodies containing the sperm, deposited in the water by the male of some species during the breeding season.

Vermiculated.—Covered with fine irregular color marks.

Vertebral.—Pertaining to the vertebrae or spinal column.

Viridescent.—Greenish.

Vomer.—A pair of bones in front of the parasphenoid and forming the floor of the olfactory capsule.

Vomero-palatine teeth.—Teeth borne on the vomerine and palatine bones.

THE REPTILES OF MICHIGAN.

BY ALEXANDER G. RUTHVEN.

INTRODUCTION.

In the opinion of the writer, the inadequateness of the available information on the reptiles of Michigan may be attributed in part to the fact that there is no available manual on the subject suitable for the use of local students. The literature consists, with few exceptions, of a few general and local lists and incidental references to Michigan specimens in general works on herpetology. Aside from their limitations as lists the more general papers are all more or less erroneous and antiquated, and the local lists at best deal with too widely separated localities to be of general interest. The other records have, of course, the disadvantage of being widely scattered. It is hoped that this report will furnish an accurate summary of our present knowledge of the subject, and also serve to encourage further work.

LITERATURE.

The publications which treat either entirely or in part of Michigan specimens are as follows:

1. Sager, Abraham. Senate Doc., State of Michigan, 1839, pp. 294-305. A list of Michigan reptiles collected by the State Geological and Natural History Survey. No localities or other data given. Copied in Senate Documents of the same year.

2. Holbrook, J. E. North American Herpetology, 1842. Gives "Michigan" in the range of several species.

3. Baird, S. F. and Girard, C. Catalogue of North American Reptiles, 1853. Specimens of *Elaphe vulpinus, Storeria dekayi, Sistrurus catenatus, Natrix sipedon and Regina leberis* listed from Michigan and two new species, *Bascanion foxii* and *Nerodia agassizii,* described on the basis of Michigan material.

4. Hallowell, Edward. Proc. Acad. of Nat. Sci. Philadelphia, 1856, p. 310. A description of a specimen of *Eumeces quinquelineatus* from the neighborhood of Flint, Michigan, as a new species—*Plestiodon vittigerum.*

5. Agassiz, Louis. Contributions to the Natural History of the

United States, I, 1857. Several species of turtles recorded from Michigan.

6. Miles, Manly. A Catalogue of the Mammals, Birds, Reptiles and Molluscs of Michigan. 1st. Bien. Rept. Geol. Surv. of Mich., 1861, pp. 219-241. A list of the reptiles known to occur in the state with a few foot-note records of localities.

7. Smith, W. H. Catalogue of the Reptilia and Amphibia of Michigan, Supp. to Science News, 1879. A list of Michigan reptiles based on the specimens in the University of Michigan Museum and the private collection of the writer. No data is given but those found in the vicinity of Ann Arbor are indicated by a star.

8. Gibbs, M. Forest and Stream, XXXIX, 1892, p. 7. I have not been able to consult this article.

9. Stejneger, Leonhard. Rept. U. S. Nat. Mus., 1893, pp. 337-487. States that *Sistrurus catenatus* is common in parts of Michigan.

10. Kirsch, Philip. Bull. U. S. Fish Comm., XIV, 1895, p. 333. Several species of reptiles listed from points in lower Michigan.

11. Cope, E. D. The Crocodilians, Lizards and Snakes of North America. Rept. U. S. Nat. Mus., 1898 (1900), pp. 153-1270. Contains records of Michigan specimens of several species.

12. Gibbs, M. Herpetology of Kalamazoo County, Michigan. Wolverine Naturalist, Feb. 1900, pp. 12-13. *Crotalus horridus* (one specimen) and *Sistrurus catenatus* recorded from Kalamazoo County with notes on the habits of the latter.

13. Clark, H. L. Notes on the Reptiles and Batrachians of Eaton County, Michigan. 4th. Ann. Rept. Mich. Acad. Sci., 1902, pp. 192-194. A list of the reptiles of Eaton County, with miscellaneous notes on size, abundance, variation, etc.

14. Clark, H. L. The Water Snakes of Southern Michigan. Amer. Naturalist, XXXVII, 1903, pp. 1-23. A careful statistical study of the water snake (*N. sipedon*) on the basis of material collected in Eaton County, Mich. The writer concludes that the red-bellied specimens (*erythrogaster*) represent a distinct species. Notes on the habits of *N. sipedon* and *Regina leberis*.

15. Clark, H. L. Notes on Michigan Snakes. 5th Ann. Rept. Mich. Acad. Sci., 1903, pp. 172-174. Miscellaneous notes on *Natrix sipedon, Bascanion constrictor, Elaphe obsoletus, Lampropeltis doliatus triangulus,* and the garter-snakes.

16. Clark, H. L. The Short-Mouthed Snake (*Eutainia brachystoma* Cope) in Southern Michigan. Proc. Biol. Soc. Wash., XVI, pp. 83-88. A discussion of the characters, variation and habits of specimens of *Thamnophis butleri* colllected in Eaton county.

17. Sperry, W. L. Variation in the Common Garter Snake (*Thamnophis sirtalis*). 5th Ann. Rept. Mich. Acad. Sci., 1903, pp. 175-179. A discussion of the variation, scutellation and tail-length of specimens of *T. sirtalis* from Eaton County. Some of the specimens are referred (erroneously) to *T. sirtalis parietalis*.

18. Ruthven, Alexander G. Butler's Garter Snake. Biol. Bull., VII, 1904, pp. 289-299. In this paper the writer records *Thamnophis butleri* from several localitles in southern Michigan, shows the distinctness of the form from *T. sirtalis* and that the specimens refered by Clark to *T. brachystoma* are referable to it, discusses the habits, distribution, characters, variations and affinities and gives the synonomy and a list of the known specimens.

19. Ruthven, Alexander G. Notes on the Molluscs, Reptiles and Amphibians of Ontonagon County, Michigan. 6th Ann. Rept. Mich. Acad. Sci., 1904, pp. 188-192. Records of the species collected by the writer in the Porcupine Mountains, Michigan, in 1903, with notes on their occurrence.

20. Clark, H. L. A Preliminary List of the Amphibia and Reptilia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 109-110. This list, compiled with the assistance of Morris Gibbs and F. Notestein, purports to be a list of Michigan reptiles with the localities (principally counties) in which the species have been observed. Unfortunately it is based principally upon records the sources of which are not given so that, while it is quite accurate as a list of Michigan species, the careful student cannot accept the localities as reliable.

21. Notestein, F. N. The Ophidia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 112-125. The writer of this paper has endeavored to give a synopsis of the reptiles of the state with keys to make possible the easy determination of specimens. In reality what he has done is to describe the species that may occur in the state without giving any state records, so that, while the paper will assist in determining Michigan specimens, it cannot be considered as a monograph on Michigan herpetology. The paper is, furthermore, marred by very numerous typographical errors which, altho it must be said not the fault of the writer, greatly impair its usefulness to the general student.

22. Whittiker, C. C. The Status of *Eutaenia brachystoma*. 7th Ann. Rept. Mich. Acad. Sci., 1905, pp. 88-92. The writer compares the published description of the type specimen of *Thamnophis brachystoma* with material of *T. butleri* and concludes that *brachystoma* is a synonym of the latter.

23. Whittiker, C. C. Variation in the Blue Racer. 7th Ann. Rept, Mich. Acad. Sci., 1905, pp. 100-102. A brief account of the natural history and a discussion of the variation in scutellation and proportionate size of extremities observed in 58 specimens of *Bascanion constrictor* from Eaton County.

24. Gibbs, Morris. Bibliography for the Amphibia and Reptilia of Michigan. 7th Ann. Rept. Mich. Acad. Sci., 1905, p. 111. A list of the papers "which directly refer to Michigan herpetology so far as known to the writer."

25. Ruthven, Alexander G. The Cold-Blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan. Rept. Geol. Survey Mich. for 1905 (1906), pp. 107-112. Lists the species (5 snakes and 1 turtle) known to occur in the northern peninsula of Michigan with notes on the habits and habitats. The list is based principally on specimens secured by the expeditions of the University of Michigan Museum and upon the field notes of the writer.

26. Hankinson, T. L. A Biological Survey of Walnut Lake, Michigan. Rept. Mich. Geol. Surv., 1907 (1908), pp. 153-288. Contains a list of eight species of reptiles from the vicinity of Walnut Lake, Oakland County.

27. Ruthven, Alexander G. The Cold-Blooded Vertebrates of Isle Royale. Rept. Geol. Surv. Mich. for 1908 (1909), pp. 329-333. A summary of the herpetology of Isle Royale based principally upon the data secured by the University of Michigan Museum expeditions.

28. Ruthven, Alexander G. Variations and Genetic Relationships of the Garter-Snakes. Bull. U. S. Nat. Mus., 61, 1908. Contains Michigan records of *Thamnophis butleri, T. sirtalis,* and *T. sauritus* and notes on the habits of these species.

29. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians. 11th Ann. Rept. Mich. Acad. Sci., 1909, pp. 116-117. The writer shows that the Michigan specimens of wood-frog are referable to the species *cantabrigensis,* extends the northward range of *Thamnophis butleri* to Huron County, summarizes the distribution of *Heterodon platyrhinus* and *Elaphe vulpinus* in the state, giving new records, and shows that Porcupine Mountain specimens of *Chrysemys* are *C. bellii.*

30. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, II. 12th Ann. Rept. Mich. Acad. Sci., 1910, p. 59. Records *Rana septentrionalis, Elaphe vulpinus* and *Chrysemys bellii* from Dickinson County.

31. Ruthven, Alexander G. Notes on Michigan Reptiles and Amphibians, III. 13th Ann. Rept. Mich. Acad. of Sci., 1911, pp. 114-115. Contains a summary of the distribution of *Diadophis punctata* and a list of the species known from Cheboygan County.

32. Ruthven, Alexander G. Amphibians and Reptiles in A Biological Survey of the Sand Dune Region on the South Shore of Saginaw Bay, Michigan. Mich. Geol. and Biol. Surv., Pub. 4, Biol. Ser. 2, 1911, pp. 257-272. A discussion of the reptile-amphibian fauna of the northern part of Huron County; fifteen species of reptiles recorded.

33. Thompson, Crystal. Notes on the Amphibians and Reptiles of Cass County, Michigan. 13th Ann. Rept. Mich. Acad. Sci., 1911, pp. 105-107. Records thirteen species of reptiles from Cass County.

METHODS OF STUDY.

The reptiles are a group which, in the opinion of the writer, has been much neglected by students of natural history. The result of this is shown by the small amount of material on habits and local distribution that has accumulated. Much of this neglect of a very interesting group is due to the wide spread aversion to reptiles, particularly to lizards and snakes. The truth is that most of this aversion is acquired and can be more or less easily overcome. It is due in no small part to the absurd stories that still pass current in the periodicals. We venture to say that if the statement were published in the daily papers that there is in Michigan but one poisonous snake (rattle snake), that the largest snakes we have are the blue racer, fox snake and pilot snake, which seldom attain a length of over six feet, that the breath of the "blowing adder" is not poisonous, that snakes do not sting with their tongues nor swallow their young, it would call forth numerous protests and snake stories by "eye-witnesses" exactly to the contrary.

It seems absurd to one acquainted with these interesting animals to have to deny such stories. Our reptiles are only dangerous as they are poisonous, and the poison is only conveyed by large fangs and only possessed by one species—the rattle snake. On the other hand there are few groups that will better repay a study of the habits, both for the reason that a knowledge of the natural history of the forms is of value in the study of their distribution and relationships and because so little is known on the subject. The work on the natural history and distribution of the forms must be preceeded by a determination of the species, but fortunately the latter is not difficult for our forms are few and in general well defined. The classification is based on structural characters, of course, but the external characters are sufficient for the identification of Michi-

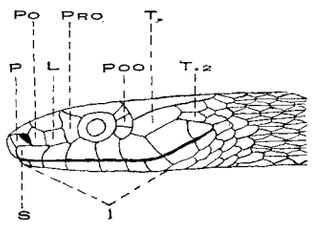

Fig. 21. Head of snake, side view, to show arrangement of scales.
P, prenasal; Po, postnasal; L, loreal; Pro, preocular; Poo, postoculars; T, first temporal; $T_{.2}$, second temporals; S, superior labials; I, inferior labials.

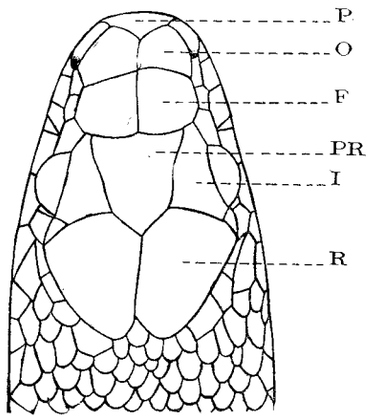

Fig. 22. Head of snake, side view, to show arrangement of scales.
P, rostral; O, internasals; F, prefrontals; PR, frontal; I, supraocular; R, parietals.

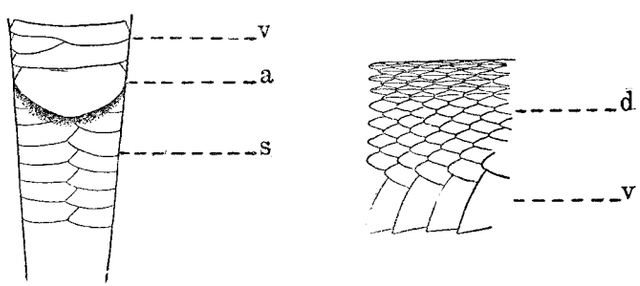

Fig. 23. Scales on the body of a snake. (After Cope.)
v, ventrals; a, anal plate; s, subcaudals, d, dorsals.

gan forms and have alone been used in this report. The anatomy is dealt with in most of the standard text-books on zoology.

In the identification of species the following characters (compare figures) should be noted:

Snakes.

1. Form of body and general size.
2. Arrangement of scales on the top, sides and under surface of head (Figs. 21, 22).
3. Arrangement of scales on dorsal surface of body and the number of rows at various places, i. e., between the head and anus (Fig. 23).
4. Whether the dorsal scales are smooth or keeled.
5. Number of large plates on the ventral surface between the head and tail (Fig. 23).
6. Character of anal plate, i. e., whether single or divided (Fig. 23).
7. Character of scales on the ventral surface of the tail, i. e., whether in a single or double series.
8. Coloration.

Turtles.

1. General size.
2. Shape of upper (carapace) and lower (plastron) shell.
3. Surface of shell, i. e., whether covered with horny plates or by a soft skin.
4. Size of plastron as compared with opening of carapace, also form of the bridge between the plastron and carapace (Figs. 25-27), and whether or not the plastron is divided by a transverse hinge.
5. Number and arrangement of plates in the different series on carapace and plastron (Figs. 24, 25).
6. Character of anterior end of upper jaw, i. e., whether notched or projected into beak.
7. Character of biting and grinding surfaces of jaws, particularly as regards width of grinding surfaces.
8. Extent of web on digits.
9. Coloration.

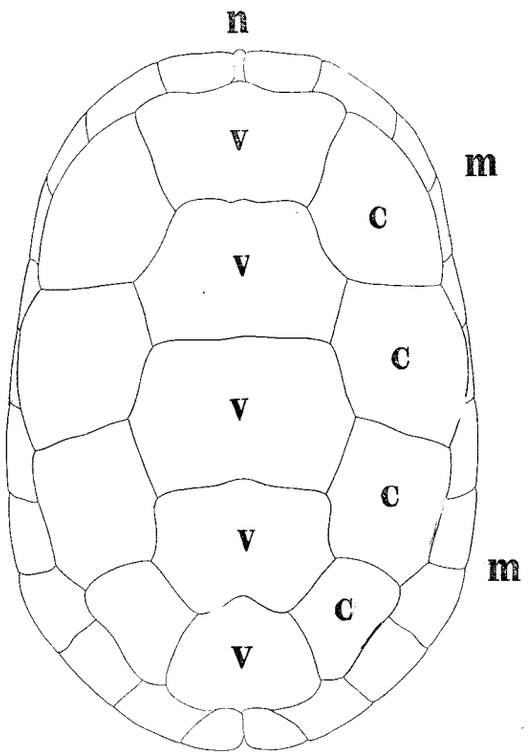

Fig. 24. Carapace of *Emydoidea blandingii*, to show position of plates. v, vertebrals; C, costals; N, nuchal; M, marginals.

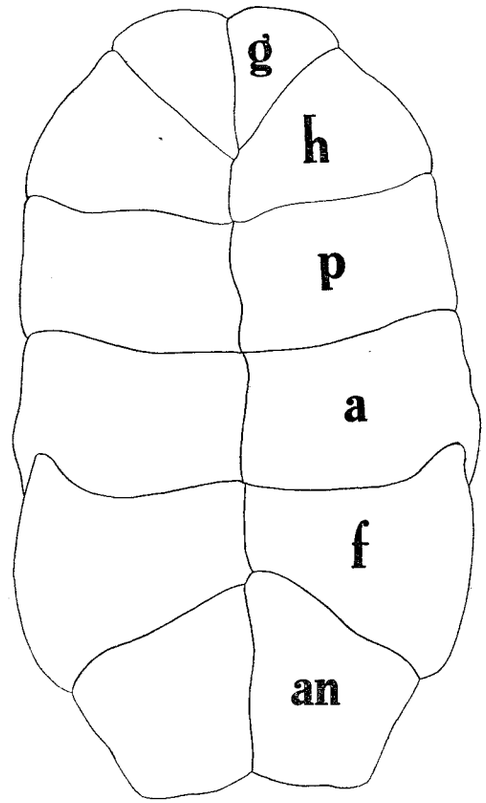

Fig. 25. Plastron of *Emydoidea blandingii*, to show position of plates g, gulars; h. humerals; p. pectorals; a abdominals; f, femorals; an, anals.

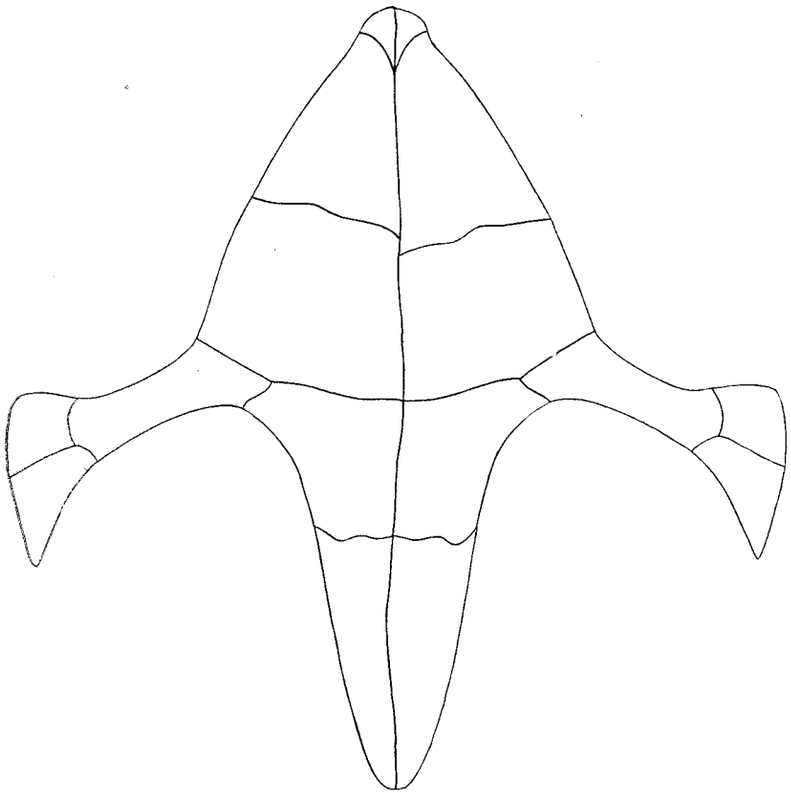

Fig. 26. Plastron of *Chelydra serpentina.*

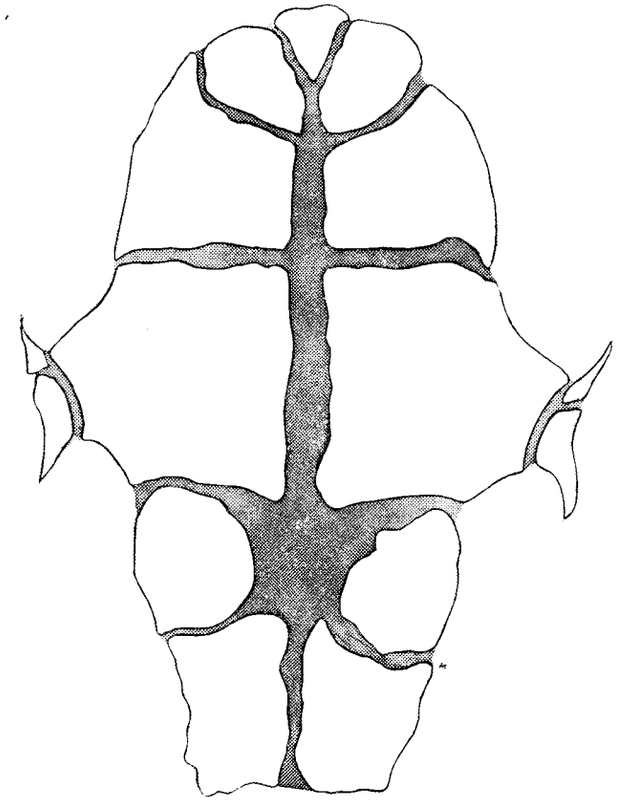

Fig. 27. Plastron of *Kinosternon odoratum.*

The above outlines may very easily be elaborated by teachers into laboratory directions. We would suggest, first, the identification of specimens accompanied by notes on individual and sexual variation; second, observations on the habits of captive specimens; third, field study of habits and habitats; fourth, the preparation of tables to show in a comparative way the characters and habits of the different species studied; and, fifth, a summary of the ways in which the characters are evidently adaptive.

METHODS OF COLLECTING AND PRESERVING SPECIMENS.

Collecting: As the rattlesnake is the only poisonous serpent in Michigan, the collecting of reptiles may be done with safety by any one well enough acquainted with this species to distinguish it. With the exception of the rattlesnake, all of the Michigan snakes may be grasped in the hands, with no more dangerous results than would occur in the case of a bird the size of a robin. It is always most convenient to grasp the animal by the neck, however, as it is then more easily handled and examined. Cloth bags about the size of those used to hold corn meal or a little smaller should be carried in the field. The snakes, turtles and lizards may be dropped into these and carried back alive to the laboratory or work room.

Lizards may frequently be grasped in the hand and always with impunity, but if seized by the tail there is great probability that this alone will be secured, as the animals part with this member readily. The most efficient way to capture them alive is to cautiously slip over their heads a noose made of horse hair, thread or fine wire and placed on the end of a stick. Turtles may be readily picked up by the carapace (upper shell), it only being necessary to avoid the jaws of the larger ones.

Collectors who wish to obtain series of specimens in a short time will find it more advantageous to shoot the larger snakes, lizards, rattlesnakes, and those forms that frequent the margins of lakes, ponds and streams. In our collecting we find it very convenient to carry a small, double-barreled shot-gun (44 gauge, which takes a 40-85 brass rifle shell, or a 28 gauge) or a 22 caliber target pistol bored smooth and shooting the .22 shot shell. We load the shotgun shells with a small charge of black powder, and dust shot (No. 14). Charges of these sizes do not usually greatly injure the specimen.

Cages. Very efficient and cheap cages for snakes and lizards may be made by placing a sliding pane of glass in the top of a shallow, light wooden box. The pane of glass serves as a window through which the animals may be observed, and also as a door through which they may be taken in or out or food introduced. It is always best to have the glass on top so that it can be opened temporarily without danger of the inmates escaping, and holes should be bored thru the side of the box and covered with screen, so as to provide air. Water in a small dish fastened to the bottom of the cage should always be present.

Turtles (except the box turtle) should be placed in a metal tank in shallow water with stones upon which they may climb. No covering is necessary if the sides are reasonably high or the edges turned inward. The box turtle should have a dry cage.

Specimens should be fed shortly after being placed in the cage, and rather regularly thereafter, for if they can be induced to eat there will be no trouble in keeping them alive. Water should be kept in the cages at all times.

Preservation of Specimens: The animals captured alive should be killed by immersing, while still in the bags, in a pail of water. When dead they should be removed from the bags and either injected freely (snakes and lizards along the belly, turtles behind the fore legs and in front of the hind legs) with 4% formalin, by means of a hypodermic syringe, or if a syringe is not available, slit open. Several slits about an inch or two inches long (according to the size of the specimen) should be made along the ventral surface of the snakes (none on the tail). One short slit will serve for the lizards, and the turtles may be slit open in front of the hind legs and behind the fore legs. The formalin solution may be made by adding 24 parts of water to 1 part of the 40% solution of formalin sold as pure, and the results are much better if the better grades of formalin (i. e., Shering's) are used. The specimens should then be placed in pans (do not crowd) and covered with the same solution. When well hardened they may be transferred to glass jars or covered crocks and covered with 75% alcohol. In the case of large specimens of turtles the shell only need be saved.

A label should be attached to each specimen, giving the locality, date of collection, collector and habitat, but if a notebook or catalog is kept, the specimen may be given a serial number and the data kept in the notebook or catalog opposite the corresponding number. The label should be tied about the body in the case of lizards and snakes (about one-third of the way back from the head in snakes and just behind the forelegs in lizards) and on the left hind leg in

turtles. Only in the case of the latter should the string be tied so tightly as to crease the skin.

DESCRIPTIONS OF MICHIGAN REPTILES.

CLASS REPTILIA.

The living reptiles are cold-blooded vertebrates that breathe by means of lungs and usually have a covering of horny epidermal scales; the latter sometimes supported by bony dermal plates. The only Michigan species that does not have the body covered with scales is the soft-shelled turtle (*Platypeltis spinifera*). In external form the body is elongate and limbless (snakes), somewhat elongate and usually quadrupedal but occasionally apodal (lizards and crocodilians), cuirassed and quadrupedal (turtles). The quadrupedal lizards are frequently confused with salamanders, but the quadrupedal salamanders (which alone occur in Michigan) always lack the bony or horny covering characteristic of reptiles, the skin being thin and moist. The apodal lizards are frequently confused with snakes, but the only apodal lizard in northeastern North America, the so-called glass snake (*Ophiosaurus ventralis*), may always be distinguished from snakes by the presence of eyelids and external ears. This lizard has never been recorded from Michigan, although it is said to occur in Wisconsin. Numerous morphological characters other than those given characterize the Class Reptilia and may be found by referring to any vertebrate zoology.

Distribution of the Class Reptilia in Michigan.—The distribution of each species is discussed in detail with its description. In general the reptile fauna of the state is characterized by the small number of forms. This is due in large part to the northern latitude of the region, as the reptiles are primarily a tropical group. The influence of temperature upon the distribution is also shown within the state. It is true in both orders that as one goes northward from the southern boundary of the state the number of species gradually decreases. Thus it may be seen by an examination of the maps that twenty-five or all but one of the species in our fauna have been recorded from the two southernmost tiers of counties while only six have thus far been found in the northern peninsula, and only one occurs there and not in the southern peninsula. It must be admitted, of course, that our information on the intrastate distribution of the species is far from complete, but enough has been learned to make it quite evident that further work will not overthrow this conclusion.

Another general fact of distribution may be pointed out, namely, that there is a western element in the fauna of the northern peninsula. This is at present only shown by the occurrence of *Chrysemys bellii* in that region, but it is in harmony with what has been shown to occur in other groups.

KEYS TO THE ORDERS AND SUBORDERS OF MICHIGAN REPTILES.*

a¹. Body elongate and covered with small scales. Anus a cross-slit. Order Squamata (Lizards and Snakes).
  b¹. Limbs present. Eyelids movable. An external ear opening. Suborder Sauria (Lizards), p. 77.
  b². Limbs absent. No external ear opening or movable eyelids. Suborder Serpentes (Snakes), p. 81.

a². Body short and broad and enclosed between two (upper and lower) shields. Limbs present. Anus rounded or a longitudinal slit. Order Testudinata (Turtles), p. 128.

ORDER SQUAMATA—SUBORDER SAURIA (LIZARDS).

Description: As indicated by the key, the lizards of Michigan may always be known from the other reptiles by the combination of characters, presence of small scales over the body and of four limbs. As already said, they are frequently confused with the salamanders but may always be told from them by the fact that the skin is never smooth and moist.

Key to the Genera and Species of Michigan Lizards.

a¹. Body covered above with fine tubercular scales. Tongue deeply bifid. *Cnemidophorus sexlineatus* (L.)†

a². Body covered above with rather large, imbricated scales. Tongue slightly notched. *Eumeces quinquilineatus* (L.).

EUMECES QUINQUILINEATUS (Linnaeus).

BLUE-TAILED SKINK.

(Pl. VIII.)

Plestiodon vittigerum,‡ Hallowell, 1856, 310.
Eumeces fasciatus, Smith, 1879, 6. Clark, 1905, 110.
Eumeces quinquilineatus, Cope, 1900, 637-638. Ruthven, 1911a, 263-264.

*It is hardly necessary to say that the keys in this paper are highly artificial. They are designed only to to furnish an easy and efficient means of identifying the species.
†The genus Cnemidophorus has not been recorded from this state, so it will not be considered further in this work. *C. sexlineatus* occurs in northern Indiana, however, and is to be looked for in southwestern Michigan in the sand dunes along Lake Michigan.
‡The synonomy given under each species includes only papers that refer to Michigan specimens.

Description: Four well developed limbs. Body covered with rather large, imbricated, smooth scales. Tongue flat, moderately long, free, slightly notched in front, and covered with overlapping scale-like papillae. Head with symmetrically arranged plates.

The color of the blue-tailed skink varies greatly with age. The color of medium sized individuals is, above dark olive with five bluish or greenish white, or yellowish stripes (one median and two lateral on either side); under surface pale; tail usually bright blue. Old specimens are reddish olive with the stripes obscure (females) or wanting (males) and the head coppery red. Young specimens are jet-black with bright yellow stripes.

Habits and Habitat: This skink is distinctly diurnal, being most active on warm, bright days in summer. Little is known of its habitat preferences in Michigan, but in other regions it is usually found in wooded areas, being seen frequently in piles of brush or fallen logs. It is very agile, and, like most of the smaller lizards, its tail breaks easily so that if seized by this appendage the animal easily escapes by parting with the captured portion. The following account of the habits of specimens observed in the sand region of Huron County has been given by the writer (Ruthven, 1911a, 263-264).

"In the woods of the sand region it was found on the dry ridges, under and in decaying logs, where it fed on the insects that frequent such situations. It was, however, much more common than elsewhere under the drift logs on the fossil beaches, and also on the middle beach on the present shore, at the extremity of Sand Point. The logs strewn along the fossil beaches were in an advanced stage of decay, and usually consisted of an outer shell of better preserved wood covering a mass of decomposed debris, the decomposition taking place most rapidly next to the ground. This apparently furnished a very favorable habitat for these lizards, great numbers of which were found in the decomposed material when the outer shell of the log had been removed. (Pl. VIII.)

"The eggs were laid in the same material, the female generally scooping out a small hollow in the bottom of which the eggs were partially buried in the debris. Both in the woods and on the beaches nests were occasionally found in the sand beneath a log or board where there was only a small amount of decaying wood, but in every case there was at least a small amount. Females taken on June 19 were pregnant, containing large eggs apparently nearly ready to be laid. The first sets observed were on July 2, and on and after this date nests of eggs were found in numbers. Everything went to show that the eggs are mostly laid about the first of July. None were observed before this date, and those collected on July 2 were all clean—they usually become much stained from the decaying wood after being in the nest for some time. The number of eggs in the set was counted in eight instances and were as follows: 6, 6, 8, 8, 9, 11, 13, 14. An examination of the pregnant females shows that the number in each set varies with the size (age?) of the female, the smaller ones having 6 to 8 eggs, the larger ones 9 to 14. It is interesting to compare this with the statement of Ditmars (1907, 202) that he found the normal numbers to be 3 or 4, and that of Strecker (1908, 169) 'the several sets that I have examined were all of 8 eggs each.'

"It was interesting to observe the behavior of the female when with her eggs. As is well known she remains with them until they are hatched, but for what purpose is not evident. We usually found them coiled about the eggs, but sometimes they simply lay beside them. In any case there seemed to be no attempt to come in immediate contact with the eggs, and indeed this would have been impossible in most instances, as the eggs themselves were not even in contact with each other, being somewhat scattered about in the decaying debris. However, there seemed to be a disposition on the part of the female to keep her set together; several times I saw a female leave her position and crawl about the eggs, and when she encountered one which I had displaced, lick it and then nose it back with the others. If care was taken in removing the outer shell of the log to expose the nest, the female would remain with the eggs, only burying herself deeper in the loose debris when her head was exposed to the light.

"The first young of the year were observed on July 31, when a female was found under a small log on a sand beach, coiled about a nest of 8 eggs from which the young were emerging."

Ditmars (1907, 202) states that the "food consists largely of insects, but well-grown specimens will feed upon the eggs of birds, or newly born wood mice, often discovered by the lizard as it investigates the crevices of fallen trees." Surface (1908a, 251) records the larva of a Geometrid moth in the stomach of one specimen. Cope (1900, 638) states that a captive specimen gorged itself with wood lice (*Oniscus*).

Range: The blue-tailed skink was probably not uncommon in the southern part of lower Michigan before the timber was removed. Whether or not it was of general distribution will probably never be known; it is now apparently very rare over much of this region.

It has been reported from Genesee County (Hallowell, 1856, 310; Cope, 1900, 637), Ann Arbor (Smith, 1879, 6), Barry, Kalamazoo, Kent, Montcalm, Ottawa, St. Joseph and Van Buren Counties (Clark, 1905, 110). It was observed to be quite common in the

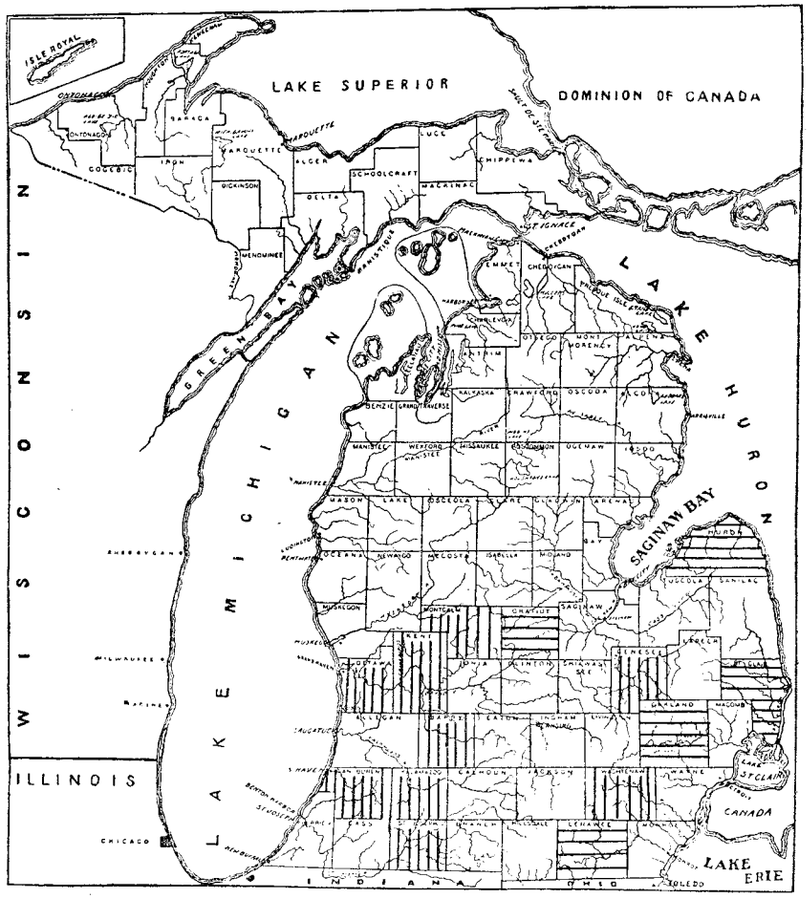

Fig. 28. Distribution of *Eumeces quinquilineatus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

sand region along the south shore of Saginaw Bay, between Bayport and Port Crescent in 1908 (Ruthven, 1911a, 263-264), and specimens have recently been received from St. Clair and Oakland Counties. Three specimens (one accompanied by eggs), collected by W. J. Beal in Lenawee County (no date), are in the University of Michigan collection, and we have examined a specimen taken at Alma,

Gratiot County. These are the only specimens from Michigan that the writer has seen. There is a record in the University of Michigan Museum catalog of a specimen (No. 369) collected by E. W. McGraw at Ann Arbor, but the specimen cannot now be found.

ORDER SQUAMATA—SUBORDER SERPENTES (THE SNAKES).

Description: As previously stated the Michigan snakes may be distinguished from the other members of the class in the state by the absence of limbs, external ear openings, and movable eyelids. The body is elongate and covered with scales. The scalation is as follows: small imbricated smooth or keeled scales forming longitudinal and diagonally transverse rows on the dorsal surface of the body and tail. A single series of large transverse and imbricated scutes on the ventral surface of the body with a somewhat larger single or divided plate (anal) just in front of the anus. A single or double row of imbricated scutes on the ventral surface of the tail. Large symmetrically arranged plates on the head.

Key to the Snakes of Michigan.

a¹. No pit between the eye and nostril. Tail not terminating in a rattle.
  b¹. Anal plate divided.
    c¹. Dorsal scales keeled (occasionally but faintly).
      d¹. Loreal plate absent, *Storeria*.
        e¹. Oculars 1-2.....*S. dekayi*, p. 83.
        e¹. Oculars 2-2.....*S. occipitomaculata*, p. 85.
      d². Loreal plate present.
        e¹. Rostral plate greatly developed and protruding.....*Heterodon platyrhinus*, p. 87.
        e². Rostral plate normal, i. e., flattened over the end of the muzzle.
          f¹. First 3-5 rows of dorsal scales smooth, the rest weakly keeled, *Elaphe*.
            g¹. Color above black or with obscure blotches .....*E. obsoletus*, p. 90.
            g². Color above yellowish to light brown with prominent dark brown blotches.....*E. vulpinus*, p. 93.
          f². Scales of all of the dorsal rows (except often the first) strongly keeled.

g¹. Dorsal scale rows never less than 21-23-21-19-17. *Natrix sipedon*, p. 95.

g². Dorsal scale rows never more than 19-17.

h¹ A light lateral stripe on the 1st and 2nd rows, no dorsal blotches. *Regina leberis*, p. 98.

h². No light lateral stripes, dorsal blotches present ..... *Clonophis kirtlandi*, p. 100.

c². Dorsal scales not keeled.

d¹. A single nasal plate pierced by the nostril. ..... *Liopeltis vernalis*, p. 102.

d². Two nasal plates, the nostril between them.

e¹. A yellow collar. Uniformly blackish above, ... *Diadophis punctatus*, p. 104.

e². No yellow collar, adults uniformly green to blackish above, young spotted..... ..... *Bascanion constrictor*, p. 107.

b². Anal plate entire.

c¹. Dorsal scales smooth. Dorsal blotches present. No stripes.... *Lampropeltis doliatus triangulus*, p. 110.

c². Dorsal scales keeled, a dorsal and two lateral (one on either side), light stripes..... *Thamnophis*.

d¹. Tail generally more than .27 of the total length, ... *Thamnophis sauritus*, p. 113.

d². Tail generally less than .27 of the total length.

e¹. Lateral stripe on the 2nd and 3rd rows. Labials generally 7/10..... ..... *Thamnophis sirtalis*, p. 119.

e². Lateral stripe on the 2nd, 3rd, 4th rows anteriorly. Labials generally 6/8..... ..... *Thamnophis butleri*, p. 116.

a². A pit between the eyes and nostril. Tail (in all but very young individuals) terminating in a rattle..... ..... *Sistrurus catenatus*, p. 124.

STORERIA DEKAYI (Holbrook).

DEKAY SNAKE.

Tropidonotus dekayi, Holbrook, 1842, IV, 54.

Storeria dekayi, Smith, 1879, 7. Notestein, 1905, 114. Clark, 1902, 194; 1905, 109. Baird and Girard, 1853, 135-136. Miles, 1861, 233. Cope, 1900, 1002-1003. Ruthven, 1911a, 266-267.

Description: A small snake seldom attaining a length of more than a foot. Body tapering toward the neck and tail. Head small but distinct. Cephalic plates normal; rostral normal. Sides of head rather high. Loreal absent, being fused with the posterior nasal; nostril situated laterally.

Dorsal scale rows, except very rarely, 17 throughout the entire length of the body. Supralabials 7; infralabials 7, very rarely 8 or 9. Oculars generally 1-2; rarely the postoculars are 3 in number, and occasionally fused into one scale, preoculars very rarely 2. Ventrals 120-137, subcaudals 44-57, anal plate divided.

The ground color above varying from dark chestnut or dark slate to pale brownish yellow, the lighter shades most common. On the vertebral line (occupying the median three and the halves of the adjacent rows) a pale yellow or greenish band, which is generally more distinct in the specimens in which the ground color is light. This band margined on either side by a darker shade of the ground color (in individuals light enough to show it), and by a row of more or less prominent black spots that may be distinct and encroach on the pale band even to the extent of fusing across it or may be so small as to be only indicated or entirely absent. The dorsal row is one of three of alternating spots that may be present on either side, all of these usually being absent or only indicated on the scales, except more often on the anterior part of the body. On the neck the spots are fused into a transverse spot on either side, these being irregular in shape and varying in size. Top of head usually dark brownish yellow, densely speckled with black. A heavy blotch of black pigment below the eye, and frequently a black bar crossing the posterior part of the first temporal and the upper and lower labials. Other head markings variable. Belly pale, with a row of very small spots on either side (one on each end of a scute) that are frequently absent and often irregular (several small ones on each scute). Newly born individuals are said to be dark gray or black above, with a ring of grayish-white around the neck. "Their dark hue changes rapidly and during the warm months suc-

ceeding their first hibernation they acquire the brown of the adult form" (Ditmars, 1907, 267).

Habits and Habitat: *S. dekayi* is rather interesting in that owing to its small size, sober colors and retiring habits it is not

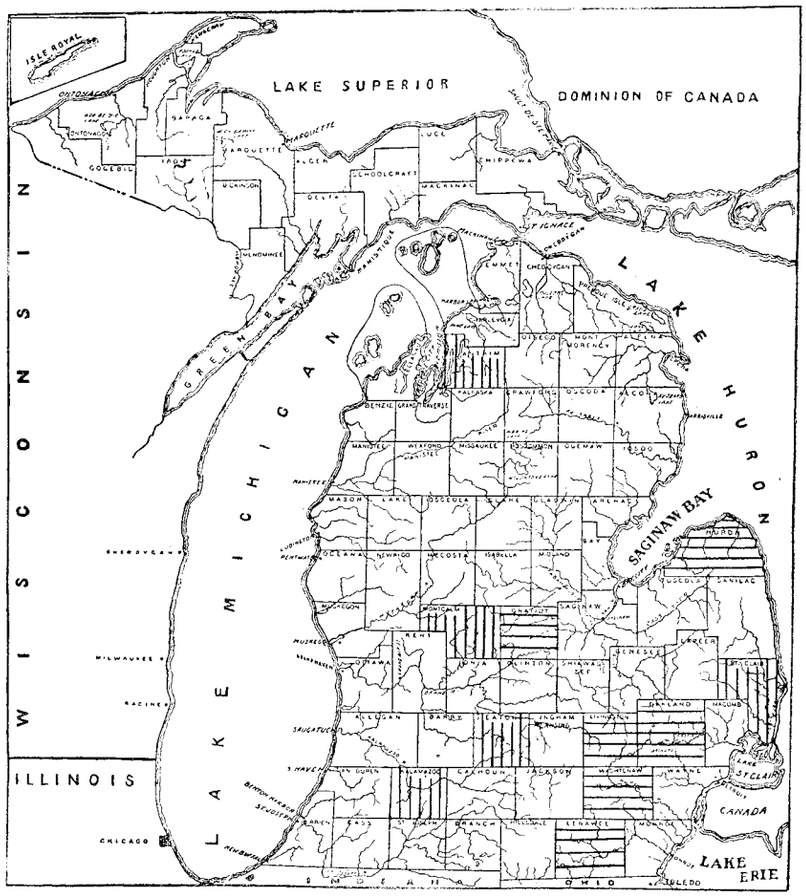

Fig. 29. Distribution of *Storeria dekayi*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

exterminated by civilization, but is able to live within the limits of towns, where it is frequently found on the sidewalks, in vacant lots, etc. It seems to prefer dry woods, and probably remains in concealment most of the time as does its ally the red-bellied snake.

Surface (1906, 139) records the following items of food in the stomachs of four Pennsylvania specimens: "Earthworms in one;

slugs in three; undetermined snails in two; and undetermined insect larvae in two." Atkinson (1901, 148) states that "The stomachs of several specimens contained earthworms and beetles." Holbrook (1842, IV, 54) states that it feeds on "various insects."

Range: The species has been reported from; Grosse Isle (Baird and Girard, 1853, 135, 136; Cope, 1900, 1002), Michigan (Miles, 1861, 233; Holbrook, 1842, IV, 54), Ann Arbor (Smith, 1879, 7), Port Huron (Cope, 1900, 1003), Eaton County (Clark, 1902, 194), Ann Arbor, Olivet, and Antrim, Kalamazoo and Montcalm Counties (Clark, 1905, 109), sand region of Huron County, from Sand Point to Port Austin (Ruthven, 1911a, 266-267). Specimens from the following localities have been examined: Ann Arbor, Portage Lake, Pittsfield, Ypsilanti, Delhi, Washtenaw County, Iosco, Livingston County, Pontiac and Orchard Lake, Oakland County, Port Huron, St. Clair County, Lenawee County, sand region from Sand Point to Port Austin, Huron County, and Alma, Gratiot County.

STORERIA OCCIPITOMACULATA (Storer).

RED-BELLIED SNAKE.

Storeria occipitomaculata, Smith, 1879, 7. Clark, 1905, 109. Notestein, 1905, 114. Ruthven, 1904a, 189-191; 1906, 110; 1909, 332; 1911a, 267; Miles, 1861, 233.

Description: A small snake attaining a length of about ten inches. Head small. Muzzle short. Cephalic plates normal. Rostral normal. Sides of head high. First temporal large, those in the second row tending to fuse into a single plate. Loreal fused with posterior nasal. Nostril lateral.

Dorsal scales in 15 rows throughout the length of the body. Supralabials usually 6, rarely 5; infralabials usually 7, occasionally 6, rarely 5 or 8. Oculars generally 2-2, rarely 3 preoculars or 1 or 3 postoculars. Ventrals 115-127; subcaudals 39-48. Anal plate divided.

Color above variable; usually a chestnut-brown, it may be light or dark gray or nearly black. A paler vertebral band margined on either side by a row of black spots or a dark chestnut band usually, but not always, present. First row of scales occasionally dark chestnut or nearly black, so that four dark bands are frequently present. Belly margined on either side by a band of gray speckled with black, the median portion red. Three (a dorsal and two lateral) yellow spots just behind the head, frequently obscure. Young when born uniformly very dark brown or black above, the nuchal spots conspicuous and the belly pink.

Habits and Habitat: The little red-bellied snake is mostly confined to woodland areas, and is very secretive, generally being found under loose stones, logs, etc. It is a very amiable little snake, and in captivity soon learns to take food from the fingers. Its food is

Fig. 30. Distribution of *Storeria occipitomaculata.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

said to consist of earthworms (Ditmars, 1907, 270), slugs (Ditmars, 1907, 270, Hay, 1892a, 498, Surface, 1906, 137-138), beetle larvae (Ditmars, 1907, 270), insects (Morse, 1904, 133).

The young are born alive and appear in small broods of from five to thirteen, the earliest date recorded being August 18 (Ditmars, 1907, 270) for a New York specimen, and the latest date September

26 (Ruthven, 1906, 111) for an Isle Royale, Michigan, specimen.

Range: The species has been reported from: Michigan (Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Porcupine Mountains, Ontonagon County (Ruthven, 1904a, 189, 191), Isle Royale, Porcupine Mountains and Kalamazoo County (Clark, 1905, 109), Porcupine Mountains, Iron County, Marquette and Isle Royale (Ruthven, 1906, 110, 111), Isle Royale (Ruthven, 1909, 332), Sand Point, Huron County (Ruthven, 1911a, 267). The writer has seen specimens from the following localities: Ann Arbor, Washtenaw County, Iron River and Crystal Falls, Iron County, Iron Mountain and Brown Lake, Dickinson County, Isle Royale, Keweenaw County, Porcupine Mountains, Ontonagon County, Marquette, Marquette County, Plainfield, Livingston County, Sand Point, Huron County, Hancock, Houghton County, Alma, Gratiot County and Dr. F. N. Notestein informs the writer that he saw it in Otsego County in 1911.

HETERODON PLATYRHINUS Latreille.

HOG-NOSED SNAKE.

(Pl. IX b.)

Coluber heterodon, Sager, 1839, 302.

Heterodon platyrhinus, Smith, 1879, 6. Clark, 1905, 110. Notestein, 1905, 118. Ruthven, 1909a, 117; 1911a, 265. Thompson, 1911, 107.

Heterodon platyrhinus niger, Smith, 1879, 6.

Description: A snake of robust build occasionally attaining the length of three feet, but usually about twenty-eight inches. Head short and rather broad. The rostral plate greatly developed and protruded upward and forward, projecting from the muzzle as the apex of a triangular pyramid; the anterior face broad and flat, the laterals slightly concave so that the lateral and dorsal edges are projecting. Internasals entirely, and prefrontals partially, separated by a narrow and elongated plate (azygous) having the form of an irregular pentagon whose sides are parallel. The azygous with more or less of a median keel (continuing from the dorsal edge of the rostral). Two large temporal scales bordering the last three supralabials and separated from the temporals by two or three rows of smaller scales. A single loreal, and two nasal plates, the nostril valvular and situated entirely in the postnasal. A single and continuous series of small plates (9, 10, 11, or 12 in number) bordering the eye on the anterior, posterior and inferior sides, occupying the place of the usual preoculars and postoculars, and separating the orbit from the supralabials.

Dorsal scale rows usually 25-23-21-19, keeled and with two pits; supralabials usually 8; infralabials 9, 10, or 11; ventrals 120-137; subcaudals 33-48; anal divided.

The ground color of the back varies from gray or yellow to red,

Fig. 31. Distribution of *Heterodon platyrhinus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

reddish brown or black. When the color is light there are three series of spots—a vertebral row of large spots alternating with a lateral row of smaller ones on either side. Tail cross-banded above. A dark band across the head on the suture between the prefrontals and occipitals and frontal; and another from the orbit to the angle of the mouth. An elongated dark blotch on either side of the neck.

Ventral surface yellow or greenish yellow, occasionally with faint blotches of brown.

In uniformly colored individuals the ground color is greenish olive to black; the ventral surface being immaculate greenish or yellowish. In black individuals the spots are usually entirely wanting; in the olivaceous specimens the black nuchal spots are often distinct, and the vertebral and lateral ones are often faintly in evidence.

Habits and Habitat: As stated below, this species has been found in but few localities in Michigan, but the evidence seems to indicate that it prefers dry woods and occurs particularly in sandy regions. It is one of the most interesting of the northeastern North American snakes. Its stocky build and upturned snout give it a particularly savage appearance, which is greatly enhanced by its peculiar habit of flattening out the fore part of the body, and hissing loudly when disturbed. It also feigns death by throwing itself on its back, writhing as if in agony with the mouth widely opened, and then lying perfectly relaxed. It will retain this posture for a considerable time, and if turned over on the ventral surface will immediately turn over on its back again. Its formidable appearance, and the peculiar habit of flattening its body and hissing loudly have furnished the basis for the most exaggerated stories, earned for it the common names blowing adder, hognosed viper, hissing viper, etc., and given rise to the general impression that it is a very venomous and greatly to be feared serpent. As a matter of fact the eastern hognosed snake is not only entirely harmless but can scarcely be induced to bite, and makes a most interesting snake in captivity. The food seems to consist almost entirely of toads, altho we have observed them to eat frogs in captivity. Insects are often found in their stomachs, but there is no reason to believe that these are taken in any other way than in the stomachs of the toads they have swallowed. The species is oviparous.

Range: The species has been reported from Michigan (Sager, 1839, 302, Miles, 1861, 233), Ann Arbor (Smith, 1879, 6), Wayne, Kalamazoo, Van Buren, Allegan and Barry Counties (Clark, 1905, 110), McKinley, Oscoda County, Manistee, Manistee County and Pearl Beach, St. Clair County (Ruthven, 1909a, 117), Huron County (Ruthven, 1911a, 265), and Cass County (Thompson, 1911, 107). We have seen specimens from Manistee, Detroit, the sand region of Huron County, between Bayport and Port Austin, Alma, Gratiot County, Cass County, and Douglas Lake, Cheboygan County.

From these records it seems probable that the species is to be found commonly, if not almost exclusively, in the more sandy parts of the state.

ELAPHE OBSOLETUS (Say).

PILOT SNAKE.

(Pl. VI.)

Coluber obsoletus, Sager, 1839, 301. Smith, 1879, 6. Clark, 1902, 192; 1903, 172.
Coluber spiloides (Part?), Cope, 1900, 841-843.
Callopeltis obsoletus, Clark, 1905, 110.
Coluber obsoletus obsoletus, Notestein, 1905, 117.

Description: A large snake attaining a length of from five and one-half to eight feet. Head moderately swollen through the jaws, and tapering gradually to the end of the snout, so that it is decidedly elongate; high on the sides; the muzzle usually straight on the sides, occasionally slightly concave in the preocular region. Eye moderate. Nostril lateral. Cephalic plates normal, the frontal plate generally longer than broad.

In the few specimens examined the dorsal scale rows are 25-23-21-19-17 and 23-25-21-19-17.* Supralabials 8, occasionally 7; infralabials 11; occasionally 12. Oculars 1-2. Temporals 2-3, occasionally 2-2. Ventrals 231-236; subcaudals 79 and 80. Anal plate divided.

A very good description of the snake is that given by Hay (1892a, 501): "In this, the general color is a black with a bluish tinge, or a pitch-black, most pronounced on the posterior portion of the body. The anterior half may be lighter, and show evidences of blotches. The whole of this part may have a decided tinge of red, this being due to the color of the skin between the scales; yet the red may run up on the bases of the scales. Occasionally the spots of the upper surface are of a decided red. The dorsal blotches extend down on the sides to about the 7th row of scales, counting the lowest. They are about 6 inches long, and are separated by the length of two scales. Alternating with these is another series which extend from the 3rd to the 7th row of scales. These spots are all feebly indicated by the sulphur yellow of the skin between the scales; and often the color is almost uniform black. There are some scales with yellow or white edges. Lower jaw and throat white. The belly is of a slate-color or black on the hinder half;

*The number of scale rows in the series is usually given as 27, so that the above formulas are probably exceeded in some Michigan specimens. Needless to say this summary of the number of scales in the different series, based as it is on a small number of specimens, is only a very general one.

anteriorly the black is mottled with yellowish, which color becomes more and more abundant, until the throat and chin are entirely yellowish. Small, or even half-grown, individuals may have a ground color of ash-gray and numerous dark blotches."

Fig. 32. Distribution of *Elaphe obsoletus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

This snake is often confused with the blue racer. It may readily be distinguished from the latter by the carinated scales and greater number of scale rows and the dark markings on the ventral surface.

Habits and Habitat: The writer has been unable to gather any data on the habitat of the pilot snake in Michigan. The food that the species is known to take is as follows: mice (Hay, 1892a, 503),

cotton-tail rabbit (Ditmars, 1907, 305), undetermined insect fragments, undetermined larvae, insects, with bird remains, undetermined species of Orthoptera, Acridiidae (grasshoppers), wood frog, undetermined birds, undetermined eggs, chicken eggs, robin eggs, red-winged blackbird, sparrow, robin, undetermined mammals, common opposum, undetermined mice, meadow mouse (*M. pennsylvanicus*), *Microtus* sp. (uncertain species), house mouse, undetermined squirrels, red squirrels, chipmunk, undetermined shrew, and weasels (Surface, 1906, 160). In the specimen taken at Ann Arbor by Winchell (see infra) the writer finds the remains of an adult sparrow.

The pilot snake is oviparous. Hay (1892, 395) records a pair that were taken in coitu on June 19, and Surface (1906, 159) states that the eggs are laid during the latter part of August or early part of September. Ditmars (1907, 306) writes that a specimen deposited ten eggs on June 26. Surface also states that the eggs are laid in loose earth or damp sawdust; Stejneger (1892, 396) has recorded a batch found in a hollow stump, and Hay (1892, 396) found a number in a pile of stable manure. The last named writer describes the eggs and young as follows: "When found the eggs were glued together in one mass. Each egg is 2 inches long and nearly an inch and a quarter in the short diameter. On the outside is found a thick, leathery, yellow covering, beneath which is a much thinner coat. From one of these eggs I have taken a young snake which measures ten and three-quarters inches in length. Attached to this embryo is a considerable mass of yolk, a condition which indicates that the embryo is not ready for hatching. Nevertheless, all the generic and specific characters are well shown. There is a well developed egg tooth. The intromittent organs are everted in the specimens examined."

Range: The status of this snake in the state is little known. It has been reported from Michigan (Sager, 1839, 301, Smith, 1879, 6), Eaton County (Clark, 1902, 193, 1903, 172), Olivet, Ann Arbor, and Kalamazoo, Van Buren and Montcalm Counties (Clark, 1905, 110). The writer has only seen four specimens that were taken within our limits, one from Alma, Gratiot County, one from Eaton County, one at Ann Arbor, by Alexander Winchell, and one from Lenawee County, by W. J. Beal. Both of the latter specimens are without dates, but they have been in the University of Michigan Museum collection for many years.

ELAPHE VULPINUS (Baird and Girard).

FOX SNAKE.

(Pl. IX a.)

Coluber vulpinus, Notestein, 1905, 117. Smith, 1879, 6. Cope, 1900, 831-833.

Scotophis vulpinus, Baird and Girard, 1853, 75-76. Miles, 1861, 233.

Callopeltis vulpinus, Clark, 1905, 110.

Elaphe vulpinus, Ruthven, 1909a, 110; 1910, 59; 1911a, 266.

Description: A robust snake, attaining a length of about four or five feet. Head rather flat, broad and rather short, being usually decidedly shorter and broader than in *E. obsoletus.* Sides of head rather low, slightly concave in preocular region. Eye moderate, pupil round. Nostrils lateral. Cephalic plates normal; the frontal generally nearly or quite as wide as long.

Dorsal scale rows 27-25-23-21, 25-27-25-23-21, 25-23-21; the first 3 or 4 smooth, the others weakly keeled. Supralabials 8, occasionally 7 or 9; infralabials 9, 10 or 11. Oculars usually 1-2. Ventrals 200-212 (196-217, Cope, 1900, 832); subcaudals 50-65 (68, Cope, 1900, 832). Anal plate divided.

Ground color above yellowish or light brown. A median series of dark chocolate brown blotches with inconspicuous black margins and separated by two scales, the first one or two anterior either entirely or partly divided on the median line. Vertebral spots usually descending to the fifth or sixth rows on the sides, the lower margin being produced in an obtuse angle. A row of smaller blotches alternating with those of the vertebral series on the sides between the second and seventh rows inclusive. These are also margined with black, and in turn alternate with another series of black blotches that involve the edge of the ventrals and the first one or two rows of dorsal scales. Belly pale yellowish with alternating series of quadrate black blotches of which the row involving the first one or two dorsal rows is the outer. Head light brown, with a dusky band across the suture of the prefrontals with the frontal and supraoculars, and another from the eye to the angle of the mouth.

Habits and Habitat: Very little is known of the habits or habitat of the fox snake. In common with some other snakes, it will, when excited, frequently vibrate the tail rapidly like the rattle snakes. As the tail terminates in a horny point, a distinct buzzing sound is produced. It is entirely harmless, and not usually pugnacious.

Ditmars, 1907, 297-298) writes of the food and breeding habits as follows: "The Fox Snake feeds largely upon small rodents, young rats and mice. To procure the former it often haunts the vicinity of barns and sheds where hay or grain is stored. From this habit

Fig. 33. Distribution of *Elaphe vulpinus*.
Horizontal ruling, specimens examined; vertical ruling, reports only.

it is sometimes called the house snake. The fully adult individuals eat mammals as large as half-grown rabbits. They occasionally prey upon birds and will eat their eggs, swallowing them entire and breaking the shell in the throat by the contraction of the muscles. The good this species does in destroying the smaller, injurious creatures of the fields, should cause it to be the recognized

friend of the farmer. One snake is worth a dozen traps, for the reptile prowls into the burrows and nests of rats and mice and eats the entire brood.

"Like all of the Colubers, the Fox Snake deposits a considerable number of eggs, generally in the hollow of a rotting stump, and leaves them without further ado, to hatch within six or eight weeks time. The eggs gradually increase in size by absorbing the moisture of the wood pulp in which they are deposited. Just prior to hatching, an egg is a third or half larger than when it was laid. One of the writer's specimens deposited 12 eggs on the first of July. They were adhesive in a single cluster. These eggs began hatching on the 21st of August, and all had not hatched until about ten days later. The female specimen was three and a half feet in length and in proportion to her size the young were very large." A specimen taken in Huron county by the writer (Ruthven, 1911a, 266) had eaten four young rabbits.

Range: The species has been reported from: Grosse Isle (Baird and Girard, 1853, 75-76), south shore of Saginaw Bay (Miles, 1861, 233), Grosse Isle (Cope, 1900, 832), St. Clair County (Ruthven, 1909a, 110), Dickinson County (Ruthven, 1910, 59), Stony Island and sand region of Huron County (Ruthven, 1911a, 266). Specimens have been examined from: Pearl Beach and Hersen's Island, St. Clair County, Stony Island and Sand Point, Huron County, Brown Lake, Dickinson County, and Monroe County. Captain C. C. McDonald, light-house keeper on Charity Island, has informed the writer that he killed a pair of these snakes in coitu on the island a number of years ago. Captain McDonald is familiar with the species, and the record can be accepted, altho the snake has not since been observed on the island.

NATRIX SIPEDON (Linnaeus).

WATERSNAKE.

Coluber sipedon, Sager, 1839, 302.
Tropidonotus sipedon, Smith, 1879, 6.
Natrix fasciata sipedon, Clark, 1902, 194; 1903, 173. Notestein, 1905, 117. Cope, 1900, 969-972. Clark, 1903b. Hankinson, 1908, 236.
Natrix sipedon, Kirsch, 1895, 333. Thompson, 1911, 106. Ruthven, 1911, 115; 1911a, 269.
Natrix sipedon fasciata, Clark, 1905, 109.
Natrix erythrogaster, Clark, 1902, 194; 1903, 172; 1905, 109; 1903b.

Natrix fasciata erythrogaster, Notestein, 1905, 117.
Tropidonotus erythrogaster, Smith, 1879, 6.
Nerodia agassizii, Baird and Girard, 1853, 41-42. Miles, 1861, 233.
Nerodia sipedon, Baird and Girard, 1853, 38-39. Miles, 1861, 233.

Description: Medium sized snakes of robust form; size three and a half to four feet. Head decidedly swollen at the base of the jaws, rather narrow and elongate, with high and straight sides. The muzzle bluntly sub-conical, so that the nostrils are directed upward to some extent. The nostrils quite small and capable of being closed.

Dorsal scales generally 23-21-19-17; occasionally 21-23-21-19-17; more rarely 23-25-23-21-19-17, and 23-21-19-(17). Labials nearly always 8-10, very rarely 9 (or 7) superior and 9 or 11 inferior scutes in the series. Ocularis 1-3, with rare exceptions 1-2 or 1-4. Temporals 1-3 with occasionally 2 in the second row. Ventrals 137-149, subcaudals 56-75. Anal divided.

The coloration of this species has been well described by Cope (1900, 970-971): "In young individuals and in those generally in which the epidermis has been removed, the normal type of coloration is seen to consist of three series of nearly quadrate dark brown spots, with still darker borders, one dorsal and one lateral on each side. These are so disposed that the two corresponding lateral spots are opposite the intervals between the dorsals, and thus appear to be connected by a light line. The longitudinal diameter of the dorsal spots, amounting to three or four scales, is the greater; just the reverse of what is the case with the lateral. Of these lateral spots there are generally about thirty-two on each side from the head to the anus, the spaces between equal to or less than the spots, not greater, as in *T. fasciata.* While the pattern is generally quite distinguishable on the posterior half of the body, anteriorly it becomes confused, the lateral blotches standing opposite to the dorsal and becoming confluent, so that the back appears crossed by lozenge shaped blotches extending to the abdominal scutellae, and this separated on the sides by triangular intervals of a lighter color.

"Occasionally the color appears to be a dull and rather light brown, with the back crossed by narrow transverse lines, with dark (nearly black, but still not distinct) margins." Frequently the general color is so dark that the animal is more or less uniformly dark brown or black above, and in some of the black individuals the belly is red (so called variety *erythrogaster*).

Habits and Habitat: This well known snake is common along

the streams and lakes of southern Michigan. It is never found far from such habitats and generally frequents logs or branches of bushes overhanging the water, into which it glides swiftly on the slightest sign of danger, and conceals itself on the bottom. On

Fig. 34. Distribution of *Natrix sipedon.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

sandy and rocky shores where bushes and trees do not come down to the waters edge (for example, along the Great Lakes) it is found under logs and driftwood.

A considerable variety of food has been recorded in the stomachs of these snakes. Surface (1906, 156) records insect fragments with toad remains, undetermined species of orthoptera, two-striped grass-

hopper, striped brown cricket, undetermined ground beetles, undetermined vertebrates, undetermined fish, catfish, white sucker, *Cottus ictalops, Cottus richardsoni,* undetermined salamander, *Plethodon cinereus,* tadpole, toad, green frogs, undetermined mammals, meadow mouse (*Microtus pennsylvanicus*), common shrew (*Sorex personatus*). Atkinson (1901, 150) says that it feeds upon "crustaceans, fish, and batrachians." De Kay (1842, 42) found it feeding on the lake lamprey, bullhead, brook trout, and white sucker. Blatchley (1891, 30) removed seven leopard frogs from a single specimen. Ortmann (1906, 495) states that crawfish form an important part of the diet of this snake. Notwithstanding the variety of food which it is thus evident that the watersnake will eat, fish form by far the greater part of the diet. In the few stomachs which we have examined from southern Michigan specimens, small fish alone were found, and these often in considerable numbers.

Range: The species has been reported from: Grosse Isle and Lake Huron (Baird and Girard, 1853, 38, 39 and 42), Michigan (Sager, 1839, 302; Miles, 1861, p. 233), Ann Arbor (Smith, 1879, 6), Lansing (Cope, 1900, 977), Hudson, Manitou Beach and Tiffin River, Lenawee County (Kirsch, 1895, 333), Eaton County (Clark, 1903, 172; 1903b; 1902, 194), Cass County (Thompson, 1911, 106), Ann Arbor, Lansing, and Olivet, and Antrim, Barry, Kalamazoo, Kent, Montcalm, Ottawa, St. Joseph and Van Buren Counties (Clark, 1905, 109), Huron County (Ruthven, 1911a, 269), Walnut Lake, Oakland County (Hankinson, 1908, p. 256), and Douglas Lake, Cheboygan County (Ruthven, 1911, 115). The writer has examined specimens from Walnut Lake and Pontiac, Oakland County, Washtenaw County, North and Stony Islands and the sand region of Huron County, Charity Island, Saginaw Bay, Douglas Lake, Cheboygan County, Shelby, Oceana County, Cass County, Allegan County, Oscoda County, and Alma, Gratiot County.

REGINA LEBERIS (Linnaeus).

LEATHER SNAKE.

Coluber septemvittatus, Sager, 1839, 302.
Tropidonotus leberis, Holbrook, 1842, IV, 51.
Natrix leberis, Clark, 1902, 194. Notestein, 1905, 116.
Regina leberis, Baird and Girard, 1853, 45-46. Clark, 1905, 110. Smith, 1879, 6. Miles, 1861, 233.

Description: Slender, medium sized snakes attaining a length of about two feet. Head rather flat from the nape, sides low.

Dorsal scale rows 19-17 in every specimen examined, except in a few that have 21 just behind the head. Labials usually 7-10, occasionally 7-9 or 7-11. Oculars 2-2, the preoculars rarely fused into a single scale. One anterior temporal. Ventrals 142-154, subcaudals 65-81. Anal plate divided.

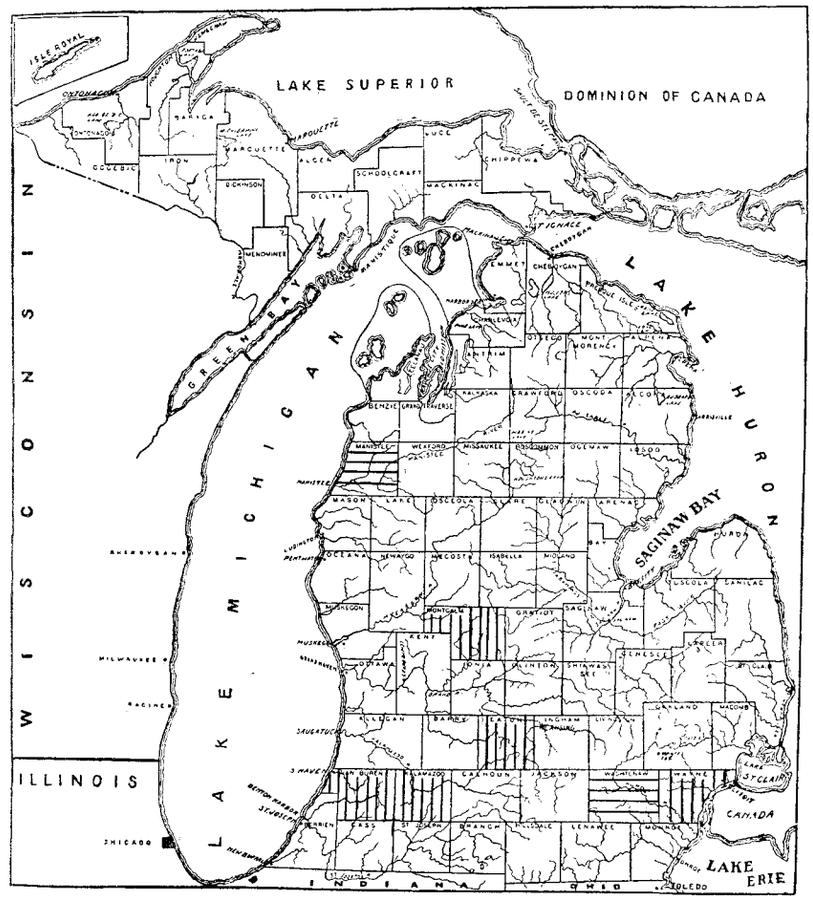

Fig. 35. Distribution of *Regina leberis.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

Ground color above uniformly dark chestnut or chocolate brown, as is also the top and sides of the head above the labials and the lower part of the lower postoculars. A bright yellow band occupies the second and upper part of the first scale row, and is continued on the head to include the supralabials, lower part of the lower postocular and the lower part of the rostral plate. Although

frequently obscure there is a narrow black line on the fifth and occasionally on adjacent parts of the fourth and sixth dorsal rows on either side and one on the median (tenth) row. Occasionally the entire area between the lower lateral line and the light lateral stripe on the second and third rows appears blackish. Ends of ventrals with the lower part of the first scale row usually brownish, forming a dark band. Belly dull yellow with two parallel bands of brown that are broken by the narrow pale margins of the scutes and unite into a single, narrow, median band on the throat.

Habits and Habitat: Little is recorded on the habits of this snake. Morse (1904, 132) states that it is often found hanging over a stream from projecting willows from which it glides rapidly into the water when disturbed." It is apparently quite aquatic. Atkinson (1901, 149) states that in its stomach "crayfish are most frequently found, also occasionally fish and small frogs." Surface (1906, 151) examined four specimens which had eaten crayfish, and one of these had eaten a toad. Ortmann (1907, 495) states that crayfish form an important part of its diet and that he has seen it disgorge *Cambarus obscurus* when captured.

Range: The species has been reported from: Grosse Isle (Baird and Girard, 1853, 45, 46), Michigan (Sager, 1839, 302; Miles 1861, 233; Holbrook, 1842, IV, 51), Ann Arbor (Smith, 1879, 6), Eaton County (Clark, 1902, 194), Olivet and Montcalm, Kalamazoo and Van Buren Counties (Clark, 1905, 110). The writer has examined numerous specimens from Washtenaw County, and one from the vicinity of Manistee, Manistee County.

CLONOPHIS KIRTLANDII (Kennicott).

KIRTLAND SNAKE.

Regina kirtlandi, Smith, 1879, 6.
Clonophis kirtlandi, Clark, 1905, 109.
Natrix kirtlandii, Cope, 1900, 997. Notestein, 1905, 116.

Description: A rather small snake attaining a length of about eighteen inches. Head small and pointed, sloping downward from the nape; sides not concave in front of eye, the latter small and slightly protruding. Nasal plates united above the nostril. The scutellation of the two Michigan specimens examined is as follows:

Dorsals	Supralabials	Infralabials	Oculars	Temporals	Subcaudals	Ventrals
19–17	6	7	1–2	1–2	56	134
19–17	5	7	1–2	1–2	54	130

Ground color light brown and narrowly restricted by large, conspicuous, quadrate, black blotches arranged in two rows on either side. Spots of the lower row larger; those of the two upper rows occasionally fused across the back. The first one or two scale rows

Fig. 36. Distribution of *Clonophis kirtlandii.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

light ash, like the ends of the ventrals. Top of head marbled with black and brown. Supralabials dull yellow. A small, well defined, black spot on the outer end of each ventral scute, forming with its fellows a row of spots along either side of the abdomen. Ends of ventrals outside of spots gray finely speckled with black. Middle of the abdomen said to be red in life, in alcohol it becomes yellow.

Habits and Habitat: This snake is apparently very rare in Michigan. We have seen but two specimens, as stated below. These were both taken in a large tamarack swamp. It is said (Cope, 1900, 997; Ditmars, 1907, 262) to frequent damp woods and to be found generally under logs; also that when near it it will take to the water and dive to the bottom like a true water snake. It is reported to feed largely on small frogs and toads, and that captive specimens will eat fish (Ditmars, 1907, 262) and slugs (Atkinson, 1901, 150). The young are born alive.

Range: The species has been reported from: Ann Arbor (Smith, 1879, 6), Kalamazoo (Cope, 1900, 997) Ann Arbor and Kalamazoo (Clark, 1905, 109).

The two specimens of this snake described above were taken near Ann Arbor. They are the only ones the writer has seen.

LIOPELTIS VERNALIS (DeKay).

GRASS SNAKE.

Coluber vernalis, Sager, 1839, 302.

Liopeltis vernalis, Smith, 1879, 7. Clark, 1902, 193; 1905, 110. Notestein, 1905, 118. Cope, 1900, 782-784. Ruthven, 1911, 115; 1911a, 267.

Chlorosoma vernalis, Miles, 1861, 233.

Description: A slender and rather small snake, attaining a length of one and one-half feet. Body about same diameter throughout, i. e., not tapering strongly toward the extremities, but the head well marked off. Cephalic plates normal in arrangement, rostral normal in form. Sides of head high, but muzzle short which tends to crowd out the plates in front of the eye. Nasals fused. Loreal when present of normal height but nearly as often absent as present; when absent it is fused with nasal. Nostril lateral.

Dorsal scale rows 15 throughout the entire length of the body, scales smooth. Supralabials usually 7, occasionally 8; infralabials usually 8, frequently 7, and rarely 9. Oculars usually 2-2, occasionally 1-2, rarely 1-3 or 2-3. Ventrals 123-134; subcaudals 71-84 (Baird and Girard cite an example with 94). Anal plate divided.

Uniformly bright green above and yellowish white beneath.

Habits and Habitat: The grass snake is an exceedingly beautiful, agile, and harmless little snake that in Michigan is usually found in dry open clearings. It is generally on the ground but may climb small shrubs. The following definite observations on the food habits have appeared in the literature: snails, spiders, insect fragments, larvae, unidentified orthoptera, crickets, grasshoppers, un-

identified lepidoptera, measuring worms, ground beetles (*Harpalus* sp.), red ants, striped salamander (Surface, 1906, 165-166); insects (Ditmars, 1907, 324-325); grasshoppers (Atkinson, 1901, 148); spiders, grasshoppers and crickets, but in preference to anything

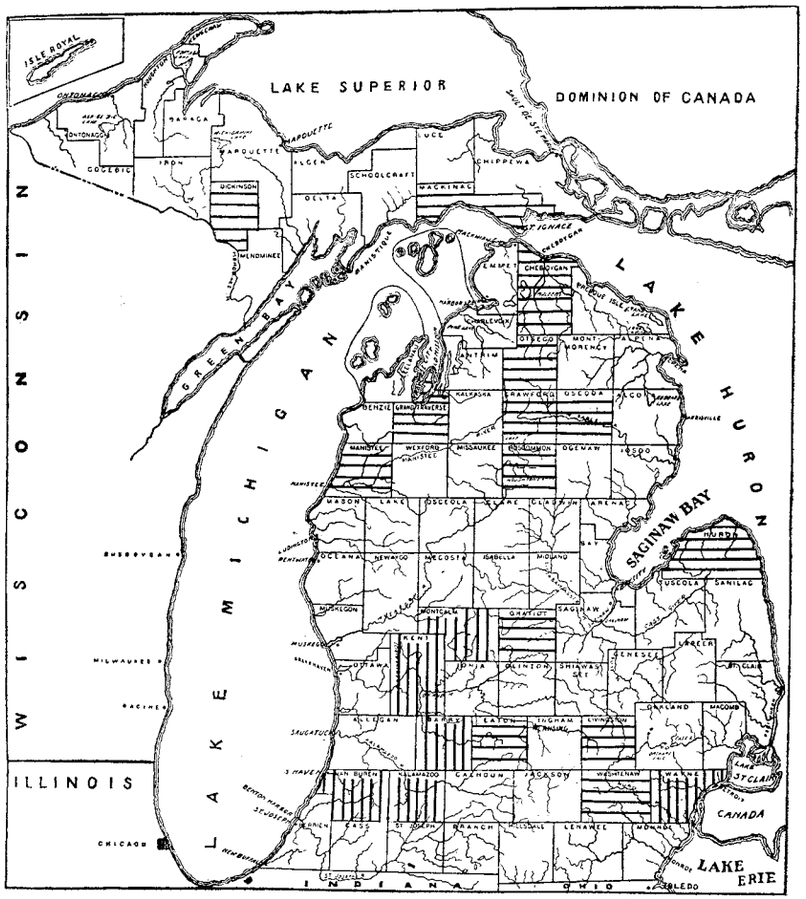

Fig. 37. Distribution of *Liopelltis vernalis.*
Horizontal ruling, specimens examined; vertical ruling, reports only.

of this character will take the larvae or caterpillars of certain moths" (Ditmars, 1907, 325).

Range: The species has been reported from: Michigan (Sager, 1839, 302; Miles, 1861, 233), Ann Arbor (Smith, 1879, 7), Detroit (Cope, 1900, 783), Eaton County (Clark, 1902, 193), Olivet, Ann Arbor, and Barry, Kalamazoo, Kent, Montcalm and Van Buren