

NOTES ON THE MAMMALS AND COLD-BLOODED VERTEBRATES OF THE INDIANA UNIVERSITY FARM, MITCHELL, INDIANA.

By WALTER L. HAIN,

*Fellow in Zoology, Indiana University, Bloomington.*

INTRODUCTION.

Indiana University has come recently into possession of a tract of land in southern Indiana formerly known as the Donaldson Farm. This tract comprises nearly 180 acres. It is, for the most part, covered with a heavy growth of large oak and tulip trees, although a part of it was once cleared and is now partially overgrown with small bushes.

For many years this property was owned by a Scotchman named George Donaldson. At his death it escheated to the State and by special act of the legislature was placed in the custody of Indiana University.

The place is one of great natural beauty, which the former owner spared no pains to preserve. A subterranean stream traverses the property, coming to the surface at two places before finally emerging from the base of a cliff in one of the most picturesque cave entrances in America.

A fellowship in zoology was established on this "farm" with the incumbent as resident care-taker, and as the writer was the first to hold this fellowship it seemed desirable that a general survey of the local fauna be made as a basis for future work, and a part of his time was accordingly devoted to making a collection of the vertebrates and observing their habits. Birds have been quite thoroughly studied at various points in southern Indiana, and are therefore entirely omitted from this paper, which forms No. 93 of the contributions from the Zoological Laboratory of Indiana University.

The writer's incumbency began September 20, 1906, and terminated September 7, 1907. All dates mentioned in this paper are to be un-

derstood as falling within this period unless otherwise stated. While collecting was not limited strictly to the university's property, practically all of the data here presented were obtained within a radius of 1 mile of that place. A few mammals were trapped along White River, 3 miles away.

The site of the University Farm is 3 miles east of Mitchell, Lawrence County, Indiana, and about an equal distance south of the east fork of White River. The elevation varies but little over a hundred feet in the region considered, nevertheless the fauna is influenced in some degree by the physiographic features.

The soil is a thin, gravelly clay, underlaid by subcarboniferous (Mitchell) limestone, through which water percolates readily, making the drainage almost wholly subterranean.<sup>a</sup> For several miles to the south and southwest there are no surface streams at all, and this area consists of a series of larger or smaller sink holes. Many of the sink holes are filled with water, either permanently or during periods of heavy rainfall. While the absence of surface streams reduces the available habitat of the brook-dwelling fishes and amphibians, the numerous ponds, varying in size from a few square yards to an acre, afford homes to many aquatic animals and the individuals of some species are extremely abundant.

The rocky, brush-covered hillsides are inhabited by large numbers of reptiles and small mammals. The caves are entered by a number of species. Altogether, twenty-seven species of vertebrates were represented in these caves, either by living examples or identifiable remains. The large number is of interest in any discussion of the origin of a cave fauna because it shows that while many animals get into caves by accident or intent, only those especially adapted for cave-life survive. The list follows:

1. Blind fish, *Amblyopsis spelæus*.
2. Sun fish, *Apomotis cyanellus*.
3. Cat fish, *Ameiurus nebulosus*.
4. Miller's thumb, *Collus richardsonii*.
5. Minnow (*not identified*).
6. Cave salamander, *Speleperes maculicaudus*.
7. Ashy salamander, *Plethodon cinereus*.
8. Green frog, *Rana clamitans*.
9. Leopard frog, *Rana pipiens*.

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<sup>a</sup>The principal caves are part of one underground water-course. At two places the roof has fallen and exposed the caves and the stream. The stream in the upper one of these breaks is known as Dalton's Spring, and the caves as the upper and lower Spring Caves. Water does not flow through the second break except after a heavy rain. Here the upper and lower openings are close together and are known as the Twin Caves. The exit of the stream is through a lofty opening into a short gorge. It is known as Donaldson's Cave or, more correctly, as Shawnee Cave.

10. Bull frog, *Rana catesbeiana*,
11. Water snake, *Natrix sipedon*,
12. Snapping turtle, *Chelydra serpentina*,
13. Box tortoise, *Terrapene carolina*,
14. Opossum, *Didelphis virginiana*,
15. Rabbit, *Sylvilagus floridanus mearnsi*,
16. Pine mouse, *Microtus pinctorum auricularis*,
17. Prairie vole, *Microtus ochrogaster*,
18. White-footed mouse, *Peromyscus leucopus*,
19. Short-tailed shrew, *Blarina brevicauda*,
20. Big-eared bat, *Corynorhinus macrotis*,
21. Little brown bat, *Myotis lucifugus*,
22. Say bat, *Myotis subulatus*,
23. Large-winged bat, *Myotis velifer*,
24. Large brown bat, *Eptesicus fuscus*,
25. Georgian bat, *Pipistrellus subflavus*,
26. Red bat, *Lasiurus borealis*,
27. Hoary bat, *Lasiurus cinereus*,

Of the above list the fishes enter by following their natural instinct to ascend a stream, and once getting beyond daylight, are unable to get out. The salamanders are partially adapted to subterranean life, and the cave salamander obtains its food and breeds in the cave. Frogs enter in autumn, seeking warmth. Some are carried in by floods also. It is doubtful whether all are able to reach the surface again; none breed in the cave.

Of the reptiles, all get in by accident. The only snapping turtle had been carried in by a flood and died of starvation or injuries. The box tortoise was alive and had probably fallen into a sink-hole from which it had not been able to escape. The snake was found just within the limits of daylight on a cold day in late spring. It had doubtless gone in for warmth, being attracted by the warm outward current of air.

Among the mammals, bats alone are adapted to subterranean existence, and even they must leave the cave to secure food. Two kinds of mice were found alive, but they were few in numbers and had certainly never become established there.

It will be seen, therefore, that the cave fauna can be divided into three groups: (1) Those whose entire life cycle is spent in the cave. (2) Those that have homes in the cave but must go outside for food. (3) Those that are accidental visitors, unable either to obtain food in the cave or to go and come at will.

The third group is the largest in number of species. These animals can not adapt themselves to subterranean existence, and for them to enter the caves is death. The second group is represented by the largest number of individuals. The species belonging to this group may be incipiently subterranean, and any change of conditions which would furnish them with an adequate supply of food within the cave might lead them to take up a permanent residence there.

The first group, comprising the true cave fauna, contains but two species of vertebrates, the blind fish, *Amblyopsis spelæus*, and the cave salamander, *Spelerpes maculicaudus*. The latter is not perfectly adapted to cave life and lives outside of caves in some localities.

The fauna of any restricted area can be divided into the same groups as those given above. Within the limits of distribution of a species, its local occurrence will be governed, in part, by the food supply. But a species is not found in every locality within its range where a sufficient amount of food can be obtained. Here the physical environment is the controlling factor, and the possibility of finding or constructing suitable dens, nests, runways, or other hiding places limits the local distribution of the species.

As far as the author is aware, the ecology of the land vertebrates has never been worked out in detail for such an area. The notes here given on the breeding habits, homes, and food of the various species were gathered for such a contribution, which, however, it has not been possible to complete.

A series from the specimens collected has been presented to the U. S. National Museum.

For providing the opportunity and necessary equipment for carrying on the work my thanks are due to Indiana University, and especially to Dr. C. H. Eigenmann, professor, and Dr. Charles Zeleny, associate professor, of zoology.

## THE COLD-BLOODED VERTEBRATES.

### FISHES.

The relation of the cave fauna to food-supply and to the local terranean fauna is best illustrated by the fishes. The subterranean streams contain a considerable number of small crustacea, plankton, and insect larvæ which constitute the food of the eyeless fish, *Amblyopsis spelæus*. The surface streams contain a much larger quantity of the same kind of food, yet these cave fishes never take up their abode in the lighted portions of the stream. On the other hand, the common brook fishes seldom enter the subterranean portions of the streams and have never become established there.

The larger environment of White River and Mill Creek were not investigated, and, with the exception of one or two hauls of the seine in the latter stream, all of the fishes collected were taken from the small creek which flows from the Shawnee Cave. This part of the stream is less than 300 yards in length and contains no large pools and none more than  $2\frac{1}{2}$  feet deep. Thirteen species of fishes were taken in this stream in the course of a few hours.

The explored portion of the subterranean stream is at least 2 miles in length, and there are pools as large as any of those of the surface run that were seined. But in the 2 miles of underground stream only

the one species has its home and but four others have been observed as rare, accidental visitors.

Two causes combine to keep the other species from becoming established in the caves. First and most important is the dislike of most fishes for entering the dark and their inability to maintain themselves away from daylight. The one species which has become established in the cave is sightless, but the eyes were certainly degenerate before it adopted a subterranean habitat. This fact accounts for its presence in the cave rather than the reverse proposition that the eyes have degenerated because it lived in the dark.

A second factor is the small amount of food to be obtained in the cave. An amphipod and an isopod are permanent residents there. The larvæ of aquatic insects, together with other animal and vegetable matter, are washed into the cave with each heavy rain. Although limited, the supply of food would doubtless be sufficient for several additional species were they able to secure it.

#### LIST OF SPECIES.

1. *Ameiurus nebulosus* (Le Sueur), horned pout; bullhead. Taken in the small creek below the cave.

2. *Ameiurus melas* (Rafinesque), black catfish. One was taken within the upper cave at a point where the light is very dim. There are specimens in the University Museum which were taken near the same spot. I am unable to say whether the fishes ascended the stream through the two lower caves or were washed down from some of the ponds which have been stocked with them, and which overflow through sink holes into the caves.

3. *Catostomus commersonii* (Lacépède), white sucker; common sucker.

4. *Minytrema melanops* (Rafinesque), winter sucker; spotted sucker.

5. *Placopharynx duquesnii* (Le Sueur).

6. *Hybognathus nuchalis* Agassiz.

7. *Pimephales notatus* (Rafinesque), blunt-nosed minnow.

8. *Cliola vigilax* (Baird and Girard).

9. *Notropis whipplei* (Girard), silver-fin.

10. *Rhinichthys atronasus* (Mitchell), black-nosed dace.

11. *Amblyopsis spelæus* De Kay, blind fish. Never seen outside the caves. One was seen in the cave with a minnow almost as large as itself half way down its throat.

12. *Apomotis cyanellus* (Rafinesque), blue sunfish. Has been taken 80 feet within the entrance of the upper cave, which it could have reached only by passing through one of the other caves. The specimens taken in the cave were starved and in very poor condition, and

it was only a matter of days before they would have passed out of the cave or starved to death.

13. *Etheostoma caruleum* Storer, rainbow darter. Not abundant.

14. *Cottus richardsonii* Agassiz, miller's thumb. Abundant. Has been seen a short distance within the lower cave.

#### AMPHIBIANS.

Amphibians were abundant as individuals, although several species common in this region were not seen. The water dog (*Necturus maculosus*), the mud eel (*Siren lacertina*), and the hellbender (*Cryptobranchus alleghaniensis*) no doubt live along the river, but no collecting was done there, and none are found on the "farm."

The economic importance of the amphibians is a subject not often mentioned in the literature of this group. Nearly all frogs and salamanders are insectivorous during part or all of their existence. Where the individuals live in numbers as great as some species were found here they must exert a beneficial influence, not much less in importance than that of birds, in keeping down insect pests.

All that is necessary to set off the egg-laying impulse in some species of amphibians is the presence of water at the time the ova are ripe. In the spring of 1907 many eggs of both salamanders and frogs were laid immediately after the heavy rains which fell during the middle of March. At this time sink holes, roadside pools, and other low places were filled with water. The heavy precipitation ceased suddenly and the water evaporated and ran away. Many amphibian eggs which had been laid in these places were left on the ground to dry up without hatching, and many larvæ perished on account of the pools drying before they had reached adult life. I estimated that not less than one-half of the eggs laid at this time (and the number of these within a radius of 1 mile must have reached into the hundred thousands) were eliminated because they were deposited where the water supply was not permanent.

#### AMBYSTOMA JEFFERSONIANUM (Green).

##### JEFFERSON SALAMANDER.

The adults of this species were not taken, although evidently abundant. On February 28<sup>a</sup> eggs were found in a small pond. This little body of water is circular in shape and only about 25 feet in diameter, with a depth of not more than 18 inches. On the above-mentioned date it was free from ice and the water was very clear. The eggs were in small masses, not perfectly regular in outline nor absolutely uniform in shape, but nearly all had approxi-

<sup>a</sup> These eggs were in the late segmentation stages and had doubtless been laid some days. The species has been known to deposit eggs early in January.

mately the form of a sphere with each pole truncated. Most of the masses were pierced near the center by a weed, the petiole of a leaf, or a small stick. Often several masses were crowded upon the same stick, which was usually so placed that it formed some support to the eggs, although it did not always hold them free from the bottom. There were about 270 of these egg masses in the one small pond. The average number of eggs in each lot was not less than 20, and probably exceeded that number, the total number being, therefore, five or six thousand.

Some of the eggs were put in aquaria in the house. They began hatching March 12. Growth was slow, the young apparently feeding to some extent on the gelatinous substance which had enveloped the eggs. When first hatched the young were about 12 mm. in length. On March 30, eighteen days after hatching, a length of 15.5 mm. had been attained.

At this period the principal food of the larval salamanders seems to be the larvæ of aquatic diptera. These could not be obtained in large quantity, and the slow growth of the young salamanders may be accounted for by lack of sufficient food, although mosquito larvæ were supplied in small numbers and were greedily eaten when not too large and active. Young salamanders that were taken from the pond at this time (March 30) were much larger, being 20 to 25 mm. in length, with heavier bodies and broader heads. Their general color is greenish; blackish dots of pigment are scattered over the entire surface of the animal. On the body these are collected into bands extending across the back and down on the sides, the "fin" being also edged with the darker color. The number and size of the pigment specks do not increase with the growth of the animal, which, therefore, becomes lighter in color with increase in size, except the edge of the "fin," where the pigment accumulates and becomes more dense.

Young taken from the pond on May 2 measured from 30 to 37 mm. At this stage the dark cross bands of pigment have disappeared and the pigment was distributed in irregular blotches. There is an indistinct longitudinal line of pale, olive yellow about the level of the spinal column, and below this a line of denser pigment. Larvæ that had attained a length of 42 to 51 mm. on May 14 have a lateral row of pale, golden-yellow spots varying in number in different individuals.

On June 14 an individual was taken that was of the same length as those of a month previous, but which had a much greater bulk. At this stage the gills and "fin" have been largely resorbed and the animal voluntarily left the water when placed in a shallow aquarium, although it had been seined from the bottom of the pond. The

color is much darker than at any previous stage. The lateral row of yellow spots is indistinct and the pale stripe is also reduced. On the top of the head the pigment is spread in an apparently uniform sheet, the individual specks not being distinguishable; on the sides they can still be made out with a little magnification and the tail is still somewhat mottled, although the pale areas are reduced.

Owing to absence at this time, no completely transformed young from this pond were obtained, and those which had been kept in the house died. On July 10 none could be found either in the pond or under the logs and stones of the neighboring woods. Some larvæ were found, however, in another pond on August 1 and one of them was kept until a week later, when it had transformed. It died before adult coloration had been assumed. At this time the gill-slits are still open, but the external gills have disappeared, as has also the "fin" or keel of the tail. The color is about the same as in the last-mentioned specimen, but the pale spots of the sides are more distinct (probably an individual character) and the dark color extends entirely around the tail.

AMBYSTOMA PUNCTATUM (Linnæus).

SPOTTED SALAMANDER.

Quite common. It was taken only in the woods, either under logs or stones. Several were kept in captivity at different times. They ate earthworms greedily, but did not touch beetles or ants.

Measurements of an adult specimen: Length, 190 mm.; snout to axilla, 36; snout to groin, 83. Costal grooves, 11. Six spots on the head bright, deep orange. A row of about nine lemon-yellow spots on each side from head to base of tail, the spots on tail irregular and some of them from the two rows confluent; limbs also spotted. In all individuals of this species which were seen, the spots on the head were deep orange, but the number so colored varied from four to seven. An adult female taken on May 23 had the ovaries filled with quite large eggs.

AMBYSTOMA TIGRINUM (Green).

TIGER SALAMANDER.

A single specimen was caught in a mouse trap set at the entrance to a small sink hole early in December. Total length, 230 mm.; snout to axilla, 38; snout to groin, 87. Color (in life), glossy blue-black, with many small spots of lemon yellow on back; sides with the yellow predominating; belly, pale yellowish brown, spotted with lemon.



## PLETHODON GLUTINOSUS (Green).

## SLIMY SALAMANDER.

Not uncommon. Found under logs in the woods and once seen in a path, along which it was evidently fleeing to escape some enemy that had succeeded in getting most of the salamander's tail. This species is said to be nocturnal, but one was found which had been feeding in the early afternoon, for it had a beetle in the upper part of the throat.

On March 19 two were found together under an old log. One was very large and the body appeared to be distended by eggs. The two were placed alive in a glass jar and supplied with beetles and earthworms, but ate these sparingly if at all. No eggs were laid, although the larger one was kept for about three months.

Length of one specimen, 138 mm.: snout to axilla, 21; snout to groin, 51. Back irregularly marked with small spots of whitish, those on the head being very minute. On the lower part of the sides these spots become confluent, forming a band of irregular blotches. Tail and underside of body with few spots of white. Underside of head and throat with larger blotches; throat with a white band, crescentic in shape. Costal grooves, fourteen.

## PLETHODON CINEREUS (Green).

## ASHY SALAMANDER.

The most abundant Urodele, but not easily found at all times. During October it was to be found under almost every log in the woods and also under the rocks near the cave entrances. With the approach of winter it was seen less frequently. The extraordinarily warm weather in early January brought it out again and I saw numbers from the 6th to the 8th of that month. From that time till April none were taken above ground. Some were found in a small cave on March 26. Early in April, when the temperature was much lower than during part of March, these salamanders suddenly became very abundant. They were to be seen in almost any part of the woods, and were especially noticeable about the entrance to the Twin Cave. Here they seemed to be migrating from the vicinity of the cave into the woods. In a few moments I found eleven of the animals hiding under stones on the bank, all within an area of a few square yards. Ten days later diligent searching in the same place failed to discover a salamander. However, they remained fairly common under old logs in the woods throughout early spring. During the summer none were found nor were the eggs or young seen.

On several occasions I have heard salamanders of this species utter a faint squeak, not unlike that of a young mouse. They are often found with mutilated tails, doubtless escaping their enemies by

sacrificing that member. They can not endure dust and will die in three or four minutes if dropped on their backs on a dusty floor so that, in turning over, the entire body becomes coated with dust. Indeed, I have found this to be a quicker method of killing them than to drop them in formalin or alcohol.

The color of different individuals of this species varies greatly. None were noted, however, of the so-called *erythronotus* variety with the red of the back bordered by parallel lines, but the *dorsalis* variety with an irregular line of red along the back was almost as common as the ashy-colored individuals.

On March 26, eight specimens, from 40 to 90 mm. in length, were found in a small cave near the University's property. This cave goes down to a depth of 40 feet or more in an irregular spiral, with projecting benches, but no rooms or lateral passages of large size. It was inhabited by this species, by cave salamanders, and green frogs, as well as bats, earthworms, and insects. Some ashy salamanders were found about 25 feet below the surface, from which they were separated by smooth vertical walls, which would have to be sealed by the animals in escaping from the cave.

These animals show a wide variation in color which it may be worth while to describe in detail, as it seems probable that there they were actually blood relatives.

The largest specimen of the lot (90 mm. in length) is marked with a dorsal stripe of dull, dark orange, bordered by a line of dull brown which, in places, almost divides the stripe: the orange is diluted with indistinct flecks of gray, the stripe becoming indistinct on tail. Sides light brown, thickly dotted with minute spots of gray. Belly with ground color paler than sides and gray spots larger and more numerous. Head similar to sides, but slightly paler. Fore legs similar to head, dorsally; hind legs slightly darker. A second specimen is about equal to the first in length, but is more slender. The color is similar, but the dorsal stripe is forked at the occiput, the divisions becoming indistinct, passing through the eye and terminating on the snout. Posteriorly the stripe terminates indistinctly on the base of the tail, the distal portion of the latter being marked with gray. A third individual is more reddish on the back than on the sides, due, however, to a reduction of the gray dots rather than to an increase in the amount of red pigment and therefore not forming a clearly defined stripe. Dorsum of tail, except at tip, brighter than that of back. The smallest individual of this lot, and one of the smallest I have seen of the species (40 mm. in length), also has a dorsal stripe, poorly defined anteriorly, but quite distinct from the middle of the body to near the tip of the tail.

Four of the specimens from this lot have no dorsal stripe. Three of these have the sides and dorsum of the tail mottled with gray and

brown, caused by the segregation of the gray specks into certain areas. The fourth is almost uniformly colored on the back and sides. Several small individuals were found which had distinct bronzy reflections as described for *P. aneus*, but which otherwise agree with *P. cinereus*.

SPELERPES LONGICAUDUS (Green).

LONG-TAILED TRITON.

A single individual of this species was taken by Mr. Ferd Payne in the valley near the mouth of the Hamer Cave half a mile west of Shawnee Cave on May 25. In general appearance it differed little from specimens of the extremely variable cave salamander, abundant in the mouth of the cave not many yards away. However, there are differences in the details of color which, with the vomerine teeth, serve to identify the specimen. Ground color a rather pale orange. Black spots numerous and more often confluent than in *maculicaudus* and forming vertical bands on the tail. The lateral row of spots not very distinct.

Total length, 150 mm.; snout to axilla, 21; snout to groin, 53. Costal grooves, 13.

SPELERPES MACULICAUDUS (Cope).

CAVE SALAMANDER.

Numbers of individuals of this species were seen; but at times specimens were difficult to find. During the summer they were very abundant near the mouth of the Hamer Cave, where they were seen in small pockets or on ledges directly above deep and swift water. During the winter they were seen in the large room of the Shawnee Cave about half a mile from the entrance and also in a large chamber at the right of the lower entrance. In both of these places larvae were found later, but high water prevented entrance to these regions during much of the time from the middle of December until April. The eggs are probably laid during this season, but they have never been described, and the writer was not fortunate enough to secure them.

An account of the life history of this species has been published by Banta and McAtee,<sup>a</sup> but they failed to say anything about the nature of the food or the manner in which it is obtained. In this region the species is found chiefly in caves, but it is not fully adapted to cave life. It is usually seen near the entrances and probably reaches the inner chambers only by accident or for the purpose of breeding. Whether these salamanders obtain food away from daylight has not been certainly determined.

<sup>a</sup> Proc. U. S. Nat. Mus., XXX, 1906, pp. 67-83.

The single observation made on their feeding habits is of interest. Human feces near the mouth of the cave formed a favorite feeding place for these salamanders. Two were captured, and an examination of their stomachs showed that the animals had been feeding on small adult flies and dipterous larvæ, which were abundant in the refuse. At this point I could not see the animals without a light, even when they moved and after my eyes had been accustomed to the twilight. It would have been impossible for the human eye to distinguish flies in such a place. Others of the species taken in better light in the Hamer Cave had also been eating flies. The eyes do not appear to be in any measure degenerate.

An individual kept in captivity for some time refused to eat earthworms, myriapods, or small beetles placed in a glass jar with it.

A specimen taken from the Hamer Cave on July 22 differs somewhat in appearance from most individuals of this species that I have seen. The body is much distended with eggs. In life the ground color is a very deep orange with the black spots large, sharply defined and round; the tip of the tail is entirely black for about 10 mm.

Another specimen has the ground color similar to the above, but the back is marked with large irregular black blotches, indistinctly outlined and often confluent, so that the orange forms scarcely more than a reticulation. On the tail the black spots are smaller and they do not extend as far down the sides as in most individuals. Still another individual is pale yellow, with medium-sized black spots on the back, and the tail covered with many small black dots.

Total length, 153 mm.; snout to axilla, 24; snout to groin, 57. Costal grooves, 13.

*SPELERPES BISLINEATUS* (Green).

TWO-LINED TRITON.

Seen only along the stream leading from the Shawnee Cave, where it was abundant. Usually it was found hiding under submerged rocks, but once or twice was seen out of the water. Adults were to be seen there throughout the year, but no eggs or very young larvæ were found. Larvæ about 25 mm. in length were found in January in a little spring-fed tributary to this stream.

One of these young killed on March 12 is 29 mm. long and the gills are short, although the tail is still strongly keeled. The pigment spots have not yet segregated into unbroken bands, but form a row of small blotches along each side of the back. The median dark stripe is scarcely indicated. The sides are uniformly sprinkled with specks of brown pigment, as are the limbs and head. By March 25 one of the larvæ had transformed. An adult female taken on March 29 had the ovaries distended with eggs which appeared to be nearly ripe.

Amphipods were found in the stomach of an adult of this species, which was found on a rock at the edge of the stream where these crustaceans were abundant. Small diptera were also found in their stomachs. Amphipods and beetles placed in the aquaria were not eaten by either larvæ or adults which were kept in captivity.

Total length, 93 mm.; snout to axilla, 14; snout to groin, 38. Costal grooves, 14. The median dark spots form a narrow, somewhat broken line from the occiput to base of tail. Lateral dark stripes becoming diffused over lower part of sides.

DIEMICTYLUS VIRIDESCENS Rafinesque.

GREEN TRITON; NEWT.

Very abundant in all of the ponds. The eggs and young larvæ were not found, but young about 35 mm. long were taken on August 1. One of these transformed between the 18th and 21st of the same month. Young of the red, or so-called *miniatus* form, were found under old logs in the woods on two occasions, and one was also found in the cave mentioned in the account of *P. cinereus*.

BUFO LENTIGINOSUS AMERICANUS<sup>a</sup> (Le Conte).

TOAD.

Very common. It was not seen until the last of April. At that time the adult toads gathered in considerable numbers about the ponds, and their high-pitched but musical note was heard every night from April till July. At this time no young toads were seen. About the 1st of July the tadpoles began to transform and the little toads became abundant everywhere. Individuals of small size, which had evidently transformed a year previous, were numerous during the summer, though none of these were seen early in the spring.

ACRIS GRYLLUS (Le Conte).

CRICKET FROG.

Perhaps the most abundant of the tailless amphibians. During the autumn it was seen everywhere, in the woods, the fields, and along the roads. While not uncommon near the ponds and creeks, it appeared to be equally at home at a distance from them. All colors, from bright green and rusty red to nearly black, were seen. The smooth-skinned variety (*A. gryllus gryllus*) was not observed.

In the spring the note of the cricket frog was not heard till later than that of the Pickering or chameleon tree-frog. The eggs were not certainly identified, but very small eggs were abundant in many of the ponds during the first two weeks of June. The cricket frog was abundant in the vicinity of these ponds, and no other frog which could possibly have laid the eggs was to be found at that time. The

<sup>a</sup> Toads from this region have recently been identified by Miss Mary C. Dickerson as *Bufo fowleri* Putnam.

eggs did not exceed 1 mm. in diameter. The gelatinous matter surrounding them was thin and transparent and appeared to be light enough to keep the eggs at the surface of the water, although they were never found entirely free from algæ or other floating vegetation. The entire egg-mass was difficult to see because of the small size of the eggs, the transparency of their envelope, and their location.

The larvæ are said by Dr. O. P. Hay to transform late in August. I saw some leaving the water about the middle of July. These could not have hatched from the eggs above mentioned. They are more active than any other amphibian larvæ I have seen. They can run about, spring from object to object, and cling with their feet, while the tail is still as long as the body. In captivity I have seen the adults leap across an aquarium and catch a fly resting on the glass of the other side.

Width of head over tympanum, 9 mm.; tip of snout to anterior edge of tympanum, 8; length from tip of snout to vent, 27; vent to heel, 26; vent to tip of longest toe, 46.

CHOROPHILUS NIGRITUS FERIARUM (Baird).

STRIPED TREE-FROG.

The striped tree-frog was not positively identified at Mitchell. Late in the autumn a frog thought to be of this species was seined from a pond, but it escaped before it could be examined. I also thought I heard its note in the spring, but did not succeed in finding the animal. It is probable, however, that it occurs in certain localities near here, as it is common in southern Indiana. On June 1 it was abundant at West Baden, 25 miles southwest of Mitchell. Heavy rains had fallen, and the frogs were in small temporary ponds voicing their shrill, rapidly repeated whistle during the early afternoon. They were not easily disturbed, and several were caught as they sat on floating leaves. During the last week of June the newly transformed young were abundant in the cypress swamp on the Indiana side of the Wabash River opposite Mount Carmel, Illinois.

A specimen from West Baden has the median stripe entire except on head and rump, where it is broken; next two stripes slightly broken; lower stripes entire nearly to groin.

Width of head over tympanum, 10 mm.; length from tip of snout to anterior border of tympanum, 8; snout to vent, 29; vent to heel, 26; vent to tip of longest toe, 46.

Some newly transformed young, from the cypress swamp previously referred to, vary considerably in color and the distinctness of the markings. One is light gray, with all the bands, as well as the bars of the legs, obscure. Two others have the dorsal stripes faint and narrow but continuous, while on two others they are broad and well defined but broken.

## HYLA VERSICOLOR Le Conte.

## CHAMELEON TREE-FROG.

Very common, but not often seen. On October 26 two young frogs of this species were found near each other in the woods, where they seemed to be looking for winter quarters. Young were frequently seen during August.

This tree-frog became active about the same time as the toad, the last of April, and its note was frequently heard from then till August 1. Throughout May it gathered in numbers around the ponds every night, and at this season it could be found everywhere in abundance during the evening. It is not easily located by the note alone, as that is somewhat ventriloquistic and ceases at the slightest alarm and is not repeated for some time after the disturbance has ceased. Prof. W. P. Hay speaks of this note as a "short, loud, trilled rattle," but this scarcely describes the most common call of this frog, to my mind, as it always seems to me to be somewhat prolonged and mournful, not unlike that of the toad, but lower pitched and less musical.

It has, however, another and very different note which I heard it utter on a spring night as I watched it by the light of a lantern sitting at the water's edge. This is short, irregular, and repeated only three or four times in succession. It may be likened to that of a young chicken calling for its mother, and it also resembles the note of the striped tree-frog.

This frog is well protected by its changeable colors, which harmonize well with the bark of trees, foliage, or stones on which most of its time is spent. But it does not always select a place where it will be inconspicuous. On a cloudy morning I saw one sitting for several hours on the flat top of a gate post, where its form made it very conspicuous, even at a considerable distance.

## HYLA PICKERINGII (Storer).

## PICKERING TREE-FROG.

More abundant, but also more retiring, than the preceding species, except during the breeding season. Its characteristic shrill cry was heard during September and October, on warm, damp days in November and December, on January 5, 6, 7, and next on March 1. After that it was almost constantly heard till about the end of June. Doctor Hay, quoting from Cope, says that it is heard after "the rattling of *Acris gryllus* \* \* \* is fairly under way." The note of this frog has, however, been familiar to me in southern Indiana all of my life, and here it invariably begins calling earlier than any other frog. Some years I have noted it in February.

Usually they are more abundant in temporary ponds and marshy fields than about the larger bodies of water. At Mitchell I found them most abundant during March and April about a temporary pond not more than 60 feet in diameter. At this place the noise of their shrill cries was so deafening that it rang in the ears like the clatter of an iron foundry. One night I captured 40 of the frogs at this place in a short time, and after noting the position and abundance of the remainder rather carefully, I estimated that there were not less than 200 in the pond. Another pond frequented by them was not more than 200 yards away, and there were many others at short distances.

They sit about the edge of the water or on a stick or weed or a bit of bark and devote their whole energy to the love song. The gular sac is distended with all the power the frog can command until it almost equals the body of the animal in size. Then, the effort of the animal exhausted, it suddenly collapses, producing a shrill, ear-piercing whistle, which is repeated three or four times in succession as rapidly as the animal can gather the force of its muscles for the act. During this effort the frog seems oblivious to all else. You can throw the brilliant glare of an acetylene reflector upon him, and he does not even turn his head to stare at it. Approach closer and place your hand over him, yet he must give expression to that cry, even though he feels your hand inclosing him in its grasp.

During the breeding season the Pickering frogs may be heard at all hours of the day, although larger numbers join the chorus in the early evening. At this season they may also be seen during the daytime. Later in the summer I did not succeed in finding a single specimen, so thoroughly do they hide when the mating instinct is dormant.

They have many enemies, who are doubtless attracted, both by the volume of the chorus when the frogs gather in such numbers, and by its excellent carrying power. I found the tracks of opossums, raccoons, minks, and weasels about the pond above mentioned. Larger frogs and also snakes eat them.

It is difficult to understand how their eggs develop in the temporary puddles which they seem to frequent most. Small masses of eggs, presumably of this species, were found in the pond previously mentioned about the last of March. Some of these hatched, but two weeks later there was no water, and not even soft mud, in the pond, and the larvæ must have been dried up.

Width of head over tympanum of largest individuals, 10 mm.; tip of snout to anterior border of tympanum, 7; snout to vent, 28; vent to heel, 24; vent to tip of longest toe, 42.



## RANA PIPIENS (Schreber).

## LEOPARD FROG.

Not uncommon, yet far less abundant than in the Kankakee marshes or even the hilly southeastern part of Indiana. It is occasionally seen in the woods, but is most abundant in meadows and pastures. The young do not appear to stay near the water in the late summer. Newly transformed young were seen leaving the water during the last week in June and throughout July. This is one of the species which seems to hibernate in the caves to some extent. Leopard frogs were seen in some numbers not far within the mouth of the cave during March and they seemed to be moving toward the outside. This frog, also, was active in January. At this time high water overflowed the bottoms and drove many hibernating animals from their winter retreats. Leopard frogs, cricket frogs, and green frogs were among the species observed at this time.

Specimens from this locality should, perhaps, be referred to the form *sphenocephala*, although they partake of some of the characters of *pipiens* also, as the two varieties are defined by Cope. Spots scarcely, or not at all, bordered by pale color. Longitudinal band of femur usually represented by spots. Two phalanges of fourth toe free, the next usually with a very narrow web. Part or all of the tibial markings broken in the middle. External vocal vesicles present in male.

Width of head, 18 mm.; length of head, 18; tip of snout to vent, 66; vent to heel, 62; vent to tip of longest toe, 104.

## RANA CLAMITANS Latreille.

## GREEN FROG.

The relative numbers of this and the preceding species differ in this vicinity from most localities with which I am familiar, *R. clamitans* here being the more abundant. It is found along the creeks and about the ponds, as well as some distance from water. The species, at times, enters the caves where I have found the frogs at least half a mile from daylight.

Green frogs become active earlier in the spring than do the leopard frogs. Eggs were found on March 19, but the laying period seems to be somewhat extended, as ripe ova were found in a female more than a month later. The eggs were laid in large masses attached loosely to reeds and grass. The young appear to transform at any time between June and September.

Frogs of this species are very voracious, apparently eating anything of suitable size that moves within their range of vision. The contents of three stomachs examined on April 30 were as follows:

No. 1, 7 ants, 2 beetles, 1 myriapod, 1 mosquito; No. 2, 6 beetles, 10 mosquitoes, 1 fly; No. 3, 5 beetles, 4 mosquitoes, 1 snail. I have known them to eat tree-frogs, both *H. versicolor* and *H. pickeringi*. Digestion must be very slow, as the stomach of a frog which had been kept in captivity without a chance to secure food for forty-eight hours contained incompletely digested remains of a beetle and of a small frog.

The color and markings of specimens taken here vary greatly. A large breeding male is quite dusky all over the dorsal surface, but there are no distinct spots; dark bars of the legs indefinite. Another, also a breeding male, has numerous, fairly distinct, black spots all over the back; irregular bars run down on the sides, and the legs are marked with definite bars and spots. Another has dorsal spots equally definite, but smaller and less numerous. I noticed that green frogs taken from a pond in the woods in which the water was filled with decaying leaves appeared much darker than those taken from near-by fields, and immersion in alcohol for several weeks did not entirely remove the difference.

Width of head, 27 mm.; length of head, 30; snout to vent, 79; vent to heel, 72; vent to tip of longest toe, 120.

#### RANA CATESBEIANA Shaw.

##### BULL FROG.

Common about the larger ponds and several times seen in the caves, on one occasion at least half a mile from the entrance. High water carried a large bullfrog out of the lower end of the Shawnee Cave in midwinter.

In spite of the reputation of its voice, the cry of this frog is less noticeable than that of any other species about here. Its note is low-pitched and musical, carrying for a long distance, but not sounding loud. It was not heard before the middle of May nor after the middle of July. In the early summer these frogs were frequently seen floating on the water with their large eyes just above the surface. At such times they are not easily disturbed, and a stone or a shot may strike the water quite near them without causing them to sink. At night they are more wary and are secured less easily than some of the other species. Their cries always cease on the approach of a noise, and they will jump into the water at the slightest disturbance.

##### REPTILES.

The numerous thickets are well suited for hiding places for snakes, and they are abundant, both in number of species and individuals. On one occasion, in a walk of about a mile, eight trails were seen in the dust where snakes had crossed the road since the passing of the last vehicle, certainly less than half an hour earlier.

The list of turtles is for the vicinity of the University Farm only, and would be greatly increased had this group been collected along White River.

*SCELOPORUS UNDULATUS* (Latreille).

PINE-TREE LIZARD; RAIL-FENCE LIZARD.

Very abundant in the woods and along the fences. They came out of winter quarters early and a number were seen before the end of March. While very active at times, they are not timid. Once I saw a young lizard about 3 inches long following some persons along a path and keeping close to their feet. I have also touched and even picked up the adults as they lay basking in the sun, apparently wide awake. At other times they run away at the slightest disturbance, usually going up a tree if there is one near at hand.

*EUMECES FASCIATUS* (Linnæus).

BLUE-TAILED SKINK.

A single immature specimen was seen, but not captured. It does not seem to be common in this vicinity but is abundant farther south, and a number were seen at New Harmony during the summer of 1907.

*CARPHOPHIS AMGENUS* (Say).

GROUND SNAKE.

Only two of these snakes were seen. The first was found under an old log on March 26. A female taken a little later contained six eggs. The eggs are subcylindrical and 14 mm. long. The stomach of the same animal contained remains of an earthworm and other unrecognizable material.

Scale rows, 12; color of ventral surface extending to middle of second row of scales; ventrals, 126; subcaudals, 23. Prefrontals absent. Length, 265 mm.

*VIRGINIA ELEGANS* Kennicott.

VIRGINIA SNAKE.

I am indebted to Mr. Ferd Payne for the first record of this comparatively rare snake from this locality. I took a second specimen in the edge of the woods near the house on August 30. The body was swollen to such an extent that the tail was sharply demarked. Dissection revealed six perfectly formed embryos, one of which was examined and found to be 95 mm. in length and similar in squamation and color to the adult except that it is slightly darker and the markings more obscure.

Color in life, brown above with a decided bluish tinge, the two or three lowest rows of scales paler than those above them; a faint pale

stripe, one entire scale and two half scales in width, down the middle of the back. On each side of this median stripe a somewhat irregular row of small black dots on the seventh row of scales, which is also darker than the other rows; another line of more scattered dots about the fifth row. Head with a number of very small dark blotches, larger and less clearly defined than those of the lateral rows. Below, sulphur yellow with a decided greenish reflection. Where the color of the sides and underparts meet there is a tinge of rosy. A bad odor, not unlike that of *Diadophis punctatus*, is very noticeable.

Scale rows, 17; ventral plates, 125; subcaudals, 34. Length, 264 mm.; tail, 38 mm.

DIADOPHIS PUNCTATUS (Linnæus).

RING-NECK SNAKE.

This species appears to be abundant here. It is generally found on the hillsides which are covered with loose rocks. It was first seen on March 31 near the Twin Cave and later was noted on all of the rocky hills in the vicinity. When captured it makes no attempt to bite, but the odor which it emits is very disagreeable, though not penetrating. It is sluggish and is said to be chiefly nocturnal in habit, but I have seen it moving about in the daytime.

Scales in 15 rows; ventrals, 146 to 148; subcaudals, 54 to 56. Color, glossy blue-black above, reddish orange below; ring of neck, lemon color, two scales in width. Length, 265 mm.

HETERODON PLATIRHINOS Latreille.

HOG-NOSE SNAKE; SPREADING ADDER.

Not uncommon. Also first seen March 31. None that I saw were of the very dark or very red colors sometimes seen in this species. This snake is much feared by most people, but is entirely harmless. I have thrust my finger against its nose and even into its mouth without being bitten. Apparently the instinct to frighten has been developed to such a degree that the habit of active defense has been lost.

I have seen a female of this species buried in the soft earth of a cornfield, apparently guarding her eggs, among which she was coiled.

PHYLLOPHILOPHIS ÆSTIVUS (Linnæus).

ROUGH GREEN SNAKE.

Not uncommon. One was rescued from a blue racer not much longer than its captive. The latter made haste to get away and did not appear to be injured, although its head and about one-fourth of the body had been swallowed.

Scale rows, 17; ventrals, 163; subcaudals, 127. Length, 875 mm.

## BASCANION CONSTRICTOR (Linnæus).

## BLUE RACER; BLACK SNAKE.

Very abundant everywhere in the vicinity. This species has often been called bad tempered and vicious, but that is not my own experience with it. Usually these snakes will glide away with great swiftness at the sound of approaching steps. However, I have approached them quietly and stroked the neck and back with my hand without the reptile attempting either to escape or to bite. When captured they become angry and will bite at anything within reach. If kept in captivity they sometimes become docile and permit very rough handling. Probably there are great individual differences in this regard.

The blue racer has a habit of rapidly vibrating its tail when alarmed, and if a dry leaf happens to be in the way the effect is very much like the noise of a rattlesnake. It is probable that the motion of the tail is a sort of nervous impulse, due to excitement, and is not, strictly speaking, instinctive nor an adaptive mimicry of the venomous species. I have seen this vibratory motion when the snake was in a dusty road where no noise was produced.

## CALLOPELTIS OBSOLETUS (Say).

## ALLEGHENY BLACK SNAKE.

Nearly as abundant as the preceding species. It is a great destroyer of birds, climbing trees, if necessary, to reach the eggs and young. It also frequents barns, stables, and poultry yards. Only the typical form was seen about Mitchell. A more distinctly marked form, apparently *C. obsoletus confinis*, was noted in Knox County about 50 miles southwest.

## STORERIA OCCIPITO-MACULATA (Storer).

## STORER SNAKE.

Probably quite common. Two individuals were taken during the year. A female in the university collection, taken at the University Farm in August, 1906, contains ten embryos. They are about 85 mm. in length and resemble the mother in color. From their condition it is evident that the species is viviparous and not ovoviviparous, as Dr. O. P. Hay supposed.<sup>a</sup>

The female mentioned above is darker than the other specimens taken and has no distinct longitudinal stripes, although the pale spot on the occipital region is present. Another of these snakes has stripes so distinct as to bear a slight resemblance to a garter snake. The

<sup>a</sup> The Reptiles and Batrachians of Indiana, 17th Rept. Ind. State Geologist, p. 498.

belly in life was near salmon color, but in alcohol has faded to greenish yellow. A dark line runs along the ventral plates at the edge of the belly. This is followed by a pale stripe. The first row of scales form the second dark line, while the second, and most of the third rows are pale; fourth, fifth, and sixth rows are dark, while a light stripe nearly three scales wide forms the mid-dorsal line. The other specimen taken is intermediate in the distinctness of the markings.

Length of the last-mentioned specimen, 170 mm. Scale rows, 15; ventrals, 127; subcaudals, 48 pairs.

*NATRIX SIPEDON* (Linnaeus).

WATER SNAKE.

Common about the ponds. One was found some distance within a cave.

*THAMNOPHIS SIRTALIS* (Linnaeus).

GARTER SNAKE.

Only a few seen.

*LAMPROPELTIS DOLIATUS TRIANGULUS* (Boie).

MILK SNAKE; HOUSE SNAKE.

Not uncommon. Elsewhere I have generally seen this species in the vicinity of buildings, but here it was numerous in the woods. I have always found this to be an evil-tempered snake. When disturbed it neither attempts to escape or to coil, but raises the anterior half or more of the body clear of the ground, forming an irregular S, and it may remain on guard in this attitude for some time.

Scale rows, 19; ventrals, 198; subcaudals, 46. Loral present. Length, 785 mm. A dorsal series of 42 spots of bright, reddish-brown, surrounded by a distinct ring of black, one scale wide. The alternating spots sometimes confluent with dorsal series. Ventrals irregularly blotched with rectangular spots of black.

*AGKISTRODON CONTORTRIX* (Linnaeus).

COPPERHEAD.

Not rare. Two were seen during the summer of 1907 and several had been taken the previous year. Like the blue racer, it produces a rattling noise when the rapidly vibrating tail comes in contact with a dry leaf. It is probably less dangerous than most people suppose, because it is often very sluggish and does not strike till thoroughly aroused. No doubt there are great individual differences in this regard.

Scale rows, 23; ventrals, 156; subcaudals, 50; 20 "saddles" of dark color extending entirely across the back, with a single exception; the pale areas between, with a pair of dark spots. Length, 710 mm.

## TRIONYX SPINIFERUS Le Sueur.

## SPINY SOFT-SHELLED TURTLE.

Not seen alive but a small boy, familiar with the ponds of the neighborhood, informed me that the soft-shelled turtles were sometimes found in them. His statements were confirmed by finding the mangled remains of one in the road not far from a pond.

## CHELYDRA SERPENTINA (Linnæus).

## SNAPPING TURTLE.

Very common. In the spring they seem to wander a great deal, traveling from pond to pond. The remains of one was found in the cave some distance from the entrance. It had doubtless entered by accident and had been unable to sustain life there. A large one killed by a boy in the neighborhood measured 11 inches in a direct line from the nuchal to the caudal plate.

## TERRAPENE CAROLINA (Linnæus).

## BOX TORTOISE.

Very common; found living in the cave. A pair were seen mating on September 6. During the later part, at least, of the sexual congress the male assumes an erect position with the hinder edge of the carapace and hind feet on the ground, the tail hooked under the female, and the head and fore limbs in the air.

## CHRYSEMYS MARGINATA Agassiz.

## WESTERN PAINTED TORTOISE.

Very abundant in the ponds. On one occasion twenty-seven were counted on a single log. There were others in the same small pond, and four other ponds within a radius of 200 yards were inhabited by turtles at the same time.

## MAMMALS.

The physical characters of the region exert a noticeable influence upon the mammalian fauna. Bats are attracted in large numbers to the caves, in which they spend a considerable portion of their lives. The rocky hillsides and woods afford homes for the smaller carnivores as well as for the wood-dwelling rodents. An abundant supply of seeds of forest trees, shrubs, and vines furnish food for the latter class of animals.

On the other hand, there are no swamps or large tracts of grassy land in the immediate vicinity, and mammals living in such places

are either restricted in range or altogether absent. *Microtus pennsylvanicus* and *Peromyscus michiganensis*, both abundant at Bloomington, 35 miles north, were not found here at all. Two other grass-inhabiting voles, *M. ochrogaster* and *Synaptomys cooperi stonci* were fairly common, but only in certain localities.

Local migration of some of the small mammals was noted. During the autumn a large number of traps were placed at different times in a small, grass-grown area where the woods had once been cleared. Among other things, a single lemming vole (*S. c. stonci*) was captured, and it seemed to be the only representative of its kind in this area. No prairie voles (*M. ochrogaster*) were taken. During January and again in March, White River overflowed its banks and backwater extended up the creek valleys. In a little valley one-sixth of a mile from the clearing above mentioned these two voles had been abundant. The flood drove them away, probably drowning some, but they suddenly became abundant in the clearing, evidently having migrated there through the woods. Several species of mice and shrews were collected in large numbers on a railway embankment which was left as a narrow island during the flood. This island formed a retreat in time of high water and from this point the species afterward radiated outward to repossess the bottom lands from which they had been temporarily driven.

#### DIDELPHIS VIRGINIANA Kerr.

##### OPOSSUM.

The opossum is very abundant, finding a congenial home in the heavy forest and among the sink holes. Most often it seems to use a woodchuck hole for its home. All the specimens taken were immature and were caught in traps. The young of the previous summer were still immature late in January. The old animals are probably more wary and are not so easily trapped. All the stomachs examined contained remains of apples, which were abundant and easily obtained. Besides apples, two stomachs contained salamanders (*A. punctatum*), one a frog, one a snail, one a bird, and one a mammal.

I never saw tracks or other signs of the opossum in the caves, though a piece of a mandible with a single molar was found in the Shawnee Cave.

#### SCIURUS NIGER RUFIVENTER E. Geoffroy.

##### FOX SQUIRREL.

The woods of the University Farm consist principally of a heavy growth of large timber. In this large tract but one fox squirrel made its home during the winter, although there were many gray squirrels. On farms in the neighborhood, where there were more open groves, fox squirrels were common. Apparently they prefer the smaller and more open woods.



## SCIURUS CAROLINENSIS Gmelin.

## GRAY SQUIRREL.

The gray squirrel is very abundant on the University Farm, seeming to delight in using the large oaks and tulip-trees for homes. In the autumn of 1906 the crop of acorns was very large. I estimated that each of the large white oaks produced from two to eight thousand acorns during that season. Eighty acres are heavily wooded with white oaks and nearly a hundred acres more have a considerable growth of these trees. Before November 1 the immense crop of acorns had been so completely garnered by the squirrels that none were in sight on top of the leaves and only an occasional one could be found by the most careful search.

## SCIUROPTERUS VOLANS (Linnæus).

## FLYING SQUIRREL.

These squirrels were probably abundant, though not often seen. One was caught in a trap at the base of a hollow tree. During the summer, others were seen and heard in the evening, running about or sailing through the air among the trees near the house.

## TAMIAS STRIATUS (Linnæus).

## CHIPMUNK.

Not very abundant in the woods. During the autumn they were often heard giving their chipping call in the fields and open woods. The loud shrill whistle is most often heard in the spring, but I have never heard them chipping at that season.

## MARMOTA MONAX (Linnæus).

## WOODCHUCK; GROUND-HOG.

Very abundant both in the woods and fields. They were seen running about late in October, but probably were not active later than the end of that month.

They began to clean out and enlarge their holes during the last days of February. On March 5 there was a heavy snow storm late in the evening. Early next morning woodchuck tracks were numerous in the snow, showing where the animals had been running about and feeding.

When they venture out in such weather as this, it is difficult to see any adaptive necessity for their hibernation. At such times they eat ferns, shrubs, and the tender shoots of young trees. Indeed, their food is very similar at all times to that of the rabbit. The latter

animal fares well during the winter months and there is no reason why the woodchuck should not get along equally well. In this instance, and probably in many others, hibernation seems to be a sort of physiological rhythm, similar to sleep, but more prolonged.

SYNAPTOMYS COOPERI STONEI<sup>a</sup> Rhoads.

STONE LEMMING MOUSE.

This animal is restricted to fields in which a dense growth of grass is allowed to grow up and remain uncut. One was caught in a live trap on October 5. It was put in a roomy cage and given food and water, but died five days later.

The lemming mouse breeds as soon as the severe weather of winter is over. A large, round nest of moss and dry grass or sticks is made and the young, usually four or five in number, are brought forth in it. The first of these nests was found March 21. It contained four young, varying considerably in bulk and weight of body, but each having a total length of from 62 to 64 mm. The mother escaped and the young were taken to the house, kept in a room at even temperature and fed milk with a pipette. They seemed to thrive at first, but three days later all died within a few hours.

The female mates again very soon after giving birth to young. The period of gestation is probably three or four weeks, and if the process is kept up all summer, and it doubtless is, the number of young produced by a single female must be not less than twenty or thirty a year. The young of the earlier litters doubtless reproduce during their first year, and the rate of increase is therefore quite rapid.

An adult female taken October 5 is grizzled brownish on the back and sides, the hairs being plumbeous at the base and the short fur tipped with bright cinnamon, while the long hairs overlying it are black. Another female taken on March 12 differs from the first only in having grayer cheeks and flanks, and this second specimen is well matched by a male taken the following day. A male taken November 23 is much paler, the reddish tips of the hairs being near drab. The feet and sides are also paler. On the back and rump there is a new growth of short fur similar to the old. A female taken April 12 is similar, but the tail, feet, and sides are even paler than the last specimen and there is no new growth of fur concealed by the older hairs.

A male taken in December has shed the old coat except in the shoulder region and at the sides of the belly. The new growth is darker on account of a number of the hairs (in addition to the coarse overfur)

<sup>a</sup> Reasons are given elsewhere (Proc. U. S. Nat. Mus., XXXII, pp. 460-461) for adopting this name for the Indiana form of lemming vole. A comparison of the skulls will readily show that it is not *gossi*, as several mammalogists have suggested to the writer.

being dark throughout instead of having pale tips. The shoulder patches of old fur are paler, contrasting sharply with the new growth. The young are dark colored and the pale tips of the hairs are buffy instead of ferruginous or cinnamon.

Measurements: Average of ten individuals, total length, 113.2 mm.; tail, 18.5; hind foot, 17.1; ear, 9. Cranial measurements, greatest length, 26; basilar length, 22; palatilar length, 12; greatest width, 12; depth over bullæ, 9.6; palatal width (outside of molars), 6; length of molar series, 6.8.

*MICROTUS OCHROGASTER* (Wagner).

PRAIRIE MEADOW MOUSE.

This is the most abundant vole and is found in the fields wherever there is a growth of grass dense enough to afford cover. Specimens caught November 22 and 23 were evidently not breeding, as the sexual organs were reduced. Of four pregnant females examined during the spring, two contained three embryos each and two contained four each. Some of the nursing females were pregnant, showing that they breed again soon after giving birth to young.

A nest was found under a railroad tie along an embankment on April 11. It contained three young apparently about a week old. The mother was not in the nest when it was found (about 4 p. m.), and the covering was replaced. Early next morning she was again absent, but about 10 o'clock she was in the nest nursing her young. When disturbed she started to run away with the young still clinging to her teats, but the whole family was captured. They were placed in a box and given plenty of fresh grass, as well as other food, and water. Nevertheless the old mouse ate her offspring during the first night and she, herself, survived only two days longer. She showed a surprising ability to climb, going up the vertical sides of the box and clinging to them while attempting to gnaw out, or running along the under surface of the screen wire which formed the top.

This species is diurnal in habits, though probably it is more or less active during the night, and it certainly is during early morning and late evening. It lives principally on grass, boring tunnels through the thickly matted growth and extending these or eating the tender shoots from along their sides as the needs require. Even in winter its food consists principally of grass, the dried blades being used to supplement the green shoots when enough of these can not be found beneath the snow and overgrowth. It does not refuse seeds, however, and is readily attracted by a bait of either cheese or oatmeal. During the early summer, when wheat is ripening, it will cut the stalks into little sections from 2 to 3 inches long, working to get the head low enough to reach and remove the grain. This work has generally

been attributed to *M. pennsylvanicus*, but I have positively traced it to *M. ochrogaster*, though the other species may have a similar habit.

The nest is generally placed underground, but sometimes an old log or board is the only covering. It is made of dry grass and bark. Two or more tunnels usually lead to it, for this species, like *M. pinetorum*, uses underground runways. Its fossorial habits lead it, doubtless accidentally, into caves. I found the skulls of two individuals in the Shawnee Cave and later trapped another there. It had been eating a pasteboard box, which was the only food at hand, and the lack of food would be a sufficient reason for preventing the species from becoming established in these caves.

The mice of this species collected at Mitchell are generally less gray than in northern Indiana. An adult male taken March 25 is still in winter pelage, the fur being long, dense, and soft. The color is dark, the black hairs preponderating, while the gray-tipped hairs are few in number. Others collected a little later have more gray hairs mixed with the black. A male taken on April 3 has very much more fulvous coloring than any other mice of this species that I have seen. The black hairs of the back are less numerous than is usual in the species, there are very few gray-tipped hairs, and all the hairs of the flanks, sides of the neck, and cheeks and lips are tipped with a broad band of fulvous. All the other specimens, collected chiefly in the early spring, are intermediate between those described.

Measurements, average of four males and four females: Total length, 144.2 mm.; tail, 36.4; hind foot, 19.6. Cranial measurements, average of six adults: Greatest length of skull, 26.6 mm.; basilar length, 23; palatilar length, 13; greatest width of braincase, 11.7; depth of brain case over bullae, 10.3; maxillary tooth row, 6.

MICROTUS PINETORUM AURICULARIS Bailey.

PINE VOLE; MOLE MOUSE.

This is an abundant vole, and is found in a great variety of locations. It lives on the rocky hills, about the caves, in the heavy woods where the carpet of dead leaves is several inches deep, and in the fields. Like the prairie vole, it is largely diurnal in habit and may often be seen scurrying back into its hole when one quietly approaches its feeding ground. It is a more omnivorous feeder than the other voles of this region. The contents of the stomachs I have examined is composed largely of seeds and roots, but I have found remains of insects in two. Sometimes grass is eaten, as well as the stems and leaves of other plants and the bark of shrubs and small trees. Where this species takes to the fields it appears to feed principally on grass.

It is not possible to say positively whether the pine vole of this locality is *auricularis* or *scalapsoides*, as the characters are interme-

diate. As the colors are quite dark and the ear large, it is thought best to adopt the former name.

Measurements, average of four: Total length, 122 mm.; tail, 19; hind foot, 16; ear from crown, 6. Cranial measurement of the same: Greatest length of skull, 25.8; basilar length, 21.2; palatilar length, 12.8; greatest width of braincase, 12.2; depth of braincase over bulke, 10.5; maxillary tooth row, 6.

PEROMYSCUS LEUCOPUS (Rafinesque).

WHITE-FOOTED MOUSE.

Here, as in many other places, this is the most abundant mammal, living in all kinds of places and eating all kinds of food. Several took up their residence under the house and in the wood pile just back of it. They were numerous under the corn shocks on the adjoining farm, and four were captured within the cave.

Some misapprehension has existed with regard to these cave mice, and it seems necessary to consider their status somewhat carefully. Prof. W. S. Blatchley says<sup>a</sup> of specimens taken in Marengo Cave: "They differed much in appearance from above-ground specimens, having larger external ears (13 mm. long by 11 mm. broad), longer whiskers (38 mm.), and more protruding eyes. \* \* \* The mice have been noted ever since the cave was discovered, but seem to keep close to the entrance, through which, however, no light passes." Dr. A. M. Banta, who has studied the fauna of the Mayfield Cave, in Monroe County, says<sup>b</sup> that the eyes of one which he captured in the cave became sore when left in the light. He does not state under what conditions it was kept, and as the species is chiefly nocturnal the same thing might occur if one of the mice which lived above ground were kept in intense light without any dark retreat. The measurements given by both Messrs. Banta and Blatchley are exceeded by many teranean specimens I have taken, and as the eyes are always strongly protuberant I doubt that any of the characters indicate even a limited amount of racial modification on account of cave life. Indeed, it is not certain that the species has ever become isolated in a cave.

A number of white-footed mice were kept in captivity at different times, but they could not be kept together. On one occasion six were caught under corn shocks and were divided equally between two cages. Next morning each cage contained two partially eaten carcasses, while of the survivors in each cage, one died within a few hours and the other a day later.

<sup>a</sup> 21st Ann. Rept. of the State Geologist of Indiana, 1896, p. 179.

<sup>b</sup> The Fauna of Mayfield's Cave. Pub. 67 of the Carnegie Institution, p. 19.

A male taken when half grown became so tame that it would eat from my hand. It remained under cover of its box during the day, but toward sunset would leave its retreat and begin to run about the cage looking for food and clambering about, often hanging downward from the roof of the cage. It would not allow me to pick it up, but would voluntarily come to my hand and nibble it or take food from it. Various kinds of food were given it; cheese and dry oatmeal were favorites. Among wild fruits none were eaten so greedily as the berries of the buck-bush (*Symphoricarpos symphoricarpos*). These berries are here the most important single item of diet for these mice in winter and also are eaten extensively by other mammals as well as birds. Acorns were also readily eaten. Seeds of the red bud (*Cercis*), the wahoo (*Euonymus*), and the bitter-sweet (*Celastrus*) were eaten only when the articles of food above mentioned were lacking. Seeds of the scarlet sumac (*Rhus glabra*) were rejected entirely.

A female with three young ate her offspring soon after being put in the cage, but the old one lived for several months. At one time, during my absence, she was without food, but ate the pasteboard box which served her for a home; she must have subsisted on this for at least a week.

Two were taken about an old pond shortly after a period of exceptionally heavy rainfall. At this time salamander eggs had been deposited in abundance around the edges of ponds and the receding water left many of them stranded on the bank. The stomachs of both of the white-footed mice taken at this place contained some gelatinous matter which I could not positively identify, but which resembled the coating of salamander eggs more closely than any other substance apt to be found in such a place.

Measurements, average of 10 adults: Total length, 160 mm.; tail, 70; hind foot, 19.5; ear from crown, 14. Cranial measurements of the same: Greatest length of skull, 25.5; basilar length, 19; palatal length, 10.3; greatest width of braincase, 12; depth of braincase over bulke, 9.3; maxillary tooth row, 4.

SYLVILAGUS FLORIDANUS MEARNSI<sup>a</sup> (Allen).

PRAIRIE COTTONTAIL; RABBIT.

Very abundant; the sink holes and rocks afford homes and hiding places. Now and then rabbits wander into the caves and usually perish if they get away from the sink holes through which they enter the larger chambers. The remains of three were found in the caves, one of them comparatively fresh, the others quite old.

<sup>a</sup> Mr. E. W. Nelson has identified the rabbits collected at Mitchell as *S. f. mcarnsi*.

During the summer I have often seen rabbits lie down on the ground where the soil was bare, smooth, and devoid of vegetation and gnaw the dirt. At one time, in a path near the house, a space of about a square yard had been gnawed away to a depth of from one-fourth to one-half an inch. This was not all done in one night, but it had been done between rains or within ten days.

During the winter I was at the University Farm the State forester complained vigorously of the damage done by rabbits to the young trees on the forest reservation about 50 miles farther south. Accordingly I paid close attention to their winter food in my locality. Comparatively little damage was done to the young hard-wood trees. The vegetation most often eaten was as follows: Wahoo, hydrangea, Christmas fern, sassafras, hepatica, red locust, and ironwood. The shellbark hickory, walnut, and sugar-maple shoots were eaten infrequently. I did not observe an oak, ash, or tulip-tree which had been injured by the rabbits, the abundance of more tender vegetation serving as an effective protection to the more valuable species.

UROCYON CINEREOARGENTEUS (Schreber).

GRAY FOX.

The gray fox is still common in this locality, although almost exterminated throughout the State. The first one I saw came up the path to within 30 yards of the house one morning. The hounds were bellowing in the distance and it stopped now and then to listen. Coming to a rail fence the animal sprang upon it and walked along the top rail for a few yards, but did not make a long leap to the side for the purpose of throwing the dogs off the trail, as the red fox is reputed to do.

Later I found a den in a secluded spot not more than 150 yards from a man's residence. When snow was on the ground the track of one of these foxes entered the Twin Cave nearly every night, for what purpose I can not say, as the cave contained no food, unless the fox was able to catch bats. A large male was caught in a steel trap set along the creek, but the skin was neglected and spoiled.

VULPES FULVUS (Desmarest).

RED FOX.

This fox was not seen or captured, but it is said to be quite as numerous as the other species. A small cave on top of the hill was inhabited by foxes, and I judged by the size of the track that it was the red rather than the gray species which lived in it.

## CANIS OCCIDENTALIS (Richardson).

## TIMBER WOLF.

It seems worth while to put on record what appears to be an authentic specimen of a wolf in this (Lawrence) county. The Indianapolis Star contained a somewhat sensational account of the capture of a wolf by a young girl at Springville, near Bedford. I wrote to the man on whose farm the animal was taken, and he replied that the story was substantially correct. The animal was first seen creeping under a deserted house, and some men were called who drove it out and shot it. The skin was disposed of and the carcass fell a prey to various carrion eaters, so that I was unable to see and verify the identification. Mr. Cobb, the farmer who furnished me with a crude description of the animal, says:

I noticed his tusches [canines] were fully  $1\frac{1}{2}$  inches long, and I think they had been broken at the tips [length doubtless overestimated]. The hide measured 6 feet from tip of nose to tip of tail, but when stretched on a 12-inch board the body part was not over  $3\frac{1}{2}$  or 4 feet long. The tail was long and bushy, something like a fox. The sides were gray, but the back was mixed gray and black, something like a rabbit. The tail was sort of yellowish gray. I suppose he would have been 2 feet in height.

Allowing for errors and exaggerations, this description does not seem to be applicable to a dog or fox. The only other possibility is the coyote. The timber wolf seems, however, to have survived the coyote in the hills of southern Indiana and has been reliably recorded from Brown, the adjoining county on the north, in recent years.

## MEPHITIS PUTIDA (Boitard).

## SKUNK.

Skunks seemed to be common in the region, but I did not succeed in locating a den on the university property, nor were their tracks often seen. Some skins in the possession of a fur buyer were examined, and they appeared to belong to this species.

## LUTREOLA VISON (Shreber).

## MINK.

Tracks were seen frequently: on one occasion they passed across the doorstep.

## PUTORIUS NOVEBORACENSIS Emmons.

## WEASEL.

Tracks of these animals were very numerous. A single one was trapped in a hole at the base of a tree.



## BLARINA BREVICAUDA CAROLINENSIS (Bachman).

## CAROLINA SHREW.

The form of the short-tailed shrew at this locality appears to be nearer *carolinensis* than *brevicauda*, although not typical. Specimens vary in total length from 95 to 105 mm.; hind foot, 11 to 14; tail, 19 to 24. All the specimens taken have a more or less distinct tinge of brownish.

This shrew is common, yet not nearly so abundant as at some other places I have collected. One day while collecting along the railway embankment I heard a loud squealing, and going to the spot I discovered a short-tailed shrew carrying away bodily a nearly grown *Microtus pinetorum*. The shrew became frightened at my approach and left its victim, which was about dead. The vole was the heavier of the two animals.

Measurements, average of five: Total length, 103 mm.; tail, 21.7; hind foot, 12.8. Cranial measurements, average of three: Greatest length of skull, 23; basilar length, 19.3; palatilar length, 10; greatest breadth of braincase, 11.6; depth of braincase over bullae, 7.3; upper tooth row, 10.

## BLARINA PARVA (Say).

## SMALL SHREW.

This shrew is almost as abundant as the larger species, but is not so generally distributed. The species seems to be partly or wholly diurnal in its movements. Its runways beneath the grass are so small as to be scarcely distinguishable. Most of the specimens obtained were taken in the vicinity of some small sink holes, which they evidently entered and in which their nests were probably made.

Measurements, average of six individuals: Total length, 74.8 mm.; tail, 16.6; hind foot, 10. Cranial measurements of the same: Greatest length of skull, 16.2; basilar length, 14; palatilar length, 7; greatest breadth of braincase, 8; depth, 5.4; upper tooth row, 7.

## CORYNORHINUS MACROTIS (Le Conte).

BIG-EARED BAT.<sup>a</sup>

This species, previously known from but one other locality in the State, proved to be common. Seven individuals were seen, but only two were secured. They were all found during the winter not far within the caves where both light and cold reached.

<sup>a</sup> A detailed account of the habits of the bats of this locality, together with some experimental studies of their sensory adaptations, has been published by the author in the Biological Bulletin, XV, 1908, pp. 135-133.

Color of adult female taken in December: Back, very near the hair brown of Ridgway, the hairs banded with four distinct rings of color; the basal one-third clove brown followed by a band of brocoli brown; next a band of dark sepia, which is tipped by a narrow band of pale brown. The mingling of the outer bands gives the animal its characteristic color. Belly, pure white, with bases of hairs nearly black; breast and sides of throat with a tinge of the color of the back. An adult male, taken on May 5, has a somewhat darker color, due to the wearing away of the pale tips of the dorsal hairs.

Measurement of an adult female: Total length, 92 mm.; tail, 43; hind foot, 10; ear, 27; forearm, 43; longest finger, 78; expanse, 225. Cranial measurements: Greatest length of skull, 18 mm.; basilar length, 12; palatilar length, 6.5; breadth over audital bullæ, 10; depth from bullæ, 9; maxillary tooth row, 6.5; mandibular length, 10.5.

MYOTIS SUBULATUS (Say).

SAY BAT.

Common but less abundant than *M. lucifugus*. During the winter a few were found associated with the last-named species, the percentage, as nearly as it could be estimated, being 1 in 20. During the late summer they entered the cave in greater numbers and for several weeks, during July and August, the Say bat exceeded any other species in numbers.

This species exhibits a considerable variation both in color and proportions. In nine specimens collected between December 17 and April 9 the hairs of the ventral surface are tipped with pure white which glistens in life and makes the animals very conspicuous when seen by lantern light in the cave. The hair of the dorsal surface of the same individuals is paler than the average, being near the drab of Ridgway on the outer third, with clove brown at the base. The ears and membranes of these specimens are also pale, and the interfemoral membrane of some individuals is edged with a narrow pale stripe. Hair soft, close, and short.

An adult female taken on February 17 is more yellow, approaching the tawny olive of Ridgway, although not exactly matching it; underparts dirty yellowish white; membranes blackish. A male taken three weeks later is still darker, and it is almost exactly matched by a male taken August 14. Other August skins are in fresh pelage. A male killed on August 9 has very short, dense fur, mouse gray in color, but the hairs minutely tipped with cinnamon and but slightly darkened at the base. Another taken the same date is very much darker throughout. Fur on dorsal surfaces of both these bats tipped with cinnamon. A male taken August 2, also in fresh pelage, is simi-

lar, but the cinnamon tips are longer and brighter and the bases of the hairs darker.

The seasonal variation in color, in so far as it can be determined from this series of eighteen skins, may be summarized as follows: The old coat of hair is shed in July or August, while the new growth is still quite short. The new hairs are at first nearly unicolor, the tint being something near mouse gray. As the hairs lengthen, the basal part grows darker, finally becoming almost black in some individuals, while the tip assumes a reddish tinge which may vary from bright cinnamon to tawny olive or raw umber. After a time the reddish tinge fades in some individuals, leaving the animals drab or grayish in color, while others retain the reddish color throughout the year. The hairs of the underside are at first dark at the base and yellowish at the tips, but the yellow fades also, leaving the animals white beneath. The dark bases do not show on either the dorsal or ventral sides.

The ear varies more than any other structural character, the extremes being 11 and 16 mm. The forearm varies from 34 to 40 mm. and the tibia from 16 to 19 mm. Cranial variation is comparatively slight.

Average measurements (from the flesh) of eight males and two females: Total length, 87.9 mm.; tail vertebrae, 37.6; hind foot, 9.9; ear, from crown, 12.7; forearm, 37.8; tibia, 17.4. Cranial measurements: Greatest length of skull, 15.3 mm.; basilar length, 11.8; palatal length, 7.3; greatest width of braincase, 8.1; depth of braincase from aduital bullae, 7.4; maxillary tooth row, 7.3.

#### MYOTIS LUCIFUGUS (Le Conte).

#### LITTLE BROWN BAT.

This is by far the most abundant species of bat in this vicinity. Not less than four hundred passed the winter in the caves of the University property, and the number may have been much larger, as these animals sometimes creep away into the small crevices where they can not be seen. During the greater part of the year they are gregarious, cave-dwelling bats, but during the summer very few are found in the cave.

Color variations consist chiefly in a difference in intensity and apparently have no relation to season or sex. Some individuals are very near the typical color of *Eptesicus fuscus* (dark cinnamon), while others are very nearly tawny olive at the tips of the hairs. Still others are much darker, near Prout's brown. Molting seems to take place at any time during the summer. The darker basal part of the hairs is not so well concealed by the reddish tips, and the color is apt to be darker just after the molt. However, there are

exceptions to this rule, some of the bats with short summer fur being the lightest in color of any of this species that I have seen. The color of the underparts also varies considerably, but it always has a yellowish or reddish tinge and is never tipped with pure white, as in some specimens of *M. subulatus*.

Average measurement of six females and four males: Total length, 89.4 mm; tail, 38.7; hind foot, 9.9; ear, 11.1; forearm, 37.4; tibia, 16.6. Cranial measurements of the same specimens: Greatest length of skull, 15; basilar length, 11.5; palatilar length, 6.8; greatest width of braincase, 7.8; depth of braincase from bullæ, 6.9; maxillary tooth row, 6.9.

MYOTIS VELIFER (J. A. Allen).

LARGE-WINGED BAT.

This species, with a habitat chiefly along the Mexican boundary region, had previously been reported from nowhere nearer than southwestern Missouri and Nick-a-Jack Cave, Tennessee. A single specimen was taken in the Twin Cave not far from the entrance on August 9. It is a female, which apparently had nursed during the present season, as there was a new growth of short, whitish hairs about the mammae. There are also white hairs along the middle line of the abdomen. Back light sepia, except some indistinct blotches on the shoulders, which are blackish.

Measurements: Total length, 97 mm.; tail, 40; hind foot, 10; ear, 12; forearm, 44; tibia, 20. Cranial measurements: Greatest length, 16 mm.; basilar length, 13; palatilar length, 8; depth of braincase over bullæ, 7.5; width of braincase, 8.5; maxillary tooth row, 7.

PIPISTRELLUS SUBFLAVUS (F. Cuvier).

GEORGIAN BAT.

Next to *Myotis lucifugus*, this is the most abundant bat. It hibernated in the cave in considerable numbers and was seen flying about in the evenings throughout the summer. It is easily distinguished from the other bats of the vicinity by its uncertain, wavering flight, which resembles that of a butterfly. In the cave it was most often found on the sides of the high walls at some distance from the entrance.

Average measurements of five adult males and five females are as follows: Total length, 78.4 mm.; tail, 35.3; hind foot, 8.8; ear, 9.5; forearm, 33.8; longest finger, 58.6. Cranial measurements, average of five individuals: Greatest length of skull, 13.4 mm.; basilar length, 10; palatilar length, 5.5; greatest width, 7.2; greatest depth, 6.4; maxillary tooth row, 5.6.

## EPTESICUS FUSCUS (Beauvois).

## LARGE BROWN BAT.

Comparatively rare. But three specimens were taken, all of which were found in the cave near the entrance. Color of an adult male taken August 2, bright bistre above, broccoli brown below. A male taken in December is very near the raw umber of Ridgway in the color of the dorsal surface.

Measurements of an adult male: Total length, 100 mm.; tail, 40; hind foot, 11; ear, 11; forearm, 45; longest finger, 80; expanse, 295. Cranial measurements of the same individual: Greatest length, 20 mm.; basilar length, 15; palatilar length, 9; greatest width of braincase, 10; depth over bulke, 8; maxillary tooth row, 9; mandibular length, 15.1.

## LASIURUS BOREALIS (Müller).

## RED BAT.

No living specimens of this bat were seen in the caves, nor do I know that it has ever been taken alive in any of the caves of the Mississippi valley. A few individuals were seen flying about in the woods on summer evenings.

About two hundred skulls of this species were found in a large chamber of Shawnee Cave and a few in a chamber of Upper Spring Cave.<sup>a</sup> The skulls were scattered on the floor of the cavern in a way that indicated that the animals had died while hanging from the roof. Only about twenty skulls of all of the other species now abundant here, were found in the same place. Apparently the red bat has changed its habit from cave-dwelling to tree-dwelling within recent times.

## LASIURUS CINEREUS (Beauvois).

## HOARY BAT.

This species was not seen alive, but two skulls were found associated with those of the last species. The hoary bat is found in this region at the present time, but it is rare.

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<sup>a</sup> A brief account of these skulls has been published in the Proceedings of the Indiana Academy of Science for 1906.