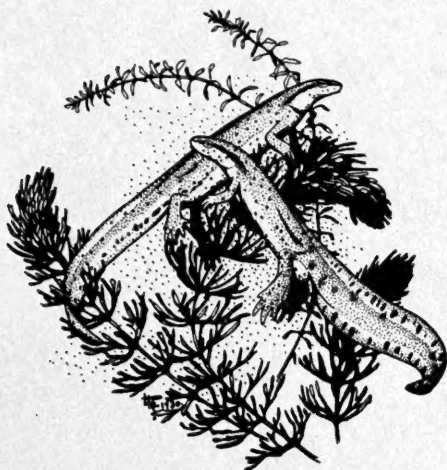


THE SALAMANDERS OF THE CHICAGO AREA

BY

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ZOOLOGY
LEAFLET 12

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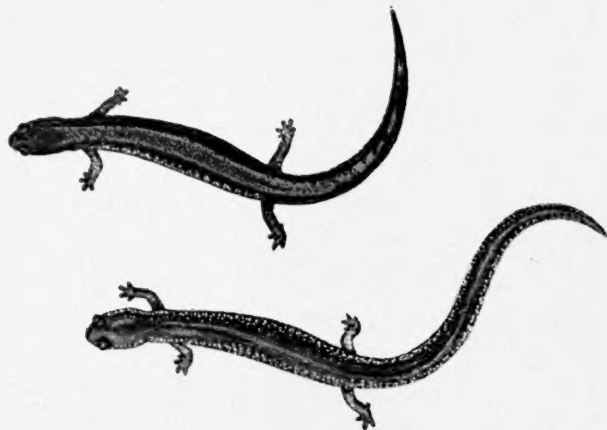
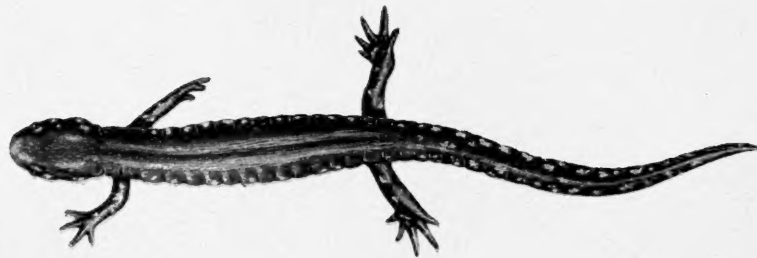
The Zoological Leaflets of Field Museum are devoted to brief, non-technical accounts of the history, classification, distribution and life habits of animals, with especial reference to subjects shown in the Museum's exhibits.

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STEPHEN C. SIMMS, DIRECTOR

FIELD MUSEUM OF NATURAL HISTORY
CHICAGO, U. S. A.



SMALLER SALAMANDERS OF THE CHICAGO AREA

1. Jefferson's salamander

2. Common newt

3. Four-toed salamander

4. Red-backed salamander (gray and red phases)

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The Salamanders of the Chicago Area

The environs of any large city inevitably include numbers of people interested in natural history, as well as numerous schools and colleges and, with these, teachers and students interested in zoology and perhaps more or less dependent on the local animal life for study material. The local fauna thus becomes an appropriate subject for leaflets and handbooks designed to afford a simple means of identification of the animals of the area concerned. For the purpose of the series of zoological leaflets to which the present belongs, the "Chicago area" is the area within fifty miles of the center of Chicago. This, accordingly, includes small corners of Michigan and Wisconsin, with wide segments of northeastern Illinois and northwestern Indiana. With the salamanders we complete the treatment of the amphibians of the Chicago area, for the frogs and toads have been dealt with in a former leaflet in this series.¹

While the number of different kinds of salamanders in the area within fifty miles of Chicago is somewhat smaller than the number of frogs and toads, the former are even more interesting to the naturalist. They exhibit a greater diversity of form and structure and a much greater variety of breeding habits. In addition, there are numerous problems about the local species which remain to be solved.

¹Zoological Leaflet No. 11, Field Museum of Natural History, 1929.

The illustrations in the present leaflet, as well as the cover vignette, are the work of Leon L. Pray, who has illustrated so many zoological publications for Field Museum. Special acknowledgment is due him for his painstaking care in the preparation of these drawings and for his unfailing interest in the project of illustrating the local fauna. All of the figures except that of the newt were drawn from specimens from the Chicago area, and the species which are illustrated in color have been painted from living specimens.

The word "salamander" has no very secure meaning in popular usage. In mythology it referred to a creature which was supposed to be able to endure fire with impunity. It is not at all clear that this myth originated with the European "fire salamander" as its basis—it may equally well have had an independent origin, the name being subsequently transferred to the animals we now know as salamanders. Their supposed ability to withstand fire has given rise to numerous technical uses of the word for instruments used in fire—such as the metal drum for coals used in drying plaster—or for the mass of metal or slag remaining in the metallurgist's furnace after the fires are drawn. On account of their lizard-like body form, salamanders are often known as lizards. They may instantly be distinguished from all true lizards by their moist, glandular, and scaleless skin, lizards being scaled *reptiles* while salamanders are scaleless *amphibians*.

The salamanders form the second of the principal groups of amphibians, the first being the world-wide frogs and toads, while the remaining group, the caecilians, is confined to the tropics. The technical classification is:

Class Amphibia	{	Order Salientia (frogs and toads)
		Order Caudata (salamanders)
		Order Gymnophiona (caecilians)

The order of the salamanders is divided by students of this group into nine *families*, no less than seven of

which (including the most remarkable forms) are found in North America. The families of salamanders are:

1. Sirenidae Southeastern North America
2. Hynobiidae Northeastern Asia
3. Cryptobranchidae Eastern North America (Ohio River)
4. Amphiumidae Southeastern North America
5. Proteidae North America, Europe
6. Ambystomidae North America
7. Pleurodelidae North America, Europe, Northern Asia
8. Salamandridae Europe
9. Plethodontidae North America, South America

The extraordinary large salamanders of the southeastern United States (illustrated on Plate IV) include the eel-shaped siren which has branched external gills and only one pair of limbs (fig. 1); the similarly shaped but very different Congo snake or lamprey eel (*Amphiuma*) which has no external gills and both pairs of limbs, though these are reduced to an extreme degree (fig. 3); the very flat-bodied, stout-limbed hellbender (*Cryptobranchus*), without gills (fig. 2), notable for its relationship to the giant salamander of Japan and to a European fossil form of Miocene age; and finally, our local fauna includes the water-dog or mud puppy (*Necturus*) (fig. 4), which has well-developed gills and well-developed limbs. The *Necturus* is somewhat obscurely related to the blind European cave salamander, the "olm" (*Proteus*). These forms are conspicuous for their size and for their isolated distributions. The most abundant salamanders of North America are the smaller forms of the family Plethodontidae, a group characterized by the entire absence of lungs. This family contains no less than eighty-six species, which may be grouped into fifteen genera, but only two of its forms are found in the Chicago area.

The life histories of salamanders provide a fascinating subject. Fertilization in all of our species takes place in an extraordinary manner. There is usually a rather well-defined courtship of the female by the male, after which the male deposits a mucous-encased sac of sperm, known as a "spermatophore." This is taken up by the female by means of her cloacal lips, and the spermatozoa then migrate to their special receptacle in the female, the spermatheca, from which they fertilize the eggs as they are laid.

The eggs of all the species which lay in water are much like frogs' eggs, and are frequently mistaken for them in early spring. There is no uniformity, however, in the place or manner of depositing the eggs, and these questions will be discussed under the several species headings below. The eggs segment regularly, and the young salamander hatches as a gill-bearing larva, often provided with a curious pair of rod-like "balancing organs." During the gilled stage, the limbs develop, the front limbs appearing first (which distinguishes them from the early stages of frog larvae). The changes on the occasion of transformation to the adult land stage consist principally in the loss of the branched external gills and a change in the texture of the skin, with considerable internal changes in the skeleton. The mouth parts and feeding habits, unlike those of frog tadpoles, undergo little change.

One of the most remarkable phenomena in the natural history of salamanders is the fact that, under certain conditions, transformation to the land form may not take place at all. The aquatic larva, instead of losing its gills, may become sexually mature and reproduce season after season. This phenomenon, in a species normally with an adult land stage, is called *neoteny*. It is most typically developed in our common tiger salamander of the western states.



MUD PUPPY (*Necturus maculosus*)

The occurrence of neoteny in certain salamanders seems to throw some light on forms like the mud puppy (*Necturus*), which may be thought of as a "permanent larva." It seems evident that in such forms the adult stage has been lost during geologic history and that it is a larval form which is known to us. Such a conjecture is especially warranted in the case of the remarkable Texas salamander from artesian waters (*Typhlomolge rathbuni*), which has been shown to belong to the family Plethodontidae, other members of which invariably have an adult land stage.

Scarcely less remarkable than neoteny is the development of numerous other salamanders on land, which involves the passage of the whole larval life within the egg. This is the case with one of our common species of salamanders, and appears as a definite tendency among the Plethodontid salamanders, culminating in viviparity in their most advanced genus, *Oedipus*, of tropical America.

Salamanders possess remarkable powers of regeneration, in which they are perhaps unique among vertebrates. Lizards are able to reproduce a lost tail, but the new one differs radically in structure from the true tail, and limbs are not regenerated. Frogs successfully regenerate extensive areas of skin, and occasional limb regeneration may take place in adult frogs, but is exceptional. Complete regeneration of limbs is the rule among tadpoles. In salamanders this power of regenerating a limb or tail with its bony structure complete seems never to be lost.

The position and number of ribs in land salamanders is indicated externally by vertical grooves on the sides, the "costal grooves," whose number is frequently useful in distinguishing the species.

Only four of the seven North American families of salamanders are represented in the fauna of the Chicago area which, furthermore, contains only seven species out

of the total of eighty known from North America north of Mexico. The Chicago species are:

PROTEIDAE

1. Mud Puppy (*Necturus maculosus*)

AMBYSTOMIDAE

2. Tiger Salamander (*Ambystoma tigrinum*)
3. Spotted Salamander (*Ambystoma maculatum*)
4. Jefferson's Salamander (*Ambystoma jeffersonianum*)

PLEURODELIDAE

5. Newt (*Triturus viridescens*)

PLETHODONTIDAE

6. Four-toed Salamander (*Hemidactylium scutatum*)
7. Red-backed Salamander (*Plethodon cinereus*)

KEY TO THE SALAMANDERS OF THE
CHICAGO AREA

- A. Large, bushy, red gills always present; back more or less black spotted on brown ground color, always in water.
Mud Puppy (*Necturus maculosus*).
- AA. Adult without gills.
 - B. Small red spots, edged with black, on the sides.
Newt (*Triturus viridescens*).
 - BB. No small red spots on back or sides.
 - C. Small white spots on back and sides.
Jefferson's Salamander (*A. jeffersonianum*).
 - CC. No small white spots.
 - D. Belly white, with sharply defined black spots.
Four-toed Salamander (*H. scutatum*).

- DD. Belly not white.
- E. No large yellow spots, back uniform gray or red.
Red-backed Salamander (*P. cinereus*).
- EE. Large yellow spots present.
- F. Yellow spots in two rows on back.
Spotted Salamander (*A. maculatum*).
- FF. Yellow spots irregular on back, in a row along edge of belly.
Tiger Salamander (*A. tigrinum*).

THE MUD PUPPY (*Necturus maculosus*)

The wholly aquatic mud puppy (Plate II) is one of the remarkable large salamanders of eastern North America. It ranges widely to the north and west, from the Atlantic Coast to Saskatchewan, and from the Gulf Coast to Quebec. An allied species (*Necturus punctatus*), somewhat smaller in size, and with a very restricted range, occurs in the Carolinas. Their only relative, within the family Proteidae, is the olm, a blind white cave salamander of the Austrian Alps.

The mud puppy is not very well known to the residents of the Chicago area. Fishermen bring one or two specimens annually to Field Museum for identification. Even the name "mud puppy" is not widely current, and country school children are likely to know them as water lizards.

It occurs somewhat sparingly in the Desplaines, Dupage, and Fox Rivers, and in the lagoons of Chicago parks which are directly connected with Lake Michigan. There seems to be a large population of mud puppies in Lake Michigan with a well-defined annual migration up the inflowing rivers, though definite observations and records on this topic are wanting.

The mud puppy is immediately recognizable by its large size, stout body, short limbs and tail and large,

almost rectangular head, with the unmistakable velvety red gills on the side of the neck. The gills are borne on three fleshy stalks on each side. They are not seen in their normal relation unless the animal is immersed in water and at rest. The color varies from grayish brown to darker brown, with a mottling of darker brown or black spots. Occasional specimens are dark brown all over with small black dots.

The eggs of *Necturus* are deposited singly, each attached by a stalk of the gelatinous envelope to the under sides of stones, logs, or other objects, in varying depths of water up to five feet or more. The eggs are deposited in groups or "nests" with an average of sixty to seventy eggs in each. The time of egg-laying extends through May and June, and hatching seems to take place in June and July. The newly hatched larvae are about 18 mm. (three-fourths of an inch) in length, and have very large yolk sacs which provide them with food until they have doubled their size. The gills are developed and the limbs are represented by "buds" at the time of hatching. The juvenile *Necturus* above 30 mm. in length have a light yellowish line on each side of the back which distinguishes them from any other local salamander larva.

The food habits of the mud puppy must vary in different situations. The under surfaces of rock in the rivers west of Chicago afford an ample supply of insect larvae, small crayfishes, and other invertebrates. They frequently take hooks baited with earthworm, and are probably wholly carnivorous. It is not impossible that the mud puppies in turn are preyed upon by the larger fish. Their relations with the fish fauna of the Great Lakes are quite unknown.

Necturus plays a useful role in North American zoological education, since it is a favorite for dissection in courses in elementary vertebrate anatomy in high schools and colleges. The number sold for this purpose by one

of the biological supply houses in Chicago amounts to about 2,000 specimens per annum.

THE TIGER SALAMANDER (*Ambystoma tigrinum*)

The tiger salamander (Plate III, fig. 2) is a typical representative of the salamander group and is our most familiar form in the Chicago area. The geographic range of this species is an extraordinarily wide one, spanning the North American continent almost from coast to coast, and extending from the Mexican plateau to southern Canada. Various local forms have developed in this widespread population, the one at Chicago being distinguished by its spotted, rather than cross-banded, color pattern. The common name is accordingly much more appropriate for the yellow-banded form of the western plains.

In our area, the tiger salamander is most readily recognized by its large yellow spots, which are irregularly arranged on the back and sides and more or less confluent on the lateral edges of the belly. The spotted sides at once distinguish the tiger salamander from the spotted salamander, the only other species with which it might be confused.

These creatures are subterranean to an extraordinary degree. They are sometimes encountered during the summer in garden soil. In the early fall they migrate overland, at night, to the nearest pond or marsh, where they hibernate and are ready for egg-laying in the spring. It is during this overland migration that they are most frequently observed, for they fall into basement area-ways which serve as pitfalls from which they are unable to escape.

The eggs are laid in clusters three or four inches across in early spring (March), and are usually attached to sticks or weed stems in shallow water. Occasionally they may be laid on the bottoms of ponds, attached to dead leaves or chips or even stones. The number of eggs in a cluster ranges up to at least seventy-five. Egg-laying takes place

soon after the ponds and marshes are free from ice, from the middle of March to early April. The larvae are hatched about fourteen days after the eggs are laid, and require about three months of growth before they are ready to transform into the gill-less adult stage. The newly hatched larvae do not have the curious balancing organs which characterize the two related forms, the spotted salamander and Jefferson's salamander.

The larvae of the tiger salamander in the plains region of western North America frequently fail to transform and continue to live and grow as gilled larvae without leaving the water. They attain sexual maturity and may then continue in this stage for generations (see above, p. 4). The large larvae are called "axolotles" from the Mexican name of the similar and related forms in the lakes near Mexico City.

Neoteny has been a favorite subject of investigation in recent years, especially with reference to the function of the thyroid in inducing transformation. A curious problem presents itself in this connection with respect to the local tiger salamander, for these are not known to produce axolotles. It would be interesting to experiment with them to see if axolotles could be produced in the laboratory. It seems not impossible that our eastern tiger salamander is in reality more distinct from that of the Great Plains than has been supposed.

THE SPOTTED SALAMANDER (*Ambystoma maculatum*)

The spotted salamander (Plate III, fig. 1) is an abundant form throughout the northeastern United States. It is apparently less abundant in the Chicago area than the tiger salamander. Field Museum has specimens from Willow Springs and from the vicinity of Highland Park.

Like the tiger salamander, the spotted salamander is black or dark brown with yellow spots, and the two species are closely similar in size and body form. The spotted salamander may easily be distinguished by its unspotted

sides and the arrangement of its spots in two fairly regular rows on the back.

The eggs of this form are laid in earliest spring. They are readily distinguishable from those of the other *Ambystomas* by the clear or semi-opaque mass of gelatine which encloses the egg-cluster. The young larvae, for the first two weeks of their life, are provided with a pair of rod-like structures beneath the head, which apparently function as "balancers."

The very remarkable courtship dance of this form was discovered by Mr. and Mrs. Breder, of the New York Zoological Society, in 1926. It has long been known that this species hibernates on land and there is a well-defined migration of great numbers of specimens to the breeding pools in spring. The Breders found that, at the culmination of this migration, there is a sort of mass courtship in which males and females in woodland pools weave in and out in aggregations composed of large numbers of individuals. This activity doubtless serves to stimulate the females to pick up the spermatophores as they are deposited by the males.

The feeding habits of this species are apparently like those of the tiger salamander. They are found under logs, on the hardwood ridges northwest of Chicago, in early autumn.

JEFFERSON'S SALAMANDER (*Ambystoma jeffersonianum*)

Jefferson's salamander (Plate I, fig. 1) is much smaller than either the tiger or spotted salamanders. Its black ground color with irregularly scattered white spots distinguishes it adequately from any other salamander in our area. The white spots are much smaller than the yellow spots of the other two species. To the east and south, however, a similar coloration appears in the wholly unrelated slimy salamander (*Plethodon glutinosus*), a member of the family Plethodontidae.

Jefferson's salamander ranges from New England to Minnesota and southward to Virginia and Illinois. It is abundant under logs and railway ties in the Dune region, in early fall, and under logs on the wooded moraine northwest of Chicago. It doubtless occurs throughout the originally timbered section of the Chicago area.

The egg masses of this species are much looser than those of the two related forms, and the number of eggs, averaging about fifteen, is much fewer. Egg-laying takes place at an earlier date than in either of the other species, almost as soon as the ponds are free from thick ice. The larvae have balancers like those of the spotted salamander, so that they are easily distinguished from tiger salamander larvae. They may be distinguished from the larvae of the spotted salamander by the concentration of the black pigment on the sides into fairly well-defined spots.

THE COMMON NEWT (*Triturus viridescens*)

The common newt (Plate I, fig. 2) ranges throughout the eastern United States, but is singularly rare in the Chicago area. It has been collected at Hesseville, Indiana, and in the Skokie marsh west of Highland Park.

The newt is easy to distinguish from any other salamander in our area by its coloration, olive or yellowish green with a row of black rimmed scarlet spots on each side, and with sharply defined black spots on the belly.

The life history of this species has received a good deal of attention. The male newt, during the breeding season, has the tail-fin so much widened that it is twice as broad as that of the female, and the hind limbs are much enlarged and provided with horny pads on their inner sides. The head of the male is provided with glands which appear to stimulate the female during the highly complicated courtship. The body of the female, distended with eggs, is plumper than the male, so that the sexes are very easily recognized. The eggs are laid singly, usually



AMBYSTOMAS OF THE CHICAGO AREA

1. Spotted salamander

2. Tiger salamander

four. The china-white belly is not merely pale but has a deposit of white pigment, against which the small black spots are even more sharply defined than are those of the newt. The costal grooves are sharply bent on the back, which somewhat resembles scaling, and from this character is derived the scientific name *scutatum*. There is a definite constriction at the base of the tail.

The breeding habits are remarkable in that they illustrate a transitional stage between the purely aquatic development of most salamanders and the terrestrial breeding habits of the more advanced plethodonts. The eggs are laid at the edges of ponds or in moss in sphagnum bogs several inches above the water, and are guarded by the female which coils about them. They require about five weeks to hatch, and the duration of larval life, which is passed in the water, is about six weeks. Egg-laying in this latitude takes place about mid-April.

As has been mentioned in the introductory notes, salamanders are capable of complete regeneration of a lost tail or limb. In a number of forms loss of the tail forms a definite defensive procedure, the tail being cast off when the salamander is attacked by an enemy, in order to enable its owner to escape, while the tail, actively squirming and wriggling with reflex motion, occupies the attention of the enemy. This phenomenon, when the tail is provided with special breakage planes for the purpose, is known as *autotomy*. In the four-toed salamander the tail is provided with such a breaking point near its base, as may be seen in the figure. It is the only species in our fauna with the breaking point so restricted.

THE RED-BACKED SALAMANDER (*Plethodon cinereus*)

The red-backed salamander (Plate I, fig. 4) is the smallest species of salamander in the Chicago fauna. Its identification offers a difficulty in that it occurs in two color phases, one red-backed and the other uniform gray.

It is easily distinguishable, however, by elimination of the distinctive characters of the other species—it has neither white nor yellow spots, and has no sharply defined black dots on the belly like those of the newt or the four-toed salamander. Adult breeding males have swollen snouts, nasolabial grooves and elongated premaxillary teeth. These may readily be distinguished by examination with a hand lens. They produce a somewhat angular outline in the shape of the head.

It has almost exactly the same range as Jefferson's salamander—the whole of northeastern North America, ranging well north into Ontario and Quebec. It is pronouncedly a salamander of the forested region, living in and beneath decayed logs, where the wealth of small insect life affords an ample food supply.

The life history is interesting for its complete adaptation to land life. The spermatophores are probably transferred from the male to the female in late autumn. The eggs, five to thirteen in number, are deposited in the crevices of damp logs, probably no earlier than June, and often as late as August. The young salamanders complete their development within the egg and hatch as small replicas of their parents.

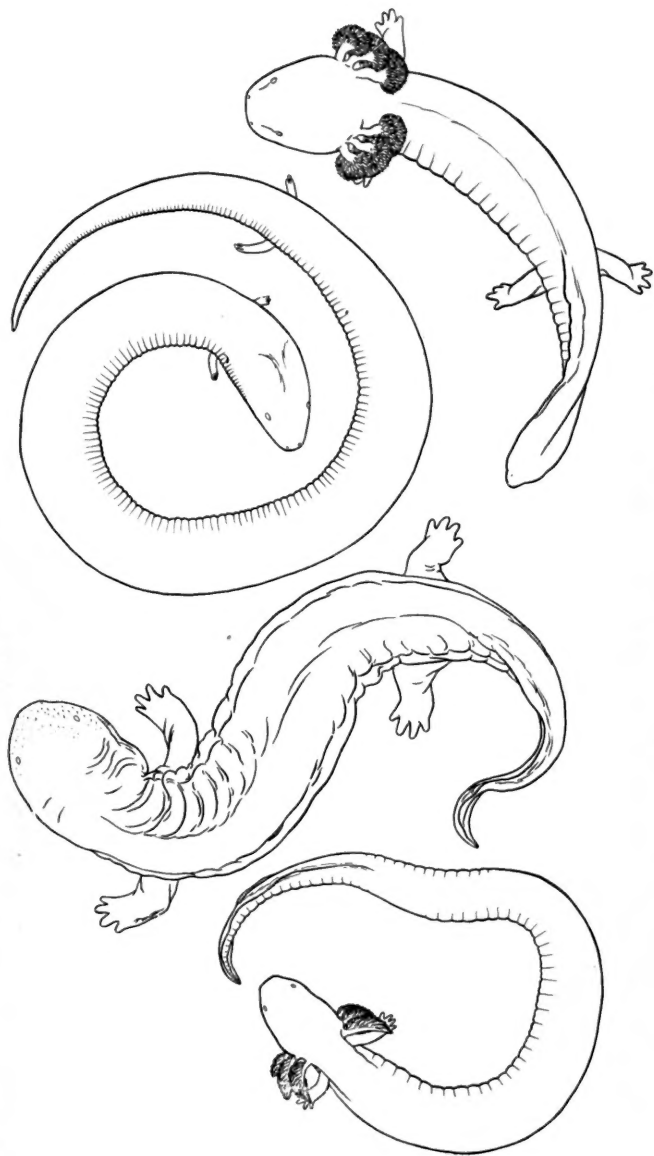
The two color phases occur in about equal numbers, and have nothing to do with sex or habitat.

Observations of egg-clusters of this species in the Chicago region are much to be desired. Terrarium observation might yield important information as to the mode of transfer of the spermatophores from male to female, and the courtship activities, which doubtless exist, are wholly unknown.

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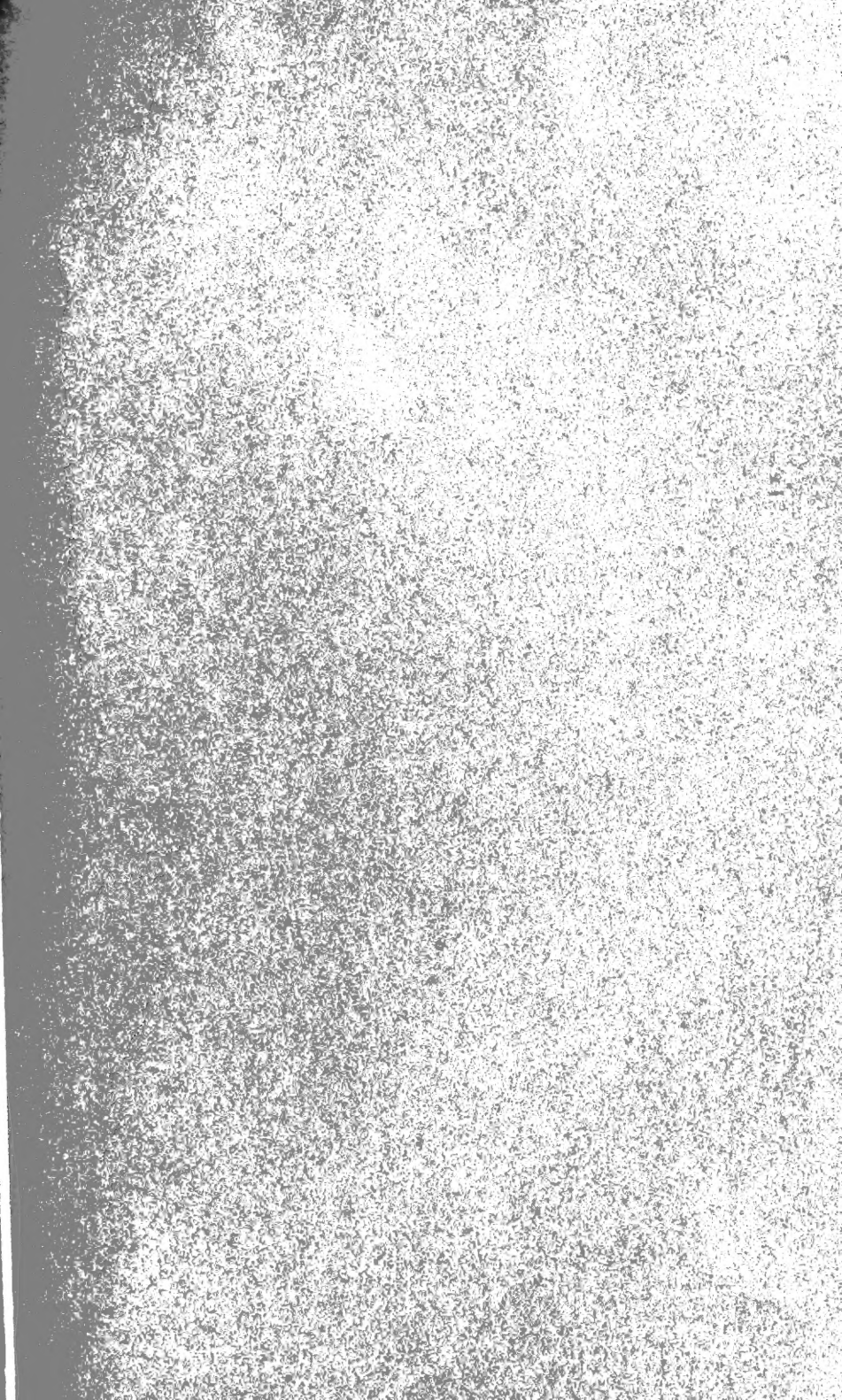
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REMARKABLE SALAMANDERS OF THE SOUTHEASTERN UNITED STATES

- 1. Siren
- 2. Hellbender
- 3. Lamprey eel
- 4. Mud puppy



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