

A SYNOPSIS FOR THE IDENTIFICATION OF THE
AMPHIBIANS AND REPTILES OF INDIANA.¹

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The present synopsis is presented with the hope that it will be of value in the correct identification of the species of amphibians and reptiles found within the state limits of Indiana. Hay's *Batrachians and Reptiles of Indiana*, published over 30 years ago, no longer gives a proper idea of our current knowledge of the herpetological fauna.

A synopsis of this type must be largely compilation, but the author has introduced some matter that he hopes will make Indiana specimens more easily identifiable than in the general manuals. The account of the two species of common toads is new, based on studies made in New York, New Jersey, North Carolina, and Indiana, although most of the characters used for differentiation were first suggested by Dr. A. G. Ruthven, several years since.

To those from whose works he has borrowed the author wishes to express his indebtedness. Of such thus utilized the following have been most valuable: Blanchard's *A Key to the Snakes of the United States, Canada, and Lower California*, 1925; his *Revision of the King Snakes*, 1921; Ruthven's *Variations and Genetic Relationships of the Garter Snakes*, 1908; Dunn's review of the snakes, turtles, and salamanders in Pratt's *Manual of the Vertebrate Animals of the United States*, 1923; and Miss Dickerson's *Frog Book*, 1906. Cope's *Batrachia of North America*, 1889; his *Crocodylians, Lizards, and Snakes of North America*, 1898; Jordan's *Manual of the Vertebrates*, 1899; and Boulenger's *Catalogue of the Chelonians in the British Museum*, 1889, have also been used. The nomenclature is almost entirely that of Stejneger and Barbour's *Check-List of North American Amphibians and Reptiles*, second edition, 1923.

Owing to the lamentably small amount of work that has been done on Indiana amphibians and reptiles in the last 30 years, the reliable distributional data still rests to a large extent on Hay's publication of 1893. Ortenburger published a short list of Indiana species in *Copeia*, No. 99, 1921, pp. 73-76. Two older papers are valuable, namely, Hahn's, on the fauna of the Indiana University farm, Mitchell, *Proc. U. S. Nat. Mus.* XXXV, 1908, pp. 545-581, and McAtee's, on Monroe County vertebrates, *Proc. Biol. Soc. Wash.*, XX, 1907, pp. 1-16.

Much work remains to be done on the gross distribution of the amphibians and reptiles before we will have accurate knowledge even of what species occur in Indiana. We may hope that a survey of the herpetology of the state will soon be made and an adequate report prepared, but no report can be made in the present state of our knowledge. A great amount of systematic collecting must be done and cooperation of the zoölogists of the state secured, before the reptiles and amphibians of Indiana can be said to be even fairly well known.

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SYNOPSIS.

- A1. Scaleless; skin glandular; moist in most forms.—*Amphibia*.
 A2. Scaly, excepting in the soft-shell turtles, where integument is leathery.—*Reptilia*.

KEY TO MAJOR GROUPS OF INDIANA AMPHIBIANS.

- A1. Tail present throughout life.—*Salamanders*.
 A2. Tail lost in adult stage.—*Frogs and Toads*.

SALAMANDERS.

- A1. Weak front legs only (order Meantes); body elongate and eel-like; up to 3 feet; reported from New Harmony, Terre Haute, Lafayette, Washington; in swamps.—*Siren lacertina* Linné—MUD EEL.
 A2. Two pairs of legs.²
 B1. Adults with bushy red external gills (order Proteida), brownish, spotted and spotted with dark; up to two feet; in lakes and rivers; throughout the state.—*Necturus maculosus maculosus* (Rafinesque)—MUD PUPPY.
 B2. Adults without external gills; smaller (order Mutabilia).
 C1. Adults with gill slits throughout life; large (size up to two feet); wholly aquatic; head flat; broad; eyes small; lateral folds of skin; brown, spotted; throughout the state.—*Cryptobranchus alleganiensis* (Daudin)—HELLBENDER.
 C2. Adults without gill slits; not over 10 inches, usually considerably less.
 D1. No groove from the nostril to the lip; no parasphenoid teeth.
 E1. Costal grooves present; vomerine teeth set transversely. (Ambystomidae.)
 F1. Boldly marked with yellow spots or with a bold pattern of gray on black body color.
 G1. A row of several brilliant canary yellow spots down each side of back, sometimes rather irregular, on a bluish or purplish black background; one plantar tubercle or none; under stones or wood in damp places; throughout the state; a very heavily built species; adults 4 inches or more.—*Ambystoma maculatum* (Shaw)—SPOTTED SALAMANDER.
 G2. Dull yellow spots thickly and irregularly distributed over a dark ground color; two plantar tubercles; under stones or boards in damp places; a large species, adults 6 inches or more; throughout the state. A variable species, unspotted specimens rarely found.—*Ambystoma tigrinum* (Green)—TIGER SALAMANDER.
 G3. Heavy H-shaped bars of milky gray across back, these often coalescing at the sides to form a heavy ladder-

² *Amphiuma means* Garden, an eel-like form similar to *Siren*, but with four weak legs, has been reported from Jeffersonville. The record is doubtful, but if *Amphiuma* does occur in southern Indiana, the species is probably the closely related *A. tridactylum* Cuvier.

shaped pattern down back; ground color black; under boards or stones in comparatively dry situations; a heavily-built species; up to 4 inches; probably throughout the state.—*Ambystoma opacum* (Gravenhorst)—**MARBLED SALAMANDER.**

- F2. Color dark or dull, often with pale grayish spots or dots.
- H1. Body extremely short and stout; head broad and depressed; 10 costal grooves; a southern species found in southern Illinois and perhaps in the southern tip of Indiana.—*Ambystoma talpoideum* (Holbrook)—**MOLE SALAMANDER.**
- H2. Body comparatively slender; costal grooves 12 to 14.
- I1. Costal grooves 12; vomerine teeth in 4 patches running behind the internal nares; throughout the state.—*Ambystoma jeffersonianum* (Green)—**JEFFERSON'S SALAMANDER.**
- I2. Costal grooves, 14; vomerine teeth in two patches, not extending along behind the internal nares; throughout the state.—*Ambystoma texanum* (Matthes) (= *A. microstomum* Cope).
- E2. No costal grooves; greenish, brownish, or red; a row of a few small black bordered red dots down each side of back; belly yellow or pink speckled with black; in ponds (water form) or on land under rotten logs in damp woods (red or brown land stage). (Salamandridae.)—*Triturus viridescens* (Rafinesque)—**COMMON NEWT.**
- D2. A naso-labial groove present from the nostril to the upper lip; parasphenoid teeth present; all slender species. (Plethodontidae.)
- J1. Toes on hind feet 4; brownish above; underside pure white boldly sprinkled with black dots; locally common around sphagnum swamps.—*Hemidactylum scutatum* (Schlegel)—**FOUR TOED SALAMANDER.**
- J2. Toes on hind feet 5.
- K1. Tongue free all around its edge, supported by a central stalk.
- L1. Body brownish or bluish mottled and blotched with gray; a more or less light line between nostril and eye; costal grooves 15; along brooks, under stones; Allegheny Mts., west to Columbus, Ohio; not yet reported from Indiana.—*Gyrinophilus porphyriticus* (Green)—**PURPLE SALAMANDER.**
- L2. Body dull yellowish, occasionally grayish, with a distinct dark line down each side of back; costal grooves 15; along brooks, under stones; common throughout the state.—

Eurycea bislineata bislineata (Green)—
TWO LINED SALAMANDER.

- L3. Body very elongate, tail much longer than body; head flat; ground color bright yellow in life, speckled with black, the spots somewhat confluent to form vertical bars on the sides of the tail; under stones, usually not far from brooks; reported from the southern half of the state.—*Eurycea longicauda* (Green)—LONG TAILED SALAMANDER.
- L4. Body very elongate, tail much longer than body; head very flat; ground color orange, spotted with black; the spots never confluent into bars on the side of the tail; in caves or about springs; southern half of Indiana.—*Eurycea lucifuga* Rafinesque³—CAVE SALAMANDER.
- L5. Body not extremely elongate; tail shorter than body; ground color reddish with black spots; probably occurring in Indiana; under stones in brooks and springs.—*Pseudotriton ruber ruber* (Sonnini)—RED SALAMANDER.
- K2. Tongue not free all around its edge; attached at its anterior margin.
- M1. Black, sprinkled to a greater or less extent with silvery gray spots, more numerous along sides; belly gray; costal grooves 14; up to 4 inches; in woodland, usually under rotting logs or in rotting piles of wood; probably throughout the state.—*Plethodon glutinosus* (Green)—SLIMY SALAMANDER.
- M2. Grayish or brownish, sometimes with a wide light or reddish dorsal band; underside finely speckled grayish; costal grooves 19; always found in woodland, under logs and stones; common, its distribution in Indiana confused with that of the next.—*Plethodon cinereus* (Green) GRAY SALAMANDER, RED BACKED SALAMANDER.
- M3. Like M2 but costal grooves 17; in woodland; southern Indiana.—*Plethodon dorsalis* (Cope)—RED BACKED SALAMANDER.
- M4. Dusky, colors in general similar to the two last, but usually more brownish; a

³ *Spelerpes maculicaudus* (Cope) of authors.

more or less evident irregular light line from eye to angle of mouth; always found under stones along courses of brooks and easily distinguished from the last by this habitat; usually in hilly country; southern Indiana.—*Desmognathus fuscus fuscus* (Rafinesque)—DUSKY SALAMANDER.

Notes to Synopsis of Salamanders.

The above synopsis cannot be used for the determination of larva salamanders. Such immature specimens are valuable, however, and should be preserved and sent to a specialist.

Costal grooves are the furrows along the sides of most salamanders. All those between the legs are counted, although the axillary and inguinal ones (in arm-pit and groin) are sometimes hard to distinguish.

Plantar tubercles are small tubercles on the sole of a salamander's foot.

For parasphenoid and vomerine teeth of salamanders, see figure 2. In some forms the parasphenoids are continuous with the vomerines, and in others the parasphenoids are absent.

The naso-labial groove of the Plethodontidae is not easy to distinguish in some species. A hand lens should be used.

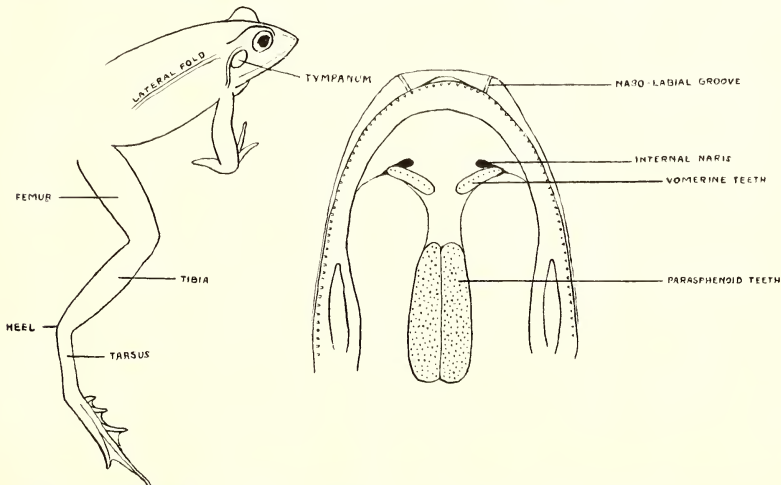


Fig. 1 (Left)—Frog (*Rana*) showing heel, lateral fold, and tympanum. Fig. 2 (Right)—Roof of mouth of salamander (*Plethodon glutinosus*) showing patches of teeth.

FROGS AND TOADS.

- A1. A large elongate or oval swelling (the parotoid gland) present behind the eye and above the circular ear-drum (tympanum). Toads.
- B1. Upper surfaces of hind legs rough with irregular enlarged horny warts; body and head very rugose and warty, becoming more so with age; cranial crests very evident; some of the warts on the

back always enlarged and horny; dark color spots of back usually each with one enlarged wart; areolae on undersurface rather coarse, each with a minute horny pustule in the adult; color reddish brown to blackish, never pale gray or with a greenish tinge; undersurface spotted; rarely entirely brick red above; song a prolonged high-pitched musical trill, heard only in the breeding season, April and early May; usually in hilly or upland country, in general from Hudson Bay south to the 39th parallel, much further south in the mountains. Nearly all previous records of toads in the state confuse this species with the next. The present species seems not to be found at Bloomington, but I have taken it at Decatur, Adams County.—*Bufo americanus* Holbrook—AMERICAN TOAD.

- B2. Upper surfaces of hind legs with small inconspicuous warts, with rare exceptions; warts on back small, almost never enlarged and horny; cranial crests inconspicuous; several small warts of equal size in each color spot of the back; areolae of undersurface very fine with no tiny horny spicules, the skin soft; light gray to dark dull drab usually with a slight greenish tinge; dark color spots very conspicuous when ground color is light; colors never tinged with reddish brown, excepting in very rare bright red specimens; undersurface spotted or immaculate; possibly occasionally interbreeding with *americanus*, this accounting for intermediate examples; song a characteristic harsh trill, decidedly less musical and shorter than that of *americanus*; breeding season late April or, more usually, May to July or, rarely August; more a lowland species than *americanus*; New England and New York south to Georgia, west to Michigan and Missouri, and along the Gulf to central Texas; its distribution in Indiana not well known. A smaller and decidedly more dapper and active toad than the last. *Bufo fowleri* Garman—FOWLER'S TOAD.
- A2. Parotoid glands absent.
- C1. Tips of fingers and toes expanded into small adhesive knobs or discs, these reduced and scarcely noticeable without close inspection in the smaller species. (Tree-frogs, Cricket-frogs.)
- D1. Toes webbed to beyond the last joint, the expanded tips very small; size small, $1\frac{1}{4}$ inches or less; snout pointed; back usually roughly warty with a central reddish or greenish band; found in damp, grassy places; breeding season May and June, in more or less deep, weedy ponds, particularly where there are pond-lilies; call a sharp rattle, resembling the rattling of marbles, but more explosive when near at hand; our commonest amphibian in southern Indiana.—*Acris gryllus* (Le Conte)—CRICKET FROG.
- D2. Toes with scarcely any web; expanded tips very small; size small, $1\frac{1}{4}$ inches or less; back smooth, with longitudinal streaks (rarely broken up into blotches) on a brownish or grayish background.
- E1. Length of leg to heel (last joint of leg) equals distance from eye to anus; head narrower, its greatest width 3.50

to 3.66 times in the length of body; a distinct spot on each eyelid; breeding season, in New Jersey, February or March; the call "may be imitated by drawing a point strongly across a coarse comb, commencing at the bottom of a jar and bringing it rapidly to the mouth"—Cope; it is not certain that the present species is distinct from the next and the distribution of the two in the state is very confused.—*Hyla (Pseudacris) triseriata* Wied—SWAMP CRICKET FROG.

- E2. Length of leg to heel equals length of body; head wider, its greatest width, at the tympana, 3.25 in length of body; eyelids involved in a median stripe; breeding season February or March; song presumably like the last.—*Hyla (Pseudacris) feriarum* (Baird)—SWAMP CRICKET FROG.
- D3. Toes half webbed; expanded tips small but distinct; size small, $1\frac{1}{4}$ inches or less; snout rather blunt; skin smooth; brownish, with darker markings on the back, these usually in the form of an indistinct X; breeding season February and March; song a high whistle, often repeated, somewhat resembling the "peep" of a lost chicken but louder and more musical, the whistles usually heard in chorus in icy pools in early spring, sounding like sleigh-bells in the distance; next to Acris the most abundant amphibian in the southern half of the state (undoubtedly found throughout), though seldom seen outside the breeding season.—*Hyla crucifer* Wied.—SPRING PEEPER, PICKERING'S HYLE.
- D4. Toes half webbed; expanded tips distinct; size medium to small, usually under $1\frac{1}{2}$ inches; snout blunt; skin smooth; body fairly plump; a pale poorly marked yellow line along upper lip; color brown, green, yellow, or gray, the color changing chamaeleon-like; seldom mottled, usually some shade of brown or green, but the green never is brilliant as in the next; iris of eye bronze; very active; breeding season May; a single very doubtful record from Brookville, Indiana, though the species may be present in the extreme southwest corner of the state.—*Hyla squirella* Latreille—SOUTHERN TREE FROG.
- D5. Toes half webbed; expanded tips very distinct; size medium to rather large, up to $2\frac{3}{4}$ inches, usually about 2; snout blunt; *skin smooth*; body slender; legs very long and slender; a *very distinct* cream colored or metallic golden line along the upper lip, extending along the side and along the tibia, the line along the side and tibia being absent in rare cases; back some shade of brilliant green, dark sage-green when in wet surroundings, light yellowish green when subjected to heat, or in rare cases even brownish; colors never so evanescent as in the last species; iris of eye golden orange; very active; one of our most beautiful amphibians; breeding sea-

⁴*Hyla pickeringii* Storer of authors.

son May; breeding in tall reed patches on the edge of streams and ponds; call a single, explosive, not very musical cry, often repeated; not yet reported from Indiana, but perhaps occurring in the extreme southwest corner of the state.—*Hyla cinerea* (Schneider)⁵—GREEN TREE FROG.

- D6. Toes half webbed; expanded tips very distinct, large; size medium, usually about 2 inches; snout very blunt; skin rough with small warts; body fat and squat; some shade of gray with an irregular marking on the back, this in most cases roughly star-shaped; in wet surroundings the colors are dull gray with a slight brownish tinge; in heat or bright light the color may be white, with but a trace of the markings; sometimes changing to green when on green vegetation; concealed surfaces of hind legs mottled bright yellow; arboreal in habit, found on bushes or low trees; breeding season late May and June, in deep, weedy, ponds frequented by Acris; call a chucking or trilled note comparable to bleating of a goat; common throughout the state, but seldom seen.—*Hyla versicolor versicolor* (Le Conte)—GRAY TREE FROG.
- D7. Similar to the last, but the concealed surfaces of the hind legs not mottled with brilliant yellow, but instead with pale greenish, and the voice a bird-like whistle; reported from Mt. Carmel, Ill., and undoubtedly found in Knox, Gibson and Posey counties.—*Hyla phaeocrypta* (Cope)—BIRD VOICED HYLEA.
- C2. Tips of fingers and toes not expanded into small adhesive pads, pointed.
- E1. Head narrow, with a small mouth; a conspicuous fold of skin across head behind eyes, size small; skin mostly smooth; blackish, brownish or grayish, often two reddish bands backward from eyes; found hiding under boards and leaves; breeding season (in North Carolina) May to August; call resembling an electric buzzer; northward through Mississippi Valley to "southern Indiana" (according to Stejneger and Barbour).—*Gastrophryne carolinensis* (Holbrook)—NARROW MOUTHED TOAD.
- E2. Head not especially narrow, no fold across head behind eyes; size larger.
- F1. A glandular fold of skin from eye down each side of back, not to be confused with fold around ear drum or tympanum.
- G1. With distinct rounded or squarish spots on back; no black patch over tympanum.
- H1. Length of leg to heel as long as or longer than total body length; back with irregular longitudinal folds between the two lateral ones; spots squarish or oval, sometimes rounded.
- I1. Spots squarish or oblong; ground tone always brownish or yellowish; never green; concealed sur-

⁵ I admit *Hyla evittata* Miller as a valid species and hence use *H. cinerea* rather than *H. cinerea cinerea*.

faces of hind legs bright yellow or orange; found in grassy meadows near water; breeding season May; call a guttural ripping sound; throughout the state.—*Rana palustris* Le Conte—PICKEREL FROG.

12. Spots oval (or rounded); ground tone usually green or greenish, often brown; head (front snout tip to rear of tympanum) 3 to $3\frac{1}{2}$ times in total body length; *no small clearly defined round white spot* in center of tympanum; found along borders of streams; breeding season March and early April; call a guttural croaking; throughout the state.—*Rana pipiens* Schreber—LEOPARD FROG.
13. Spots oval (or rounded); head long; about $2\frac{1}{2}$ times in total body length; a small clearly defined white spot at center of tympanum; otherwise as in *R. pipiens*; along streams; a southern species, apparently coming up into Indiana along the larger rivers, its distribution in the state not well known.—*Rana sphenoccephala* (Cope) — SOUTHERN LEOPARD FROG.
- H2. Back and sides rough with elongate warts between the lateral folds; leg to heel less than total body length; all spots definitely *rounded* with conspicuous light borders; a lightish blotch on tympanum; always grayish, never greenish; a rare southern frog taken a few times in Illinois and southern Indiana.—*Rana areolata* Baird and Girard.
- G2. Back without distinct rounded or squarish color spots, often with small black spots; no black patch over tympanum; skin with no folds between the two lateral ones; body brown, head usually green; throat of male yellow; around or in water; breeding season last of March to first of May; breeding call compared by Miss Dickerson to cutting heavy cloth on a table with shears; other calls are a musical "t-chung" and a high pitched scream, the latter given when alarmed and jumping into water; throughout the state.—*Rana clamitans* Latreille—GREEN FROG.
- G3. Back without spots, fairly smooth; brown or gray with a black patch over tympanum.
- J1. Length of leg to heel (first joint of leg above foot) just equals total body length; in woodland; a northern species reported by Ortenburger from Warren and Jennings counties.—*Rana cantabrigensis* Baird—NORTHERN WOOD FROG.
- J2. Length of leg to heel greater than total body length; in woodland; breeding season late February or March; call a hoarse croaking somewhat similar to that of *R. pipiens*; several times

reported from Indiana but doubtless at times confused with *R. cantabrigensis*.—*Rana sylvatica* Le Conte—WOOD FROG.

- F2. No glandular fold down each side of back, as under F1; greenish, adults very large; in weedy ponds; breeding season late April to May; call a deep bass "jug-o-rum"; throughout the state.—*Rana cutesbeiana* Shaw—BULL FROG.

KEY TO MAJOR GROUPS OF INDIANA REPTILES.

- A1. Form elongate, legless, or with four legs; eyes capable of being closed; no wide ventral plates extending across belly.—*Lizards*.
 A2. Form always elongate, legless; eyes incapable of being closed; wide ventral plates extending across belly.—*Snakes*.
 A3. Body incased in a rounded shell, usually calcareous, but leathery in some; four legs.—*Turtles*.

LIZARDS.

- A1. Legless, snakelike; occasional throughout the state.—*Ophisaurus ventralis* (Linné)—"GLASS SNAKE."
 A2. With four legs.
 B1. Color mottled grayish or brown; scales rough; southern Indiana; uncommon.—*Sceloporus undulatus* (Latreille)—SWIFT.
 B2. Color not mottled grayish; scales not rough.
 C1. Scales very small above, large on belly; striped longitudinally with green, black, and yellow; rare; once reported from Wheatland.—*Cnemidophorus sexlineatus* (Linné)—RACE-RUNNER.
 C2. Scales very smooth, not greatly enlarged on belly; small, seldom over 4 inches; dull brownish with lengthwise markings.—*Leiopisma laterale* (Say)—GROUND LIZARD.
 C3. Striped longitudinally with yellow, or whitish, on a black background, or brownish with a lighter brown or reddish head.
 D1. Dark olive green to black with two well defined white (or yellow) lines on each side, tail bluish black; tail bluish underneath in young; not reported from Indiana but perhaps occurring.—*Eumeces anthracinus* (Baird)—BLACK SKINK.
 D2. Black, with five fine yellow stripes, tail brilliant blue, this changing with age so that the adult males lose the blue of the tail, the stripes fade, the body grows brownish and the head mahogany to bright cherry-red; the females do not entirely lose the stripes and the blue of the tail, and the head never becomes red; southern half of the state.—*Eumeces fasciatus* (Linné)—BLUE TAILED SKINK, RED HEAD.

SNAKES.

- A1. Poisonous snakes. (See notes following key.)
 (a) A rattle on tip of tail; with cross bands of yellow and black, or wholly black; top of head with small scales; in wooded regions.—*Crotalus horridus* Linné—TIMBER RATTLESNAKE.

- (b) A rattle; dark brown or gray with darker spots; top of head with large plates; swampy country.—*Sistrurus catenatus catenatus* (Rafinesque)—MASSASAUGA, SWAMP RATTLER.
- (c) No rattle; brilliant reddish brown to dull brown with hourglass-shaped bands across back; head broad and flat on top; not usually found along borders of streams; a pit (like a second nostril) between nostril and eye; in wooded regions.—*Agkistrodon mokasen* Beauvois—COPPERHEAD.
- (d) No rattle; dull olive-brown; a pit between eye and nostril; top of head very flat and broad, forming an acute angle with side of head; common along streams in southern Illinois; doubtless found in Posey County.—*Agkistrodon piscivorus* (Lacépède)—WATER MOCCASIN, COTTONMOUTH.
- (e) No rattle; red, whitish (or yellow) and black bands, all three entirely encircling body; yellow bands in contact with red; Hamilton County, Ohio, and Milan, Indiana.—*Micrurus fulvius* (Linné)—CORAL SNAKE.

A2. Non-poisonous species.

B1. Scales of the back each with a ridge (keel) down the middle, this sometimes very faint and difficult to detect except by allowing the light to reflect on a scale under magnification.

C1. Rostral scale (at tip of snout) more or less upturned and pointed; form short and thick. See also under O3.

D1. Snout slightly upturned; body wholly black or with a series of dark, squarish dorsal patches alternating with a series on each side, these on a brownish or reddish background; underside of tail usually conspicuously lighter than abdomen; common.—*Heterodon contortrix* (Linné)—HOG NOSED SNAKE.

D2. Snout much upturned; body gray with a series of dark, dorsal patches alternating with a smaller series on each side; underside of tail not conspicuously lighter than abdomen; reported from Brookville.—*Heterodon simus* (Linné)—SOUTHERN HOG NOSED SNAKE.

C2. Rostral scale not upturned and pointed.

E1. Anal plate (scale over vent) divided into two by a median diagonal suture.

F1. Color bright green; very slender; southern Indiana.—*Ophedryx aestivus* (Linné)—KEELED GREEN SNAKE.

F2. Color not green.

G1. Scales around middle of body, not counting the wide ventral plates, in 15 or 17 rows; length not over 1 foot.

H1. Scales in 15 rows; belly usually red; throughout the state.—*Storeria occipitomaculata* (Storer)—RED BELLIED SNAKE.

H2. Scales in 17 rows; belly usually pale; throughout the state.—*Storeria dekayi* (Holbrook)—BROWN SNAKE.

G2. Scales in 19 or more rows; size usually large.

11. Ventral plates (wide scales on underside from head to vent) 190 or more; scale rows 25 to 33; belly flattened; keels of scales usually weak.
- J1. Ventral plates 222-241; red or reddish with darker spots; belly white or yellowish, boldly checkered with black; very doubtfully found in Indiana; reported from Mt. Carmel, Illinois; and, on very unsatisfactory evidence, from Brookville and Greencastle, Indiana.—*Elaphe guttata* (Linné)—CORN SNAKE.
- J2. Ventral plates 194-211; gray or brown; a series of blotches on the back, the anterior and posterior margins of these blotches generally straight or convex; rare in Indiana.—*Elaphe vulpina* (Baird and Girard)—FOX SNAKE.
- J3. Ventral plates 226-244; blotches, if present, generally concave on their anterior and posterior margins. (*Elaphe obsoleta*, the distribution of the two varieties in the state not known.)
- K1. Young and adult gray with darker series of blotches; scale rows 27 or 29; up to 6 feet.—*Elaphe obsoleta confinis* (Baird and Girard)—SPOTTED PILOT SNAKE.
- K2. Young as in the last; adult becoming pitchy black; scale rows 25 or 27; up to 6 feet.—*Elaphe obsoleta obsoleta* (Say)—PILOT BLACK SNAKE.
12. Ventral plates less than 165; scales usually strongly keeled.
- L1. Body with longitudinal stripes; scale rows 19.
- M1. Two long dark stripes on middle of belly; probably throughout the state.—*Natrix septemvittata* (Say)—QUEEN SNAKE.
- M2. One long median dark stripe on belly, or no markings, except on lateral end of ventral plates; found in Illinois but not yet recorded from Indiana.—*Natrix grahamii* (Baird and Girard).
- L2. Body plain or with transverse bands or spots.
- N1. Scale rows 19; 2 series of indistinct round spots on back alternating with a series of large blotches on each side; said by Hay to be common near Indianapolis and throughout the state.—*Natrix kirtlandii* (Kennicott).
- N2. Scales in 23 to 25 rows, usually 23; belly usually with numerous reddish, black-edged half-circles; lateral spots

not alternating with dorsal spots so far forward as the head; common along streams throughout the state.—*Natrix sipedon sipedon* (Linné)⁶—COMMON WATER SNAKE.

- N3. Scales in 23 to 25 rows; uniform dark above and uniform light or reddish below, with dusky mottlings on posterior ventrals in old individuals and dark bases to ventral plates in young; Wabash Valley in Indiana.—*Natrix sipedon erythrogaster* (Forster) — COPPER-BELLY.
- N4. Scales usually in 27 rows (occasionally 25, 29, or 31); eye in contact with the upper lip scales (labials); dorsal spots 26 to 33; a single series of conspicuous spots along each side, alternating and connecting with dorsal spots; reported from Lafayette and New Harmony.—*Natrix rhombifera* (Hallowell).
- N5. Scales usually in 29 to 31 rows, sometimes 27; eye separated from upper labials by one or more subocular scales; dorsal spots about 50; two series of small, often ill-defined, spots in alternation along each side; dorsal spots small and indistinct; reported from southern Illinois and possibly occurring in Posey County.—*Natrix cyclopion* (Duméril and Bibron).

E2. Anal plate entire, not divided.

- O1. Nostril enclosed in a single scale; lower labials 5 to 7; three narrow dorsal stripes; a small southern and western species; reported from Hughes, Ohio, on the strength of a specimen (No. 10088) in the National Museum, but Hay quotes Stejneger as saying this example is a *Storeria*; found at Urbana, Illinois, and probably occurring in Indiana.—*Tropidoclonion lineatum* (Hallowell).
- O2. Nostril between two scales; lower labials 8 or more; scales in 23 rows or less; striped longitudinally; sometimes with regularly arranged spots between the stripes.
- P1. The stripe on the side anteriorly on the third and fourth scale rows, counting upward from the ventral plates.

⁶ Stejneger and Barbour, *Check-List*, page 108, footnote 1, misquote Blanchard in giving the type locality of *Natrix fasciata confluens* as Butler County, Michigan, the range thus appearing to include Indiana. "Missouri" should be substituted for "Michigan."

- Q1. Tail, from vent to tip, usually more than .27 total length.
- R1. Upper lip plates (labials) usually 7, not counting rostral, i. e., the scale on the tip of the snout; throughout the state about ponds.—*Thamnophis sauritus sauritus* (Linné)—RIBBON SNAKE.
- R2. Upper labials usually 8; intergrading with the above in Illinois and probably in Indiana.—*Thamnophis sauritus proximus* (Say)—PLAINS RIBBON SNAKE.
- Q2. Tail generally less than .27 total length.
- S1. Scale rows usually 19-21-19-17 (beginning at anterior end and taking counts at various places to as far back as vent); upper labials 7 or 8; reported from Irvington and "southeastern Indiana."—*Thamnophis radix radix* (Baird and Girard)—PLAINS GARTER SNAKE.
- S2. Scale rows usually 19 to 17; upper labials 6 or 7; throughout most of the state.—*Thamnophis radix butleri* (Cope)—BUTLER'S GARTER SNAKE.
- P2. Stripe on side anteriorly on second and third rows; common throughout the state.—*Thamnophis sirtalis sirtalis* (Linné)—COMMON GARTER SNAKE.
- O3. Nostril between two scales; scale rows 29 or more; size up to 6 feet; spotted; reported to be common in some parts of Illinois and probably occurring in western Indiana.—*Pituophis sayi* (Schlegel)—BULL SNAKE.
- B2. Scales smooth; not keeled.
- T1. Anal plate (large scale over vent) divided into two by a diagonal median suture.
- U1. Scales anteriorly in 13 rows; plain brown; head small and pointed; eyes small; occurring throughout at least the southern part of the state; burrowing.—*Carphophis amoena* (Say)—WORM SNAKE.
- U2. Scales in 25 to 29 rows; genus *Elaphe*, of which some specimens have the keels of the scales so faint as to be scarcely visible; see under I1.
- U3. Scales anteriorly in 15 to 19 rows.
- V1. Black, bluish, or slate gray with a bright yellow or orange under side and usually a yellow "collar" about the neck; not green; up to 18 in.
- W1. Upper labials (lip plates) usually 8; belly usually immaculate but sometimes with a median series of small, black spots, more or less imperfectly developed; probably throughout the state.—*Diadophis punctatus edwardsii* (Merrem)—RING-NECKED SNAKE.
- W2. Upper labials (lip plates) usually 7, rarely 8; belly spots scattered, showing a tendency to fuse into a single row, or irregularly massed; probably occurring in southern

Indiana.—*Diadophis punctatus stictogenys* Cope—RING NECKED SNAKE.

- V2. Grass green, belly whitish; size small, slender; probably common but seldom seen; reported from New Harmony and Brown County.—*Liopeltis vernalis* (Harlan)—SMOOTH GREEN SNAKE.
- V3. Plain brown, size small, seldom over 8 inches; scales often with a faint color-line down the center, appearing like a keel; scales in 17 rows, 15 rows in the closely related *V. valeriae valeriae*, reported from Ohio; reported only from Brown County, and from Mitchell, Lawrence County; this latter reference having been missed by Blanchard.—*Virginia valeriae elegans* (Kennicott).
- V4. Not as under V1, V2, and V3.
- X1. Scales in 15 to 17 rows.
- Y1. Gun-barrel black or very dark gray above, dark blue-gray below; caudals (plates beneath tail, from vent backward) average 106; young olive, with darker spots; southern Indiana; grading into the next.—*Coluber constrictor constrictor* (Linné)—BLACK-SNAKE, RACER.
- Y2. Blue gray, olive brown, or greenish above, below light bluish, greenish, or yellow; caudals average 82; northern Indiana.—*Coluber constrictor flaviventris* (Say)—BLUE RACER.
- X2. Scales in 19 rows; size large; blue black, with a series of red spots along each side; belly red blotched with black; a horny spine at the end of the tail; reported from Wheatland.—*Farancia abacura* (Holbrook)—HORN SNAKE.
- T2. Anal plate entire, not divided.
- Z1. Ground color black, a whitish or yellowish spot on practically every scale of the back; reported from the Wabash Valley, Illinois, and doubtless occurring in southeastern Indiana.—*Lampropeltis getulus holbrooki* (Stejneger)—HOLBROOK'S KING SNAKE.
- Z2. Ground color black; few of the dorsal scales with a whitish or yellowish spot; a faint indication of irregular white cross-lines on mid-dorsal region; a little known form, reported from Wheatland, Lafayette and Vigo County; I have seen several specimens from Henryville in the American Museum, New York.—*Lampropeltis getulus nigra* (Yarrow)—BLACK KING SNAKE.
- Z3. Ground color brownish; pattern of black-edged brown or dark red dorsal blotches, only narrowly in contact with the fifth row of scales (counting up from ventral plates) or extending no lower than the sixth or seventh rows; sometimes dusky length-wise stripes are present, through the spots; occasional. *Lampropeltis calligaster* (Harlan)—YELLOW BELLIED KING SNAKE.

- Z4. Pattern of dorsal blotches, red, brown, or gray, on a yellowish-brown or gray background, these broadly in contact with the fifth or a lower row of scales; dorsal saddles 35 to 60, reaching down to fifth or third row of scales; often two rows of lateral alternating blotches; head with a black-bordered light band from eye to angle of mouth and usually a V-shaped light spot on back of head; intergrading with the next in Indiana; young gray with red spots; throughout the state.—*Lampropeltis triangulum triangulum* (Lacépède)—MILK SNAKE.
- Z5. Similar to Z4 but dorsal saddles 23 to 35 extending down to the third row of scales or lower; only one series of alternating spots; head marking of the last variety partly or not at all developed; southern Indiana.—*Lampropeltis triangulum sypila* (Cope)—MILK SNAKE.
- Z6. Pattern of red, white, or yellow, and black rings, only the black and red ones entirely encircling the body; yellow bands *not* in contact with red; reported from Kentucky and very possibly found in extreme southern Indiana.—*Lampropeltis elapsoides elapsoides* (Holbrook)—RED KING SNAKE.

Notes to Synopsis of Snakes. The characters for identifying the poisonous snakes are given in condensed form. The rattlesnakes can be confused with no harmless snakes but unfortunately the others can.

The copperhead is most frequently confused with the hog nosed snake. This harmless reptile is really very different from the copperhead, however. It never has hourglass-shaped bands but squared spots arranged checker-board fashion. There is more reason to confuse the copperhead with some of the water snakes, but his flat, wide head and usual habitat should easily distinguish him. The water snakes have long heads, never very broad or much flattened.

The cottonmouth can easily be mistaken for some of the water snakes, but here again the extreme level, flatness of the top of the head and its acute angle with the side of the head distinguishes him.

The coral snake has a small, narrow head and is easily confused with the red king snake. However, the coral snake has broad black and broad red bands, narrowly separated by fine yellow bands, while the king snake's light yellow bands do not come in contact with the red, being edged with black.

TURTLES.

- A1. Shell soft and leathery; snout elongate.
- B1. Anterior border of "shell" with conical spine-like tubercles; light head-streaks uniting on end of snout, at base of proboscis.—*Amyda spinifera* (Le Sueur)—SOFT-SHELL TURTLE, FLAP-JACK.
- B2. Anterior border of "shell" without conical tubercles.—*Amyda mutica* (Le Sueur)—SOFT-SHELL TURTLE, LEATHER TURTLE.
- A2. Shell hard and calcareous.
- C1. Tail long with a row of prominent tubercles along its upper edge.

- D1. Eyes close together; head covered with soft skin; throughout the state; in ponds and streams.—*Chelydra serpentina* (Linné)—SNAPPING TURTLE.
- D2. Eyes distant, lateral; head very large, covered with smooth, symmetrical plates; size large, up to 40 inches or more; a ferocious and dangerous reptile; in larger rivers; a southern species; found rarely northward into the Wabash.—*Macrochelys temminckii* (Holbrook)—ALLIGATOR SNAPPER.
- C2. Tail short, excepting in young of some species; without prominent tubercles above.
- E1. Under shell with 9 to 11 plates; margin of upper shell not flaring but turned downwards.
- F1. Under shell narrow, its posterior lobe not more than half width of upper shell; two lobes of under shell little movable, not capable of closing shell; probably throughout most of the ponds and streams of the state.—*Sternotherus odoratus* (Latreille)—MUSK TURTLE, STINKPOT.
- F2. Under shell wider; posterior lobe considerably wider than half the upper shell; both lobes hinged and capable of closing the shell; probably throughout the state.—*Kinosternon subrubrum* (Lacépède)[†]—MUD TURTLE.
- E2. Under shell with 12 plates; edges of shell more or less flaring.
- G1. Under shell without hinge, immovably joined to carapace.
- H1. Red markings around edge of shell; common throughout the state in ponds.—*Chrysemys marginata marginata* (Agassiz)—WESTERN PAINTED TURTLE.
- H2. Black with small round yellow spots on shell; northern Indiana, in ponds.—*Clemmys guttata* (Schneider)—SPOTTED TURTLE.
- H3. Brownish, legs reddish to brown; each plate of the upper shell deeply sculptured with concentric striae to form an elevation; in dry or damp woods; a terrestrial species; young with shell rather flat and little sculptured and the tail nearly the length of the body; not recorded from Indiana but perhaps occurring in the northern part of the state.—*Clemmys insculpta* (Le Conte)—WOOD TURTLE.
- H4. Not as under H1, H2, and H3.
- I1. Head covered with soft skin.
- J1. A triangular yellowish spot back of eye; middle series of plates on carapace scarcely serrated; common in all waters of Indiana.—*Graptemys geographica* (Le Sueur)—GEOGRAPHIC TURTLE.
- J2. A transverse crescent back of eye; middle series of dorsal plates distinctly serrated; occasional in Indiana.—*Graptemys pseudogeographica pseudogeographica* (Gray)—LE SUEUR'S TURTLE.
- I2. Top of head with thin, hard skin; genus *Pseudemys*; several species doubtfully recorded from Indiana and all specimens should be carefully preserved.

[†] *Kinosternon pensilvanicum* (Gmelin) of authors.

- K1. Edges of both jaws smooth.
- L1. An elongate red patch behind eye; southeastern Indiana.—*Pseudemys elegans* (Wied)—CUMBERLAND TURTLE.
- L2. Head without red marking; reported from Wheatland.—*Pseudemys troostii* (Holbrook)—YELLOW BELLIED TURTLE.
- K2. Lower jaw serrated; shell wrinkled at sides; no red spot on side of head; reported on insufficient evidence from Mt. Carmel, Illinois; very doubtfully in Indiana.—*Pseudemys concinna* (Le Conte).
- G2. Under shell with a movable transverse hinge across its middle; a movable cartilaginous lateral suture uniting under and upper shells.
- M1. Shell depressed; under shell emarginate behind; toes well webbed; northern lake region of Indiana, in ponds.—*Emys blandingii* (Holbrook)—BLANDING'S TURTLE.
- M2. Shell elevated (except in young); under shell rounded or truncate behind; toes scarcely webbed; terrestrial, in dry woods.
- N1. Shell with traces of a keel; common.—*Terrapene carolina carolina* (Linné)—BOX TURTLE.
- N2. Shell with no traces of a keel; flat above; occasional.—*Terrapene ornata* (Agassiz)—ORNAMENTED BOX TURTLE.

NOTES REGARDING PRESERVING AMPHIBIANS AND REPTILES.

For accurate identification and reliable locality records it is usually necessary to preserve specimens of amphibians and reptiles. A concise locality tag should accompany each specimen or group of specimens from a single locality.

Amphibians are best killed in 25 to 40 per cent alcohol. Soon after, the specimens should be placed in 60 to 70 per cent alcohol, the larger ones with a small slit in the abdomen to allow the fluid to penetrate. After a week or so, when the alcohol has weakened considerably, they should be put in fresh permanent fluid of about 65 per cent.

Small lizards are injected with strong alcohol in the abdomen and placed in about 75 per cent alcohol.

Snakes should be injected with strong alcohol at several points along the abdomen and into the base of the tail, care being taken not to injure the penis in male specimens, as this is valuable in taxonomic work. Permanently preserved in 75 per cent.

Turtles should be injected into the body cavity, into the bases of all four limbs and into the head. Preserved in 75 per cent.

Formalin (formaldehyde) may be used but it is not nearly as satisfactory as alcohol.