The Life Zones of Indiana as Illustrated by the Distribution of Orthoptera and Coleoptera Within the State.

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During the past twenty years much of my spare time has been devoted to the collecting and classification of the insects of Indiana, especially Orthoptera, or katydids and grasshoppers, and Coleoptera, or beetles. In the report of the Department of Geology for 1902 the results of the work on Orthoptera were published, about 150 species being therein classified and described. The Coleoptera are at present being worked up, and I hope to be able to publish a descriptive catalogue of them within the next two years. Up to the present about 2,700 species have been collected in the State.

The collecting and detailed study of the distribution of the above mentioned insects in Indiana has developed certain facts regarding the life zones of the State which I thought might be of interest. In a map accompanying his paper entitled "Life Zones and Crop Zones of the United States," published in 1898, Dr. C. H. Merriam, chief of the Biological Survey of the U. S. Department of Agriculture, showed the "Upper Austral Zone" as covering the entire State with the exception of a very small area of the Lower Austral in the extreme southwestern corner. The facts brought out regarding the distribution of Orthoptera and Coleoptera in Indiana, which are supplemented by numerous field notes on other groups of insect and animal life, and on the flowering plants, prove conclusively that the "Transition Zone," represented by the Alleghanian fauna and flora, overlaps the northern fourth of the State, while the "Lower Austral Zone," represented by the Austroriparian fauna and flora, overlaps the greater part of the southern third. The Carolinian fauna and flora of the Upper Austral embraces, of course, the prevailing forms of life in the State, 93 of the 148 species of Orthoptera belonging to it. The majority of these range over the entire State, mingling with the representatives of the Alleghanian fauna in the north and with those of the Austroriparian fauna in the southern third. The proportion of Coleoptera belonging to

the Carolinian fauna will be about the same, but the exact figures cannot as yet be given. To the Carolinian fauna belong also the great majority of the other forms of animal life in the State.

As some members of the Academy may not be acquainted with Dr. Merriam's paper I would state that he divides the continent of America, according to the distribution of its animals and plants, into three primary transcontinental regions, viz., Boreal, Austral and Tropical. The Boreal region covers the whole of the northern part of the continent from the Polar sea southward to near the northern boundary of the United States. and occupies also the higher parts of the three great mountain systems, viz., the Sierra-Cascade range, the Rocky and the Alleghany mountains.

The Tropical region is represented in the southern part of the peninsula of Florida only. The Austral occupies the intervening territory, covering the whole of the United States and Mexico except the Boreal mountains and Tropical lowlands.

Each of these three great regions is again subdivided into a number of minor belts or areas, known as zones, and characterized by particular associations of animals and plants, the Austral region, which alone is represented in Indiana, being subdivided into the three transcontinental belts mentioned above, namely, the "Transition," "Upper Austral" and "Lower Austral" zones.

THE TRANSITION ZONE.

The uppermost of the three Austral divisions is the transcontinental belt in which the Boreal and Austral elements overlap. In Indiana it is represented in the two northern tiers of counties, which counties embrace several hundred fresh water lakes within their bounds. These lakes range in size from an area of half an acre up to five and a half square miles. About their margins are often extensive areas of low boggy land covered with numerous forms of plant life whose main distribution is far to the north and which have here their southern limit. Among the more characteristic plants of the Alleghanian flora, which are found only in the northern fourth of Indiana, are the following: Larch or tamarack, *Larix laricina* (Du Roi); arbor vitae or white cedar, *Thuja occidentalis L.;* false lily of the valley, *Unifolium canadense* (Desf.); moccasin flower, *Cypripedium acaule Ait.;* showy lady's slipper, *Cypripedium reginae* Walt.; bog orchis, *Arethusa bulbosa* L.; fen orchis, *Leptorchis loeselii* (L.); sweet fern, *Comptonia peregrina* (L.); paper or canoe birch, *Betula papyrifera* Marsh; speckled or hoary alder, *Alnus incana* (L.); gold-thread, *Coptis tri-*

folia (L.); round-leaved sundew, *Drosera rotundifolia* L.; black chokeberry, *Aronia nigra* (Willd.); round-leaved wintergreen, *Pyrola rotundifolia* L.; shinleaf, *Pyrola elliptica* Nutt.; creeping wintergreen, *Gaultheria procumbens* L.; large cranberry, *Oxycoccus macrocarpus* (Ait.); chickweed wintergreen, *Trientalis americana* Pursh., purple bladderwort, *Utricularia purpurea* Walt., and the twin-flower, *Linnæa borealis* L.

Among the mammals and reptiles the following representatives of the Alleghanian fauna occur in the northern fourth of the State: Canada porcupine, *Erethizon dorsatus* (L.); red squirrel or chickaree, *Sciurus hudsonicus* Erxleben; star-nosed mole, *Condylura cristata* (L.); hoary bat, *Atalapha cinerea* (Beauv.); American badger, *Taxidea americana* (Boddaert); speckled tortoise, *Clemmys guttata* (Schneider); and Blanding's tortoise, *Emys meleagris* Shaw.

Of the Orthoptera from the State, 23 species, or 15.5 per cent of the total, may be classed as belonging to the Alleghanian fauna and as occupying the southern limits of the Transition Zone, which lies between the Boreal and Upper Austral zones. These truly northern members of our Orthopteran fauna are as follows:

INDIANA ORTHOPTERA BELONGING TO THE ALLEGHANIAN FAUNA.

1. *Orphulella pelidna* (Burm.)
2. *Orphulella speciosa* (Scudd.)
3. *Stenobothrus curtipennis* Harr.
4. *Mecostethus lineatus* Scudd.
5. *Camnula pellucida* (Scudd.)
6. *Hippiscus haldemanni* (Scudd.)
7. *Spharagemon wyomingianum* (Thom.)
8. *Trimerotropis maritima* (Harr.)
9. *Schistocerca rubiginosus* (Harr.)
10. *Hesperotettix pratensis* Scudd.
11. *Melanoplus fasciatus* (Walker)
12. *Melanoplus extremus* (Walker)
13. *Melanoplus angustipennis* (Dodge)
14. *Phœtaliotes nebrascensis* (Thom.)
15. *Paroxya scudderi* Bl.
16. *Scudderia pistillata* Brunn.
17. *Conocephalus robustus* Scudd.
18. *Orchelimum indianense* Bl.
19. *Orchelimum delicatum* Brun.
20. *Orchelimum gladiator* Brun.
21. *Nemobius paulstris* Bl.
22. *Nemobius confusus* Bl.
23. *Gryllus arenaceus* Bl.

No list of the Coleoptera of the Transition Zone has ever been published, but about 1848 Louis Agassiz and other parties made a trip to the northern shore of Lake Superior, and in a volume published in 1850, treating of the natural history and other features of that region, Dr. J. L. Le Conte listed the beetles taken and described many new species. Of these more than forty have been taken in the northern fourth of Indiana

and nowhere else in the State. They occur for the most part in and around the borders of the Tamarack marshes, which are familiar features in many of the counties in this area of Indiana. Numerous other species whose range is given by Le Conte and Horn as "southern border of British America and northern United States" occur in this Transition Zone of the State, and a complete list of them will be given in the paper on Coleoptera when published.

THE LOWER AUSTRAL ZONE.

The extreme northern boundary of the Lower Austral life zone passes in a northwest-southeast direction through the following counties in Indiana: Vigo, Clay, Owen, Monroe, Jackson, Jennings, Jefferson and Switzerland. In the territory south of this line the Austroriparian fauna of that zone overlaps and merges with the Carolinian fauna of the Upper Austral zone. The extension northward on the western line of the State is, without doubt, due to the presence of the broad and sheltering valley of the Wabash River, within the confines of which certain southern forms have found a climate mild and suitable to their habits. Within this valley the following members of the Austroriparian flora grow indigenously, a number of them as far north as Terre Haute: Bald cypress, *Taxodium distichum* (L.); upright burhead, *Echinodorus cordifolius* (L.); showy amaryllis, *Hymenocallis occidentalis* (LeC.); pecan, *Hicoria pecan* (Marsh); swamp or downy poplar, *Populus heterophylla* L.; chinquapin, *Castanea pumila* (L.); Texan red oak, *Quercus texana* Buckley; pipe vine, *Aristolochia tomentosa* Sims; American lotus, *Nelumbo lutea* (Willd.); Carolina moonseed, *Cebatha carolina* (L.); great burnet, *Sanguisorba canadensis* L.; water or swamp locust, *Gleditsia aquatica* Marsh; water ash, *Fraxinus caroliniana* Mill, and crossvine, *Bignonia crucigera* L.

Among other characteristic southern plant forms occurring in Indiana south of the northern boundary of the Lower Austral zone are: The yellow pine, *Pinus echinata* Mill.; mud plantain, *Heteranthera reniformis* R. & P.; false aloe, *Agave virginica* L.; Spanish oak, *Quercus digitata* (Marsh); southern hackberry, *Celtis mississippiensis* Bosc.; American mistletoe, *Phoradendron flavescens* (Pursh.); cucumber tree, *Magnolia acuminata* L.; pencil flower, *Stylosanthes biflora* (L.); Carolina buckthorn, *Rhamnus caroliniana* Walt.; yellow passion flower, *Passiflora lutea* L.; Hercules club, *Aralia spinosa* L.; persimmon, *Diospyros virginiana* L.; unicorn plant, *Martynia louisiana* Mill.; catalpa, *Catalpa catalpa* (L.), and the rough button-weed, *Diodia teres* Walt.

The southern mocking bird, *Mimus polyglottos* (L.), nests in numbers as far north as Terre Haute, and the "chuckwills widow," a southern ally of the whip-poor-will, occurs in Knox and Gibson counties; while among the batrachians and reptiles the hellbender, *Cryptobranchus alleghaniensis* (Daud.); the southern cricket frog, *Acris gryllus* Le Conte; the corn snake, *Ophibolus doliatus* (L.); Say's chain snake, *Ophibolus calligaster* (Say); the bead snake, *Elaps fulvius* (L.); the ground lizard, *Oligosoma laterale* (Say); the alligator snapping turtle, *Macrochelys lacertina* (Schweigger), and the yellow-bellied terrapin, *Pseudemys troosti* (Holbrook), all forms whose main distribution is far to the south, find in southern Indiana a congenial abiding place.

It is not strange, therefore, that we find living with these plants and animals a number of Orthoptera and Coleoptera whose range has heretofore been thought to be confined to the region mapped by Merriam as the "Lower Austral." Thirty-two of the 148 species of Orthoptera, or 21.6 per cent of the total, may be classed as southern forms. They are as follows:

INDIANA ORTHOPTERA BELONGING TO THE AUSTRORIPARIAN FAUNA.

1. *Temnopteryx deropeltiformis* Brunn.
2. *Ischnoptera inaequalis* Sauss-Zehnt.
3. *Ischnoptera major* (Sauss.-Zehnt.)
4. *Stagmomantis carolina* (L.)
5. *Gonatista grisea* (Fab.)
6. *Anisomorpha ferruginea* (Pal. de Beauv.)
7. *Tettix arenosus* Burm.
8. *Neotettix hancocki* Bl.
9. *Tettigidea spicata* Morse.
10. *Tettigidea lateralis* (Say).
11. *Syrbula admirabilis* (Uhl.)
12. *Hippiscus phœnicopterus* (Germ.)
13. *Mestobregma cinctum* (Thom.)
14. *Trimerotropis citrina* Scudd.
15. *Leptysma marginicollis* (Serv.)
16. *Schistocerca damnifica* (Sauss.)
17. *Melanoplus morsei* Bl.
18. *Melanoplus impudicus* Scudd.
19. *Amblycorypha uhleri* (Brunn.)
20. *Conocephalus bruneri* Bl.
21. *Atlanticus dorsalis* (Burm.)
22. *Camptonotus carolinensis* (Gers.)
23. *Ceuthophilus stygius* (Scudd.)
24. *Ceuthophilus uhleri* Scudd.
25. *Myrmecophila pergandei* Brun.
26. *Nemobius canus* Scudd.
27. *Nemobius cubensis* Sauss.
28. *Gryllus firmus* Scudd.
29. *Miogryllus saussurei* (Scudd.)
30. *Phylloscirtus pulchellus* (Uhl.)
31. *Apithes agitator* Uhl.
32. *Orocharis saltator* Uhl.

Of the species listed but four, one of them being the Carolina mantis or rear-horse, *Stagmomantis carolina* (L.), and the others *Camptonotus carolinensis* (Gers.), *Syrbula admirabilis* (Uhl.) and *Orocharis saltator* Uhl., have been taken in small numbers as far north as Marion County; all of the others only south of the line mentioned as forming the northern border of the Lower Austral.

In this Lower Austral zone I have also taken more than one hundred species of beetles whose range heretofore has been given as the Gulf or Southern States. Among them are some of the largest and most striking members of Coleoptera taken within the State, regular "Oh, my! beetles;" that is, those which beget the ejaculation "Oh, my!" when they are noted by persons not especially interested in the order. Among these two of our largest tiger beetles of the genus *Tetracha;* the stag beetle, *Lucanus elaphus* Fab.; the rhinoceros beetle, *Dynastes tityrus* Linn.; the unicorn beetle, *Xylorycles satyrus* Fab., and the fig-eating beetle, *Allorhina nitida* L., are examples most worthy of note.

It will be noted that the line which separates the Lower Austral from the Upper Austral zones in the State corresponds somewhat approximately with the southern border of the glacial invasion of Indiana, and it is more than probable that the ancestors of many of these southern forms existed in southern Indiana in preglacial times, when the climate was much warmer than now. It is also probable that many of these Orthoptera and Coleoptera, as well as a number of those species inhabiting the entire State, advanced into the State from the south as fast as it was uncovered by the receding ice.

UPPER AUSTRAL ZONE.

Of the Upper Austral Zone, which covers the greater portion of the State and whose fauna and flora overlap and merge with those of the Transition Zone in the north and the Lower Austral Zone in the south, I have but little to say, as this fauna and flora are the ones whose members are most familiar to all present. Merriam, in his paper above cited, states that counting from the north, the Upper Austral area, represented by the Carolinian fauna and flora, is that in which the sassafras, tulip tree, hackberry, sycamore, sweet gum, redbud and short leafed pine first make their appearance. Along with these trees and shrubs are found the opossum, gray fox, fox squirrel, cardinal, Carolina wren, tufted titmouse, blue-gray gnatcatcher, summer tanager and yellow-breasted chat.

As already mentioned, the great proportion of the Orthoptera and Coleoptera of the State belong to this Carolinian fauna, and a great majority of the same species are found in Ohio, the eastern two-thirds of Kentucky, nearly all of Illinois, Iowa and Missouri and the eastern halves of Nebraska and Kansas.

To the facts above given many others could doubtless be added by those members of the Academy from the extreme northern or southern portions of the State who have studied rather closely the fauna and flora of their respective areas.