

scribed from specimens taken at Dallas, and the Gulf Coast of Texas and in Arizona. It has since been taken east of the Mississippi at Lake Drummond, Dismal Swamp, Va., Southern Pines, N. Car., Stone Mountain, Ga., and in Walton Co., Fla. These records are given by R. & H. (1916, 247) who state that the Florida specimen was "taken from the stomach of a turkey killed in a pine forest," while the single Georgia specimen was "found in a dusty road bordered on each side by heavy pine woods."

### Family VII. TETTIGONIIDÆ.<sup>61</sup>

#### KATYDIDS AND THEIR KIN.

"I sit among the leaves here, when evening's zephyrs sigh,  
And those that listen to my voice I love to mystify;  
I never tell them all I know, altho' I'm often bid,  
I laugh at curiosity, and chirrup, 'Katy did.'"

The family Tettigoniidæ comprises those insects commonly called katydids, green or long-horned grasshoppers, cone-headed grasshoppers and stone or camel crickets, the name "grasshopper" rightfully belonging to its winged members and not to the short-horned locusts or Acrididæ. The principal distinguishing characters of the members of the family Tettigoniidæ, as given in the key, p. 149, are the long, slender, tapering, many-jointed antennæ which, when turned back, usually extend far beyond the tip of abdomen; almost universal absence of ocelli or simple eyes; the four-jointed<sup>62</sup> tarsi or feet; and the sword-shaped or falcate ovipositor of the females, which is made of four flattened plates with the edges near its tip often horny and serrate. The head in many of the species is wedge-shaped and the mouth-parts are well developed, the maxillary palpi being very long and the mandibles especially long and sharp-pointed. This enables the insect to dig into plant tissue or to eat the seeds of grasses, as many of them do. The tegmina, when present, are usually leaf-like and of a delicate structure, having no stiff chitinous anterior veins. When closed the left one usually overlaps the right, and, in the larger forms, they slope obliquely downwards instead of being bent abruptly, as in the Gryllidæ or true crickets, while in most cases, the wings are slightly longer than the tegmina. The meso- and metathorax are less closely united than in the Acrididæ,

<sup>61</sup>This family of the suborder Saltatoria was for many years known as Locustidæ. but the genus *Locusta* of Linnæus was founded for a true locust and not for a katydid, hence recent American writers have used the name Tettigoniidæ, which is based upon the Linnæan genus *Tettigonia*, given to a European katydid and meaning "grasshopper" and "angle," on account of the shape of the tegmina. In Europe Kirby and some of the other writers use the family name Phasgonuridæ for the same insects, while Karney and others still retain "Locustidæ."

<sup>62</sup>The members of the genus *Daihinia*, no one of which occurs in our territory, have the fore and hind tarsi three-jointed.

PLATE V.



A PAIR OF CONE-HEAD GRASSHOPPERS, *NEOCONOCEPHALUS ENSIGER* HARRIS, ON GOLDEN-ROD.

Female above: male below. (From a photograph of living specimens by Dr. J. L. Hancock, Lakeside, Mich.)

and in the winged forms the hind legs are usually longer and much more slender. The males have, in many instances, abdominal appendages corresponding to the parts of the ovipositor which are used as clasping organs.

The stridulating or musical organ of the males is quite similar in structure to that of the male cricket, being found at the base of the overlapping dorsal area of the upper tegmen and usually consisting of a transparent membrane, of a more or less rounded form, which is crossed by a prominent curved vein, which, on the under side, bears a single row of minute file-like teeth. In stridulating, the tegmina are moved apart and then shuffled together again, when these teeth are rubbed over a vein on the upper surface of the other wing cover, producing the familiar, so-called "katydid" sound. Each of the different species makes a distinct call or note of its own, and many of them have two calls, one which they use by night and the other by day. Any one who will pay close attention to these different calls can soon learn to distinguish each species by its note as readily as the ornithologist can recognize different species of birds in the same manner.

In the northern States the notes of the katydids and green grasshoppers are not heard till in July, as they do not attain their wings until then. C. V. Riley who, like our own beloved Indiana Riley, had within his soul a true love for the poetry of nature, has well set forth (1874, 153) his ideas of the why and wherefore of the songs of this family thus: "During spring, while our birds are making love, and the males rival each other in their attempts to please the females with happy, jubilant song, Dame Nature is rearing a troupe of insect musicians, which, in their turn, will string their lyres and play their courtship-tunes in the later seasons, when the song of the feathered performers is mostly hushed.

"Leyden's lines—

'Oft have I listening mused the sultry day  
And wondered what thy chirping song might say'—

but express an inquiry often made as to the purpose and object of the grasshopper song. He who believes all things made for man and his enjoyment, and that nothing can have a purpose that does not include him in its scope, will not find an answer to the query; and should remember that ere man grew out of savagery the earth rang again with song and sound.

"But to the mind of the naturalist, trained in deciphering Nature's hieroglyphs, the chattering song is very plainly inspired by love. The male Katydid doubtless feels something of the same satisfaction in playing to his companions, and especially to Katy,

as a prima donna does in singing to an audience. There is a pleasure in the act which is the outcome of its being; and the fact that the males are principally the players, shows that the gift is not only a source of pleasure, but one of much importance to the species; for the rivalry among the males is as great as among higher animals, and a good instrument becomes, in this light, most important to the individual and to the species. The best player wins his coveted love, while the feeble and the cripples stand no chance to impair the vigor of the race."

While only the males are musicians, both sexes of the winged forms are provided with supposed auditory organs or ears. These, when present, are similar in structure and position to those of the cricket, being oblong or oval cavities covered with a transparent or whitish membrane, known as the drum or tympanum, and situated one on each front leg, near the basal end of the tibiæ. The drum is a thin, tense membrane covering a network of nerves, ganglion cells and auditory rods. In all the wingless *Tettigoniidæ* the stridulating organs are necessarily absent and as the insect can make no sound, it has no use for ears and these are also absent. This is taken as strong evidence that the cavity on the fore leg is in reality an auditory organ, which is denied by Forel (1887) and some other writers, who believe that all insects are deaf with no special organs of hearing, but that sounds are heard or appreciated by their tactile organs.

The color of each species of *Tettigoniidæ* is, as in most Orthoptera, admirably adapted to its usual surroundings. The winged forms, as the katydids and cone-headed grasshoppers, live amidst the foliage of trees or clumps of grass, and are therefore a nearly uniform bright green, while the wingless forms, which dwell in caves or hollow trees and beneath rocks and logs are, for the most part, gray or brown in hue. Our larger species, with wings fully developed, use them as their principal means of travel, their slender hind legs being used only to give themselves an upward impetus at the beginning of flight.

In both the northern and southern states the members of this family winter chiefly in the egg stage, the eggs being laid in grasses, reeds, galls on willow, stems of plants, bark of trees and shrubs and even between the upper and lower layers of leaves, the ovipositor being especially adapted for this method of egg deposition. In southern Florida some of the species pass the winter, in part at least, as nymphs, or even as adults, but the number of both species and individuals then there found is far less numerous than of the *Acrididæ*. The young of the *Tettigoniidæ*, like

those of the other families of Orthoptera, when hatched from the egg resemble the adults in form but are wholly wingless. As they increase in size they moult or shed the skin five times, the wings each time becoming more apparent, until after the fifth moult, when they appear fully developed, and the insect is mature or full grown, never increasing in size thereafter. Throughout their entire lives they are active feeders, mostly herbivorous in habit, and when present in numbers necessarily do much harm to growing vegetation. Most of the species can be easily reared from the young nymphs, their successive moults being of much interest. They may be fed on lettuce and it is said that some of the larger species will eat flies and other soft-bodied insects. The males are very pugnacious, and often try to devour one another, so that they should be kept apart.

The species of Tettigoniidæ occurring in the United States are distributed among eight subfamilies, seven of which are represented in the eastern states.

KEY TO EASTERN SUBFAMILIES OF TETTIGONIIDÆ.

a. Tegmina and wings present;<sup>63</sup> general color green, rarely pale brown; fore tibiæ always with an auditory organ near the base.

b. Prosternal spines absent; vertex ending in a blunt spine or rounded and deflexed, rarely or never with a projecting tubercle or cone; tegmina shorter than wings, rarely (*Phrixia*) subequal to them; hind tibiæ with an apical spine on each side.

Subfamily I. PHANEROPTERINÆ, p. 458.

bb. Prosternal spines present; vertex either terminating in a sharp flat spine or produced upward and forward into a rounded tubercle or prominent cone; hind tibiæ with an apical spine on outer side only or on neither.

c. Tegmina leaf-like, very broad, concave within, longer than the wings; vertex terminating in a sharp, flat spine; disk of pronotum crossed by two distinct transverse sulci.

Subfamily II. PSEUDOPHYLLINÆ, p. 494.

cc. Tegmina narrow, expanded but little, if any, at middle, usually shorter than the wings; vertex terminating in a rounded tubercle or prominent cone; disk of pronotum without, or with only one, transverse sulcus.

d. Front and middle femora spined beneath;<sup>64</sup> vertex produced forward into a long, usually sharp cone; larger and more robust species, the length of body 24 or more mm.

Subfamily III. COPIPHORINÆ, p. 502.

<sup>63</sup>Wings absent, tegmina very small and general color brown in the aberrant genus *Belocephalus*; both tegmina and wings absent in the female of *Odontoxiphidium*.

<sup>64</sup>Except in some of the species of *Neoconocephalus*. Although both Redtenbacher (1891, 13) and Scudder (1897c, 54) separate their tribes *Conocephalini* and *Xiphidini* by the sole character of the presence or absence of spines on the fore and middle femora, there are several species of *Neoconocephalus*, the principal genus in the former tribe, which have these femora wholly unarmed beneath.

*dd.* Front and middle femora unarmed beneath; vertex terminating in a rounded tubercle with concave sides; smaller, more slender species, length of body less than 24 mm.

Subfamily IV. CONOCEPHALINÆ, p. 533.

*aa.* Tegmina and wings absent, or the former rudimentary; general color gray or brown.

*e.* Pronotum extending back to the abdomen; prosternal spines usually present; tegmina present, usually rudimentary; fore tibiæ with a hearing organ near the base.

Subfamily V. DECTICINÆ, p. 586.

*ee.* Pronotum short, not covering the whole top of thorax; prosternal spines absent; tegmina and wings absent; fore tibiæ without a hearing organ near the base.

*f.* Eyes elongate-ovate, vertical, situated at the side of the basal joint of antennæ; ovipositor ensiform, curved strongly upward; tarsi depressed, their joints lobed beneath.

Subfamily VI. GRYLACRINÆ, p. 602.

*ff.* Eyes subrotund, situated partly above the basal joint of antennæ; ovipositor nearly straight; tarsi compressed, the joints not lobed.

Subfamily VII. RHAPHIDOPHORINÆ, p. 606.

### Subfamily I. PHANEROPTERINÆ.

#### THE BUSH AND ROUND-HEADED KATYDIDS.

The species of this subfamily are among the largest of our winged Tettigoniidæ, and, with those of the Pseudophyllinæ, are commonly known as "Katydids." The name Phaneropterinæ is based upon the typical old world genus, *Phaneroptera* Serv., meaning, "visible wing," and refers to the exposed tips of the inner wings which extend beyond the tegmina in repose. They all agree in having the head short, face vertical, or nearly so; vertex varying greatly in width, the fastigium either ending in a blunt deflexed spine or broadly rounded, never projected in front of eyes as a cone or sharp spine; eyes small, variable in form, situated close to and at the side of basal joint of antennæ; pronotum short, its disk flat or concave, more or less narrowed in front, usually meeting at right angles the perpendicular lateral lobes, its posterior lobe prolonged distinctly behind them with usually a wide, deep humeral sinus or emargination at the junction; median carina wanting or very faint, lateral ones more or less distinct, hind margin broadly rounded, rarely (*Arethæa*) obtuse-angled; lateral lobes flat, their hind margin and lower posterior angle broadly rounded; lower margin rounded or sinuous, front margin variable; tegmina as described in key, usually a bright uniform green in color; wings long and strong, folded like a fan; meso- and metasterna broadly lobed along their median line; legs variable