

THE GENUS *ANAXIPHA* IN THE UNITED STATES (ORTHOPTERA:
GRYLLIDAE)¹

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The crickets of the genus *Anaxipha* are straw-colored to brown and about five to eight mm. in length. They are very active and commonly inhabit low dense

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plants, but are occasionally found among litter on the ground or in tall shrubs or small trees. Unlike true ground crickets such as *Nemobius*, they are able to walk up the side of a glass jar.

Rehn and Hebard (1912) recognized only two species of *Anaxipha* as inhabiting North America north of the Rio Grande. One was the common, widely distributed *A. exigua* (Say, 1825), which, prior to 1912, was the only species recorded from the United States. The second was *A. pulicaria* (Burmeister, 1838), described from Jamaica. They placed *Cyrtoxipha delicatula* Scudder, 1877, as a synonym of *A. pulicaria*, based on the long-winged form of the species. They also mentioned differences in the shape of the head and pronotum, between *Cyrtoxipha* and *Anaxipha*. They included a key to separate the two species of *Anaxipha*. The characters mentioned included the relative lengths of the hind femur and ovipositor and the proportions of the tympanum in the male tegmen. They also mentioned the longitudinal dark lines on the outer face of the femur in *exigua*.

Hebard (1915) added *A. imitator* (Saussure, 1878) and *A. scia* Hebard, 1915, to the list of species occurring in the United States. Rehn and Hebard (1916) recorded a fifth species, *A. vittata* (Bolivar, 1888). It was characterized by a sharply contrasting color pattern, which Rehn and Hebard (1916) said was weakly indicated in some specimens. Blatchley (1920) reduced *vittata* to the rank of a subspecies, giving, as the main reason, the variation in color pattern. It is well to mention here that certain specimens referable to *pulicaria* at that time, as well as many specimens of *exigua* and *scia*, have dark markings which conform more or less to a common pattern. From 1924 until the present time, most students of the Orthoptera have followed Hebard in recognizing five species in the United States, namely *imitator*, *exigua*, *scia*, *pulicaria*, and *delicatula*, the name *pulicaria* being used for the species previously recognized as *vittata* and the name *delicatula* for species formerly identified as *pulicaria*. The present contribution to the knowledge of *Anaxipha* is the result of an effort to find additional characters by which the several species may be defined. The correct names of some species may be in doubt for years.

The writer's interest in *Anaxipha* began some time after he became a resident of North Carolina in 1928. It soon became evident that there were two species of *Anaxipha* in the vicinity of Raleigh, namely *delicatula* and *exigua*. *Anaxipha delicatula* appears in the adult stage only during early summer, whereas *exigua* is in the adult stage from late July until October or later. Both species occur in some habitats, adults of one following the other with little or no interval between.

Additional species were found in the coastal regions of North Carolina. A species occurring in the salt marshes had a tinkling song very much like that of *exigua*. This species also had an obscure longitudinal stripe on the outer face of the hind femur, like *exigua*. Living or recently killed specimens showed the stripe so plainly that they were placed with *exigua* at first. Later it was noticed that the salt marsh specimens had shorter ovipositors than *exigua*, and that the tarsal claws were smooth whereas those of *exigua* had about three teeth between the middle and the apex. In 1940 the writer had an opportunity to examine the type of *scia* at Philadelphia and was convinced that the cricket in the North Carolina

salt marshes was the same as the type of *scia*. No specimens of *exigua* have been found in North Carolina salt marshes.

In searching for new useful characters for species diagnosis, the writer found that the phallus or male copulatory organ in *Anaxipha* had a very distinct structure in several species. By examination of the phallus of many specimens it was found that there were two species referred to *delicatula* which could be separated in the male sex but not as yet in the female. Dr. A. B. Gurney has determined by examination of the type that the name *delicatula* should be applied to the species with wider distribution in North Carolina. The other species, which is probably new, has been taken only near the coast.

NEW CHARACTERS FOR USE IN DIAGNOSIS

THE HIND FEMUR STRIPE.—This is not a new character but it is one which needs some explanation. In *exigua* and *scia* it is a broad dark stripe with entire unincised margins which runs along the sulcus just below the middle of the outer face of the hind femur. It is most distinct in *exigua* but even in this species a few specimens have a stripe but a little darker than the ground color of the femur. There is some indication that these specimens were in a teneral condition when killed. Another difficulty arises when the muscles inside the femur dry in contact with the cuticle. This produces a reddish brown discoloration which may obscure the natural pattern, especially if it occurs along the sulcus.

Pale specimens of *scia* have a solid femur stripe like that of *exigua*, but in dark specimens the ground color of the femur is often so dark that the stripe is obscured. In *pulicaria* there is a dark net-like pattern on the dorsal part of the outerface of the femur, while above and below the sulcus there may be more or less broken, dark narrow lines with jagged margins, quite different from the solid stripe in *exigua* and *scia*. At its best, the femur stripe is not a good character because it depends on the presence of hind legs, which are easily broken off.

THE TARSAL CLAWS.—All the species except *scia* have prominent teeth on the lower edge of the claw (Fig. 18, 19, 22). All claws on a specimen are similar in structure but usually only one or two are in a good position for examination, or are free of foreign material. The best way to examine the claw is to look at the end of the last tarsal joint, with the line of vision about parallel to that joint. If the background is strongly lighted and the claw itself in shadow, the teeth are easily seen in profile. Dust particles may be removed by careful brushing with a fine-pointed moist brush.

FRINGES ON TIBIAL SPINES.—This character has the same fault as the femur stripe in that it depends on the presence of at least one hind leg. It is a fringe of long hairs on each of the six spines on the distal half of the hind tibia (Fig. 23). The hairs, numbering five to ten, are nearly parallel and in a single line on the side nearest the tibia. Short hairs, but little longer than the diameter of the spine, cover the spine on all sides. Fringe hairs appear to be easily broken, because some specimens have lost nearly all. Even one or two long hairs in the proper place indicate that the fringe was once present. This fringe should not be confused with the combs of hairs on the largest spurs at the distal end of the hind tibiae.

Four species have fringed spines but two do not, so the value of the character is limited.

THE PHALLUS.—The male copulatory organ lies in a horizontal position directly above and concealed by the subgenital plate. In a fresh specimen the phallus can be pulled out by stretching the thin cuticle at the base. The specimen will dry with the phallus exposed. Dry specimens must be relaxed by keeping them in a moist chamber, and by wetting the tip of the abdomen with a small brush. If this fails, the tip of the abdomen may be removed so that the phallus can be dissected under water. It can be kept with the specimen in a drop of glycerin in a minute vial, or attached dry to a paper point.

The function of the whole organ is evidently the same as in other crickets, to mold a spermatophore and insert its tube into the genital organs of the female. Our interest in the phallus is on account of the specific differences in structure shown by it. The partly sclerotized terminal portion of the phallus is about 0.5 mm. long. It has a flattened cylindrical shape, becoming flatter at the free end. The ventral side, in resting position, bears a median groove which holds the tube of the spermatophore when it is formed. The groove lies in a thin, pale sclerite with poorly defined margins, which takes up about half the area of that side of the phallus. Between the median sclerite and the lateral margins, the cuticle is very thin and flexible, and sinks in, causing the whole organ to be much flatter when dry.

On the dorsal side, the cuticle is somewhat more rigid. A dark, sclerotized supporting frame in the shape of the letter H is found in most species. The space between the proximal arms of the frame is occupied by thin cuticle. The distal arms form the lateral supports of the terminal portion of the phallus. Distally they have a pointed or truncated free edge which bears several curved bristles. Between these lateral processes are fleshy terminal lobes which probably are movable in life. In a freshly killed specimen these lobes will tilt on an axis running diagonally from near the midline on the dorsal side to a point on the ventrolateral side. This capacity for movement is occasionally responsible for some distortion although most of the specimens dry with the terminal lobes in the same position. The terminal lobes are sparsely clothed with minute short hairs. The median groove on the ventral side terminates as a sharp point in the notch where the terminal lobes of the two sides meet. Evidently the terminal lobes have a part in guiding the spermatophore tube to the proper place in the female.

The cross-bar in the H-shaped frame will be called the yoke. Distal to the yoke on the dorsal side between the lateral processes, the cuticle is sparsely clothed with short hairs. Specific differences are found in the shape of the yoke, of the lateral processes and of the terminal lobes. *Anaxipha exigua* and *scia* (Fig. 3-6) are almost alike. The lateral process in *scia* has a longer and more slender point.

The phallus of *A. imitator* has the most distinctive structure (Fig. 1, 2). It is less flattened than in the other species. There is no clearly defined yoke, but distal to the usual location of the yoke there is a prominent swelling about half as wide as the whole phallus. The lateral processes are thin blades with acute

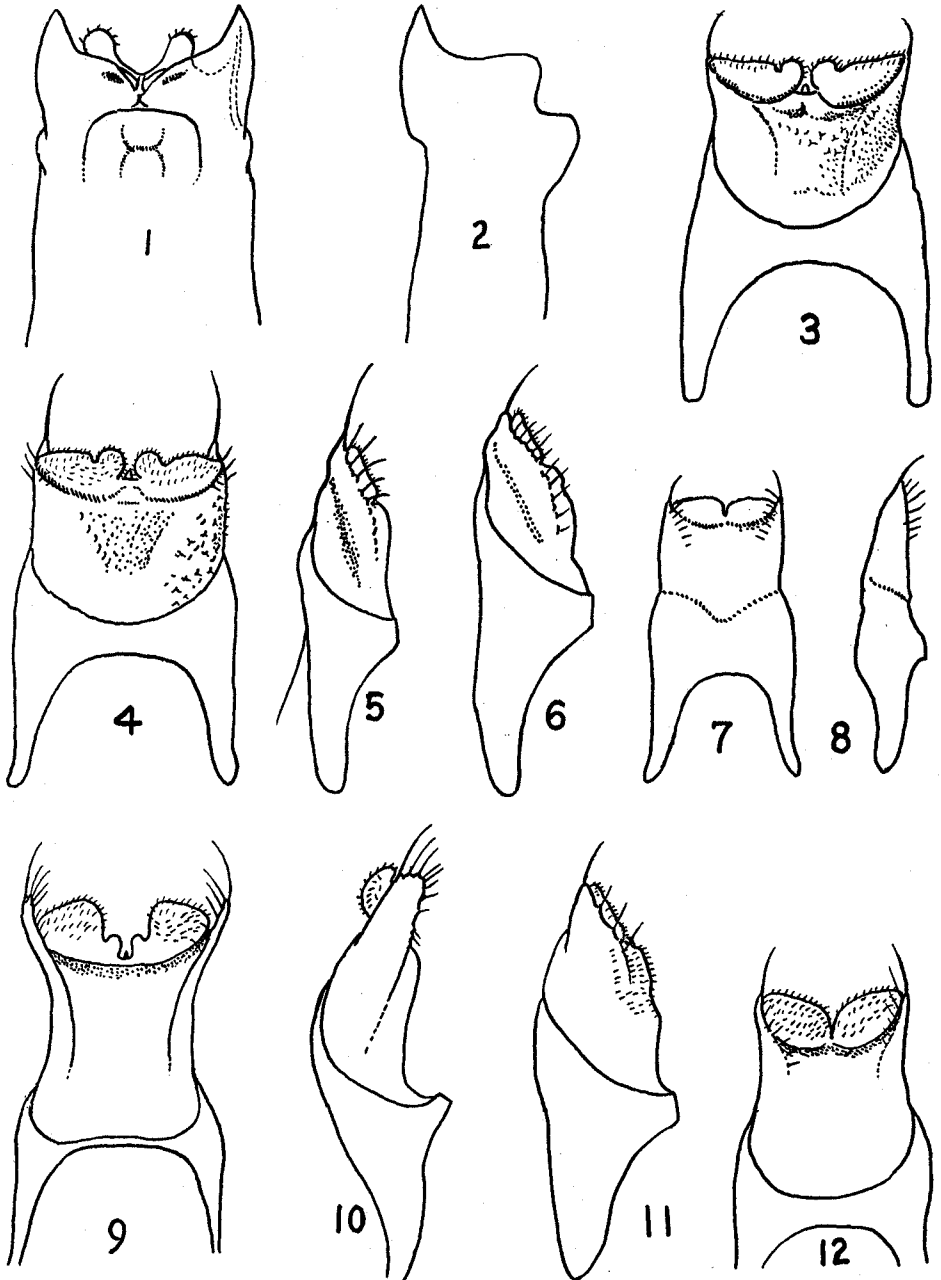


FIG. 1-12. Dorsal and left lateral views of phallus of *Anaxipha*. FIG. 1, 2. *A. imitator*, Matheson Hammock, Fla. FIG. 3, 6. *A. exigua*, Raleigh, N. C. FIG. 4, 5. *A. scia*, Carolina Beach, N. C. FIG. 7, 8. *A. pulicaria*, Gainesville, Fla. FIG. 9, 10. *A. litarena*, Carolina Beach, N. C. FIG. 11, 12. *A. delicatula*, Fayetteville, N. C.

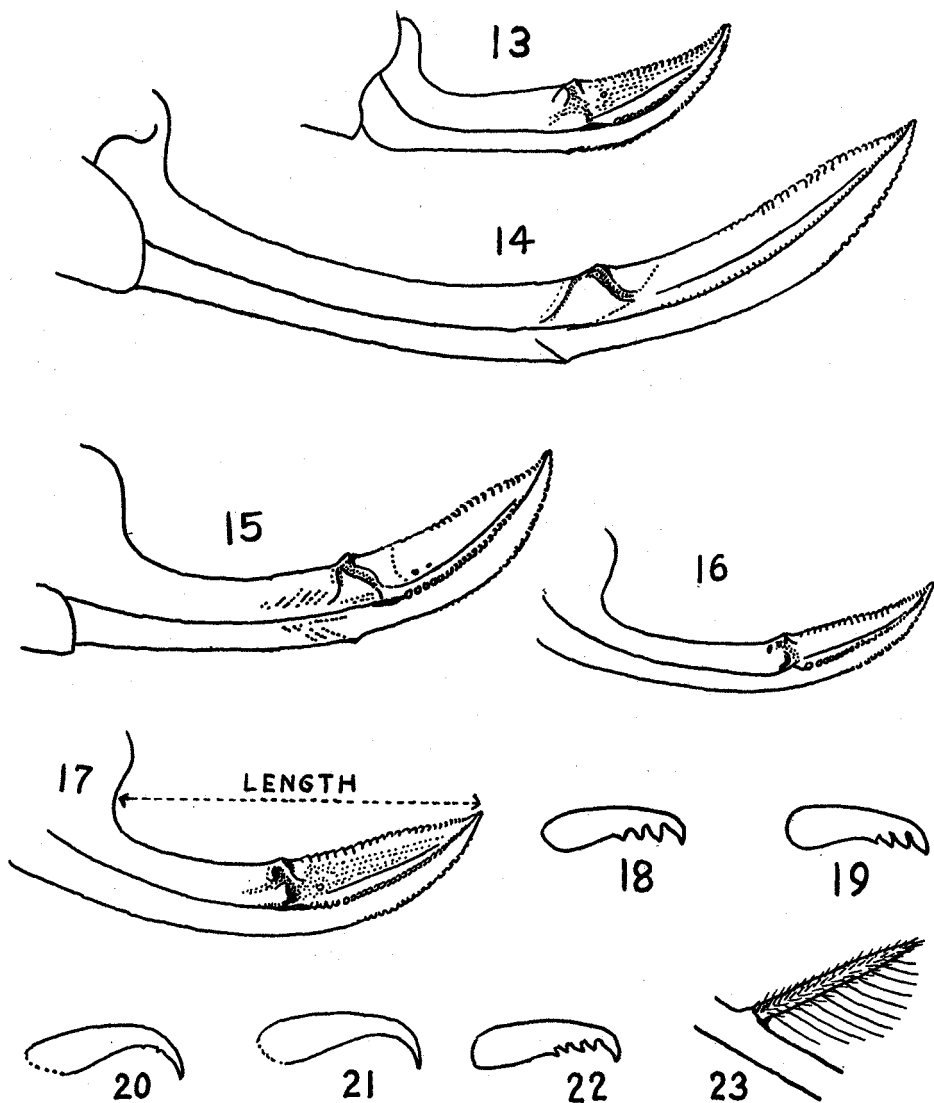


FIG. 13-23. Ovipositors (13-17) and claws (18-22) of caudal tarsi of species of *Anaxipha*. FIG. 13. *A. imitator*. Paradise Key, Dade Co., Fla. FIG. 14. *A. exigua*, Raleigh, N. C. FIG. 15. *A. scia*. Carolina Beach, N. C. FIG. 16. *A. pulicaria*. Warburg Lake, Alachua Co., Fla. FIG. 17. *A. delicatula*. Raleigh, N. C. FIG. 18. *A. exigua*. Gainesville, Fla. FIG. 19. *A. delicatula*. Raleigh, N. C. FIG. 20. *A. scia*. Brickell's Hammock, Miami, Fla. FIG. 21. *A. scia*. Carolina Beach, N. C. FIG. 22. *A. litarena*. Carolina Beach, N. C. FIG. 23. One of the spines of a caudal tibia, showing the fringe of long hairs (*A. scia*).

tips which are oriented in a diagonal direction, being farthest apart on the ventral side. In profile (lateral view) they have the same shape as in ventral or dorsal view. In either case they bear a resemblance to a cat's ears. On the ventro-internal face each lateral process is provided with a thin keel extending from the base to

near the apex. The keel is visible in ventral view. Between the two lateral processes, there are shorter rounded lobes, each having a few minute bristles on the distal edge. These thin lobes are attached near the base of the keel and appear to be homologous with the terminal lobes of the other species. On the ventral side of the phallus there is a broad median hollow bearing the spermatophore groove on its middle line.

KEY TO THE SPECIES OF *ANAXIPHA*

1. Side of body with a broad dark brown stripe extending from eye across lateral field of pronotum and tegmen and exposed portion of folded wing. Ovipositor stout, ventral margin almost straight in proximal half, curved in distal half, widest at middle, decreasing in both directions. Proximal joint of caudal tarsus about twice as long as the other two combined. Phallus terminating in paired structures resembling cat's ears. *imitator*.
No lateral dark stripe as above. Ovipositor curved for almost entire length, width nearly uniform. Proximal joint of caudal tarsus not more than one and a half times as long as the other two combined. Phallus with terminal fleshy lobes between the tips of lateral processes. The processes bearing bristles near the apex. 2
2. Caudal femur with a broad dark stripe, with entire margins, along the sulcus on the lateral face. (This stripe may be obscured when general color is dark.) Ovipositor, in profile, with an obtuse, slightly protruding angulation near the middle of the ventral margin. Terminal lobes of phallus truncated at apex and bearing apically a pair of small knobs which nearly touch at the middle line. 3
Caudal femur without a broad dark stripe along the sulcus on lateral face but sometimes (in *pulicaria*) with a narrow line having jagged margins or a row of confluent spots. Ventral margin of ovipositor curved all the way and without a slight angle near the middle. Terminal lobes of phallus without knobs at apex. 4
3. Tarsal claws with three distinct teeth on the disto-ventral margin. Ovipositor with blade (not including the thick base) over 2 mm. long and about half as long as caudal femur. *exigua*
Tarsal claws without teeth. Ovipositor blade generally under 2 mm. Caudal femur about 2.3 to over 3 times the length of the ovipositor blade. *scia*
4. No fringe of long hairs on the spines of the caudal tibia. Pale, with sharply delineated pattern of dark brown on head, pronotum and legs. Small for the genus. Phallus thin, wedge-shaped, truncated, with yoke poorly defined but very broad. *pulicaria*
Spines of caudal tibia bearing a row of long, thin hairs on the side nearest the tibia. Straw-color to pale brown, with more or less obscured brownish pattern. Yoke of phallus narrow, often dark in color, with clearly-defined margins. 5
5. Terminal lobes of phallus sub-truncate in dorsal view, with deep notch between. Lateral processes pointed, not exceeding the terminal lobes. Phallus straight in lateral view. No character known for separating female from the next species. *delicatula*
Lateral processes of phallus, in dorsal view, curving outward distally and exceeding the terminal lobes, each of which bears a small knob mesad near the base. In lateral view, the phallus bent dorsally at the yoke, the lateral process being rounded or truncate at the apex where it bears several bristles. *litarena*

A. imitator (Saussure, 1878)

A. imitator has the most distinctive characters of any species of *Anaxipha* occurring in the United States. In addition to the unique shape of both the ovipositor (Fig. 13) and the phallus (Fig. 1, 2), the color pattern is different from that of any other species. The long, dark lateral stripe from the eye to the tip of the folded wings serves to distinguish the species at a glance. In general appear-

ance it comes closest to the macropterous form of *A. pulicaria*, but it differs from that species in having unmarked hind femora. It also resembles *pulicaria* and differs from the other four species in lacking a fringe of long hairs on each of the six caudal tibial spines, as described under the subject of new characters. Only the macropterous phase has been found and it is doubtful if the short-winged form occurs at all. In all other species of the genus in the United States the short-winged forms predominate.

The known distribution of the species in the United States is confined to southern Florida. It was described from Cuba. Hebard (1915) collected it near Miami on sloping ground, covered with a litter of dried leaves, between the jungle of Brickell's Hammock and a red mangrove swamp. The writer has one pair dated March 15, 1915, from Hebard's series taken at that time. The following Florida specimens were lent to the writer: (1) Dade County, Key Largo, Apr. 25, 1937, 1 ♂, 4 ♀ (on jungle floor), H. F. Strohecker; (2) Matheson Hammock, near Miami, Nov. 11, 1936, 1 ♂, H. F. S.; (3) Dade Co., Paradise Key (Royal Palm State Park), Aug. 30–Sept. 1, 1925, 20 adults, T. H. Hubbell; (4) Broward Co., Fort Lauderdale, Sept. 3, 1925, 1 ♀, T. H. H.

Hubbell collected at night with a headlight by sweeping along hammock margins and roads and trails within the hammock. He found that *A. imitator* was abundant in ferns and herbages, and also occurred in shrubs, two to four feet from the ground.

Not much is known about the habits of *A. imitator* but Hebard (1915) mentioned that it was found on the ground, jumping and flying nimbly about. He described the song as a series of short trills lasting one or one and a half, occasionally two, seconds, with normal intervals a little less than a second.

A. exigua (Say, 1825)

This is the largest and most widely distributed of any of the native species. In the field it can be recognized by the clearly marked stripe on the hind femur. This species and *scia* have a slight angulation on the ventral margin of the ovipositor where a diagonal ridge on the ventral blade (first valvula) meets the ventral margin (Fig. 14). It differs from *scia* in the sculpturing on the dorsal blade (third valvula). Both species have, in common with others in the genus, a slight angulation on the dorsal margin, where a shallow diagonal furrow meets the margin. The furrow has a rough surface while the surface on both sides is shiny. The proximal shiny area includes a transverse ridge. In *scia* (Fig. 15), the dorsal end of the ridge meets the furrow, whereas in *exigua* there is a considerable interval between them, and the surrounding shiny area is broader and smoother (Fig. 14).

Anaxipha exigua has the longest ovipositor of any native species in the genus, both in actual length and in relation to the hind femur and the whole body. No specimen examined by the author has an ovipositor under 2 mm., but some are only 2.2 mm. No ovipositor longer than 3.2 has been examined. The length of the caudal femur divided by the ovipositor length gives a number close to 2, with a range of 1.87 to 2.27. The ovipositor, as here measured, includes only the blade, measured on a straight line (see Fig. 17). The body, excluding the ovipositor, is

generally not more than a millimeter longer than the hind femur, in dry specimens.

Anaxipha exigua is the only species of the genus to be found over much of the eastern half of the United States. Rehn and Hebard (1912) looked up original charts and found that the type locality for *exigua*, usually given as Missouri, was actually 80 miles west of Kansas City, in Kansas. This would place it very close to the present western limit of distribution of the species. Blatchley (1920) gives the known range of *exigua* as "from southern New England west to Minnesota and Nebraska and south and southwest to Jacksonville, Florida and Brownsville, Texas." Hebard (1925, 1931, 1932) named a number of limital localities extending slightly the known range. Cantrall (1943) found the species in Livingston County in southeastern Michigan. Walker and Urquhart (1940) collected it in extreme southern Ontario near Lake Erie, mostly from a marsh on Point Pelee.

In the collection of the University of Michigan Museum of Zoology, *A. exigua* is represented from only five Florida counties, all of them within a hundred miles of the northern boundary of Florida. Other parts of Florida have been thoroughly collected for Orthoptera. If the species occurred farther south it probably would have been collected there.

Anaxipha exigua has not been collected nor has its song been identified in the higher parts of the Blue Ridge and westward in North Carolina. The species probably occurs in all other parts of the state.

Anaxipha exigua occurs in the adult stage in late summer, in both the southern and northern parts of its range.

In the north, *A. exigua* probably is eliminated or reduced in numbers by early frost. In southeastern Michigan, Cantrall (1943) says that the species is gone by late September. In the south the species is often present until late November.

HABITAT.—*A. exigua* has been collected from quite a variety of habitats, but most of them have one or two features in common. They are low, moist places or dense thickets, or both. Blatchley (1920) states that in northern Indiana it is found among the sphagnum mosses growing in dense tamarack swamps and also on the shrubs about the margins of lakes and marshes. He also states that farther south it is often very abundant on the leaves and stems of arrow arum, cat-tail flags, button bush and other semi-aquatic plants. On the George Reserve in southeastern Michigan, Cantrall (1943) states that *A. exigua* is characteristic of the wet shrub zone, and is invariably seen or heard on shrubby plants, its favorite being button bush (*Cephalanthus occidentalis* L.).

The unpublished collecting notes of T. H. Hubbell contain descriptions of habitats where *A. exigua* was collected as follows: (1) woods bordering a river, (2) cane brake vegetation on slopes of a gully, (3) thick herbage on marshy valley floor, (4) tall weeds on gravel bar and sand banks, (5) willow-blackberry-herbage thickets along stream, (6) swamp forest flood plain, the wetter areas covered with *Saururus* and other succulent herbs, forming stands about two feet tall, (7) dead leaves in bottom of ravine.

In his ecological study of the Welaka area in Putnam County, Fla., Friauf

(1953) found *A. exigua* in only three types of habitat, but it was "abundant" in all three, when present at all. They were designated as follows: (1) moist ruderal grassland, (2) bayhead, (3) alluvial hammock, or river swamp. *Anaxipha exigua* was found in the herbage or shrub stratum.

SONG TYPES AND HABITATS OF *A. EXIGUA* IN NORTH CAROLINA.—A very puzzling situation exists with regard to the local distribution of song types. The writer learned to recognize, during his first year in North Carolina, three types of cricket songs, which, when traced to the singer, proved to be those of *Anaxipha exigua*. The three songs were named some years later in a publication by the writer (1951) as follows: (1) slow tinkle, (2) fast tinkle, and (3) trill. Each song is apparently produced as a series of sound pulses, each pulse made by a single movement of the tegmina and resulting in a sharp chirp. The main difference between the song types is in the frequency of the chirps which in all three types is influenced in a similar manner by temperature. In the slow tinkle the chirps are slow enough to count, except possibly on hot summer days. On cool mornings, at temperatures of 60 to 65°F. there are 3 to 3.5 chirps per second, and at 70 to 75°F. there are 4 to 5 per second.

The fast tinkle is too fast to count even at 60 to 65°F., when the chirp frequency is about 7 to 8 per second. At 75°F. the fast tinkle has an estimated frequency of 11 chirps per second. At this rate or faster the song still has a tinkling quality. The slow tinkle at high temperature approaches the fast tinkle at low temperature. The trill at first appears to be a continuous prolonged sound, but on careful listening it is found also to be a series of discrete chirps, but of such high frequency that it is impossible to estimate the number per second. When a trilling male starts to sing after being disturbed it sometimes trills in short trains of sound of one or two seconds' duration before starting a continuous trill.

For timing chirp rates too fast to count, the writer made use of a crude instrument for producing tapping sounds at different rates which could be compared in the field with cricket songs. The instrument consisted of a piece of thin, flat steel spring about a foot long, weighted with lead at one end and clamped between blocks of wood at the other end. By shifting the level of the spring between the blocks, the spring could be made to swing at rates varying from three to five per second. With a little practice it was found possible to shake the whole device in such a way as to keep the spring swinging at a fairly uniform rate. Two brass arms could be adjusted so that the spring would tap lightly against one arm at one end of each swing, or both arms at opposite ends of the swing. The instrument was taken to the field with the latter adjustment and the length of the swinging end was varied until the frequency of taps simulated the chirp frequency of the fast tinkle song under observation. One arm was then moved away until the slower tapping rate was counted. The chirping rate of the cricket was twice as fast as the reduced tapping rate. This device made it possible to estimate chirping rates up to ten per second or a little faster.

The determination of chirp frequency with this device may be slightly inaccurate but there is no doubt about the existence of three song types in the species.

The greatest chance of error is in confusion with other species of *Anaxipha* or with certain species of *Nemobius*. The slow tinkle is very much like the song of *Nemobius fasciatus tinnulus*, which is a series of discrete chirps at a slightly higher frequency. The song of *N. f. fasciatus* has a chirp frequency a little faster than the fast tinkle of *A. exigua*. The trill of *A. exigua* resembles the trilling song of certain species of both *Anaxipha* and *Nemobius*. The songs of *A. exigua*, slow tinkle and fast tinkle, are clearer, more bell-like, and maintain an even more constant rhythm than the rhythmical *Nemobius* songs they are compared with above.

The two tinkling songs of *A. exigua* together constitute one of the commonest elements of the cricket chorus to be heard in late summer and fall, especially in the piedmont area of North Carolina. In the mountain region, no song that could be identified as one of the tinkling songs of *A. exigua* has been heard, except on the lower foothills of the Blue Ridge, where the fast tinkle song and the cricket producing it have been identified. In the higher parts of the mountains the recognition of the fast tinkle is made difficult by its resemblance to the song of *Nemobius fasciatus fasciatus*, which is heard singing wherever grass grows in the mountains.

A few observations were made on the daily song period of the two tinkling races of *exigua*. Like many species of crickets they can be heard both in daylight and in dark and are most commonly silent during the hot parts of the day. A few start singing in the late afternoon and evening, and more after dark, but it is not until morning again that the full chorus is singing.

Allard (1910) described the song of *A. exigua* in northern Georgia as a shrill, prolonged, tinkling "ti-ti-ti-ti-ti." Cantrall (1943) described the song in southern Michigan in the same manner. These descriptions evidently apply to one of the tinkling songs, but since there is no mention of frequency they could refer to either the slow or the fast tinkle. In North Carolina both songs are heard in the same places but the fast tinkle usually outnumbers the slow tinkle. They occur in woody thickets in sunny situations, both upland and lowland. The two songs are found less commonly among tall weeds than in blackberry briars, young trees, shrubs, vines and other woody plants growing along forest borders, roadsides, ditches and small unshaded streams. They are also heard about dwellings, in ornamental shrubs and hedges. A pure population of crickets producing either the fast or slow tinkle has not been found, except for very small areas, such as a clump of bushes. No habitat has been found in which one form is regularly present and the other absent.

The writer has sometimes listened to one individual cricket for many minutes without hearing it change its song. He has also kept a male of one song type or the other with a female in a jar where the song could be heard frequently. No shift to one song type from another has ever been observed. It is probable that each male is capable of producing only one kind of song. The relation of the slow tinkle to the fast tinkle is still an unsolved problem. It could be a case of dimorphism for a song type. A solution of the problem by crossing experiments would encounter serious practical difficulties. The collection of the crickets from

woody thickets is very difficult and there is no way of identifying the females as to song type. Another difficulty would appear in the care of the eggs, because there is only one generation per year and the eggs would need to be kept viable over winter in the pithy plant stems where they are deposited.

The habitat distribution of the race producing the trilling song of *A. exigua* is entirely different from that of the two tinkling songs. The trilling race prefers deep shade rather than sunlight. The song was first heard by the writer in a deep, shaded ravine near Raleigh, N. C., where the song was traced to the singer on the ground among dead leaves. Later, the race was found along other wooded valleys and on plants growing in water and wet ground on the shaded banks of an old mill pond. The trilling race was found in greatest abundance in small patches of marshy ground, completely shaded and subject to flooding, in alluvial deposits along a small creek. In such places it was found largely on a plant called Lizard's tail, *Saururus cernuus* L., which grows about two feet high. Sometimes the crickets became so abundant that a few sweeps of the net through the tops of the Lizard's tail caught as many as five at one time. The combined singing of so many males filled the air with a shrill ringing sound. In the Lizard's tail marshes the crickets were living on the tops of the plants, as indicated by the ease with which they were collected by sweeping. In the wooded valleys many of the crickets were found among the dead leaves on the ground or on low plants a few inches from the ground. One was traced by its song to an alder leaf over six feet above ground.

Two of the three types of stridulation by *Anaxipha exigua* heard in North Carolina are also known to occur in Ohio, where they have been studied by Edward S. Thomas of the Ohio State Museum. His observations are summarized here from unpublished information. He says that the trill is heard abundantly in low ground throughout Ohio, where the song is produced by a large race of *A. exigua*. The other song, which is a fast tinkle like the song of *Nemobius fasciatus*, is produced by a smaller race of *A. exigua*. It is heard in hot dry uplands, usually associated with pines. It is also heard in leaf litter on the ground, and in all kinds of shrubbery. It has not been found north of Sugar Grove, Fairfield County, Ohio. Thomas found no significant difference in the male genitalia of the two forms but thinks they could be separated on the basis of size alone. Specimens of both races have well-marked femur stripes and females of both have a distinct angulation on the ventral margin of the ovipositor. Thomas has never found in Ohio the third type of *A. exigua* song, the slow tinkle, but he claims to have heard it at low altitudes near Gatlinburg, Tennessee.

A. scia Hebard, 1915

This species and *exigua* have some features in common, such as the dark femur stripe and the general shape of the phallus (Fig. 4, 5). The phallus of *scia* has the lateral process tapering to a more acuminate point than in *exigua*. The ovipositor in both species (Fig. 14, 15) has a very slight angulation in the ventral margin near the middle as seen in profile, differing in this respect from the other species except *imitator*. The ventral angulation is more distinct in *exigua* and

the sculpturing near the middle of the dorsal component of the ovipositor differs in *scia* and *exigua*, as shown in the drawings and explained under *exigua*. No ovipositor, in specimens identified as *scia*, has been found as long as 2.0 mm., but ovipositors as long as 1.7 mm. and 1.8 mm. are fairly common.

The most unique character of *scia* is the shape of the tarsal claws (Fig. 21), which are long, curved and smooth whereas the other species of *Anaxipha* have a row of three or four teeth on the disto-ventral side. Unfortunately, one to three very small teeth have been found in a few specimens (Fig. 20) that agree with *scia* in other respects. The color of *scia* is generally a medium brown with the head and pronotum a little darker than the tegmina. Florida specimens seem to average a little darker than North Carolina specimens.

The female type of *scia* and the male allotype were collected by Hebard among tidal litter in a mangrove swamp at the edge of Brickell's hammock, Miami, Fla., on March 16 and 15, 1915. No other adult specimens were collected at that time, but the writer has one female and two male specimens bearing Hebard's label showing that they were collected at the same place on March 8, 1919. The writer examined and measured the type and allotype in 1940. His measurements generally agree with Hebard's (1915) published description, except in the length of the ovipositor, which was found to measure 1.85 mm. in the type whereas the published description gave 2.7 mm., a length which is entirely out of line with other specimens. A possible explanation is that the thick basal portion might have been included in Hebard's measurement, rather than the blade alone as measured by the writer (see dotted line, Fig. 17).

The length of the hind femur divided by the length of the ovipositor gives a higher number in *scia* than in *exigua*. Some sample specimens of *scia* gave measurements as follows:

Series	Ovipositor	Femur Divided by Ovipositor
Miami, Fla., March 16, 1915 (type)	1.85	2.3
Miami, Fla., March 8, 1919	1.7	2.4
Cortez Beach, Fla., Jan. 4, 1925	1.65	2.5
Cedar Keys, Fla., July 12, 1925	1.7	2.7
Carolina Beach, N. C., Sept. 14, 1932	1.75	2.9
Carolina Beach, N. C., Sept. 14, 1932	1.82	3.0
New Bern, N. C., Aug. 27, 1946	1.72	2.9
New Bern, N. C., Aug. 27, 1946	1.8	3.3
Amargosa Desert, Nev., Aug. 23, 1919	1.85	2.6

Additional information on the habits and distribution of *A. scia* has been obtained from the field notes of several collectors of this little known species. The unpublished notes are summarized by states as follows:

Florida: MANATEE CO.: Cortez Beach, Jan. 4, 1925, 4♂, 3♀, T. H. Hubbell; collected at night by beating young mangrove seedlings and other vegetation growing in chamber-like openings roofed by mangrove branches. LEVY CO.: Cedar Keys, July 12, 1925, 10♂, 2♀, T. H. H.; collected at night with headlight in shoreward margins of salt marsh on northeast side of Cedar Key, by trampling clumps of reeds into the muck and looking for crickets to crawl out. **South Carolina:** GEORGETOWN CO.: Georgetown, Aug. 17, 1931, 1♂, macropterous, S. B.

Rochester. **North Carolina:** NEW HANOVER CO.: Carolina Beach, Sept. 12, 1928, 1♂, 1♀, Fulton. Sept. 14, 1932, 23♂, 17♀, Fulton. Aug. 30, 1939, 4♂, 7♀, Fulton; in salt marsh, tall grass and rushes. CRAVEN CO.: New Bern, Aug. 27, 1946, 17♂, 16♀, Fulton; tall grass at water's edge. HYDE CO.: Swanquarter, Aug. 11, 1953, 4♂, W. M. KULASH; macropterous, at light, near a large salt marsh. **Virginia:** Tappahannock, Sept. 9, 1915, 1♀, Hebard. **New Jersey:** Mullica River near New Gretna, August 24, 1924, Hebard; salt marsh. **Nevada:** Amargosa Desert, Fairbanks Ranch, Ash Meadows, August 23, 1919, 1♂, 2♀, Hebard. Further information on this remarkable series is quoted from a letter by Hebard which reads as follows: "The crickets were found in a large colony in Tules (the western bull rush) around a large pool of strongly alkaline water. Individuals were near the surface of the water where the males were keeping up a continuous trilling, more liquid and higher pitch than all of *Nemobius*. Three individuals were taken after long search. . . They seek the thickest grasses and can be driven into the open . . . only with the greatest difficulty."

From the assembled data it is evident that *scia* is found mainly in two habitats, mangrove swamp and salt marsh. The species is definitely distributed along the coast and is probably confined to tidewater. At present the recorded distribution is from Miami, Fla., to Mullica River, N. J., on the Atlantic Coast, and at Cedar Key and Cortez Beach on the Gulf Coast. The species should occur in salt marshes along the Gulf from Florida to Texas, but so far as the writer is aware no specimens have been collected west of Cedar Key, except the remarkable series from Nevada far to the west of even the widespread *A. exigua*. The habitat is probably not very different from the salt marshes along the Atlantic Coast. The interesting question is how this species got started in such an isolated place.

The three Nevada specimens agree with specimens of *scia* from the east in all known characters except general color, which is very pale in the Nevada specimens. They have very conspicuous stripes on the hind femora, the claws are toothless, the ovipositor is a little less than 2 mm. long and has the slight angulation on the ventral margin, and the phallus is similar to that of eastern specimens of the species.

In Florida, *scia* has been found in the adult stage in January, March, July and September. In North Carolina, *scia* has been found as adults in every month from July to October, inclusive, but has not been seen or heard at other times.

The stridulation of *scia* in North Carolina results in a rapid tinkling, like little bells, very much like the tinkling songs of *A. exigua*. It is a rhythmical repetition of pulses of sound at a high frequency. It has not been possible to compare out-of-doors the songs of *scia* and *exigua*, because the two species are seldom found in the same place.

The writer believes that the pulse frequency of *scia* lies between the slow tinkle and the fast tinkle of *exigua* as described under that species. At temperatures between 60°F. and 65°F. the slow tinkle of *exigua* has 3-4 pulses per second, *scia* 4-5, and the fast tinkle of *exigua* is estimated at 7-9 pulses per second. Thus the song of *scia* is similar to the song of *Nemobius fasciatus tinnulus*, which never occurs in the same habitat with *scia*. *Anaxipha scia*, like *exigua*, sings most vigorously in the morning, and very little on cool nights.

A. pulicaria (Burmeister, 1838)

After studying a large number of specimens in the Philadelphia collections from the West Indies, and Central and South America, Hebard (1924) concluded that the name *A. pulicaria* should be used for the species which Rehn and Hebard (1916) recognized and discussed as *A. vittata*. Hebard (1924) pointed out that the name *A. delicatula* (Scudder, 1877) was available for the species which previously had been determined as *A. pulicaria*. He also stated that Bolivar's *vittata* may be a synonym of *pulicaria*, the description of *vittata* being based on West Indian material and of such a character that definite assignment can not be made without examination of the type.

The species now recognized as *pulicaria* can be identified by several characters. The structure of the phallus is probably the most dependable character (Fig. 7, 8). It is flatter than in other species and tapers to a thin, wedge-shaped truncated tip. In some specimens the phallus becomes warped on drying and results in a trough-shaped organ. The yoke is unpigmented, very broad (as measured along the middle line) and has poorly defined boundaries. The spines on the hind tibiae lack a row of long hairs on the side nearest the tibia. The fringe is present in all the other native species of *Anaxipha* except *imitator*. The presence of the fringe can be taken to indicate that the specimen is not *pulicaria* or *imitator*. The absence of all fringe hairs could indicate that they have been broken off, in which case the identification must be based on other characters. The same is true if both hind legs are missing. The ovipositor (Fig. 16) is short, pale and narrow, usually measuring about 1.3 mm. in length and 0.2 mm. in width.

The body is pale straw-color with a dark brown sharply contrasting pattern on the head, pronotum and legs. The pronotum has a dark pattern on the median area of the disk and on the upper half of the lateral lobes. The hind femur has many diagonal, elongated, brown spots, which in some specimens are united to form one or more jagged lines. The size is usually very small, probably smaller than any species except *imitator*; in fact, the several macropterous individuals of *pulicaria*, in the collections examined, bear a strong superficial resemblance to *imitator*.

Fifty specimens from the University of Michigan Museum of Zoology were examined. All of them were from Florida, taken by several collectors, including T. H. Hubbell, Fred W. Walker, H. L. Speer, and J. J. Friauf. Most of these specimens were collected in Alachua County, around Gainesville or Levy Warburg Lake. Other Florida specimens were taken in Marion County at Ocala National Forest and in Putnam County at Welaka. The dates represented include March, April, June, July and August. Five of the fifty specimens are macropterous.

Unpublished collecting notes by Hubbell give some information on the habitats where the species is found: (1) sweeping tall dry grass, hillside pasture, at night; (2) sweeping herbaceous undergrowth in high hammock, at night; (3) sweeping lush herbage in margins of hammock at dusk.

Only one specimen from a locality outside Florida has been seen by the writer, a single male specimen which he collected at Edisto Beach, S. C., on August 31,

1949, by sweeping grass about a foot high in a flat sandy area on the land side of the first dune, near the beach.

Rehn and Hebard (1916) listed four specimens under the name *A. vittata* (Bolivar). These specimens, which should now be identified as *A. pulicaria*, are as follows: Albany, Ga., Aug. 1, 1913, 1 ♀; Atlantic Beach, Fla., Aug. 24, 1911, 1 ♂; Punta Gorda, Fla., 1 ♀; Key West, Fla., Mar. 15, 1910, 1 ♀.

A. delicatula (Scudder, 1877)

When Hebard (1924) found that the name *A. delicatula* (Scudder, 1877) was available for the species previously identified as *A. pulicaria*, he was not aware that two species were involved. Several years later, the writer compared the structures of the phallus of the species of *Anaxipha* represented in his collection. The males, identified as *delicatula*, were found to be of two species, but the females appeared to be all of the same species. Until better female characters are found, the females will have to be identified by being associated with a series of males of one of the two species, or by being collected in a habitat or geographical area inhabited by only one of the two species.

The immediate problem was to determine which of the two species was *A. delicatula*. Fortunately, Scudder's type was still in good condition and on loan to the U. S. National Museum from the Museum of Comparative Zoology at Cambridge, Mass., where the type is at present located. Dr. A. B. Gurney relaxed the type and made it possible to see the phallus, which was found to be of the short straight form shown in Fig. 11 and Fig. 12. Scudder's description of *Cyrtoxipha delicatula* was based on a macropterous male specimen collected in Florida by J. H. Comstock. Following the description, Scudder wrote, "one male, Fort Reed, April 23. I have also received a male of the same species from Sand Point, Florida, collected May 1, by Hubbard and Schwartz." This comment by Scudder gives the impression that the Sand Point specimen might have been received after the description had been written. This specimen apparently has been lost or destroyed. At any rate the Fort Reed type serves to fix the name *delicatula* for the species having the straight phallus and wider distribution. The other species, which runs through the key to the last couplet, is described by the writer as a new species, *A. litarena*.

Scudder placed his *delicatula* as a species of *Cyrtoxipha* on account of the long wings which are now known to occur as a phase in a small proportion of every short-winged species of *Anaxipha* found in the United States. The macropterous forms are commonly found attracted to lights at night.

Anaxipha delicatula is the only species other than *A. exigua* found as far inland, in North Carolina, as Raleigh, Fayetteville and Hamlet. The Fulton collection also has a macropterous female taken in a trap light at Clemson College, S. C., June 21, 1931, by O. L. Cartwright.

The species has been collected in the adult stage in eastern piedmont North Carolina from May 22 to July 21. During most of this period *A. exigua* occurs only as nymphs. Often the two species are found in the same habitat but not in the same stage. *Anaxipha delicatula* occurs in the piedmont and coastal plain, in

marshes and stream borders, especially in those having large tufts of marsh grasses or a cover of Lizard's tail (*Saururus*). The writer has also a series of four male and five female specimens from the salt marsh at Carolina Beach, collected June 12, 1930.

Other specimens supplying data on the seasonal history or geographic range of the species include the following:

Florida: DADE CO.: Jacksonville, Sept. 19, 1927, 1♂, J. S. Rogers. July 30, 1942, 1♂, R. C. Barnes. Paradise Key, April 7, 1951, 1♂, 3♀, H. and A. Howden; these 4 specimens taken at a light, all macropterous, the females tentatively identified by association with the male. LIBERTY CO.: Hosford, March 21-24, 1954, 32 adults, T. H. Hubbell; perhaps a new species or race. **Louisiana:** New Orleans, June 9, 1923, 2♂, T. H. Hubbell; damaged specimens. **Illinois:** Giant City State Park, June 15, 1955, 1♂, 1♀, R. D. Alexander.

The total range of the species in the United States is from the southern tip of Florida, north to Clemson College, S. C., Hamlet and Raleigh, N. C., and west to New Orleans, La. There is evidence to show that the species probably occurs in northern Virginia in the vicinity of the District of Columbia. Allard (1930) reported the occurrence in this area of a species singing in marshy places in May. This he identified as *pulicaria*, but it seems very improbable that this was the species identified as *pulicaria* by Hebard (1924). Allard's descriptions of the song, habitat, and seasonal history all point to *delicatula* as the probable species.

The crickets collected by Alexander in southern Illinois extend the known range of the species about 500 miles up the Mississippi, if further study does not show them to be a new species. Examination of the crickets showed agreement with *delicatula* in most of the characters found in the genus, including the structure of the phallus, which was dissected out and glued to a paper point by E. S. Thomas. The time of year in the adult stage also points to *delicatula*. The song, as observed by Alexander, is essentially the same as the song of *delicatula* described in this paper. Alexander first heard the song among *Andropogon* in a dry hillside prairie about a hundred yards above a swale, but it was much more common in marshes on cat-tail (*Typha*) or other marsh plants. He heard the song near Cairo, Wolf Lake, Makanda and Carbondale, all in southern Illinois. At two places, Wolf Lake and Carbondale, the song was traced to an individual singer. Four males and two females were collected at Giant City State Park and one male at Carbondale. They were kept alive for observations on the song. During the trip home, all but one male and one female disappeared. There seems to be little doubt, however, that they were all of the same species, *A. delicatula*.

The Illinois crickets differ from specimens of *delicatula* in their brown color, but other series collected near Raleigh, N. C., in early summer, approach this condition. The specimens collected by Hubbell in Liberty County, Fla., are even darker brown. An examination of the phallus of one specimen showed close relationship to *delicatula*, but further study will be necessary before the status of these specimens can be finally determined. Alexander suggests that the brown color of the Illinois specimens might be abnormal, owing to the high humidity at the time they were pinned. Some other insect specimens collected at the same time turned black on account of slow drying.

The song of *A. delicatula* as observed near Raleigh, N. C., is a high-pitched prolonged trill with tonal qualities of *Oecanthus nigricornis*, but weaker, like *Nemobius cubensis*. Sometimes the trill is broken into shorter phrases or trains of three or four seconds' duration with brief breaks between. Some individuals start singing after being disturbed, with phrases shorter than one second before resuming the continuous trill. Others start with a continuous trill, which seems to be the normal calling song when the crickets are undisturbed.

***Anaxipha litarena*² sp. nov.**

MALE.—Size and form about average for the genus. Body about 6 mm. long or 6.8 mm. including the tegmina. Head width at eyes, 1.6 mm.; length, vertex to occiput, 1.0 mm. Length of eyes, 0.66 mm. Length of first antennal segment, 0.4 mm. Occiput with small scattered bristles; head between the eyes with a few inwardly curved bristles, below which the number of larger bristles increases, those near the middle line forming a double row, diverging between the antennae. Face below antennae with few small bristles. Terminal segment of maxillary palpi flattened in form of isosceles triangle; apical side slightly shorter than the other two. Pronotum (in dorsal view) width of anterior margin, 1.3 mm.; posterior margin, 1.65 mm. Right tegmen, width of dorsal field, 2.3 mm.; length, 4.7 mm.; depth of lateral field, 0.9 mm. Tympanum of tegmen, length, 2.3 mm.; width, 1.4 mm.; dimensions of inner oval, 2.1 × 1.0 mm. No wing visible. Hind femur length 4.5 mm.; maximum width, 1.2 mm.

Length of tarsal joints

	Proximal	Joints 2 and 3 Combined
Front leg	0.5 mm.	0.66 mm.
Middle leg	0.4 mm.	0.66 mm.
Hind leg	0.8 mm.	0.7 mm.

Length of hind tibia to base of large spur, 4.0 mm. Length of proximal portion to base of proximal spine, 2.0 mm. Length of the 3 external spines on right hind tibia: proximal, 0.56 mm.; middle, 0.60 mm.; distal, 0.56 mm. Interspace to next spine in same row: proximal, 0.56 mm., middle, 0.5 mm.; distal, 0.66 mm. (to spur). Tibial spines with a maximum of 6 long fringe hairs on the side next to the tibia. Hind tarsal claws with 2 or 3 small teeth on the distroventral margin. Anterior tibiae with a sensory tympanum on the caudal face only.

Supporting structure of phallus (Fig. 9, 10) in the usual H-form. Distal half bent dorsad just distad to the yoke. Distal portion constricted beyond yoke, lateral processes then bent strongly outward, then curving inward again so as to lie parallel at the apex, which is the widest part of phallus beyond the yoke. Tips of lateral processes (brown) exceeding the terminal lobes (white). Each terminal lobe with a large distal portion and a small knob-like proximal portion. The distal portions widely spaced, the proximal knobs narrowly separated at the base of the notch. The free tips of the lateral processes truncated and bearing several bristles on the apex and dorsal margin. The terminal lobes bearing scattered short hairs.

COLOR.—Body a pale buff or straw-color. Face without a dark pattern; below antennae, paler; above antennae, with small dark spots where bristles are or were attached. A narrow pale median line extending from vertex to occiput. Pronotum with pale lateral lobes, dorsal area slightly brown with pale,

² From *litus* (shore) and *arena* (sand).

narrow, median line. Hind femur straw-color, with a light reddish brown pattern on the upper half, the darker color in diagonal streaks enclosing elongated pale spots. No dark stripe at the sulcus. Abdomen brown on the sides and venter but with a pale stripe on the mid ventral line.

HOLOTYPE.—Male, Carolina Beach, New Hanover Co., N. C. Collected by the author, June 12, 1930, on a shrub, *Iva*, growing on the first dune near the ocean. To be deposited in the U. S. National Museum.

PARATYPES.—Paratypes listed below include only male specimens in which the phallus has been pulled out to make it visible. No allotype or female paratypes have been designated because no female characters are known for distinguishing the species from *delicatula*. Numbers in parentheses, following locality and date, refer to the number of paratypes in each series.

Fulton collection.—**North Carolina:** Carolina Beach, June 12, 1930, (2); April 20, 1930, (4); Sept. 11, 1931, (1); Aug. 31, 1939, (8); Harkers Island, June 11, 1931, (4); Lake Mattamuskeet, July 29, 1946, (2) (1 macropterous). **Florida:** Panama City Beach, Sept. 4, 1949, (3). **South Carolina:** Cherry Grove Beach, July 31, 1936, (4).

University of Michigan Museum of Zoology.—**Florida:** ALACHUA CO.: April 12, 1924, F. W. W. (8); Aug. 24, 1924, F. W. W. (1); April 21, 1924, F. W. W. (1); Aug. 5, 1924, F. W. W. (2); April 5, 1924, F. W. W. (2), March 13, 1924, T. H. H. (1); April 11, 1925, T. H. H. (1); May 3, 1924, T. H. H. (1); March 4, 1925, T. H. H. (1); April 2, 1925, T. H. H. (1); April 1930, T. H. H. (1). COLUMBIA CO.: July 22, 1925, T. H. H. (3). GADSDEN CO.: River Jtc., July 25, 1925, T. H. H. (1). LEON CO.: Tallahassee, April 23, 1924, T. H. H. (1). LEVY CO.: Cedar Keys, Oct. 18, 1924, F. W. W., T. H. H. (3). LIBERTY CO.: Old Camp Torreya, April 27, 1924, and July 27, 1925, T. H. H. (2). MADISON CO.: Ellaville, April 22, 1924, T. H. H. (4). MARION CO.: Juniper Springs, Sept. 4, 1938, and Sept. 9, 1938, H. and F. (2). MARION CO.: Micanopy, April 4, 1926, T. H. H. (2). OKALOOSA CO.: Delaco, Aug. 11, 12, 1935, T. H. H. (1). **Louisiana:** Mandeville, Feb. 25, 1923, T. H. H. (4). **Georgia:** Macon, June 3, 1928, F. W. W. (1).

F. W. W. = F. W. Walker T. H. H. = T. H. Hubbell H. and F. = Hubbell and Friauf

The paratypic series shows a little variation in size. The length to the tip of the tegmen shows a range from about 4.5 to nearly 7 mm. The general color is pale brown with some darker stippling and in some series a slightly obscured dark pattern on the head and pronotum is present. This pattern was more prominent in the series from Harkers Island, N. C., and the sand ridge near Carolina Beach, N. C. There is also some variation in the phallus which may be partly a matter of the form it takes on drying. In some specimens the lateral processes extend beyond the terminal lobes but in others the two parts terminate at about the same level. The truncated tips of the lateral processes may be narrow or broad. The terminal lobes are probably the parts most subject to distortion on drying. The size of the teeth on the tarsal claws is variable but no specimen has been found entirely devoid of teeth.

NOTES ON HABITAT.—The species has a wide range in habitats. At Carolina Beach, N. C., it was first found in April, 1930, in undergrowth on a dry sand ridge. In June and September it was beaten from shrubs on the dunes near the ocean. On August 30, 1939, a good series was taken in the salt marsh. At Lake Mattamuskeet, N. C., and at Panama City Beach, Fla., it was collected from tall grasses growing in water and on the shore.

A wide range of habitats is also shown by specimens collected in Florida by

T. H. Hubbell and F. W. Walker. The small size of the series collected there suggests that the species was seldom very abundant or that it was hard to capture. The largest Florida series was collected by Walker at Warburg Lake, Alachua Co., April 12, 1924, by sweeping herbaceous undergrowth at night in high hammock with some pine and palmetto mixed in. This collection included eight male paratypes and 15 female specimens which are probably of this species, and three specimens of *pulicaria*. Other Florida series with one to four male paratypes were collected in a variety of habitats, several of which are described as follows: (1) low pine woods with thickets of wax myrtle, elsewhere a dense ground cover of palmettos, dwarf oaks and vines; (2) open grove of oaks, holly and pine on river bank, undergrowth of tree seedlings and herbage; (3) small shrubs and herbage along margin of ravine forest, and partly cleared area; (4) in shrubbery and herbage along road in open sweet gum-magnolia-oak hammock; (5) hammock bordering Newnans Lake; (6) open stand of turkey oaks on white sandy soil, with undergrowth of oak seedlings, herbs and clumped grasses, *A. litarena* mostly on herbage; (7) Lizard's tail (*Saururus*) patches in depressions in woods; (8) mesophytic upland forest; (9) salt marsh, northwest side of Cedar Key.

NOTES ON SONG.—Some notes on the song of *A. litarena* were taken on June 8, 1931, on the shore of Harkers Island, Carteret County, N. C., where all the males collected were of this species. At a temperature of 72°F. at night, the song was a series of short trills varying from 9 to 16 per 10-second period, the trills being longer than the rests and of variable length. The rests were very brief so that the song of a group appeared to be continuous. The singing started in late afternoon and continued all night and part of the morning. The crickets were silent after about 10 a.m. At a temperature of 85°F. in the morning, one was counted doing 24 trills in 10 seconds and another at a slower rate of 16 per 10 seconds. The sound was high-pitched but not as clear as that of some crickets. It was very similar to the song of *A. delicatula* of inland marshes.

Four males of *Anaxipha litarena* were collected on a sand ridge near Carolina Beach, N. C., on April 20, 1930. One was kept alive in a jar for observation on the song. At 67°F. the next night, the song was similar to that observed on Harkers Island, a series of shrill trills, about 8 per 10 seconds and each trill of about one second's duration. On April 30, at 75°F. the same cricket sang with 13 to 20 trills per 10 seconds. A caged cricket of the same species from Newnans Lake near Gainesville, Fla., supplied by T. H. Hubbell, sang in a very similar manner. The trills were of variable length and sometimes were in series of three or four separated by somewhat longer pauses. At Carolina Beach, N. C., at about 70°F. on the night of June 12, 1930, a song was heard in *Iva* bushes on the first dune, with 20 to 24 trills per 10 seconds. Three specimens which were caught proved to be *A. litarena*. One of these was later selected as the type, and the other two as paratypes.

SUMMARY

Prior to 1912 only one species of *Anaxipha* was known to inhabit the United States. This species, *A. exigua*, is widely distributed over the eastern half of the

nation. From 1912 to 1916, four more species were recognized in the United States and in 1924 the names of two species were changed. Since 1924 most students of the Orthoptera have followed Hebard in recognizing five species, namely, *imitator*, *exigua*, *scia*, *pulicaria* and *delicatula*. In the present work, the writer has found new diagnostic characters in the concealed male phallus, and, for certain species, in the ovipositor, tarsal claws and hind tibial spines. The most unique phallus was found in *A. imitator*. A very distinct type of phallus was also found in a new species, *A. litarena*, which is apparently related to *delicatula*. No characters were found for separating the two species in the female sex. A key for identification of the six species is included.

The stridulation and most-frequented habitats are described by the writer from his own notes or those of other collectors or from the literature. *Anaxipha exigua* in North Carolina has three types of song, which have not been correlated with any specific characters. One type is found most frequently in shady marshes. The other two are associated with thickets in sunny uplands, both being found in the same habitats.

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