THE

TETTIGIDAE

OF

NORTH AMERICA

BY

JOSEPH LANE HANCOCK

WITH ELEVEN PLATES AND MANY
TEXT FIGURES BY THE AUTHOR

CHICAGO
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THE TETTIGIDÆ OF NORTH AMERICA

JOSEPH LANE HANCOCK

INTRODUCTION

The present monograph treats of a group of small orthoptera, some of the members of which are the smallest representatives of the Acrididæ. The group of Tettigidæ,* as found within the confines of the territory here covered, has received until recently but little special attention. Tettigids or grouse-locusts, the name by which these insects are commonly known, are widely distributed over the world, there being fewer species here than occur in some foreign tropical countries. Still North America is much richer than Europe in the actual number of species. The present contribution brings together, as far as possible, what is known of the species inhabiting North America, Central America, Mexico, and the West Indies, the aim of its preparation being to stimulate further study of this inconspicuous, though most interesting, orthopteran group. While approximately ninety-nine species are here mentioned, further investigation might have rendered the treatment more complete and satisfactory by the addition of new material. Whatever the field may be it is fully appreciated that before our ink is dry new discoveries may change some of our present conceptions.

During the nine years of study, in which a riper knowledge has been sought, it has been necessary to revise the manuscript many times, owing to accumulated observations and descriptions of species and data published by other observers. Types of a great many of the described forms have been critically examined. The author has been able to add materially to the knowledge of the habits of some of these little orthoptera. The drawings of the various plates and text

* The *Tettigidæ* should not be confused with *Tettigiidæ*, a name sometimes applied to the *Cicadidæ*.

figures were made by the author and with but few exceptions, designated further on, are taken from nature.

After the description of each species the bibliography is appended. This part of the work was facilitated by the recent appearance of the excellent "Index of North American Orthoptera," by Dr. S. H. Scudder. New synoptical tables are presented herewith, which modify to some extent those already published by the author. In the biological field there are many problems here suggested which invite the student of evolution. For instance, of peculiar interest is the last ecdysis in which the elytra in many of the northern forms, which in the earlier larval stages are obscured from view, now take a position at the side of the body in the posterior elytral sinus. The wings likewise become explicate, taking a folded position when at rest under the pronotum, where they become partly visible. Few groups of insects present such numerous variations, which, viewed from the quantitative standpoint, are as yet but little appreciated. Again, the embryology of the group will doubtless throw important light on very interesting questions of its phylogeny.

It would have been impossible to present the subject, even in its present form, without the kind co-operation of a number of observers who generously aided me in various ways. To them the author here takes pleasure in acknowledging his obligation.* Professor Ignacio Bolivar, of Madrid, Spain, identified some of the doubtful species referred to him, and very generously furnished a number of exotic forms. Mr. A. P. Morse, of Wellesley, Massachusetts, in a like spirit of generosity, allowed me to examine a large series, and contributed a number of species to my collection. Some of his types were also examined. Dr. S. H. Scudder, through whose correspondence a number of species have been clearly defined, allowed me the opportunity of examining his type examples of *Tettix acadicus* and *Paxilla obesa*. To Professor H. De Saussure the author is indebted for a rare copy of one of his memoirs and correspondence. From Mr. Malcolm Burr,

*I am much indebted to the officers of the United States National Museum for placing the collection comprising three hundred and thirty-two specimens at my disposal for study.

of East Grinstead, England, came the gift of interesting exotic species, valuable for comparison. To Professor J. G. Needham, Lake Forest University, the author is under obligations for the determination of certain points in the tracheation of the wings. Through friendly association or contributions of series to my collection may be mentioned Professor W. M. Wheeler, University of Texas; Professor W. S. Blatchley, Indianapolis, Indiana; Dr. F. W. Goding, New South Wales, Australia; Professor M. J. Elrod, and C. C. Adams, Bloomington, Illinois; Dr. R. W. Kunze, Phoenix, Arizona; Professor C. F. Baker, Auburn, Alabama; Dr. Martin Matter, J. E. McDade, and Professor O. S. Westcott, of Chicago; Dr. Hugo Karl, Lawrence, Kansas; C. F. Adams, Atherton, Missouri; O. W. Barrett, Mexico; R. J. Crew and E. M. Walker, of Toronto, Canada; B. T. Gault, Glen Ellyn, Illinois; the late A. Bolter, of Chicago; and Professor Otto Lugger, of St. Anthony Park, Minnesota, also now deceased.

Foremost in laying the foundation of our present systematic knowledge of the Tettigidæ was the admirable essay (1887) of Professor Ignacio Bolivar. Upon this work more than any other the writer has based the present systematic studies. It will be observed that, through lack of adequate material at that time, the species of North America were not treated thoroughly and the identity of species was more or less confused. But as a notable general contribution the work of Bolivar stands as a classic. Earlier writers described here and there an isolated species. Those who have enriched the subject may be mentioned: Say, De Saussure, Burmeister, Harris, and Scudder. Notable among the more recent contributions are several by my colleague, Mr. A. P. Morse, whose systematic studies of North American and Central American species have been the most important. Citations from other observers will be found in the body of this article.

ORIGIN OF THE NAME TETTIX.

The genus *Tettix* was first known by the appellation *Tetrix*, which was given by Latreille (1804) to a well defined group of Acridians, which in succeeding years became known under various names, but we recognize these insects from the time of Linnæus (1764), whose figures are unmistakable. *T. bipunctatus* and *T. subulatus* of Europe were

for the first [illegible] known. The synonymy of the term as applied to the entire group which we have designated as the *Tettigidæ* from this early period to the present time, is as follows: *Locusta* Linnæus (1754), *Acrydium*, Fabricius (1775), Zetterstedt (1821), *Acridium*, Stål (1874), Scudder (1878), Kirby (1878), DeHaan (1842), *Tetrix*, Latreille (1840), Burmeister (1838), Harris (1841), *Proscopia*, Serville (1839), *Tettigaria* p. p. Fieber (1853), *Tettigura*, De Saussure (1861), *Tetrix* p. p. Scudder (1862), *Tettigidæ*, Walker (1871), Bolívar (1878), Brunner (1882), Hancock (1902), *Tettigetta*, Thomas (1872), Fernald (1888), Morse (1894), Buetenmuller (1901), Blatchley (1901), Lugger (1898), Smith (1900), Walker (1903), Scudder (1897), Morse (1902), Saulcy (1901), *Tettigides*, Shipley (1903).

Although Latreille first applied the term *Tetrix*, as we understand the name to-day, it is essentially the same genus as that defined by Charpentier (1811) as *Tettix*, and later used by Fischer (1853), and so on down to the present time. The word *Tetrix* is of Greek origin, meaning grasshopper. Harris supposed that Latreille applied the term to the *Tettigidæ* from some fanciful resemblance to the heath-cock of Europe. In North America the name grouse-locusts has to some extent been applied to Tettigids in consequence of this supposed similarity. A number of common names have been created for the various species. Thus Harris gave five names to a single species, *Tettix ornatus*, basing these names principally upon color remarkings.

Notwithstanding the very marked characters dividing the Tettigian group from the other orthoptera, the earlier authors in some instances failed to grasp the real taxonomic differences. We find, for instance, members of the genus *Choriphyllum* Serville (See Plate I., Figure 1), placed among the *Membracidæ*, a fundamentally different order of insects, though possessing the same analogous, prothoracic development. By reason of the great difficulty in classifying the species synonyms have accumulated.

CHARACTERS DISTINGUISHING THE GROUP.

The characters which distinguish the Tettigidæ from other groups of orthoptera may be stated briefly as follows: They are among the smallest orthoptera. They have a large pronotum, covering the mesonotum, the metanotum, and not infrequently extending beyond the end of the abdomen and the apex of the posterior femora; presenting very small, rudimentary elytra formed like little lobes or scales, and situated on each side of the body within the posterior elytral sinus at the base of the wings. The wings may be large and well developed. They are remarkable for the narrowing of the wing proper or the part before the anal furrow (this portion being usually exposed and partially chitinized) and for the enormous development of the anal area, as more fully described and illustrated further on. The elytra and wings are not infrequently rudimentary or even absent; the

prosternum is specialized in a sternomentum (chin-piece); the mesosternal plate is wider than long, the metasternum strongly curved; there is no aroleum between the terminal claws of the tarsi; the ninth and tenth terga of the abdomen in both sexes are provided with a median longitudinal sulcus; the subgenital plate of the male, viewed in profile, is conical or triangular, the cerci conico-cylindrical and very small, the supraanal plate lanceolate or triangular; the female ovipositor serrulate, with sharp diverging extremities. During the last ecdysis in arriving at the adult stage, the elytra take their position on either side of the body and the wings become extended and folded under the pronotal process.

DISTRIBUTION.

The Tettigidæ were divided by Bolivar into seven sections, none of which it is necessary to revise. Of this number four subfamilies appear to be represented, namely: *Cladonotinæ*, *Metrodorinæ*, *Tettiginæ*, and *Batrachidinæ*. Of the *Cladonotinæ*, the remarkable leaf-like *Choriphyllum*, Walk., and *Phyllonotus*, Hanc., are represented in the West Indies. Members of these genera exemplify the highest type of protective resemblance. Another genus, *Tylotettix*, Morse, comes from Nicaragua. Of the *Metrodorinæ* the following genera: *Chiriquia*, Morse, *Otumba*, Morse, and *Platythorus*, Morse, are from Nicaragua. The *Tettiginæ* are represented by eleven genera; the first, *Nomotettix*, Morse, is largely distributed in the northeastern United States, but appears as well in Kansas, Nebraska, Illinois, and southward. The genus *Tettix*, Charp., is numerously represented by various species covering the temperate region, extending north, and two species appear in the southern United States. This genus was formerly thought to be represented by one species in South America, namely, *T. asperulus*, Bol., but this species appears to come under the genus *Apotettix*, Hanc. *Neotettix*, Hanc., is essentially a southern genus. *Micronotus*, Hanc., as we have already mentioned, is from the West Indies. *Apotettix*, Hanc., appears in Mexico and Texas. The genus *Ochetotettix*, Morse, is Mexican. The

distribution of *Paratettix*, Bol., is north, northeast, and southward into Mexico and Central America. *Clypeotettix*, Hanc., is Central American and Mexican. *Allotettix*, Hanc., is Central and South American. *Telmatettix*, Hanc., is found in the western, and southern United States, Mexico, and southward. *Paxilla*, Bol., is represented by a very singular monotypic species in Florida and Georgia. *Tettigidea*, Scudd., is quite widely distributed over North America, Mexico, and Central America. *Plectronotus*, Morse, is a Central American genus, while *Scaria*, Bol., is Central American extending southward.

RECENT ADDITIONS OF GENERA.

Some species which were formerly known under the genus *Batrachidea* were brought together by Morse (1894), under the genus *Nomotettix*. A genus which remained until recently unrecognized in the southern United States was brought to light by Hancock (1898). To this genus he gave the name *Neotettix*. Still more recently Morse (1899) added to our fauna the genus *Merotettix* from California, a very curious genus somewhat like the *Criotettix* of the Philippines. Bolivar included in the genus *Paratettix* an assemblage of species which, after more critical study, evince differences of structure of such a range as to separate them into generic positions. To summarize: *P. aztecus* of Bolivar forms the type of a distinct group (*Telmatettix*, Hanc.), having the vertex strongly narrowed anteriorly. *P. peruvianus*, Bol., forms another group (*Allotettix*, Hanc.), characterized by a prolongate body and equal length of the posterior tarsal articles. Similarly *P. schochii*, Bol., typifies a group (*Clypeotettix*, Hanc.), in which the head is somewhat retracted within the dilate pronotum, and the femora present an extraordinary clypeate form. It is seen *Paratettix* proper is narrowed down to a circumscribed group which still comes within the meaning of Bolivar's original description. Morse (1900) has made known a number of interesting genera in the material gathered for the Biologia Centrali Americana. *Tylotettix*, *Chiriquia*, *Otumba*, *Platythorus*, *Ochetotettix*, and *Plectronotus* are worthy of special mention.

The genus *Micronotus*, Hanc., is a West Indian type which might easily be taken for a *Tettix* or *Neotettix* were it not for the filamentous elongate character of the antennæ. It will probably prove upon further study that the genus *Apotettix*, Hanc., has a more extensive range.

TEMPERATE FORMS COMPARED.

The species of temperate North America are, generally speaking, simpler in structure than those of the subtropical or purely tropical regions. In the latter regions their bodies are more extremely modified in structure, the pronotum being particularly specialized owing to the prominent part it plays in covering and protecting the body. The body of Tettigids sometimes takes on grotesque forms; for instance, the pronotum may be strongly compressed or foliaceous, as evidenced in *Choriphyllum*, or the median carina may be cristate as in *Nomotettix*, the pronotum depressed as in *Paratettix*, elongate as in *Allotettix*, tumid as in *Paxilla*. These suggest the possibilities of modification of structure. The correlation of parts offers one of the most interesting points of view from which to study these insects.

The relative frequency of certain long wing forms as compared with their near congeners, the short-wing forms, is well illustrated in temperate latitudes by the species *Paratettix cucullatus*, Morse. In the northeastern parts of the United States especially the brachypterous forms are exceedingly rare. The same agency is at work in the case of *Tettix granulatus*, Scudd., in which the short-wing forms are quite rare. On the other hand, *Tettix o. triangularis*, Morse, and its macropterous prototype, *ornatus*, Harr., are in some situations equally common.

Many species of Tettigidæ are dimorphic, some more or less polymorphic as well as polyornate, showing a remarkable plasticity. It was this knowledge of the great variety of structure that led Professor Bolivar to speak of them as proteiform. It will be observed that some genera are rich in closely allied species and by properly directed interbreeding the

line of demarkation, no doubt, would be found in many instances to insensibly disappear and real species be fewer. As a matter of convenience the line is drawn arbitrarily in dividing species, whereas in nature there is one continuous descent. In a number of instances numerous Tettigids of different species have been kept alive for successive years under observation by the author in vivarium jars, and their habits in nature have also been watched. The hatching and raising of larvæ from the eggs to adult life was accomplished under observation, their feeding habits determined and a knowledge of certain phases of their life history was gleaned. Some observations having a special bearing on our subject are given in the form of notes under their proper headings. These researches were made with a view of determining certain questions in biology, which in a few instances are satisfactorily answered. On the other hand, an endless field of inquiry is opened which it is proposed to carry further in the future.

COLLECTING.

In the marshy meadows in the latter part of May or the first week in June the attention is attracted to the hordes of locusts, principally the young of the larger Acridiidæ, of which the genus *Melanoplus* predominates.* The sight becomes bewildered on trying to trace the individuals. Perhaps the grass and other vegetation has gained marked headway by the advancing of the season. In such situations the water of the marsh may have evaporated considerably, giving one an opportunity of walking over ground previously inundated. Here, along with the young of the other orthoptera mentioned, but lying close to the ground, are to be found certain members of the Tettigidæ. The jump of the Tettigid is peculiar in that it is quick and inconspicuous, and in this that

* There was a luxuriance of vegetation after recent rains, the marshy meadow was fairly glowing in flowers of Phlox, which gave beautiful color to the field. But this was one of an almost bewildering number of species of plants which on every inch of the black loam struggled to outdo its neighbors. Just so with the insect life. As I stood in one spot I could enumerate dozens of kinds, some of which had now for the first time emerged upon the scene this season. This was the picture presented to the eye now, where a month previous the shortly cropped marshy land had been the habitat of numerous *Tettigidæ*, while now it is next to impossible to find one. Observation made at Chicago, June 20, 1898.

it alights almost invariably on the ground. The young of the larger orthoptera usually alight on grass or stems of plants, dodging behind them for protection. The remarkable color of these Acridians, harmonizing in every instance with the soil, makes it sometimes difficult to locate them. This protective

FIG. 1. Some individual variations in the markings of *Tettix ornatus triangularis*. All found on light loam in an open meadow, within an area of a few yards, at Kenilworth, Illinois, July 10. Adult females enlarged from photograph by the author.

resemblance is carried out to perfection, the little insects living on the soil scattered with debris faded out by the hot sun, and the lights and shadows, in whatever way they play, are copied exactly. No shade, color, or arrangement of markings seems impossible of simulation, and every individual is a study in color harmony. Other points of the environment, and the habits connected therewith, are noted further on. The insects may be taken by hand or with a net; with the latter they are frequently taken by the method known as "sweeping."

PROTECTIVE COLORING.

The innumerable shades of color in the soil are sometimes copied in the young Tettigids most exquisitely. Along the sheltered banks of the Des Plaines River, in Illinois, the author saw hundreds which, on viewing them closely, showed the similarity existing between the colors of the ground and those of the little locusts. As evidence of this several young specimens of *Tettix*, from five to six millimeters in length, were peculiarly marked with frosted white, and these were on ground which was similarly colored from fungi or decayed algæ and other microscopic dead vegetable organisms. A

singular instance of this protective resemblance at one point was discovered where fragments of reddish bits of insect borings, fallen from outstretched limbs of trees, were exactly matched with a patch of color on the pronotum, usually in front of the shoulders and on the sides. Mottlings of various kinds upon the hind femora still further helped to protect the species on the ground. Half dead and bleached grasses, sedges, and other plants which give a yellowish cast to the ground, along with the ripened seeds falling in profusion, add shades of reds and browns. In this environment was noticed a *Tettix* with the back a light grayish fuscous, conspersed with whitish granulations, and a strongly marked banner spot between the shoulders of rich yellow ochre. This banner spot broke the continuity of surface and was perfectly protective, and the same individual was still further adorned by the same shade of yellow on the pronotal process and knees of the hind femora. But the ornamentation did not cease here, for two triangular spots behind the yellow banner spot, and a dark edging in front of it, was present. The eyes were hyaline above, a blackish stripe passing through the middle horizontally, and spoke-like radiations from the center gave a hazel appearance to them. Annulations of fuscous on the legs and antennæ added to the effectual protection of this species. The femora at the middle third was tinted a bright sienna. It seems from these observations and others previously noted that it is paramount to the perpetuation of the species that colors must vary through a wide range in individuals of the same species. The picture presented to the mind on viewing the live insects in their natural environment is far more satisfactory to the student of color than viewing the changed or darkened cabinet specimens. Observation taken at Riverside, Illinois, August 18, 1899. See further observations in sequence.

HABITS.

Many if not all of the species of Tettigidæ in the temperate region hibernate, secreting themselves among debris such as dead leaves, twigs, mosses, grasses, as well as under logs and bark, and in the little crevices in the earth where they happen

to be late in the fall of the year. They live on the ground, usually near water, either in boggy places, along the banks of streams, the shores of small lakes or swamps, in woods, or more rarely on dry upland ground. They feed upon the vegetable mold or decomposing soil sometimes mixed with algæ,* or

FIG. 2. Swampy meadow inhabited by Tettigidæ. From a photograph.

on the lichens, mosses, tender sprouting grasses, sedges, germinating seeds of plants and debris found in such situations. Particularly sought-after morsels are the various colored surface clays and the black muck, consisting of rich vegetable mold.† They are ravenous eaters, as one might infer from the dietary list just mentioned, and the fecal excrement, on reaching the

* A microscopic examination of the abdominal contents of *Tettix* showed numbers of mold spores and algæ mixed with particles of quartz sand. There were also some infusoria-like bodies and macerated material. (July 4, 1901.)

† See article by the author on "The Food Habits of the Tettigidæ." Ent. Record and Jour. Variation. X. p. 6-7. 1898.

end of the abdominal appendages (*Tettix*), is thrust away from the body by a rapid kick of the hind tibia.

In the middle of May (Illinois) the first eggs are laid in the ground, the female accomplishing this act by making a shallow burrow with her ovipositor. The young larvæ hatched from this brood mature by fall, passing the following winter in the adult state. The broods hatched in late June and early July are often immature by the time winter arrives, and we find them hibernating in the pupa state. Thus it is that the Tettigidæ are about the earliest insects to be found in the Spring, appearing as early as March. The time of incubation varies with the temperature, the early broods of *Tettix* hatching in twenty-three days, but as the days become warmer this period is shortened to sixteen days. The number of eggs of *Tettix* and *Paratettix* vary considerably, but they are more often ten, thirteen, or sixteen in each burrow; in *Tettigidea* varying from twelve to twenty-six. A departure from the habit common to the larger Acrididæ, is the laying of eggs irregularly together in a pear-shaped mass instead of an egg-pod. (See Plate XI., Figure 2.) In depositing the eggs, they are laid, one by one, side by side, as shown in the accompanying illustration, forming a round mass at the bottom of the burrow, the attenuated extremities directed upward vertically. A glutenous secretion which is excreted after each egg passes from the vagina holds the eggs together. The burrow is round, rather shallow in *Tettix*, deeper in the genus *Tettigidea*, usually from five to ten millimeters below the surface; and after the eggs are deposited the opening is covered up by particles of earth scraped up with the hind tarsus (Tettix) or the ovipositor (*Tettigidea*). The acutely pointed extremity in the eggs of *Tettix* serves admirably for protection. Owing to the shallowness of the burrow the tops of the eggs are quite near the surface, and sometimes exposed, though the female usually endeavors to conceal the eggs with various particles of earth. In certain situations, as when they are deposited in lichens or moss, an insect enemy might easily pass the exposed pointed extremities without molestation. Again the pointed pole of the eggs would be more difficult to destroy

or would be mistaken for the tops of seeds of grasses, or parts of plants, especially the leaves of polytrichum. With the genus *Tettigidea*, where the eggs are laid deeper in the

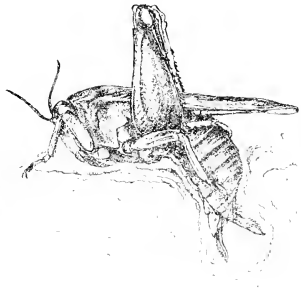


FIG. 3. *Tettigidea parvipennis* preparing the burrow for the eggs. Enlarged about four diameters.

ground, their extremities, while attenuated, would not be so liable to attack from this source, and are not in consequence so specialized at the cephalic pole.

CHANGING ENVIRONMENT.

In the early spring the vegetable mold immediately bordering rivers is frequented by numerous Tettigids, and while *Paratettix cucullatus* remain close to the edge of the streams the year round, *Tettix* seem to be forced back farther and farther away as the season's wealth of vegetation comes up and spreads over the river banks. Similarly in swampy meadows in the spring *Tettix* and *Tettigidea* are more easily detected than later on in the season when the wild flora of considerable height then covers the earth. On the other hand, in the late fall some species are taken quite easily; *Nomotettix*, for instance, which frequent drier sandy soils.

Moreover, at this later period, in favorable places some species, as *Tettigidea* and *Tettix* migrate, and for that reason become abundant locally, for the time being at least.

MIGRATORY HABITS.

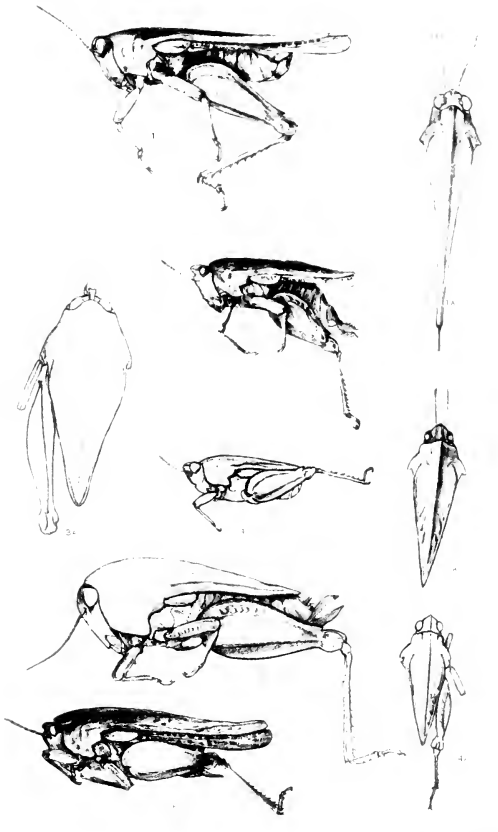
One can scarcely conceive of the activity shown in the life of the Tettigidæ unless special study has been devoted to them. The warm summer sunlight brings this activity to perfection; the long-winged adult forms delight to sport in the sunshine, instantaneously spreading widely and as quickly closing the prismatic semi-transparent wings. The flight of Tettigids is rapid, noiseless,* and inconspicuous, or some of the abbreviated forms hug the ground closely, scarcely ever attempting flight. Tettigids have amazing leaping power, and their small size and inconspicuous colors and markings have usually made them scarce in collections in which other insects are well represented. A restless period seems to seize some species in the fall of the year, especially among the long-winged forms of the genera *Tettigidea* and *Tettix*. At this time local flights have been recorded of considerable extent. In northeastern Illinois during sudden storms multitudes are blown into Lake Michigan, from which, however, they usually are washed ashore, forming wind rows with the other insects suffering like calamity, yet ultimately escape unharmed owing to their naturally semi-aquatic habits. In the American Naturalist, 1894, the writer recorded a flight of these locusts, and since then, on several occasions in the fall, similar migrations have been observed.† With these insects during the flights other larger *Acrididæ*, *Locustidæ* and *Gryllidæ* are not infrequently associated.

SEXES UNITING IN THE SPRING.

The tendency of present-day penetration into the deeper causes of the evolution of sex makes it necessary to record

* Riley says of *Tettix granulatus* that they fly with a buzzing noise like a flesh fly. Rep't U. S. Ent. Comm., p. 256, 1877.

†Prof. J. G. Needham, in an interesting article in "Occasional Memoirs of the Chicago Entomological Society," I, pp. 19-26 (1893), relates a remarkable experience in finding multitudes among the insect drift along the shore of Lake Michigan.



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the sexual habits of insects, and these little orthoptera are not without interest in this regard.

In the spring the male and female effect conjugation, varying from a few hours to days before the egg-laying process commences. In *Tettigidea* the two sexes often stay together for some days at a time. The male, being much smaller, rides about on the female's back unless she rids herself of his presence by a vigorous jump. During actual conjugation the subgenital plate of the male is capable of being lifted up from a horizontal plane to nearly upright. Its superior surface is grooved in the middle and it is anteriorly obtusely angulate. This superior portion answers as a shield which covers the opening of the spermatic ducts. It is upon this obtusely pointed anterior border that the edge of the last abdominal segment (sternum) below the female ovipositor is clasped, thus affording a hold and retaining the proper position of the genitalia during copulation.* The superior shield or surface ordinarily when at rest is covered partly by the pointed supra-anal plate. The difference in their positions in activity and repose is extraordinary, the stuctures in activity being drawn out of any semblance to their passive position; and it must be remembered the anterior border of the shield is not at all observable ordinarily, only that part behind showing which is not covered by the supra-anal plate.

In *Tettix* the two sexes do not often remain long in copulation, often only a few minutes at a time. During the active egg-laying period the female is sought after by the males.

POLYANDRY AMONG THE TETTIGIDÆ.

The existence of polyandry among the Tettigidæ forms an important factor in accounting for variations. In those species where the sexes remain longer together, as in the genus *Tettigidea*, the extent of polyandry is not so great as among *Tettix* and allied genera, in which the individuals stay together but a short period, thus allowing a greater number of males access to the female. It will be remembered that among *Tettix* and

* In some orthoptera chitinous hooks arm the caudal end of the penis.

allied genera an unusual diversity of coloring and polymorphism exists. Polyandry occurs in most if not all the species and in *Tettix* the number of different males received by one female may be considerable, as shown in the experimental evidence. (See experiments further on.)

SEXUAL HABITS.

When the male sights the female he walks with a hurried, tremulous gait, or sometimes it is jerky. Stealing nearer, he runs up close, climbing on her back from the side. Sometimes in his excitement he faces temporarily in a reversed position while on her back. The males seem to recognize each other and though they may climb on each others' backs, they seem to appreciate the sex, yet the sexes resemble each other with the exception of size, the female being considerably the larger. As shown by experimental observations, copulation lasts from a few seconds to several minutes. In *Tettix* there is no anatomical provision for clasping the female permanently, so that the male and female cannot go about together for long periods, as occurs in the genus *Tettigidea* and some other genera. At the sight of another species or an uncongenial male the female usually shakes her body. The author saw a female *Tettix gibbosus* recognize a male one and a half inches away, and she made her aversion known in the way above mentioned. After sexual conjugation the ovipositor is made to open and close repeatedly to favor the entrance of the male secretion.

In *Tettigidea parvipennis* the male jumps on the female's back, riding about in this position until she becomes quiet. At the same time he watches for the opportunity of effecting conjugation. In his excitement he begins to lengthen out the abdomen preparatory to emission. The appendages undergo a jerking motion, then suddenly his hind legs straighten out behind in a convulsive orgasm over her body, the appendages now becoming moistened. Immediately reviving, he backs a little, keeping, however, his forelegs grasping her body. With his abdomen extended and reaching

down below the female's and to one side, he turns up the end so that it affixes the subgenital plate by its anterior border, as we have described, to the process of the last sternum below her ovipositor, fastening it securely in position. Now he rides with impunity about on her back out of her reach. At this time his hind legs are usually drawn up out of the way, taking no part in grasping her body. The female becomes, after a time, resigned to the male's presence and goes about as usual. The male, unwilling to leave his position, often takes food while still clinging to her back.

TETTIGIAN SPERMATOZOA.

The spermatozoa are found in multitudes as hair-like bodies in two whitish glands at the extremity within the male abdomen. When these glands are opened at the proper time

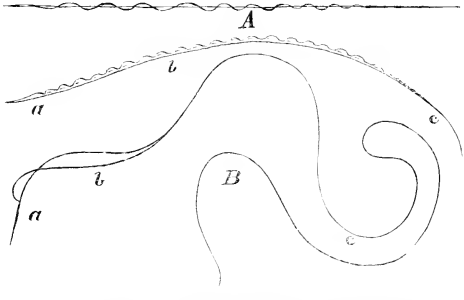


FIG. 4. Spermatozoon of *Tettigidea parvipennis*. A, dorsal and lateral aspect of body: *a*, cephalic segment; *b*, mesosegment; *c*, caudal segment. B, *Paratettix cucullatus*, the different parts designated as in preceding figure.

under favorable conditions with a needle, the spermatozoa, which are not motile at first, upon exposure to a warmed saline solution exhibit remarkable movements. In *Tetti-*

gidea parvipennis, with a twelfth Leitz oil immersion objective, the author observed a thin undulate protoplasmic keel, which arises close to the head and extends nearly the whole length of the body (Fig. 4A), but becoming attenuated and disappearing near the extremity of the body. The body of the spermatozoa is exceedingly long and hair-like, bending from side to side in the medium in which it was examined. Motion is communicated by the waving keel movements which pass along throughout its length. This keel or carina acts as a long fin which propels the body. It seemed on first viewing these spermatozoa that a spiral motion in the axis of the body was apparent, but on further examination and waiting for the motions to become slow it was found that this was a deception caused by looking on the dorsal aspect of the body, the undulating motion giving a false impression of revolutions. The spermatozoa of *Tettigidea* has a very short compresso-pointed head-piece and comparatively short tail-piece.

In *Paratettix cucullatus* (Fig. 4B) the body of the spermatozoon is exceedingly drawn out into a hair-like form. The head is short, thin, and acutely pointed; the middle-piece is formed into a high, rather short, protoplasmic keel. Commencing at the point of meeting with the head, the middle-piece is suddenly expanded and nearly the same width for a short distance backward, when it becomes rapidly attenuated and continues as an unkeeled portion, finally joining the long hair-like tail. *Paratettix* spermatozoa are keeled much wider than those of *Tettigidea*, and in this genus the keel extends only a small part of the whole length, the edge of the keel not being sinuate as in *Tettigidea*.

HOW THE EGGS ARE LAID.

Speaking generally, when the female desires to lay her eggs, she selects a suitable spot on the earth, sometimes on the muddy ground (*Paratettix*), or on vegetable mold, or among moss and lichens (*Tettix* and *Tettigidea*). Satisfied as to the spot, she curves the abdomen under her; the blades of the ovipositor, directed downward, are forced into the ground.

By undergoing a spreading and closing process, this instrument, composed of two pairs of serrulate blades, Fig. 3, separates the particles readily, while at the same time the boring is facilitated by turning the abdomen upon the long axis of the body. The ovipositor is carried down to its utmost depth in the ground by lengthening of the abdomen. It not infrequently happens that just before and during ovipositing the male is found on the female's back. During this time of egg-laying the front and middle pairs of legs are so raised that she stands on "tip-toe," while the hind legs are drawn up to the sides, out of the way, taking no part whatever in the process. As will be noted in the sequence the time consumed in ovipositing varies, one hour being an average in *Tettix*.

APPEARANCE OF EGGS.

Plate XI., Figures 2–3a.

In *Tettix ornatus triangularis* the egg is elongate, one and three quarters of a millimeter in length, slightly curved in its long axis. It is one-third as wide as its length, without the narrow extremity. The posterior extremity or pole is obtusely rounded, the anterior pole slightly smaller, and here it is suddenly reduced into a small, rather acute, extended and sometimes curved process. The eggs of *Tettigidea parvipennis* differ from *Tettix* in being more "wine-bottle" form, and larger; the width is contained five times in the total length, the egg being rather straight in the long axis, and beginning a little before the middle, being more gradually attenuated toward the anterior pole, where, near the end, it is a little more suddenly reduced. The anterior pole is not so acutely pointed as in *Tettix*. The posterior pole is obtusely rounded.

When recently laid, the eggs are a beautiful pinkish white, but after more advanced incubation they turn to a more opaque greenish yellow-white.

HATCHING OF TETTIGIDÆ.

The young, which are always white, excepting the reddish eyes, emerge from a little hole which the first hatched makes by worming its way to the surface. Were we watching the spot from which a new brood was about to make their exit into the outer world, we would see them, one by one, following the leader, coming out upon the ground through a little opening. As if exhausted after a struggle the young larva on reaching the outside lies motionless for a moment. Then vigorously spreading the legs and expanding the body, the veil-like amnion is torn open and immediately the little earthly visitor finds a footing on the ground. One after another emerges (each hardly waiting for its predecessor to come out of the opening), and goes hurriedly through the shedding of the amnion vestment, which, as we have said before, is folded backward and at last kicked off by the hind tibia. Within a little distance from the hole and encircling it are seen sometimes these vestiges in the form of scarcely visible scattered white specks.

The young larvæ emerge from the attenuated extremity, or anterior pole, the head being thus directed in the later embryological stages. It more often happens that the egg splits lengthwise during the escape of the larva. After breaking through the egg shell and pushing up to the surface, the amnion is shed, as above described. From this time on to maturity we have seen individual variations of marking and coloring, as well as differences in structure emanating from the same mass of eggs, but this will be considered at greater length further on.* When a few moments have passed all are out upon the ground, having gained a footing and scattered a short distance away. It is at this time it sometimes happens an accident befalls one of the new-born, which, though having sufficient strength to come to the surface, fails in its effort to throw off the amnion and thus perishes from exhaustion. Then again it not infrequently occurs that a tardy individual comes out a longer or shorter period after the others.

*See article by the author on the experimental hatching of *Paratettix cucullatus*. Trans. Am. Ent. Soc., XXIII, 241-242, 1896.

The reaction of the environment on the little Tettigids from now on is interesting to observe. During a time extending from a few minutes to a half hour after emerging, the pale white larvæ undergo pigmentation and are soon lost from view, the most careful scrutiny becoming necessary to detect them now on the ground.

SIZE OF TETTIGIDÆ LARVÆ.

As the eggs would indicate, the young of *Tettigidea*, when first born, are considerably larger than *Tettix* or *Paratettix*, and are quite easily distinguished even at this early period. In *Tettigidea parvipennis*, just before the first ecdysis or the first larval stage, the body is quite slender; the pronotum about twice the length of the head. After the first ecdysis or during the second larval stage, the body becomes more compact or stouter, the pronotum becoming proportionately larger, more strongly carinate and arcuate, and then an apical process lengthens out, covering nearly half the abdomen. In the first stage there are ten joints in the antennæ, the joints being divided by a whitish line, but in the second stage the third and fourth antennal articles become distinctly divided, increasing the number to eleven.

PRONOTAL CHANGES.

As each molt proceeds, the pronotum, which in the beginning only just covers the metanotum, gradually develops, and during the last or fourth molt reaches its maximum size and the antennæ then consist of the full complement of twenty-two articles.

APPEARANCE OF THE ELYTRA.

It is after the fourth, or rarely the fifth, ecdysis that the elytra, which have not heretofore been visible, take their position at the sides of the body, and the wings extend backward and longitudinally folded under the now fully developed pronotal process. The adult can thenceforth be distinguished from the larva.

COLORS CLEARLY MARKED.

After the last ecdysis the colors are most vivid and clean. How long the Tettigid can continue living in its adult life is not known, but certainly we know it can live as long as two years, and it is not improbable it lives much longer. After a year the markings usually become of duller hue, and sometimes the body becomes tinged greenish from the attachment of a lichen growth to the surface.

The first ecdysis takes place in about ten days;* the insect then may be quite differently colored from the stage just preceding, or may carry onward the same coloration, the same being true of the markings. This applies to all the different stages.

FIRST ECDYSIS OF TETTIGIDS.

We might suspect the process about to take place by the quiet actions of the insects on the ground, grass-stem, or other

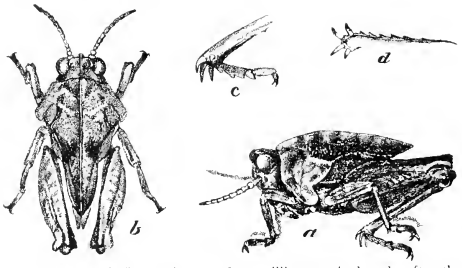


FIG. 5. Larva of *Tettix obscurus*, four millimeters in length, after the second ecdysis, *a* and *b* lateral and dorsal aspects of body. Note the absence of clytral sinus.

low plant upon which they climb. Granting we are looking at a larva on the ground, the insect is seen to attach its feet

* The females grow much faster and are bulkier than the males. This rapidity of growth is to a great extent dependent on the food eaten, and in turn the nutrition exerts an influence on the period of ecdysis.

with a firm grasp and drop the antennæ downward; the color becomes perceptibly paler, when shortly the skin splits over the head region to the vertex in the median line, the rent then extending backward over the dorsum. The head and antennæ are then released from the mask, which on loosening is facing downward and forward; the forward and middle pair of legs and abdomen, and finally the hind legs, are extricated in the order named. The larva, then completely free to act, though not yet hardened, walks forward a little on the ground, the posterior tibæ somewhat bowed. Here, near the empty cuticle, the insect remains to sun itself and take on the necessary pigmentation, for the body is pale; a little darker, however, than when first born. The pronotum has not at first materially changed, but soon commences to stretch out behind into a rudimentary apical process. The head and body become more compact, and by comparison with the preceding stage the modification of form is remarkable. The changes above related take about an hour.

LAST ECDYSIS AS ILLUSTRATED BY TETTIX ORNATUS TRIANGULARIS.

The last molt, which is the most striking feature of the metamorphosis of Tettigians, is well illustrated by the following observation made May 29th. The specimen, *Tettix ornatus triangularis*, had but one hind leg, but this did not inconvenience the process. The insect grasped the ground firmly with its claws, then inclining forward, with the antennæ lowered and spread downward, a series of jerking or convulsive movements of the insect's body occurred. This motion included a rocking to and fro. Then the cuticle of the pronotum split at the median line of the dorsum and over the top of the head; the head, antennæ, and front pair of legs were extricated in their turn, while lastly came the hind femora. The wings, which were at first pale, unfurled at the same time the elytra began to take their position at the sides of the body. The apical process of the pronotum was at first very soft and short, and also colorless, gradually stretching out to nearly the knee of the hind femora. The abdomen

was usually drawn out or stretched at first, but appeared to diminish in length a little as the parts were undergoing the adjustment and change to their natural proportions. The hind femur was weak and the tibia was pliable for a short period immediately following its redrawal from the empty cuticle. The cast-off cuticle was left still grasping the ground, the head part thrown down and the rent along the dorsum gaping.* The newly metamorphosed insect finally crawled up a stalk of grass to get the full benefit of the sun and take on the normal pigmentation.

PHYLOGENY AS SUGGESTED BY THE METAMORPHOSIS.

In the temperate region all the species have a climacteric period, one in which the insects on becoming mature enter a new phase of existence different from the preceding last pupa stage. This final period of metamorphic perfection (imago) is characterized by the establishment of the sexual functions and taking on of distinctly adult characters. The elytra shift their position to the sides of the body and the wings become explicate and functionally perfect. With some of the tropical species, on the other hand (see *Choriphyllum*, Plate I.), this distinctly metamorphic stage, denoting a period of anabolic surplus of vitality, is not so apparent, there being no external evidence of a distinct period between the last pupa stage and imago. The insects here referred to are wingless and have no elytra or any anatomical place provided for them, the sinus for their reception at the usual point at the side of the body being absent. The seasons alone can not be responsible for this peculiar condition, for we also find species in the tropics living near-by possessing elytra and wings. It seems to be in a large measure due to the reaction of the organism to the environment, effecting in turn an adaptation of structure to a special purpose, obviously of a protective character. In this evolution these Tettigids have suffered the loss of the marked distinction of pupa and imago characteristic of other Tettigidæ, whose metamorphosis is apparently one stage

* A male *Paratettix cucullatus* in the author's collection had never completely discarded the cuticle during life. It is attached to the distorted pronotum.

removed. A part of the phylogenetic history of the species is recapitulated in the larva and pupa, and there is suggestive evidence that the early progenitors of living forms presented a highly cristate condition of the pronotum, as shown now in some forms further south. It will be seen that in all the genera of the temperate region of North America the median carina of the pronotum in the larval and pupal stages presents a cristate character, and there is but one strongly marked sinus situate inferiorly. The cristate character in the larva is correlated with the acquiring of a numerical increase of the antennal articles. These larval characters are retained in adults of such specialized forms as *Choriphyllum*. It is probable the ancestors of the Tettigidæ had but one sinus inferiorly located on the pronotum, while the wings and elytra were still undeveloped and metamorphosis was less complete. The knowledge gleaned from the post-embryonal studies show that the Tettigidæ are a remarkably highly specialized group, doubtless originally starting from the lowest portion of the trunk from which arose the various other groups of the Acrididæ, and that they (Tettigidæ) occupy a distinct position.*

ENEMIES.

During the life of these little Tettigians they are more or less constantly in danger of enemies among the arachnida, insecta, and some of the vertebrata. The larva of a red mite (Trombidian) is one of the most frequent sources of annoyance. Acting as a parasite the Trombidian larva clings on the body and attaches itself out of the reach of the victim. There it remains to sap the juices of the host's body. It is found on many species. Among insect pests, ants and bugs are sometimes deadly to them. In a wet ditch in June the writer found a number of small dark-brown ants dragging along the ground a female *Tettix ornatus* which had just been killed by them. When endeavoring to capture some *Tettix* at the same place my attention was drawn to a colony of these ants acting in a panicky state of excitement, the cause of this being that they had darted upon the insect the author was pursuing, tumbling

* The embryology is left out here for future consideration as a separate contribution.

it over and biting it savagely about the neck. The little locust finally escaped by a vigorous jump.

According to P. R. Uhler (1884) *Galgulus oculatus*, an hemipteran insect, is a serious enemy. They may often be seen, says Uhler, "in the month of May walking about between stones on the low banks of brooks and streams, where *Tettix* and *Batrachidæ*[*] abound, watching an opportunity to seize one of these insects, and when the favorable moment arrives, leaping suddenly upon one of them, clasping it with tight embrace between the front femora and tibia and there sucking out its vital juices." In a marshy meadow in May the writer suspected, from seeing a number of common toads jumping about on the ground where Tettigids were also quite numerous, that they might form the food of the batrachians. The stomach of one of the adult toads there taken, on subsequent examination, was found to contain a crab spider, some beetles, *Tettigidea parvipennis*, *Tettix ornatus*, with material too macerated to identify. The Tettigids were partly digested, but the remaining pronotum was sufficiently preserved in each species to furnish a certain clue. Professor S. A. Forbes (1888), in his researches on the food of fresh water fishes, found that these acridians were eaten by fishes. *Ictalurus punctatus* had eaten *Tettigidea* in June, *Hyodon tergisus* had fed on *Tettix* in October, and it is related of *Lepomis pallidus* that it had devoured *Tettigidea* in June and November. The robin also is said to feed quite freely on these orthoptera. As the Tettigids commence to multiply in the spring and early summer we find numerous frogs, toads, and snakes living in the same environment, that doubtless find them within easy reach and prey upon them. These enemies are probably but a small part of those Tettigians have to contend against.

[*] Probably refers to *Paratettix*

EXTERNAL ANATOMY.

Figure 6.

To properly study the various modifications of the external organs, the profile is necessary in conjunction with observations made from above and those made from the front view. Other less used positions may be called into use. Beginning with the head, which lies in a vertical plane in relation to the body, it is usually strongly encircled by the antero-dorsal and antero-lateral margin of the pronotum above, while below the

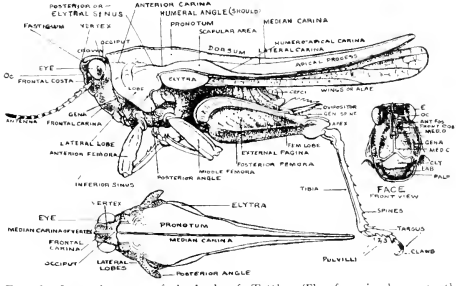
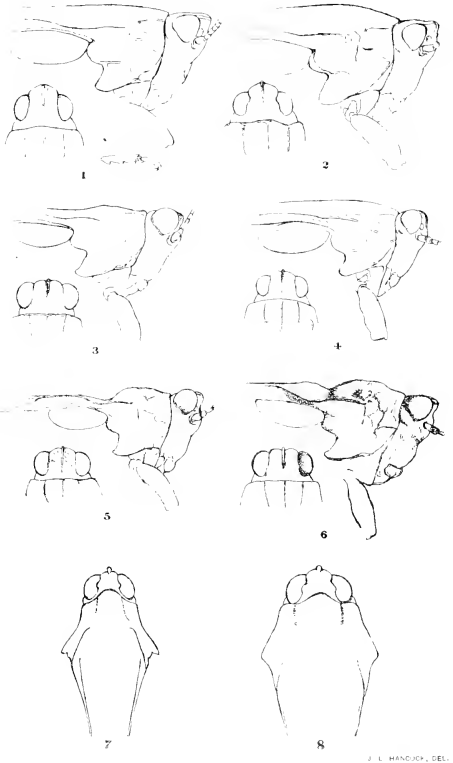


FIG. 6. Lateral aspect of the body of *Tettix*. The face is shown to the right, the pronotum and head below. Parts of the anatomy are designated by self-explanatory nomenclature.

mouth parts are surrounded by the sternomentum. The superior surface of the head is bounded anteriorly by the fastigium, which is usually carinated transversely (not visible in *Choriphyllum*). The vertex lies behind the fastigium and between the eyes and is much used in classification. The crown is all the dorsal aspect of the head from the fastigium in front to and including the occiput behind. The occiput or posterior portion of the crown is sometimes mammillate or sometimes concealed (*Paratettix* and *Clypeotettix*). The contour of the face may be more or less

oblique, flattened, or curved. When viewed in front the component parts contributing to this outline are the frontal costa above and the frontal carina below. The vertex varies extremely and it is often divided by a mid-carina. It may be broad or more or less narrow, and is compared in breadth with one of the eyes. The eyes are nearly always conspicuous and globular, or subelliptic; their outline in profile may be circular or triangular. The ocelli are three in number in the form of a triangle, the base directed upward and backward. The median ocellus is placed anterior to the other two in the lower portion of the grooved frontal costa. The others are situated sometimes almost in the same vertical line or back and above on either side of the frontal costa before the eyes. The antennæ are variable in length and the number of articles, there being as few as twelve and as many as twenty-two. In shape they are cylindrical or filiform. They are longest in *Tettigidea*, Scudd., and *Plectronotus*, Morse, where they reach to the humeral angle or base of femora, and are very slender in *Choriphyllum*. The frontal costa extends down the middle of the face, commencing above at the fastigium and ending at the median ocellus. It is more or less furcate, or the branches may strongly diverge, forming a frontal scutellum. Viewed in profile the frontal costa is sometimes sinuate, rounded, or flat above. It is not infrequently continuous upon the vertex as the median carina, where it may end more or less abruptly or extend and disappear further back on the crown. Below, on the face, it is continuous with a single frontal carina which bifurcates near the clypeus. The collective parts of the mouth rest against the sternomentum; the maxillary palpi have the extremity enlarged. The pronotum is remarkably developed posteriorly into an apical process extending beyond the posterior femora, or it may be abbreviated; the dorsum may be flattened, tectiform, compressed, or very much elevated and foliaceous, while the surface may be smooth, rugose, rugulose, arenose, scabrous, or tuberculose. The anterior margin of the pronotum is most frequently truncate. The pronotum extends down on either side of the body forward, forming the lateral lobes. The outer surface is usually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bounded above by the anterior lateral carinæ (absent in *Paxilla*), which appear in front of the humeral angles. A median carina is more or less present on the dorsum of the pronotum, continued backward on the apical process, and there are two lateral carinæ which anteriorly cover the humeral angles on each side and are continued backward on the process. An infra-apical carina arises behind the shoulders over the apex of the elytra and runs a short curved course downward and backward to form the inferior marginal carina of the process. It has been termed the humeral apical carina and defines the limits of the scapular area. The lateral lobes are obliquely directed, the posterior margin sinuate; the superior or infra-humeral elytral sinus receives the base of the elytra and above it is the overlying humeral angle; an inferior lateral sinus is usually present and a superior or median lobule is located between the two; the inferior border of the lateral lobe of the pronotum behind terminates in an angle (the pos-

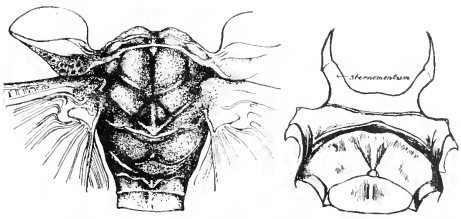


FIG. 7. Dorsal aspect of the thorax with the pronotum removed, showing the mesonotum and metanotum of *Tettix granulatus*. Ventral aspect of the thorax of same species to the right, showing sclerites. Anteriorly the modified prosternum is indicated as the sternomentum, which surrounds the mouth parts.

terior angle which takes on various forms), and is much used in descriptions, while anteriorly the angle is nearly always more or less subrounded and rarely used taxonomically.

The mesonotum, Fig. 7, has the squamous elytra attached, the metanotum the posterior wings; the prosternum is extraor-

dinarily modified in front, and is separated from the metasternum by a convexed and rather deep furrow, the convexity being directed forward.

The small squamous elytra are more or less oval, covering a small portion of the base of the wings; the wings are not infrequently well developed, extending to the posterior extremity of the pronotum or beyond it. The anterior

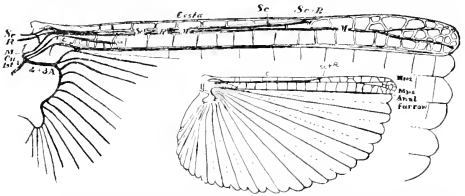


FIG. 8. Hind wing of *Paratettix cucullatus*. More reduced figure below. Tracheæ occupy the veins represented by solid lines of anal area. The basal origin of the tracheæ designated at the left.

border, being the exposed portion when folded up at the sides, is chitinous in the apical half and more or less opaque. In recent specimens, which have just undergone the last exuvi-

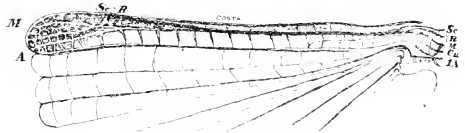


FIG. 9. Hind wing of *Tettigidea parvipennis pennata*. The media shown at M is free at the distal portion and divided into three subbranches. Original.

ation, it is quite hyaline, and it is at this stage the tracheation can best be observed. The anal field is traversed by many transverse nervules, which form square and rectangular spaces.

The narrowing of the wing proper, the part before the anal furrow, has had the effect of bringing together the veins,

subcosta, media, and radius so that they have completely fused in the middle, subcosta being free for a little distance at its base, the media being free at its apex, its distal two-fifths.

This narrowing has also resulted in the suppression of the cubitus to a much greater extent than in any other orthoptera at present examined. Whether the radial sector is lost

FIG. 10. Hind wing of *Tettix gibbosus*. Costal trachea wanting; its place taken by long anterior branch of subcosta from base.

or is fused with the distal end of the media is not yet clear. In the wing apex of *Tettix gibbosus*, as shown in figure,* the subcostal, radial, and medial tracheæ take the courses to the wing margin, showing clearly how the tips of the correspond-

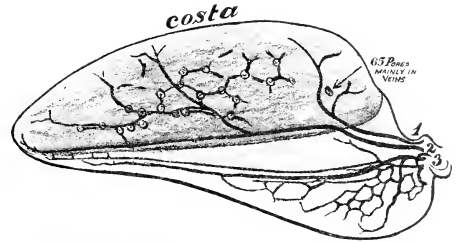


FIG. 11. Elytra or forewing of *Paratettix cucullatus*, showing three tracheæ designated at the basal portion as 1, 2, and 3. Some pores are shown.

ing veins may be designated. In this region of the wing *Tettix gibbosus* is somewhat more reduced in venation. In *Tettigidea parvipennis pennata* the media is free at the apex

* For drawings and valuable suggestions on venation of the wings the author is indebted to Dr. J. G. Needham.

and subdivided into three branches. The basal attachments of the tracheæ are similar to those found among the orthoptera generally, and designated as shown in the figures.

The elytra or forewings show three tracheæ, but there is no clue as yet to their homologies. The Tettigidea appear to be the most specialized orthopterous type so far as the venation is concerned.

The middle femora are subject to marked variations and are useful in distinguishing species. They are sometimes quite unaltered (in which case they are spoken of as entire), or com-

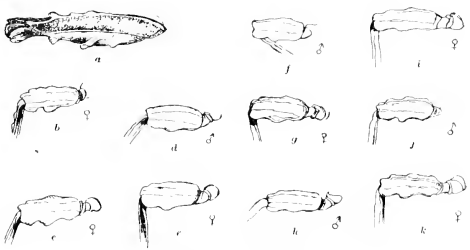


FIG. 12. Femora of *Paratettix* showing variations. *a*, Hind femora of *P. tuberculatus* sp. n.; *b*, mid-femora of same species; *c*, mid-femora *P. mexicanus* var. from Rio Cocula, Gro. Mex.; *d* and *e*, *P. morsei extensus*, California; *f* and *g*, *P. mexicanus*, La Antiqua, Mex.; *h* and *i*, *P. cucullatus*, Toronto, Can.; *j* and *k*, *P. texanus*, Paige, Texas.

paratively slender, carinated, quite broad, or rarely passing into lobed or clypeate forms. The legs are more or less compressed, the first femora less modified, but in *Batrachidina* furrowed above; the hind femora are proportionately large, reaching the maximum relative size in *Nomotettix*. Near the apex of the superior carina is the femoral lobe, present only in a slight degree in our species. The genicular spine is placed at the very extremity of the femora; the posterior tibiæ are multispinose; the four anterior tarsi are short, the terminal segment being longer than the two others united.

In the posterior tarsi the first segment is as long or longer than the last two. The tarsi are serrulate above, and below divided into three little acute, obtuse, or flat pulvilli; the second segment is very small in all the tarsi; the claws are dentate at the base beneath.*

The first abdominal sclerite presents at the caudal margin of the dorsal portion various modifications in the different

FIG. 13. Peculiarities of the first abdominal sclerites: *a* and *f*, lateral and dorsal aspect of *Tettix arenosus*; *b* and *h*, *Paratettix texanus*; *c* and *i*, *Tettix granulatus*, male; *d* and *j*, *Tettix ornatus triangularis*, male; *e* and *g*, *Tettix gibbosus*, male.

species. It is observed by elevating the pronotum. In *Tettix granulatus* the margin has a raised eminence, folded, and projecting caudad. The various figures here given show some of the variations in this portion of the anatomy.

* ABDOMINAL APPENDAGES.

It is of interest to compare the characters of the abdominal appendages, though, it must be said, in these orthoptera which require the most delicate handling, they are not easily accessible. I have found that by bringing water nearly to the boiling point and immersing the specimen for about a minute usually accomplishes the desired softening in small species so that the abdomen can be pressed to one side, after the legs have been pushed down. This is of course assuming the specimen is a pinned example. This process is required owing to the almost immovable pronotal process being in the way. Both male and female characters of the genitalia afford some distinctive features, but for the reasons named they are less used in classification than the vertex, pronotum, pulvilli, etc. (See Plate XI., Figs. 1-1a and 5-5a.)

SYNOPSIS OF SUBFAMILIES AND GENERA.

Small orthoptera presenting no aroleum between the tarsal claws; the pronotum completely covering the body; elytra small and lobiform.

1. Anterior femora more or less compressed, carinate above.
2. Frontal costa furcate between the eyes, the branches strongly diverging, forming a frontal scutellum. I. subfamily CLADONOTINÆ.
3. Body largely compressed, above completely foliaceous.
4. Pronotal margins in profile forming a subrhomboidal contour. Gen. *Choriphyllum*, Serv.

4. 4. Pronotum at the superior dorsal margin in profile, arcuate-subangulate. Gen. *Phyllonotus*, gen. n.

3. 3. Body not compresso-foliaceous.
5. Pronotum sharply tectiform, anteriorly truncate, median carina cristate, arched anteriorly, nearly straight posteriorly. Gen. *Tylotettix*, Morse.

2. 2. Frontal costa narrowly or moderately forked. Posterior angle of lateral lobes of pronotum laterally little produced, posteriorly obliquely truncate. II. subfamily METRODORINÆ.
6. Median carina of pronotum conspicuously serrato-undulate. Elytra minute, elongate. Vertex concave. Gen. *Chiriquia*, Morse.
7. Pronotum flat above, little depressed. Elytra lanceolate. Body slender. Gen. *Otumba*, Morse.

7. 7. Pronotum strongly depressed. Body stout. Vertex truncate. Elytra and wings absent. Gen. *Platythorus*, Morse.

8. Posterior angle of the lateral lobes of pronotum turned downward, more or less rounded, not obliquely truncate. Antennæ with twelve to fourteen articles. Antero-dorsal margin of pronotum truncate or angulate, or rarely angulate produced. III. subfamily TETTIGINÆ.

9. Vertex advanced beyond the eyes, wider than one of them, in profile united with the frontal costa, generally angulate anteriorly.

10. Antennæ with twelve, rarely thirteen articles. Pronotum with the dorsal front margin more or less angulate produced, median carina cristiform, more or less arcuate longitudinally; median lobule of the posterior margin of lateral lobes generally feebly developed; the posterior elytral sinus shallow or moderately deep. Gen. *Nomotettix*, Morse.

10. 10. Antennæ with fourteen or often thirteen articles. Pronotum generally not advanced upon the head to the eyes; median lobule of posterior margin of the lateral lobes more or less well developed; the posterior elytral sinus quite deep.
Gen. *Tettix*, Charp.

11. Vertex viewed in profile united with the frontal costa rounded or depresso-rounded, little advanced beyond the eyes, equal to or considerably wider than one of them.

12. Vertex considerably wider than one of the eyes; branches of the frontal costa more or less strongly divergent. Antennæ consisting of twelve or thirteen articles. Gen. *Neotettix*, Hanc.

13. Antennæ strongly filimentous-elongate. Body small. Facial costa rather narrowly furcate, subparallel, viewed in profile sinuato-convex. Median carina of pronotum undulate. Distribution West Indies.
Micronotus, gen. n.

14. Eyes small, distinctly globose. Antennæ short and stout. Vertex distinctly wider or twice as wide as one of the eyes, advanced about as far or little beyond the eyes. Body rugose or minutely tuberculose. Distribution southwestern United States and Mexico southward. *Apotettix*, gen. n.

15. Vertex equal in width to one of the eyes. Body narrow between the shoulders. Frontal costa narrowly forked, straight, and evenly divergent. Distribution California. Gen. *Merotettix*, Morse.

16. Facial costa widely forked. Pronotum presenting a short supernumerary carina midway between the humeral angles and the median carina. Distribution Mexico and southward.

Gen. *Ochetotettix*, Morse.

9. 9. Vertex not advanced beyond the eyes. Median carina of pronotum generally scarcely elevated.

17. Body usually broad between the shoulders. Vertex narrower or as wide or little wider than one of the eyes, little narrowed anteriorly. Second femoral carinæ more or less undulate, or sinuate, or sinuato-lobate, very rarely entire.

Gen. *Paratettix*, Bol.

18. Dorsum of pronotum transversely convexo-tectiform between the shoulders. Femora expanded, marginal carinæ strongly carinate-clypeate. Distribution Mexico and southward.

Clypeotettix, gen. n.

19. Body narrow, strongly prolongate, apical process attenuate; occiput naked behind the eyes. First and third articles of posterior tarsi subequal or equal in length. Distribution Central America southward. Gen. *Allotettix*, Hanc.

20. Vertex strongly narrowed in front, the front border about one-half to nearly the breadth of one of the eyes. Body usually slender. Frontal costa narrow subparallel. Distribution western and southwestern United States, Mexico, Central America.

Gen. *Telmatettix*, Hanc.

1. 1. Anterior femora above distinctly sulcate. Pronotum in front produced more or less above the head, the antero-dorsal margin hooked, or cuspidate, or obtuse-angulate, or rounded. Antennæ with sixteen to twenty-two articles.

IV. subfamily, BATRACHIDINÆ.

21. Body strongly tumid. Dorsum of pronotum convex, lightly punctate, lateral carinæ in front of the shoulders wanting. Distribution southern United States. Gen. *Paxilla*, Bol.

22. Lateral carinæ in front of the shoulders present.

23. Dorsum of the pronotum between the carinæ more or less conspersed with longitudinal wrinkles, or scabrous, or granulose; behind the shoulders between the carinæ concave.

Gen. *Tettigidea*, Scudd.

24. Facial costa sinuous. Pronotum scabrous. Elytra minute. Distribution Central America.

Gen. *Plectronotus*, Morse.

25. Median carina of pronotum anteriorly strongly ascendant. Middle femora with the superior marginal carina terminating in a spine. Body slender, smooth. Distribution Central America and southward. Gen. *Scaria*, Bol.

CATALOGUE.

I. CLADONOTINÆ.

Gen. Choriphyllum, Serv.

(1) 1. C. westwoodi, new n. Plate I., Fig. 2.
(2) 2. C. foliatum, sp. n. Plate I., Fig. 1.
(3) 3. C. rhombeum, Walk.

Phyllonotus, Gen. n.

(4) 1. P. sagrai, Serv.
(5) 2. P. saussurei, Bol. Plate I., Fig. 7.
(6) 3. P. plagiatum, Walk.

Gen. Tylotettix, Morse.

(7) 1. T. sinuatus, Morse. Plate I., Fig. 4.

II. METRODORINÆ.

Gen. Chiriquia, Morse.

(8) 1. C. serrata, Morse. Plate I., Fig. 6.

Gen. Otumba, Morse.

(9) 1. O. scapularis, Morse. Plate I., Fig. 5.

Gen. Platythorus, Morse.

(10) 1. P. camurus, Morse. Plate I., Fig. 3.

III. TETTIGINÆ.

Gen. Nomotettix, Morse.

(11) 1. N. parvus, Morse. Plate II., Figs. 4-4a.
(12) 2. N. acuminatus, Hanc. Plate II., Figs. 2-2a.
(13) 3. N. sinufrons, Hanc.
(14) 4. N. compressus, Morse.
(15) 5. N. cristatus, Morse.
(16) 6. N. carinatus, Brun. Plate II., Fig. 5.
(17) 7. N. floridanus, sp. n.
(18) 8. N. arcuatus, sp. n.

Gen. Tettix, Charp.

GRANULATUS GROUP.

(19) 1. T. granulatus, Scudd. Plate IV., Figs. 2-2a, and Plate III., Fig. 1.
(20) 2. T. g. variegatus, var. n.
(21) 3. T. incurvatus, Hanc. Plate III., Fig. 2.
(22) 4. T. huggeri, Hanc. Plate IV., Figs. 6-6a.
(23) 5. T. brunneri, Bol.

ORNATUS GROUP.

(24) 6. T. acadicus, Scudd. Plate IV., Figs. 3-3a.
(25) 7. T. ornatus, Harris. Plate III., Fig. 4, and eggs Plate XI., Figs. 3-3a.
(26) 8. T. o. triangularis, Scudd.
(27) 9. T. hancocki, Morse. Plate IV., Fig. 4, and appendages Plate XI., Figs. 5-5a.
(28) 10. T. h. abbreviatus, Morse. Plate IV., Figs. 1-1a.
(29) 11. T. crassus, Morse.
(30) 12. T. c. affinis, var. n.

ARENOSUS GROUP.

(31) 13. T. arenosus, Burm. Plate IV., Figs. 5-5b, and Plate III., Fig. 3.
(32) 14. T. a. costatus, var. n.
(33) 15. T. obscurus, Hanc. Plate V., Figs. 1-2a.
(34) 16. T. gibbosus, Hanc. Plate V., Figs. 3-5a, and Plate III., Fig. 6.
(35) 17. T. fluctuosus, Hanc.
(36) 18. T. decoratus, Hanc. Plate V., Figs. 6-6a, and Plate III., Fig. 5.
(37) 19. T. blatchleyi, sp. n.

Gen. Neotettix, Hanc.

(38) 1. N. bolivari, Hanc. Plate VI., Figs. 4-4b, and appendages Plate XI., Figs. 1-1b.
(39) 2. N. rotundifrons, Hanc. Plate VI., Fig. 5.
(40) 3. N. femoratus (Scudd), Hanc.
(41) 4. N. bolteri, Hanc. Plate VI., Figs. 6-6b.

Gen. Micronotus, gen. n.

(42) 1. M. quadriundulatus, Redt.

Gen. Apotettix, gen. n.

(43) 1. A. convexus, Morse. Plate VII., Figs. 2-2a.
(44) 2. A. tectus, Morse.
(45) 3. A. eurycephalus, sp. n. Plate VII., Figs. 4-4a.
(46) 4. A. e. brevipennis, var. n.
(47) 5. A. rugosus, Scudd. Plate VI., Figs. 1-1a.

Gen. Merotettix, Morse.

(48) 1. M. pristinus, Morse.

Gen. Ochetotettix, Morse.

(49) 1. O. barretti (Hanc.) Morse. Plate VII., Fig. 3-3a.
(50) 2. O. volans, Morse.

Gen. Paratettix, Bol.

(51) 1. P. cucullatus, Morse. Plate VIII., Figs. 6 and 7.
(52) 2. P. texanus, sp. n. Plate VIII., Figs. 4 and 5, and Plate VI., Figs. 2-2b.
(53) 3. P. t. nanus, var. n.
(54) 4. P. mexicanus, Bol. Plate VIII., Figs. 12 and 13, also var. Figs. 1 and 2.
(55) 5. P. m. abortus, var. n.
(56) 6. P. tuberculatus, sp. n. Plate VIII., Fig. 3.
(57) 7. P. morsei, sp. n. Plate VIII., Figs. 10 and 11.
(58) 8. P. morsei extensus, Morse. Plate VIII., Figs. 8 and 9, and face Fig. 16.
(59) 9. P. toltecus sonorensis, var. n.
(60) 10. P. toltecus, Bol. Plate VIII., Figs. 14 and 15.
(61) 11. P. arizonus, race. n.
(62) 12. P. robustus, sp. n.
(63) 13. P. frey-gessneri, Bol.
(64) 14. P. durus, Morse.
(65) 15. P. sinuatus, Morse.

Gen. Clypeotettix, gen. n.

(66) 1. C. schochii, Bol. Plate IX., Figs. 10 and 11, and Plate VII., Fig. 1.

Gen. Allotettix, Hanc.

(67) 1. A. peruvianus, Bol. Plate IX., Fig. 5.

Gen. Tehmatettix, Hanc.

(68) 1. T. hesperus, Morse. Plate IX., Figs. 8 and 9.
(69) 2. T. parviverticis, var. n. Plate IX., Figs. 3 and 4.
(70) 3. T. aztecus (Sauss.) Bol. Plate IX., Figs. 1 and 2.
(71) 4. T. aridus, sp. n. Plate VI., Figs. 3-3a.
(72) 5. T. fallax, Bol.
(73) 6. T. minutus, sp. n. Plate VII., Figs. 5-6a.
(74) 7. T. m. rugosus, var. n.

IV. BATRACHIDINÆ.

Gen. Paxilla, Bol.

(75) 1. P. obesa (Scudd), Bol. Plate II., Figs. 3-3a.

Gen. Tettigidea, Scudd.

(76) 1. T. armata, Morse. Plate X., Fig. 6.
(77) 2. T. a. depressa, Morse.
(78) 3. T. apiculata, Morse. Plate X., Fig. 2.
(79) 4. T. acuta, Morse.
(80) 5. T. spicata, Morse. Plate X., Fig. 5.
(81) 6. T. prorsa, Scudd. Plate X., Fig. 1.
(82) 7. T. p. elongata, Morse.
(83) 8. T. parvipennis pennata, Morse. Plate X., Fig. 7, and eggs Plate XI., Figs. 2-2a.
(84) 9. T. parvipennis, Morse. Plate X., Fig. 8, and text Fig. 3.
(85) 10. T. medialis, var. n. Plate X., Fig. 10.
(86) 11. T. lateralis, Scudd. Plate X., Fig. 9.
(87) 12. T. polymorpha, Scudd. Plate X., Fig. 11.
(88) 13. T. jalapa, Hanc. Plate X., Fig. 4, and Plate II., Figs. 1-2a.
(89) 14. T. australis, Hanc.
(90) 15. T. guatemalteca, Bol. Plate X., Fig. 3.
(91) 16. T. bruneri, Morse.
(92) 17. T. chichimeca, Sauss.
(93) 18. T. nicaraguæ, Brun.
(94) 19. T. plagiata, Morse.
(95) 20. T. parvula, Morse. Plate III., Fig. 7.
(96) 21. T. nigra, Morse. Plate III., Fig. 8.
(97) 22. T. tecta, Morse.

Gen. Plectronotus, Morse.

(98) 1. P. scaber, Morse.

Gen. Scaria, Bol.

(99) 1. S. hamata (De Geer), Bol.

CLADONOTINÆ.

The body is tomentose, generally rugose, covered with irregular tubercles, often strongly compressed and even foliaceous. The head is large and wide, the front a little oblique, a large scutellum of variable form showing in the middle, consisting of two carinæ more or less compressed and united above to form the frontal costa. The vertex is wide and always separated from the eyes by a space, generally double the diameter of one of them. The antennæ are inserted before the eyes and separated at the base by the whole width

of the frontal scutellum. The basal segments are short and thick, the rest are filiform and segments six to nine are the longest; the last segment of the palpi is longer than the first and subacuminate. The pronotum projects more or less above the head, very rarely truncate in front, sometimes strongly compressed or foliaceous above, its posterior process nearly always short and truncate or even excised at the extremity, sometimes, however, extending to the middle of the posterior tibia. The elytra and the wings are usually absent, exceptionally developed. The sternomentum is strongly reflected around the mouth and more or less sinuate anteriorly. The femora are compressed and the carinæ in most of them have lobes (or even spines or tubercles in exotic species), the femoral and genicular teeth are little developed; the posterior tibiæ, little or not at all widened towards the end, have the carinæ armed with rather strong spines, more numerous on the external carina where they are continued to the extremity; the apical spurs are strong and the inferior external is sensibly the smaller, the first segment of the posterior tarsi nearly as long as the last, and obscurely furrowed above, the claws dentate at the base.

GEN. CHORIPHYLLUM, SERV.

Granulate. Face little oblique; antennæ widely separated, frontal scutellum above narrowed, lateral carinæ above converging. Vertex much wider than one of the eyes. Pronotum large, strongly compressed, completely foliaceous, with radiating veins, anteriorly extended above the head, posterior process not passing the femora, or strongly extended beyond, apex obliquely truncate. Elytra always absent. Anterior femora narrow, distinctly longer than wide; carinæ percurrent; posterior femora above compressed, apical half serrulate; genicular tooth acute; first article of the posterior tarsi distinctly longer than the third.

Choriphyllum, Serville, Hist. Nat. des Ins. Orth., 754 (1839).

Choriphyllum, Fieber, Entom. Monogr.

Hymenotes, Stal.

DISPOSITION OF SPECIES.

1. Superior marginal carina of the posterior femora lobate. *westwoodi* nom. n.
2. Pronotum in profile distinctly enlarged posteriorly. Body large. *foliatum* sp. n.
2. 2. Pronotum in profile subenlarged posteriorly; angles subrounded. *rhombeum* Walk.

CHORIPHYLLUM WESTWOODI, NOM. N.

Plate I., Figure 2.

Professor Westwood gives a good figure of a species of *Choriphyllum* from Jamaica which has the posterior femora above distinctly lobate, and both the anterior femoral margins also appreciably lobate. Of this species Professor Westwood says: "Thighs notched like edges of a leaf in the Banksian specimen seem to indicate a different species." The figure accompanying the description carried out that assertion and this species was left unnamed. It does not seem to have been properly interpreted by later authors. It should more properly have been given a distinct position. It may be called *Choriphyllum westwoodi.*

CHORIPHYLLUM FOLIATUM, SP. N.

Plate I., Figure 1.

Body rather large. Visible portion of head between the eyes very wide, convexed, in profile roundly elevated above the eyes, and produced anteriorly nearly the width of one of them; between the eyes the upper portion of the facial costa feebly carinate, the branches of the lower portion widely and roundly scutellate, strongly angulato-carinate; the face is very little convex just below the scutellum, the median carina here being distinct; eyes rather small, hardly prominent. The vertex just above the eyes provided on each side with a scarcely visible eminence (the rudiments of anterior carinæ of the vertex). Palpi flattened. Antennæ about five millimeters long,

inserted considerably below and in advance of the eyes about one-third the breadth of one of them, the first joint large, the second round and diminutive, the remaining ten or eleven articles becoming extremely attenuated. Pronotum foliaceous, strongly angulose, the portion above being thinned out and partially translucent when held against the light; the dilated opaque portion of the pronotum below divided by a strongly arcuate line and highest at the middle; sides of the pronotum distinctly veined and punctate. Dorsum in profile elevated into an angle a little behind the middle, in front of the angle sloping forward nearly straight over and beyond the head; the part before the angle a little sinuate, at the antero-produced portion suddenly truncate and bisinuate; the short horizontal inferior margin straight, anteriorly angulate (two millimeters in length), extending beyond the head; behind the angulate dorsal summit a little more precipitously declined, subconcaved, posteriorly marked by slight sinuations and the apical extension backward, forming the posterior process, provided with a prominent tooth near the apex, which here projects backward a little farther than the inferior marginal apex, and scarcely or about as far as the angulate apex of the posterior femora. Viewed from above the dorsal median margin is sulcate; the humeral angles are obliterated; the lateral carinæ exquisitely modified into veins. Elytra and wings wanting. The posterior angle of the lateral lobes small, subangulato-truncate behind, with a small, deep, subrounded sinus above; the inferior margin of the lobes scarcely at all laterally deflected; toward the apex the inferior lateral margin of the pronotum very little but broadly convexo-concaved. Anterior femora narrow, above carinate, below lobate at the anterior third, and a very small secondary lobe just following; middle femora slender, both margins very slightly lobate near the extremity; posterior femora slender compressed, superior marginal carina a little beyond the outer half suddenly reduced; genicular tooth strongly angulate produced, external femoral paginæ scabrous, between the superior marginal carina and the next one below three or four enlarged elevated papillate eminences.

Length of body, 16 mm.; pronotum, 19 mm.; hind femora, 9 mm.

Locality, Jamaica.

This interesting species described from a female example received in good state of preservation from Mr. Malcolm Burr, of East Grinstead, England.

CHORIPHYLLUM RHOMBEUM L.

Head granulate. Pronotum densely punctate; dorsum largely foliaceo-dilate, posteriorly scarcely extended as far as the hind femora; viewed in profile very high, gradually subexpanded backward, posteriorly suddenly sinuato-truncate, here being nearly perpendicularly truncate, below the middle obtuse sublobate; dorsal top margin straight, posteriorly obtuse roughened, scarcely declined toward the front. The anteriorly produced part above the head suddenly subangulate, nearly straight, obtusely sinuate and from here strongly declined, the inferior margin of this produced part obtusely rounded. Anterior femora above foliaceo-carinate, below and behind the middle provided with an obtuse lobe; intermediate femora above carinate, below back of the middle provided with a smaller lobe; posterior femora above dilated, dorsal margin behind the middle suddenly reduced.

Body length, ♀, 11 mm.

Locality, Jamaica.

Cicada rhombea, Baker, Phil. Trans., Vol. 54, p. 55, pl. 6 (1764).

Cicada rhombea, Linne, Syst. Nat., ed. XII., pl. 1, p. 704 (1767).

Membracis rhombea, Fabr., Ent. Syst., IV., 8, 2, Syst. Rhyng., p. 7.

Acridium (Hymenotes) rhombeum, de Haan, Bijdrag., p. 165, pl. 12, fig. 11.

Hymenotes compressus, Stal. Recensio, Orth., I., p. 153 (1873).

Choriphyllum rhombeum, Walker, Cat. Derm. Salt., Brit. Mus., V., 845 (1871), Jamaica; Thomas, Rep. U. S. Geol.

Surv. Terr., V., 245 (1873), Cuba; Bolivar, Ann. Soc. Ent. Belg., XXXI., 202, 203 (1887), Jamaica; Scudder, Index N. Am. Orth., 76 (1901).

PHYLLONOTUS, GEN. N.

Allied to *Choriphyllum*, but distinguished by having the dorsal margin of pronotum in profile between the antero-posterior extremities arcuato-subangulate, anteriorly convexly advanced over and beyond the head, posteriorly reduced and obliquely truncate.

Choriphyllum, Bol.

DISPOSITION OF SPECIES.

Dorsal margin of pronotum in profile arcuato-subangulate between the antero-posterior extremities.

1. Body large, highest over the head. *sagrai*, Serv.
2. Highest point of pronotum at the middle, body small. *saussurei*, Bol.

2. 2. Highest point of pronotum a little behind the middle. Length of body, ten millimeters. *plagiatum*, Walk.

PHYLLONOTUS SAGRAI, SERV.

Head granulate. Pronotum densely punctate; dorsum largely foliaceo-dilate, posteriorly the apex passing the femora, in profile in front greatly elevated over the head, from here forward greatly declined, backward distinctly angulate, posteriorly obliquely truncate, behind the middle dorsal margin sinuate. Anterior femora compressed, above foliaceo-carinate, below with a small triangular lobe; middle femora carinate; posterior femora wide at the base, carina very highly compressed, the apical half suddenly reduced and serrulate; tibia annulated with yellow; the third pulvillus of the posterior tarsus below straight and longer than the second.

Body length, ♀, 10 mm.; pronot., 19 mm.; post. fem. 7 mm.

Locality, Cuba (Bolivar).

Choriphyllum sagrai, Serv., I., c. p. 755, pl. 8f, 5 (1839).

Acridium (Hymenotes) sagrai de Haan, Bijdrag., p. 165.

Hymenotes sagrai Guerin in La Sagra's Hist. de Cuba. Art. p. 148, pl. 12, fig. 10. Westw. Charles W. III., fig. 67, 4.

Bolivar Essai Tettig., Ann. Soc. Ent. Belgique, p. 203 (1887).

Scudder, Index N. Am. Orth., 76 (1901).

PHYLLONOTUS SAUSSUREI, BOL.

Plate I., Fig. 7.

Head and pronotum granulate, less highly cristate than *P. sagrai*, posterior process reaching a little beyond the apex of femora, in profile the middle greatly elevated, from here backward more greatly declined than toward the front, posteriorly obliquely truncate, the dorsal margin behind in middle undulate. Anterior femora carinate, below lightly lobate; posterior femora wide, the superior carina compressed, the apical half serrulate.

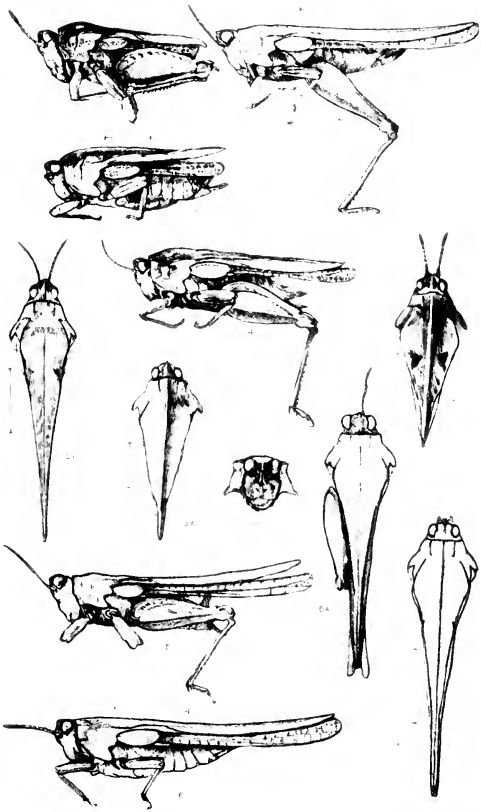
Body length, ♀, 7 mm.; pronot., 12 mm.; post. fem., 5.5 mm.

Choriphyllum saussurei, Bol. Bolivar Essai Tettig., Ann. Soc. Ent. Belgique, Vol. XXXI., 203, pl. 1, fig. 5 (1887), Cuba; Mem. Soc. Zool., France, I., 146 (1888); Id. Orth., Cuba, 31 (1888); Id. Gundl., Ent. cub., II., 347 (1890); Id. Scudder, Index N. Am. Orth., 76 (1901).

PHYLLONOTUS PLAGIATUM, WALK.

Female, testaceous or dead leaf color, wingless. Antennæ very long and slender. Crest of the pronotum foliaceous, extending much beyond the head and the tip of the abdomen, adorned with various black spots of different size and shape, its edge slighty undulating, forming a little behind the middle, a rounded angle. Legs slender; four anterior femora bidentate beneath; hind tibiæ with very short spines.

Length of body, 10 mm.



J. L. HANCOCK, DEL.

Jamaica (Walker).

Choriphyllum plagiatum, Walker, Cat. Dermap. Salt., V., 845 (1871); Thomas, Rep. U. S. Geol. Surv. Terr., V., 245 (1873); Scudder, Index N. Am. Orth., 76 (1901).

GEN. TYLOTETTIX, MORSE.

Related to *Diotarus*, but having the face retreating, the facial scutellum deeply concave, with high marginal carinæ; the vertex strongly convex in front, with a very prominent mid-carina; the anterior margin of the pronotum truncate; the genicular and femoral lobes of the hind femora prominent.

Morse, Biol. Cent. Am. Orth., II., 6 (1900).

TYLOTETTIX SINUATUS, MORSE.

Plate I., Fig. 4.

Face retreating, with prominent carinæ; in profile, slightly excavated at the lower edge of the scutellum, deeply (almost rectangularly) so at its upper margin, where the carinæ unite to form the very prominent mid-vertical carina, which is continued backward to a point just behind the level of the front margin of the eyes. Seen from above the vertex is twice the width of one of the eyes, the mid-carina projects in front of the eyes nearly the width of one of them, and on each side of this the front margin of the vertex is formed by a short transverse carina projecting convexly between the mid-carina and the eyes, but reaching neither. Pronotum rather sharply tectiform, the mid-carina cristate, arched anteriorly, nearly straight posteriorly; front margin truncate; hind process abbreviated, not reaching the apex of the hind femora, with rounded, submarginat tip; lateral carinæ bent inward, elevated and compressed behind the humeral angles, sinuate in both dorsal and lateral views; hind process with oblique elevated rugæ, three or four on each side, running inward and forward from the humero-apical carinæ nearly to the mid-carina; scapular area, wings, and elytra absent. Fore and mid femora stout, two and one half times as long as wide, strongly carinate, lobate beneath with sinuate margins; hind femora stout, genicular and femoral lobes prominent.

Total length, ♂, 8.7 mm.; pronotum, 7.7 mm.; post. fem., 5.25 mm.; antennæ, 2.3 mm.

Habitat. Nicaragua (Shimek, in Coll. Bruner).

One male, from a swampy locality.

Morse, Biol. Cent. Am. Orth., II., 6, fig. (1900).

Crimisus sp. Bruner, Bull. lab. Nat. Hist. Univ. Iowa, III., No. 3, 61, fig. 1.

Scudder Index N. Am. Orth., 338 (1901).

METRODORINÆ.

In general we find the body is little or not at all rugose, of quite large size, the pronotum not strongly prolongate, but rather widely subulate. The head is not crowded into the pronotum so far as the eyes; in general it is more or less compressed backward, the vertex being nearly always higher than the disk of the pronotum; the eyes are large and projecting; the antennæ are of variable length and filiform, and inserted in front of the anterior inferior border of the eyes; the superior ocelli are placed between the eyes and nearer their anterior border; it is between them that the frontal costa divides into two diverging branches forward, although separated nearly always by a narrow sulcus. The pronotum is depressed above, always truncated in front and prolonged backward, or in some it may not reach the extremity of the abdomen, in the others well prolonged beyond and ending in a sharp point. The median carina is scarcely elevated, offering sometimes small cratiform elevations; the humeral angles obtuse; the lateral lobes having their posterior angle directed outward as a lobe, obliquely truncate behind and rather angular. The elytra and the wings have the ordinary form, except in the genus Platythorus, in which they are both wanting; in *Chiriquia* the elytra are minute and elongate, while in *Otumba* the elytra are lanceolate. The legs are generally rather long, the posterior tibiæ somewhat spinose, the terminal spurs unequal, the tarsi narrow at the first segment, which equals the third in length, or nearly so. The valves of the ovipositor are serrulate-acute at the extremity and denticulate along the borders.

GENUS CHIRIQUIA, MORSE.

Related to *Pterotettix*, especially in the form of the elytra, but differing from that genus in having the posterior ocelli below the level of the eyes and also in the structure of the vertex.

Morse, Biol. Cent. Am., II., 7 (1900).

CHIRIQUIA SERRATA, MORSE.

Plate I., Fig. 6.

Body somewhat depressed. Face moderately retreating; eyes large, globose, very prominent, elevated on the sides of the vertex; antennæ inserted below the level of the eyes, equidistant from the eyes and each other; posterior ocelli barely below the level of the eyes. Vertex horizontal, elevated at the sides above the eyes to form transverse carinæ, running obliquely downward and inward to the mid-carina; the latter conspicuous from above, but hidden in side view by the prominent eyes, dividing opposite their lower part into high, rather widely divergent antrorse rami; from above the vertex is nearly twice the width of one of the eyes, distinctly excavate, with a prominent median tooth (the mid-carina) reaching the level of the front margin of the eyes. Face in profile strongly crenate, the middle arc formed by the prominent rami of the frontal costa, the upper arc by the eyes terminated by a minute portion of the transverse carinæ of the vertex. Pronotum with truncate anterior margin and cuneate apex, of moderate width at the shoulders, granulate, rather flat above, with the exception of several prominent transverse rugæ, which form on the mid-carina a series of low teeth between the shoulders and apex, and in front of the humeral angles a high cristiform eminence convexly arcuate in front, concave behind, its height from the shoulders equal to two-thirds the depth of the lateral lobes; lateral lobes laminate, strongly produced, squarely truncate at the apex. Elytra minute, the exposed portion linear, five times as long as broad; wings fully developed, reaching the apex of the pronotum, which passes the abdomen

by about one millimeter. Anterior and middle femora very slender, the latter five times as long as broad, with irregularly sinuate margins; hind legs missing.

Total length, ♂, 9.4 mm.; pronotum, 8 mm.

Habitat, Nicaragua, Castillo (Shimek in Coll. Bruner); Panama, Volcan de Chiriqui, 2,500 to 4,000 feet (Champion).

Two males. Professor Bruner's specimen is immature, and he referred it with some doubt to another genus, as noted above; but so similar is it to the adult male from Chiriqui described that I have no doubt of their specific identity. (Morse.)

Morse, Biol. Cent. Am. Orth., II., 7, fig. (1900).

Bruner, Cota saxoca (Bol., part), Bull., lab. Nat. Hist. Univ. Iowa, III., No. 3, 61.

Scudder, Index N. Am. Orth., 73 (1901).

GEN. OTUMBA, MORSE.

Related to *Metrodora*. Face strongly retreating; eyes very large and prominent, elevated; vertex truncate. Pronotum somewhat depressed, flat above; humeral-apical carinæ exceptionally developed and separated from the lateral carinæ by a deep groove; scapular area very large, external angles of lateral lobes rectangular. Femora elongate, slender.

Morse, Biol. Cent. Am. Orth., II., 7, 8 (1900).

OTUMBA SCAPULARIS, MORSE.

Plate I., Fig. 5.

Antennæ long, reaching the humeral angles, filiform, very slender, joints 9–12 the longest. Face very retreating, convex opposite the insertion of the antennæ, which are placed a little below the level of the eyes; eyes very large, globose, and prominent; posterior ocelli exceptionally large, situated between the lower part of the eyes. Vertex truncate, scarcely as wide as one of the eyes, horizontal, terminating anteriorly in oblique transverse carinæ; the mid-carina distinct, but very small. Facial costa forking at the middle of the eyes (behind the ocelli) into very narrowly divergent, nearly straight,

moderately elevated antrorse rami, which are rather widely open below. Pronotum somewhat depressed, elongate, truncate in front, subulate behind, flat above, slightly depressed at the shoulders, granulate, coarsely rugose anteriorly, slightly swollen on each side between the end of the humero-apical carina and principal sulcus; the shoulders narrow, humeral angles very obtuse, sides of the hind process straight; mid-carina scarcely distinct, lateral carinæ prominent; humero-apical carinæ distinct, continued forward in a straight line on the shoulders to meet the lateral carinæ one millimeter behind the groove opposite the apex of the elytra. Elytra elongate, four times as long as wide, narrowly lanceolate, subactite at each end, nearly straight above, arcuate below. Anterior and middle femora slender (6 by 1, 5 by 1) with undulate margins; hind femora long and slender, genicular and femoral lobes small, third joint of posterior tarsi equal to or a little longer than the first.

General color rufous-brown, varied with fuscous, with blotches of pale green on the hind femora and on sides of the pronotum.

Total length, ♀, 12.5 mm.; pronotum, 11.4 mm.; post. fem., 6 mm.; antennæ, 4 mm.; width of the shoulders, 2.6 mm.

Habitat, Nicaragua, Greytown (Shimek in Coll. Bruner). (Morse.)

Morse, Biol. Cent. Am. Orth., II., 7, 8, fig. (1900).

Amorphophus sp. Bruner, Bull. lab. Nat. Hist. Univ. Iowa, III., 3, 61, fig. 2.

Scudder, Index N. Am. Orth., 235 (1901).

PLATYTHORUS, MORSE.

Related to *Amorphopus*, but possessing elongate antennæ, with very large basal joints inserted on a level with the lower margin of the eyes; the anterior and middle femora little expanded; posterior tarsi with the first joint longer than the third; lateral lobes of the pronotum turned outward, obliquely truncate, obtuse, and rounded. (Morse.)

Morse, Biol. Cent. Am. Orth., II., 8 (1900).

PLATYTHORUS CAMURUS, MORSE.

Plate I., Fig. 3.

Body much depressed, granulate; eyes of moderate size. Vertex horizontal, one and one-third times as wide as one of the eyes, squarely truncate, with small but distinct mid-carina, the transverse carinæ separated from it by a shallow groove, but continued into low ridge running backward along each side of the mid-carina. Antennæ elongate, distinctly passing the shoulders, filiform, joints 7–10 the longest, the basal joint two-thirds the width of one of the eyes in length, inserted in a line with the lower margin of the eyes. Facial costa low above, forking midway between the ocelli and vertex into high, narrowly divergent rami, which form in profile a strong protuberance opposite the points of insertion of the antennæ. Pronotum strongly depressed, granulate, flat above, truncate in front, cuneate behind, with pinched almost mucronate apex; mid-carina distinct in front of and behind the shoulders, nearly obsolete elsewhere, in profile undulate; lateral lobes laminately produced, obliquely truncate at the apex, angles obtuse, rounded. Elytra and wings absent, anterior and middle femora strongly carinate, with sinuato-lobate margins. Hind femora partaking of the general depressed form of the body, but very stout from side to side; femoral lobes small, genicular lobes prominent, acutely pointed.

Total length, ♀, 9.6 mm.; pronotum, 8.5 mm.; post. fem., 6.3 mm.; antennæ, 5.5-6 mm. (estimated).

Habitat, Nicaragua, Chontales (Janson).

One female. (Morse.)

Morse, Biol. Cent. Am. Orth., II., 8, fig. (1900).

Scudder, Index N. Am. Orth., 269 (1901).

TETTIGINÆ.

To this section belong some of the smallest species, including the common forms of *Tettix* of North America as well as those of Europe.

Summing up the general characters: the body is rugose

or granulate, the front of the face is little oblique, and the vertex in most of the species is limited anteriorly by two more or less oblique carinæ, which are directed backward along the internal border of the eyes; these carinæ sometimes depressed forward and concave, and then the two longitudinal furrows of the vertex are open anteriorly. The frontal facial costa bifurcates above in front, and its two branches are prolonged forward almost always diverging until they meet the median ocellus; the antennæ are composed of twelve to fourteen segments, are usually rather short and inserted a little in front of the anterior inferior border of the eyes; the palpi are entire, cylindrical, or a little flattened at the extremity. The pronotum is truncate in front or is produced in an angle over the head as in *Nomotettix;* the dorsum is usually flat, although strongly carinate or cristate in some species; the humeral angles obtuse; the lateral lobes directed downward, and the lobe formed by the posterior angle projecting but very rarely, and then rounded and not angulate. The elytra are always in the form of a scale, oblong and punctate, and the wings are well developed in most of the species; the sternomentum is largely reflexed about the mouth. The legs are variable; the anterior femora carinate above, and not at all sulcate; sometimes the middle femora possess large clypeate dilatations (*Clypeotettix*), their carinæ often undulate (*Paratettix*) or entire, the posterior tibial carinæ appreciably parallel, being but little or not at all widened toward the extremity, their carinæ having numerous spines, the terminal spurs rather long and inequal, the posterior tarsi slender and their first segment longer than the third.

GEN. NOMOTETTIX, MORSE.

Body small, a little compressed, usually brachypterous, granulate rugose. Vertex wider than one of the eyes, middle carinate, in profile angulate produced in front of the eyes; crown usually mammillate posteriorly between the eyes. Frontal costa more or less sinuate, viewed in front the rami approximate and parallel; antennæ short, filiform, with thirteen or

more rarely twelve articles, not reaching the humeral angles, viewed in profile inserted barely in front of the anterior inferior border of the eyes. Dorsum of pronotum more or less compressed, between the shoulders rather narrow; median carina strongly cristate and longitudinally more or less arcuate; antero-dorsal margin of pronotum advanced upon the head, angulate, posteriorly cuneate, most rarely subulate; lateral lobes of pronotum bisinuate posteriorly, the infra humeral lateral sinus shallow, the inferior lateral sinus deep, angulate, the median lobule between the two feebly developed, the posterior inferior angle obtuse angulate. Elytra narrow acuminate. Marginal carinæ of anterior and middle femora entire; posterior femora more or less stout; carinæ of posterior tibiæ multispinose, the first tarsal article longer than the second and third combined.

Tettix, Harris: Batrachidea, Scudder, Nat. Mon. N. Am. Orth., 478 (1862), Bost. Jour. Nat. Hist.; Thomas Synop. Acrid. N. Am., 189 (1873); Fernald, Orth. N. Eng., 48 (1888), separate; Tettix, Bolivar, Essai (260), 86 (1887); Nomotettix, Morse, Psyche, Oct., 150 (1894); Hancock, Ent. News, June, 135 (1898); Scudder, Guide N. Am. Orth., 189 (1873); Hancock, Psyche, Jan. 6 (1900).

DISPOSITION OF SPECIES.

1. Vertex shallowly fossulate on either side of the median carina opposite anterior portion of the eyes; antero-dorsal margin of pronotum, viewed from above, obtuse angulate; body rugose.
2. Face strongly retreating; body very small. *parvus*, Morse.
3. Vertex, viewed from above, with front border strongly angulate; body larger. *acuminatus*, Hanc.
4. Anterior border of vertex convex; face moderately retreating, ampliate. *sinuifrons*, Hanc.

1. 1. Vertex quite deeply longitudinally fossulate on either side of the median carina opposite anterior portion of the eyes, frontal carina laterally compressed.

5. Median carina of pronotum strongly compressed, in profile strongly arcuate, translucent, punctulate; posterior femora scarcely at all ampliate. *compressus*, Morse.

6. Body larger; median carina of pronotum lower; posterior femora distinctly ampliate. *cristatus*, Morse.

7. Pronotal process posteriorly extended beyond the knee of hind femora. *carinatus*, Brun.

8. Body smaller; median carina of vertex in profile scarcely elevated above the eyes; elytra not strongly elongate.

9. Pronotum between the shoulders strongly tectiform, between the carinæ transversely subconcave; body rugose, scabrous. *floridanus*, sp. n.

10. Median carina of pronotum longitudinally arcuate, between the shoulders transversely compresso-cristate, between the carinæ strongly concave; body granulate, rugose. *arcuatus*, sp. n.

NOMOTETTIX PARVUS, MORSE.

Plate II., Figs. 4–4a.

Small, vertex projecting in advance of eyes about two-thirds the length of an eye, the anterior margin obtuse angulate, its sides nearly straight, rounding shortly into sides of crown, the mid-carina showing from above as a very small, slightly projecting tooth; mid-carina low on the crown, disappearing opposite the middle of the posterior half of the eyes; profile rounded or round-angulate at top, deeply excavate opposite eyes, subprotuberant opposite lower border of eyes, the face more retreating than in *cristatus;* sides of crown subparallel, slightly excavate opposite anterior portion of eyes; mammillæ of occiput scarcely distinct. Pronotum sharply tectiform, the mid-carina lower and less arched longitudinally than in *cristatus ;* anterior margin of dorsum projecting but little over the head, obtuse-angled, the sides straight or very slightly excavate; surface scabrous.

Length of body, ♂, 6.5-6.8 mm.; pronot., 5.5-6 mm.;

post. fem., 4 mm.; antennæ, 2 mm.; ♀, 8.5 mm.; pronot., 7.6 mm.; antennæ, 2 mm.

This species differs from *N. cristatus* in the smaller size; lower carina, less angulate anterior margin, and more scabrous surface of the pronotum; more advanced vertex, with less distinct carina in top view; more projecting vertex, more retreating face, and flatter crown in side view, with excavation opposite the eyes shallow and rounded instead of sharply excised.

St. Anthony Park, Minnesota, Professor Otto Lugger. (Morse.)

Morse, Jour. N. Y. Ent. Soc., Vol. III., p. 14, fig. 1, pl. II, Vol IV.

Specimens in my collection from the same locality were presented to me by Professor Lugger, and it seems to be a local species closely allied to *N. acuminatus*, Hancock. Lugger, Orthop., Minn., 3d Ann. Rep. State Exp. Station, 106, fig. 62 (1898); Scudder, Cat. Orth., U. S., 15 (1900); Scudder, Index N. Am Orth., 209 (1901).

NOMOTETTIX ACUMINATUS, HANC.

Plate II., Figs. 2–2a.

Similar to *N. parvus*, differing as follows: Larger, including relative proportions of body. Vertex from above more acute angulate, the mammillæ of occiput more distinct; the antero-dorsal margin of pronotum a little more angulate produced over the head; wings posteriorly reach slightly beyond the apical process. From *cristatus* it is distinguished by the more slender form of the body, besides having the median carina of the pronotum less arcuate longitudinally.

Length of body, ♀ 9 mm.; pronotum, 8 mm.; hind femora, 5 mm.; antennæ, 2.5 mm.

Locality, Lawrence, Kansas. (Hugo Kahl.)

Nomotettix acuminatus, Hancock, Ent. News, X., 8 (1899); Scudd., Cat. Orth. U. S., 15 (1900); Scudd., Index N. Am. Orth., 208 (1901).

NOMOTETTIX SINUFRONS, HANC.

Body a little compressed, rugose, granulate; crown mammillate posteriorly between the eyes, occiput considerably exposed. Vertex fully twice as wide as one of the eyes, rugose, in profile distinctly higher than the eyes, and strongly produced in front of them; median carina distinct anteriorly, obliterated posteriorly, projecing a little from the middle of the convex front border; on either side of the median carina of the vertex shallowly fossulate or subdepressed between the anterior half of the eyes; viewed in front the frontal carinæ substraight. Frontal costa moderately sulcate, rami parallel, in profile strongly advanced in front of the eyes, a little sinuate between them, face a little retreating. Pronotum rugose, granulate, antero-dorsal margin angulate, the sides of the angle subconcave, in profile anteriorly produced scarcely beyond the posterior border of the eyes; dorsum between the shoulders narrow, humeral angles widely obtuse, posteriorly the process cuneate, reaching about as far as the knee of the hind femora; median carina of pronotum distinct, compresso-carinate, longitudinally rather low subarcuate, highest between the shoulders, lateral carinæ indistinct. Wings not reaching so far as the apical process; elytra narrow, subacuminate. Femoral margins entire; posterior femora stout, the first article of the posterior tarsi much longer than the third, serrulate above, pulvilli flat below.

Body, ♀ 9.5 mm.; pronot., 8.5 mm.; post. fem., 6 mm.

Locality, Minnesota, St. Anthony Park. (Lugger.)

This species is nearly allied to *N. cristatus*, differing from that species principally in the body being a little more rugose; the vertex a little wider and more flattened, coarsely granulate, convex at the anterior border, the median carina of vertex less distinct and but little projecting, the occiput more uncovered; the facial frontal costa less sinuate; the face more ampliate; the pronotum, while anteriorly angulate, projects but little over the head; the median carina of pronotum less thinly cristate and in profile longitudinally presenting a lower

arcuation. From *parvus* it is distinguished by the convex front border of the vertex.

Nomotettix sinufrons, Hanc., Ent. News, X., 278, 279 (1899), Minn.; Scudder, Cat. Orth., U. S., 92 (1900); Scudder, Index N. Am. Orth., 208 (1901).

NOMOTETTIX COMPRESSUS, MORSE.

Body small, compressed, granulate, polyornate. Vertex nearly twice as wide as one of the eyes, a little higher in profile than the eyes, and strongly produced in front of them; front border subrounded; median carina anteriorly distinct, viewed in profile a little convex, from above a little projecting at the front border; anteriorly on each side of the median carina of the vertex longitudinally rather deeply fossulate, the frontal carinæ laterally compressed and subangulato-rounded. Frontal costa in profile between the eyes moderately sinuate, the face distinctly retreating, viewed in front the frontal costa sulcate, the rami parallel. Pronotum strongly compressed, antero-dorsal margin angulate produced over the head to about the posterior third or half of the eyes, sides of angle concave; dorsum between the shoulders narrow, transversely strongly concave between the carinæ; humeral angles widely obtuse; pronotal process posteriorly acuminate; median carina of pronotum strongly compresso-cristate, longitudinally arcuate, highest between the shoulders, often presenting numerous translucent punctulations when held against the light; more or less broken linear in arrangement. Wings not reaching so far as the apex of pronotum; elytra narrow, subacuminate. Femoral carinæ a little compressed, entire; posterior femora scarcely at all ampliate; pulvilli of posterior tarsi flattened below, the second nearly as long as the third.

Length of body, ♂ 6.3-7 mm.; pronot., 6-6.2 mm.; post. fem., 4-4.3 mm.; antennæ, 2.2 mm; ♀, 7.1-8.7 mm.; pronot., 6.5-8 mm.; hind fem., 5 mm.; antennæ, 2.2 mm.

Locality, Clark, Ind. (Wheeler); Vigo County (Blatchley); Dune Park, Ind. (Hancock).

Resembling *cristatus*, but the body is smaller and more

compressed, the median carina of the pronotum more arcuate, often with distinct translucent punctulations in broken linear arrangement; the posterior femora scarcely at all ampliate.

Variations as evidenced from an examination of forty-seven specimens from Dune Park, Indiana: The punctulations of the median carina sometimes appear like one or several lines of irregular pin holes; the median carina may be without distinct pin-hole punctulations, but more or less translucent, or both conditions may appear in the same individual; on the other hand, an occasional one may appear with the median carina sufficiently opaque as to scarcely admit light through it.

HABITS.

This species of Nomotettix lives on dry, sandy soil, lightly covered by fragments of twigs, leaves, and various fine debris accumulated from past seasons. It frequently seeks retreat among prickly pear cactus on mossy covered ground, slightly sheltered by trees, among sand dunes. It is a curious little species, occurring in certain localities in Indiana where there was no evidence of much moisture, and though sometimes quite common locally, it required the exercise of tact on hand and knees to capture the sprightly little insects. In the cool fall morning they did not appear to jump far, but as the sunlight warmed the ground they became more active. Some were in the last pupa stage, but the majority were adult. This species was associated with an occasional individual of *Tettix ornatus*. Dune Park, Indiana, October 7, 1901.

On two occasions this species was found frequenting mossy ground skirting a swampy opening. They were on dry, sandy earth at the edge of a wood, the opening being surrounded by sand dunes. Nearly full grown pupa were found August 9, 1897.

" Very similar to *N. cristatus*, resembling it in size and proportions of body, but differing as follows: Median carina of pronotum a little higher, especially opposite the shoulders, more smoothly arched on top, and distinctly compressed into a keel, which is about one millimeter in height at the shoulders and so thin in section that punctulations of its surface

appear translucent when held to the light. Dorsal front margin of pronotum much advanced upon the head, projecting over it a distance nearly or quite equal to one-half the distance between the lateral carinæ, with the sides strongly concave, *cristatus* projecting but one-fifth to one-third the above distance and with the sides less concave.

Length of body, ♂, 8.4 mm.; pronotum, 7.8 mm.; hind fem., 5-6 mm.; antennæ, 2.5 mm. ♀, 9-9.5 mm.; pronot., 8.5-8.8 mm.; hind fem., 5-6 mm.; antennæ, 2.8 mm."

After describing this species Morse was not confident it was racial or specific.

Nomotettix compressus, Morse?

Morse, Journ. N. Y. Ent. Soc., Vol. III., 15 (1895).

Locality, North Carolina (Atkinson and Morse); Indiana, Maryland, Georgia (Morse).

Scudd., Cat. Orth., U. S., 15 (1900); Scudd, Index N. Am. Orth., 209 (1901).

NOMOTETTIX CRISTATUS, MORSE.

Body small, brachypterous, a little compressed; granulate, subrugose, polyornate, light fuscous variable, frequently presenting triangular black spots on the disc of the pronotum, either in pairs or merging together or wanting. Crown mammillate on each side between the posterior third of the eyes. Vertex about twice the width of one of the eyes, having a distinct scarcely convex median carina, in profile advanced beyond the eyes a little less than one-half the length of one of them; the front border of the vertex viewed from above convex, from in front concave, the median carina projecting as a little tooth. Frontal costa in profile deeply angulato-sinuate between the eyes, between the antennæ a little protuberant, but not so far as the vertex; viewed in front the frontal costa is distinctly and suddenly furcate, the rami moderately separated and parallel. Eyes rather small, subelliptic from above, subconico-globose in profile. Antennæ in profile inserted a little below the antero-inferior border of the eyes, filiform, with twelve to thirteen articles. Pronotum having the antero-dorsal margin angulate produced (usually about one-third the

length of one of the eyes over the head), posteriorly the pronotal process is acute, extending backward nearly to or a little beyond the knee of hind femora, humeral angles obtuse, between the shoulders rather narrow, transversely between the carinæ concave. Median carina of pronotum distinctly cristate, longitudinally arcuate, more rarely with a number of translucent punctulations visible when held against the light (not so numerous or apparent as in *compressus*); lateral and antero-lateral carinæ moderately developed; lateral lobes of pronotum posteriorly bisinuate, the superior sinus shallow for the reception of the elytra; the inferior quite deep, forming nearly a right angle; the little lobule between the two feebly developed, being subconvexed; posterior angle of lateral lobe obtuse angulate. Elytra small, elongate, subacuminate; wings rudimentary, not extended backward so far as the apex of pronotal process. Anterior and middle femora entire, the middle femora more compressed, posterior femora stout; tibiæ not at all ampliate at the extremity, multispinose; first, second, and third pulvilli of posterior tarsi successively increasing in length, flattened below, the first and second acute.

Morse gives the following measurements:

Total length, ♂, 7.7-9 mm.; pronot., 7.1-8.5 mm.; pronotum passing hind fem., 1-1.5 mm.; wings passing pronotum, .5-1.3 mm.; length ♀, 8.6-10.2 mm.; pronot., 8-9.5 mm.; pronotum passing hind fem., .5-1 mm.; wings passing pronotum, .7-2 mm.

In Massachusetts it is reported by Professor Morse to be common locally. He has taken it in every month of the year excepting November. Young specimens were taken in October, commonly of small or medium size, and in June about half-grown; in middle of July very small, and one in the last stage was taken in northern Vermont. It would appear from these observations that the breeding period in New England is later than it is in allied species farther south and west, ovipositing probably being in the latter part of June or early July.

Tetrix cristatus, Harris, MSS. Batrachidea cristata, Scudd. Materials, Bost. Journ. Nat. Hist. VII., 478 (1862); Thomas,

Syn. Acrid. N. Am., V., 190 (1873); Fernald, Orth. N. Eng., 48; Batrachidea cristata, Harris, Morse, Psyche, 54, 107 (1894); Nomotettix cristatus, Morse, Psyche, VII., 150, 152, pl. 6, figs. 1, 1a-d (1894); Blatchl., Can. Ent., XXX., 64 (1898); Morse, Psyche, VIII., 320 (1899); Scudd., Cat. Orth. U. S., 15 (1900); Smith, Ins. N. J., 158 (1900); Scudd., Index N. Am. Orth., 209 (1901).

Through the generosity of Professor Morse, the author had an opportunity of examining twenty specimens which had been taken April 22, 1899, in Massachusetts, and four days later the colors were still preserved. On first examining the specimens the colors were quite vivid, but after softening them for mounting the daylight exposure caused a rapid change in coloration. In some specimens four rich black spots upon the dorsum of the pronotum were conspicuous, the posterior pair being the largest. These were bounded laterally sometimes by a light, almost white, line not appreciable in cabinet specimens. The black spots are sometimes obscure, being replaced by a plain gray, or there occurs an evident attempt at fusion of the spots into imperfect longitudinal bands. A light yellowish white inclosure may appear (as a spot) between the dark spots on the pronotal disc.

In writing of *Nomotettix cristatus* in Massachusetts, Professor Morse says:

"This species lives on light sandy soils, but especially in dry pastures and other wild land sparsely covered with a scanty growth of curling tufts of Danthonia grass, scraps of Cladonia lichens, and the leathery leaves of Antennaria. It is perhaps more plentiful in damper portions of such localities, but differs much from the other species of the subfamily in this particular, the others preferring soils perpetually moist or even the shores of lakes or streams."

Locality, New Jersey, Pennsylvania, New England States.

NOMOTETTIX CARINATUS, BRUN.

Plate II., Fig. 5.

Head, legs, and lateral lobes of pronotum resembling *cristatus*. Pronotum anteriorly angulate produced, posteriorly subulate, rugose, between the shoulders transversely strongly tectiform; pronotal process extended backward beyond the knee of posterior femora; median carina of pronotum a little compressed, longitudinally slightly convex, a little higher over the shoulders, posteriorly gently concave. Wings explicate, extended a little beyond the process.

Length of body, ♀, 9.2 mm.; pronot., 11.8 mm.; post. fem., 5.3 mm.

Morse gives the following measurements: ♂, 11-11.5 mm.; pronot., 9.5-10.7 mm.; ♀, 11-12.5 mm.; pronot., 9.8-11.5 mm.; posterior femora breadth contained 2.5 times in the length; pronotum extending beyond the posterior femora; ♂, 2-3 mm.; ♀, 1-2.8 mm.; wing extension beyond pronotum, ♂, .4-.8 mm.; ♀, .3-1 mm.

Locality, Massachusetts (Morse), New Jersey (Smith), Nebraska (Bruner).

Batrachidea carinata, Scudd., Mat. Bost. Journ. Nat. Hist., 497 (1862); Thom., Syn. Acrid. N. Am., 190 (1873); Fernald, Orth. N. Eng. (Separate), 49 (1888); Batrachidea carinata, Scudd.; B. cristata, Harr., Morse, Psyche, 54 (1894); Morse, Psyche, 107 (1894); Nomotettix cristatus carinatus, Morse, Psyche, 150, 151 (1894); Nomotettix carinatus, Brun., Ann. Rept. Nebr. Bd. Agric., 1896, 138 (1897); Smith, Ins. N. J., 158 (1900); Scudd., Index N. Am. Orth., 209 (1901).

Morse maintains that *carinatus* is a reversion to the earlier long-winged type of female *cristatus*, consequently a variety of that species.

The proportion of the former to the latter individuals, as determined locally, is one or two to the hundred in Massachusetts, where observations were made. It is found associated with *cristatus*.

NOMOTETTIX FLORIDANUS, SP. N.

Body small, a little compressed, rugose scabrous, sometimes light reticulate with fuscous, with two obscure black spots on the pronotum. Vertex nearly twice as wide as one of the eyes, median carina distinct, in profile low, scarcely elevated above the eyes, anteriorly rounded angulate, viewed from above distinctly projecting at the middle of the front border; on either side of the median carina of vertex anteriorly distinctly fossulate between the eyes; front border convexo-subtruncate; frontal carinæ compressed laterally, rounding into sides, lateral margins of crown subparallel. Frontal costa in profile produced in front of the eyes about one-fourth to one-third their length, deeply angulato-sinuate between the eyes; face rather strongly retreating. Pronotum rugose, scabrous; antero-dorsal margin strongly angulate; sides of angle scarcely concave, in profile acute, advanced over the head a little more than one-half the length of the eyes; dorsum between the shoulders narrow, transversely strongly tectiform, between the carinæ subconcave; posteriorly apical process obtuse, not reaching so far as the apex of posterior femora; median carina of pronotum subarcuate, highest between the shoulders; median lobule of lateral lobes almost obliterated; scapular area above the elytra distinct, nearly as high as the exposed portion of the elytra. Wings very little developed; elytra very small, their length a little more than twice their breadth. Femoral margins entire, compressed; posterior femora ampliate, rugose; first article of posterior tarsi as long as the second and third combined.

Length of body, ♀, 8 mm.; pronot., 6.9 mm.; post. fem., 4.7 mm.

Locality, Port Orange, Florida; Enterprise, Florida (Bolter).

Described from two females. One of the specimens in the author's collection received from the late A. Bolter, Chicago; the other in the collection of the University of Illinois. This species is allied to *compressus*, but is distinguished by the vertex, it being as viewed from above more convexo-subtrun-

cate; the pronotum not so strongly compressed, in profile longitudinally less arcuate; the body rugose, scabrous; the elytra smaller, less elongate; the median lobule of the lateral lobes of pronotum almost obliterated, the posterior femora ampliate. From the other species it can be readily distinguished by referring to the key.

NOMOTETTIX ARCUATUS, SP. N.

Body small, strongly compressed, granulate, rugose, dark fuscous. Vertex about twice as wide as one of the eyes, front border convex, median carina distinct, in profile very little convex, scarcely elevated as high as the eyes, viewed from above, distinctly projecting from the middle of the front border; anteriorly on either side of the median carina of the vertex fossulate between the eyes; frontal carinæ laterally a little compresso-rounded into the sides at the anterior portion of the eyes. Frontal costa angulato-sinuate between the eyes; face strongly retreating. Antero-dorsal margin of pronotum obtuse angulate, in profile advanced over the head nearly to the middle of the eyes; posterior pronotal process acuminate, not extended quite so far as the apex of posterior femora, between the shoulders narrow; humeral angles widely obtuse; median carina of pronotum strongly compresso-arcuate, highest at the shoulders, between the carinæ transversely strongly concave; median lobule of posterior margin of lateral lobes nearly obliterated. Wings undeveloped; elytra small, the width contained two and one-half times in the length (while in *N. cristatus* the width is contained about three times in the length). Femoral carinæ compressed, entire; posterior femora distinctly ampliate, at the outer third of the superior marginal carina provided with a very small acute tooth.

Length body, ♀, 8 mm.; pronot., 7.5 mm.; post. fem., 5 mm.

Locality, Tifton, Georgia (Pilate).

The species described by Bolivar as *Tettix cristatus*, Scudd., agrees with this species, and the fact that he gives the locality as Georgia is further evidence that this was the species

meant in his description. The measurement of male and female he gives as follows:

Length of body, ♂ ♀, 7-9 mm.; pronot., 7.5-9 mm.; post. fem., 4.5-6 mm.

Tettix cristatus, Bol., Essai. Ann. Soc. Ent. Belg. XXXI., 257, 260 (1887).

In the following group are some which present the most suggestive problems of variation; there is evidence of the recent origin of many changes in structure. The tendency to vary is inherent in all the forms, the line of demarkation not easily drawn between species, but it is clearly apparent from an examination of a considerable series from distant and intermediate localities that appreciable changes in structure are taking place through the reaction of the organisms on their environment; varieties and species are being formed moderately rapidly, and some of the forms have not yet attained the degree of specialization to which they are trending. The descriptions of the species give a composite conception to the mind, the variations being of such wide range as to baffle separate description of each individual phase. The difference between the extremes of the *granulatus* and the *arcuosus* groups is very wide, approaching separate generic rank.

DISPOSITION OF SPECIES.

GRANULATUS GROUP.

1. Median carina of pronotum more or less distinctly elevated, percurrent; dorsum transversely tectiform.
2. Body slender, pronotal process posteriorly extenuate; vertex viewed from above obtuse angulate.
granulatus, Scudd.

2A. Pronotal process and wings more or less abbreviated. *g. variegatus*, var. n.

2. 2. Dorsum between the shoulders wider; apical process and wings shorter; scapular area higher over the outer fourth of elytra; face broader, ampliate.
incurvatus, Hanc.

3. Vertex in dorsal view with anterior border convex; frontal costa viewed in profile not at all sinuate. subspec. *huggeri*, Hanc.

4. Pronotum distinctly incrassate; superior lateral sinus of lateral lobes shallow; frontal costa in profile moderately sinuate; face retreating. *brunneri*, Bol.

ORNATUS GROUP.

5. Vertex in dorsal view obtuse angulate; median carina distinctly projecting as a tooth at the middle of the front border; frontal costa protuberant opposite lower part of eyes. *acadicus*, Scudd.

6. Body rather slender; median carina of pronotum distinct, percurrent, in profile a little elevated anteriorly; front margin of vertex convex; superior lateral sinus of pronotum quite deep. *ornatus*, Harr.

6A. Pronotum and wings more or less abbreviated. var. *o. triangularis*, Scudd.

7. Pronotum anteriorly between and before the shoulders with the median carina arcuate, compresso-elevated; middle femora enlarged, in the male nearly or quite one-half as broad as long; body more robust. *hancocki*, Morse.

7A. Pronotum and wings abbreviated. *h. abbreviatus*, Morse.

7. 7. Middle femora of moderate proportions; body robust. *crassus*, Morse.

7. 7A. Pronotum and wings abbreviated. *c. affinis*, var. n.

ARENOSUS GROUP.

1. 1. Median carina of pronotum not at all or very little elevated, in profile barely undulate or anteriorly gibbose; dorsum transversely flattened or subconvex.

8. Frontal costa narrowly sulcate, rami closely approximate; vertex distinctly depressed anteriorly; eyes

in dorsal view prominent, moderately large; body rather slender, pronotal process posteriorly extenuate acute. *arenosus*, Burm.

8A. Pronotum and wings abbreviated; dorsum between the shoulders broader depressed; frontal costa more abruptly furcate, the rami more appreciably separated. *a. costatus*, var. n.

9. Vertex slightly depressed anteriorly, in profile advanced beyond the eyes, equal to about one-fourth the diameter of one of them; frontal costa in profile distinctly sinuate; eyes of medium size; body moderately robust. *obscurus*, Hanc.

9A. Pronotum anteriorly before the shoulders more or less strongly constricted, gibbose; median carina low, frequently indistinctly undulate, posteriorly subhorizontal. *gibbosus*, Hanc.

9B. Median carina of pronotum posteriorly with small undulations. var. *fluctuosus*, Hanc.

9C. Body very small; dorsum anteriorly gibbose, posteriorly strongly flattened. var. *decoratus*, Hanc.

10. Lateral carinæ of pronotum decidedly compressed; dorsum behind the shoulders compresso-narrowed. *blatchleyi*, sp. n.

GEN. TETTIX, CHARP.

Body lightly rugose, granulate. Vertex viewed from above wider than one of the eyes, laterally more or less sinuate; middle carinate, anterior border angulate, or convex or subtruncate, viewed in profile more or less distinctly produced in advance of the eyes. Frontal costa more or less or not at all sinuate. Antennæ short, not reaching to the shoulders, stout or slender, consisting of twelve to fourteen articles, inserted hardly in advance of the eyes. Dorsum of pronotum transversely between the shoulders may be subcompressed, tectiform, flattened, subconvex, or lightly depressed; pronotum truncate anteriorly or antero-dorsal margin scarcely angulate, posteriorly extenuate acute or the apical process

abbreviated; humeral angles strongly obtuse, lateral lobes posteriorly bisinuate; posterior angle of the lateral lobes obtuse; inferior margin oblique, more or less lightly reflected laterally. Femora entire or margins undulate, posterior tibiæ near the apex a little enlarged, carinæ serrulate, short spinose; first article of posterior tarsi elongate, distinctly longer than the third, the pulvilli may be flat below or subspiculate.

Tettix, Charpentier, Germar, Zeitsch III., 315 (1841).

Tetrix, Latreille, Hist. Nat. d. Crust. et. Ins., XII., 161 (1804).

Tettix, Fischer (1853).

Bolivar, Essai, 257 (1887).

Morse, Psyche, 149 (1894).

Scudder, Cat. N. Amer. Orth., 24 (1897).

Hancock, Ent. News, 138 (1898).

Hancock, Psyche, 6, 7 (1890).

GRANULATUS GROUP.

TETTIX GRANULATUS, SCUDD.

Plate IV., Figs. 2, 2a.
Plate III., Fig 1.

Body slender, granulate, or little rugose. Crown of head united with the frontal costa, forming a subconoid profile. Vertex viewed from above nearly twice as wide as one of the eyes, front margin obtuse angulate, advanced farther than the eyes, perceptibly widened posteriorly, lateral margins a little sinuate, occiput naked; median carina of the vertex distinct, not projecting beyond the frontal apex, on either side of the median carina longitudinally a little fossulate, viewed in profile low, scarcely raised above the eyes; the small frontal carinæ of the vertex forming the front margin, nearly horizontal, viewed from above laterally angularly curved at the antero-inner margin of the eyes, scarcely compressed, and here the vertex a little wider. Frontal costa viewed in profile strongly advanced beyond the eyes, between the eyes hardly sinuate, between the antennæ scarcely convex; viewed in front the frontal costa narrowly sulcate, rami parallel, very little more

divergent at the median ocellus; face distinctly retreating. Eyes small, viewed from above elyptic. Antennæ short, stout. Pronotum anteriorly truncate posteriorly long extenuate; the apex acute, passing the posterior femora, not extended quite so far as the wings; antero-dorsal margin sometimes indistinctly obtuse angulate; dorsum narrow, transversely between the shoulders tectiform; humeral angles widely obtuse angulate; median carina of pronotum distinctly elevated, percurrent, in profile nearly straight, sometimes scarcely undulating, a little more elevated anteriorly between the shoulders; lateral lobes posteriorly strongly bisinuate, the elytral sinus nearly as deep as the inferior sinus, the median lobule between the two angulate; posterior inferior angle obtuse, scarcely rounded below. Elytra subampliate, elongate, rounded apically; wings fully developed. Femora slender, margins entire; posterior femora much reduced near the apex; first article of posterior tarsi a little longer than the other two together, the pulvilli flat below, the first small, acute, the second about twice as long as the first, the third nearly as long as the first and second together.

Length body, ♂, 8-9 mm.; pronot., 10.5-11 mm.; post. fem., 4.9-5.5 mm.; ♀, body, 10-11 mm.; pronot., 12.5-13.7 mm.; post. fem., 6-6.3 mm.

Acrydium granulatum (Kirby), Faun. Bor. Am. Ins., 251 (1837).

Tettix granulatus (Kirby), Scudd., Bost. Jour. Nat. Hist., VII., 474 (1862).

Tettix granulatus (Scudd.), Thomas, Rep. U. S. Geol. Surv.

Tettix granulatus (Kirby), Fernald., Orth. New Eng.

Tettix granulatus (Kirby), Bolivar, Essai (1887).

Tettix granulatus (Kirby), Morse, Psyche.

Tettix morsei, Hancock, Ent. News.

See further on for complete bibliography.

Locality, temperate and boreal regions of North America.

Agassiz, B. C. (Walker); De Grassi Pt. L. Simcoe, Ont. (Walker); Toronto, Can. (D. G. Cox, Baker); Colorado (Baker); St. Anthony Park, Minn. (Lugger); Wellesley,

Mass. (Morse); Evanston, Kenilworth, Chicago, Glen Ellyn, Richmond, Riverside, Winnetka, in Illinois (Hancock); N. Illinois (C. T. Brues); Evanston, Ill. (J. G. Needham); Montello, Nee-pee-nauk, Wilson's Island, L. Puckaway, in Wisconsin (Hancock); Dune Park, Ind. (Hancock); Kewanna, Ind. (Blatchley); Michigan Agric. Coll. (Baker); Sparta, Wis. (Hancock); also recorded from Minn., Mass., Me., N. H., Hudson Bay, Arc. Am., L. Huron, Conn., Can., Iowa, Nebr., Dak., Mont., Van Couver, Kan., New York, Montreal, Col., Ont., Staten Is., Vic., N. J., Manitoba.

A female specimen from northern Illinois in the collection of the late A. Bolter, of Chicago, measured sixteen millimeters in total length, this being the maximum size of any examples examined. A series of specimens from St. Anthony Park, Minn., furnished by the late Professor Otto Lugger presented some departures from the usual form. There was variation in the angularity of the vertex, the frontal margin of some examples being inordinately obtuse, resembling *Tettix luggeri;* the median carina of the pronotum instead of the usual straight profile was undulating in its backwards course; the dorsum more decidedly rugose, while the posterior tarsal characters were but little changed.

The color is extremely variable in this species, and polyornate, light or dark, fuscous, sometimes presenting yellowish white lateral stripes, one on each side of the pronotal disc, which may be continued forward on each side of the vertex. Again, a light median longitudinal band may extend the entire length of the pronotum, of uneven width, and rich black pigmentation may be present on each side contrasting strongly with the light band. Occasionally a light spot appears on the pronotal disc.

The light band on the dorsum of pronotum is remarkably protective while these little locusts are in their natural habitat, simulating the dried grass-blades perfectly.

Variety 2. Pronotal process and wings more or less abbreviated; superior lateral sinus of lateral lobes less deep. In this variety the posterior process extends scarcely beyond the apex of the posterior femora and hardly passing the wings, or

the process may be intermediate in length between this variety and the typical form with fully developed wings and pronotum, but the wings do not extend quite to the apex. The elytra are slightly shorter.

Length body, ♀, 10.1-10.2 mm.; pronot., 9.5-11.4 mm.; post. fem., 6.1-6.2 mm.; body ♂, 7 mm.; pronot., 8 mm.; post. fem., 5 mm.

Very rare. Specimens from Michigan and Wisconsin.

Variety 3. Body diminutive, otherwise the same. From Colorado (Baker) on Grizzly Creek, S. W. of North Park; also Larimer County, about 7,500 feet elevation.

BIBLIOGRAPHY OF TETTIX GRANULATUS.

Scudder, Can. Nat., vii. 288 (1862); Bost. Journ. Nat. Hist., vii. 474 (1862); Smith, Proc. Portl. Soc. Nat. Hist., i., 151 (1868); Packard, Guide Ins., 572 (1869); Walk., Cat. Derm. Salt. Brit. Mus., v., 812 (1871); Can. Ent., IV., 31 (1872); Smith, Rept. Conn. Bd. Agric., 382 (1872). Thom., Rep. U. S. Geol. Surv., V., 182 (1873); Scudd., Hitchc., Rept. Geol. N. H., I., 378 (1874); Riley, Rept. Ins. Mo., viii, 150, fig. 47 (1876); Prov., Ent. Can., viii. 137 (1876); Taune, Ent. Can., ii. 46 (1877); Bess., Bienn. Rept. Iowa Agric. Coll., vii. 210 (1877); Brun., Can. Ent., ix, 145 (1877); Riley, Locust Plag., 230, fig. 42 (1877); Rept. U. S. Ent. Comm., I., 256, fig. 11 (1878); Thom., Bull. U. S. Geol. S., iv, 484 (1878); Scudd., Rept. U. S. Ent. Comm. ii. App. 28 (1881); Brun., U. S. Ent. Comm., iii, 61 (1883); Riley, Stand. Nat. Hist., ii, 102, fig. 208 (1884); Brun., Bull. Wash. Coll., i, 139 (1885); Lintn., Rept. Ins. N. Y., ii. 197, fig. 59 (1885); Caull., Can. Ent., xviii, 212 (1886), Can. Orth., 14 (1887); Bol., Ann. Soc. Ent., Belg., XXXI., 266-266 (1887), separate, 91-92 (1887); Caull., Rept. Ent. Soc., Ont., xviii. 71 (1888); Fern., Ann. Rept. Mass. Agric. Coll., XXV., fig. 18 (1888); Fern., Orth. n. Eng., 46, fig. 18 (1888); Dar., Ent. Amer., V., 81 (1889); Fletch., Rept. Exp. Farms, Can., 1888, 63 (1889); Smith, Cat. Ins. N. J., 415 (1890); Town, Proc. Ent. Soc. Wash., ii, 44 (1891); McNeill, Psyche, vi, 77 (1891); Osb., Proc. Iowa. Acad. Sc., I., 117 (1892); Brun., Publ. Neb. Acad. Sc., iii, 28 (1893); Cock., Trans. Am. Ent. Soc., XX., 337 (1894); Morse, Psyche, vii, 54, 106, 154, 163, pl. 6, figs. 3, 3a (1894); Blatchley, Can. Ent., XXVI., 220-221 (1894), Bent., Bull. Am. M. Nat. Hist., vi, 300 (1894); Hanc., Trans. Am. Ent. Soc., XXIII., 237, pl. 6, figs. 3, 3a, pl. 9, fig. 28 (1896); Blatchley, Orth. Ind., 22 (1897); Ball. Proc. Iowa Acad. Sc., IV., 238 (1897); Brun., Ann. Rept. Neb. Bd. Agric., 1896, 138 (1897), Scudd., Appal., viii, 304 (1898); Scudd., Alp. Orth. N. A., 6 (1898); Blatchley, Can. Ent., XXX., 64 (1898); Lugg., Orth. Minn., 167, 108, fig. 63 (1898); Walk., Can. Ent., xxx. 123 (1898); Tayl., Ott. Nat., xii. 89 (1898); Hanc., Ent. News., X., 279-280 (1899); Scudd., Cat. Orth. U. S., 16, 92 (1900); Fogg, Proc. Manch. Inst. Art. Sc., I., 45 (1900); Scudd., Psyche, IX., 100-101 (1900); Smith, Ins. N. J., 150 (1900); Needham, Occ. Mem. Chic. Ent. Soc., I., 24 (1900); Scudd., Index. N. Am. Orth., 318-319 (1901).

HABITS.

The author found Tettigids in the woods on the ground about prostrate tree-trunks, which were molding in decay and covered with greenish lichens and moss. The yellowish and brownish fallen leaves were everywhere scattered over the bed of the forest. Occasionally, when the wind was not blowing, the author was able to mark the presence of Tettigids by the sound made as they jumped upon the dried leaves. *Tettix granulatus* and *Tettigidea parvipennis femnata* were especially common here. The young of *Chimarocephala viridistaeniata* (both varieties), about half an inch long, also jumped about, sometimes being for the moment mistaken for Tettigids. Wilson's Island is surrounded by marshy land.—Wilson's Island, Lake Puckaway, Wis. Oct. 1, 1901.

At the edge of a pond overgrown with swamp grass the author found *Tettix granulatus*, *Tettix ornatus* and *T. o. triangularis*. In another locality at the muddy border of a small lake *Tettix gibbosus* and *Tettix granulatus* were observed in considerable numbers along with half-grown pupa. In the woods where a little temporary rivulet had drained the rich soil, leaving the margins muddy, were *Tettigidea f. fenestrata*, *Tettix granulatus* and *Tettix gibbosus*. The Tettigids seemed rather scattered in their distribution locally, and the discovery of these insects at this time in the spring is evidence of their hibernation through the winter. Only two other species of locusts were met with belonging to larger orthoptera. These were in the pupal stage, living among the dried leaves in the woods.—Glen Ellyn, Ill., April 23, 1899.

Blatchley mentions that he has met with this species only in winter from beneath logs in Vigo County, Indiana. The same observer found it very common in the depths of a tamarack swamp in company with *Tettigidea polymorpha*. In writing of the habits of this species, Morse says it prefers sedgy meadow-lands and swales on sandy soil, occasionally flooded by rains or freshets, and perpetually moist. Most of his specimens were taken on a boggy swamp which had been filled in with sand and on which water stood most of the time. Baker found the species hibernating under stones at Ft. Collins, Col., in March.

TETTIX LUGGERI, HANC.

Plate IV., Figs. 6–6a.

Vertex viewed from above slightly advanced beyond the anterior border of the eyes; anterior border convex; median carina distinct, viewed in profile low nearly horizontal, elevated but little above the eyes; lateral margins of vertex very little sinuate. Frontal costa viewed in profile distinctly advanced beyond the eyes, not at all sinuate, scarcely convex between the antennæ; frontal costa with the vertex together forming an obtuse conoid profile, apex not prominent. Pronotum anteriorly truncate, posteriorly extenuate, passing beyond the apex of posterior femora; dorsum between the shoulders tectiform; median carina of pronotum percurrent and distinct. Wings extended beyond the apex of pronotal process.

Length body ♀, 15 mm.; pronot., 14.5 mm.; post. fem., 6 mm.

Locality, Minnesota (Lugger); Illinois (Bolter).

A slender form allied to *T. granulatus*, but differing principally in the character of the vertex and frontal costa. The head in this species is not unlike that of *Tettix turki* of Europe.

In a considerable series of specimens of *Tettix granulatus* from Minnesota, the vertex presents variable forms intermediate between *granulatus* and *luggeri*. The evolution of the angulate vertex was excellently shown to have arisen from a

less pronounced type. *Tettix luggeri* appears to have a comparatively recent origin.

Tettix luggeri, Hancock, Lugg. Orth., Minn., 109 (1898); Scudder, Cat. Orth. U. S., 17 (1900); Scudd., Index N. Am. Orth., 319 (1901).

TETTIX INCURVATUS, HANC.

Plate III., Fig. 2.

Somewhat resembling *granulatus*, but differing as follows: Average length of body shorter, more robust; head not quite so produced; vertex at the occiput more covered; dorsum of pronotum between the shoulders wider, more distinctly tectiform; dorsal front and lateral front margins of pronotum encroaching on the head; median carina of pronotum a little more elevated, compressed anteriorly, lateral and frontolateral carinæ of pronotum little more compressed; scapular area higher, especially over the outer fourth of the elytra; face broader, ampliate; femora scarcely stouter.

Length body ♀, 14-15 mm.; pronot., 13-13.5 mm.; post. fem., 6.5-7 mm.; ♂, body 11-12 mm.; pronot., 10-10.5 mm.; post. fem., 5.3-6 mm.

In the male the wings extend slightly farther than the pronotal process from .5 to 1 mm.; in the female this condition varies, the wings extending slightly farther than the apex of pronotum or sometimes not so far.

Locality. Palouse, Washington (J. C. Warren), author's collection; New Mexico (Cockerell); Colorado (Caudell).

Found in openings among pines near the Palouse River, Washington, sometimes on moss or white clover (Warren).

Tettix incurvatus, Hancock, Am. Nat., xxix. 761, 762, fig. 1 (1895); Scudd., Cat. Orth. U. S., 17 (1900); Scudd., Index N. Am. Orth., 319 (1901).

TETTIX BRUNNERI, BOL.

Body broad, granulate, fusco-testaceus, above frequently with two black spots on the pronotum. Vertex about twice or a little more than twice the width of one of the eyes; median

carina distinct, viewed in profile moderately elevated above the eyes and a little convex; the median carina not projecting; front border obtuse angulate, strongly advanced beyond the front margin of the eyes; between the eyes on either side of the median carina of vertex anteriorly a little longitudinally fossulate, rather flat posteriorly, lateral margins sinuate; the frontal carinæ of vertex horizontal, viewed from above laterally angularly curved and compressed at the antero-inner border of the eyes, here in front between the little lateral carinæ the vertex broadened; crown of head at occiput covered nearly to the eyes. Frontal costa viewed in profile moderately sinuate between the eyes, viewed in front sulcate, the rami subparallel, scarcely more divergent at the median ocellus. Pronotum anteriorly truncate, posteriorly acute, sides nearly straight; apical process abbreviated, extended barely as far or considerably passing the posterior femora; dorsum between the shoulders broad, transversely sharply tectiform; humeral angles carinate, obtuse angulate; median carina of pronotum distinctly elevated, percurrent viewed in profile near the antero-dorsal margin a little more compressed horizontal or a little concave posteriorly; lateral lobes posteriorly bisinuate, the superior lateral sinus moderately shallow; the inferior sinus rather widely angulate, the median lobule between the two with obtuse angulate margin. Elytra elongate, apex rounded; wings equaling or slightly passing the pronotal process. Femoral margins entire; middle femora scarcely compressed; posterior femora moderately narrowed posteriorly towards the apex, the first article of the posterior tarsi strongly longer than the last two together, the pulvilli straight below, the first pulvilli quite small, the second about twice as long as the first, the third as long as the first two together.

Body, ♂, ♀, 9-12 mm.; pronot, 10-12 mm.; post. fem., 5.5-6 mm. (Bolivar).

The female specimen in the author's collection, presented by Professor Ignacio Bolivar, has the following dimensions:

Body, ♀, 11 mm.; pronot., 10.5 mm.; post. fem., 6 mm.

Professor Morse gives the measurement of this species as follows:

Total, ♂, 10.3 mm.; ♀, 11.4-14.5 mm.; pronot., ♂, 9.3 mm.; ♀, 10.5-12 mm.; post. fem., ♂, 5-6 mm.; ♀, 6-6.6 mm.; width of shoulders, ♂, 3 mm.; ♀, 3.5 mm.; antennæ, ♂, 3 mm.; ♀, 2.5-3 mm.; pronot., passes posterior femora, .3-2.5 mm.

Locality, Hudson Bay (Bolivar); Oregon (Scudd.), Morse; Laggan (Morse); Green River Wyo. (Morse); Tennessee Pass, Colo. (Bruner), Morse.

Tettix brunneri, Bolivar, Essai XXXI., 92 (1887).

Tettix tentatus, Morse, Jour. N. Y. Ent. Soc., VII., 200 (1899).

Tettix granulatus, Hanc., Ent. News, 279 (Dec. 1899); Scudd., Cat. Orth. U. S., 16, 92 (1900); Scudd., Index N. Am. Orth., 317 (1901).

This species comes near *Tettix bipunctatus* of Europe, but the latter is much smaller, the median carina proportionately more cristate, approaching Nomotettix and the frontal costa of the face in *bipunctatus*, viewed in profile, is not sinuate.

ORNATUS GROUP.

TETTIX ACADICUS, SCUDD.

Plate IV., Figs. 3 3a.

Body robust, light clay colored or fulvous, variously ornate, sometimes with a light spot on the disc or more often with two black spots on the pronotum. Vertex viewed from above more than twice the width of one of the eyes, strongly advanced beyond the anterior margin of the eyes, the front margin obtuse angulate, lateral margins sinuate, between the lateral margins and median carina longitudinally fossulate, deeper between the middle of the eyes, occiput covered nearly to the eyes; median carina of vertex distinct anteriorly, projecting from the middle of the front margin, on either side slightly sulcate, mammiform eminence on each side posteriorly; frontal carina of vertex laterally compresso-rounded into the sides; viewed in profile crown of head scarcely elevated above the eyes. Frontal costa viewed in profile strongly advanced beyond the eyes, distinctly sinuate between the

eyes, viewed in front the rami moderately divergent, a little more separated at the median ocellus. Pronotum anteriorly truncate, the antero-dorsal margin scarcely angulate, posteriorly acute, apical process abbreviated; dorsum between the shoulders broad, transversely sharply tectiform, humeral angles strongly obtuse, carinate; median carina of pronotum distinctly elevated, compressed between the shoulders, towards the front convex, posteriorly nearly straight or scarcely subsinuate concave; dorsum transversely between the carinæ concave; lateral lobes posteriorly bisinuate; the superior sinus shallow, the inferior sinus widely angulate, the median lobule between the two feebly developed; posterior inferior angle of lateral lobes obtuse, widely rounded below and somewhat laterally distended. Elytra elongate, towards the apex subacuminate; wings abbreviated, extended nearly to the apex of pronotum, but not so far as the end of ovipositor. Femoral margins entire or barely subsinuate at lower margins of first and second femora; posterior femora rather slender.

Body, ♀, 10 mm.; pronot., 9 mm.; post. fem., 5.5 mm.

Locality, near Lake of the Woods (Scudder), type specimen; St. Anthony Park, Minn. (Lugger); Nebraska (Bruner); Colorado (Cockerell); Canada (Scudder); New Mexico (Scudder).

Tettix acadicus, Scudd., Ann. Rept. Chief Eng., 515 (1876); Bruner, Publ. Nebr. Acad. Sc., III., 29 (1893); Cockerell, Trans. Am. Ent. Soc., XX., 337 (1894); Scudd., Proc. Bost. Soc. Nat. Hist., XXVII., 209, 217 (1896); Bruner, Ann. Rept. Nebr. b. ag., 1896, 138 (1897); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index. N. Am. Orth., 316 (1901).

The figure of *Tettix ornatus*, given by Lugger in his Orthoptera of Minnesota, page 109, appears to have been drawn from a specimen of *Tettix acadicus*. The writer infers this from the hair line, the robust character of the figure, and the abbreviated pronotum and wings. The figure here given is drawn from Mr. Scudder's type specimen.

TETTIX ORNATUS, HARRIS.

Plate III., Fig. 4.
Eggs Plate XI., Figs. 3–3a.

Body of moderate size, rather slender, granulate. Vertex viewed from above about equal in width to one of the eyes, a little advanced beyond their anterior margin; the front margin of vertex convex, lateral margins a little sinuate, widened posteriorly, on either side of the median carina longitudinally a little fossulate, deeper between the middle of the eyes; median carina of vertex distinct anteriorly projecting as a small tooth at the middle of the front margin, either side very little sulcate, occiput naked behind the eyes; crown of head viewed in profile not at all elevated above the eyes. Frontal costa in profile moderately advanced beyond the eyes, between the eyes lightly sinuate, between the antennæ a little protuberant, at the junction with the median carina of the vertex angulate, the apex rounded, viewed in front the rami very little diverging, being a little wider at the median ocellus. Eyes rather small. Antennæ moderately stout. Pronotum anteriorly truncate, posteriorly subulate, extended beyond the posterior femora, but not so far as the wings; dorsum between the shoulders tectiform, rather narrow, humeral angles widely obtuse angulate; median carina of pronotum distinct, percurrent nearly horizontal, in profile behind the anterior margin scarcely compresso-elevated, between the shoulders very little elevated, posteriorly scarcely concave; lateral lobes of pronotum posteriorly bisinuate; the superior lateral sinus quite deep, nearly as deep as the inferior sinus; the median lateral lobule obtuse angulate, the posterior inferior angle of the lateral lobes obtuse at the apex, very little rounded below and scarcely distended laterally; scapular area narrow, widened a little posteriorly over the apical portion of the elytra. Elytra rather elongate, subacuminate towards the apex; wings fully developed, extended a little beyond the pronotal process. Femoral margins entire or indistinctly sinuate at the lower margins of the first and second femora; mid-

dle femora moderately expanded, in the male about one-third as broad as long; the posterior femora rather slender, the first article of the posterior tarsi longer than the second and third together, the first pulvilli small, the second about twice as long as the first, the third as long as the first and second together, flat below.

Length body, ♀, 12-12.5 mm.; pronot., 10.3-10.8 mm.; post. fem., 5.5-6 mm.; body ♂, 10.2-10.5 mm.; pronot., 9 mm.; post. fem., 4.3-4.4 mm.

Distribution, temperate and boreal regions.

Locality, Chicago, Kenilworth, Bloomington, Riverside, Grossdale, Winnetka, in Illinois (Hancock); northern Illinois (Brues); Atherton, Mo. (Adams); What Cheer, Ia. (Hancock); St. Anthony Park, Minn. (Lugger); Ames, Ia. (Ball); Garden City, Kan. (Kahl); Lawrence, Kan. (Kahl); Kansas (Westcott); Colorado (Baker); Wellesley, Mass. (Morse); Brattleboro, Vt. (Morse); Montello, Wis., L. Puckaway (Hancock).

From the preceding localities 33 ♀'s and 21 ♂'s represented in the author's collection. Also recorded from N. Y., Me., N. H., Vt., Conn., Mo., Ind., Nova Scotia, S. C., Can., Nebr., Brit. Am., N. Mex., Tex., Quebec, Staten Is., N. J., Ky., Miss.

HABITS.

At the edge of the woods, a few hundred feet from a marsh, a great many *Tettix* were found among the wooded debris, such as dried leaves, twigs, and moss. The moss in these situations formed a compact carpet covering the ground, and upon this floor I found most of the Tettigids. Beyond the woods, in a damp, abandoned field which had formerly been ploughed where the rich soil had become covered with weeds and moss, *Tettix ornatus* were found scattered about in numbers. Near Montello, Wis., September 30, 1901

On the sun-exposed cement walks facing open lots near Lake Michigan nearly full-grown pupa and mature *Tettix ornatus* and *triangularis* were found by the score. At this time of year (August) a large percentage of *Tettix* have made their last molt, and the author found many in which the body was still soft and yielding. The colors at this stage and time are fresh and strongly marked; the varieties being almost limitless.—At Kenilworth, Ill., August 7th.

On sandy soil where the light vegetable mold was sprinkled with fine gravel I found eight specimens of *Tettix ornatus*. These specimens vary in the following particulars:

1. Dorsum of the pronotum with pale white marginal lines, one on each side; obscure triangular black spots on the disk.
2. Color gray, speckled, and with triangular black spots on the dorsum.
3. Dorsum of the pronotum with clear white marginal lines, one on each side; with black triangular spots. This example is clearly "bilineate," such as described by Harris.
4. Dorsum fuscous, femora with a transverse obscure yellowish bar.

5. Dorsum with a median percurrent band extending forward, including the head, colored a conspicuous yellowish white, and a similar colored band transversely arranged on the femora, no black spots present.

6, 7, and 8. Pronotum reddish yellow conspersed with darker fuscous, no triangular black spots visible.—Near the shore of Lake Michigan, Cheltenham (Chicago), October 25, 1868.

Near the Lake Shore at Cheltenham the author visited a point where in the preceding fall some *Tettix* were found. May 18th, after searching carefully, only six *Tettix ornatus* were taken, one *triangularis* and one *Tettigidea*. A fresh growth of green clover with areas of lichens, mosses, and grasses, with various weeds, covered the ground, yet the ground was so light that there was a sprinkling of gravel showing. The power of flight was well developed in *ornatus*, and the color markings were as follows:

1. Grayish fuscous, a yellowish white narrow band running the entire length of the pronotum through the middle, and including the head, widening and including the apical process behind. Femora externally lichen marked, obscure gray. Black spots on the pronotum not distinct.

2. Pronotum with distinct white line on each side of the disc, with two triangular velvet black spots distinctly marked; posteriorly, the pronotum reddish gray. Femora with transverse light band on upper margin.

3. *T.* body grayish.

4. Body grayish marmorate, lichen colored, with indistinct dark spots on the pronotum.

5. Similar to preceding.

6. Body conspersed with dark fuscous. This is *triangularis*.

7. Young pupa, brightly marked like No. 4 described above.—Cheltenham (Chicago) May 18, 1867.

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TETTIX TRIANGULARIS, SCUDD.

Body diminutive in stature, granulate, brachypterous; similar to the preceding *T. ornatus*, but distinguished by the more or less abbreviated pronotal process and wings. This

short-wing form and *ornatus* interbreed as shown in experiments of the author. It is more common than *ornatus* in certain localities in Illinois and Wisconsin, where the numerical relation between the two forms reaches about fifteen to one.

Distribution, same as preceding, existing together in the same localities. Morse unites the two forms *ornatus* and *triangularis*, giving the following measurements:

Total length, ♂, 8.3-12.5 mm.; pronot., 7.5-10.8 mm.; pronot., passing post. fem., 0-3.4 mm.; wings rel. to pronot., —.5- + 1 mm.; total length, ♀, 9-13.5 mm.; pronot., 8-12 mm.; pronot., rel. to post. fem., 0-3.5 mm.; wings rel. to pronot., —.5- + 1.5 mm.

The author collected a number of *Tettix ornatus*, form *triangularis*, at Kenilworth, Ill. They were very common on the cement sidewalks bordering a field near the lake shore (L. Michigan). This locality was visited several times during the summer, but now nearly all the specimens are mature, and only rarely an immature specimen is observed. It will be observed that *Tettix triangularis* lives in fields which are sandy but covered lightly by vegetable mold, while *Tettix gibbosus* (the short-wing form being the commonest) lives in boggy woods much more secluded than *triangularis*.—September 9, 1899

Tettix ornatus triangularis, Morse, Psyche, vii, 107 (1894), Blatch., Can. Ent., iii, 64 (1898).

Tettix triangularis, Scudd., Bost. Journ. Nat. Hist. vii, 475 (1862); Smith, Proc. Portl. Soc. Nat. Hist., I., 151 (1869); Walk., Cat. Derm. Salt. Brit. Mus., V., 814 (1871); Smith, Rept. Conn. Bd. Agric., 1872, 383 (1872); Thom., Rept. U. S. Geol. Surv. Terr., 185 (1873); Scudd., Hitchc., Rept. Geol. N. H., I., 370 (1874); Prov. Nat. Can., viii, 137 (1876); Brun., Can. Ent., ix, 145 (1877); Lintn., Rept., Ins. N. Y., ii, 107 (1885); Caull., Can. Ent. xxiii, 212 (1891); Bol., Ann. Soc. Ent. Belg., xxxi, 205 (1887); Caull., Rept. Ent. Soc. Ont., xviii, 71 (1888); Fern., Ann. Rep. Mass. Agric. Coll., XXV., 130-131 (1888); Smith, Cat. Ins. N. J., 415 (1890); Mowns., Proc. Ent. Soc. Wash., ii, 44 (1891); McNeill, Psyche, vi, 77 (1891); Dav., Proc. Nat. Sc. Assn., Staten Isl., Feb. 14 (1891). Brun., Publ. Nebr. Acad. Sc., ii, 28 (1893); Morse, Psyche, vii, 54 (1894); Bent., Bull. Amer. Mus. Nat. Hist., vi, 310 (1894). Brun., Ann. Rept. Nebr. Bd. Agric., 1896, 138 (1897); Lugg., Orth. Minn., 109 (1898); Smith, Ins. N. J., 159 (1900); Scudd., Index N. Am. Orth., 320-321-322 (1900).

TETTIX HANCOCKI, MORSE.

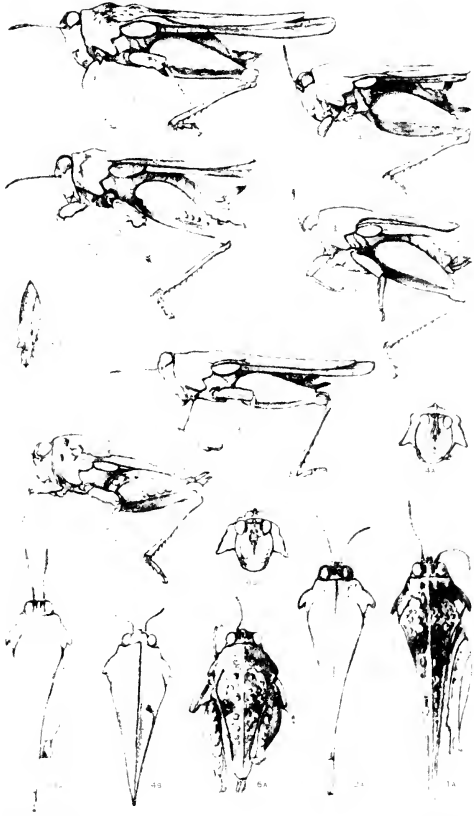
Plate IV., Fig. 4, and appendages.

Plate XI., Figs. 5–5a.

Body rather robust, granulate-rugose. Vertex viewed from above about twice the width of one of the eyes, distinctly advanced beyond their anterior margin; the front margin of vertex scarcely obtuse, angulate, or convex; lateral margins sinuate, on either side of median carina shallowly longitudinally fossulate, deeper between the middle of the eyes; median carina of vertex strongly distinct anteriorly, projecting as a

small tooth from the middle of the front margin, on either side at the junction with the frontal costa a little sulcate, occiput naked behind the eyes; crown of head viewed in profile appreciably elevated above the eyes. Frontal costa in profile strongly advanced beyond the eyes, between the eyes moderately but sharply sinuate, between the antennæ protuberant, nearly as far as the vertex above, at the apical junction with the median carina of the vertex angulate, rounded at the apex, viewed in front furcate, the rami quite widely separated, distinctly diverging to the median ocellus. Eyes very small. Antennæ moderately short, the articles rather elongate. Pronotum anteriorly truncate, the antero-dorsal margin sometimes scarcely angulate, posteriorly extenuate acute, passing beyond the posterior femora, but not so far as the wings; dorsum between the shoulders broadly tectiform, humeral angles strongly distinct, carinate, angulate; median carina of pronotum distinctly elevated, percurrent, anteriorly between and in front of the shoulders longitudinally compresso-arcuate, posteriorly scarcely concave; posterior marginal carinæ distinct, between the carinæ rugose; lateral lobes of pronotum posteriorly bisinuate, the superior sinus moderately deep, the inferior sinus strongly angulate incised, the median lobule between the two obtuse angulate; the posterior inferior angle of the lateral lobes obtuse, inferior margin below rounded, laterally somewhat expanded. Elytra strongly elongate subacuminate towards the apex; wings fully explicate passing the pronotal apex; margins of first femora entire; the second femoral margins dilate, below subsinuate, in the male strongly expanded, being nearly or quite one-half as broad as long, the first half being distinctly ampliate viewed in either direction; posterior femora of moderate size, the first article of posterior tarsi longer than the second and third together, the pulvilli flat below, the first pulvilli small, acute, the second little longer than the first, the third nearly as long as the first and second together.

Locality, Douglas Co., Kansas, 900 feet (Kahl); Atherton, Mo. (Adams); Vigo Co., Ind. (Blatchley); Sidney, Man. (Walker); St. Anthony Park, Minn. (Lugger); Ames, Ia.



(Ball); also recorded from Montreal, Prince Arthur, Sudbury, Toronto, De Grassi, Pt. Ont., N. Red River, Englewood, S. D., Lincoln, Nebr., and Moline, Ill.

A series of forty specimens from the points mentioned is in the author's collection.

Of this species Morse writes: "Allied to *T. ornatus*, from which it differs in its more robust form with wider and generally more projecting vertex, slightly more prominent mid-carina, in the generally more abruptly forked and wider facial costa, and notably in the enlarged middle femora; the expanded portion of the latter in the male is nearly or quite one-half as broad as long (in *ornatus* seldom more than one-third), in the female the difference is less noticeable. The humeral angles of the pronotum are more pronounced and the mid-carina is a little more elevated in its anterior portion. Dimorphism in wing and pronotum length occurs, the specimens (and sexes) before me (19 ♂♂, 27 ♀♀) being about equally divided between the two forms, with a few of intermediate character. For the short-winged form (Plate IV., Figs. 1–1a.) the trinominal *T. h. abbreviatus* may be used."

Measurements: Total, ♂, 8.3-12.4 mm.; ♀, 9-13 mm.: pronot., ♂, 8.2-11 mm.; ♀, 8-12 mm.; post. fem., ♂, 5-5.5 mm.; ♀, 5.5-6 mm. Width of shoulders, ♂, 2.6-3 mm.; ♀, 2.8-3.5 mm.; antennæ, 3-3.5 mm.

In long-winged examples the pronotum and wings pass the posterior femora from three to four millimeters.

Tettix hancocki, Morse, J. N. Y. Ent. Soc., VII., 200, 201 (1899); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 319 (1901).

TETTIX CRASSUS, MORSE.

A variable and very perplexing form of the *ornatus* group, closely related to, and seemingly intermediate between, typical *ornatus*, *hancocki*, and *acadicus*. It is distinguished from *ornatus* by the more robust form with wider shoulders, wider and more projecting vertex, and less prominent eyes; it lacks the enlarged middle femora of *hancocki*, which it otherwise

resembles closely; the form of the body is shorter and more depressed, the humeral angles more pronounced, the vertex less projecting, and the tegminal sinus less frequently shallow than in typical *acadicus* (Morse).

Locality, Colorado, Denver, Poudre River.

Tettix crassus, Morse, J. N. Y. Ent. Soc., VII., 201 (1899); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 317 (1901).

Types of this species were examined by the author.

ARENOSUS GROUP.

In the form *gibbosus* is centered a most curious evolution of structures which have involved the *arenosus* group in obscurity. These changes consist of certain modifications of the pronotum, presenting a more or less abbreviation of that structure, with the wings coincident with general broadening, more flattening, or even depressed, condition of the dorsum between the shoulders and posteriorly between the carinæ. Anteriorly before the shoulders there appears more decided constriction, elevating this part of the dorsum into a gibbose eminence; the median carina of the pronotum being low, indistinct, and often formed into slight undulations posteriorly behind the gibbose elevation; this latter condition more particularly characterizes the variety *fluctuosus*. Correlative with these modifications is the more projecting character of the frontal facial costa and its more or less distinctly sinuate profile. Leaving these types of variation, it is found on the other hand there is a disposition to greater simplification of structural changes in another direction, especially as regards the pronotal structures, causing the forms to approach in certain respects the *ornatus* group. There is less tendency to the gibbose type, with the substituting of a simple and more even elevation of the dorsum between and before the shoulders. A series of several hundred specimens arranged before the author suggests these remarks, showing these variations in different stages, which, if taken singly, are not sufficiently differentiated to allow of taxonomic expression. It is in these

forms an inviting field is open for the study of more definite quantitative variation. Summing up the tendency of evolution from the material on hand, it appears that when we pass from the south to the north, the long, extenuate form given to the body is gradually through adaptive changes given way to slightly more robustness of stature and abbreviation. Examples remain of both types in the north, but the ancestral forms with long wings seem numerically to be much less represented and to tend to extinction.

TETTIX ARENOSUS, BURM.

Plate IV., Figs. 5–5b.
Plate III., Fig. 3.

Body moderately slender, rugose-granulate. Vertex viewed from above about twice the width of one of the eyes, depressed anteriorly, advanced scarcely beyond the anterior margin of the eyes, the front margin subtruncate or scarcely convex, rounding laterally into the sides, lateral margins subparallel, on either side of the median carina longitudinally fossulate, scarcely deeper between the middle of the eyes; median carina of vertex indistinct, barely projecting as a minute tooth at the middle of the front border, occiput behind the eyes naked, crown of head in profile not quite so elevated as the eyes. Frontal costa in profile advanced beyond the eyes equal to about one-sixth the diameter of one of them, lightly sinuate between the lower portion of the eyes, very little protuberant between the antennæ, at the junction with the median carina of the vertex projecting as a small, angulate prominence before the eyes with apex a little rounded, viewed in front the frontal costa narrowly furcate, the rami parallel, very closely approximate. Eyes moderately large, in dorsal view especially prominent. Antennæ appreciably slender, articles strongly elongate. Pronotum anteriorly strictly truncate, in front of the shoulders rather strongly constricted, posteriorly long extenuate acute, process strongly passing the posterior femora, but not extended so far as the wings; dorsum between the shoulders transversely flattened, scarcely convex, rather narrow, between the

carinæ posteriorly distinctly flattened, humeral angles moderately prominent; median carina of pronotum indistinct, appearing as a thin line, in profile not at all elevated or barely irregularly undulate, anteriorly before the shoulders a little elevated over the dorsal constriction, posteriorly scarcely concave; lateral lobes of pronotum posteriorly strongly bisinuate, the superior lateral sinus distinct, the inferior sinus moderately deep and angularly incised, the median lobule between the two obtuse; posterior inferior angle of the lateral lobes rounded below, the inferior margin scarcely distended laterally; scapular area narrow, little widened posteriorly. Elytra moderately elongate, apex subrounded; wings fully developed, passing the pronotal process from one-third to three-fourths of a millimeter. Femoral margins frequently dentate, the anterior femora sometimes indistinctly sinuate or lobed at the outer third below; margins of middle femora a little compressed, below at the first fourth and outer third a little lobate; posterior femora moderately slender, first article of posterior tarsi a little longer than the second and third together, the first and second pulvilli together a little longer than the third, the apices of the first and second subspiculate, the third pulvilli nearly flat below.

Length body, ♀, 14 mm.; pronot., 12.3-12.6 mm.; post. fem., 5.3-5.7 mm.; ♂ body, 11.1-12.1 mm.; pronot., 9.8-10.8 mm.; post. fem., 4.3-4.8 mm.

The pronotum passes the post. femora in the female from three to five millimeters; in the male from three to four millimeters.

Bolivar gives the following dimensions: Length body ♂, ♀, 6.5-10 mm.; pronot., 10-12 mm.; post. fem., 4.5-6.5 mm.

Locality, southern United States. Opelousas, La. (G. R. Pilate); Paige, Tex. (Fickiessen); also recorded from S. C., Fla., Ga., Ill., Nebr., Ind., Miss., Iowa.

Tettix arenosus, Burm. (Tettrix) Handb. Ent., ii, 639 (1838); Walk., Cat. Derm. Salt., Brit. Mus., v, 813 (1871); Scudd., Proc. Bost. Soc. Nat. Hist., XIX., 90 (1877); Scudd., Ent. Notes, VI., 31 (1878); Brun., Rept. U. S. Ent. Comm., iii, 61 (1883); Bol., Ann. Soc. Ent. Belg., 269

(1887); McNeil, Psyche, VI., 77 (1891); Brun., Publ., Nebr. Acad. Sc., iii, 28 (1893); Blatchl., Can. Ent., XXVI., 219, 220 (1894); Ashmead, Ins. Life, VIII., 26 (1894); Blatchl., Can. Ent., XXX., 64 (1898); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Amer. Orth., 317 (1901).

TETTIX OBSCURUS, HANC.

Plate V., Figs. 1–2a.

Figure on title page.

Allied to *arenosus*, body more robust. Vertex viewed from above fully twice the width of one of the eyes, little depressed anteriorly, advanced a little beyond the anterior margin of the eyes, the front margin subtruncate or scarcely convex, laterally angularly curved into sides, lateral margins subparallel, on either side of median carina longitudinally shallowly fossulate; median carina of vertex barely distinct anteriorly, projecting very little or scarcely at all from the middle of the anterior border, occiput behind the eyes naked, crown of head in profile nearly or about level with the superior margin of the eyes. Frontal costa in profile advanced beyond the eyes equal to about one-fourth the diameter of one of them, distinctly sinuate between the lower portion of the eyes, between the antennæ convexly protuberant; at the junction of the frontal costa with the median carina of vertex projecting before the eyes in the form of a small angulate eminence, the apex obtuse; viewed in front the frontal costa moderately furcate, the rami very gradually diverging or subparallel towards the median ocellus. Eyes a little prominent, of medium size. Antennæ slender. Pronotum truncate anteriorly, strongly constricted before the shoulders, posteriorly long subulate acute, process passing the posterior femora, not extended so far as the wings; dorsum between the shoulders moderately broad, transversely flattened, subconvex, humeral angles strongly prominent, posteriorly between the carinæ distinctly flattened; median carina of pronotum not distinct, in profile nearly horizontal, interrupted and frequently presenting very small undulations, anteriorly a little higher over the constricted portion

of the pronotum, posteriorly scarcely broadly concave; lateral lobes of pronotum posteriorly strongly bisinuate, the superior lateral sinus distinct, the inferior sinus moderately deep, obtuse angulate incised, the posterior inferior angle of lateral lobes rounded, laterally distinctly dilate; scapular area of moderate height. Elytra distinctly elongate, apex subrounded; wings fully developed, passing the pronotal process from one-third to one millimeter. Inferior margin of anterior femora often dentate-sinuate or may be sublobate at the outer third; margins of middle femora distinctly compressed, dentate-sinuate, below frequently sinuate-sublobate; posterior femora moderately large, the first and second pulvilli subspiculate, together about as long or a little longer than the third.

Length body, ♀, 13-13.9 mm.; pronot., 11.5-13 mm.; post. fem., 5.5 mm.; ♂, body, 11-11.7 mm.; pronot., 9.9-11 mm.; post. fem., 4.5-5.2 mm.

Tettix obscurus, Hanc., Trans. Am. Ent. Soc., xxiii, 239, pl. 7, Figs. 9, 9a, 10, 10a, pl. 9; figs. 23, 25 (1896); Lugger, Orth. Minn., 109 (1898); Scudd., Cat. Orth. U. S., 17 (1900); Scudd., Index N. Am. Orth., 320 (1901).

Tettix inflatus, Hanc., Trans. Am. Ent. Soc., xxiii, 238, pl. 7, fig. 8; pl. 9, fig. 26 (1896); Scudd., Cat. Orth. U. S., 17 (1900); Scudd., Index N. Am. Orth., 319 (1901).

Tettix angustus, Hanc., Trans. Am. Ent. Soc., xxiii, 238, pl. 6, figs. 4, 4a; pl. 9, fig. 24 (1896); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 317 (1901.)

Allied to *arenosus*, from which it may be distinguished by the slightly larger form, with vertex less depressed anteriorly, the frontal costa in profile more projecting beyond the eyes, the distance being equal to about one-fourth the diameter of one of them—in *arenosus* it is nearer one-sixth—the sinuation more distinct between the lower portion of the eyes; viewed in front the facial costa is more appreciably furcate; the eyes not so prominent; the pronotum, while subulate, not so long extenuate posteriorly; the elytra more elongate.

Locality, Atherton, Mo. (Adams); Kansas City, Mo. (Adams); Ames, Iowa (Ball); Vigo Co., Ind. (Blatchley); Montello, Wis., L. Puckaway (Hancock); Riverside, Ill.

(Hancock); Cassopolis, Mich. (Hancock). St. Anthony Park, Minn. (Lugger); Pulaski Co., Ill. (Gault); Douglas Co., Kansas (Kahl); Lawrence, Kansas (Kahl); Richmond, Ill. (Hancock); Winnetka, Ill. (Hancock); DeGrassi Pt., Ont. (Walker); Bloomington, Ill. (C. C. Adams and M. J. Elrod).

Tettix angustus, Hanc., is a variety which merges into *arcuosus* on the one side and *obscurus* on the other. It was described from Illinois.

TETTIX GIBBOSUS, HANC.

Plate V., Figs. 3–5a.

Plate III., Fig. 6.

Allied to *obscurus*; exceedingly variable; body moderately robust, somewhat flattened, rugose, granulate; vertex similar excepting that the median carina viewed from above projects a little more from the middle of the front border and more appreciably sulcate on either side. In profile the facial costa is advanced before the eyes and strongly sinuate opposite the lower portion of the eyes, between the antennæ distinctly protuberant, viewed in front the rami quite widely separated. Pronotum truncate anteriorly, strongly constricted before the shoulders, in profile forming a small arcuate-gibbose elevation; the dorsum immediately behind the gibbosity between the shoulder more or less distinctly depresso-sinuate, posteriorly the dorsum between the carinæ flattened, rugose, the median carina indistinctly sinuate, nearly horizonal; dorsum between the shoulders quite broad, humeral angles distinct, carinate, projecting laterally over the elytra, posteriorly the horizontal process more or less abbreviated, the extreme apex more often straight but sometimes curved downwards, frequently passing the wings or not extended quite as far; scapular area quite high posteriorly.

Length body, ♀, 11 mm.; pronot., 10 mm.; post. fem., 5.1-5.8 mm.; ♂, body 7.5-10 mm.; pronot., 7-10 mm.; post. fem., 5-5.5 mm.

Locality, Riverside, Winnetka, Richmond, in Illinois (Hancock); Pulaski Co., Ill. (Gault); Ames, Ia. (Ball); Vigo

Co., Ind. (Blatchley); Montello, L. Puckaway, Wis. (Hancock); Lawrence, Kan. (Kahl); Atherton, Mo., and Kansas City, Mo. (Adams); St. Anthony Park, Minn. (Lugger); Toronto, Can. (Walker).

Tettix gibbosus, Hanc., Trans. Am. Ent. Soc., xxiii, 239, 240, pl. 6, figs. 5, 5a (1896); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 318 (1901).

Tettix fluctuosus, Hanc., Trans. Am. Ent. Soc., xxiii., 240, pl. 7, figs. 6, 6a (1896); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 318 (1901).

Tettix decoratus, Hanc., Trans. Amer. Ent. Soc., xxiii, 240, 241, pl. 7, figs. 7, 7a; pl. 9, fig. 31 (1896); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 318 (1901).

Tettix fluctuosus, Hanc., and *Tettix decoratus*, Hanc., (Plate V., Figs. 6, 6a) are varieties of *gibbosus*, and are not sufficiently constant to give them specific rank.

HABITS.

Heavy rain August 23d drenched the country (3.65 inches was the fall in Chicago). The rain had the effect of driving the Tettigids away from the immediate margin of the river to open woods just beyond, to the east of this point at Riverside. The author on hands and knees searched the grounds. One male *Tettigidea p. pennata* and two long-winged *Tettix* coming under the form of *fluctuosus* var., the other *obscurus* were found. Males of *gibbosus* in large series were taken. The variety of coloring, as usual, was most interesting. One specimen of *Tettix* nearly full grown had the upper surface of dorsum and lobes grayish white. It was found on the ground among dried bleached vegetation of the same general color; the legs were reddish. Another specimen *Tettix gibbosus*, marked very much like the preceding, was brighter. Two specimens nearly full grown were gray on the dorsum, and with obscure black spots and an oblique pure white spot on each side.—Riverside, Ill., August 25, 1898.

The rank growth of grass and wild rice with other vegetation at the margin of the river seems to drive the Tettigids into the timbered soil back from the river to a distance of one hundred feet or more. This does not apply to *Paratettix*, but especially to *Tettix*. At the roots of large oak trees where the soil was interspersed with fine gravel, a number of *Tettix gibbosus* were found.—Riverside, Ill., August 18, 1896.

At Winnetka, Ill., the author caught over a hundred *Tettix* in an effort to discover the variations possible in a given species. Some streets running north and south were little used, and on the east side the ground between the sidewalk and street was the strip furnishing the material above mentioned. I discovered that the Tettigids could easily be frightened from the ground onto the walks, where they were slightly more conspicuous, and more easily caught. Most of them were taken in this way. The sidewalks skirt the dense woods here, which in the spring are swampy. Recent drainage (within four years) has caused many of the wet places to disappear, destroying at the same time many haunts of animal life. Among the Tettigidæ I found *Tettix gibbosus*, a woods-loving species, most common. The soil is light clay covered with weeds, mosses, lichens, and the other usual flora common to damp situations. The genus *Tettigidea* was also represented. One of the interesting points brought out was the variety of coloring presented by *Tettix gibbosus*, which is herewith appended:

1. Individuals with white banner spot on disc of pronotum. Body gray. Scarcely perceptible traces of black spots, two behind and two in front of the white pronotal marking on the disc.

2. There were some otherwise gray, with the exception of the outer half, or third, of the posterior femora yellow, the pronotum having faint dark spots behind the disc, the pronotal process yellow.

3. Rarely one with body grayish and at the middle of the outer side of the posterior femora with a longitudinal line of white not extending so far as the knee.

4. Rarely one with body blackish, above clearly speckled with white; the femora also marked above in the same way.

5. Similar to the above excepting on each side the lower margin of the pronotal lobes edged with yellow. (One specimen in 100.)

6. Body gray with four black spots, two in front almost obsolete and two behind the dorsal disc, conspicuous, triangular in form. (Common.)

7. Body similar to the preceding except that there are no black spots in front of the disc, and having a white spot (sometimes raised into a little eminence) scarcely in front of the black spots, posteriorly on the disc of the pronotum.

§ In a damp woods near Diamond Lake, Cassopolis, Michigan, where the fallen trees had rotted away, leaving the richest of black muck, I found a number of *Tettix*, all adult. There were long and short-winged forms of *Tettix obscurus* and *gibbosus*.—June 9, 1900.

TETTIX BLATCHLEYI, SP. N.

Allied to *gibbosus*; body rugose-granulose or subtuberculose. Vertex nearly twice the width of one of the eyes, lightly depressed, median carina feebly developed anteriorly, little projecting, on either side little longitudinally fossulate, the front border slightly convex or subtruncate, barely advanced beyond or about as far as the eyes. Frontal costa in profile distinctly advanced beyond the eyes, strongly sinuate, opposite the eyes angularly excavate, between the antennæ distinctly protuberant, viewed in front rather narrowly sulcate, subparallel or hardly diverging. Antennæ slender. Eyes in dorsal view elyptic, the breadth contained one and two-thirds in the length. Pronotum anteriorly truncate, posteriorly subulate, passing the posterior femora; dorsum rugose, before the shoulders strongly constricted, behind the shoulders distinctly compresso-narrowed, humeral angles distinct, laterally little produced, between the shoulders moderately broad, depressed, posteriorly depressed; median carina indistinct, barely elevated, in front of the shoulders lightly gibbose, posteriorly little interrupted rugose; lateral carina before the shoulders compressed, behind the shoulders sinuate-compressed, posteriorly on the process distinct; scapular area narrowed anteriorly, distinctly higher posteriorly; the posterior elytral sinus of lateral lobes moderately deep, the inferior sinus deeply angu-

larly incised; posterior angle obtuse rounded below, inferior margin dilated. Elytra oval, punctate; wings not quite reaching or little passing the pronotal process. Anterior femora nearly entire, carinate above, below bearing trace of lobe at the outer third part; middle femora dentate, lightly sinuate, below at the outer third part sometimes bearing a minute lobe; posterior femora with the external pagina strongly rugose, possessing oblique ridges, tibiæ annulate with fuscous, first article of posterior tarsi longer than the third, the first pulvilli small, acute, the second and third longer and equal in length, the tibiæ lightly armed with spines.

Length body, ♀, 10.3-11.5 mm.; pronot., 9.5-10.7 mm.; post. fem., 5-5.3 mm.

Locality, Ormond, Florida, April 9, 1899 (Blatchley); Hancock, two females.

Belonging to the *arcuosus* series, distinguished by the slightly more rugose pronotum, more decidedly compressed lateral carinæ, and the compresso-narrowing behind the shoulders of the dorsum.

GEN. NEOTETTIX, BANC.

Body small, granulate, rugose-scabrous. Vertex wider than one of the eyes, the front margin convex or rounded; median carina prominent anteriorly, on either side between the eyes scarcely fossulate; viewed in profile the vertex rounded, a little advanced before the eyes. Frontal costa convex, viewed in front strongly furcate. Antennæ rather stout, short, composed of twelve or, rarely, thirteen articles. Pronotum anteriorly truncate or antero-dorsal margin scarcely angulate, advanced over the head to the eyes, humeral angles strongly obtuse, between the shoulders tectiform or convexo-tectiform; median carina of pronotum distinct, elevated between the shoulders; the posterior inferior angle of the lateral lobe obtuse; the inferior lateral sinus quite deeply and angularly incised, superior sinus shallow, median lobule between the two convex. Femoral margins entire; the posterior femora ampliate, the first article of the posterior tarsi distinctly longer than the second

and third together, the pulvilli acute but more or less flat below.

Neotettix, Hancock, Ent. News, IX., 138 (1898).

DISPOSITION OF SPECIES.

1. Frontal carinæ of vertex laterally scarcely compressed; width of vertex nearly twice that of one of the eyes, front border convex; body granulate. *bolivari*, Hanc.
2. Vertex equal to about one and two-thirds the width of one of the eyes, front border rounded, frontal carinæ laterally scarcely at all compressed; body smaller, granulate-rugose. *rotundifrons*, Hanc.

2. 2. Vertex but little broader than one of the eyes, front border scarcely rounded; body arenose. *femoratus* (Scudd.), Hanc.

3. Body strongly rugose, scabrous; dorsum transversely convex between the shoulders. *bolteri*, Hanc.

NEOTETTIX BOLIVARI, HANC.

Plate VI., Figs. 4–4b.

Appendages Plate XI., Figs. 1–1b.

Body granulate; color variable, very frequently light fuscous, sometimes marked with two black spots on the pronotum or a light spot between the shoulders. Crown widened posteriorly, mammillate; vertex nearly twice as wide as one of the eyes, median carina prominent anteriorly, viewed in profile elevated a little above the eyes, the vertex viewed from above scarcely fossulate anteriorly between the eyes on each side of the median carina; the anterior border of the vertex convex, composed of very small concave carinæ, laterally scarcely compressed and rounded into the sides. Frontal costa viewed in profile produced a little beyond the eyes and imperceptibly joining the median carina of the vertex, forming a rounded contour. Eyes subglobose. Antennæ short, appreciably stout. Pronotum anteriorly truncate, the antero-

dorsal margin frequently subangulate, posteriorly the apical process presenting a subacute apex, nearly or quite reaching the end of the posterior knee, the sides substraight; posterior lateral carinæ scarcely prominent; dorsum between the shoulders rather narrow, strongly tectiform, humeral angles widely rounded; median carina of pronotum percurrent, strongly elevated, longitudinally convex towards the front; posterior inferior angle of the lateral lobes obtuse, rounded below; the inferior lateral sinus quite deep, the superior shallow, the median lobule between the two widely convex. Elytra elongate subacuminate; wings abbreviated, not reaching quite so far as the apical process. First and second femoral carinæ entire, the middle femora moderately large; the posterior femora ampliate, tibial carinæ multispinose; first article of the posterior tarsi longer than the last two united, the apices of pulvilli acute but somewhat straight below, the first and second pulvilli short.

Length body, ♂, 8-8.5 mm.; pronot., 7-8 mm.; post. fem., 5 mm.; ♀, 9.10 mm.; pronot., 7.5-8.5 mm.; post. fem., 5.5-6 mm.

Described from a series of twenty specimens in the author's collection.

Locality, Opelousas, La., Tifton, Ga. (Pilate); Auburn, Ala. (Baker); North Carolina (Bolivar).

Tettix femoratus, Scudd., Bolivar Ann. Soc. Ent. Belg., XXXI., 264 (1887); Neotettix bolivari, Hancock, Ent. News, IX., 139, 140, pl. 8, figs. 2, 2a-d (1898); Scudder, Cat. Orth. U. S., 15 (1900) south U. S.; Scudd., Index N. Am. Orth., 208 (1901).

NEOTETTIX ROTUNDIFRONS, HANC.

Plate VI., Fig. 5.

Body small, granulate, rugose. Vertex viewed from above equal to about one and two-thirds the width of one of the eyes, the front border rounded, advanced about as far as the anterior margin of the eyes, frontal carinæ laterally, between the anterior portion of the eyes, scarcely at all compressed;

crown mammillate, scarcely widened posteriorly between the eyes; median carina of the vertex distinct anteriorly, viewed in profile elevated a little above the eyes, convex; viewed from above on either side of the median carina anteriorly feebly fossulate. Frontal costa in profile a little advanced in front of the eyes, joining with the median carina of vertex to form an obtuse-rounded profile, viewed in front strongly furcate, the rami diverging, widest between the antennæ. Pronotum anteriorly truncate, posteriorly the process terminating acutely, reaching to or slightly over-reaching apex of posterior femora; median carina of pronotum distinctly elevated, towards the front slightly arcuate longitudinally; dorsum transversely tectiform, rather narrow between the shoulders; humeral angles strongly obtuse, lateral carinæ indistinct. Wings abbreviated, not quite reaching to, or passing a little beyond the apex of posterior pronotal process; elytra small, rounded apically. Femoral margins entire, posterior femora strongly ampliate; first and second pulvilli of posterior tarsi acute, the third pulvilli flat below.

Length body, 9 mm.; pronot., 7.5-8 mm.; post. fem., 5.5 mm.

Locality, Jacksonville, Florida (Bolter).

Described from two female examples. In one specimen the body is reticulated with fuscous, contrasting with yellowish white; dimorphism occurs in the wing lengths. This species is slightly smaller than *bolivari*, and the vertex as viewed from above is not so broad.

One specimen in Bolter collection, University of Illinois; one in author's collection.

Neotettix rotundifrons, Hancock, Ent. News, IX., 139, pl. 8, figs. 3, 3a-d (1898); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 208 (1901).

NEOTETTIX FEMORATUS, (SCUDD.) HANC.

Vertex little broader than one of the eyes, barely projecting in advance of them; the front scarcely rounded; pronotum reaching to the tip of the abdomen not including the oviposi-

tor; median carina very prominent, slightly arched; surface arenose; elytra small, well rounded, with shallow punctures; wings not longer than the elytra; hind femora very broad and stout.

Length body, 9.5 mm.; pronot., 8 mm.; post. fem., 5.2 mm.; elytra 1.6 mm.

Locality, Maryland.

Tettix femoratus Scudd., Trans. Am. Ent. Soc., ii, 305.

Tettix femoratus Scudd., Thomas, Syn. Acrid. of N. Am. in Rept. U. S. Geol. Survey, 185 (1873).

Neotettix femoratus Hancock, Ent. News, IX., 139, 140, 141 (1898), Maryland; Scudder, Cat. Orth. U. S., 16 (1900), South and West St.

The type specimen, now lost, was formerly in the collection of the American Entomological Society, and the species has not since been recovered, so the author has been informed by Dr. Scudder.

NEOTETTIX BOLTERI, HANC.

Plate VI., Figs. 6–6b.

Body small, rather robust; strongly rugose scabrous. Vertex nearly twice as wide as one of the eyes, the front border very slightly convex, advanced about as far as the anterior border of the eyes; median carina small, obliterated on the crown behind the middle of the eyes, viewed in profile a little produced in front of the eyes, subrotundate; crown mammilate, in profile a little convexo-elevated above the eyes. Frontal costa distinctly furcate. Pronotum anteriorly truncate, posteriorly obtuse, not extended backwards so far as the apex of the posterior femora; median carina of pronotum distinct, arcuate longitudinally, higher between the shoulders; dorsum transversely convex, between the shoulders strongly rugose, with conspicuous excrescences showing in transverse section or viewed in front, antehumeral carinæ appearing very slightly, anterior lateral carinæ in front, short, slightly compressed. Elytra elongate, apex subacutely rounded; wings undeveloped. Middle femora with a row of minute swellings between the

middle carinæ, margins entire; posterior femora broad cristate, external pagina provided with strongly diagonal rugose ridges between the middle carinæ; between the superior margin and the carinæ a curved row of subrounded rugose excrescences.

Length of body, 9.0 mm.; pronot., 7.8 mm.; post. fem., 5.5 mm.

Locality, Jacksonville, Florida (Bolter).

Described from one specimen now in the University of Illinois collection.

Neotettix bolteri Hancock, Ent. News, IX., 139, 140, pl. 8, figs. 1, 1a-e (1898); Scudd., Cat. Orth. U. S., 16 (1900); Scudd., Index N. Am. Orth., 208 (1901).

MICRONOTUS GEN. NOV.

Body small, brachypterous. Antennæ slender, extremely filamentous-elongate, consisting of twelve or, rarely, thirteen articles. Eyes small; behind the eyes a very small portion of occiput exposed. Vertex in dorsal view wider than one of the eyes, a little advanced beyond them; median carina anteriorly distinct; on either side between the eyes the vertex longitudinally shallowly subfossulate. Frontal costa in profile projecting beyond the eyes, scarcely sinuato-convex; viewed in front the branches distinctly separated, moderately diverging. Dorsum of pronotum subtectiform; humeral angles prominent; median and lateral carinæ of pronotum distinct; the posterior inferior angle of the lateral lobes obtuse, the inferior lateral sinus strongly angulate incised, the superior lateral sinus quite deep, giving prominence to the median lobule. Elytra oval or elyptical; wings abbreviated. Margins of middle femora (female) more or less sinuate; posterior femora rather stout; first article of posterior tarsi distinctly longer than the second and third together.

This genus is closely allied to *Tettix*, from which it is distinguished by the less smaller and more decidedly filamentous character of the antennal articles. From *Neotettix* it is distinguished by the less rounded vertex (viewed in pro-

filer and narrower furcation of the frontal costa. The genus *Meroticix*, with which it also might possibly be confounded, has the eyes larger, the vertex narrower, and the humeral angles of the pronotum reduced in size.

MICRONOTUS QUADRIUNDULATUS, REDT.

Body small, granulo-scabrous. Antennæ slender, extremely filamentous, consisting of twelve articles, from the fifth to the ninth strongly elongate, the last three articles shorter, a little compressed; eyes small. Vertex in dorsal view wider than one of the eyes, in the middle carinate, on either side between the eyes somewhat fossulate; the median carina of vertex projecting very little from the convexo-truncate front border; the anterior carinæ of vertex a little convexo-elevated laterally. Frontal costa in profile a little advanced beyond the eyes, in the female equal to about one-fourth the diameter of one of the eyes, in the male less, scarcely sinuate between the eyes, moderately convexo-protuberant between the antennæ; viewed in front the rami distinctly separated and slightly diverging. Pronotum anteriorly truncate, posteriorly cuneate, apical process nearly or about reaching the apex of posterior femora, the sides substraight; dorsum between the shoulders moderately broad; median carina of pronotum subcompressed anteriorly before the shoulders, in profile more or less quadriundulate in the female, humeral angles obtuse, distinctly carinate, posterior lateral carinæ distinct. Elytra oval or scarcely elyptical; wings somewhat rudimentary, abbreviated in the female, still shorter in the male. Margins of anterior femora entire; inferior margin of second femora distinctly undulate in the female, or compresso-ampliate in the male; posterior femora stout; first article of posterior tarsi longer than the two following articles united, the first and second pulvilli acute, together about as long as the third.

Length body, ♂ 4-5 mm.; pronot. 4-5 mm.; post. fem. 3.6 mm.; ♀, 6.4 mm; pronot. 6 mm.; post fem., 4 mm.

Locality, Haiti (Crew); St. Vincent; Grenada.

Described from specimens in the author's collection.

Tettix quadriundulatus, Bruner, v., Wattenwyl and J. Redtenbacher, Orth., Isl. St. Vincent, Proc. Zool. Soc. (1892), fig. 10, pl. 16.

Neotettix quadriundulatus Redt., Hancock, Can. Ent., xxxii, 25 (1900), Haiti.

Neotettix quadriundulatus Hanc., Scudder, Index N. Am. Orth., Bost. Soc. Nat. Hist., vi, 208 (1891).

In 1892 Redtenbacher described the above species as *Tettix quadriundulatus*, his specimens coming from the Island of St. Vincent. Hancock (1900) mentioned the species as occurring on the Island of Haiti, at the same time placing the species in the genus Neotettix. A more recent critical study of specimens having the slender, fragile antennæ still intact, shows that this species cannot be ascribed to any existing genus, hence the new genus created to receive it.

APOTETTIX GEN. NOV.

Body rather small, rugose-scabrous, minutely tuberculose. Head somewhat crowded into the pronotum; antennæ stout, consisting of thirteen articles; eyes small, globose. Vertex much wider than one of the eyes or nearly twice the width, the front border not, or a little, advanced before the eyes, convexo-truncate; middle of vertex carinate rather conspicuously forwards, a little projecting anteriorly, disappearing backwards between the middle of the eyes; the front border is formed of little concave carinæ, which take their origin on either side of the mid-carina of the vertex and are elevated and flexed backwards at the inner side of the anterior half of the eyes; between the anterior half of the eyes, on either side of the mid-carina fossulate, posteriorly the crown becomes appreciably wider between the eyes. Facial costa viewed in front rather widely sulcate, or moderately narrow, subparallel, in profile advanced beyond the eyes, between the eyes more or less slightly concave, between the antennæ convex. Antennæ inserted a little before and scarcely below the anterior inferior border of the eyes. Pronotum anteriorly truncate, posteriorly subulate, passing the knee of the hind femora or abbreviated

with nearly straight sides and acute at the apex; dorsum between the shoulders convex or obtusely tectiform; median carina of pronotum elevated, more or less abruptly interrupted between the shoulders, distinct posteriorly. Margins of anterior femora entire; middle femoral margins more or less undulate; posterior femora stout, tibiæ multispinose; first article of posterior tarsi longer than the third, the pulvilli to some extent flat below.

This genus is closely related to *Paratettix* on the one side and *Tettix* on the other. The short-wing forms might easily be mistaken for *Nototettix*.

DISPOSITION OF SPECIES.

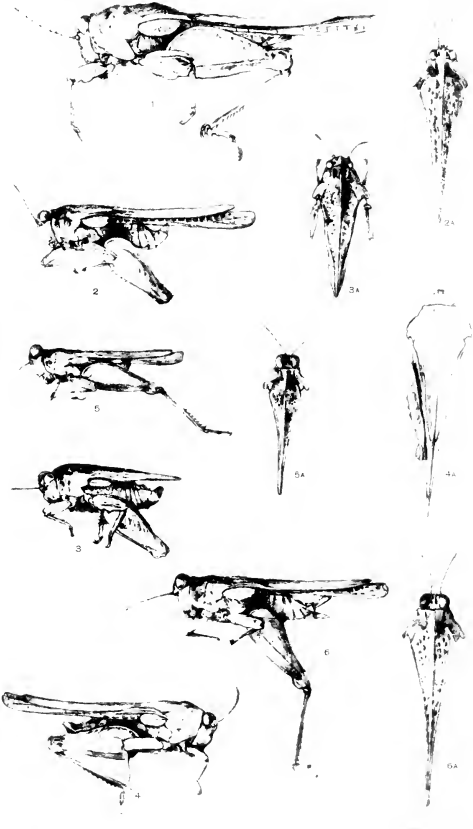
1. Eyes unusually small; vertex equal to twice the width of one of the eyes in the female; pronotum convex on the shoulders in both sections, subulate; median carina distinct behind the shoulders, but not elevated. *convexus*, Morse.

1. A. Median carina of pronotum elevated throughout, subcristiform anteriorly; apical process and wings abbreviated. form *c. tectus*, Morse.

1. 1. Eyes larger; vertex advanced not quite so far as the eyes; pronotum between the shoulders broader; posterior femora stouter; body less scabrous. *curycephalus* sp. n.

1. 1. A. Apical process of pronotum and wings abbreviated. form *c. brevipennis* new.

2. Fronto-lateral carinæ of vertex subrectangular, vertex of female equal to about once and a half the breadth of one of the eyes; pronotal process and wings fully developed; dorsum minutely tuberculose. *rugosus*, Scudd.



A. L. HANCOCK, DEL.

APOTETTIX CONVEXUS, MORSE.

Plate VII., Figs. 2–2a.

Antennæ stout. Eyes small, globose. Vertex nearly twice as wide as one of the eyes, truncato-convex, a little advanced; mid-carina small, little produced. Facial costa rather widely sulcate, sides subparallel, in profile advanced before the eyes, smoothly convex opposite the points of insertion of the antennæ, slightly concave above them. Pronotum truncate anteriorly, subulate behind, granose-scabrous, convex on the shoulders in both sections; the mid-carina elevated and subcompressed anteriorly, slightly depressed and scarcely distinct on the shoulders, distinct but not elevated behind them. Wings caudate, passing the hind process. Elytra oblong, rounded or subacuminate at the tip. Femora rather slender; mid-femora with both margins gently sinuate; pulvilli of hind tarsi flat or rounded below, the second and third equal.

Total length, ♂, 11.7 mm., ♀, 12.5 mm.; pronotum, ♂, 10.3 mm., ♀, 10-10.7 mm.; post. fem., ♂, 4.6 mm., ♀, 5.-5.4; antennæ, ♂, 2. mm.

Locality, Ayotla, Mexico (Barrett) Hancock; Jalapa, Mexico (Barrett) Hancock; Mexico City (Bruner, F. D. Godman).

A pair in Professor Bruner's collection and a female obtained by Mr. Godman. This is a peculiar species, bearing considerable resemblance to *Paratettix rugosus*, but distinguished from it by the wider and somewhat advanced vertex, the smaller eyes, stouter antennæ, less robust form, and unexpanded middle femora of the male. (Morse.)

Tettix convexus, Morse, Biol. Cent. Amer. Orth., ii, 10 (1900); Scudd., Index N. Am. Orth., 317 (1901).

APOTETTIX TECTUS, MORSE.

Antennæ stout, joints very short and broad. Vertex nearly twice as wide as one of the eyes, a little advanced, truncato-convex, the mid-carina prominent. Eyes small, globose. Facial costa rather narrowly sulcate, moderately protuberant, in profile convex opposite the points of insertion of the anten-

nae, shallowly excavate opposite the eyes. Pronotum obtusely tectiform, anterior margin truncate, apex cuneate, not passing the hind femora; mid-carina elevated, subcristate anteriorly and sinuate on the shoulders, undulate behind them. Anterior femora with the margins entire or slightly undulate. Middle femora stout, the margins slightly sinuate, with three small lobes above and two below. Posterior femora robust; posterior tarsi with the pulvilli flat or rounded below.

Total length, ♂, 7.5-8 mm., ♀, 8.3 mm.; pronotum, ♂, 6.7-7.4 mm.; post. fem., ♂, 4.5 mm., ♀, 4.8 mm.; antennæ, ♂, 2.5 mm.

Locality, Ayotla, Mexico (Barrett) Hancock; Mexico City (Bruner, H. H. Smith).

Two males obtained by Mr. H. H. Smith and a female in Professor Bruner's collection.

This species bears a striking resemblance in profile to *Paratettix sinuatus*. Morse describes a female which had a malformation of the pronotum in the shape of a convex elevation running transversely across the middle of the hind process.

Tettix (?) tectus, Morse, Biol. Cent. Am. Orth., ii., 11 (1900); Scudd., Index N. Am. Orth., 321 (1901).

APOTETTIX EURYCEPHALUS, sp. n.

Plate VII., Figs. 4–4a.

Body moderately small, rugose-granulate, grayish fuscous. Vertex about one and two-thirds as wide as one of the eyes, advanced barely beyond their anterior border, viewed in profile rounded or rounded-subangulate, advanced a little beyond the eyes; median carina of vertex conspicuous, in profile arched a little higher than the eyes. Frontal costa very little depressed before the eyes, between the antennæ convex, viewed in front the rami rather moderately and gradually divergent. Eyes distinctly globose, rather small. Antennæ short and stout. Pronotum anteriorly truncate, posteriorly subulate, median carina distinct, elevated before the shoulders, between the shoulders depressed; dorsum rugose-granulate, between the shoulders transversely scarcely convex, strongly

rugose; dorsal front margin of pronotum strongly encroached upon the head to the eyes, humeral angles distinctly carinate, appreciably angulate, posterior lateral carinæ prominent; posterior inferior angles of the lateral lobes obtusely angulate, the inferior sinus quite deep, the superior sinus shallow. Elytra quite large, punctate, elliptical, obtuse at the apex. Wings fully explicate. Anterior and middle femora entire; posterior femora quite stout; first article of posterior tarsi equal in length to the second and third combined, the first and second pulvilli acute, the third straight below.

Length of body, ♂, 12.5 mm.; pronot., 11 mm.; post. fem., 5.5 mm.

Locality, Paige, Texas (Fickiessen).

Distinguished from *concavus* in having stouter posterior femora, greater breadth across the shoulders, more pronounced angulato-carinate humeral angles, as well as less scabrous condition of the pronotum.

APOTETTIX BREVIPENNIS, FORM NEW.

Body compact, brachypterous, fusco-variegated. Vertex nearly twice the breadth of one of the eyes, the subtruncate anterior border advanced about as far as the anterior margin of the eyes; mid-carina distinct between the anterior half of the eyes, and here on each side the vertex is concaved. Viewed in profile the frontal costa scarcely convex and considerably advanced before the eyes, viewed in front moderately and evenly furcate. Eyes small, globose. Antennæ stout, a little compressed. Pronotum anteriorly truncate, broad between the shoulders, posteriorly abbreviated, sides of the apical process straight, the apex obtuse; dorsum scarcely tectiform, rugose-granulate; median carina distinct, percurrent, but more prominently elevated in front of the shoulders; humeral angles distinctly angulate-carinate, posterior lateral carina prominent. Posterior inferior angle of the lateral lobes obtuse, the inferior sinus deep, the superior sinus shallow. Elytra rather small, granulate punctate; wings barely reach beyond the apical process and not quite so far as the

knee of posterior femora. First and second femoral margins entire; posterior femora robust; first article of the posterior tarsi as long as the last two united; all three pulvilli acute.

Locality, Paige, Texas (Fickiessen).

Described from numerous specimens.

Length of body, ♂ 8.5 mm.; pronotum, 8 mm.; hind fem., 5.5 mm.; ♀, 7.5 mm.; pronotum, 6.7 mm.; post fem., 5 mm.

This species might easily be mistaken for *Neotettix*. It is probably the short-winged form of *Apotettix curvicephalus*.

APOTETTIX RUGOSUS (SCUDD.), BOL.

Plate VI., Figs. 1 1a.

Body rugose-scabrous, dark or grayish fuscous variegated. Vertex wider than one of the eyes in both sexes, front border truncate advanced almost as far as the anterior border of the eyes, on either side of the median carina fossulate. Frontal costa viewed in profile scarcely sinuate, between the antennæ moderately protuberant. Pronotum anteriorly truncate, posteriorly long subulate passing the posterior femora, between the shoulders transversely convex, strongly rugose, median carina very little elevated, interrupted a little in front of the shoulders, uneven in its course; posterior angle of the lateral lobes obtuse, inferior margin oblique. Elytra oblong; wings passing the apical process of pronotum. Middle femora distinctly undulate; the third pulvilli of posterior tarsi about equal in length to the first and second together, the first and second spiculate, the third straight below.

Length of body, ♂, 15 mm.; pronot., 12.5 mm.; post. fem., 6.5 mm.; ♀, body 14 mm.; pronot., 12 mm.

Locality, Port Orange, Fla. (Bolter) Hancock; Fort Reed, Fla. (Scudder); Mexico (Bolivar); Bruner records it from Nebraska; Ormand, Fla. (Blatchley).

Tettix rugosus, Scudd., Bost. Jour. Nat. Hist., vii. 476 (1862); Paratettix rugosus, Bol., Ann. Soc. Ent. Belg., xxxi, 273, 274 (1887); Brun., Publ. Nebr. Acad. Sc., iii., 20 (1893); Scudd., Cat. Orth. U. S., 18 (1900); Scudd., Index N. Am. Orth., 241 (1901).

The measurement of the male above given was taken from the type generously loaned by Dr. Scudder.

MEROTETTIX, MORSE.

Body small relatively compressed, rugose-scabrous. Vertex equal in width or slightly less than one of the eyes. Frontal costa narrowly forked, the branches straight and evenly divergent. Pronotum anteriorly truncate, posterior process with straight sides, acute; dorsum transversely between the shoulders narrow; humeral angles strongly obtuse; superior lateral sinus of pronotum shallow.

Morse, Jour. N. Y. Ent. Soc., viii., 199 (1899); Hancock Psyche, 6 Jan. (1900).

MEROTETTIX PRISTINUS, MORSE.

Body small, rugose-scabrous. Vertex equal in width to one of the eyes or slightly less, front border somewhat convex, projecting very little in advance of the eyes, narrowly sulcate on each side of the median carina at its union with the frontal costa; crown between the eyes broadly and shallowly fossulate on each side of high median ridge, rapidly widening backwards from the middle of the eyes. Face in profile quite retreating below antennæ; the frontal costa roundly protuberant, scarcely sinuate above, rami viewed in front straight, slightly and evenly divergent. Pronotum scabrous or rugose; disk nearly flat, slightly elevated in front of the shoulders, the front margin truncate; median carina of pronotum distinct throughout, highest and almost subcristate midway between front margin and shoulders, undulate behind; lateral carinæ distinct, their anterior portions converging behind; dorsum transversely between the shoulders narrow, humeral angles strongly obtuse; posterior process of pronotum with straight sides, acute, the apex sometimes deflected, about reaching posterior knees; superior lateral sinus very shallow. Wings two-thirds or three-fourths as long as the pronotal process, but apparently abortive. Anterior and middle femora slender, with entire or slightly sinuate margins; posterior femora only moderately stout,

much less so than in *Neotettix*. First article of posterior tarsi distinctly longer than succeeding ones united, pulvilli straight or rounded below, acutely pointed, the third nearly as long as the others combined.

Length of body, ♂, 6.5-7.5 mm.; pronot., 6-7 mm.; post. fem., 4.5-5 mm.; ♀, body, 8-9 mm.; pronot., 7.7-9 mm.; post. fem., 6 mm.

Locality, San Domingo, California (M. A. Frazer).

The above description somewhat modified from Morse.

A type specimen in the author's collection presented by Professor Morse.

This species resembles in general appearance *Criotettix pullus*, Bol., from the Philippines.

Merotettix pristinus, Morse, Jour. N. Y. Ent. Soc., vii., 199, 200 (1899); Scudd., Index N. Am. Orth., 196 (1901).

OCHETOTETTIX, MORSE.

Kelated to and resembling *Neotettix*, but differing from that genus in the wider furcation of the facial frontal costa, which approaches that of the Cladonotinæ; in the presence of supernumerary carinæ between the humeral angles and the median carina, and in having the humero-apical carinæ joined to the lateral carinæ, leaving no scapular area.

Ochetotettix, Morse, Biol. Cent. Amer. Orth., ii., 9 (1900).

DISPOSITION OF SPECIES.

1. Lateral lobes of pronotum with the superior sinus shallow; wings absent. *barretti*, Hanc.

1A. Lateral lobes of pronotum with the superior sinus of normal size; wings and pronotum fully developed. *volans*, Morse.

OCHETOTETTIX BARRETTI, HANC.

Plate VII., Figs. 3–3a.

Vertex very broad, twice the width of one of the eyes, and projecting in advance of them, its front margin convex, with a prominent median tooth, the mid-carina, whose apex is nearly half the length of one of the eyes in advance of their front margin; shallowly excavate above on each side of the mid-carina; the crown elevated, with indications of mammillæ close to and nearly opposite the middle of the eyes. Eyes of moderate size, but little protuberant. Face in profile convex, with a slight emargination at the lower end of the rami of the facial costa. Antennæ very short, inserted just below the level of the eyes, separated by a space three to four times greater than the distance between them and the eyes. Facial costa forking high up, opposite the upper part of the eyes, the rami of moderate height, smoothly sinuous, convergent below, forming a deep, concave, broadly lanceolate scutellum, acutely pointed above. Pronotum moderately tectiform, truncate before, cuneate behind, reaching the apex of the hind femora, the humeral angles very obtuse, sides of hind process nearly straight; surface granular-tuberculate; mid and lateral carinæ prominent, sharp, the former arched in front of the shoulders, straight or slightly undulate behind. Supernumerary carinulæ short, distinct, placed just in front of the humeral angles, parallel to the lateral carinæ, midway between them and the mid-carinæ. Lateral lobes with the posterior sinus very shallow, somewhat as in *Neotettix*.

Elytra narrowly lanceolate, rounded at the apex. Wings absent. Anterior and middle femora short and stout, of the female two and one-half by one, of the male almost clypeate, barely two by one, the lower margins lobate; hind femora stout, genicular and femoral lobes conspicuous.

Total length, ♂, 7 mm., ♀, 6.8-8 mm.; pronotum, ♂, 6 mm., ♀, 6.2-7 mm.; post. fem., ♂, 4 mm., ♀, 4.4-5 mm.; antennæ, ♂, 1.5 mm., ♀, 2 mm.

Locality, Tizapan, D. F., Mexico (O. W. Barrett), Han-

cock; Chilpancingo, Guerrero; Atoyac in Vera Cruz (H. H. Smith).

A male from Atoyac and three females from Chilpancingo (Morse).

Neotettix barretti, Hancock, Ent. News, X., 277, Dec. (1899); Ochetotettix barretti, Morse, Biol. Cent. Amer. Orth., ii., 9 (1900); Scudd., Index N. Am. Orth. 210 (1901).

OCHETOTETTIX VOLANS, MORSE.

A larger species, with fully developed wings and pronotum readily distinguished from its congener by having the posterior sinus of the lateral lobes of the pronotum of normal size; the surface is more smoothly granulate; the shoulders broader, with more pronounced humeral angles; the elytra larger, long elliptical, with rounded apex. The femora are of the same general character, but less stout, especially the intermediate pair of the male.

Total length, ♂, 11-11.5 mm., ♀, 12-12.8 mm.; pronotum, ♂, 10.5 mm., ♀, 11-11.7; post. fem., ♂, 4.5-4.8 mm., ♀, 5.5-6 mm.; antennæ, ♂, 2 mm., ♀, 2-2.5 mm.; pronotum beyond the post. fem., 3.5 mm.

Locality, Mexico, Dos Arroyoa, Chilpancingo. Venta de Zopilote, Xucumantlan, and Omiiteme, all in Guerrero 1,000 to 8,000 feet (H. H. Smith).

Two males and five females (Morse).

Ochetotettix volans, Morse, Biol. Cent. Amer. Orth., II., 9 (1900); Scudd., Index N. Am. Orth., 210 (1901).

GENUS PARATTETTIX, BOL.

Body granulate, scabrous or rugose. Vertex horizontal, narrower or equally wide or little wider than one of the eyes, very little narrowed anteriorly, middle carinate, on either side more or less concave or longitudinally fossulate or canaliculate, posteriorly the longitudinal canaliculations frequently abruptly ending by a transverse ridge; the truncate front margin of vertex not at all projecting beyond the eyes. Frontal costa between the antennæ more or less protuberant, declined

towards base, rarely subsinuate. Eyes prominent, subglobose. Antennæ filiform little longer than the head, composed of fourteen articles, inserted barely before the eyes. Palpi not dilated, same color as body. Dorsum of pronotum rather flattened, anteriorly truncate, posteriorly subulate passing the apex of femora or abbreviated; median carina low, little elevated; humeral angles obtuse; lateral lobes posteriorly bisinuate, posterior lateral angle turned downwards little obliquely reflexed, apex subrounded. Elytra oval or elongate, punctate; wings fully explicate or abbreviated. Anterior femora compressed carinate above, frequently undulate, middle femora more or less undulate, sinuate, or sinuatolobate below, posterior tibiæ at apical third portion distinctly ampliate, spinose, first article of posterior tarsi elongate, longer than the third, the first and second pulvilli frequently spiculate, the third straight below, longest.

Paratettix, Bolivar, Ann. Soc. Ent. Belg., XXXI., 271 (1887); Morse, Psyche, 149, Oct. (1894); Scudder, Guide Orth., 24 (1897); Hancock, Psyche, Syn. Subf. and Gen. N. Am. Tettig., 7, Jan. (1900).

The members of this genus are unusually aquatic, the expanded tibiæ acting in a measure as paddles for swimming.

DISPOSITION OF SPECIES.

1. Body rather broad between the shoulders, smoothly granulate; vertex equal to one of the eyes or a little wider.

1A. Middle femora quite slender, the width contained about three times in the length, inferior margin scarcely undulate. *cucullatus*, Morse.

1B. Middle femora stouter, the width contained about two and a half times in the length, inferior margin decidedly undulate. *texanus*, sp. n.

1C. Apical process of pronotum not passing posterior femora; body more scabrous; rami of frontal costa a little more widely separated.

form *texanus nanus*, new.

2. Dorsum lightly scabrous-granulate; median carina of pronotum anteriorly a little compresso-elevated; vertex equal to one of the eyes or little narrower; body not so stout.

2A. Middle femora strongly sinuate-lobate. *mexicanus*, Bol.

2B. Pronotal process and wings abbreviated.
form *mexicanus abortus*, new.

3. Posterior femora at outer half of superior margin dentate, external surface of pagina with tubercles; wings fully developed. *tuberculatus*, sp. n.

4. Fronto-lateral carinæ of vertex convex, lateral margins of crown sinuate; body moderately robust; dorsum subtectiform; middle femora broad, lightly lobate below.

4A. Apex of pronotal process not passing the posterior femora. *morsci*, sp. n.

4B. Apex of pronotal process passing the posterior femora about one millimeter; wings extenuate.
form *morsci extensus*, Morse.

5. Body less robust; vertex not quite so wide, subequal to one of the eyes or little wider, fronto-lateral carinæ substraight; middle femora strongly compresso-carinate, distinctly lobate below.

5A. Apex of pronotal process passing the posterior femora. form *tolteeus sonorensis*, new.

5B. Apex of pronotal process not passing the posterior femora; elytra narrow. *tolteeus*, Bol.

5C. Pronotum anteriorly sulco-rugose; body small.
race *arizonus*, new.

6. Body strongly robust, scabrous; dorsum between the shoulders transversely convexo-elevated; pulvilli of posterior tarsi straight below. *robustus*, sp. n.

7. Vertex subquadrate, equal in width to one of the eyes; pronotum anteriorly coarctate.
Spec. Cuban *frey-gessneri*, Bol.

8. Margins of middle femora entire or nearly so, rather stout.

8A. Vertex wider than one of the eyes; pronotum

rather flat above, long subulate; median carina distinct, but low, in front of the shoulders subcompressed and elevated. *durus*, Morse.

8B. Pronotum with the shoulders more elevated; median carina higher, acute, compressed throughout, subcristate in front of the shoulders; posterior process abbreviated. form *sinuatus*, Morse.

PARATETTIX CUCULLATUS, MORSE.

Plate VIII., Figs. 6 and 7.

Body moderately large, depressed, rather smoothly granulate. Vertex viewed from above equal to or a little wider than one of the eyes, not projecting in advance of them, the front border truncate, middle carinate; the median carina projecting very feebly from the middle of the front border; on each side of the median carina the vertex longitudinally fossulate for about two-thirds the length of the eyes. Frontal costa in profile slightly sinuate, scarcely advanced at all before the eyes, moderately protuberant between the antennæ, viewed in front the rami moderately separated, very little divergent. Eyes globose, large and prominent. Antennal articles distinct. Pronotum anteriorly truncate, posteriorly subulate extenuate, nearly horizontal; dorsum between the shoulders transversely lightly convex, posteriorly depressed, antero-dorsal margin advanced upon the head to the eyes, in front of the shoulders little constricted, humeral angles obtuse; median carina of pronotum low, feebly elevated, frequently a little sub-compressed anteriorly before the shoulders; lateral lobes of pronotum posteriorly bisinuate, the posterior superior or elytral sinus quite shallow, posterior inferior angle strongly rounded below. Elytra moderately large, elongate, towards the apex acuminate. Femora appreciably slender; anterior femora indistinctly sinuate or sublobate near the outer third below; middle femora slightly subsinuate above, more distinctly though by no means strongly sinuate below, first article of posterior tarsi a little longer than the third, the first and second pulvilli spiculate.

Length of body, ♂, 15-15.5 mm.; pronot., 12.5-13.4 mm.; post. fem., 6.8-7 mm.; antennæ, 4.5 mm.; ♀, 12.5 mm.; pronot., 10.1-10.3 mm.; post. fem., 5.5 mm.

Morse gives the following measurements: Total length, ♂, 11.13.5 mm.; pronot., 9.5-11 mm.; pronot., passing fem., 2.-2.5 mm.; wings passing pronot., .5-1.5 mm. Total length, ♀, 13.5-15.5 mm.; pronot., 11-13 mm.; pronot passing fem., 2.5-3 mm.; wings passing pronot., 1-2 mm.

Distribution Northeastern U. S. and Canada.

Locality, Toronto, Ont., and Lampton, Ont. (Walker); New Haven, Conn. (Morse); St. Anthony Park, Minn. (Lugger); Bloomington, Ill. (C. C. Adams and M. J. Elrod); Grossdale, Glen Ellyn, Riverside, Chicago, and Rivergrove, in Ill. (Hancock); Putnam and Vigo Co., Ind. (Blatchley); What Cheer, Ia. (Hancock); Kansas (Westcott); Douglas Co., Lawrence, Burlington, and Garden City, in Kansas (Kahl); Atherton, Mo. (Adams); also recorded from N. J., Ky., N. H., Mass.

Abbreviated examples of this species appear to be very scarce, but one or two having come under the author's observation. Some examples of this species from Atherton, Mo., have the margins of the middle femora entire or very nearly so.

The color resembles closely the surroundings, often being mottled russet-red, yellowish gray, or dull black. Numerous specimens are in the author's collection.

HABITS.

The muddy shores of the Skunk River in Iowa affords a favorable habitat for water-loving and semi-aquatic insects. On this river, seven miles from What Cheer, the writer found that the Tettigids were unusually abundant June 29, 1894, the species mostly represented being *Tettigidea concolor*. Swarms, many of which were in sexual union, were frightened up from the immediate margin of the water while the author made excursions along the shore. A diversity of color existed among this species; many were colored exactly like the wet varicolored soil. Some had rich russet-red over the whole upper surface of the body, or the visible portions of the individuals were entirely clay-colored or a part of the pronotum only was colored in this manner, while still others were almost coal-black above. These varieties, to say nothing of many more not mentioned, were in perfect harmony with the environment. On careful inspection it was interesting to observe with what accuracy these colors agreed with the tinges of reds, yellows, browns, and grayish blacks existing here and there as patches in the soil. The extreme caution of these insects made it difficult to capture them, and as they use their wings perfectly in flight this added to the difficulty of taking the species. Keeping close to the water's edge, the author drove them

along with an open umbrella until coming to a little projection of land upon which a large number had congregated. Finally, upon a sudden rush at the insects they flew up in hundreds, to find that to return to land was impossible; they fell back into the water. It was only necessary now to gather the little swimmers in as they made exquisite use of their dilated paddle-like hind tibiæ in seeking the shore. The aquatic powers of this species are more perfect than those of any other of our local species. There were a few *Tettix gibbosus* in association with *Paratettix*.

PARATETTIX TEXANUS, SP. N.

Plate VIII., Figs. 4 and 5.

Plate VI., Figs. 2–2a.

Body rather large. Color variable, sometimes ferruginous variegated with fuscous, paler above; tibiæ light obscurely infuscate. Vertex equal in width to one of the eyes in the male, in the female a little wider, the front border truncate, advanced nearly as far as the anterior border of the eyes; anteriorly the vertex is a little narrowed, the little obtusely curved antero-lateral carinæ extend backwards about one third the length of the eyes, and scarcely subdivergent; viewed from above the vertex depressed, median carina appreciably distinct, scarcely at all projecting in front, on either side canaliculate longitudinally for about two-thirds the length of the eyes, where a transverse ridge defines the limit posteriorly. Frontal costa in profile scarcely advanced before the eyes, depressed, not appreciably sinuate before the eyes, moderately protuberant opposite the antennæ, face below sinuate, the distance from the protuberant portion to the anterior inferior border of the eyes is about equal to half the length of the eye; viewed in front the rami of frontal costa rather narrowly separated, substraight and but little divergent. Antennæ quite slender. Pronotum anteriorly truncate, posteriorly long extenuate, passing considerably beyond the posterior femora, subhorizontal; dorsum rather plainly granulate, between the shoulders lightly convex, in front of the shoulders sparingly constricted; median carina of pronotum low, indistinct, sometimes very little compressed anteriorly behind the front margin; humeral angles carinate, obtuse, the anterior carinæ hardly distinct, short, parallel. Elytra rather narrow, acuminate towards the apex; wings long, passing considerably

beyond the pronotal apex. Anterior femora with the superior margin subentire, below feebly lobate a little beyond the middle, the margin of lobe minutely serrate; middle femora above undulate, the apical half often divided into three more or less minute undulations, below decidedly undulate, the portion beyond the middle formed into a small subrounded lobe with serrate margin; the width of middle femora is contained about two and one-half times in the length in the female, in the male it is a little less, appearing a little more ampliate in the latter sex; the superior margin of the posterior femora provided with obtuse tooth before the small genicular spine just below the knee, external pagina lightly scabrous, the oblique lines feebly or not appreciably tuberculate; first article of the posterior tarsi a little longer than the third, the first and second pulvilli spiculate, sometimes the apices subflattened, the base of the third pulvilli about twice as long as the second.

Length of body, ♂, 14.5-16.5 mm.; pronot., 12-13.8 mm.; post. fem., 6-6.9 mm.; ♀, body 11.5-13 mm.; pronot., 8.9-10.3 mm.; post. fem., 5-5.5 mm.

Locality, Texas (Bolter); Paige, Texas (Fickiessen) Hancock; Opelousas, La.; Agr. College, Miss. (Weed) Hancock; also reported from Georgia and South Carolina.

This species is similar to the preceding with dimensions nearly the same, but with vertex slightly narrower, margins of middle femora more decidedly undulate-lobate, while in *P. cucullatus* there is scarcely any evidence of a lobe, or it may be suggested by slight undulate margin. The width of the femora as compared to the length is less, as shown in the key to the species. It is quite likely this species passes insensibly into *P. cucullatus* on the north. Over one hundred specimens, mostly from Texas, furnished the data for the above observations.

Paratettix texanus nanus may be applied to the short-wing form having characters nearly the same, but with abbreviated pronotal process and shortening of the wings. There are sometimes two dark spots on the pronotal disk, the surface scabrous, the sides of the pronotum straight posteriorly, with

apex acute; the median carina slightly more distinct throughout. The middle and posterior femora appear a little stouter.

Length of body, ♂, 10-11.5 mm.; pronot., 8.5-9.7 mm.; post. fem., 6-7 mm.; ♂, body, 8-8.5 mm.; pronot., 7.1-8 mm.; post. fem., 5.5 mm.

Locality, Paige, Texas; Opelousas, La.

Scarcely distinguished from the short-wing form *Paratettix mexicanus abortus*.

PARATETTIX MEXICANUS, BOL.

Plate VIII., Figs. 12 and 13.

Variety Figs. 1 and 2.

Body not quite as large as *texanus*. Grayish or light yellow clouded or spotted with fuscous, back of shoulders often with two subtriangular dark spots, anterior and middle tibiæ with two bands of fuscous, one near the middle, the other at the extremity. Some black spots frequently arranged in series along the pronotal carinæ. Surface of body granulate-scabrous. Vertex equal to one of the eyes or little narrower, the front border truncate, advanced almost as far as the anterior border of the eyes, concave anteriorly, median carina scarcely at all elevated, barely projecting as a minute tooth; on either side of the median carina of the vertex narrowly canaliculate longitudinally, abruptly ending by a transverse ridge posteriorly; fronto-lateral carinæ bent at right angle to the front margin, extending straight backwards about one-third of the inner border of the eyes; lateral margins of crown scarcely sinuate. Frontal costa barely advanced before the eyes, subsinuate, between the antennæ scarcely convex, facial profile lightly sinuate below; viewed in front the rami rather widely separated, moderately divergent to the median ocellus. Pronotum anteriorly truncate, posteriorly subulate, rather suddenly narrowed but not long extenuate, apex acute, passing the knee of posterior femora; dorsum between the shoulders transversely subflattened, frequently with little short secondary carinæ, posteriorly subdepressed; median carina of pronotum very little elevated, thin, subcompresso-elevated anteriorly,

lateral carina distinct, posterior inferior angle of the lateral lobes strongly rounded below, somewhat obliquely reflexed, the median lobule posteriorly widely convex, the superior or posterior elytral sinus shallow. Elytra subacuminate towards the apex; wings considerably passing the pronotal process. Anterior femora a little compressed, inferior margin beyond the middle a little sublobate with minutely dentate margin; middle femora compressed, undulate above, inferior margin frequently triundulate, the middle undulation decidedly lobate with dentate margin; superior margin of posterior femora provided with a small tooth before the knee and genicular spine, first article of posterior tarsi a little longer than the third, first and second pulvilli acutely cuspidate, the first and second together are about as long as the third, the third being more straight below.

Length of body, ♀, 14 mm.; pronot., 10.8 mm.; post. fem., 6 mm.; wings pass pronotal process 2 mm.

Locality, Rio Cocula, Mex. (Barrett) Hancock.

Tettix mexicana Sauss., Rev. et. Mag. Zoöl. (Orth. Nova Am.), 400 (1861); Paratettix mexicanus, Bolivar, Ann. Soc. Ent. Belg., xxxi., 275 (1887); Paratettix caudatus, Bruner, Bull. Lab. Nat. Hist. Univ. Iowa, iii., No. 3, 62 (1895).

Distribution, Central America, Mexico, California, and Arizona, and possibly some of the other Southern states.

This species is also recorded from the following points in Mexico: Savanito and Sierra Nola (Scudder); Cuernavoca, Teapa (Smith); Atoyac (Smith, Schumann); San Rafael, Vera Cruz (Heyde, Bruner, and Smith); San Lorenzo, near Cordova (M. Trujillo) Morse; from Guatemala (Champion) Morse; from Nicaragua (Bruner) Costa Rica; Cache, Volcan de Irazu (Rogers) Morse. Bolivar records *Paratettix mexicanus* from Tex., Geo., N. C., and Mex.; Riley mentions it from California.

Paratettix mexicanus, Bol., Riley, N. Am. Faun., vii., 251 (1893); Brun., Publ. Nebr. Acad. Sc., iii., 29 (1893); Townsend Insect Life, vi., 31 (1893); Brun. Ann. Rept. Bd. Agric., 1896, 138 (1897); Scudd., Cat. Orth. U. S., 17 (1900); Morse, Biol. Cent. Am. Orth., ii., 12, 13 (1900); Scudd., Index N. Am. Orth., 241 (1901).

Several varieties of this species exist presenting slight differences in the vertex and middle femora together with abbreviation of wings and pronotal process. For the form having the pronotal process and wings abbreviated the trinominal *Paratettix mexicanus abortus* may be used. Eight specimens of this form are in the author's collection.

PARATETTIX TUBERCULATUS, SP. N.

Plate VIII., Fig. 3.

Allied to *Paratettix mexicanus*, which it resembles nearly in proportion of body, but distinguished principally by the tuberculate character of the posterior femora. The anterior femora little compressed, the inferior margin scarcely lobate a little beyond the middle; middle femoral margins distinctly sinuate, superior margin towards the apex broken into small undulations, below strongly sinuate-lobate, near the middle formed into distinct lobe with substraight or slightly curved border; posterior femora moderately stout, the apical half of superior marginal carina serrate, the femoral lobe formed into a distinct tooth projecting subinwards, two or three oblique ridges of external pagina a little beyond the middle tumescent, the straight carina below with a prominent tubercle, and a second appears midway between it and the apex; as viewed from above both tubercles projecting plainly from the lateral surface; at a corresponding distance there is a trace of a tubercle at the anterior fourth on the straight carina; the posterior tarsal characters are the same as in *mexicanus*.

Length of body, ♀, 12.5 mm.; pronot., 9.2 mm.; post. fem., 5.6 mm.

Locality, Vera Cruz, Mexico (Barrett) Hancock.

PARATETTIX MORSEI EXTENSUS, MORSE.

Plate VIII., Figs. 8 and 9, and face Fig. 16.

Body moderately robust, little rugose; color variable, grayish or light spotted with fuscous behind the shoulders with two large dark impressed spots, and four or five spots along

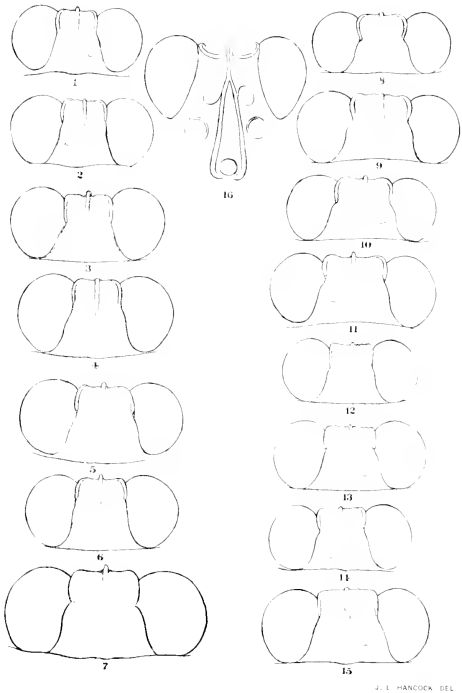
the course of median carina. Vertex in male and female appreciably wider than one of the eyes, front margin truncate, advanced about as far as the eyes, median carina prominent, a little projecting, on either side longitudinally canaliculate, the fronto-lateral carinæ prominent, convex, sides of crown sinuate, posteriorly transversely ridged or submammillate. Frontal costa in profile a little advanced before the eyes, subdepressed, at the junction with the median carina rounded, opposite the antennæ little convex; viewed in front the frontal costa rather strongly furcate, the rami straight and evenly divergent. Eyes globose. Pronotum anteriorly truncate, posteriorly the apical process short, extended beyond the posterior femora about one millimeter; dorsum between the shoulders little elevated, transversely subtectiform, median carina distinct throughout, anteriorly near the front margin subcompresso-elevated, superior or elytral sinus of lateral lobes shallow, the posterior inferior angle obtuse. Elytra elongate acuminate towards apex; wings fully developed, passing pronotal process from two to three millimeters. Anterior femora little compressed, entire; margins of middle femora distinctly compressed, entire above, feebly lobate about the middle of lower margin; posterior femora subampliate, first article of posterior tarsi distinctly longer than the third, first and second pulvilli acute, the third straight below.

Length of body ♀, 14.5 mm.; pronot., 10.2 mm.; post. fem., 6 mm.; body ♂, 12 mm.; pronot., 8.8 mm.; post. fem., 5.1 mm.

Locality, San Bernandina, Cal. (Morse) Hancock. Recorded from Arizona, and several other points in California.

Morse gives the measurements as follows: Total length, ♂, 11.5-13.5 mm., ♀, 12-14.5 mm.; pronot., ♂, 8.7-10 mm., ♀, 8.5-11.5 mm; body, ♂, 7-9 mm., ♀, 9-11 mm.; post. fem., ♂, 5-6 mm., ♀, 5.5-6.5 mm.

Paratettic toltecus extensus, Morse, Jour. N. Y. Ent. Soc., vii., 198 (1899).



J. L. HANCOCK DEL.

HEAD CHARACTERS

PARATETTIX MORSEI, SP. N.

Plate VIII., Figs. 10 and 11.

The abbreviated form of *Paratettix morsei extensus*. Vertex in both sexes distinctly wider than one of the eyes. Dorsum little more elevated between the shoulders, transversely subtectiform, acute, anteriorly little compressed; pronotal process posteriorly not extended so far as the apex of posterior knee; elytral sinus of lateral lobes shallow. Elytra moderately narrow; wings undeveloped.

Length of body, ♀, 10.5 mm.; pronot., 8.5 mm.; post. fem., 6.2 mm.; ♂, body 9 mm.; pronot., 7 mm.; post. fem., 5.8 mm.

Locality, California (Morse) Hancock.

PARATETTIX TOLTECUS, BOL.

Plate VIII., Figs. 14 and 15.

Body small, robust, rugulose, grayish fuscous, tibia annulate, dorsum behind the shoulders frequently with two dark, depressed spots. Vertex in the male subequal or little narrower than one of the eyes, in the female a little wider, front margin advanced as far as the eyes, truncate, the frontolateral carina straight, median carina conspicuous anteriorly, a little projecting, on either side longitudinally canaliculate, viewed in front the rami rather widely separated, evenly divergent. Eyes globose. Antennæ slender. Pronotum anteriorly truncate, posteriorly abbreviated, not passing the posterior femora, sides straight, apex obtuse; dorsum transversely between the shoulders subtectiform acute, rugose, frequently with minute secondary midway carinæ, humeral angles widely obtuse, distinct, lateral carinæ scarcely compressed; median carina of pronotum distinctly elevated throughout, little subcristate anteriorly; superior elytral sinus of lateral lobes shallow, the median lobule scarcely convex, the posterior inferior angle strongly obtuse, a little roundly reflected. Elytra narrow, acuminate towards apex; wings undeveloped. Anterior femora little compressed, superior

margin entire, inferior margin subsinuate at outer third part; middle femoral margins strongly compressed, inferior margin at the middle distinctly lobate; the width of middle femora contained nearly twice in the length; posterior femora stout, oblique ridges of external pagina frequently tumescent; first and second pulvilli of posterior tarsi acute, the third pulvilli straight below, the first tarsal article little longer than the third.

Length body, ♂ (to apex of femora) 10 mm.; pronot., 7 mm.; post fem., 6 mm.; ♀, 8 mm.; pronot., 6 mm.; post. fem., 5 mm.

Locality, Cuernavaca, Mex. (Barrett) Hancock; Cocula Guer'o, Mex. (Barrett) Hancock; Preston, Ariz. (R. E. Kunze); Baker, Coll., New Mexico, Hancock. Recorded from California, Nebraska, Nicar., Low. California.

Tettix toltecus, Sauss., Rev. Mag. Zoöl., 401 (1861); Paratettix toltecus, Bol., Ann. Soc. Ent. Belg., xxxi., 273 (1887); Riley, N. Am. Fauna, vii., 251 (1893); Brun., Publ. Neb. Acad. Sc., iii., 29 (1893); Towns., Ins. Life, vi., 31 (1893); Brun., Bull. Lab. Nat. Hist. Univ. Iowa, iii., pt. 3, 62 (1895); Brun., Ann. Rept. Neb. Bd. Agric., 1896, 138 (1897); Scudd., Cat. Orth. U. S., 18 (1900); Morse, Biol. Cent. Am. Orth., ii., 11, 12 (1900).

Race *arizonus* new. Specimens from Preston, Arizona, present certain peculiarities, viz.: female light spotted with fuscous; dorsum moderately elevated between the shoulders, transversely subtectiform, scabrous; before the shoulders extending downwards on either side of lateral lobes the pronotum appears inordinately sulco-rugose.

Length of body, female, 9.5 mm., male, 7.5 mm.; pronot., ♀, 7 mm., ♂, 6 mm.; post. fem., ♀, 5.5 mm., ♂, 4.5 mm.

New Mexican specimens have the surface of body rather smoothly granulate; the median carina of pronotum subcompresso-elevated throughout, a little more elevated before the shoulders, between the shoulders transversely tectiform. In this and the preceding variety there is evidence of small tubercles projecting laterally from the external pagina of pos-

terior femora of the lower straight carina above the inferior margin.

Length of body, ♂, 9.5 mm.; pronot., 7.8 mm.; post. fem., 6 mm.

PARATETTIX TOLTECUS SONORENSIS, FORM N.

Body of moderate size, rugose, light grayish or fuscous. Similar in the character of the vertex to *tolteeus*. The frontal costa viewed in front scarcely so widely furcate; the dorsum of pronotum transversely not quite so acute, elevated between the shoulders, the apical process passing the posterior femora, though not long extenuate. Wings fully explicate, passing the pronotal apex two and a quarter to two and a half millimeters; the elytra wider in proportion to length than in *tolteeus*, strongly acuminate towards apex. Middle femora strongly compressed, below lobate at the middle part, the femora being nearly as broad as in *tolteeus*.

Length of body, ♂, 13.5 mm.; pronot., 9.8 mm.; post. fem., 6 mm.; ♀, body, 11 mm.; pronot., 8 mm.; post. fem., 5 mm.

Locality, Cocula Guerrero, Mex., Soledad, V. C., Mex., Jalapa, V. C., La Antigua, Mex., Cordova, Mex. (Barrett) Hancock.

Undoubtedly the long-wing form of *Paratettix tolteeus*. There appears to be several or more varieties. This is evidently not the form described by Professor Morse, as *P. tolteeus eatensus*, which is described under *P. morsei eatensus*.

From *Paratettix m. eatensus* it is distinguished by the slightly narrower vertex, less robust form of the body, with slightly less elevation of dorsum between the shoulders.

PARATETTIX ROBUSTUS, SP. N.

Body distinctly robust, rugose. Larger than *tolteeus*, which it nearest resembles; grayish fuscus with dark spots back of shoulders. Vertex wider than one of the eyes, advanced about as far, median carina little prominent anteriorly, lightly projecting, front border truncate, transverse,

rather lightly fossulate longitudinally on each side of median carina. Frontal costa in profile appreciably advanced before the eyes, subdepressed, very little protuberant opposite antennæ, viewed in front strongly furcate, rami straight, evenly divergent. Pronotum truncate anteriorly, posteriorly abbreviated, extended nearly to apex of posterior femoral knees; dorsum between the shoulders transversely a little convexly elevated; median carina distinct throughout, subcompressed anteriorly. Anterior femora below feebly lobate at outer third; middle femora rather broad, below lobate little beyond the middle part; posterior femora ambliate, external pagina rugose scabrous, pulvilli of posterior tarsi straight below, first article distinctly longer than the third.

Length of body, ♀, 10.2 mm.; pronot., 9 mm.; post. fem., 6.2 mm.

Locality, Yellowstone Park, Wyo., (Baker) Hancock.

PARATETTIX FREY-GESSNERI, BOL.

Vertex equal in width to one of the eyes, not narrowed anteriorly; frontal costa behind the antennæ obliquely depressed, not advanced before the eyes, below the median ocellus smoothly excised. Pronotum anteriorly truncate more or less coarctate, posterior angle of lateral lobes with apex narrowly rounded. Elytra oblong, apex widely rounded. Anterior femoral margin below more or as much undulate as the superior; the third pulvillus of posterior tarsi shorter than the first and second together.

Length of body, ♂ ♀, 7-10 mm.; pronot., 9-10.5 mm.; post. fem., 4.5-6 mm.

Locality, Cuba (Bolivar).

Paratettix frey-gessneri, Bolivar, Ann. Soc. Ent. Belg., xxxi., 282 (1887); Scudder, Index N. Am. Orth., 241 (1901).

PARATETTIX DURUS, MORSE.

Vertex truncate, wider than one of the eyes, transverse, narrowed anteriorly, mid-carina little produced. Eyes prominent, oblong. Facial costa rather widely sulcate, rami evenly

divergent, sometimes subparallel, in profile little protuberant. Pronotum rather flat above, except anteriorly, scabrous granulate, mid-carina subcompressed and elevated anteriorly, depressed at the shoulders, acute, but not elevated, undulate or nearly horizontal behind them; hind process subulate, passing posterior femora about two millimeters infuscate at the apex. Anterior femora subundulate beneath; middle femora rather stout, entire, or very slightly undulate above, subsinuate beneath. First joint of posterior tarsi distinctly longer than the third.

Total length, ♂, 10-11.5 mm.; pronot., 8.7-9.3 mm.; post. fem., 4.3-5 mm.; antennæ, 2.5 mm.

Hab., Mexico, Medellin in Vera Cruz (Heyde, in coll. Bruner); Teapa and Frontera in Tabasco (H. H. Smith) Morse.

Paratettix durus, Morse, Biol. Cent. Am. Orth., ii., 11, 13 (1900), Mexico; Scudder, Index N. Am. Orth., 241 (1901).

FORM PARATETTIX SINUATUS, MORSE.

Very similar to the preceding, *P. durus*, but differing from it in having the mid-carina of the pronotum more elevated throughout and more sinuate in profile, and the pronotum a little more elevated on the shoulders. Hind process of the pronotum abbreviated, cuneate not passing the hind femora, and of the same length as the wings.

Total length, ♂, 6.8-7.4 mm., ♀, 8.4-9 mm.; pronotum, ♂, 6.3-6.7 mm., ♀, 7.4-7.6 mm.; post. fem., ♂, 4.4-4.7 mm., ♀, 5 mm.; antennæ, ♂, 2.5 mm., ♀, 2.5 mm.

Hab., Mexico, Guanajuanto (Deams, in coll. Bruner, ♂), San Rafael, Vera Cruz (Townsend, in coll. Bruner ♂ ♀).

Two pairs San Rafael and a ♂ from Guanjuanto (Morse).

Paratettix sinuatus, Morse, Biol. Cent. Am. Orth., ii., 13 (1900); Scudder, Index N. Am. Orth., 242 (1901).

CLYPEOTETTIX, GEN. NOV.

Allied to Paratettix. Vertex subequal to one of the eyes or scarcely wider, not advanced so far as the eyes. Eyes subprominent, globose. Head retracted closely under the pronotum. Pronotum strongly dilated between the distinctly reflected inferior margins of lateral lobes; the posterior angle strongly rounded; dorsum between the shoulders transversely little convexo-tectiform or tumescent. Femora dilated, margins strongly carinato-clypeate. Type Paratettix schocki, Bol., herein described.

CLYPEOTETTIX SCHOCKI, BOL.

Plate IX., Figs. 10 and 11.
Plate VII., Fig. 1.

Body granulate. Vertex little narrowed anteriorly, front border subequal to one of the eyes in the male, or scarcely wider in female, not advanced so far as the eyes, truncate, middle carinate, hardly elevated, on either side of median carina longitudinally canaliculate, the frontal carinæ of vertex concave; viewed from above only the vertex and eyes appear visible, the head being more or less retracted under the anterior margin of the pronotum. Frontal costa depressed not advanced before the eyes, between the antennæ very little protuberant, sinuate below, viewed in front rather distinctly furcate, the rami gradually diverging. Eyes subprominent, distinctly globose. Antennæ filiform, consisting of fourteen articles. Pronotum anteriorly truncate, posteriorly long, subulate, the apical process extended beyond the posterior femora, humeral angles widely obtuse; dorsum between the shoulders little elevated; median carina of pronotum indistinct, towards the front often undulate, in front of the shoulders frequently subcompresso-elevated; the posterior inferior margin of lateral lobes widely and obliquely dilato-reflected, the posterior inferior angle roundly obtuse, the inferior lateral sinus rather deeply but broadly incised, the superior lateral sinus very shallow, the middle lobule convex. Elytra rather

wide, acuminate towards the apex, surface punctate; wings extended beyond the pronotal process in the female from two to three millimeters. Anterior femora compressed, superior marginal carina cristate, below in front of the anterior half sublobate; middle femora distinctly clypeate, the inferior marginal carina towards the extremity subsinuato-lobate or sometimes dentate; posterior femora compresso-ampliate, the superior marginal carina arcuato-cristate, near the apex acute-bilobed, margins of posterior tibiæ spined, towards the extremity distinctly ampliate; first article of posterior tarsi scarcely longer than the third, the third pulvilli about as long as the first and second combined, flattened below, the first pulvilli spinose, the second acute. Valves of ovipositor strongly serrato-dentate.

Length of body, ♀, 15-16.2 mm.; pronot., 11.3-13.1 mm.; post. fem., 6.1-7 mm.; ♂, body, 11.5-13.9 mm.; pronot., 9-10.8 mm.; post. fem., 4.9-5.9 mm.; antennæ ♂, 3.4 mm.

Described from numerous specimens in author's collection.

Bolivar gives the following measurement: Body, ♂ ♀, 8-10 mm.; pronot., 10-12 mm.; post. fem., 5.5-6 mm.

Morse gives total length, ♂, 10.7-13.5 mm., ♀, 14-17.5 mm.; pronotum, ♂, 8.6-11.3 mm., ♀, 11.5-15 mm; post. fem., ♂, 4.5-6 mm., ♀, 6-7.5 mm.; pronotum passing beyond post. fem., ♂, 2-2.5 mm., ♀, 2.5-3.5 mm.; wings passing pronotum, ♂, 1-2 mm., ♀, 1.5-3 mm.

Locality, Cuernavaca Morelos, Mex., Yantepec Morelos, Mex., Bolsas Guerrero, Mex., Rio Cocula, Gro. (Barrett) Hancock; Guatemala and Mexico (Bolivar); Colima, Mex. (Scudder) Morse; Chilpancingo, Rincon, and Xucumanatlan, all in Guerrero, 2,800 to 7,000 feet (Smith); Jalapa (Bruner); Guatemala (Champion); Nicaragua Chontales (Janson); Ometepe (Shimek in coll. Bruner) Morse.

Paratettix schocki, Bolivar, Ann. Soc. Ent. Belg., xxxi., 274 (1887); Brun., Bull. Lab. Nat. Hist. Univ. Iowa, iii., pt. 3, 62 (1895); Morse, Biol. Cent. Am. Orth., ii., 11, 12 (1900); Scudd., Index N. Am. Orth., 242 (1901).

VARIATIONS OF CLYPEOTETTIX SCHOCKI, BOL.

Some specimens present a strong lobe on the inferior marginal carina of the anterior femora. Several examples have the pronotum between the shoulders more tumescent than usually occurs, and these appear to have the part of the pronotum before the shoulders, but very little constricted. With this latter peculiarity is correlated retraction of the head under the pronotum, the length of the head being extremely short; moreover the femora are more strongly carinato-clypeate. The inferior carina of the middle femora is scarcely the same in any two specimens. Again, there is appreciable variation of the posterior tarsal pulvilli. Some of the above described examples are undoubtedly subspecific, and show new lines of departure in the evolution of species and the future trend in the specialization of parts.

GEN. ALLOTETTIX, HANC.

Body rugose, tuberculose; face oblique, viewed in front narrow. Vertex little narrowed anteriorly, scarcely wider than one of the eyes, or subequally wide, middle carinate, on either side lightly canaliculate, occiput naked behind the eyes; the front border of vertex hardly advanced so far as the eyes, subtruncate, the frontal carinæ elevato-rounded laterally. Eyes in profile moderately elevated, subconoidal. Frontal costa narrowly furcate the rami little divergent. Antennæ in profile inserted a little below the anterior inferior border of the eyes. Pronotum depressed, rather narrow, truncate anteriorly, strongly prolonged posteriorly (as in Scelimena) ending in a sharp attenuated apical process; median carina of pronotum scarcely elevated; humeral angles strongly obtuse, the superior lateral sinus of lateral lobes quite shallow, the inferior sinus deeply incised, the posterior inferior angle directed obliquely downwards and scarcely at all outwards, obtuse. Elytra elongate; wings as long as the process. Femora slender, margins entire, posterior tibia provided with few spines (four in the outer row, more or less); the first and third articles of posterior tarsi about equal in length.

Allotettix, Hancock, Ent. News, 276, X., Dec. (1899); Morse, Biol. Cent. Am. Orth., ii., 12 (1900).

ALLOTETTIX PERUVIANUS, BOL.

Plate IX., Fig. 5.

Obscure ferrugineous, fusco variegated. Vertex nearly as wide as one of the eyes, horizontal, towards the front subnarrowed, scarcely transversely carinate anteriorly. Frontal costa between the antennæ obliquely depressed, obscurely sinuate. Pronotum posteriorly long subulate, median carina between the shoulders sinuate, here being indicated by scarcely compressed tubercles; dorsum tuberculate, between the shoulders presenting concavities; posterior angle of the lateral lobes with apex widely rounded. Elytra oblong, subacuminate; wings as long as the process. Femora slender, carina entire, first article of the posterior tarsi not longer than the third; the first and second pulvilli together shorter than the third, the basal pulvilli have acute short spines.

Length of body, ♂ ♀, 9-13.5 mm.; pronot, 13.5-14 mm.; post. fem., 5.5-7 mm.

Paratettix peruvianus, Bolivar, Am. Soc. Ent. Belg. XXX., 272 (1887); Giglio-Tos Bull., Mus. Zoöl. Univ. Tor., xii., No. 301, 3 (1897); Morse, Biol. Cent. Amer. Orth., ii., 12 (1900); Scudd., Index N. Am. Orth., 241 (1901); Allotettix peruvianus, Hancock, Ent. News, 276, X., Dec. (1899).

Locality, Pumamarco, Peru, Mus. de Varsovia (Bolivar); Peru (Hancock); Panama, Colon, Rio Cianoti Punta di Sabana, Darien, Peru (Morse); Darien (Giglio-Tos).

GEN. TELMATETTIX, HANC.

Body more or less slender, granulate, or rugose. Vertex narrowed anteriorly, the width equal to from about one-half to nearly the whole of one of the eyes, middle carinate, projecting very feebly, on either side of median carina narrowly longitudinally canaliculate, crown strongly longer than the width; front border of vertex subsinuato-truncate or truncate,

viewed from above not advanced so far as the eyes or about as far; frontal carinæ concave, little elevated laterally into curved fronto-lateral carinæ. Frontal costa depressed, between the eyes barely or not at all advanced before them, rarely subsinuate, viewed in front narrowly furcate, more or less compressed. Eyes more or less globose. Antennæ filiform consisting of fourteen articles, inserted barely before the anterior inferior border of the eyes. Dorsum of pronotum smoothly granulate, or sabulose or tuberculose; pronotum anteriorly truncate, advanced upon the head to the eyes, posteriorly passing the posterior femora or abbreviated; median carina low, scarcely or little elevated; humeral angles obtuse; lateral lobes of pronotum posteriorly bisinuate, the elytral sinus moderately shallow, posterior inferior angles of lateral lobes turned downwards, apex subacute or subrounded, the inferior margin viewed from above scarcely at all laterally reflexed. Elytra elongate acuminate; wings fully developed, rarely abbreviated. Femora slender, entire, or rarely the anterior femora subcompressed and subundulato-lobate below; posterior tibiæ more or less ampliate towards the extremity, carinæ spinose; first article of posterior tarsi little longer or subequal to the third, the third pulvilli distinctly the longest, and flat below, the first and second more or less acute or rounded below.

Telmatettix, Hancock, Psyche, 7, January (1900).

DISPOSITION OF SPECIES.

1. Body large, moderately slender; vertex little narrower than one of the eyes; dorsum between the shoulders little elevated; eyes rather small.
hesperus, Morse.
2. Vertex about half as wide as one of the eyes or a little more; body slender. *parvivertis*, var. n.
3. Body smaller, vertex in the male little less than half the width of one of the eyes; facial costa narrowly compressed. *azteeus* (Sauss.) Bol.
4. Posterior angle of lateral lobes obtuse, widely rounded

below; facial costa moderately compressed; body slightly stouter. *aridus*, sp. n.

5. Anterior femora obscurely undulate, inferior margin at the middle with little lobe; pronotal process barely passing the posterior knees; dorsum subgibbose anteriorly. *fallax*, Bol.

6. Dorsum rugose minutely tuberculose, humeral angles subdistinct; median carina distinct, subundulate. *minutus*, sp. n.

7. Pronotum posteriorly not passing knees of hind femora; dorsum lightly rugose-tuberculose. *m. rugosus form n.*

TELMATETTIX HESPERUS, MORSE.

Plate IX., Figs. 8 and 9.

Body moderately slender, smoothly granulose, pronotum anteriorly advanced upon the head to the eyes. Color variable, rufous, gray, or black, frequently with the posterior femora and lower third of sides of pronotum pale. Vertex distinctly narrowed anteriorly, narrower than one of the eyes, the crown of the head approximately twice as long as the breadth, (between the fronto-lateral carinæ in the male); the front border of vertex subsinuato-truncate, advanced to or very nearly as far as the anterior border of the eyes, median carina appreciable anteriorly, scarcely minutely projecting, on either side of median carina longitudinally canaliculate. Frontal costa in profile little obliquely depressed and not advanced before the eyes, between the antennæ subprotuberant, little sinuate below, viewed in front narrowly furcate, the rami a little more widely separated below. Eyes rather small, globose. Pronotum granulose, anteriorly truncate, not constricted before the shoulders, posteriorly extenuate, passing the posterior femora from two and a half to four millimeters; dorsum between the shoulders narrow, a little elevated, transversely depresso-convex, humeral angles not at all prominent, obtuse; median carina indistinctly or very little elevated, between the shoulders obscure, scarcely compressed before

the shoulders, posteriorly nearly horizontal; the posterior margin of lateral lobes strongly bisinuate, the elytral sinus quite deep, posterior inferior angles obtuse, the inferior lateral margin viewed from above not dilated. Elytra elongate, acuminate at apex; wings fully developed, passing the pronotal process from one to two millimeters. First article of posterior tarsi slightly longer than the second and third together, the pulvilli flat below, the first and second small, acute pointed, together about equal to the third.

Length of body, ♀, 14.9-15.5 mm.; pronot., 12.5-13.2 mm.; post. fem., 6.3-6.6 mm.; ♂ body, 12.5-13.5 mm.; pronot., 10.9-11.5 mm.; post. fem., 5.6-5.9 mm.

Three males and three females in the author's collection received from Professor Morse.

Morse gives the total length: ♂, 12-14 mm., ♀, 14-16.3 mm.; pronotum, ♂, 10.3-11.8 mm., ♀, 12-14.5 mm.; body, ♂, 7.5-9 mm., ♀, 9-11 mm.; post. fem., ♂, 5-6 mm., ♀, 6-7.5 mm.

Locality, Glendale, Oregon (Morse) Hancock. Reported from California.

Paratettix hesperus, Morse, Jour. N. Y. Ent. Soc., vii., 198 (1899); Scudd., Cat. Orth. U. S., 17 (1900); Scudd., Index N. Am. Orth., 241 (1901).

TELMATETTIX PARVIVERTICIS, VAR. N.

Plate IX., Figs. 3 and 4.

Dark fuscous varying to pale ferrugineous. Body slender, smoothly granulose. Vertex strongly narrowed anteriorly, between the antero-lateral carinæ the breadth about equal to one-half or a little more than half of one of the eyes, the crown being about two and one-quarter to two and a half times longer than the breadth; front border of vertex sinuato-truncate, not advanced quite so far as the eyes, median carina thin, minutely projecting, on either side of median carina narrowly longitudinally canaliculate. Frontal costa in profile depresso-subconvex, scarcely advanced beyond the eyes, viewed in front narrowly furcate, the rami closely approxi-

mate, feebly wider below. Eyes prominent, globose. Pronotum smooth granulose, anteriorly truncate, sulci nearly obliterated before the shoulders, posteriorly little extenuate, acute, passing the posterior femora about one to one and a half millimeters; dorsum between the shoulders narrow, scarcely elevated, transversely little convex, humeral angles widely obtuse, not at all prominent; median carina very thin throughout, not perceptibly elevated, posteriorly nearly horizontal; posterior angle of lateral lobes of pronotum subacute, little rounded below, the inferior margin viewed from above not dilated. Elytra elongate, acuminate towards the apex; wings fully developed, passing the posterior femora from one and a half to two millimeters. Femora slender, entire; first article of posterior tarsi little longer than the third, the first and second pulvilli acute, together their length not quite equal to the third.

Length of body, ♀, 12.9-14.5 mm., pronot., 10-11.9 mm.; post. fem., 5.1-6 mm.; ♂, body, 11.5 mm.; pronot., 9 mm.; post. fem., 4.9 mm.

Locality, Balsas and Cocula, in Guerrero, Mex. (Barrett) Hancock. Described from six specimens.

TELMATETTIX AZTECUS (SAUSS.), BOL.

Plate IX., Figs. 1 and 2.

Body slender, sabulose-granulose. Color, blackish or fusco-cinereous, frequently the inferior lateral margins of the pronotum yellow. Vertex strongly narrowed anteriorly, equal to about one-half the breadth of one of the eyes (little more in female, little less in male), breadth of the crown between the antero-lateral carinæ contained two and a quarter to three times in the length, front border subsinuato-truncate, not advanced quite so far as the front margin of the eyes, median carina subdistinct, on either side narrowly longitudinally canaliculate. Frontal costa obtusely depressed, barely advanced before the eyes, viewed in front strongly narrowed, compressed, very feebly wider below. Eyes moderately prominent, globose. Pronotum sabulose-granulose, anteriorly

truncate, not at all constricted before the shoulders, posteriorly subulate, acute, passing the posterior femora; between the shoulders narrow, scarcely elevated, transversely convex, humeral angles widely obtuse, not at all prominent; median carina low, indistinct, between the shoulders obscure; the posterior inferior angle of lateral lobes of pronotum acute, scarcely rounded below, viewed from above the inferior margin not at all laterally expanded. Elytra elongate, acuminate towards apex; wings fully developed, passing pronotal process about one and a half millimeters. Femora slender, entire; first article of posterior tarsi longer than the third, the third pulvilli as long as the first and second together, flat below.

Length of body, ♀, 12.1 mm.; pronot., 9.8 mm.; post. fem., 5 mm.; ♂, body, 10.2 mm.; pronot., 8-9.1 mm.; post. fem., 4.3-4.4 mm.

Morse gives total length: ♂, 7.5-13.3 mm., ♀, 9.3-13.5 mm.; pronotum, ♂, 5.6-8.7 mm., ♀, 8-11 mm.; post. fem., ♂, 3.7-4.5 mm., ♀, 4.5-6 mm.; antennæ, ♂, 3 mm., ♀, 3 mm.; pronotum passing posterior femora, ♂, 0-2 mm., ♀, 0.5-2 mm.; wings passing beyond pronotal process, ♂, 0.8-1.8 mm., ♀, 0.3-1.7 mm.

Bolivar mentions the length, body, ♂ ♀, 7 mm; pronot., 10-12 mm.; post fem., 6 mm.

Locality, Cordova, Vera Cruz, Mex., Cocula, in Guerrero, Mex. (Barrett) Hancock. Reported from northern Sonora (Morrison); Villa Lerdo, Durango (Hoge); Tepic Orizaba (Bruner); Acapulco, Atoyac, Teapa (Smith); San Lorenzo, near Cordova (Truzillo); Antilles, Cuba (Morse); Yantepec, Morelos (Rehn). In North America, Arizona, and California.

Tettix aztecus (Sauss.), Rev. Mag. Zoöl., 1861, 400 (1861); Orth. Nova Am., ii., 31 (1861); Paratettix aztecus (Sauss.) Bol. Ann. Soc. Ent. Belg., xxxi., 282, 283 (1887); Morse, Biol. Cent. Am. Orth., ii., 12, 14 (1900); Scudder, Index N. Am. Orth., 241 (1901); Telmatettix aztecus (Sauss.) Rehn, Trans. Am. Ent. Soc., xxvii., June (1901).

TELMATETTIX ARIDUS, SP. N.

Plate VI., Figs. 3–3a.

Similar to *Telmatettix azteeus*, distinguished by the slightly stouter body with the humeral angles a little more prominent; transversely between the shoulders less convex; the posterior angle of lateral lobes of pronotum more widely rounded below; viewed in front the facial costa not so narrowed and less compressed. Color cinereous.

Length of body, ♀, 12 mm.; pronot., 10 mm.; post. fem., 5.5 mm.; ♂, body, 10.2 mm.; pronot., 8.5 mm.; post. fem., 4.5 mm.

Locality, Palm Springs, California (Morse) Hancock.

TELMATETTIX FALLAX, BOL.

Grayish cinereous. Vertex strongly narrowed forwards; frontal costa little compressed, between the antennæ obtusely depressed, not produced before the eyes. Pronotum depressed, granulate, apex acute, barely extended beyond the posterior knees, between the shoulders sometimes fusco-bimaculate, median carina anteriorly subgibbose; posterior angle of the lateral lobes with apex widely rounded, inferior margins subreflexed. Elytra oblong, fusco-punctate, apex subacuminate; wings extended, passing the apical process. Anterior femora compressed, carinæ obscurely undulate, below at the middle with small lobe; third article of posterior tarsi little shorter than the first; pulvilli rounded below, first and second united shorter than the third.

Length of body, ♀, 9 mm.; pronot., 8 mm.; post. fem., 4.5 mm.

Locality, Guatemala (Bolivar).

Paratettix fallax, Bol., Ann. Soc. Ent. Belg., XXXI., 282 (1887); Morse, Biol. Cent. Am. Orth., ii., 12, 13, 14 (1900); Scudder, Index N. Am. Orth., 241 (1901).

TELMATETTIX MINUTUS, SP. N.

Plate VII., Figs. 5 6a.

Body small, slender, rugose-tuberculose. Color variable grayish or fuscous, with two indistinct subdepressed dark spots behind the shoulders; male frequently with the face below the eyes, lateral parts of body, and external portion of femora white. Crown of head between the eyes narrowed anteriorly, between the fronto-lateral carinæ the width is contained in the length about twice in the female, a little more than twice in the male; vertex about three-fourths the width of one of the eyes in the female, about one-half in the male, frontal margin sinuato-truncate not advanced quite so far as the anterior margin of the eyes, median carina moderately distinct, little projecting, on either side of median carina longitudinally canaliculate. Frontal costa in profile depressed, scarcely advanced before the eyes, viewed in front narrowly furcate, little compressed, separated very little wider opposite the median ocellus, in the male subparallel. Eyes globose. Antennæ slender. Pronotum rugose-tuberculose or sometimes sabulose-tuberculose, less rugose in male, anteriorly truncate, subconstricted before the shoulders, posteriorly the pronotal process passing the femoral knees from one-half to one and a half millimeters; dorsum nearly horizontal subdepressed, between the shoulders distinctly rugose-tuberculose, narrow, transversely scarcely convex, indistinctly bicarinate over the scapular portion of shoulders, the short anterior carinæ subcompresso-elevated; median carina of pronotum distinct, subsinuate, scarcely subcompressed anteriorly; scapular area narrow; elytral sinus of lateral lobes of pronotum shallow, posterior inferior angle distinct, the inferior margin subangulato-rounded. Elytra elongate-acuminate; wings fully developed, passing the pronotal process from one-half to one and eight-tenths millimeters. Femora entire, slender. First article of posterior tarsi very little longer than the third, the third pulvilli nearly as long as the first and second together, the first and second pulvilli acute, the third flat below.

Length of body, ♀, 10.5-11.9 mm.; pronot., 9-9.5 mm.;

post. fem., 5-5.2 mm.; ♂, body, 7.9-8.6 mm.; pronot., 6-7.5 mm.; post. fem., 3.7-4.1 mm. Intermediate form: ♀, body, 7.8-9.5 mm.; pronot., 6.6-8 mm.; post. fem., 4.2-5 mm.

Six females and eight males in the author's collection. One specimen from Soledad, V. C., Mex., is still smaller than given above, with the elytra narrower.

Locality, Cordova and Soledad, V. C., Mex. (Barrett) Hancock.

TELMATETTIX MINUTUS RUGOSUS, N. FORM.

Similar to the preceding *Telmatettix minutus*, distinguished by the slightly broader vertex, the median carina more projecting; the less tuberculose dorsum being lightly rugose-tuberculose; median carina hardly subobtusely compressed anteriorly; wings little passing the pronotal process, but the pronotal process abbreviated and not passing the apex of posterior femoral knees.

Length of body, ♀, to end of ovipositor, 9 mm.; pronot., 6-7.5 mm.; post. fem., 5-5.5 mm. Two females.

Locality, Cuernavaca Morelos, Mex. (Barrett) Hancock.

BATRACHIDINÆ.

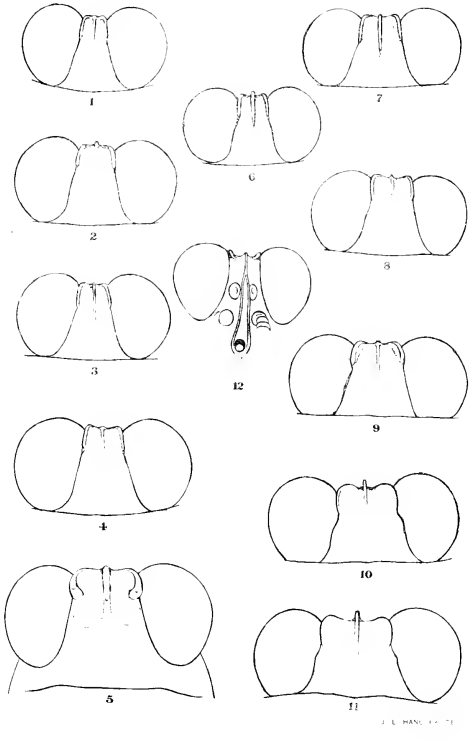
This section contains four genera with which we are here concerned, namely: Paxilla, Bol.; Tettigidea, Scudd.; Plectronotus, Morse; and Scaria, Bolivar. General characters: body slightly rugulose, granulose, or scabrous; the front vertical or slightly oblique; the vertex generally large and truncate in front, or slightly projecting; the frontal costa sometimes continued without sudden transition with that of the middle of the vertex, other times the vertex not being at all carinate; the frontal costa begins at the base or even frontal region, always sulcate from the base to the median ocellus, sometimes rather widely separated, usually narrow. Antennæ inserted on a line with the anterior inferior border of the eyes, and between the eyes, slender, generally moderately long, composed of sixteen to twenty-two segments, the first article being much larger than the others, the second globular and

small. The eyes large, very projecting, rounded, or depressed, not elevated, triangular in form, above covered by the small supra-ocular lobes of the vertex; the posterior ocelli placed in the median part of the frontal portion between the eyes. The maxillary palpi large with the apical segment more or less wide, depressed, and yellowish colored. The pronotum always tectiform, anteriorly advanced above the head covering the occiput, rounded, obtuse angulate or terminating in a small cusp directed forward between the eyes, posteriorly the process acute, variable in length; the lateral lobes more or less vertical and bisinuate at the posterior border, the inferior sinus being more often rounded and not angular, the posterior inferior angle straight, or acute angled, directed downwards and not, or scarcely, reflected. The elytra more or less rounded at the extremity and nearly always marked with a light spot near the extremity; the wings vary in length, being shortened in some and prolonged beyond the process of the pronotum in others. The legs entire; the anterior femora having the carina straight, not festooned, above; the posterior femora with the median external surface rather large, of regular form, with the interstices of the oblique folds granular or squamose; the posterior tibiæ larger toward the extremity, the carina multispinose, the first segment of the posterior tarsi scarcely longer and sometimes equally as long as the last, the pulvilli of the first segment rounded, not ending in a spine, at the same time being of equal length, or the last may be a little longer.

Batrachideæ, Bol., Ann. Soc. Ent., Belgique, xxxi, 119, 120 (1887).

GEN. PAXILLA, BOL.

Body rugulose, rather shiny; head broad. Vertex arcuate in front, on each side transversely carinate, middle longitudinally carinate. Frontal costa rounded, the base sulcate; antennæ short, having twenty to twenty-two articles somewhat distinct, inserted in the part inferiorly and between the eyes. Eyes not at all exserted, subtriangular. Pronotum tectiform, angulate in front, posteriorly subacute, not reach-



HEAD CHARACTERS

ing the apex of femora; dorsum rugulose, with no longitudinal rugæ, lateral carinæ in front of the shoulders wanting. Elytra narrow, wings abbreviated. Anterior femora with straight entire carinæ; posterior femora rather broad, external pagina subsquamate, pinnate, femoral lobe small, posterior tibiæ multispinose, externally sulcate; first article of the posterior tarsi sulcate above, elongate, little longer than the third article, pulvilli below rounded subequal in length.

Paxilla, Bolivar, Ann. Soc. Ent. Belgique, XXXI., 120 (1887).

Tettigidea, Scudder.

PAXILLA OBESA, SCUDD.

Plate II., Figs. 3–3a.

Shining nigro-fuliginous, the dorsum of pronotum sometimes dull plumbeo-testaceous; lower two-thirds of face of male and lower third of deflected lobe of pronotum pale clay brown; legs and elytra black, the posterior femora sometimes with an inferior premedian and preapical minute testaceous spot. Body very robust, unusually smooth, the entire head and pronotum being depressed, rugulose, and shining; all the angles rounded. Fastigium of vertex broadly rounded in front, scarcely projecting beyond the eyes, the median carina, continuous with the frontal carina, conspicuous and prominent, compressed though with rounded surface. Frontal costa very prominent, broadened slightly below, very narrowly sulcate; viewed from the side, projecting beyond the eyes fully half their width and broadly convex. Pronotum reaching the tip of the abdomen only, produced and very convex in front, its sides considerably deflected, the median carina being elevated and equal throughout, though obtuse and in profile somewhat arched. Elytra almost smooth; wings scarcely longer than the pronotum.

Length, ♂, 9 mm., ♀, 12 mm.; of antennæ, ♂, 3.75 mm., ♀, 4 mm.; of hind femora, ♂, 6 mm., ♀, 8 mm.

I can add very little to the excellent description above after Dr. Scudder. The type specimen which I have been

able to figure measures: ♀, length to end of ovipositor, fourteen millimeters, to end of pronotum, twelve millimerters. Mr. A. Bolter, of Chicago, found this specimen on the banks of the Halifax River at Port Orange, Florida, in April, 1875, and as he relates "in the neighborhood of a swampy place." The other specimens so far as known were taken by H. K. Morrison in Georgia, as given by Dr. Scudder.

Following is the translated description of Bolivar:

Black, ♀, or obscure fuscous, above plumbeous, front of head and sides of pronotum obliquely streaked with pale; ♂, somewhat shiny, granulate. Pronotum with the median carina regularly arcuate, dorsum somewhat rugulose-cicatrate, posterior process subacute. Elytra nearly smooth. Wings shorter than the pronotum. Anterior femora incostate, above obscurely sulcate, intermediate femora above sulcate, bicostate, external pagina longitudinally costate, incrassate, and subcrennulate, posterior femora with the external pagina covered with little scales. Valves of the ovipositor subscabrous.

Body length, ♂ ♀, 10-15 mm.; post. fem., 6-8,5 mm.

Tettigidea obesa, Scudder, Ent. Notes, VI., 12; Bost. Soc. Nat. Hist., Vol. XIX., 1877–78.

Locality, Georgia, Morrison (coll. of M. Bruner, of Bolivar, in Mus. Stockholm and in Geneva).

GEN. TETTIGIDEA, SCUDDER.

Body granulose-rugulose; front moderately oblique. Vertex strongly wider or equal in width to one of the eyes; antero-lateral carinæ terminating obliquely or rounded, middle carinate, more or less compresso-elevated. Frontal costa largely compressed, advanced before the eyes and above coalescing with the median carina of the vertex, viewed in front narrowly or moderately sulcate. Eyes in dorsal view more or less elyptic, conoidal in profile. Antennæ short, consisting of twenty-two articles. Pronotum obtuse tectiform between the shoulders, anterior margin rounded, angulate, acute, or cuspidate, posteriorly acute, more or less extenuate,

passing the posterior femora or abbreviated; median carina of pronotum conspicuous, acute; small lateral carinæ before the shoulders present; dorsum of prenotum granulose or provided with irregularly disposed longitudinal rugulæ, sometimes vein-like. Elytra towards the apex frequently marked by a pale spot; wings abbreviated or more frequently passing the apical process. Anterior femora above sulcate; middle femora externally generally unicostate; posterior femora with the external pagina possessing oblique bands, interstices granulose; first and third articles of posterior tarsi subequal in length or the first a little longer, the first, second, and third pulvilli increasing in length, or the second and third subequal, the inferior margin not at all spinose, usually straight below. Valves of ovipositor sub-scabrous or dentate.

Tettigidea, Scudder, Bost. Jour. N. Hist., vii., 476 (1862); Bolivar, Ann. Soc. Ent. Belgique, xxxi., 121 (1887).

DISPOSITION OF SPECIES.

1. Pronotum with the antero-dorsal margin acutely produced over the head covering the occiput, dorsum more or less longitudinally rugulose.
2. Vertex little advanced beyond the eyes; antero-dorsal margin of pronotum strongly produced terminating in sharply pointed cusp with excavate sides.
3. Pronotal process and wings passing posterior femora. *armata*, Morse.

3A. Apical process of pronotum abbreviated, wings abortive. *a. depressa*, Morse.

5. Eyes depressed, not prominent; vertex subconical, distinctly produced before the eyes, anterior carinæ strongly oblique; dorsal front margin of pronotum produced subrectangular, terminating in finely pointed deflected cusp. *apiculata*, Morse.
6. Dorsum transversely between the shoulders subconvex, smoothly granulose with faint irregular rugulæ, the produced antero-dorsal margin of pronotum lightly sinuate; eyes prominent. *acuta*, Morse.

7. Body slender, finely rugulose; dorsum between the shoulders narrower; median carina of pronotum less distinct. *spicata*, Morse.

1. 1. Pronotum with the dorsal front margin obtuse angulate or rounded.

8. Head in dorsal view distinctly conical; eyes not at all prominent; dorsal front margin of pronotum broadly convex, posteriorly abbreviated. *prorsa*, Scudd.

8A. Wings and pronotal process or wings alone passing beyond the posterior femora. *p. elongata*, Morse.

9. Vertex broad, with the frontal carinæ strongly oblique, the breadth about twice that of one of the eyes in the female, in the male strongly wider than one of the eyes; eyes not prominent; dorsal front margin of pronotum distinctly produced, obtuse-angulate.

10. Wings and pronotal process passing posterior femora. *parvipennis pennata*, Morse.

10A. Pronotum and wings abbreviated. *parvipennis*, Morse.

11. Body rugose-rugulose; antennæ slender; eyes prominent; dorsal front margin of pronotum lightly produced, obtuse-angulate or slightly convexo-angulate. *medialis*, var. n.

12. Dorsal front margin of pronotum broadly rounded, pronotal process and wings passing beyond the posterior femora. *lateralis*, Scudd.

12A. Pronotum and wings abbreviated. *polymorpha*, Scudd.

13. Body smoothly granulate; vertex obtuse, little advanced beyond the eyes, wider than one of them, frontal carina rounded; antero-dorsal margin of pronotum obtuse-angulate; pronotal process and wings passing posterior femora. Spec. Mexican, *jalapa*, Hanc.

14. Species resembling *chichimeca* with wings fully developed. Spec. Mexican, *australis*, Hanc.

15. Vertex narrower than one of the eyes, obtuse, little

advanced beyond the eyes; antero-dorsal margin of pronotum rounded-subangulate, dorsum almost deprived of the irregular longitudinal rugulæ; pronotal process scarcely passing posterior femora; wings fully developed. *guatemaltica*, Bol.

The following key to the species of Central America does not include any of the above mentioned species.

KEY TO SPECIES OF CENTRAL AMERICA.[*]

A. Vertex blunt, more or less truncate; eyes prominent.

B. Posterior sinus of the lateral lobes of the pronotum relatively shallow; vertex truncate.

C. Dorsum of pronotum smoothly granulate, horizontal, distinctly depressed at the shoulders. *bruneri*, Morse.

C. C. Dorsum of pronotum with conspicuous, nearly percurrent irregular longitudinal rugulæ; horizontal or somewhat depressed at the shoulders in the male, arched near the front margin in the female. *chichimeca*, Sauss.

B. B. Posterior sinus of the lateral lobes of the pronotum of usual depth; vertex scarcely truncate; pronotum granulate, horizontal in the male, a little arched in the female. *nicaraguæ*, Brun.

A. A. Vertex a little advanced, subangulate; pronotum decidedly arched longitudinally. *plagiata*, Morse.

A. A. A. Vertex advanced; eyes not prominent.

D. Vertex equal to or less than one of the eyes in width, the mid-carina well developed; anterior margin of the pronotum little produced, rounded; surface smoothly granulate, rugulæ barely visible; scapular area distinct, triangular, widest at the humeral angles; a very small and slender species. *parvula*, Morse.

D. D. Vertex wider than one of the eyes.

E. Scapular area absent; surface smoothly granulate;

[*] As some of the species mentioned are unknown to the present writer, the key here given is taken literally from Prof. A. P. Morse's article in the Biologia Centrali Americana.

anterior margin of the pronotum little advanced, rounded; mid-carina of vertex feebly developed. *nigra*, Morse.

E. E. Scapular area present, narrow; surface irregularly rugulose; anterior margin of the pronotum strongly advanced, angulate, or rounded-angulate; mid-carina of vertex well developed. *tecta*, Morse.

TETTIGIDEA ARMATA, MORSE.

Plate X., Fig. 6.

Very similar to *T. acuta*, Morse, differing in having a less projecting vertex, and a distinctly or strongly rugulose pronotum with sharp carinæ. The anterior margin of the pronotum usually more produced, with excavated sides, and terminating in a sharply pointed cusp. Median carina distinct, sharp, nearly horizontal, with sometimes a slight depression opposite the elytra. Wings and pronotum considerably passing the posterior femora.

Length of body, ♀, 15.4-18 mm.; pronot., 13.8-16.5 mm.; post. fem., 7-8.5 mm.; ♂, 12.8 mm.; pronot., 11.5 mm.; post. fem., 6 mm.; antennæ, ♂, 3.5 mm., ♀, 4-5 mm.; pronotum passing post. fem., ♂, 1.7 mm., ♀, 2.5-3.5 mm.; wings passing pronot., ♂, .7 mm., ♀, 1.1-1.7 mm.

Locality, Vigo Co., and Monroe Co., Ind. (Blatchley); Dune Park, Ind. (Hancock); Dallas, Texas (Morse); Chicago and Riverside, in Ill. (Hancock).

Tettigidea armata, Morse, Jour. N. Y. Ent. Soc., vii., 107 (1895); Blatchley, Orth. Ind., 22 (1897); Scudd., Cat. Orth. U. S., 18 (1900); Scudd., Index N. Am. Orth., 314 (1901).

TETTIGIDEA ARMATA DEPRESSA VAR., MORSE.

Differing from the preceding *T. armata* in having the pronotum equalling or not reaching the apex of posterior femora and the wings more or less abortive; the dorsum of the pronotum sinuate in profile, being more or less depressed between the shoulders, and at the pronotal apex.

Locality, Vigo County, Ind. (Blatchley); Dune Park, Ind. (Hancock); Jacksonville, Fla. (Ashmead); New Orleans, La. (Coleman); St. Johns River, Fla. (Allen); Ft. Reed, Fla. (Comstock) Morse.

Tettigidea armata depressa var., Morse, Jour. N. Y. Ent. Soc., iii., 107,108 (1895); Blatchley, Orth. Ind., 22 (1897); Scudd., Index N. Am. Orth., 314 (1901).

TETTIGIDEA APICULATA, MORSE.

Plate X., Fig. 2.

Body slender. Vertex considerably advanced before the eyes, recalling *prorsa*, once and a half (male), or twice (female) as wide as one of the eyes, not protuberant above. Eyes about twice as long as wide, little protuberant, surrounded by a slight but distinct lip. Carina large, much elevated on top of vertex, abruptly abbreviated opposite anterior part of eyes; strongly sinuous on face, protuberant opposite eyes, subexcavate below them. Pronotum cuspidate before, subulate behind, considerably passing the posterior femora, the dorsum coarsely and distinctly rugulose excepting on a narrow band over the shoulders and the lateral lobes which are granulose. Median carina distinct, acute. Anterior margin much produced over the head (one-half the distance between lateral carinæ), nearly rectangular, the sides sinuate, expanded next base and excavate next apex, terminating in a sharp, finely pointed and slightly deflected cusp, which reaches to the posterior end of the carina of vertex. Wings passing the pronotum. Posterior femora rather slender, elongate.

Dark reddish brown, paler on face and lower half of lateral lobes of pronotum, passing into luteous on posterior tibiæ.

Length of body, ♂, 13.7 mm.; pronot., 12.2 mm.; post. fem., 6 mm.; ♀, body, 18 mm.; pronot., 15.5 mm.; post. fem., 8.4 mm. Pronotum passing post. fem., ♂, 1.8 mm., ♀, 2.5 mm.; wings passing pronotum, ♂, 1.4 mm., ♀, 1.8 mm.

Locality, New Orleans, La. (Morse).

Tettigidea apiculata, Morse, Jour. N. Y. Ent. Soc., iii, 16 (1895); Scudd., Cat. Orth. U. S., 18 (1900); Scudd., Index N. Am. Orth., 314 (1901).

TETTIGIDEA ACUTA, MORSE.

Very similar to northern specimens of *T. lateralis*, differing as follows: Anterior margin of pronotum produced into an acutely pointed process, reaching nearly to the mid-carina of vertex; the latter is less prominent opposite the lower part of eyes and higher on top of head, and the occiput is less protuberant. Dorsum of pronotum smoothly granulated, with very faint, irregular rugulæ; mid-carina distinct, but slight, especially at shoulders, where the pronotum is nearly convex in cross section, instead of tectiform. From *apiculata* it may be readily distinguished by the vertex.

Color, brown to dark brownish fuscous, more or less of the top of pronotum straw-colored.

Elytral pale spots rather larger than in *lateralis*.

Length of body, ♀, 16.8-17.3 mm.; pronot., 15.5-15.8 mm.; hind fem., 8 mm.; pronotum passing hind femora, 1.5-2.5 mm.; wings passing pronotum, 1.-1.4 mm.

Locality, New York (Morse).

Tettigidea acuta, Morse, Jour. N. Y. Ent. Soc., iii, 15, 16 (1895); Scudd., Cat. Orth. U. S., 18 (1900); Scudd., Index N. Am. Orth., 314 (1901).

TETTIGIDEA SPICATA, MORSE.

Plate X., Fig. 5.

Body small, slender, intermediate in structure of vertex between *apiculata* and *armata*, but more nearly allied to the latter. Vertex more projecting than in *armata;* the body narrower between the shoulders; the lateral carinæ of pronotum slightly developed; the median carina less distinct; the dorsum more finely rugulose.

Length of body, ♂, 11.6 mm.; pronot., 10.5 mm.; post. fem., 5.5 mm.; ♀, body, 15.6-16.2 mm.; pronot., 14.4 mm.; post. fem., 7.6 mm. Antennæ of male 3.3 mm., ♀, 4 mm.

Pronotum passing post. fem., ♂, 1.7 mm., ♀, 2.5 mm.; wings passing pronotum, ♂, .7 mm., ♀, .7-1 mm.

Locality, Georgia and Florida (Morse).

Tettigidea spicata, Morse, Jour. N. Y. Ent. Soc., iii, 108 (1895); Scudd., Cat. Orth. U. S., 18 (1900); Scudder, Index N. Am. Orth., 316 (1901).

TETTIGIDEA PRORSA, SCUDD.

Plate X., Fig. 1.

Varying from dark testaceous to blackish, generally darkest on the sides, but the face and lower third of pronotum generally pale yellow in the male; antennæ luteous, black on apical fourth or less. Face more than usually oblique; eyes not so prominent as usual; fastigium broadening greatly in front, its anterior edge forming with the contour of the eyes an almost continuous curve, subangulated in front, giving the head a bluntly conical aspect, very different from that of any other known species; near the extreme tip of the fastigium commences a low, blunt, but moderately stout carina, continuing down the face as the frontal costa, where it is very prominent, compressed, equal, convex on side view and slenderly sulcate. Pronotum rather slender, but only as long as, or even shorter than, the abdomen, scabrous, the front margin broadly convex, the median carina distinct, but not very elevated, the outer edges beyond the sinus marginate, and between them and the median carina two or three vein-like dull longitudinal ridges. Tegmina nearly smooth, wings no longer than pronotum.

Length of body, ♂, 8.5 mm., ♀, 11 mm.; of antennæ, ♂, 3 mm., ♀, 3.6 mm.; of hind femora, ♂, 5 mm., ♀, 7 mm.

Locality, Georgia.

Tettigidea prorsa, Scudd., Proc. Bost. Jour. Nat. Hist., xix., 34, 35 (1877); Brun., Rept. U. S. Ent. Comm., iii., 61 (1883); Bolivar, Ann. Soc. Ent. de Belg., xxxi., 297 (1887); Scudd., Cat. Orth. U. S., 18 (1900); Morse, Jour. N. Y. Ent. Soc., iii., 16, pl. ii., figs. 4–4a (1898).

The above description is taken from Dr. Scudder's article.

TETTIGIDEA PRORSA ELONGATA VAR., MORSE.

This form is exactly like *prorsa*, but with the pronotum and wings, or wings alone, extending beyond the hind femora.

Length of body, ♂, 10.8 mm.; pronot., 8.6 mm., ♀, 13.2 mm.; pronot., 10.5 mm. Pronotum passing hind fem., ♂, .6 mm., ♀, .2 mm.; wings passing pronotum, ♂, 1. mm., ♀, 2. mm.

Locality, Georgia (Scudder and Henshaw), Morse.

Tettigidea prorsa elongata, Morse, Jour. N. Y. Ent. Soc., iii, 16 (1895); Scudd., Index N. Am. Orth., 316 (1901).

TETTIGIDEA PARVIPENNIS PENNATA, MORSE.

Plate X., Fig. 7.
Eggs Plate XI., Figs. 2–2a.

Body large in the female, comparatively small and slender in the male, granulose-rugulose. Vertex viewed from above scarcely more than twice or about twice the width of one of the eyes in the female, in the male considerably wider than one of the eyes,* front border obtuse angulate, strongly advanced before the eyes, the fronto-lateral carinæ oblique, little more rounded in the male, lateral margins of crown strongly sinuate, posteriorly widened, supra ophthalmic lobules conspicuous, median carina well developed anteriorly, in profile little arcuato-elevated above the eyes or in the male less prominent; the vertex little or barely elevated above the superior margin of the eyes. Frontal costa largely compresso-convex, narrowly sulcate beginning little below the fastigium and extending to the median ocellus, in profile strongly advanced before the eyes, equal to about one-half their length, the front below not at all sinuate and distinctly declined. Eyes elliptic not prominent, in profile distinctly conoidal. Last two apical articles of palpi depressed, color light. Antennæ rather short, stout, consisting of twenty-two

*This measurement refers to the extreme width between the fronto-lateral carinæ of vertex compared with the exposed portion of the eyes, as will be appreciated by reference to figures of vertex

articles more or less distinct. Pronotum anteriorly more or less produced over the occiput, distinctly angulate, the lateral margins of angle straight, posteriorly subulate acute, passing the posterior femora; dorsum granulose, longitudinally rugulose, frequently with distinct branching vein-like rugulæ more evident in the male, between the shoulders moderately broad, transversely tectiform, humeral angles widely obtuse, before the shoulders not constricted; median carina of pronotum prominent, little elevated, between and before the shoulders lightly arcuate sloping towards the front, posterior lateral carinæ conspicuous, midway longitudinal rugulæ often distinct on the process posteriorly. Lateral lobes of pronotum posteriorly bisinuate, the superior elytral sinus small and moderately shallow, the inferior sinus widely and subobtusely angulate incised, apex of the posterior inferior angle acute; scapular area moderately distinct elongate bicarinate above. Elytra elongate subacuminate, externally near the apex marked by a very small variable light spot; wings extending beyond the pronotal process about one and one-half millimeters or less. Femora entire; anterior femora above sulcate; middle femora externally distinctly unicostate; posterior femora moderately large, tibial carinæ distinctly multispinose, the first article of the posterior tarsi longer than the third, all the pulvilli from the first to the third gradually increasing in length, and straight below. Ovipositor strongly dentate.

Length of body, ♀ 14.8-17.5 mm.; pronot., 13.2-15.5 mm.; post. fem., 6.5-7.8 mm.; ♂, body, 12.2-13.2 mm.; pronot., 10-11.9 mm.; post. fem., 5.3-6 mm.

Locality, Illinois, represented by numerous specimens from Chicago (McDade, Brues, Hancock), Bloomington (C. C. Adams, M. J. Elrod), Winnetka (Logan, Hancock), Riverside (Hancock), Richmond (Hancock), Glen Ellyn (Gault, Hancock); Missouri (Adams); Kansas (Kahl); Indiana (Blatchley, Hancock); Wisconsin (Hancock); Minnesota (Westcott, Lugger); Iowa (Hancock); Ontario, L. Simcoe (Walker). Also recorded from New England states, N. Y., N. J., Penn., W. Va., and Ottawa, Canada.

Tettigidea parvipennis pennata, Morse, Jour. N. Y. Ent.

Soc., iii., 109 (1895); Blatchley, Can. Ent., XXX., 64 (1898); Needham, Insect Drift on Shore Lake Michigan, Occ., Memoirs Chic. Ent. Soc., V., No. 1, 24 (1900); Lugger, Orth. Minn. Univ., Minn. Agr. Exp. St. Bull., No. 55, 201 (1897); Scudder, Index Orth. N. Am., 315 (1901).

The color of the species varies extremely, frequently grayish or fuscous, the legs clouded with fuscous, or the dorsum may be light clay-yellow or ferrugineous, or with a light lateral stripe on each side; the femora often present a light spot externally above, little before the middle, in the male the face below the eyes and the lower portion of lateral lobes of pronotum and underneath the body light.

TETTIGIDEA PARVIPENNIS, MORSE.

Plate X., Fig. 8.

Fig. 3 text figure.

Similar to the preceding, *pennata*, with the body moderately robust in the female, the characters of the vertex nearly the same with barely less prominent eyes. The frontal costa distinctly convex; vertex in profile little more protuberant above the superior margin of the eyes. Dorsum of pronotum between and before the shoulders distinctly acute tectiform, the median carina anteriorly little arcuate, posteriorly substraight, lateral margins posteriorly straight, the apex of process acute or subacute, reaching to or very little passing the posterior femoral knees, apical portion sometimes depressed. Elytra elongate; wings abbreviated.

Length of body, ♀, 12.6-14 mm.; pronot., 12-13 mm.; post. fem., 6.8-8.1 mm.; ♂ body, 8.9-10 mm.; pronot., 8.2-9 mm.; post. fem., 5.3-5.5 mm.

A male and female of diminutive size from Minnesota, measured: ♀, 11 mm., ♂, 9.1 mm.; pronotum, ♀, 9.2 mm., ♂, 7.5 mm.; post. fem., ♀, 5.9 mm., ♂, 5 mm.

Tettigidea parvipennis—dimorphic form of *pennata*.

Locality, in Illinois, Chicago (McDade, Hancock), Glen Ellyn (Hancock), Winnetka (Hancock); in Missouri, Atherton (Adams); Kansas (Westcott); Maine, Freyburg (Morse); Min-

nesota, St. Anthony Park (Lugger); Indiana, Vigo County (Blatchley); L. Simcoe, Ontario (Walker). Reported from New England, N. Y., N. J., Penn., W. Va., Iowa, and Ottawa.

Tetrix parvipennis, Harris, Hitchc., Rept. Geol. Mass. 1st Ed., 583 (1833); Tettigidea parvipennis, Morse, Jour. N. Y. Ent. Soc., iii., 108, 109 (1895); Hanc., Trans. Am. Ent. Soc., xxiii., 242, 243, pl. 7, figs. 12–12a.; Ball., Proc. Iowa Acad. Sc., IV., 238 (1897); Scudd., Appal, VIII., 304 (1898); Blatchl., Can. Ent., XXX., 64 (1898); Walk., Can. Ent., XXX., 124 (1898); Scudd., Cat. Orth. U. S., 18 (1900); Scudd., Index N. Am. Orth., 315 (1901).

HABITS.

In openings in the woods, in places which had been bogey but which were now dried by the heat, I found a few *Tettigidea parvipennis*, both immature and mature specimens, and one or two *Tettix gibbosus* (Bowker's Grove, Ill., Aug. 30, 1897).

The male of *Tettigidea parvipennis* is quite prettily marked with white over the face and below in front on the pronotum on each side. The palpi are also of the same color and they are kept constantly in motion when the insect is feeding. These colors are more perceptible if viewed in profile and front. From above this ornamentation is obscured, only the somber earthen fuscous of the back, top of head, eyes and legs is seen. The female is not ornamented with white, except as to the palpi which are thus marked.

At Twin Lakes, Wisconsin, the author came to a spring in which the overflowing water passed down as a little brook to the shore of a large lake. In the neighborhood of the spring were butternut and a variety of luxuriant forest trees, and in the shade a natural black muck gave nourishment to a rich growth of lichens in the greatest variety, masses and other forms of both low and high orders. Even the tree trunks kept constantly moist were covered with green lichens. In these perpetually boggy surroundings Tettigids were found associated with crickets so abundant that the ground was sprinkled over with them. Most numerous were *Tettigidea parvipennis* while an occasional *Tettix granulatus* was seen. Nearer the spring *Tettix gibbosus* was most common. In all the author caught by hand sixty-seven. The color of *Tettigidea parvipennis* was amazingly variable, but every insect was perfectly in keeping with the environment. Here one would be on the lichens, another on the swamp grass, and still others on the black muck, and yet all generally speaking accorded with the surroundings. The dried specimens have changed since, so that the light clay ochre-yellow on the pronotum of some, and the spots of the same color on the dark ground on the femora have become dull. Whole rows of specimens which when fresh presented the prettiest variations now present a dark, uninteresting hue.—Aug. 27, 1898.

TETTIGIDEA LATERALIS, SCUDD.

Plate X., Fig 9.

Nearly allied to *pennata*. Body moderately large, distinctly granose-rugulose. Vertex in dorsal view little less than twice the width of one of the eyes in the female, in the male little wider than one of them, the fronto-lateral carinæ slightly oblique, little more rounded in the male, lateral margins of crown strongly sinuate, widened posteriorly, the supra ophthalmic lobules more or less conspicuous, median carina

hardly elevated, the crown in profile barely protuberant above the superior margin of the eyes. Frontal costa strongly advanced before the eyes, about half their length, lightly convex, compressed, narrowly sulcate. Eyes elliptic in dorsal view, conoidal in profile. Antennæ slender filiform. Pronotum anteriorly more or less rounded, lightly produced over the occiput, posteriorly subulate, acute, passing the posterior femora; dorsum distinctly rugose, granulose, with irregularly disposed longitudinal rugulæ, before the shoulders frequently strongly rugose, between the shoulders rather narrow, transversely tectiform, humeral angles widely obtuse; median carina of pronotum conspicuous, little elevated, subarcuate or subdepresso-arcuate anteriorly, lateral carinæ of pronotal process distinct; lateral lobes of pronotum posteriorly moderately bisinuate, posterior angle acute; scapular area appreciably narrow, more or less bicarinate above. Elytra elongate, more or less subrounded acute, marked near the apex with a light spot; wings extended beyond the pronotal apex about two millimeters or less. Femora entire; first and third articles of posterior tarsi subequal in length, the second and third pulvilli equal or subequal in length.

Length of body, ♀, 13.9-17 mm.; pronot., 11.2-14 mm.; post. fem., 6.5-7.6 mm.; ♂, body, 11.5-13 mm.; pronot., 9-10 mm.; post. fem., 5-6 mm.

Specimens from Louisiana and Texas appear larger than those from Florida, while those from southern Illinois are still stouter.

Locality, Missouri, Atherton (Adams); Louisiana, Opelousas (Pilate); Texas, Paige (Fickiessen); Indiana, Vigo Co. (Blatchley); Florida, Lake City, and Ft. Capron (Quaintance); Illinois, Johnson and Pulaski Counties (Gault); Tennessee (Morse); Georgia, Tifton (Pilate). Also recorded from Md., W. Va., Ky., N. C., and Miss.

Acridium laterale, Say Am. Ent., pl. 5 (1824).

Tetrix, 1st Ed., 583 (1833); Tettigidea lateralis, Scudd., Bost. Jour. Nat. Hist., vii, 477 (1862). See Scudder's Index N. Am. Orth., 314, 315 (1901), for complete bibliography.

TETTIGIDEA POLYMORPHA, SCUDD.

Plate X., Fig. 11.

Similar to *lateralis* slightly stouter, granulose, longitudinal rugulæ faintly indicated. Vertex broad, eyes prominent subglobose; the crown not or little protuberant above the eyes in profile. Frontal costa sulcate, the branches barely separated, subparallel. Pronotum anteriorly distinctly rounded, lightly produced over the occiput, posteriorly abbreviated obtuse or acute, not reaching apex of posterior femora; dorsum before the shoulders arcuate, transversely acute tectiform, between and behind the shoulders subdepressed; superior elytral sinus of lateral lobes shallow. Wings abortive; elytra small subrounded at the apex. Posterior femora moderately stout.

Length of body, ♀, 12 mm.; pronot., 10 mm.; post. fem., 7 mm.; ♂, body, 10 mm.; pronot., 9.5 mm.; post. fem., 5.5 mm.

Locality, Lake City, Fla. (Quaintance). Hancock, Maryland, West Virginia, southern Illinois, Kentucky, Tennessee, North Carolina, Mississippi, Louisiana, Texas, Georgia. Reported from northeastern states.

Tettix polymorpha, Burm., Haub. Ent., ii., 659 (1838); Tettigidea polymorpha, Scudd., Bost. Jour. Nat. Hist., vii, 447, 448 (1862).

The bibliography of this species as well as some of the others of this group is exceedingly confusing as several forms are referred to under one species. The typical form is undoubtedly from South Carolina. The above description applies to the form found in Florida, and it is not certain but that it is distinct.

Scudder, Index N. Am. Orth., 315, 316 (1901).

Morse's studies, Jour. N. Y. Ent. Soc., iii, 108, 109 (1895), brought forward certain evidence to show that *Tettigidea lateralis* of Say is confined to the southern states, the species inhabiting the northeastern states being *parvipennis* and its congenor *pennata*. My studies of considerable material confirms this view, but in addition there appears to be an intermediate form of *Tettigidea* from southern Illinois,

Missouri, Tennessee, and Louisiana, with possibly a more extensive range.

TETTIGIDEA MEDIALIS, VAR. X.

Plate X., Fig. 10.

Body slightly more robust than the Florida form *lateralis*. The pronotum anteriorly presents a rounded-angulate front margin instead of being distinctly rounded, produced slightly over the occiput; the dorsum rugose-rugulose, the tarsal characters intermediate. The maximum measurement given under *lateralis* applies to this form.

TETTIGIDEA JALAPA, HANC.

Plate X., Fig 4.
Plate II., Figs. 1–1a.

Rather large, granulate. Above fusco-ferruginous, dark fuscous over the entire face and sides, the last few segments at the end of the abdomen pale, legs pale throughout, the maxillary palpi a little depressed apically and light, below the edges of prominent points and abdominal rings light. Vertex a little wider than one of the eyes; nearly flat, hardly advanced before the eyes, widening posteriorly, the front border very little convex, passing laterally into small rounded and somewhat elevated carinæ ending abruptly near the anterior inner border of the eyes; on either side and just behind appear the small lobes situated about the middle inner margin of the eyes in small, sunken fossæ; mid-carina rather thin, extending backwards only as far as the ending of the lateral carinæ, very little elevated, in front insensibly coalescing with the frontal costa; in profile the apex obtusely rounded angulate, the frontal costa depresso-convex before the eyes and advanced about one-fourth their width; below the face moderately declined; viewed in front the frontal costa strongly sulcate, the branches commencing near the apex in front gradually diverging to the middle ocellus, and more than usually sepa-

rated. Eyes prominent and globose. Antennæ slender, reddish, inserted a little above and in front of the anterior inferior border of the eyes. Pronotum anteriorly angulate, the sides substraight, posteriorly long and subulate; the apex acute, passing the posterior femora; dorsum smoothly granulate, with no longitudinal wrinkles, or scarcely a vestige of vein-like arrangement of the granules between the shoulders; median carina distinctly elevated, nearly straight or gradually arched a little higher between and a little before the shoulders; humeral angles strongly obtuse; dorsum between the shoulders tectiform; the anterior carinæ near the margin curved, becoming a little divergent posteriorly; the borders of the posterior angle of the lateral lobe nearly form a right angle, acute at the apex; the posterior margin straight and vertical. Elytra nearly smooth externally, with a short, thick, oblique, pale spot near the apex. Femora entire; the anterior and middle femora somewhat slender; the posterior femora rather broad, the first article of the posterior tarsi equals the third in length; the pulvilli subrounded below, the third little the longest.

Length of body, ♂, 14.5 mm.; pronot., 12 mm.; post. fem., 7 mm. The wings extend beyond the apical process of the pronotum one millimeter.

Locality, Jalapa, Vera Cruz, Mexico, elevation 4,000 feet (Barrett), Hancock.

Tettigidea jalapa, Hancock, Can. Ent., xxxii, 25, 26 (1900), Mex.; Scudder, Index to N. Am. Orth., 314 (1901).

TETTIGIDEA CHICHIMECA AUSTRALIS, VAR., HANC.

Body rather small, fuscous, above ferruginous obscurely clouded with fuscous; face below the eyes light, spreading laterally over the lower portion of lateral lobes, pale underneath the abdomen; femora light, obscurely clouded; tibia a little more distinctly striped with fuscous. Vertex scarcely narrower than one of the eyes, obtuse, angulate, little advanced before the eyes, the front marginal carinæ directed obliquely backwards and ending near the anterior inner angle

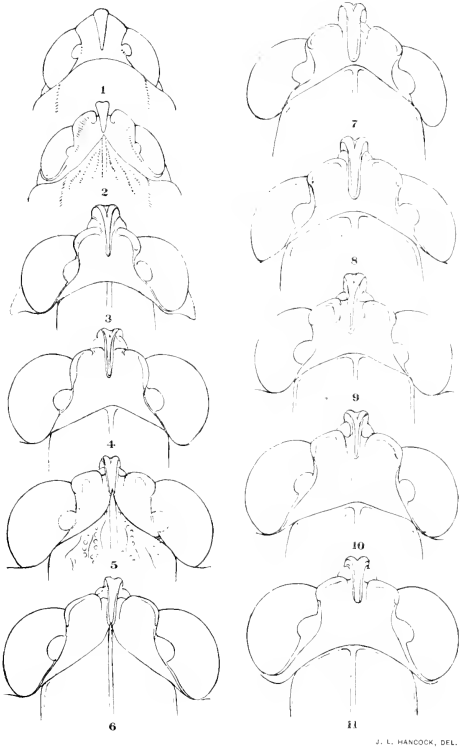
of the eye, where the eye is a little conically elevated, feebly sulcate on each side longitudinally, the little lobes not very distinct, middle carinate, posteriorly extending only as far as the lateral carinæ, anteriorly coalescing with the shining frontal costa; in profile the vertex obtusely rounded, advanced before the eyes about one-third their breadth, the frontal costa convex, the distance between the anterior margin of the frontal costa and that of the eyes widening considerably below; face below imperceptibly continued without being sinuate and quite declined; the apex strongly obtusely rounded. Viewed in front, the frontal costa sulcate commencing near the apex, the branches from here to the middle ocellus subparallel, and not so widely divergent as in jalapa. Pronotum with the dorsum anteriorly obtusely angulate, the sides a little convex, posteriorly subulate acute, passing the posterior femora; dorsum granulate, with an indistinct longitudinal wrinkle on either side running parallel with the humeral angles, otherwise scarcely rugose; median carina distinctly elevated, gradually but slightly arcuate between the shoulders, sloping to the front margin; anterior lateral carina near the front margin substraight and subdivergent posteriorly; humeral angles strongly sloping laterally, viewed in front obtuse, between the shoulders convex, median carina clouded with fuscous. Elytra almost smooth, dark externally, marked with a minute light oblique line near the apex. Wings extended beyond the apex of pronotum. Femoral carinæ entire, posterior femora quite large, the first and third articles of the posterior tarsi about equal in length, all the pulvilli of equal length.

Length of body, ♂, 11 mm.; pronot., 9.5 mm.; post. fem., 5.5 mm. Wings extending about one millimeter beyond the process of pronotum.

Locality, Cuernavaca Morelos, Mexico (Barrett) Hancock.

Tettigidea chichimeca australis, Hancock, Can. Ent., xxxii, 26, 27 (1900), Mex.

Scudder, Index N. Am. Orth., 314 (1901).



J. L. HANCOCK, DEL.

HEAD CHARACTERS

TETTIGIDEA GUATEMALTECA, BOL.

Plate X., Fig. 3.

Light gray fusco-variegated, femora clouded with fuscous. Vertex narrower than one of the eyes, front border obtuse, little produced, middle carinate, in profile rounded. Pronotum anteriorly rounded-subangulate, posteriorly subulate, the apex scarcely passing the posterior femora; dorsum nearly smooth with longitudinal rugulæ almost obscure; between the shoulders convex; median carina of pronotum little elevated, marked with light fuscous; lateral carinæ near the front margin showing, curved, diverging behind. Elytra smooth, fuscous, externally pale, marked with a pale oblique spot before the apex; wings long posteriorly extended beyond the apex of the pronotum. Posterior femora minutely granulate; first article of posterior tarsi with the pulvilli below subrounded, the third little the longest.

Length of body, ♀, 10 mm.; pronot., 10.5 mm.; post. fem., 6 mm.

Locality, Guatemala (Bolivar); Honduras (Staudinger), Hancock.

Tettigidea guatemalteca, Bol., Ann. Soc. Ent. Belg. xxxi, 298 (1887); Morse, Biol. Cent. Am. Orth., ii, 15, 18 (1900-1901); Scudd., Index N. Am. Orth., 314 (1901).

TETTIGIDEA BRUNERI, MORSE.

Eyes prominent, globose, vertex blunt, nearly truncate, equal to (♂), or wider than (♀), one of the eyes, horizontal, the crown of the female a little elevated; the mid-carina well developed, extending but little backward. Facial costa prominent, widest below, rather widely sulcate. Pronotum granulate, tectiform, distinctly depressed at the shoulders; front margin little advanced; hind process abbreviated, not reaching the apex of the hind femora, depressed, sometimes a little reflected at the tip, sides straight; scapular area barely indicated or lacking entirely; median carina prominent, sharp, subcristiform; lateral carinæ well developed near the front

margin, parallel, acutely divergent behind, obsolete in front of the principal sulcus; posterior sinus of the lateral lobes shallow, one-third to two-thirds as deep as the anterior lobes. Hind femora robust, margins of the apex concave, genicular and femoral lobes well developed.

General color brown; face, vertex, and apex of abdomen pale yellow; mid-carina of pronotum sometimes spotted with fuscous. A notable color variation is that presented by one female, in which the eyes, the top of the head, and the anterior portion of the pronotum (in the form of a triangle whose apex reaches the first sulcus) are yellow.

Total length, ♂, 9-10.5 mm., ♀, 13-14 mm.; pronot., ♂, 7.5-8.3 mm., ♀, 10.5-11 mm.; post. fem., ♂, 6-6.5 mm., ♀, 7.5-8 mm.; antennæ, ♂, 3.5-4 mm., ♀, 4-4.5 mm.

Locality, Mexico (colls. Bruner and Scudder), Morse.

Tettigidea bruneri, Morse, Biol. Cent. Am. Orth., II., 15, 16 (1900), Mex.; Scudder, Index N. Am. Orth., 314 (1901).

TETTIGIDEA CHICHIMECA, SAUSS.

Fuscous, frequently pale; femora marked with yellow, tibia reddish; granulose. Vertex anteriorly obtuse angulate. Pronotum anteriorly obtuse angulate, posteriorly acute, apex not passing the femora; median carina towards the head distinctly arcuate-declivitous; lateral carinæ behind the anterior margin distinct, backwards subdiverging; dorsum longitudinally rugulose. Elytra externally rufescent, marked near apex; wings abbreviated. Posterior femora broad, granose-strigate; first article of posterior tarsi with the pulvilli subequal in length.

Length of body, ♂, 10 mm.; pronot., 9 mm.; post. fem., 6 mm.

Locality, Mexico.

Tettix chichimeca, Sauss., Rev. et. Mag. de Zoöl., xiii, 400 (1861); Tettigidea chichimeca, Bol., Ann. Soc. Ent. Belgique, xxxi, 296 (1887); Morse, Biol. Cent. Am. Orth., ii, 15, 16 (1900).

TETTIGIDEA NICARAGUAE, BRUNER.

About the size of *T. lateralis*, Say, but without the longitudinal ridges upon the dorsum of pronotum as in that species. Its general color much darker than in any described species except *T. multicostata*, Bolivar, from Brazil. Eyes a little larger and more prominent than usual in the genus, separated by a space about equal to their diameter, the vertex more bulging than in the described known species, viewed from the side projecting considerably above the upper edges of the eyes, but little constricted in the middle, the front angles broadly rounded and only slightly carinated just in advance of the constriction; median carina prominent and forming with the frontal costa a well rounded projection in advance of the eyes when viewed from the side; the frontal costa quite wide, sulcate from the fastigium to the ocellus and tuberculate as in the rest of the face. Pronotum with its front edge well rounded and advanced upon the occiput, the lateral angles of shoulders broadly rounded and the posterior edge long and acutely produced, extending beyond the tips of the hind femora, the median carina sharp and prominent throughout, the dorsal surface rather coarsely granulate and lacking the usual longitudinal ridges found in the other species of the genus. Posterior femora moderately heavy and slightly surpassing the tip of abdomen in both sexes.

General color, dark brown, inclining to dull black. The legs and slender apical portion of pronotum mottled with lighter and darker shades, the former with a decidedly banded appearance.

Length of body, ♂, 9.5 mm., ♀, 13.5 mm.; pronot., ♂, 10.25 mm., ♀, 15 mm.; post. fem., ♂, 5.3 mm., ♀, 7.85 mm.; width of pronotum, ♂, 2.5 mm., ♀, 3.5 mm. (Bruner).

Locality, Nicaragua, Central America (Bruner); Mexico (Morse).

Tettigidea nicaraguae, Brun., Bull. Lab. Nat. Hist. Univ. Iowa, iii, pt., 3, 62, 63, figs. (1895); Morse, Biol. Cent. Am. Orth., ii, 15, 16 (1900).

Morse says of this species: "This is the largest species of

the genus that I have seen from Central America, and is noticeably dimorphic in wing-length." He gives the following measurements:

Total length, short-winged, ♂, 11 mm., ♀, 14-16 mm.; long-winged, ♂, 12.8-13.5 mm., ♀, 17-18 mm.; pronotum, short-winged, ♂, 10.3-10.4 mm., ♀, 13.2-14 mm.; long-winged, ♂, 10.5-12 mm., ♀, 15-16.2 mm.; post. fem., ♂, 5.6-7.3 mm., ♀, 7.8-9 mm.; antennæ, ♂, 4 mm., ♀, 4.5 mm.

For convenience the short-wing form may be known as *Tettigidea nicaraguæ brevis*.

TETTIGIDEA PLAGIATA, MORSE.

Antennæ filiform, very slender. Eyes scarcely subprominent. Vertex and crown distinctly convex, faintly excavated at the sides; vertex advanced, subangulate, a little wider than one of the eyes, the sides parallel, the mid-carina small, little produced backward. Facial costa narrow throughout, widest below. Pronotum convex-tectiform, arched longitudinally, the surface granulate, with faint, short, irregular rugulæ; the anterior margin advanced one-fourth its width, rounded angulate; median carina prominent, acute; lateral carinæ obsolete anteriorly, distinct behind the principal sulcus; scapular area reduced to a mere line; hind process long-subulate, passing posterior femora 1.8 millimeters, exceeded 1.4 millimeters by the wings; lateral lobes with the upper sinus rather deeper than usual. Elytra large, long-elliptical, with an oblique subapical pale bar. Femora slender, the posterior pair with a narrow pale streak bounding the lower margin of the external pagina internally.

Length of body, ♂, 13.5 mm.; pronotum, 11.8 mm.; post. fem., 6.4 mm.; antennæ, 3.5 mm.

Locality, Mexico, Cuernavaca, in Morelos (H. H. Smith); Chilpancingo (Smith).

Tettigidea plagiata, Morse, Biol. Cent. Am. Orth., ii, 15, 17, fig. (1901); Scudder, Index N. Am. Orth., 315 (1901).

TETTIGIDEA PARVULA, MORSE.

Plate III., Fig. 7.

Antennæ slender, filiform. Vertex narrow, equal to or barely as wide as one of the eyes; median carina prominent. Facial costa prominent, narrowly sulcate, widest below. Pronotum punctate or smoothly granulate, with a few indistinct longitudinal rugulæ on the shoulders, the humero-apical carinulæ distinct, bounding a well-marked scapular area, which is widest at the humeral angles; hind process subulate. Elytra widest subapically, obliquely truncate at the apex, with a subapical oblique pale bar. Wings fully developed. Hind femora robust, margins of the apex but little concave.

Length of body, ♂, 10.5 mm.; pronot., 8.5 mm.; post. fem., 5 mm.; ♀, body, 12.5 mm.; pronot., 10 mm.; post. fem., 6 mm.; antennæ, ♂, 3.5 mm., ♀, 3.5 mm.

Locality, Mexico, Cuernavaca, in Morelos (H. H. Smith).

Tettigidea parvula, Morse, Biol. Cent. Am. Orth., ii, 15, 17, fig. (1901). Two males and two females.

Morse says of this species: "This is the smallest and most slender species of *Tettigidea* known to me. It resembles *T. plagiata* in the general form of the body, but the hind femora are proportionally stouter, the facial costa is more prominent, the crown less elevated, the vertex narrower, and the size much smaller. It may possibly prove to be referable to *T. guatemalteca*, Bolivar."

TETTIGIDEA NIGRA, MORSE.

Plate III., Fig. 8.

Vertex and crown strongly convex above, a little less angulate in front than in *T. Tecta;* the median carina smaller, less prolonged backward, barely reaching the level of the eyes. Facial costa narrowly sulcate, the upper part narrower, with parallel sides. Pronotum tectiform, median carina prominent, subcristiform; the surface smooth, finely granulate, the transverse sulci impressed; scapular wanting or very

nearly so; front margin rounded-angulate, advanced one-fourth to one-third its width; hind process abbreviated, not reaching the end of the femora; lateral lobes with the posterior sinus of usual size, sometimes a little shallow. Elytra of usual size and form, with a subapical oblique pale bar. Wings absent. Color black, except the face below the eyes, the apex of the pronotum, and the apex and venter of the abdomen; tibiæ and tarsi fasciated with fuscous.

Length of body, ♂, 8.5-9 mm.; pronot., 8-8.5 mm.; post. fem., 5.5-6.4 mm.

Locality, Mexico, Xucumanatlan, Omilteme in Guerrero, 7,000 to 8,000 feet (H. H. Smith).

Three males. In color this species presents a notable exception to the general reddish brown hue prevalent in the genus (Morse).

Tettigidea nigra, Morse, Biol. Cent. Am. Orth., ii, 15, 18 fig. (1901); Scudder, Index N. Am. Orth., 315 (1901).

TETTIGIDEA TECTA, MORSE.

Vertex horizontal, advanced before the eyes a distance equal to one-fourth its width, angulate, with subprominent median carina, which extends well backwards; the lateral margins converging backwards to its narrowest part just in front of the coronal lobes, where its width is one and a half times that of one of the eyes. Facial costa with upper and lower halves nearly equal in width. Pronotum distinctly tectiform, especially in the female; the anterior margin strongly advanced, one-third its width or a little more, parallel to the sides of the vertex, angulate at the apex; surface smoothly granulate; median and lateral carinæ prominent, with two to four irregular additional rugulæ; scapular area present, narrow; posterior sinus of the lateral lobes shallow; hind process abbreviated. Elytra rather shallow, long-elliptic, unmarked. Wings absent. Femora stout, especially the posterior pair, in which the upper margin of the external pagina is distinctly convex and that of the femur itself straight.

Length of body, ♂, 9 mm.; pronot., 8.5 mm.; post. fem.,

5.5 mm.; ♀, body, 12.5 mm.; pronot., 11 mm.; post. fem., 6.5 mm.

Locality, Mexico, Cindad, in Durango, 8,100 feet (Farrer).

Two males and one female. This species resembles *T. prorsa*, but differs from it in the more angular front margin of the pronotum, wider vertex, more prominent eyes, and stouter hind femora (Morse).

Tettigidea tecta, Morse, Biol. Cent. Am. Orth., 15, 17, 18 (1901); Scudder, Index N. Am. Orth., 316 (1901).

GEN. PLECTRONOTUS, MORSE.

Nearly allied to Tettigidea in general structure, but differing from it in the form of the facial costa, the minute elongate elytra, and especially in the structure of the pronotum, which is coarsely scabrous, with the posterior sinus of the lateral lobes all but obsolete and the angles a little reflected.

Plectronotus, Morse, Biol. Cent. Am. Orth., ii, 14 (1900).

PLECTRONOTUS SCABER, MORSE.

Antennæ, 21-22-jointed, slender, filiform, about reaching the base of the hind femora. Eyes of moderate size prominent. Vertex scarcely (♂), or one and one-half times (♀), as wide as one of the eyes, truncate in front, the mid-carina of moderate size and but little produced backwards; the front margin transversely carinate, the carinulæ and surface immediately behind them slightly depressed. Crown horizontal. Facial costa rather broadly sulcate, the margins sinuous, approximated below the points of insertion of the antennæ; in profile, strongly convex opposite the lower margin of the eyes, moderately concave opposite the middle of them. Pronotum tectiform very coarsely scabrous, granulate; the front margin advanced, with concave sides and uncinate apex extending to the end of the mid-carina of the vertex, a little behind the level of the front of the eyes; the hind process abbreviated, its sides convex, apex acute; lateral lobes rather deep, the posterior angles acute, somewhat rounded at the tip and turned a little outward, the posterior sinus barely indi-

cated; mid-carina subcristiform, sinuate, depressed at the shoulders, elevated and subcompressed in front of them; lateral carinæ well developed, coarsely granulate-tuberculate on the humeral angles, which are very obtuse. Elytra minute (less than 1 mm. in length), elongate, rounded at the apex, the lower margin pale yellow. Legs much as in Tettigidea, but somewhat less stout; pulvilli of first joint of hind tarsi small.

Length of body, ♂, 9 mm., ♀, 12 mm.; pronotum, ♂, 7 mm., ♀, 10 mm.; post. fem., ♂, 5.4 mm., ♀, 7 mm.; antennæ, ♂, 5.5 mm., ♀, 6 mm.; post. fem. beyond pronotum, ♂, 1.5 mm., ♀, 1.5 mm.

Locality, Costa Rica, Cache (Rogers), Morse.

Morse, Biol. Cent. Am. Orth., ii, 14 figs. (1900); Scudd., Index N. Am. Orth., 270 (1901).

GEN. SCARIA, BOL.

Body slender, nearly smooth. Face strongly oblique. Eyes strongly globose. Vertex narrower than one of the eyes. Frontal costa sulcate, middle compresso-elevated, at the vertex abruptly abbreviated. Antennæ elongate, filliform. Palpi with the apical article longer than the penultimate, widely compressed. Dorsum of pronotum nearly plane, anteriorly more or less compressed, acutely produced, hooked, posteriorly long, extended beyond the apex of femora, median carina towards the front ascendant, posteriorly subdepressed; lateral carinæ behind the anterior margin subobsolete; humeral angles obtuse almost straight. Elytra oblong, frequently punctate towards the apex with yellow spot; wings perfectly explicate.

Femora carinate; superior carina of intermediate femora with the apex produced in a spine; femoral spine small; genicular spine nearly absent; first article of posterior tarsi subequal in length to the third.

Scaria, Bolivar, Ann. Soc. Ent. Belgique, XXXI., 127 (1887); Morse, Biol. Cent. Am. Orth., ii, 19 (1901).

SCARIA HAMATA, BOL.

Olivaceous, on either side widely streaked longitudinally with black; inferior margins of lateral lobes of pronotum yellow; underneath the body, head, and legs pale rufescent; labrum fuscous; elytra black, yellow punctate before the apex; posterior femora below streaked with fuscous. Pronotum anteriorly little compressed. Wings passing beyond the pronotal apex, fuscous. Anterior femora with or without small spine. Median carina of pronotum percurrent, in the male depressed shortly behind the shoulders. Posterior tibiæ ferruginous, superior lateral margins towards apex lightly dilated, minutely serrulate, also dentate, internal margin near the apex unarmed.

Length of body, ♂ ♀, 9-12 mm.; pronot., 11.5-14 mm.; post. fem., 5.5-6.5 mm.

Locality. Surinam, Hautes Amazonus (Bolivar); Cayenne (Bolivar); Nicaragua (Bruner); Bolivia (Staudinger), Hancock; Guiana (Morse).

Scaria hamata, Bol. Ann. Soc. Ent. Belgique, XXXI., 127 (1887); Brun. Bull. Lab. Nat. Hist. Univ. Iowa, iii. 3, 62 (1900); Morse, Biol. Cent. Am. Orth., ii, 19 (1901).

Tettix hamatus of Stal, Acrydium hamatum of De Geer (1773).

THE UNITED STATES NATIONAL MUSEUM COLLECTION.

The United States National Museum Collection is represented by seven genera and thirty-four species and varieties, as follows:*

Nomotettix compressus, Morse.
Washington, D. C. (Riley); Cent. Missouri (Riley); Lakeland, Md. (Pratt); Virginia (Riley).

Nomotettix floridanus, Hanc.
Baldwin, Fla. (Schwarz).

Tettix acadicus, Scudd.
N. New Mexico (Riley); San Louis, Col. (Bruner); Wyoming (Riley).

Tettix hancocki, Morse.
Wyoming (Morrison); St. Louis, Mo. (Riley); Nebraska (Riley); Swift Current, Brit. America (Riley); Oregon, Mo. (Kanker).

Tettix hancocki abbreviatus, Morse.
Las Vegas, N. Mexico (Barber and Schwarz); Webster Point, Neb. (Riley); Constantine, Mich. (Riley).

Tettix crassus, Morse.
Constantine, Mich. (Riley); West Point, Neb. (Riley).

Tettix ornatus, Harris.
Wyoming (Riley); Oregon, Mo. (Kanker); West Point, Neb.

Tettix arenosus, Burm.
Georgia (Morrison); Lakeland, Md. (Pratt).

Tettix blatchleyi, Hanc.
New York.
One female similar to type from Florida, but also resembling *T. gibbosus*, Hanc.

Tettix obscuras, Hanc.
Indiana; Washington, D. C.; Jackson Co., Ill. (French); Constantine, Mich. (Townsend); Douglas Co. Kan. (Gamner); West Point, Neb.; Central Ill.; Central Mo.; Tennessee (Riley); Indiana (Bollman).

Tettix gibbosus, Hanc.
West Point, Neb.; Central Mo. (Riley).

Tettix granulatus, Scudd.
Constantine, Mich. (Townsend); Wyoming (Riley); Colorado (Cockerell); Graham's Park, Col. (Baker); Garland, Col. (Riley); Am. Fork, Utah (Schwartz).

Tettix granulatus variegatus, Hanc.
Van Couver Is. (Riley); Placer Co., Cal. (Kocheie).

Neotettix rotundifrons, Hanc.
Georgia (Morrison).

*This collection, comprising three hundred and thirty-two specimens, was placed at my disposal after the MS. was partly in type.

Neotettix bolivari, Hanc.

Bloomington, Ind.; Jacksonville, Fla. (Schwarz).

Neotettix bolivari longipennis, var. new.

Resembling *N. bolivari*, Hanc., but with the pronotum and wings extending beyond the posterior femora.

Length body (entire) ♂, 11.5 mm.; pronot. 9 mm.; post. fem. 5.6 mm.

Wings pass pronotal process 1.1 mm.; pronotum pass femora 1.1 mm.

Locality, Columbus, Tex. (Riley).

Neotettix coarctatus, sp. n.

Vertex similar to *N. bolivari*; the body smaller and more compact.

This species is further distinguished from *bolivari* by the rugose surface of the pronotum, the more angulate shoulders, the dorsum behind the shoulders being slightly compressed; the external femoral pagina rugose.

Color, dark fuscous, with two black spots on the pronotum.

Length body (entire), ♀, 8 mm.; pronot. 6.8 mm.; post. fem. 5 mm.

Locality, New Mexico; Cocoanut Grove, Fla. (Riley).

Neotettix variabilis, sp. n.

Allied to *N. rotundatrons*, body small, rugose, tuberculose. Vertex strongly wider than one of the eyes, middle carinate, in profile roundly elevated but scarcely higher than the eyes. Frontal costa widely sulcate, above fusing with the medium carina of the vertex, in profile depresso-convex, advanced before the eyes. Pronotum rugose, tuberculose; dorsum between the shoulders narrow, humeral angles obtuse. Femora entire, rugose, pilose. Elytra small, elongate, wings only slightly developed. Color, grayish, reticulated with fuscous.

Length body, ♀, 8 mm.; pronot. 7 mm.; post. fem. 4.8 mm.

Locality, Cocoanut Grove, Fla. (Riley).

Paratettix cucullatus, Morse.

Missouri (Riley); Washington, D. C. (Riley); Ohio; Ames, Iowa.

Paratettix texanus, Hanc.

New Orleans, La. (Shufeldt); Tennessee; Am. Fork, Utah (Schwarz); Lake Drummond, Dismal Swamp, Va. (Palmer).

"Under old leaves near Brazos River, Columbia, Texas" (E. A. Schwarz).

Paratettix morsei, Hanc.

Los Angeles, Cal. (Coquillet); Ft. Grant, Ariz.; Natoma, Cal.; Santa Cruz, Cal.; var. from Panamint, Cal. (Koebele).

In the series are some resembling *tolteeus*.

Paratettix morsei extensus, var. Hanc.

A variety approaching *mexicanus* from Los Angeles, Cal. (Coquillet).

Paratettix morsei extensus, Hanc.

Ft. Grant, Arizona (Riley); Natoma, Cal.; Santa Cruz, Cal. (Koebele).

Pronotum broad between the shoulders, the median carina prominent and arcuate anteriorly; body larger than in type forms.

Telmatettix, aridus, Hanc.

Los Angeles, Cal. (Coquillet).

Telmatettix parviverticis, Hanc.

Ft. Grant, Ariz. (Riley).

Telmatettix parviverticis, var., Hanc.

Panimint, Cal. (Koebele).

Paxilla obesa, Bol.

Jacksonville, Fla. (Ashmead).

Tettigidea lateralis, Scudd.

Pensacola, Fla. (Bollman); New Orleans, La. (Shufeldt).

Tettigidea medialis, Hanc.

Central Missouri (Riley); Washington, D. C. (Riley); Baden, Mo. (Riley); Virginia (Riley); Georgia (Morrison); Indiana (Bollman).

Tettigidea apiculata, Morse.

Florida (Morrison).

Tettigidea armata, Morse.

South Louisiana (Townsend); Florida (Morrison); New Orleans, La. (Riley).

Tettigidea armata depressa, Morse.

South Louisiana (Townsend).

Tettigidea parvipennis, Morse.

Constantine, Mich. (Riley); West Point, Neb. (Riley).

Tettigidea parvipennis pennata, Morse.

Constantine, Mich. (Riley); Ohio; West Point, Neb. (Riley); Iowa (Gillette); Carbondale, Ill. (French).

VIVARIUM EXPERIMENTS.

METHOD.

The vivarium jars used in the following experiments are what are known as liquid battery jars, of a size 7¼ by 8¼ inches and of clear glass. In the bottom sufficient earth was used to support live vegetation, usually transplanted intact from the natural environment of Tettigids. Grass seeds were occasionally fed or allowed to grow in the jars for the comfort of the occupants. It becomes necessary sometimes to transfer species when they show the slightest indications of failing vitality. Water freely supplied, of course, is a necessary adjunct to their well-being. Even with due care after a time, or in the course of weeks or months, the males frequently die, as they are weaker than the females. A thin veiling tied on the mouth of the jars is a necessary precaution to prevent their escape. Some species take kindly to their new quarters in a short time, and when first introducing the species in the jars, if kept in moderate darkness for a day or two they are not so liable to bodily injury. A few individuals in each jar will survive much longer than when overcrowding is attempted. A little numbered tag is useful in marking the site where eggs are laid.

EXPERIMENTAL OBSERVATIONS OF TETTIGIDS.

In a jar in a window exposed to the southeast, the Tettigids are enjoying the sunshine. The bottom of this jar is covered with rich black loam, retaining the original surface transferred from the locality where the species were taken. This includes microscopic plants such as algæ, lichens, and mosses. The little collection of five insects recently inclosed comprises one female *Paratettix* with long wings, two female and three male *Tettix*, besides a *Tettigidea parvipennis*. The *Tettix* are short-wing forms and one of the females, found in oak woods, had a strongly carinate pronotum. The other specimens were taken from a swampy locality.

HABITS IN CONFINEMENT.

The author saw a male *Tettix* approach the female *Paratettix* several times, and she even allowed him to climb on her back, but she refused to spread one of the femora from the side of the pronotum to conjugate.

The *Paratettix* shows more restlessness than any of the other Tettigids. She frequently exercises her wings flying to the netting above. *Tettigidea parvipennis* is a quiet, passive species in confinement and a vociferous eater. The amount of excrement she passes litters up the jar in a short time. The long-wing forms of all species are of course more active, owing to a desire to exercise their wing power. A little fresh black muck placed in the jar at intervals is selected at once by the little occupants for food, which they gather around and eat with a relish. July 4, 1901.

HATCHING OF TETTIX ORNATUS.

At eleven minutes of three p. m. I discovered in jar No. 1 a new brood issuing from the ground. Three have come out, while following close in the trail come two together, pushing the last one ahead. A few moments after the first came out it jumped two inches away. There was one that came out previous to my first observation. I saw a pale specimen alone, one inch away, and suppose it is one of the brood, six in all. There is a probability that some came out before this. There is a determination to get away from the egg site as soon as the locust emerges, each walking toward the source of light in the jar. Instantly after the amnion is shed the little Tettigids stand on their feet, getting their equilibrium. Sometimes the insect by forcible convulsive motion of the body succeeds in breaking the egg shell and comes up out of the ground with the amnion still intact; then by an expanding movement of the legs the amnion tears open and the young set free at once find a footing on the ground. In another instant it may be walking quite freely away or even jump, if disturbed, a distance of one or two inches. June 14, 1868.

TETTIX ORNATUS HATCHING IN JUNE.

A brood hatched in my absence to-day in jar 1. I saw about half-a-dozen specimens, still pale, on my return. June 15, 1868.

ECDYSIS OF TETTIX ORNATUS—SECOND EXUVIATION—DIVERGENCE OF COLORING IN THE SAME BROOD.

There is evidence in my vivarium jars that the brood hatching May 31 are shedding their skins for the second time. One under my eyes has climbed upon a grass blade an inch from the ground and is pale. Near it, an eighth of an inch away, clinging to the grass, is the cast-off cuticle. Three others evince ecdysis having taken place to-day. The first shedding occurred on the tenth and eleventh days of the present month (eight and nine days ago); June 10, 1868. The following day I found new evidence of exuviation by the discovery of a specimen emerging from the cuticle. It was pale, as usual, though some slight pigmentation was observable. Another specimen of reddish color cast its skin. In the seven specimens left of this brood hatched May 31 there is considerable divergence in the variety of ornamentation, showing this peculiarity extends to individuals of the same brood.

BROOD OF TETTIX ORNATUS HATCHED, CONSISTING OF TWELVE SPECIMENS—TARDINESS IN HATCHING OF TWO SPECIMENS.

I found a brood coming out of the ground at 1 o'clock p. m., which consisted then of ten specimens. They came out as usual, one after another, but at 2:30 p. m. another tardy individual appeared, making eleven up to this time. Again at 4:25 p. m. another hatched, making twelve in all. June 20, 1868.

THE NUMBER OF EGGS HATCHING IN TETTIX ORNATUS; THIRTEEN AND TWELVE INDIVIDUALS IN EACH BROOD.

The following observations on the hatching of *Tettix* were made June 22, 1898: First brood of *Tettix*, consisting of thirteen specimens, hatched at 12:50 p. m.; second brood at 2:20 p. m., twelve individuals; third brood at 4:40 p. m., thirteen, making a total of thirty-eight specimens for three females. June 22, 1898.

EGGS OF TETTIX ORNATUS MORE SWOLLEN IN THE ADVANCED STAGE OF INCUBATION.

The eggs of *Tettix ornatus* which I have examined at the seventeenth day of incubation are quite swollen at either end. The tail-like anterior pole at the cephalic extremity appears relatively long and slender. The surface of the egg is rough. On extracting one of the embryos it was found almost ready to hatch. June 23, 1898.

FIFTEEN IN A BROOD OF TETTIX ORNATUS.

Fifteen specimens of *Tettix* came out of the ground at 12:50 p. m. June 23, 1898.

MALES WEAKER THAN THE FEMALES—DYING IN VIVARIUM IN JULY.

Another dead male in the jar this morning shows how much less they can stand than the females. A number of males have died and this is the last one in the jar. Up to this time the specimens (females) have been quite thrifty, though it is a matter of difficulty to keep lichens growing in sufficient abundance to keep pace with their devouring habits. July 3, 1898.

THIRD ECDYSIS OF TETTIX ORNATUS; GROWTH DEPENDS ON FOOD SUPPLY.

On July 2 three cuticles, and the following day two, making five out of the seven specimens of a brood under observation, casting the third exuvia. From the evidence at hand the shedding of the skin depends upon the growth of the individual, and secondly upon the food supply. July 3, 1898.

TETTIX ORNATUS LAYS EGGS JUNE 20 AND AGAIN JULY 7.

A long-wing form (*Tettix ornatus*) oviposited to-day. This is the identical specimen that laid eggs on June 20, this being the second batch of eggs, with a week intervening.

TETTIX ORNATUS, FIFTEEN DAYS' INCUBATION.

On July 29 a specimen of *Tettix ornatus* laid eggs in vivarium and they were marked by a tag. Suspecting that it was nearly time for the

young to appear I took up the eggs to find only empty shells, the young having escaped. There was a new brood hatched on the fourteenth inst., but I could not locate the spot from which they emerged; it is more than probable they came from the above-mentioned eggs. This being true, they hatched in fifteen days. The weather has been unusually warm, thus favoring rapid incubation.

A SPECIMEN OF TETTIX ORNATUS HATCHING MAY 31 LIVES UNTIL AUGUST 9 IN VIVARIUM.

Of seven specimens hatched May 31 only one now remains alive. There were two of this brood "bilineate," having light side stripes on the pronotum; the rest were brownish with dark spots above. August 9, 1898.

TETTIX ORNATUS HATCHING IN JUNE COMES TO MATURITY AUGUST 14.

A specimen hatched in June has shed its last skin, coming to maturity August 14, 1898.

TETTIX ORNATUS AND TRIANGULARIS IN CONJUGATION, ESTABLISHING THE FACT THAT THESE ARE THE SAME SPECIES

I caught thirteen specimens of *Tettix* at Cheltenham (Chicago) in the same locality I had taken them on previous years. An abandoned road covered now by grasses, lichens, strawberries, and a multitude of other plants, was the source of these specimens. The land is sandy below the superficial layer of vegetable mold. There was one male *granulatus*, the others representing the forms *ornatus* and some *triangularis*. At 9 o'clock a. m. all the specimens which were put in a vivarium jar were awakened to activity by the warm sunlight pouring in upon them through the window. I saw at two different times a male *triangularis* in conjugation with a female *ornatus* (long-wing form). In one instance they were together several minutes, establishing beyond doubt that these two forms belong to the same species. Confirmatory of this is the fact of their being found associated together in nature. May 8, 1898.

OVIPOSITION OF TETTIX ORNATUS — MALE STAYS ON THE FEMALE'S BACK DURING PROCESS — EGGS SHALLOWLY DEPOSITED IN THE GROUND.

At five minutes of nine o'clock a. m., I noticed a female *Tettix ornatus* (in vivarium) on a little patch of lichen-covered ground with her abdomen curved under her, ovipositing. A male is on her back, and though burdened by him a very slight up-and-down motion is perceptible in the female's body. Her position is peculiar, the front and middle pair of legs raised so she is standing on tip-toe, while the back legs are drawn up partly to the sides, out of the way, and taking no part whatever in the operation. I looked in the jar a short time previous, and the female had not taken her

present position then. She works rather slowly, probably by reason of the fine roots of the lichens impeding the ovipositor. The male shifts his position occasionally, but remaining passive most of the time, still retaining his hold on her back. There is every evidence that he is cognizant of the female's performance. At 10 o'clock, one hour after my first observation, I saw the female withdraw her abdomen from its position in the ground. The male, still keeping on her back, now becomes more active, endeavoring conjugation by extending the end of the abdomen below hers, and protruding the folds from within the genital aperture, while she, with some slight motion, still standing almost over the same spot, does not seem to join in his advances. Now they jump apart (10:18 a. m.). The male's pronotum extended beyond the posterior knee and the wings were as long as the process. The pronotum was a dull earth color, only slightly ornate. The female is of the bilineate type, but less vividly marked than some specimens. After the female had left the spot the eggs could be discerned, barely showing their pointed extremities projecting upward at the opening of the burrow, almost hidden by the thick growth of lichens. May 9, 1898.

From these eggs, which were deposited May 9, I saw larvæ emerge June 1, or twenty-three days after. The place of ovipositing was marked by a little tag, as is customary with me in carrying out my observations.

HATCHING OF TETTIX ORNATUS, TWELVE IN THE BROOD — TIME OF TAKING ON PIGMENTATION WAS HALF AN HOUR.

At six minutes past ten a. m., on looking in my breeding jar, I saw three *Tettix ornatus* larvæ emerging from a hole in the lichens. They are pale white, somewhat translucent, with the exception of the eyes. One at a time several more follow. After a lapse of four minutes two more come out, the eighth and ninth in their order, all grouped within a space of an inch. Now, startled by the sudden presence of an adult specimen leaping near, one jumped two and a half inches, or thirty-five times the length of its own body. This little performer was five minutes old.

At seventeen minutes past ten the tenth appears and now they are scattering still farther away from the burrow. A few moments intervene and then the eleventh emerges. Now, twelve minutes after the first was hatched, the color begins to alter a little. The eleventh up to this time has not entirely freed itself of the amnion, which is being thrown off behind. At the same time a twelfth specimen is appearing, the little head showing at the opening at the level of the ground surface; a moment later its forelegs are strenuously waving and free and it is making an effort to draw itself up. At 10:29 o'clock this specimen has its head out, immediately afterwards comes its body. They have all left the site but this one.

The first hatched of the brood have become appreciably clouded or opaque at twenty-four minutes of eleven. Looking around one sees the individuals quietly resting on the ground, except one which has crawled up the stalk of a little plant. None are eating. At twenty minutes to eleven the first hatched are almost invisible, changing to grayish, and it becomes difficult to follow them with the eyes. Complete transformation of color

has taken place at seventeen minutes of eleven, or a little more than half an hour, their bodies being protectively colored like the ground. This brood was not complete until twelve o'clock, when another tardy specimen was born, increasing the number to thirteen. May 7, 1898.

SUMMARY OF HOW THE EGGS ARE LAID IN TETTIX ORNATUS — PROTECTIVE RESEMBLANCE IN THE EGGS, SIMULATING LICHENS OR MOSS.

The process of egg-laying, summed up in brief, is as follows: The female selects a desirable spot and, curving the abdomen under the body, she proceeds to drill a hole by repeated spreading and shutting the blades of her ovipositor. When the hole is of sufficient depth she lays one egg at a time, to which she affixes a transparent glutinous substance so they will adhere. I have seen this on freshly laid eggs.* Then as the full complement is deposited, without moving her body she removes the abdomen having the ovipositor attached, and with her hind legs commences to cover up the hole; if the eggs are in a soil on which there are loose particles with which she may cover her eggs, using the tarsi to handle the fragments. On the other hand, when she places her eggs in a carpet of moss or lichens she does not attempt to cover them over. This would indicate she realized that the pointed extremities so much resembled the lichens that there need be no fear for their future. The depth to which she buries her eggs varies; sometimes they can be seen in lichens, but in other soils they are laid about four or five millimeters deep.

I was impressed while making an examination of the eggs in their natural environment with the evident object of the tail-like projection at the end of each egg. Snugly laid as they are with their sides together in a cluster, these little points stick up, presenting a resemblance to the pointed lichens. The pointed ends offer a safe contrivance against the eggs being eaten by insect enemies. May 31, 1898.

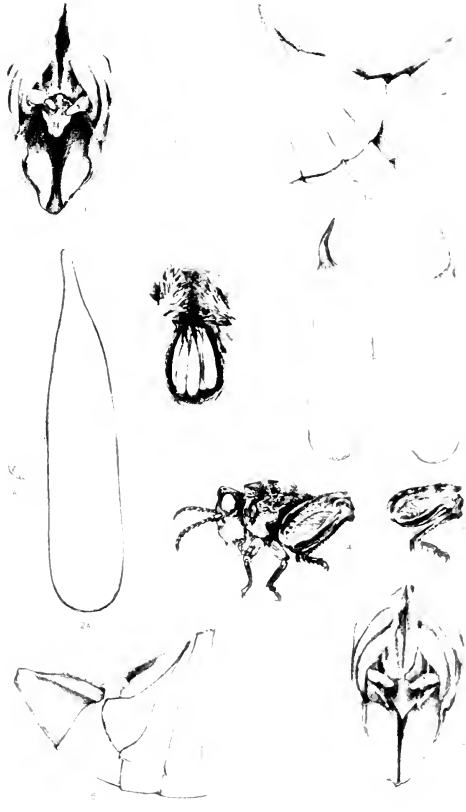
EXPULSION OF FÆCES BY MEANS OF THE HIND TIBIA.

I have noticed in *Tettix* a peculiar habit of aiding the expulsion of fæcal matter by a quick backward kick of the hind tibia. The fæcal mass, consisting of an oval body, is sent away from the body with some force. May 7, 1898.

OBSERVATION ON THE HATCHING OF TETTIX ORNATUS — TIME ELEMENT PERFECTLY MAINTAINED IN DEVELOPMENT OF EMBRYOS — HATCHING SIMULTANEOUSLY AFTER TWENTY-THREE DAYS — HANDLING THE YOUNG IN TRANSFERRING TO NEW VIVARIUM.

At 2:30 p. m., while looking in the vivarium, a new brood of *Tettix* emerged. In fifteen minutes they were scattered over the ground. They presented a pale, translucent, whitish color, with dark eyes, and the brood

*See Plate XL, Fig. 2a.



was made up of fourteen specimens. One was unable to throw off the amnion, and it lays beside the hole. It had reached the outside, but no further, showing that it had wormed its way out and finally fell exhausted. It is remarkable how nearly uniform in development this little brood was, all coming into the world simultaneously after twenty-three days' incubation. I transferred this new family to another freshly prepared jar, picking each one up separately on the tip of a glass rod previously dipped in water to moisten it. On this affixed drop of fluid each was transferred and wiped off on a piece of grass gently. In a few moments they recovered from the bath, and were perfectly at home. May 31, 1898.

THE NUMBER OF LARVÆ IN EACH BROOD OF TETTIX ORNATUS TABULATED—THIRTEEN LARVÆ THE AVERAGE—SIMULTANEOUS EMERGENCE OF LARVÆ.

At 11:15 a. m. a new brood of *Tettix ornatus* emerged, consisting of thirteen individuals. They came rather crowding each other, several at a time, with little intervals between. At the end of three minutes all were out. A summary of the broods hatched in two days in vivarium may be tabulated thus:

First brood, May 31, 1898, 12 larvæ, emerging rather rapidly in regular order, one tardy. Total, 13 larvæ.

Second brood, May 31, 1898, 13 larvæ, one unable to throw off the amnion. Total, 13 larvæ.

Third brood, June 1, 1898, 13 larvæ. Total, 13 larvæ.

Two additional larvæ found; unable to place them.

June 1, 1898.

TETTIX ORNATUS BROOD OF SIXTEEN HATCHED JUNE 1.

While looking in the vivarium jar at 1:15 p. m. sixteen larvæ came out almost simultaneously, spreading in all directions, the sunlight attracting them to the margin of the jar. The parent female is not recorded. June 1, 1898.

TETTIX ORNATUS OVIPOSITING, EIGHTEEN MINUTES COVERING HER EGGS FROM VIEW.

I noticed two females deposit their eggs at the same time in vivarium. One of these commenced to oviposit at 4 o'clock p. m., completing the process at 4:40 p. m. She made no attempt to cover her eggs, they being laid among lichens. The second specimen took a position at the margin of the jar. After a half hour she commenced covering her eggs, not moving from her original position, using first one leg, then the other, in dragging particles of sand, lichens, earth, and other debris over the hole, in this process reaching dexterously out behind to get them until the eggs were completely hidden from view. She spent eighteen minutes in accomplishing the task. Her pronotum is not extended far behind. June 1, 1898.

TWENTY-THREE DAYS THE TIME OF INCUBATION IN TETTIX ORNATUS.

At 6 30 a. m. larvæ emerged from eggs I saw deposited May 10 at 10 50 a. m., twenty-three days ago, thirteen individuals coming out almost simultaneously with little intervals between. These eggs were showing from above, so shallowly were they oviposited among lichens. June 1, 1868.

HOW THE LARVA THROWS OFF THE AMNION, DESCRIBED IN DETAIL IN TETTIX ORNATUS.

10:55 a. m. Now under my eyes the fourth and fifth larvæ of a new brood of *Tettix ornatus* are emerging from the ground. The last, or fifth, is forced up out of the ground like a little mummy encased in the veil-like amnion. The legs pinioned to the sides and head foremost it comes up like a sphinx. In a moment more the legs move vigorously, spreading and rending them loose from their cramped quarters and convulsive movements of the body cause a rent in the delicate amnion. Now the vestment is rapidly pushed off backward and, free to breathe, the young kicks it off hurriedly, and in little folds it gathers at the tip of the abdomen, when with a final kick the body is released of all incumbrance. The pale white body is free to commence life's struggle; each individual, endeavoring to separate from the egg site, starts off, little by little leaving the place of its birth, moving towards the light, then remaining quiet, drinking in the sun's warm rays, and transforming rapidly into the ground colors for its protection. Eight finally hatched from the above brood. At 11:18 a. m. seven are hatched, and another at 11:33 appears. June 4, 1868.

APPEARANCE OF THE EGG OF TETTIX ORNATUS JUST BEFORE HATCHING.

The freshly laid eggs of *Tettix ornatus*, as shown in the plate, are more slender than those well advanced in incubation. Just before hatching they become more swollen and are quite smooth; the tail-like extremity of the upper pole looks smaller. Held to the light, the dark eyes of the embryo, whose head now occupies this pole, can be discerned through the egg shell.

TETTIX ORNATUS, HAVING BUT ONE LEG, COVERS HER EGGS.

At 3 p. m. *Tettix ornatus* spent fifteen minutes depositing her eggs in vivarium. The specimen has but one hind femur, which she used to cover the eggs. I could see her clearly working, viewed from profile, and I observed that her hind claws are used to scrape the particles into the hole; particles of considerable size were pulled along. This female is grayish on the pronotum, with blackish markings. Fifteen minutes were spent in covering her eggs. June 5, 1868.

TETTIX NINE DAYS OLD WITH REDDISH FEMORA, PROTECTIVELY COLORED LIKE THE SPORE-HEADS OF CERTAIN LICHENS AMONG WHICH THEY LIVE—THREE OUT OF THIRTEEN IN THE SAME BROOD THUS MARKED.

Three specimens of a brood of *Tettix ornatus* which are nine days old have the outer one-half of the extremity of the hind femora a distinct red. This color matches exactly the pear-shaped spore-heads which grow upon the thread stalks from one-half to one inch high, among the common moss *Polytrichum*, and among which Tettigids frequently oviposit. These little specimens with reddish femora had not yet undergone the first ecdysis, and several more of the same brood were grayish. They are a little over two millimeters in length.

FIRST ECDYSIS OF TETTIX ORNATUS, TENTH AND ELEVENTH DAY AFTER BIRTH.

Looking in the vivarium, I saw one specimen almost white; the secret was revealed later when I found an empty skin that had been shed. Still later I found three more specimens molting. This establishes the time of the first ecdysis at the tenth or eleventh day after birth. June 10, 1898.

TETTIGIDS PLAY IN THE SUNSHINE, TRYING THE WINGS—RAINBOW IRIDESCENCE REFLECTED FROM THE TRANSPARENT WINGS.

Tettix ornatus while standing quietly on the ground in the sunshine loves to play by instantaneously spreading widely its wings, exposing them to the air for only a fraction of a second. Many Tettigids do this preparatory to flight, as if trying their wings in exercise before attempting flight. It requires close observation to see this performance, for the wings being almost transparent, suffused with prismatic iridescence, are difficult to see plainly. June 12, 1898.

OVIPOSITION OF TETTIX TRIANGULARIS, MALE ACTIVE DURING THE PROCESS—ENDS OF EGGS CAN BE SEEN IN THE SHALLOW BURROW.

At thirteen minutes of eleven a. m. a female *Tettix triangularis* has commenced to make a burrow with her ovipositor, selecting a lichen covered spot (in vivarium jar). She has now her ovipositor in the soil, and although on superficial examination appears motionless, careful examination shows a very slight movement of the body. The specimen is bilineate on the pronotum. Her abdomen is curved down under the pronotum and wings as usual during oviposition. She is about ten millimeters long. The presence of the sunlight has created great activity in the jar. At 11 a. m. a male, the identical one that figured in our observations of yesterday (May 9), has jumped on her back in a reversed position. Whether alarmed or not, she has withdrawn her ovipositor, and stands in a normal position on

the ground. The male has turned about, trying conjugation, exerting himself to the utmost to unite, reaching below her ovipositor to one side. Doubtless she is unfavorably impressed; she struggles slightly with her hind legs to be relieved. During the male's attempt at coupling the protruding and withdrawing of the organ copulatrix is attended with the escape of seminal fluid. At 11:14 a. m. they separate. The points of the eggs are now visible in the little hollow between the lichens. May 10, 1898.

OVIPOSITION OF TETTIX TRIANGULARIS — ELEVEN EGGS LAID — HOW SHE COVERS THE EGGS COLOR OF THE NEWLY LAID EGGS PINKISH WHITE.

At seven minutes of eleven o'clock another *Tettix triangularis* female came under observation. I saw her select a place and gradually sink her ovipositor and abdomen in the ground between the damp lichens. At 12 o'clock she withdrew the ovipositor, and in a skillful manner used first one hind leg, then the other, scraping up little particles of dirt (with the tarsi), with which she covered her eggs. This process lasted eight minutes, after which she walked away from the spot to go about eating. Parting the soil, I found the egg mass containing eleven eggs neatly secreted in the little excavation between the compactly growing mosses. The eggs were agglutinated together at the sides into a solid egg-mass, with the pointed ends upward, and were a beautiful pinkish white color. May 24, 1898.

TETTIX ORNATUS COVERS HER EGGS, OVIPOSITING LAST OF JUNE.

At five o'clock p. m., a specimen of *Tettix ornatus* is laying eggs. The same specimen has laid eggs before. She is grayish, with side lines (bilineate) on the pronotum, and has the wings fully developed. I saw her act uneasy before selecting the present site. From the other *ornatus* examples in the jar she is distinguished by the grayish color, the others being rather purplish brown. At 5:30 she took out her ovipositor and is engaged in covering the hole as previously described in the preceding form, *triangularis*. The hole was made in black muck. June 29, 1898.

TETTIX TRIANGULARIS OVIPOSITING THE LAST OF JUNE — SECOND, OR POSSIBLY THE THIRD, OVIPOSITING — METHOD OF COVERING HER EGGS DESCRIBED.

At four p. m. a *triangularis* specimen with conspicuous side stripes has oviposited. This same specimen laid eggs before, this being the second or possibly the third time. After ovipositing, she spent thirty minutes scraping up particles of earth to fill up the opening, working entirely with the left tarsus, the claws of which she used in this painstaking task. The opposite tarsal claws had been lost by accident. She was obliged to perform the work with the remaining member, although she would try occasionally to use the injured one. This specimen is easily identified among ten others in the jar. When she first commenced covering the hole she took the ma-

terial immediately behind her, but as she progressed she reached farther and farther back as far as the whole length of the extended leg to get the particles. The specimen was quite short. She chose the black muck in which to bury her eggs. June 20, 1898.

TETTIX TRIANGULARIS OVIPOSITING LAST OF JUNE.

At ten minutes past ten o'clock p. m. I witnessed a specimen of *Tettix triangularis* oviposit. This specimen has broken a period of recent quiescence of egg-laying. The weather is torrid. June 29, 1898.

TETTIX TRIANGULARIS LIVING TWO MONTHS IN VIVARIUM.

Two female *Tettix triangularis*, taken May 7, died after living two months in vivarium jars. July 6, 1898.

LARVÆ FOUND IN JUNE UNDERGONE THREE MOLTS.

Searching a swampy stretch of grassy ground which was abundantly mixed with moss, I found a number of *Tettix* about the same stage of growth as a brood which has gone through the third molt in my vivarium. An adult *triangularis* was found here. This year, I infer from these and other observations, *Tettix* laid their eggs in nature in May. Observation made in a swampy meadow at Chicago, June 26, 1898.

EXPERIMENTAL EVIDENCE OF POLYANDRY SUGGESTING THE TRANSMISSION OF MANY LINES OF DESCENT THROUGH THE MALE.

The author introduced a female *Tettix gibbosus* into one of his vivarium jars in which were three males of the same species. One of the males almost at once detected the new arrival. Presently moving over to where she was, and without interference, coitus took place, the sexes remaining together but a few moments, when the male left her. In five minutes another male came over to where she was feeding, making the usual advances, jumping on her back and trying twice to effect conjugation, but each time she shook her body vigorously. When the male tried to place his abdomen down close beside hers, she refused to separate the hind femora on that side, an act necessary for the union of the sexes. Failing in this, he jumped from her back, walked about an inch away, only to return again a moment later. This time when he came back she received him. In a few minutes another male, the third in the order named, appeared on the scene, displacing the second, and succeeded also in sexual union with her, though at first she shook her body as she had done before to get rid of her male suitors.

The polyandrous habits of this species were demonstrated, and continued observation showed that from time to time she was in conjugation twenty-two times before ovipositing. From this it is inferred that the female spermaceca may possibly contain a great variety of spermatozoa,

which may live for a time and enter the micropile of the succession of ten to fifteen eggs that may afterwards develop. The transmission of many lines of descent to the same brood through the male have an important bearing on the causes of variation.

A BROOD OF TWENTY FOUR TETTIGIDEA PARVIPENNIS HATCHES, PIGMENTATION ACQUIRED IN FIFTY MINUTES.

A brood of twenty-four *Tettigidea parvipennis* came out of the ground at twenty minutes of four o'clock p. m., leaving all the little folded amnions near the hole where they emerged. The *Tettigidea* larva is much larger than *Tettix*, and at once recognizable. The adult parents were placed in the jar May 23, and were from Windsor Park, Ill. Within three minutes the larvæ were all out of the burrow; in less than an hour (fifty minutes) they began to take on a clouded appearance of sufficient depth of pigmentation to easily escape detection. June 13, 1897.

TETTIGIDEA PARVIPENNIS, EIGHTEEN DAYS' INCUBATION.

Some eggs laid by *Tettigidea parvipennis* on June 28, hatched July 15 (1901), or in eighteen days. Seventeen eggs were laid in this mass.

PERSISTENCE OF THE SEXES REMAINING TOGETHER DURING CONJUGATION.

For three days the male of *Tettigidea parvipennis* has, with only short intervals of a few hours, kept on the female's back, copulation being almost constant. June 15, 1898.

TETTIGIDEA PARVIPENNIS OVIPOSITING, THE MALE SEEKING THE FEMALE AFTERWARDS. TWELVE EGGS LAID.

At 3:40 p. m. *Tettigidea parvipennis* started to oviposit between the stalks of grass, but seemed dissatisfied, and made no further effort to lay her eggs until 5:30 p. m., when she selected a lichen-covered spot. In the operation of ovipositing she continued as late as nine o'clock p. m., and when I last saw her at night she still had her abdomen buried in the ground. The following morning on looking in the jar I found her in copulation with the male. The eggs were laid five millimeters below the surface, and the egg-mass contained twelve eggs. June 22, 1898.

TIME OF INCUBATION IN TETTIGIDEA PARVIPENNIS, EIGHTEEN DAYS.

At 1:30 p. m. six eggs which I had left in vivarium hatched. The young larvæ are distinctly larger than *Tettix*. The parents of these eggs, *Tettigidea parvipennis*, were introduced into the jar June 3, and on the 5th, the female oviposited, making the time of incubation eighteen days. The weather has been favorable to hatching. June 23, 1898.

INCUBATION TWENTY DAYS OR UNDER—INCREASED HEAT SHORTENING TIME OF INCUBATION IN JUNE.

I noticed to-day that some larvæ recently hatched are in the jar containing adult specimens taken June 3. The larvæ have hatched under twenty-three days. Judging from the size, they are not older than twenty-four hours, which would make twenty days in hatching, providing the eggs were laid the first day the adults entered the jar. But I have no certain evidence of this. At any rate, incubation was twenty-three days or less. The greater heat now coming on, having gradually increased in the past month, evidently operates in more rapid development of the embryon, shortening the time of incubation materially. June 25, 1898.

HATCHING OF TETTIGIDEA PARVIPENNIS IN JULY.

Several *Tettigidea parvipennis* hatched to-day. July 5, 1898.

TETTIGIDEA PARVIPENNIS HATCHED JULY 5 MATURES AUGUST 27, 28, AND 29, RESPECTIVELY.

Tettigidea parvipennis raised in vivarium, and hatched July 5, have shed their last skins, August 27, 28, and 29, making their maturing period fifty-three to fifty-six days. I am convinced that nutrition governs this period to a considerable extent, shortening or lengthening the time depending on the amount of food being obtained by the individuals. The difference between a larva and pupa state is not easy to observe in the Tettigids owing to the pronotum obscuring observation of the wing formation during ecdysis. As near as I have been able to determine, there are four molts before the imago is reached, and possibly five if nutrition and rapidity of development is maintained.

SPERMATOZOA LIVE A LONG TIME WITHIN THE BODY OF THE FEMALE—FORTY-FIVE EGGS LAID BY TETTIGIDEA PARVIPENNIS IN THREE CONSECUTIVE PERIODS—FIRST TWENTY-ONE, SECOND SEVEN, THIRD SEVENTEEN EGGS.

A female *Tettigidea parvipennis* which I found in a swampy meadow May 11, remained in vivarium without association with the male. On June 22, or forty-two days after being taken, she oviposited (9:15 a. m. to 10:20 a. m.). Fertilization must have taken place in nature, and here is evidence that the spermatozoa lives a long time within the body of the female. There were twenty-one eggs in the mass closely cemented together. On carefully exposing the eggs they are covered now (two days after) by a whitish deposit, and underneath the white covering they appear pale greenish gray. The eggs were laid about ten millimeters below the surface of the ground, the egg-mass forming a pear-shape body with the pointed extremities upwards. The individual eggs are shaped somewhat like a long wine-bottle, see Plate XI., Figs. 2 and 2a. Following this observation, I saw the same female, above referred to, again oviposit. This time she

started at 3:55 p. m. (June 28), removing her ovipositor at 4:25 p. m. The egg-mass contained seventeen eggs. I subsequently discovered seven larvæ which had hatched in the jar containing this female, which were her brood. From these accounts forty-five eggs have been laid by this female, and as subsequent observation determined, the eggs were all fertile.

TETTIGIDEA PARVIPENNIS HATCHES IN FOURTEEN DAYS—WEATHER WARM.

Tettigidea parvipennis eggs laid June 22 hatched to-day, making incubation fourteen days. There were twenty-one eggs in the egg-mass. The weather has been unusually warm, favoring hatching. July 6, 1901.

TWENTY-SIX EGGS LAID BY TETTIGIDEA PARVIPENNIS JULY 9.

At 7 p. m. a specimen of *Tettigidea parvipennis* oviposited. On taking these eggs up the following morning for embryological preparation, I found twenty-six eggs constituting the egg-mass. This is the largest number that I have observed laid by this species at one time. July 9, 1901.

TETTIGIDEA PARVIPENNIS LAYS SIXTEEN EGGS JULY 8.

Tettigidea parvipennis laid sixteen eggs in vivarium to-day. July 8, 1901.

NINETEEN EGGS LAID BY TETTIGIDEA PARVIPENNIS JULY 10.

Nineteen eggs constitutes an egg-mass laid by *Tettigidea parvipennis* to-day. July 10, 1901.

POSITION OF THE MALE POSTERIOR FEMORA DURING COUPLING OF SEXES PECULIAR, IN TETTIGIDEA.

During conjugation of *Tettigidea parvipennis*, when the male rides around on the female's back, the posterior legs are frequently drawn up at the sides with the tibiæ close to the femora, then standing almost perpendicular to the body.

THE MALE TETTIGIDEA PARVIPENNIS GRASP OF THE FEMALE—HIS CONVULSIVE ACTION DURING AND BEFORE COITUS.

The peculiar convulsive spasm or orgasm which I observed in the male *Tettigidea* before coitus had taken place, was afterwards observed while the pair were coupled. This performance of the male probably shows each time there is an emission of spermatozoids. The male appendages grasp the sharp edge of the last abdominal segment underneath the ovipositor of the female during coitus, requiring enormous extension of the male's abdomen. His hind legs are drawn up, not taking any hold whatever, his grasp being dependent on the first and second pair of legs. June 12, 1898.

APPEARANCE OF THE EGGSHELLS DEMONSTRATING THAT THE EMBRYO BREAKS THE SHELL LONGITUDINALLY TO ESCAPE.

On taking the empty eggs up (*Paratettix*) I found that the larvæ in escaping had burst the shell in most cases on two sides longitudinally, the pointed end of the eggs being directed upwards. The eggs are laid about an eighth of an inch (four millimeters) below the surface in a cluster. May 7, 1898.

MUTILATION NOT INHERITED IN THE OFFSPRING OF TETTIX ORNATUS—EIGHTEEN DAYS' INCUBATION.

Seven *Tettix* eggs which I had put back in vivarium after examination, hatched while I was looking in the jar at noon to-day. The eggs were laid at 3 p. m. June 6, or eighteen days ago, by a long-wing specimen of *ornatus*. The *Tettix* had but one hind femur, the other having been lost by accident. All the larvæ were normal, showing the mutilation had no effect upon the offspring.

DEFORMITY OF THE TIBIÆ IN TETTIGIDEA NEWLY BORN—THE CLAWS ALSO ABSENT ON THE POSTERIOR TARSI.

A remarkable deformity occurred in a newly hatched *Tettigidea parvipennis* specimen. Since hatching the individual had never disconnected the two hind tibiæ which were fused together. I found on examination that they were joined throughout their length, and the tarsi had no claws. On separating the tibiæ the specimen shortly after died. June 24, 1898.

TETTIGIDS TAKEN FOR VIVARIUM EXPERIMENTS—SALACIOUS HABITS OF TETTIGIDEA SEXES REMAIN LONG TOGETHER—IN TETTIX A SHORT PERIOD AT A TIME.

In a marshy meadow (south of Chicago) eleven specimens of Tettigids were taken for vivarium experiments, and virgin earth taken for covering the bottom of the jars. A male and female *Tettigidea parvipennis*, one female *Tettix granulatus*, and *Tettix ornatus* and *triangularis* made up the species. I placed them free in one jar. The male and female *parvipennis* coupled almost immediately, and remained together the next day. In coupling *Tettix*, sexes do not remain long together; on an average ten or fifteen minutes suffices. June 3, 1898.

On June 4 *Tettigidea parvipennis* remained sixteen hours together in copulation.

TETTIX GRANULATUS IN CONJUGATION.

A pair of *Tettix granulatus* were in copulation last night, and this morning they were still together. June 4, 1898.

POLYANDRY IN TETTIX ORNATUS.

A male *Tettix ornatus* in vivarium has effected coitus with three females. June 4, 1898.

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NOTE—For further bibliography, see under each species and genus.

EXPLANATION OF PLATES.

All the drawings were made by the author, and with few exceptions, as noted below, were made from specimens in my own collection, or from types which were loaned. The figures are magnified from five to ten diameters, or in a few instances much more, as the subject warranted.

PLATE I.

Fig. 1. *Choriphyllum foliatum*, female, sp. n. Jamaica.
Fig. 2. *Choriphyllum westwoodi*, nom. n. after Westwood.
Fig. 3. *Platythorus camurus*, Morse after Morse.
Fig. 4. *Tylotettix sinuatus*, Morse after Morse.
Fig. 5. *Otumba scapularis*, Morse after Morse.
Fig. 6. *Chiriquia serrata*, Morse after Morse.
Fig. 7. *Phyllonotus saussurei*, Bol. after Bolivar.

PLATE II.

Fig. 1. *Tettigidea jalapa*, Hanc., male, Vera Cruz, Mexico.
Fig. 1a. Same, pronotum and head, dorsal view.
Fig. 2. *Nomotettix acuminatus*, Hanc., female, Lawrence, Kansas.
Fig. 2a. Same, pronotum and head, dorsal view.
Fig. 3. *Paxilla obesa*, Bol. Port Orange, Florida.
Fig. 3a. Same, pronotum and head, dorsal view.
Fig. 4. *Nomotettix parvus*, Morse, St. Anthony Park, Minnesota.
Fig. 4a. Same, pronotum and head, dorsal view.
Fig. 5. *Nomotettix carinatus*, Brun., Wellesley, Massachusetts.

PLATE III.

Fig. 1. *Tettix granulatus*, Scudd., Wellesley, Massachusetts.
Vertex and tarsus below.
Fig. 2. *Tettix incurvatus*, Hanc., Palouse, Washington.
Vertex, dorsal view.
Fig. 3. *Tettix avenosus*, Burm., Opelousas, Louisiana.
Vertex of same, dorsal view.
Fig. 4. *Tettix ornatus*, Harris, Chicago, Ill.
Vertex of same, dorsal view.
Fig. 5. *Tettix decoratus*, Hanc., var., Chicago, Ill.
Vertex of same, dorsal view.
Fig. 6. *Tettix gibbosus*, Hanc., Riverside, Ill.
Vertex of same, dorsal view.
Fig. 7. *Tettigidea parvula*, Morse after Morse.
Fig. 8. *Tettigidea nigra*, Morse after Morse.

PLATE IV.

Fig. 1. *Tettix hancocki abbreviatus*, Morse, female, Ames, Iowa.
Fig. 1a. Same, pronotum and head, dorsal aspect.
Fig. 2. *Tettix granulatus*, Scudd., female, Dune Park, Indiana.
Fig. 2a. Same, pronotum and head, dorsal aspect.
Fig. 3. *Tettix acadicus*, Scudd., female, from Dr. Scudder's type.
Fig. 3a. Same, pronotum and head, dorsal aspect.
Fig. 4. *Tettix hancocki*, Morse, female, Lake Superior, Minnesota.
Fig. 5. *Tettix arenosus*, Burm., female, Opelousas, Louisiana.
Fig. 5a. Same, pronotum and head, dorsal aspect.
Fig. 5b. Same, face, front view.
Fig. 6. *Tettix luggeri*, Hanc., female, St. Anthony Park, Minnesota, from type.
Fig. 6a. Same, pronotum and head, dorsal aspect.

PLATE V.

Fig. 1. *Tettix obscurus*, Hanc., female, Glen Ellyn, Illinois.
Fig. 1a. Same, profile view.
Fig. 2. *Tettix obscurus*, Hanc., male, Glen Ellyn, Illinois.
Fig. 2a. Same, profile view.
Fig. 3. *Tettix gibbosus*, Hanc., female, Illinois.
Fig. 4. *Tettix gibbosus*, Hanc., ancestral form, profile, Illinois.
Fig. 4a. Same, pronotum and head, dorsal aspect.
Fig. 5. *Tettix gibbosus*, Hanc., male, ancestral form, Illinois.
Fig. 6. *Tettix decoratus*, var., smaller form, Riverside, Illinois.
Fig. 6a. Same, pronotum and head, dorsal aspect.

PLATE VI.

Fig. 1. *Apotettix rugosus*, Scudd., female, Port Orange, Florida.
Fig. 1a. Same, pronotum and head, dorsal aspect.
Fig. 2. *Paratettix texanus*, sp. n., Texas.
Fig. 2a. Same, pronotum and head, dorsal aspect.
Fig. 2b. Post. femora of unusual appearance.
Fig. 3. *Telmatettix aridus*, sp. n., female, Santa Monico, S. California.
Fig. 3a. Same, pronotum and head, dorsal aspect.
Fig. 4. *Neotettix bolivari*, Hanc., female, Opelousas, Louisiana.
Fig. 4a. Same, face, front view.
Fig. 4b. Same, pronotum and head, dorsal aspect.
Fig. 5. *Neotettix rotundifrons*, Hanc., female, Jacksonville, Florida.
Fig. 6. *Neotettix bolteri*, Hanc., female, Jacksonville, Florida.
Fig. 6a. Same, pronotum and head, dorsal aspect.
Fig. 6b. Same, face, front view.

PLATE VII.

Fig. 1. *Clypeotettix schocki*, Bol., female, Rio Cocula, Gro. Mexico.
Fig. 2. *Apotettix convexus*, Morse, male, Jalapa, V. C. Mexico.
Fig. 2a. Same, pronotum and head, dorsal aspect.
Fig. 3. *Ochetotettix barretti*, Hanc., male, Tizipan, D. F. Mexico.
Fig. 3a. Same, pronotum and head, dorsal aspect.
Fig. 4. *Apotettix curvicephalus*, sp. n., female, Paige, Texas.
Fig. 4a. Same, pronotum and head, dorsal aspect.
Fig. 5. *Telmatettix minutus*, Male, Cordova, V. C. Mexico.
Fig. 5a. Same, pronotum and head, dorsal aspect.
Fig. 6. *Telmatettix minutus*, sp. n., female, Cordova, V. C. Mexico.
Fig. 6a. Same, pronotum and head, dorsal aspect.

PLATE VIII.

Showing Vertex.

Fig. 1. *Paratettix mexicanus*, var., male, Mexico.
Fig. 2. *Paratettix mexicanus*, var., female, Mexico.
Fig. 3. *Paratettix tuberculatus*, sp. n., female, Mexico.
Fig. 4. *Paratettix texanus*, sp. n., male, Paige, Texas.
Fig. 5. *Paratettix texanus*, sp. n., female, Paige, Texas.
Fig. 6. *Paratettix cucullatus*, Morse, male, Chicago, Illinois.
Fig. 7. *Paratettix cucullatus*, Morse, female, New Haven, Connecticut.
Fig. 8. *Paratettix morsei extensus*, sp. n., male, S. California.
Fig. 9. *Paratettix morsei extensus*, sp. n., female, S. California.
Fig. 10. *Paratettix morsei*, sp. n., male, S. California.
Fig. 11. *Paratettix morsei*, sp. n., female, S. California.
Fig. 12. *Paratettix mexicanus*, Bol., male, Mexico.
Fig. 13. *Paratettix mexicanus*, Bol., female, Mexico.
Fig. 14. *Paratettix toltecus*, Bol., male, Mexico.
Fig. 15. *Paratettix toltecus*, Bol., female, Mexico.
Fig. 16. Face of *Paratettix morsei extensus*, sp. n.

PLATE IX.

Showing Vertex.

Fig. 1. *Telmatettix aztecus*, Bol., male, Mexico.
Fig. 2. *Telmatettix aztecus*, Bol., female, Mexico.
Fig. 3. *Telmatettix parvaverticis*, sp. n., male, Mexico.
Fig. 4. *Telmatettix parviverticis*, sp. n., female, Mexico.
Fig. 5. *Allotettix peruvianus*, Bol., female, Mexico.
Fig. 6. *Telmatettix minutus*, sp. n., male, Mexico.
Fig. 7. *Telmatettix minutus*, sp. n., female, Mexico.
Fig. 8. *Telmatettix hesperus*, Morse, male, Oregon.
Fig. 9. *Telmatettix hesperus*, Morse, female, Oregon.
Fig. 10. *Clypeotettix schocki*, Bol., male, Mexico.
Fig. 11. *Clypeotettix schocki*, Bol., female, Mexico.
Fig. 12. *Telmatettix minutus*, sp. n., face, front view.

PLATE X.

Showing Vertex.

Fig. 1. *Tettigidea prorat*, Scudd., female, Florida, after Morse
Fig. 2. *Tettigidea apiculata*, Morse, female, after Morse.
Fig. 3. *Tettigidea guatemaltica*, Bol., female, Honduras.
Fig. 4. *Tettigidea jalapa*, Hanc., male, Mexico.
Fig. 5. *Tettigidea spicata*, Morse, female, Tifton, Georgia.
Fig. 6. *Tettigidea armata*, Morse, female, Dune Park, Indiana.
Fig. 7. *Tettigidea parvipennis pennata*, Morse, female, Lake Simcoe, Ontario.
Fig. 8. *Tettigidea parvipennis*, Morse, female, Freyburg, Maine.
Fig. 9. *Tettigidea lateralis*, Scudd., female, Opelousas, Louisiana.
Fig. 10. *Tettigidea medialis*, sp. n., female, Knoxville, Tenn.
Fig. 11. *Tettigidea polymorpha*, Scudd., female, Lake City, Florida.

PLATE XI.

Fig. 1. *Neotettix bolivari*, Hanc., abdominal appendages, male.
Fig. 1a. Male appendages in profile.
Fig. 1b. Apical margin of subgenital plate of male.
Fig. 2. *Tettigidea parvipennis*, eggs, group of twelve showing natural position as laid in the ground; laid June 22, 1898.
Fig. 2a. Newly laid egg, highly magnified, of same species.
Fig. 3-3a. *Tettix ornatus triangularis*, eggs, two views greatly enlarged.
Fig. 4. A young *Tettix*.
Fig. 4a. Hind femora.
Fig. 5. *Tettix hancocki*, profile of abdominal appendages of male.
Fig. 5a. Same, dorsal aspect.

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