

ZORAPTERA NOT AN APTEROUS ORDER.

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The discovery of a winged form of a supposedly apterous order of insects is an event of importance in systematic entomology certainly well worth recording.

The discovery of alated specimens of *Zorotypus* was made by Mr. H. S. Barber while collecting in Texas in the autumn of 1918. This unusually keen collector of the smaller and rarer forms of insect life was interested in the occurrence of *Zorotypus* within our borders, and when on a trip to Texas took the opportunity to see if specimens of this hitherto rare insect could be found in that State. Unexpectedly good results rewarded the search, for on October 20th a colony of *Zorotypus* was located under the bark of a log and, in addition to numerous specimens of the ordinary apterous form, including various stages of both sexes, he secured eight alated adult specimens, all females, five of which had lost the wings, and three large nymphs with well developed wing-pads. The value and intense interest of this find were immediately apparent, and the material was generously transmitted to me, as was also other material comprising dealated adult females collected later. These specimens, together with material collected in Florida in the spring of 1919 by Barber, Snyder and Wetmore form the basis of the present contribution to the knowledge of the Zoraptera.

Dr. G. C. Crampton, the able student of insect morphology, spent a week in Washington studying the structural details of these interesting insects. The results of his studies appear in a paper on phylogeny which immediately follows this paper. The discussion of the morphological details given by Dr. Crampton supplements admirably the following general systematic discussion.

The study of comparatively abundant material of *Zorotypus* comprising both winged and apterous specimens of two distinct species, gives a fair knowledge of this most interesting group. But future field observations and careful breeding will have to solve the many unworked problems, including that of the biology of the various forms. It is not even surely known if the life history is a simple one, or if there are different castes, similar to Termites. However, it is assured that there are apterous as well as fully winged adults and it is almost equally sure that there are two forms of reproducing apterous individuals, and mayhap more. We have in the recently described species *Z. hubbardi*¹ the following types of individuals:

¹ Caudell, *Can. Ent.* Vol. 50, pp. 375-381 (1918).

1. The fully winged chitinized adults with well developed eyes and ocelli, most specimens studied having lost the wings by shedding them in a manner similar to that in Termites.

2. A very slightly or barely chitinized nymph² with nine segmented antennae, similar to those of the adult, with eyes and ocelli situated subcutaneously and with wing-pads more or less developed.

3. Unchitinized apterous larvae without external eyes or ocelli, and possessing antennae with but eight segments, though otherwise similar to those of the adult.

4. A wingless, unchitinized form, without eyes or ocelli, and with 9-segmented antennae, the form described in my former paper as adults, and which they very surely are. In this case some of them certainly are nymphs corresponding to form 2 of the winged phase as above enumerated. But it appears impossible to differentiate them, as they agree in all diagnostic character with the more mature adult form. The apterous, unchitinized larva of this type is also apparently inseparable from those of the winged phases.

In *Z. snyderi*, the new species herein characterized, we have the same forms as in *hubbardi* and in addition there is an apterous form, fully chitinized and superficially resembling the dealated chitinized adult of *Z. hubbardi*, but differing in having neither eyes nor ocelli. The larvae and nymph are as in *Z. hubbardi*, the 9-segmented antennae of the latter indicating its stage of development. For the present, descriptive notes on these various types of the two species is all that can be given, leaving the future to reveal the biological relationships of the various forms.

Z. hubbardi Caudell. In addition to the ten specimens in the lot discussed in the former paper, a total of over one hundred specimens has been examined in the preparation of the present treatment of *Z. hubbardi*. The material represents collections from three localities in Texas and four in Florida. In Texas Mr. Barber took three fully winged and five dealated adult females, three nymphs of the alated form, thirty-five unchitinized apterous adults and seven larva and nymphs under the bark of a liquidambar log near Jackson's Landing on Buffalo Bayou, about eight miles below Houston; this was the first discovery of the winged form and

² The term nymph is usually applied indiscriminately to the various stages of insects with incomplete metamorphosis, from the first stage after leaving the egg to that preceding maturity. But a separate term is sometimes needed to designate that stage of a winged insect's development when wing-pads first appear. This is especially desirable in the case of *Zorotypus*, where it is apparently in this stage of development that the antennae become nine-segmented, and the wing-pads appear. The term nymph, therefore, is used in the present paper for the immature stages succeeding the molt at which wing-pads appear, larvae being used for the stages preceding that molt.

comprised the only specimens of *Z. hubbardi* yet secured with the wings attached. The date of this initial find was October 20, 1918. A fortnight later, November 5th, he collected additional dealated adults and apterous unchitinized specimens under the bark of a pine stump near Wallisville in Chambers County. He also secured a single apterous unchitinized adult female ten miles north of Liberty on November 20th. In Florida Mr. Barber took one adult and one nymph of the apterous form at Timm's Hammock, or Naranja, on February 24, 1919, and at the same place and date Mr. Alex. Wetmore took one dealated female of the alated form and one apterous adult form. On March 1st Mr. Wetmore collected again at this locality and took a number of apterous specimens. Mr. T. E. Snyder collected specimens of the apterous form in Florida at the following localities: Princeton, February 24th; Miama Beach, February 28th, and at Ortega, near Jacksonville, March 5th, all in 1919.

Adult of Winged Form (Female, Male Unknown) (Figs. 1, 2.)

The general appearance of the winged adult is very well represented by Figs. 1 and 2, the latter depicting the lateral aspect of a dealated specimen.

This winged form differs fundamentally from the apterous form in various ways; the head differs very little in shape from that of the apterous form, the apparent difference shown in Fig. 1, as compared with Fig. 4, being due to the different angles at which the head was viewed while being drawn. In the winged form, however, there are well developed and clearly fasceted eyes and three prominent ocelli, the latter situated in the form of an anteriorly directed triangle, as shown in the illustrations; the ocelli are moderately protuberant, projecting noticeably beyond the level of the surrounding surface of the head. The eyes are large, the facets visible under a moderately high magnification, and in alcoholic specimens usually appear as if surrounded by a whitish area of varying width; this light area, however, disappears almost entirely when the specimen is dried, and then is seen to form a part of the eye itself and not an area surrounding it. Fig. 2 was made from a specimen in spirits.

The antennal structure is practically as in the apterous form, as is also the armature of the posterior femora, the form of the dorsal thoracic segments, however, as might be expected, differs very decidedly from that of apterous individuals, as shown by the figures. The whole insect is here quite heavily chitinized, the general color being blackish, a decided contrast to the scarcely chitinized whitish colored apterous specimens.

The wings have a reduced venation quite different from that of allied orders of insects; the figured specimen shows the venation better than any description can portray it. The wings are evidently habitually shed, as in the Termites, as 15 of the 18 adult specimens examined are dealated, only the stubs of the wings remaining. The fracture of the wing does not take place at

any definite point but, so far as observed, always occurs at some point basad of the commencement of the veins, which is, as shown in Fig. 1, a short distance from the base of the wing. The wing stubs of dealated specimens appear like two paired projections, the membrane between the costal and anal marginal stubs being visible only on close examination, as it splits and folds closely to the stubs.

The abdomen is elongate, mesially broadened and has eight distinct chitinized dorsal segments, the first four shorter than the others, the basal ones sometimes not very distinct. The eighth segment is broadly rounded posteriorly; beyond this eighth dorsal segment is a broad, apically rounded, partially chitinized, moderately declivate plate; these features are discussed and figured by Dr. Crampton in the paper immediately following this. In his paper Dr. Crampton indicates that there are 9 ventral segments, including the Hypopygium or 8th ventral segment, and the Hypoproct or sub-anal plate; but as I make them out, there seems to be only 8 visible segments and the basal one of these is not always easily observed.

Length, to tip of abdomen, 2 mm., anterior wings, 3 mm.

Eighteen specimens, 3 winged and 15 dealated, from the following localities: Buffalo Bayou, 18 miles below Houston, Tex., October 10, 1918, Barber, 3 winged, 4 dealated.

Near Wallisville, Chambers County, Tex., near, but not in, occupied galleries of Termites, November 5, 1918, Barber, 9 dealated.

Miami Beach, Fla., under bark of red mangrove near base where it was damp, with *Prorhinotermes simplex*, T. E. Snyder, 1 dealated.

Naranja, Fla., March 1, 1919, Alex. Wetmore, 1 dealated.

Nymph of Winged Form. (Fig. 3.)

The only specimens of this form examined are apparently in the last stage prior to the change to maturity.

This form has well developed wing-pads, and the general appearance is well shown by Fig. 3. The thoracic structure differs materially from that of the adult, also better appreciated from the figures than by description; the eyes and ocelli are present and distinct, but are situated subcutaneously, as shown by careful examination of alcoholic material but not brought out in the figure; in dry material the covering cuticle is more opaque, making the organs of sight much more obscure, the ocelli in fact being almost or quite invisible in such specimens.

The antennae are essentially as in the adult but the posterior femora are without strong chitinized spines below, in this particular agreeing with the corresponding stage of the apterous form. The nymphs in this stage of development, that apparently preceding maturity, are very slightly chitinized and the dorsal hairs and bristles of the body and legs are pale and obscure.

Buffalo Bayou, 8 miles below Houston, Tex., October 20, 1918, Barber, 3 specimens.

Mr. Snyder, an able student of Termites, suggests that it may be possible that some of these supposed nymphs may be brachypterous reproductive adults, similar to certain forms present in Termites. But microtome sections of several specimens made by Miss C. B. Thompson, Prof. of Zoology in Wellesley College, have not substantiated this supposition.

Apterous Unchitinized Adult. (Fig. 4.)

This is the form, and the only form, of *Zorotypus hubbardi* discussed in the original account and description of this species, the two specimens mentioned in that paper as probably male nymphs being really adult females.

Mention was made in this former paper to certain pigmented lateral spots on the head of this form, seen in a couple of specimens mounted on a slide. Since that note was written Miss Thompson sectioned the head of this form with the view to determining if there really were vestigial eyes present or not. Her decision is set forth in the following quotation from a letter written by her to Mr. T. E. Snyder:

"There are no functional compound eyes nor ocelli. In some specimens nothing is left of the compound eyes but the optic nerve running to a mass of fatty tissue just the size of the eyes in the dealated form, but in one specimen in among the fatty tissue there were vestiges of the outer parts of several ommatidia, the cones and cuticle. So we may call this, together with the optic nerves present in all specimens, evidence of faint vestiges of a *very degenerate* compound eye."

The general appearance of this apterous form is well represented by Fig. 4. This represents a female and, like the other figures illustrating the present paper, except Fig. 5, was drawn by Mrs. Mary Carmody Thompson. As indicated by this figure, there is probably one more abdominal segment than stated in the original account of the species, the terminal segment, however, being illy defined. An examination of the somewhat ample material accumulated since the previous account of this insect was written shows some variation to exist in the ventral armature of the posterior femora; rarely there are no chitinized spines on the ventral inner margin of these femora; in such cases the specimens may be ones but recently transformed and killed before completely chitinized. But usually there are two chitinized spines on this margin, as described in the former paper, and sometimes there is a third somewhat smaller spine situated about midway between the base of the femora and the basal one of the other two spines, and rarely there are also a few very short spines between the longer ones and distad of the apical ones.

The mesonotum is noted in the original paper as being about one-half as long as the pronotum; this is not correct, the actual length being about the same as that of the pronotum, as shown in Fig. 4. The terminal setae of the cercus are usually about one and one-half times as long as the cercus itself. The fourth segment of the antennae is also usually a little smaller in all dimensions than the succeeding ones, though there is some variation in this respect, as there is indeed in other features of the antennal structure; one specimen has one antennae normal while the other one is abnormal in having but eight segments instead of nine; that this abnormal antennae is complete is shown by the structure of the terminal segment. In two specimens, one from Texas and one from Florida, the antennae are asymmetrical, as in each one antennae is normal while the opposite one has the fourth segment scarcely larger than the third. The hairs and bristles of the entire insect are pale and inconspicuous.

In the article immediately following the present one Dr. Crampton describes a minute hooked structure of the obscure ninth segment of the abdomen of the male which was not noticed in the previous account. This character is illustrated by Dr. Crampton in his Fig. 2, and he calls it the notocornus, or notal horn. Opposite this organ, on the posterior margin of the eighth segment of the abdomen is a small projection which Dr. Crampton calls the notoprocessus, or tergal process, and this is also shown in his figure.

The nymph of this form is very likely represented in the numerous specimens examined, but, if so, cannot be distinguished from the more mature specimens. It appears quite certain that some of these apterous unchitinized individuals are really adults, for if they were all nymphs it seems as if at least a few of the corresponding apterous chitinized adults would be found. But not a single such adult has been found among the scores of individuals examined by the writer, and Mr. Barber, a keen observer and one who has seen hundreds in nature, has seen none. Mr. Barber is also quite certain that a fragment of an egg found by him, but subsequently lost, was laid by one of these wingless unchitinized individuals, and other specimens have been seen with a rounded object visible within the body which may be an egg. Future observations will eventually settle this point.

Length about 2 mm. or a little more.

Numerous specimens from the following localities: Naranja, Fla., Mar. 1, 1919, A. Wetmore; Miami Beach, Fla., Feb. 28, 1919, Snyder; Princeton, Fla., Feb. 24, 1919, Snyder; Ortega, near Jacksonville, Fla., Mar. 15, 1919, Snyder; near Wallaceville, Chambers Co., Tex., Nov. 5, 1918, Barber; ten miles north of

Liberty, Tex., Nov. 20, 1918, Barber; Buffalo Bayou, eight miles below Houston, Tex., Oct. 20, 1918, Barber.

The Larva of Winged and Apterous Forms.

Immature stages of the wingless *Zorotypus* were not represented in the material forming the basis of the former paper, the two on a slide recorded as probably being male nymphs being really adult females. But in the material studied in the preparation of this present paper there are a goodly number of larvae.

In general appearance these resemble quite closely the eyeless and apterous unchitinized adult described above; the antennae, however, differ decidedly from those of adults and nymphs in having only eight segments instead of nine, and generally the second segment alone is decidedly smaller than the others, instead of both second and third being small; the terminal five segments of the antennae of the larva also tend to be noticeably less elongate than in the more matured insect, this feature is more obvious in the younger specimens examined. There is some variation in the relative size of the segments of the antennae; thus the third segment is usually noticeably smaller than the fourth but often it is not, or barely, so. The reduction of the number of antennal segments in the young from nine to eight is probably brought about by the union of the third and fourth segments, as is indicated by a very obscure indication of an illy defined transverse sub-basal sulcation of this larger segment, faintly visible in one or two of the several specimens examined. The larvae are also differentiated by the smaller size and by the absence of chitinized spines on the ventral margin of the posterior femora. A few apparently mature individuals lack such spines, but, as stated above, these are very likely freshly matured individuals. The hairs and bristles of the body are pale and obscure. There are about three sizes of larvae, the smallest measuring about 1 mm. in total length, the largest almost twice as much. There are no characters, so far found, to separate the larvae of the winged and apterous forms. Thus the above notes apply to both.

Many specimens from: Naranja, Fla., Feb. 24, 1919, Barber; id, Mar. 1, 1919, Wetmore; Princeton, Fla., Feb., 24, 1919, Snyder; Ortega, near Jacksonville, Fla., Mar. 15, 1919, Snyder; near Wallaceville, Chambers Co., Tex., Nov. 5, 1918, Barber; Buffalo Bayou, eight miles below Houston, Tex., Oct. 20, 1918, Barber.

Zorotypus Snyderi, n. sp. (Fig. 5.)

All of the material of this apparently undescribed species was taken by Mr. T. E. Snyder, in whose honor the insect is named, at Miami Beach, Fla., all on April 29, 1918, except one apterous, pigmented male on Feb. 28, 1919. In 1918 pieces of a red mangrove log containing colonies of a white ant, *Prorhinotermes simplex* Hagen, were brought to the Field Station of the Bureau of

Entomology at East Falls Church, Va., and enclosed in 50-lb. lard cans. These proved congenial quarters for the Termites, which lived and thrived. In the summer of 1919 it was discovered for the first time that the cans also harbored a thriving colony of *Zorotypus*, furnishing the material here discussed, except a single male above noted as being taken in 1919.

This is a very distinct species from *Z. hubbardi*, but seems quite closely allied to the Costarican species described¹ by Sylvestri as *Z. neotropicus*. It does not agree, however, sufficiently well with the characters of *neotropicus* as described by Sylvestri to justify its being considered that species.

In this species are found the various forms or phases as noted above under *hubbardi* and in addition there is an apterous and fully pigmented adult. The various forms are here descriptively noted.

Adult of Winged Form (Female, Male Unknown).

In general appearance very like *hubbardi* as shown in Fig. 1. The size and color is practically the same, as is also the structure except as here noted. Antennae with the second segment small as in *hubbardi* but with the third segment of sub-equal length with the fourth and enlarging from the base to the apex, where it is nearly as thick as the fourth segment; beyond the third segment the antennae are about as in *hubbardi*. Fig. 5, drawn by Mr. R. E. Snodgrass, shows the antennae of this species. Thoracic segments from a dorsal view not differing noticeably from those of *hubbardi*. Bristly hairs of the abdomen, especially those situated posteriorly above, noticeably stouter and longer, the terminal bristle of the cercus fully twice as long as the cercus itself. Fore tibiae with short spines above and below, those on the ventral margin not worthy of special notice such as is described in *Z. neotropicus*. Hind femora with more conspicuous bristles above and armed beneath with two long slender spines on the apical fourth of the outer margin and with a series of about ten shorter and stouter ones on the apical three-quarters of the inner margin, the basal two and one near the apex the larger. Some variation will probably occur here. Abdomen essentially as described under the corresponding stage of *Z. hubbardi*. The more heavily armed posterior femora, the basal structure of the antennae and the longer terminal seta of its cerci make very easy the separation of this species from *Z. hubbardi*. Length, to tip of abdomen, about 2½ mm., fore wings 3 mm.

A single fully winged female which I choose as the Holotype, Miami Beach, Fla., 1917, Snyder. No dealated specimen found.

The fact that no winged males of either of our species of *Zorotypus* are known might seem to indicate that there are no males of this form. But, considering that but sixteen winged specimens in all have thus far been found, this would be a presumptuous hypothesis to advance.

¹ Boll. Lab. Agr. Portici, vol. 10, p. 120 (1916).

Nymph.

Of this stage specimens of three or four periods of development have been examined. Several specimens in the stage apparently immediately preceding complete maturity, corresponding to those noted under *hubbardi* in having well developed and mobile wing-pads, occurred.

Specimens in this stage of development can be readily distinguished from the corresponding form of *hubbardi*, as the diagnostic characters of the alated adult are present here also, and in addition the eyes only are distinctly present subeutaneously, the ocelli not being indicated; there may, however be variations found to exist here when more material is examined. But in the earlier stages of this form, where the wing-pads are not well developed the diagnostic characters so readily separating the more advanced nymphs and the adults from *hubbardi* are progressively less well marked. In the smaller of the two or three stages noted the characters are closer to those of *hubbardi*, the bristles and spines of the legs being less specifically different and the structure of the antennae varying to the form found in *hubbardi*. The second and third segments of the antennae of the smallest specimen area, are sub-equal and both decidedly smaller than the others. But the spines of the body are black and very decidedly more conspicuous than in *hubbardi*, especially when seen against a white background, and the terminal bristle of the cercus is fully twice as long as the cercus itself, characters serving to identify with considerable assurance even the smallest specimens of this stage. The eyes are not, or barely, visible in smaller specimens, growing more distinct as the insects approach maturity.

Length $1\frac{3}{4}$ - $2\frac{1}{4}$ mm. Wing-pads of largest specimens about $\frac{1}{2}$ mm.

Four specimens with fully developed wing-pads and half a dozen younger specimens, all from Miami, Fla., collected by Snyder.

The specimens with fully developed movable wing-pads are apparently quite different from the smaller, less developed ones without movable wing-pads. They may, indeed be brachypterous adults, as considered by Snyder as set forth under the corresponding phase of *hubbardi*.

Apterous Chitinized Adults. (Fig. 5.)

Female.—This form, not represented, so far as now known, in *hubbardi*, superficially resembles dealated specimens of the winged form. The head is, however, without either eye or ocelli, the place where the eyes would be located being marked only by a few obscure bristles. The antennae are as described in the winged adult, as are also the posterior femora, though here more of the inner ventral spines are stout. There is some variation apparent in the exact number of these spines, but usually there are about seven or eight. Otherwise this apterous adult form is essentially like the winged form described above.

Male.—Similar to the female except the apical segments of the abdomen; here, what is apparently the ninth dorsal segment is roundly prolonged apically, depressed below the plane of the eighth segment, the tip more heavily chitinized than the membranous basal portion, and the apex notched mesially with three minute tuberculous teeth on each side of the notch and with a small hook in the apex of the notch. This last described character is exceedingly minute and very difficult to make out even under fairly high magnification. The apical ventral segment is mesially cut apically by a V-shaped notch, and several small spines are situated on the lobes formed by this notch. The penis is concealed, very rarely visible as a simple minute chitinous point.

Seventeen females, 6 males. One of these females confined in a vial between June 4 and 12, 1919, deposited a single egg, which is briefly described at the end of this description.

Apterous Unchitinized Adult (or Nymph of Apterous Chitinized Adult).

Among the lot of a dozen or so specimens examined there are probably three forms represented. First very surely the nymph of the apterous pigmented adult last described, second possibly the reproductive unpigmented adults corresponding to that noted under *Z. hubbardi*, and the third the nymph of the last. But no morphological character has been found for separating the material into such divisions, all specimens being essentially alike except for minor variation. This form is essentially the same as the unchitinized apterous adult of *hubbardi* as set forth in the original description of that species, and as amended and figured in the present paper, except for the specific characters noted in the discussion of the winged form of the present species.

The constant feature distinguishing this from the corresponding form of *hubbardi* is the terminal bristle of the cercus being twice as long as the cercus itself, the more coarsely and densely spinous ventral surface of the post femora and especially the more conspicuously black bristled body. The larger and more elongate third segment of the antennae is also diagnostic but, as in the nymph of the winged form, this character grows less marked in the earlier stages of development, the third segment, especially in small specimens, but often also in larger ones as well, being but little or no larger or longer than the second. Probably the best method for the separation of this form of these two species is to examine the specimens under a glass against a white background, when the black hairs and bristles of *snyderi* are very decidedly more conspicuous than the lighter ones of *hubbardi*.

Specimens of this complex examined range in total length from about $1\frac{1}{2}$ to nearly $2\frac{1}{2}$ mm.

Larva.

This stage is represented by a goodly number of specimens. It is apparently impossible to separate those destined to transform to winged specimens from those giving rise to apterous

adults. Nor is the separation of these larvae from the corresponding stages of *Z. hubbardi* so easy, especially in the smaller specimens. The bristles and leg spines are not sufficiently developed to exhibit decided differences and the segments of the eight jointed antennae are not very strikingly different from those of *hubbardi*, though in larger specimens they grow more towards the type characteristic of *snyderi*. The terminal setae of the cercus, moreover, are so small as to be generally not easy to observe and they constitute, therefore, not a convenient character for separation. There are, however, two good characters which will invariably enable one to separate with assurance the respective larvae of these two species: the first is the hairs and bristles of the body, for in *snyderi* especially when viewed against a white background, as noted under the description of the pupa, the dorsal hairs and bristles of the body and legs are decidedly conspicuous, while in *hubbardi* they are apparently finer and light colored, being scarcely visible; the second character is the antennae which, especially of the smaller specimens, are very noticeably larger and heavier in *snyderi*. The relative size and shape of the antennal segments of these nymphs vary decidedly and seem to furnish no dependable character for separating the two species. In both species the usual structure of the antennae of a young nymph is as follows:

The second segment of the antennae is half as long as the basal one and noticeably smaller, being itself about as long as broad, almost globular in shape; third segment slightly larger than the second and of similar shape; fourth segment decidedly larger than the third and globular, the fifth still larger and also globular, apically barely perceptibly pointed, sixth and seventh scarcely larger than the fifth, but very slightly elongated and apically a little more pointed; the eighth, and last, segment is basally as large as the preceding one and tapers nearly from the base to a narrowly rounded apex, the whole segment about twice as long as the basal width. In the succeeding stages of *snyderi* the third segment becomes more elongate in the larger, and presumably the more completely developed, specimens and then becomes useful in distinguishing these larvae from those of *hubbardi*.

In the material examined, apparently representing about three instars, the individuals range from about 1 m. to $1\frac{3}{4}$ mm. in total length.

The typical material of this species is in the collection of the U. S. National Museum.

Type.—No. 22880, U. S. N. M.

Egg.

On July 4, 1919, a number of individuals, representing apterous chitinized adults, larva and nymphs, were isolated in small vials and cells, each with a small fragment of wood. On the

12th a small egg was noted on the piece of wood enclosed with an adult female. It is barely possible that this was there when the fragment of wood was enclosed, and is not the egg of *Zorotypus* at all. But that it is really the egg of this insect, and was deposited by this specimen is very probable. This egg is $\frac{5}{8}$ mm. in length by $\frac{3}{8}$ broad, the ends broadly and evenly rounded and the surface roughened by small hexagonal areas with elevated divisional lines. The probability of this being the egg of *Zorotypus* is enhanced by the fact that this sculpturing of the surface is as Mr. Barber recalls being true of a fragment of an egg he found with *Z. hubbardi* in Florida, and that another exactly similar egg was found in the cans containing the colony of *Zorotypus*. If this is really the egg of *Zorotypus* the size would indicate that these insects probably deposit a single egg at a time.

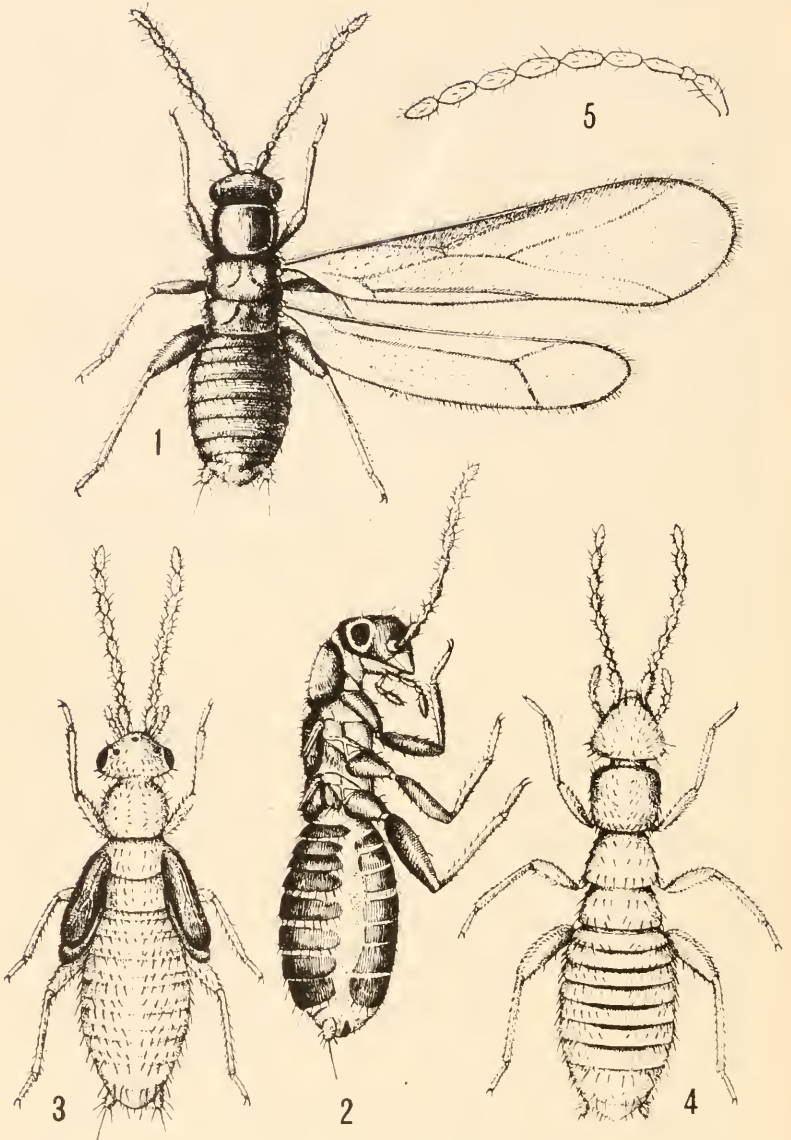
This insect does not thrive in solitary confinement, as out of a lot of 27 specimens enclosed, mostly one in a receptacle, on June 4, 1919, most were dead by June 20, a number dying before that date and few living beyond the middle of July. Growth, at least under such conditions, is seemingly slow, as nothing in the way of development occurred, other than probable deposition of an egg by a female as noted above, and the changing of one larva with 8-jointed antennae enclosed on June 4 to a nymph with 9-jointed antennae on the 25th.

Conclusion.

The discovery of the fact that *Zoraptera* is a winged order has served to strengthen its distinction from allied groups. The relationship of *Zoraptera* to allied orders is discussed by Dr. Crampton in the article immediately following this.

The habit of shedding the wings by the adult alated form is apparently an acquired one. In the blattid genus *Panesthia* this habit is now apparently being acquired, but is in a comparatively early stage of development; here the wings are torn off by only a moderate percentage of individuals and in a somewhat irregular manner, the fracture, however, following more or less the course of the anal vein. The development of this habit in the *Zoraptera* approaches that attained in the Termites, where in some cases there are well defined cross-sulci formed at the point of alar rupture.

Both species of *Zorotypus* are social insects, occurring in colonies of various sizes. They generally occur near Termites, but are not usually mingled with them and are probably never really inquilinous with them, as was at first thought probable, due to their usual proximity to white ants and their frequent occupancy of their galleries. Mr. Snyder took specimens of *hubbardi* at Ortega,



CAUDELL.—ZOROTYPUS.

near Jacksonville, Fla., under the loose moist bark of a decaying log where there were no Termites present. Thus it appears as if their frequent occurrence with or near Termites is only a result of their requiring the same environmental conditions, mainly a matter of the proper amount of moisture.

The discovery of alated individuals of *Zorotypus* raises some doubts as to the real status of the wingless individuals, heretofore the only form known. From a general consideration of the structure of both alated and apterous specimens and from the fact that this is a social insect may be inferred that it is a case of cast, allied to the closely related order Isoptera. The fact that alated adults shed the wings in a manner similar to that of the white ants seems to strengthen this view. If such is actually the case, however, it will have to await actual demonstration until something more is known of the biology of these interesting insects.

In Texas and in Florida nymphs of the hemipterous genus *Systelloderus* were taken in colonies of *Zorotypus*. These insects are predacious and probably feed on the *Zorotypus*. The Texas species, taken by Mr. Barber near Liberty on November 20, 1918, was determined by Mr. Gibson as *S. biceps* Say. Mr. Wetmore took the Florida bugs at Timm's Hammock on March 1, 1919. This form was determined by Gibson as a species near *angustus* Champ., of the West Indies.

Associated with the *Zorotypus* at Timm's Hammock Mr. Wetmore found a number of very young nymphs of the earwig *Anisolabis annulipes*, which resembled in size and action specimens of *Zorotypus* so much as to be mistaken for them. Mr. Barber has also noted this resemblance in the field.

EXPLANATION OF PLATE.

- Fig. 1. *Zorotypus hubbardi* Caudell. (Alated adult of winged form. Female.)
 Fig. 2. *Zorotypus hubbardi* Caudell. (Dealated adult of winged form. Female.)
 Fig. 3. *Zorotypus hubbardi* Caudell. (Nymph of winged form. Female.)
 Fig. 4. *Zorotypus hubbardi* Caudell. (Unchitinized adult of apterous form. Female.)
 Fig. 5. *Zorotypus snyderi* Caudell. (Antenna of chitinized adult of apterous form. Male.)
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