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THE ELECTRORETINOGRAM AS A MEASURE OF WAVE-LENGTH SENSITIVITY TO LIGHT*

By Theodore Louis Jahn
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The voltage developed across the retina of vertebrates when the eye is illuminated by light of different wave-lengths has been used by various investigators to determine the spectral sensitivity of the eye (Graham and Riggs, 1935; Graham, Kemp, and Riggs, 1935; Granit and Munsterhjelm, 1937; Granit and Wrede, 1937; Therman, 1938; earlier work reviewed by Kohlrausch, 1931, and Granit, 1936). The possibility of determining the spectral sensitivity of insects and other invertebrates in this manner has been pointed out by Crescitelli and Jahn (1939), Jahn and Crescitelli (1939), and Jahn (1940, 1942). Recently the work on the electrical response of the insect eye has been reviewed by Weiss (1944, 1945) who emphasized the similarity between the voltage-wave-length curves of the electroretinogram (ERG) and those obtained in behavior studies by Bertholf (1931, 1932) and by Weiss, Soraci, and McCoy (1941, 1942, 1943), Weiss (1943a) and Weiss, McCoy, and Boyd (1944). Inasmuch as consideration of the ERG as an index of visual sensitivity seems destined for considerable future attention, it is probably worthwhile to emphasize certain advantages of the method and also certain necessary precautions and to present a further analysis of the data of Crescitelli and Jahn (1939) on *Melanoplus*.

* Aided by a grant from the Rockefeller Foundation for research on the Physiology of the Normal Cell.

The studies of Crescitelli and Jahn were made primarily to determine whether or not there was a specific effect of wave-length of stimulating light on the wave-form of the ERG. It was proven conclusively that in *Melanoplus differentialis* and *Samia cecropia* that the wave-form is a function of intensity and that there is no effect of wave-length *per se.* This was an important point since the existence of such an effect would be evidence of the existence of true color vision. (The converse is not necessarily true.) The voltage–wave-length curves were not of primary interest at that time, and a complete analysis of them was not presented. However, the published data on *Melanoplus,* although incomplete in certain respects and intended for quite a different purpose, are valid as far as they go, and in view of the problem of wave-length sensitivity, they seem worthy of further consideration.

TREATMENT OF DATA

In several papers in which the ERG has been used in an attempt to determine the spectral sensitivity of the eye the voltage has been plotted against wave-length. The use of such curves has been criticized by Hecht and Pirenne (1940), who emphasized the necessity of plotting the reciprocal (or the log of the reciprocal) of the intensity necessary to produce *the same physiological response* (*e.g.,* an ERG of given magnitude and wave-form) against wave-length. This point is well taken, and the recommended method is the only one which permits a comparison of the "sensitivity" curve with the absorption curve of the visual pigment (see also, Hecht, 1937). The reason for making this distinction is that in the use of voltage–wave-length curves it is assumed that the voltage–log *I* curve is linear, and this assumption is true only over a limited range (Hartline, 1928; Graham and Riggs, 1935; Wulff, 1943; and others). Graham and Riggs (1935) and Graham, Kemp, and Riggs (1935) plotted the reciprocal of the intensity necessary for a given electrical response against wave-length in their studies of the visibility curve of the white rat and the pigeon, and they obtained data which closely approximate the known visibility curves for other vertebrates.

A close similarity has been observed between voltage–wave-length and known or presumed visibility curves, but this close similarity should be considered a coincidental rather than a necessary relationship. In animals in which neural elements may contribute to the ERG the voltage–wave-length curves merely give a rough approximation of the form of the sensitivity–wave-length curve. In fact, the only dependable characteristic of such curves is the position of the maxima or minima, and the ratio of the values of voltage at two wave-lengths bears no necessary relationship to the ratio of the sensitivity of the eye at these two wave-lengths. The approximation of the human visibility curve by the voltage–wave-length curve of the frog eye (Granit and Munsterhjelm, 1937; Granit and Wrede, 1937; Therman, 1938) is apparently without a necessary logical basis except for the position of the maximum. Hartline (1930) in his study of dark adaptation in *Limulus* obtained very similar curves for voltage–wave-length and for reciprocal intensity–wave-length. However, this relationship was not true for responses of small magnitude, and the similarity is not of general significance.

Apparently the usual reason why students of the ERG have not obtained $1/I$–wave-length curves is that more numerous records are necessary for voltage–wave-length curves, and the physiological state of the eye is not easily controlled over the necessarily longer period of time. This, however, is not true of most of the insects which do not possess a diurnal rhythm, and *Melanoplus* seems to be a satisfactory animal for that purpose.

THE ERG OF MELANOPLUS

The data for the present analysis are taken from Figure 1 of the paper by Crescitelli and Jahn (1939). In this figure the ERG is given for various wave-lengths and intensities of the stimulating light. An attempt was made to match the wave-form and voltage of the ERG for various wave-lengths, and the intensity at which the match occurred is marked on each record. Therefore, the recorded intensities for each matched series gives us a measure of the relative intensity necessary to produce a given response. The figure contains seven series of ERGs, and six of these (rows 1 to 6) are well matched; the seventh is of dubious value for the present purpose.

These data are given in Figure 1. The reciprocal of the intensity measured in arbitrary units (the unit was the intensity necessary to give the same thermopile-galvanometer deflection as 4 foot-candles of visible light from a 500-watt tungsten lamp)

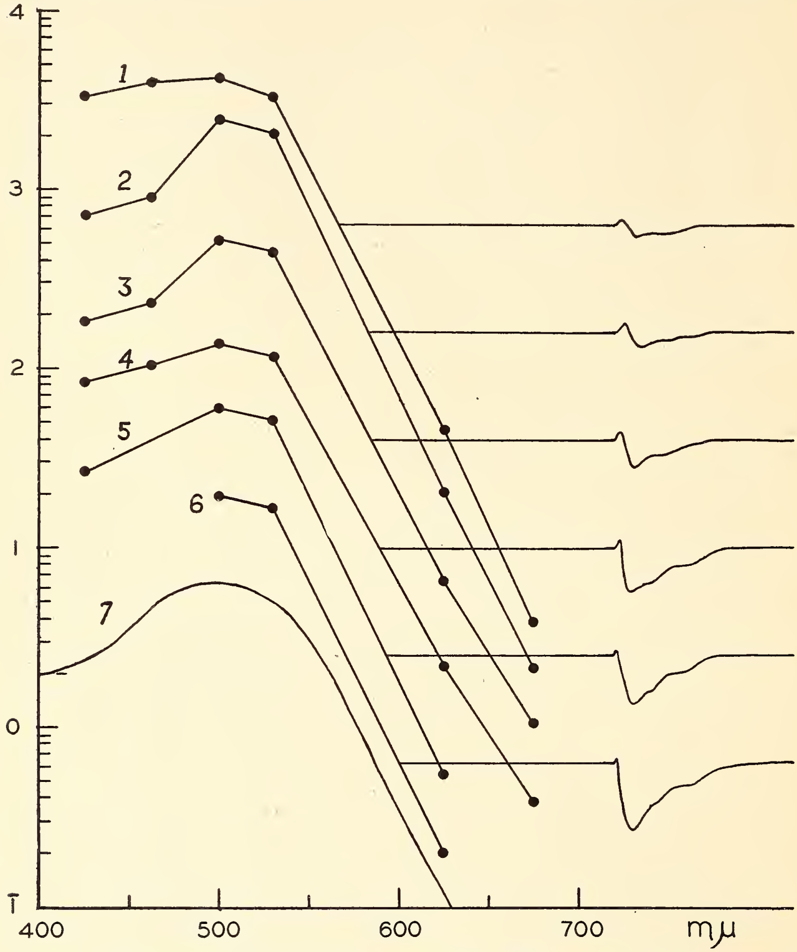

FIG. 1. Curves 1–6, the logarithm of the reciprocal of the intensity necessary to produce a given wave-form and magnitude of the ERG plotted against wave-length of stimulating light in millimicrons, *Melanoplus differentialis* data of Crescitelli and Jahn (1939). On the right is a copy of the ERG at each level of response. Curve 7, absorption curve of visual purple, logarithm of photometric density ploted against wave-length.

necessary to produce a given electrical response is plotted on a logarithmic scale against wave-length. The curves are numbered in accordance with the rows in the original figure, and the wave-form and relative magnitude of each response level are indicated by the corresponding diagrams of the ERG. The ordinate has been made logarithmic because of the wide range of values. In Figure 2 the same data have been plotted on an arithmetic scale

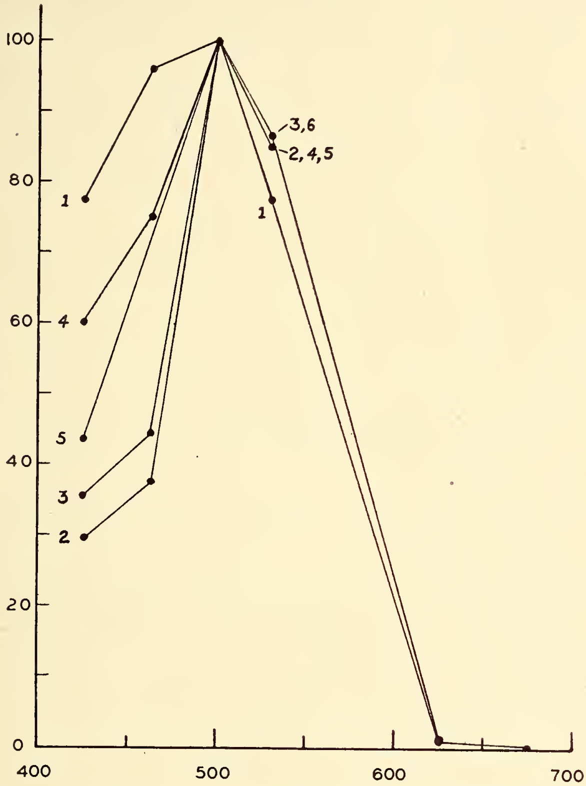

FIG. 2. Percentage effectiveness of light in producing a given ERG plotted against wave-length. Same data as Figure 1. Ordinate is per cent of the reciprocal of the intensity with the data for 500 millimicrons set at 100.

where the ordinate is the percentage of the reciprocal of the intensity centered at 500 mμ.

All data to the right of the peak are quite consistent; data to the left show a considerable variation. Curve 1 was obtained with very small responses which could not be matched as accurately as those for curves 2 to 5. Therefore, it is concluded that curves 2 to 5 give the closest available approximation of the wave-length–sensitivity curves for *Melanoplus.*

DISCUSSION

These curves for *Melanoplus* are in general agreement with those obtained for the behavior of numerous insects by Weiss *et al.* (1941–1944) in that there is a peak at about 500 mμ, a great decrease on the longer wave-length side, and a lesser decrease on the short wave-length side. Other work on the spectral sensitivity of insects is reviewed by Weiss (1943). The similarity of the present curves for *Melanoplus* and the absorption curve for visual purple (review, Hecht, 1942) is more pronounced than of those given by Crescitelli and Jahn (1939).

The obvious advantage of the electrical method over that of behavior studies is that the sensitivity is determined independently of the reactions of the animal. Any definite discrepancy between the results of electrical and behavior methods when used on the same animal under comparable conditions would constitute positive evidence of wave-length discrimination, *i.e.,* of true color vision. At present, data suitable for such a comparison apparently do not exist.

Other electrical methods, which are applicable both to the problem of wave-length sensitivity and to that of wave-length discrimination, involve the study of single neural units. Graham and Hartline (1935) dissected the optic nerve of *Limulus* so that the response of single fibers to different wave-lengths of light could be recorded. Granit (Granit and Svaetichin, 1939; Granit, 1941, 1943, 1945, and others) placed micro-electrodes on single neurones in the retina of a variety of vertebrates. By these methods reciprocal energy–wave-length curves were obtained. Granit found that in some vertebrate retinæ the peak sensitivity is quite different for different neural units. This is excellent proof not only of the existence but also of the mechanism of color vision. So far these methods have not been applied to insects.

The most recent treatment of color vision in insects is the report of extensive field experiments by Milne and Milne (1945).

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LIFE HISTORY AND HABITS OF THE FLAT GRAIN BEETLE (LÆMOPHLŒUS MINUTUS OLIV.)

BY NELLIE M. PAYNE

Although the flat grain beetle is one of the common pests in mills and warehouses, neither its life history nor food habits have been accurately determined. Cotton (1941) considers that the flat grain beetle is not a primary pest of grain but a secondary invader because it follows attack of the more vigorous insects such as the rice weevil. Portchinsky (1913) classifies the flat grain beetle as merely an insect occurring in grain, not a real pest.

FOOD HABITS

Flat grain beetles do live in the cultures of grain weevils, not only live but thrive. The question arises, then, do they have to live on something produced by the grain weevil? Cultures were set up accordingly (1) in the siftings from a weevil culture; (2) in a mixture of shorts and siftings and (3) in shorts alone. One culture was grown in equal parts of shorts and finely ground sulfur. Beetles throve in all media but contrary to expectation lived as well in shorts as in the grain weevil siftings or in the shorts plus siftings. Presence of sulfur did not retard their development. Since cultures in whole wheat flour or shorts are easier to maintain than those in siftings, the flat grain beetles are now cultured in shorts. Raising insects in siftings is difficult because the siftings from weevil cultures often become moldy and tend to cake in the rearing bottles. Flat grain beetles can live in sound food. They cannot feed on unbroken grain, probably for the reason that *Tribolium* cannot, namely, the mouth parts are not adapted to boring in through the hard coat of the grain, and the whole grain is too large for them to chew.

Flat grain beetles can live on a high protein diet of fish meal and shorts. They do not show, however, any tendency to cannibalism. Over a period of several years no flat beetle has been observed eating another or eating the immature stages. If cannibalism does occur it is rare.

METHODS OF TRANSFERRING

Since flat grain beetles both jump and fly, transfer by brush is difficult. The adult beetles, however, do climb up filter paper or paper toweling. When they are actively climbing they do not usually attempt to jump or fly, unless they are in direct sunlight. Tapping the paper lightly will dislodge the beetles clinging to it. Larvæ will also climb rough surfaces but are not easily removed by tapping. They can be brushed off without injuring them if the brushing is done with care. Eggs may be seen with a hand lens and may be transferred with a small brush from culture to culture.

LIFE HISTORY

Insects were reared in a cabinet which usually stayed at 78° F. (25.5° C.) but for a few hours fell to 75° F. (23.8° C.). Humidity was maintained close to saturation by means of saturated peat moss. When the cabinet was opened, relative humidity would fall sharply.

Information on the length of the various stages was obtained simultaneously. Mated adults were placed in a vial, then removed after one day. Eggs laid by these adults were kept under observation till they hatched. The prepupal and pupal stages were determined by isolating full-grown larvæ, watching them spin cocoons, then isolating the cocoons. Data on the various stages were also obtained by observing the offspring of a pair of beetles throughout the immature stages. The sum of the durations of the stages, which were studied simultaneously, were thus checked by the length of time required for the same individuals to complete their development. In other words the individual parts of the life cycle were determined both in sequence and simultaneously.

Eggs are laid in the food stuff. They are elongated and white. When first laid they are sticky enough for food particles to adhere to them. At the temperatures of the experiment the duration of the egg stages was 8–10 days.

From hatching of eggs to the time of spinning a cocoon was from 26 to 36 days, for the bulk of the culture. Some stragglers required as long as 45 days to complete the larval stage. The larvæ are typically Cucujidæ with typical hooked anal appendages. Their hard, flat appearance contrasts strongly with the subcylindrical *Tribolium* larvæ which are generally found with them in a natural infestation.

When larvæ become full grown they spin cylindrical cocoons. In some cases the ends of these are so flat as to suggest segments of a coarse woolly thread cut off with scissors. If the cocoons happen to be spun against a glass surface they are somewhat flattened. The side of the cocoon next to the glass remains transparent so that observations can be made of changes in the cocoon. The prepupal stage takes about two days. When the larva begins to spin it is still of full length. Inside the cocoon it shortens and gradually assumes a prepupal state. The pupal stage proper lasts 6–9 days. When the adult breaks to pupal skin to emerge, it is white as are other freshly emerged Coleoptera. The white adult, however, does not break through the cocoon, but becomes brown and hard before emerging. Adults emerge through the end of the cocoon. In cultures, white adults never appear for the reason that they remain in the cocoon. Young adults can, however, be told from older ones by their bright brown color. Older beetles gradually become a dull black.

Adults live for months. Freshly emerged adults were isolated on the 24th of June. Both males and females were living in December. Females may live as long as a year. Individual records of fecundity were not kept but the offspring from a single pair of beetles mated June 15 was somewhat over one thousand by December. These beetles were given adequate food and living space but no other care.

SUMMARY

1. The flat grain beetle (*Læmophlœus minutus* Oliv.) can be reared on whole wheat flour or shorts as well as on siftings from weevil cultures.

2. *L. minutus* may live as a scavenger but can live on sound material.

3. At 78° F. and humidity near saturation the duration of the immature stages is 46–57 days. Adults live from 6 months to a year.

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A NEW FORM OF MYRMECINA

BY JANE ENZMANN
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The genus *Myrmecina* Curtis 1829 is known from Europe, where the two species *graminicola* Latreille and *sicula* Ern. André occur. From the Indomalayan region a large number of species have been recorded (Cf. Emery, 1923, Gen. Ins.); *Myrmecina* seems to be absent from South America and Africa. In North America the genus is represented by two subspecies and one variety of the European *M. graminicola,* namely subspecies *texana,* subspecies *americana* and its variety *brevispinosa.* The new form described here resembles *americana* but is also close to the species type from the old world.

Myrmecina graminicola Curtis subsp. quadrispina subsp. nov.

(Figs. 1, 2)

Length 2.5 mm. Color nearly black; mandibles, antennæ, and legs reddish yellow. Front of head brownish red.

Head a little longer than broad, deeply concave behind, sides convex. Eyes small, a little in front of the sides of the head. Mandibles with numerous blunt teeth, the basal teeth larger; when closed there is an open triangle between the mandibles and the anterior edge of the clypeus. Center part of the clypeus elevated, the elevated part with three small teeth in front. Antennal scapes strongly curved, thickened in the upper part, reaching the posterior corners of the head. Antennæ 12-jointed, club 3-jointed, of the usual shape in this genus. Head above with coarse longitudinal striæ, diverging behind, becoming reticulate, the interspaces punctate. Frontal area very distinct, not striated, feebly punctate.

Thorax in front nearly as broad as the head, with sharp humeral angles. Thorax strongly narrowed behind, sharply margined on the sides, very feebly impressed between pro- and mesonotum in the holotype, the impression may be absent in other specimens. Impression between meso- and epinotum narrow but distinct. Epinotum with four spines; the first pair of spines blunt and straight, the second pair, which is the true pair of epinotal spines, longer than the distance apart at the base, slender, strongly upward curved. Strongly longitudinally rugose, some of the rugæ bifurcating on the prothorax; on the sides of the thorax, near the margins, somewhat vermiculate. Both, interspaces and summits of the rugæ finely punctate. There are four large rugæ between the anterior spines. The latter connected by a crest in front of

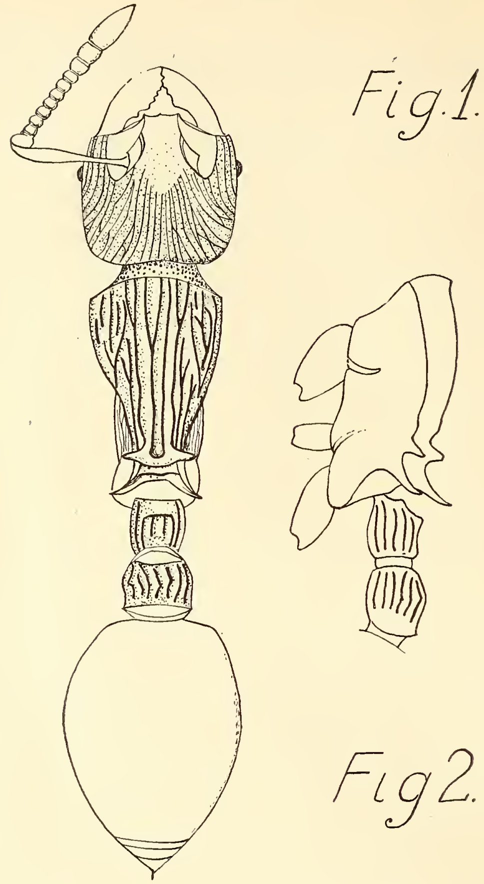

FIG. 1. *Myrmecina graminicola* ss *quadrispina,* dorsal view.

FIG. 2. Thorax and pedicel of same in profile.

which there is a hollow space. Posterior pair of spines connected by a transverse crest in front of which there is a single transverse ruga. Sides of thorax irregularly longitudinally rugose.

Petiole from above nearly square, with slightly concave anterior border and convex sides. Postpetiole wider than the petiole, broader than long, sessile. Both nodes coarsely and irregularly rugose punctate.

Gaster truncated in front, the first segment taking up most of the dorsal surface of the abdomen.

Pilosity very sparse, a little more abundant on the shiny gaster. Pubescence absent.

This ant was described from a single specimen collected on the southern slope of Blue Hills, Boston. Holotype No. 1 in my private collection. Other specimens of this ant were found near the water tower of Roslindale, Massachusetts, about three miles from the type locality.

The new ant differs from its nearest relative *M. graminicola* subsp. *americana* Emery by the following characters: the sculpture on head and thorax is much coarser in *quadrispina,* the epinotum is armed with four spines (two spines and two lateral tubercles in *americana*), the epinotal spines are strongly curved and much longer, the color is very much darker and the pilosity very scant (more abundant in *americana*). It differs from the European type by the absence of a median keel on the clypeus, though it has a median anterior tooth like *graminicola.*

The new species can be placed easily by means of the appended key.

KEY TO THE WORKERS OF THE NORTH AMERICAN FORMS OF MYRMECINA

1. Clypeus with a median keel; length about 2.5 mm.; clypeal teeth much blunter than in the American forms. Europa and Northern Asia as far as Japan .... *graminicola* Emery 1895.
   Clypeal keel absent; the median part of the clypeus is usually smooth ...... 2.
2. First gastric segment shagreened or granulated; length 2–2.9 mm.; epinotal spines nearly as long in *americana,* but their tips blunt and turned upward at the end. Texas .... *texana* Wheeler 1908.
   First gastric segment smooth and shiny, or sublucid .... 3.
3. Epinotal spines longer than broad at their bases, turned upward in the apical half; sculpture of thorax coarsely rugulose, mesonotum behind with two large blunt spines. Massachusetts.
   subsp. *quadrispina* subsp. nov.
   Epinotal spines straight; mesepinotal armature consisting of blunt tubercles or corners at best; sculpture on thorax much finer and more regular; epinotal spines longer than broad at their bases; brownish yellow. Indian Garden, Arizona; Texas .... *americana* Emery 1895.
   Epinotal spines straight and not longer than their distance apart at the base; brownish yellow .... var. *brevispinosa* Emery 1895.

ADDITIONAL NOTES ON BAPTISIA INSECTS

BY S. W. FROST
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In my recent paper, "Insects Feeding and Breeding on Indigo, Baptisia[1]," I inadvertently omitted *Thanaos baptisiae* which Wm. T. M. Forbes described and definitely recorded as breeding on Baptisia from Massachusetts, Illinois and Arizona. Apparently the same form was recorded from Nebraska, North Carolina and Florida. In correspondence Forbes[2] questions Beutenmuller's record of *Thanaos juvenalis* Fab., from wild indigo stating that *juvenalis* is supposed to be an oak feeder and suggests that *T. horatius* Scud., might be expected on Baptisia, as it is a legume feeder.

B. B. Fulton[3] reported that the eggs of *Oecanthus nigricornis* Walk., have been found in the stems of *Baptisia tinctoria.* This tree cricket oviposits in the stems of numerous plants but prefers those of raspberry and blackberry.

The fulgorid *Acanalonia bivittata* (Say) has been found frequently on *Baptisia tinctoria.* This common species visits a wide variety of plants including cranberry, low shrubs and plants in grassy lowlands. Its food plant is unknown.

1 Jour. N. Y. Ent. Soc., 53(3): 219–225.

2 Psyche, 43(3): 111–113.

3 Geneva Tech. Bull., 42: 38.

INSECTS AND THE SPECTRUM

BY HARRY B. WEISS

In the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for September, 1944 (vol. 52, p. 267–271), under the title "Insect Responses to Colors," the results of various workers were summarized, showing that both the electrical responses of the insect eye and the motor responses of the insect itself to different colors of equal physical intensity are due to differences in sensitivity, or to the absorption of light, which varies with wave-length, by the primary photosensitive substance of the visual sense cells, and are not the effects of wave-length by itself. The investigators, by properly adjusting the intensities, were able to match the response to one color with the response to any other color. Under the stimulus of colors of equal physical intensities the visibility curve for the insect eye is qualitatively similar to the group motor behavior curve of insect response to various wave-lengths in the visible part of the spectrum.

The present article has been written for the purpose of gathering from the literature any additional evidence that may have a bearing on the subject of insect responses to color stimuli. Folsom[1] found that *Aphis gossypii* Glov. occurred in much greater numbers on cotton plants treated with calcium arsenate than on untreated plants. And more evidence of a similar sort in connection with the use of certain insecticides has been accumulated by Gaines *et al.*,[2] Bilby,[3] and by Smith and Fontenot.[4] Both McGarr[5] and Gaines[6] found that although the use of cryolite-sulfur dusts increased the aphid population somewhat, on cotton,

[1] Calcium arsenate as a cause of aphis infestations. Jour. Econ. Ent., 20(6): 840–843, 1927.

[2] Effect of different calcium arsenates upon boll weevils, cotton aphids and plant bugs and upon yields. Jour. Econ. Ent., 34(4): 495–497, 1941.

[3] Cotton investigations in Peru. Jour. Econ. Ent., 35(2): 193–197, 1942.

[4] Notes on the effect of arsenicals upon the cotton aphid, predators and other insects. Jour. Econ. Ent., 35(4): 596, 1942.

[5] Control of the cotton aphid and boll weevil in 1940. Jour. Econ. Ent., 34(4): 580–582, 1941.

[6] See footnote 2.

this increase was much less than when calcium arsenate was used. Hill and Tate[7] found that the aphid *Myzus persicæ* (Sulz.) increased significantly in numbers in experimental and commercial plantings of potatoes where zinc arsenite had been used for controlling the potato flea beetle. Moore[8] in studying the reactions of the potato aphis *Macrosiphum solanifolia* Ash., to unsprayed potato leaves and to potato leaves sprayed with Bordeaux mixture, found that aphids were definitely attracted in larger numbers to sprayed leaves. He also found that there was no difference in the wave-lengths of light reflected from the two leaf surfaces (sprayed and unsprayed), but that the light reflected from the sprayed leaf surface was more intense, and that more of the longer wave-lengths was absorbed by the sprayed leaf.

Moore[9] also reported that *Myzus persicæ* (Sulz.) was attracted to potato plants that had been sprayed with Bordeaux mixture because of the increased intensity of the light reflected from the sprayed surfaces, the numbers of insects appearing to follow the inverse square law of light intensities. He also stated that the cabbage aphid *Brevicoryne brassicæ* L., could be reduced in numbers, below those on untreated plots, by the use of colored dusts. Black dust was the most effective one in reducing the infestations. Moore believes that light intensity is the most important factor in attracting the insects to the sprayed surfaces.

Herms[10] working wih the Clear Lake gnat *Chaoborus lacustris* Freeborn, and electrocuting light traps in which red, green, light-blue, dark-blue, blue, violet, ultra-violet and white lights were used, each of approximately the same intensity, found that almost the same number of gnats was collected from each trap over a given period of time, indicating that the gnats have no selective color response. Herms concluded that the response was due to the intensity and not to differences in wave-lengths of the lights. He found that up to the point of deterrence, the number of insects

[7] Increase in aphid populations on potato plants sprayed with zinc arsenite in western Nebraska. Jour. Econ. Ent., Feb. 1943.

[8] Studies on the reaction of potato aphids to sprayed and unsprayed potato leaves. Jour. Econ. Ent., 28(2): 436–442, 1935.

[9] Reactions of aphids to colored insecticides. Jour. Econ. Ent., 30(2): 306–309, 1937.

[10] The Clear Lake gnat. Univ. of Calif. Bull. 607: 20, 1937.

attracted to a light is directly proportional to the increase in the intensity of that light. In this experiment the wave-lengths ranged from 3500 Å to 7000 Å and the intensities were equalized by using 60-watt lamps for all colors. The wattage of a lamp is not an accurate measurement of the intensity of the energy emitted and the wave-length bands were too broad for anything approaching monochromatic colors. Because of this it is difficult to interpret the results more specifically. Experimental work by others has demonstrated that if the physical intensities of the wave-lengths are really equalized, there is a difference in response to the different colors, although this is due to the absorption of light, which varies with wave-length, by the primary photosensitive substance of the visual sense cells.

Others have found intensity [brilliance] to be important also. Ficht and Hienton,[11] working with European corn borer moths and electric traps, state that certain color bands of the visible spectrum were preferred by the moths, the violet-blue band being the most attractive. These authors found that intensity was an important factor in the attractiveness of the lamp to the moths, the number of moths attracted being in almost direct proportion to the intensity of the light in the visible spectrum. These authors worked with broad bands, *i.e.*, 3800–5000 Å (violet and blue); 5000–6000 Å (green and yellow); 6000–7000 Å (orange and red).

There seems to be little doubt about the ability of many insects to distinguish differences in brightness. According to Bertholf[12] the honeybee "begins to distinguish between two illuminated areas when the intensity of one is reduced to at least 70 per cent of the intensity of the other." He found that in bees "the exact percentage of white light required to equalize a given chromed beam in stimulative effect was very difficult to ascertain accurately," due probably to the inability of the bees to recognize differences in brightness unless they are of some magnitude.

Bertholf first used such low percentages of white that they definitely induced fewer reactions than the chromed beam. Then he

[11] Some of the important factors governing the flight of European corn borer moths to electric traps. Jour. Econ. Ent., 34(5): 599–604, 1941.

[12] Reactions of the honeybee to light. Jour. Agric. Res., 42(7): 379–419, 1931.

gradually increased the intensity of the white by small steps "until it definitely induced more reactions than the chromed beam." He then was able to select a point which fairly represented "the percentage of white that just equalled the chroma in stimulative effect."

From an extensive and carefully conducted traplight experiment involving 660 species represented by 12,869 specimens and from the utilization of only such of the species that entered the traps in statistically significant numbers Milne and Milne (1944) draw certain conclusions among which are the following: "Difference in response to any given set of colored lights is on a specific basis, not a generic or family basis. Thus some insects definitely see red light, even if the honeybee does not." "Some species respond primarily to brilliance. This is not true of the preponderance of species. Traps of the same color but different brilliance are not selected chiefly on the basis of intensity." "Preference for one color over another by a species seems to be somewhat independent of brilliancy (at least within the range of brilliancy investigated in these experiments), but the relative attraction of unbalanced white and a color depends to some extent on the difference in light output between the two. Because all lights were alike except for colored coatings on some which removed some wave-lengths, the experiments where the insects selected a dull light in preference to a bright one, are clearly independent of the spectral luminosity function of the insect eye."

These authors admit that more control of wave-length would have been desirable and that their attracting lights should have been more monochromatic, but the use of small filters was not feasible in view of the high intensity needed for outdoor experiments. From the behavior of the species that came under their observation and from their careful analysis of the results I do not see how their conclusions could have been other than what they are.

In view of my own work, however, I cannot agree with them that the response to colored lights is on a specific basis. I found that the group behavior pattern to colored lights of equal physical intensity was essentially the same for many species in several orders; also that there was a shifting of individuals from one light to another during each test, but that the behavior of the group was fairly constant during each test. In other words, some individuals that went to ultra-violet on the first test would go to green on the second and perhaps blue on the third, but at the end of each test the proportion of the total that went to each color was practically the same. Since individual insects are erratic photometers, this may explain why the Milnes' traplight species behaved the way they did.

The Milnes also conclude that although some species respond primarily to brilliance, this it not true for the preponderance of species. My own opinion, based upon the fact that I could change the group behavior response by increasing the brilliance of the colors and upon the work of Crescitelli and Jahn (1939) on the electrical responses of insect eyes to different qualities of light, leads me to believe that of the two, brilliance or intensity is probably more important than wave-length in initiating responses to various wave-lengths in the spectrum to which insects react. Insects will react positively to all wave-lengths from approximately 3650 Å to 7200 Å, the shorter wave-lengths usually requiring much less intensity than the longer ones in bringing about a positive response. This is due to the greater sensitivity of the insects to the shorter wave-lengths. An insect's reaction to light, colored or white depends upon its sensitivity at a particular time, upon the intensity of the wave-lengths to which it is first exposed, the angle of incidence, temperature, moisture, air currents, etc., and in its natural state it is not as good a photometer as a group of laboratory specimens over which one has some control.

Donald L. Collins (Jour. Exp. Zool., 69(2): 165–185, 1934), insofar as the codling moth is concerned, found that the nature of the moth's reactions to constant, or changing light varied according to the position of the iris pigment and he believes that the iris pigment migrations are important in determining the behavior. It is known that the movement of the iris pigment in the eyes of nocturnal insects does not occur instantly or at all speedily. Under natural conditions the movement is gradual. If, when the pigment is in a position to admit as much dim light as possible, the nocturnal insect is exposed to a bright light, the pigment does not respond rapidly enough to exclude the brightness and as a result the insect is stimulated far beyond its normal night behavior. This continues until the pigment moves to a position wherein the brightness is intercepted. This iris pigment movement appears to have a bearing upon light-trap captures.

On the basis of the results reported upon in the paper entitled "Insect Responses to Colors" together with some of those just summarized, it is apparent that insects when exposed to a spectrum of equalized physical intensities extending from 3650 Å to 7200 Å, behave as if they have color preferences. The stimulating efficiency increases slightly from zero at 7200Å to 5700 Å from where it rises to a maximum of 4920 Å in the visible spectrum. It then declines to a low level at 4640 Å from which point it ascends to a peak maximum at 3650 Å. However, such reactions to colors of equalized intensities instead of being interpreted as color preferences may be looked upon as representing the absorption spectrum of the primary photosensitive substance of the visual sense cells. The absorption of light by this substance varies with wave-length and the production of a given response needs a certain amount of photochemical change which in turn requires the absorption of a constant amount of energy. Thus it is seen that a wave-length stimulus possesses both a physical and a physiological intensity and that although the physical intensities of wave-lengths may be equalized, the physiological intensities produce different effects due to the fact that the absorption of light by the primary photosensitive substance in the visual sense cells, varies with wave-length.

The same results that were obtained by exposing the insects to a spectrum of equalized physical intensities from 3650 Å to 7200 Å, could by inference from the work of Bertholf and others, be obtained by exposing them to a series of white lights properly adjusted in physical intensities.

The ability to distinguish one color from another is not proof of color vision unless the colors are of equal brilliance to the insect. Just what constitutes brilliance to an insect is unknown. Ultra-violet, which is very effective in producing a positive reaction, is black to us. In the work of Weiss *et al.*, the physical intensities of the wave-lengths were equalized but the brilliance of each varied and it was the combination of wave-length and intensity that either initiated or failed to initiate a response.

When insects are confronted by wave-length bands, of equalized physical intensities, from 3650 Å to 7200 Å, the primary photosensitive substance of their visual sense cells absorbs the energy at 3650 Å to a greater extent than the energy at other wave-lengths. Ultra-violet light as well as other short wave-lengths of light contain more energy than the longer wave-lengths and chemical reactions are produced more readily by them. The resulting photochemical reaction is accompanied by physical changes in nerve fibers including a change in the electrical activity which is finally transmitted to the muscles. [The theory of the electrical transmission of nerve impulses to effector organs has been superseded by the factual demonstration of chemical transmission. See "Chemical Transmission of Nerve Impulses" by Otto Loewi, American Scientist, 33(3): 159–174, 1945.] As a result insects are particularly sensitive to ultra-violet light of 3650 Å and react positively in greater numbers to this wave-length in preference to all others of equal physical intensity provided it is not intense enough to cause repellency. It is also true that the photosensitive substance of the visual sense cells of insects will function at any wave-length between 3650 Å and 7200 Å if the physical intensity of the wave-length is sufficient and constant.

On the basis of the importance of intensity [brilliance] as set forth by the authors of various laboratory and field tests, one wonders if color has any significance to insects if the intensity or luminosity of any wave-length is sufficient to elicit a response. On the other hand, many flower-visiting insects behave as if they have color perception. There is the work of Lubbock, Forel, Frisch, Lutz, etc., in training bees to associate the finding of food with certain colors, and the work of Bertholf upon the stimulating effect of different wave-lengths in the ultra-violet and visible spectra and upon training bees to distinguish differences in chromas of the same brightness associated with food. Numerous other observations involving butterflies and colored paper flowers and colored papers and the behavior of other insects tested by the use of the optomotor reaction are summarized by

Wigglesworth (1934) to indicate that color vision exists in many other insects. In some of these tests, however, nothing is reported to show that the workers knew what spectral colors were actually reflected from their colored flowers and papers and the results as a whole show a diversity of behavior which it is hard to believe exists. It is also difficult for some observers to divorce themselves from their own color sensations and to realize that insect sensitivity to a spectrum extending from about 3650 Å to 7200 Å makes it unwise to explain their reactions in terms of human color vision.

Lutz found that few flowers reflect any considerable proportion of ultra-violet. Of the 25 flowers studied only 4 were found to reflect more than 10 per cent of radiation shorter than 3800Å. Quoting from his paper—"All colors of the spectrum from red to ultra-violet inclusive are found in light reflected by one flower or another. Of these light waves reflected by flowers, those of relatively great length, red to green are more common than those of shorter length, blue to violet. Flower-visiting insects do not 'see' red to green as well as they do blue to ultraviolet." Since this was written it has been demonstrated that they do "see" the longer wave-lengths if the intensities are strong enough. Lutz's work with ultra-violet and flower-visiting insects did not, as he has stated, show that ultra-violet flowers are more attractive to insects, but that ultra-violet is a "color" to insects just as red is a color to man. He found that ultra-violet flowers were no more popular with insects than flowers reflecting colors visible to humans.

It is not thought that insects depend as much upon their sense of sight as they do upon their sense of smell and one wonders if their activities that appear to be associated with colors could not be initiated by luminosity or brightness alone in combination with any wave-length of the spectrum to which they are sensitive, so long as it was intense or bright enough to be absorbed. The question then arises as to why, when a group of insects is exposed to various wave-lengths of equal physical intensities from 3650 Å to 7200 Å, all do not go to ultra-violet which is presumably the brightest. This can only be answered by saying that not all individual insects are in the same physiological state at the same time and that there exist some variations by individuals in the sensitivity of their visual receptors. Such variations may be due to a depletion of the primary photosensitive substance in the visual sense cells resulting in a positive movement to lower illuminations. Until restorative processes take place in the visual sense cells of such individuals, their sensitivity to ultra-violet declines. In the experimental work of Weiss *et al.,* it was observed that there was a shifting of individuals that went to the different wave-lengths, in successive tests, but little difference between the final group behavior results of each test.

The assumption that insects might react positively only to different degrees of brightness regardless of wave-length would mean that the investigators who trained bees to come to different colors for food and to color patterns marking the site of their nests—were really training these insects to associate different reflected degrees of luminosity or luminosity patterns with their food or nest. In the same way it would have to be assumed that flower-visiting insects, and others, insofar as they depend upon vision to find sources of nectar and food, locate these by means of reflected luminosity, the juxtaposition of the little reflected luminous areas of variable intensity and quality received by the ommatidia giving rise to some sort of contrast between the flower and its surroundings.

Butterflies require several days' training before they will associate particular colors with the presence of food and after an interval of one day only traces of the acquired response remain.[13] Bees may be trained in as little as two hours and they may retain this training for four days.[14] Among the Hymenoptera visual and olfactory memory are important in enabling the insects to find their way to and from their nests.

Learning in insects is usually connected with the association of an unaccustomed stimulus with a common stimulus to which there is an established reaction, the newly acquired habit being called a conditioned reflex. "If an insect appears to 'learn' or to give a certain reaction after a number of repetitions, it is supposed that some primary resistance in the synapse has been

[13] Ilse, D. Z. vergl. Physiol., 8: 658–692, 1928.

[14] v. Frisch, K. Zool. Jahrb. Physiol., 35: 1–182, 1914.

broken down and that the conduction of the stimulus over the same tract in the central nervous system becomes smoother and finally automatic.''[15]

Brues, who studied the color patterns of butterflies by photography in ultra-violet light, concludes, "That the visual picture of butterflies produced in the human eye differs in varying degrees from photographs made by reflected ultra-violet light. A range of 3300 Å to 5900 Å which includes some ultra-violet that is photographically very active (3650 Å) appears to approach the human image very closely, and theoretically at least should represent the image in the insect eye. It follows that certain red and orange markings are readily visible to insects on account of the ultra-violet that they reflect and not by reason of the reflected orange or red which affects our own eyes." Whether the image is seen by the insects in colors or as reflected luminous areas of variable brightness is not known but if the red and orange markings reflected ultra-violet, this wave-length might appear brightest to the insect. In any event insects are particularly sensitive to this color. On the other hand, there is no reason why orange or red that did not reflect ultra-violet could not elicit a response from an insect if the reflected intensities of these colors were strong enough.

In conclusion, it appears that of the two inseparable constituents, wave-length and intensity, the latter seems to be the most important in producing reactions. As color and brightness are forms of consciousness and as it is impossible to definitely interpret insect behavior into any such kind of awareness, I am inclined to agree with Snodgrass that this particular phase of the subject is hardly worth discussing because the facts cannot be known.

The following bibliography is supplementary to the one published in the Journal of Economic Entomology, 36(1): 1–17, 1943.

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FIVE NEW SPIDERS OF THE GENUS NEOANTISTEA

BY W. J. GERTSCH

In the following pages are described five new species of *Neoantistea,* a genus established by the present writer in 1934 (Gertsch, American Museum Novitates, No. 712, pp. 18–31) for a small group of spiders in the family Hahniidæ. Since that time, when only four well-marked species were known, a considerable number of specimens have accumulated in the collection of the American Museum of Natural History, from which material all the present new forms come and in which collection are deposited all the type specimens. In addition, two species were described from the Southwest by Chamberlin and Ivie in 1942 (Bull. Univ. Utah, vol. 32, pp. 28 and 29, figs. 59 to 63) ; and one from Maryland in 1945 by Muma (Proc. Biol. Soc. Washington, vol. 58, pp. 101 and 102, figs. 18 and 19). The number of known species is now twelve.

Neoantistea procteri, new species
(Fig. 1)

MALE.—Total length, 3.15 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	1.60	0.18	0.80	0.20	0.40	1.70
Width	1.36	0.75	0.93	0.28	0.37	1.30

Carapace dark chestnut brown, bright and shining, with a narrow marginal black seam and marked with numerous radiating dark lines and streaks. Midline and clypeus with the usual long black setæ, the carapace otherwise quite smooth. Eye tubercles black. Sternum, labium and cheliceræ reddish brown, clothed with fine black hairs. Maxillæ, coxæ and legs yellowish brown, but much of the yellow integument of the legs is masked by wide black annulæ which are on the femora, tibiæ and metatarsi. Abdomen black above but showing numerous pale grayish spots which coalesce behind to form chevrons, and with two large brownish muscle scars visible near the middle. Venter of the abdomen paler. Spinnerets ringed with dusky, except the middle pair which are all pale.

Structure typical, in very close agreement with *agilis.* Clypeus equal in height to a diameter of the anterior lateral eye. First row of eyes strongly procurved as seen from in front, the median very large, almost touching, their bases scarcely farther from the laterals which are smaller in the ratio 22: 16. Posterior row of eyes strongly procurved, the line along the caudal edges of the laterals falling just in front of the front edges of the median, the median eyes separated by slightly more than their diameter (15/13), a diameter from the equal lateral eyes. Median ocular quadrangle slightly longer than broad (48/46), slightly narrowed behind (46/41), the front eyes very much larger in the ratio 22: 14. Cheliceræ normal, the lower margin of the right one with three contiguous teeth, the lower margin of the left chelicera with a somewhat larger tooth and a small contiguous denticle. Maxillæ produced at the outer tip into a spurred process similar to that found in *radula*.

Legs of normal length for the genus, evenly but sparsely clothed with long fine hairs. First femur with a single, first tibia with a double series of long hairs which originate from rather conspicuous elevated bases. Second leg with similar tubercles but less strongly developed. First leg: femur, 1.40 mm., patella, 0.60 mm., tibia, 1.00 mm., metatarsus, 0.96 mm., tarsus, 0.60 mm. Tibia and patella of the fourth leg, 1.50 mm.

Abdomen of normal shape. Spiracle much nearer the genital furrow than the spinnerets.

Male palpus as shown in Figure 1.

Type Locality.—Male holotype from St. John's River near Geneva, Florida, April 11, 1938 (W. J. Gertsch).

It gives me great pleasure to dedicate this pretty species to Dr. William Procter of Bar Harbor, Maine.

Neoantistea procteri belongs in the series in which the patellar spur of the palpus is a relatively short spine. Both *radula* and *barrowsi* of the eastern United States belong in this group but they are much larger species and have more robust palpi. The teeth on the lower margin of the cheliceræ are probably abnormal in the single specimen of *procteri* known, especially since in this group we ordinarily find a single stout tooth on the lower margin.

Neoantistea jacalana, new species
(Fig. 2)

FEMALE.—Total length, 2.95 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	1.25	0.20	0.75	0.17	0.33	1.95
Width	1.10	0.60	0.75	0.26	0.30	1.45

Coloration essentially as in *agilis*. Carapace strongly marked with radiating black lines and spots. Sternum yellowish brown, dusky, especially on the margins. Legs light yellowish brown, marked with wide black rings as in most of the species of the genus. Abdomen mostly black above, varied with numerous, small white markings, with indistinct chevrons in the caudal half and a pair of rather small brown muscle scars.

Structure very much as in *agilis*. Clypeus equal in height to nearly the diameter of an anterior lateral eye. First row of eyes procurved, a line along the upper edges of the laterals, cutting a small portion of the lower edges of the median. The eyes scarcely separated and of equal size. Second eye row procurved, the median separated by their full diameter, about ⅔ as far from the somewhat larger lateral eyes. Median ocular quadrangle as broad as long, slightly narrowed in front (32/27), the eyes subequal in size. Chelicerae with three teeth on the lower margin. Maxillæ broadly rounded at outer apical margin.

Legs of average length. First leg: femur, 1.05 mm., patella, 0.42 mm., tibia, 0.80 mm., metatarsus, 0.76 mm., tarsus, 0.52 mm. Tibia and patella of the fourth leg, 1.40 mm.

Abdomen normal, the spiracle much nearer the genital furrow than the spinnerets. Epigynum as illustrated in Figure 2.

Type Locality.—Female holotype and three female paratypes from twenty miles south of Jacala, Hidalgo, Mexico, July 6, 1944 (L. I. Davis).

This strongly marked species is similar in size and general appearance to *N. agilis*. It is distinct in the eye relations and especially in the details of the epigynum.

Neoantistea alachua, new species
(Figs. 3 and 4)

MALE.—Total length, 2.70 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	1.25	0.30	0.73	0.16	0.30	1.60
Width	1.10	0.65	0.80	0.23	0.30	1.10

Coloration and structure in very close agreement with *agilis* Keyserling, and most other species.

Clypeus equal in height to scarcely the diameter of an anterior median eye. First eye row strongly procurved as usual, the eyes nearly contiguous, the median larger in the ratio 19: 14. Posterior eye row procurved, a line along the caudal edges of the lateral slightly cutting the front edges of the median eyes, the median separated by their diameter, scarcely as far from the equal laterals. Median ocular quadrangle slightly broader than long (38/36), narrowed behind in the same ratio. Chelicerae with a single tooth on the lower margin. Maxillæ essentially as in *agilis* but the small tubercles on the outer margin more strongly developed.

Legs normal, the first pairs with only weakly developed cusps on the ventral surface. First leg: femur, 1.15 mm., patella, 0.45 mm., tibia, 0.80 mm., metatarsus, 0.80 mm., tarsus, 0.53 mm. Tibia and patella of the fourth leg, 1.33 mm.

Palpus as illustrated in Figure 3.

FEMALE.—Total length, 3.40 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	1.40	0.20	0.76	0.18	0.32	2.30
Width	1.15	0.70	0.86	0.28	0.32	1.70

Coloration and structure in very close agreement with the male. Epigynum as illustrated in Figure 4.

Type Locality.—Male holotype from five miles west of Gainesville, Florida, April 18, 1938 (W. J. Gertsch). Female allotype from Gainesville, Florida, taken from a quail crop. Male paratype from Gainesville, Florida, June 28, 1938 (H. K. Wallace).

This species differs from *agilis* in having the lower margin of the cheliceræ armed with a single enlarged tooth. The male palpi are quite similar but the tibial apophysis in *alachua* is proportionately much longer, somewhat more slender and the patellar spur is shorter. The female has the anterior median eyes clearly larger and differs further in the details of the epigynum.

Neoantistea mulaiki, new species
(Figs. 5 and 6)

MALE.—Total length, 4.60 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	2.20	0.40	1.25	0.32	0.60	2.60
Width	1.90	1.10	1.40	0.42	0.55	1.90

Coloration as in *riparia* and related species. Carapace bright reddish brown, the margins pale, variegated as usual with dusky radiating lines. Cheliceræ and labium dark reddish brown. Sternum, maxillæ and legs nearly concolorous, light yellowish brown, the legs showing the normal dark annuli rather faintly. Abdomen pale beneath, the dorsum with the usual dusky pattern of chevrons and spots and the conspicuous brown muscle scars.

Structure close to that of *riparia*. Clypeus equal in height to diameter of anterior lateral eye. First row of eyes procurved, the line along the lower edges of the median cutting through the centers of the laterals, the eyes contiguous or nearly so, the medians larger in the ratio 24: 20. Second row of eyes strongly procurved, the median separated by the long diameter, slightly nearer the equal lateral eyes. Median ocular quadrangle longer than broad (52/46), as wide behind as in front. The posterior eyes smaller in the ratio 24: 18. Cheliceræ with the lower margin armed with a single tooth. Maxillæ produced at outer apex into a short process bearing four or five tubercles.

First legs armed beneath with a double series of long fine hairs which originate from strongly developed tubercles. First leg: femur, 1.90 mm., patella, 0.95 mm., tibia, 1.50 mm., metatarsus, 1.33 mm., tarsus, 0.80 mm. Tibia and patella of the fourth leg 2.25 mm. long.

Palpus as illustrated in Figure 5.

FEMALE.—Total length, 4.00 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	1.60	0.30	0.96	0.23	0.40	2.70
Width	1.45	0.75	1.50	0.35	0.36	2.00

Coloration and structure in very close agreement with the male.

Eyes in the first row subequal in size. Posterior median eyes separated by their full diameter, about half as far from the equal lateral eyes. Median ocular quadrangle longer than broad (46/42), as wide in front as behind, the front eyes larger in the ratio 20: 16. Lower margin of the furrow of the chelicera with three teeth.

Legs normal. First leg: femur, 1.30 mm., patella, 0.55 mm., tibia, 0.90 mm., metatarsus, 0.85 mm., tarsus, 0.60 mm.

Epigynum as illustrated in Figure 6.

Type Locality.—Male holotype, female allotype and paratypes from Monterrey, Mexico, June 10, 1936 (L. I. Davis).

Records.—Female paratype, 20 miles north of Limon, Tamaulipas, Mexico, April 9, 1939 (L. I. Davis). Male and female paratypes from Saltillo, Mexico, July 3, 1936 (L. I. Davis). Male paratype from San Antonio, Texas, December 28, 1935 (L. I. Davis). Female paratype from San Antonio, Texas, August, 1935 (L. I. Davis). Female paratypes, Llano, Texas, July 9, 1936 (L. I. Davis). Female paratype, Cotulla, Texas, July 8, 1936 (A. M. & L. I. Davis). Female paratype, Conroe, Texas, August 14, 1938 (Ciralyn & A. M. Davis). Male, female paratypes, Comfort, Texas, July 8, 1936 (L. I. Davis). Female paratype, east of Edinburg, Texas, January 26, 1934 (S. Mulaik). Female paratype, Edinburg, Texas, mud daubers nest (S. Mulaik). Female paratype, 32 miles southeast of Laredo, Texas, April 10, 1936 (Haynes). Female paratype, Port Bolivar, Texas, June 5, 1936 (S. Mulaik). Male paratypes, off Bird Island, Cameron County, Texas, May 19, 1934 (S. Mulaik).

This is a species of the *riparia* group. The male palpus has a small, pointed spur on the patella which is much farther removed from the base of the segment than in *santana* Chamberlin and Ivie. The tubes of the female epigynum are small and much convoluted, the pattern being different in almost every specimen.

Neoantistea crandalli, new species
(Figs. 7 and 8)

MALE.—Total length, 4.50 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	2.10	0.45	1.20	0.32	0.60	2.70
Width	1.80	0.90	1.40	0.44	0.55	1.90

Coloration and structure essentially as in *riparia* and allied species. Clypeus equal in height to the diameter of an anterior lateral eye. First row of eyes procurved, the median larger than the laterals in the ratio 25: 22. Second eye row recurved, the median separated by more than the diameter (22/17), half as far from the equal lateral eyes. Median ocular quadrangle as broad as long, slightly narrowed in front (50/52), the front eyes much larger than the posterior medians in the ratio 25: 16. Cheliceræ with a single large tooth on the ventral margin. Maxillæ with the outer angular process set with five tubercles.

Legs as in *riparia,* the first two pairs armed with the usual double series of stout elevations from which spring curved black hairs. First leg: femur, 2.10 mm., patella, 0.95 mm., tibia, 1.75 mm., metatarsus, 1.50 mm., tarsus, 0.85 mm. Tibia and patella of the fourth leg, 2.35 mm.

Palpus as illustrated in Figure 7.

FEMALE.—Total length, 3.80 mm.

	Carapace	Front	Sternum	Labium	Maxillæ	Abdomen
Length	1.70	0.30	1.00	0.26	0.45	2.40
Width	1.45	0.70	1.08	0.32	0.40	1.90

Structure and coloration in close agreement with the male.

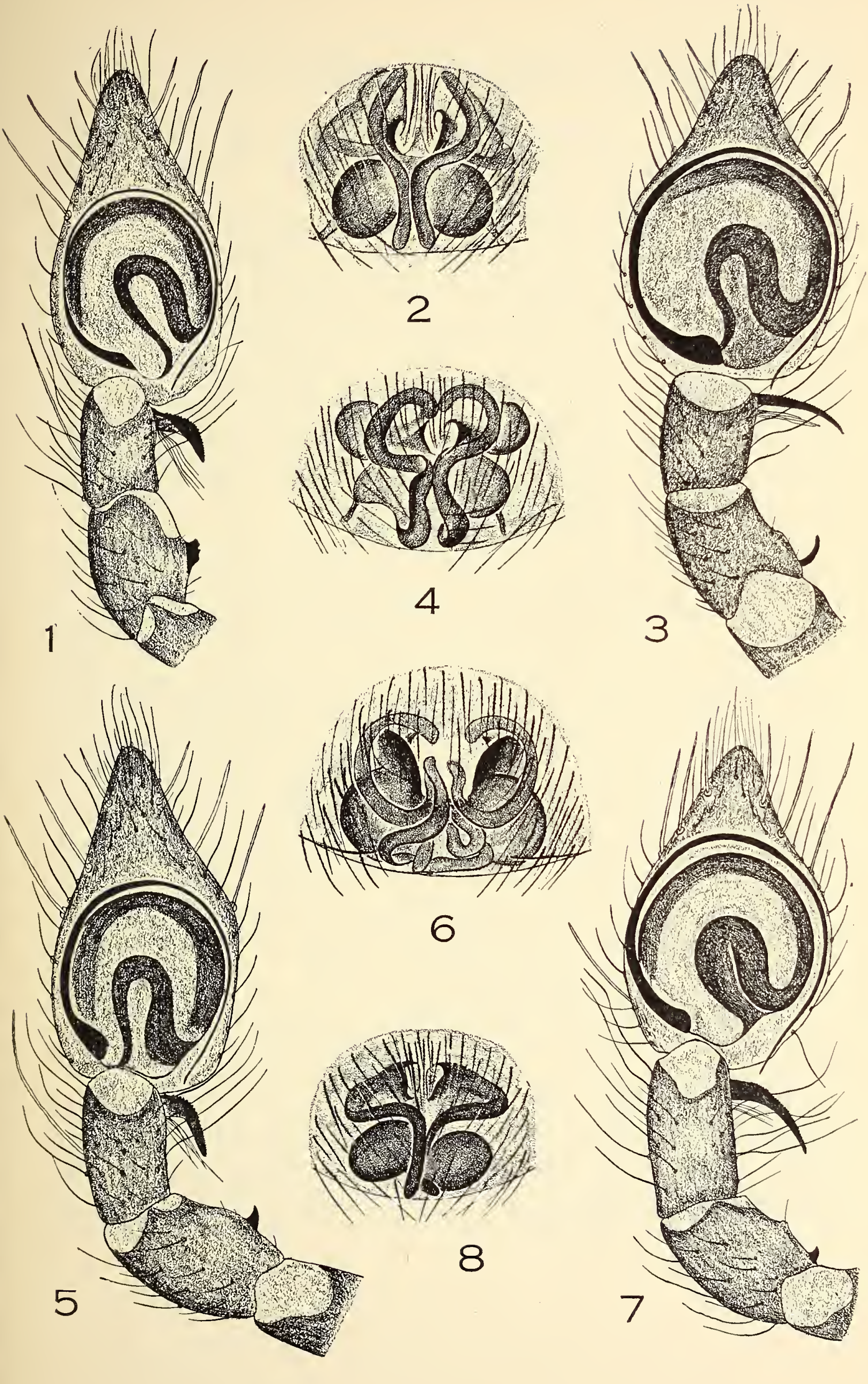
Epigynum as illustrated in Figure 8.

Type Locality.—Male holotype and paratype from Patagonia, Arizona (Crandall). Female paratype from White House Canyon, Santa Rita Mountains, Arizona, October 15, 1936 (O. Bryant). Male paratype from Madera Canyon, Santa Rita Mountains, Arizona, July 16, 1940 (W. J. Gertsch).

This species is closely allied to *Neoantistea riparia* Keyserling. It differs in having the tibial apophysis more strongly curved. The male paratype is somewhat smaller (carapace, 1.90 mm. long) and has the first legs less robust and with only moderately developed tubercles beneath the basal segments. In the epigynum of the female the tubules are relatively slender, at most one-fourth as wide as the spherical receptacles.

PLATE I

Figure 1. *Neoantistea procteri,* new species, left male palpus, ventral view.
Figure 2. *Neoantistea jacalana,* new species, epigynum.
Figure 3. *Neoantistea alachua,* new species, left male palpus, ventral view.
Figure 4. *Idem,* epigynum.
Figure 5. *Neoantistea mulaiki,* new species, left male palpus, ventral view.
Figure 6. *Idem,* epigynum.
Figure 7. *Neoantistea crandalli,* new species, left male palpus, ventral view.
Figure 8. *Idem,* epigynum.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BOOK NOTICE

Entomological Nomenclature and Literature. By W. J. Chamberlin, Oregon State College, 1946. $10\frac{3}{4}$ x $8\frac{1}{4}$ inches, 135 p. frontis., lithoprinted.

To the serious student who is beginning the study of entomology, Dr. Chamberlin's book is a necessity, opening up as it does avenues to the nomenclature and literature of the subject and enabling the student to find his way about, without wasted effort. The first part of 47 pages is devoted to entomological nomenclature, its origin, the need for it, keys and their construction, the international rules, sample opinions of the international commission, and a bibliography of important papers on nomenclature. This section could be read with advantage by many who are supposed to have passed the beginner's stage.

The second part of 73 pages is concerned with entomological literature and includes lists of general bibliographic works on natural history, entomological bibliographies, indexes to popular scientific literature, guides to the publications of the United States Department of Agriculture, and other departments that have issued publications of entomological value, and a guide to state publications. In addition there is a list of serials devoted to entomology in whole or in part, both domestic and foreign, a list of general works on entomology, lists of catalogues and monographs on single orders and smaller groups, including mites, ticks and spiders, important references to biological control, bee culture, classification, fossil insects, glossaries, historical entomology, medical entomology, morphology, embryology and physiology, quarantines, and zoological names.

The third part of 15 pages deals with scientific publications, the preparation of articles, correction of proof, a glossary of terms used in printing, etc.

This is the second edition of this highly useful bibliographic work which has been enlarged by additional references and Part III. Works of this nature that facilitate study and research should be encouraged and supported by all our entomological organizations.—H. B. W.

TWO NEW CHARACTERS IN THE GEOMETRIDÆ

By Wm. T. M. Forbes
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The Geometridæ, with over a thousand genera and far more than ten thousand species, have suffered in their classification from a lack of good characters that could be seen without dissection. A large part of the genera are at present based on mere appearance, or features, like the details of the radial venation, which are notoriously variable, so that any other structures that show tangible differences should be taken into account. In an attempt to define better the genera of the eastern United States the two following structures have been noted as relatively easy to see. The first shows good grouping characters, while the second appears erratically, frequently differing between closely related genera, and in a few cases within an obviously sound genus, but is easily seen and rarely shows intermediate states.

THE CHÆTOSEMA

The Lepidoptera and Trichoptera share a set of curious organs on the top of the head; each a raised area of the surface, bearing a group of radiating setæ, with which in the Lepidoptera ordinary scales may be intermixed. In the Trichoptera there may be several pair of these, and they are merely called the *warts;* in the Lepidoptera there is a single pair, behind the antennæ (or ocelli if present), known as the chætosemas. They vary from massive structures meeting on the mid-line of the head (as in many Zygænidæ) to complete absence, as in the Noctuidæ. In the Geometridæ they are always present, and the typical condition is a smallish round or oval, not too well-defined wart, bearing a group of radiating setæ on each side behind the antenna and separated from it by a bare space, and close above the eye.

This is the condition in all the primitive forms examined, the Brephinæ, most Œnochrominæ, including the Hedylini and Ametris group; also in all the Hemitheinæ examined, most Sterrhinæ, most Ennominæ, and the isolated genera and small groups:

Sphacelodes, the Palyadinæ, the Melanchroiinæ. The only subfamily in which this type has not been seen is the Hydriomeninæ.

The second type is the normal one in the Hydriomeninæ: here each of the two tufts is extended transversely, but gradually narrowing to a point at its upper end. These points may almost meet on the mid-line, but are separated by a wider or narrower bridge of ordinary scaling. This is the normal type in the Hydriomeninæ, where it occurs in all the main sections except the *Eudule* group and a series of genera that appear at first glance transitional to the Sterrhinæ (the Asthenini and Rhodometra types). It also occurs in a number of Sterrhinæ, and here intergrades imperceptibly into the first type, so that it may not be a useful practical character; but curiously in the genera that in other features connect the Sterrhinæ and Hydriomeninæ the structure of the chætosema is clean-cut; the Sterrhines all having the small separate lateral chætosemas, while the Hydriomenines have the Asthenine type, with a procession of setæ across the middorsal line.

A third place where this arrangement of opposed triangles is found is in the *Semiothisa* (*Macaria*) group; and here it looks like a useful grouping character; for it is limited to that group among all the Ennominæ, and intermediate conditions are rare.

So far as our northeastern fauna is concerned the genera which show it are: *Mellilla, Isturgia, Semiothisa, Itame. Dysmigia loricaria* and *Physostegania pustularia* also show it, but doubtless should be sunk to *Itame.* The transitional types are *Enconista dislocaria* and *Eumacaria latiferrugata,* which should also be separated from *Itame* on clean-cut characters of gena and fore leg (*Enconista*) and venation(both), as well as less striking differences in male genitalia. In these two, while the chætosema is limited to a lateral area and rounded, it is definitely longer transversely than from front to back. A partial survey of outside genera shows it also in the Semiothisa group generally, including the primitive African ones with complete venation, *Elpiste, Discalma,* and *Tephrina.* Genera with some resemblance to Semiothisa and Itame, or which have been sometimes grouped with them which have the normal Ennomine chætosema are *Hesperumia, Ematurga, Orthofidonia, Protitame, Æthalura, Athroolopha,* *Bupalus, Krananda, Trigonoptila, Zeheba,* and *"Macaria" angustimargo* Warren and *proximaria* Leech. We may note this coincides closely but not exactly with the presence of two strong dorsal spines on the uncus.

The Asthenine type of chætosema is a curious one. There are the two normal lateral tufts, as in most Geometridæ, but between them extends a procession of single setæ in a groove of the scaling right across the middorsal line, the transition from tuft to line being sudden, unlike the forms with transverse triangles. In the true Asthenine group this line is a regular or sinuous curve; as in *Venusia, Euchœca* in our fauna and *Asthena* and *Hydrelia* in Europe. *Trichodezia* has an intermediate condition, but probably should also be placed here; and in *Hydrelia* some of the species have the character imperfectly developed, with a well marked interruption of the series of setæ. We also get this line of setæ in a groove of the vestiture in the genera *Pardodes, Minoa, Hastina* (transitional), *Cambogia* and *Amaurinia;* but in some of these the eyes are so large that the vertex is quite narrow, and then the row may be straight. I have only noted this arrangement among the Sterrhinæ in *Ptychamalia,* but it may be more general in the South American fauna. In our fauna this Asthenine character proves a useful one for *Venusia* and *Euchœca.*

In another small group of genera the chætosema has moved back, so that it is closer to the middorsal line than to the eye. None of these so far as seen are local types; the tuft is small and in this position in two genera examined now standing as Œnochrominæ: *Zanclopteryx* from South America and *Derambila* from the Old-World tropics; while these two genera differ in size of eye and gena, they are closely similar in appearance, and I believe are really closely related. Derambila may be of faint interest to North American workers, since it includes the true *lumenaria* Hübner, the species which Hulst unaccountably mixed up with our *pendulinaria.*

In the two African Œnochromine genera *Aletis* and *Cartaletis,* we have still another variation; here the chætosema is far from the eye, but the two almost meet on the middle line, and each is very large and with the bristles mixed with scales, like *Eudule.* It seems hardly likely that there is a real connection with *Eudule,* but the combination of orange to luteous coloring, day-flight and rubbery "protective" texture is of interest.

Eudule itself has a curious chætosema, which reminds one of the Zygænid condition. The organs of the two sides keep of full width or nearly so right to the middle line, where they meet and may fuse indistinguishably. The setæ are mixed (except at the two ends) with whorls of short erect scales; but these are well set off from the ordinary vestiture-scales in front and behind. In the closely related South American genus *Mennis,* the two chætosemas have a short space between them, but still they are broad almost to the middle line, and the admixture of scales is similar.

Finally I have seen a further type in a single undetermined Hydriomenine from Indochina, received as a species of Pomasia, but not very close to the descriptions of that genus. In this form each chætosema is a thick crescent, starting on each side at the usual point, but curving around and forward without losing much in width till the two inner ends run parallel to each other between the bases of the antennæ. In this type, unlike the Eudule and Aletis groups, there are no scales mixed with the setæ.

We may note that the well-known European genus *Odezia,* formerly placed with the Hydriomeninæ but transferred to the Œnochrominæ by recent workers, has the double triangle normal for the Hydriomeninæ, but entirely unrepresented in the (relatively few) Œnochrominæ examined.

THE GENA

The other neglected character is the gena. This is the strip of chitine which runs across the lower edge of the eye, from the mouth to the occiput. Its development is closely correlated with the size of the eye, but in a few genera it is easier to judge than the latter character. Where the eye is small it is a broad sclerite, while when the eye is large (as usual in the Geometridæ) it is reduced to a narrow strip, or may totally vanish, except for small triangular portions of its front and hind ends. A character more easily used in a key is the presence or absence of scaling on its outer surface; this may vary from nothing or a few scales at the anterior end or a clothing of light and deciduous scales, almost always rubbed off, to a heavy and full clothing, continuous with that of the front. The genal characters do not tend to make useful grouping characters like the chætosema, but appear erratically—in general broad genæ or scaled genæ are associated with bright coloring and diurnal flight. Usually a whole genus will be alike in these characters, but sometimes they define mere species groups, and they rarely, if ever, hang together for as large a series as a tribe. But except in the few cases where the scaling is limited to the very front edge of the gena, or it is deciduous, they make a very convenient key-character. Roughly speaking, half the genera with broad genæ and small eyes show scaling, but in the genera with narrow genæ and large eyes, scaled genæ are very rare—the only cases noted in our own fauna are *Epirrhoe sociata* (the rest of the genus having small eyes and wide genæ), and male *Cingilia catenaria,* where they are fugitive. There are also a few exotic cases, I think always closely related to small-eyed types.

The following list of forms with scaled genæ show the extremely erratic distribution of the character.

BREPHINÆ: *Brephos* and *Leucobrephos.* In both these genera the scaling of the gena is absolutely continuous with the front, but sharply set off from the occiput with a cusp; also the gena has sparse bristles mixed with the scales, a character not noted elsewhere.

ŒNOCHROMINÆ: *Alsophila* (both *pometaria* and *æscularia*) is one of the embarrassing cases. The gena is wide in the female, with well-fixed scaling, very narrow in the male with fugitive scales, hardly ever present in caught material. *Paleacrita,* by the way, shows exactly the same dimorphism, but *Operophtera* is scaleless in both sexes.

Of exotics, *Egea culminaria* shows fugitive scaling, *Zanclopteryx* (but not *Derambila*) has well-set scales; but *Petovia* and *Heliothea, Aletis* and *Cartaletis,* show well-developed genæ without scales. Note that *Odezia* has a scaled gena, but this is probably Hydriomenine, as formerly placed (see under the chætosema).

HEMITHEINÆ: The only case of scaled gena I have noted is *Mesothea.* In general Hemitheinæ have very large eyes, but even *Chlorissa,* with eyes somewhat reduced, lacks the scaling.

STERRHINÆ: Here again large eyes are the rule, but *Xystrota* and *Holarctias,* with reduced eyes and large genæ, still lack the scaling. I have found them among eastern Americans only in *Timandra amaturaria,* which has a narrow but dense row of scales; curiously, four Old World species of *Timandra* examined had no scales at all, though the gena was not much narrower.

In the yellow South American types formerly called Cyllopodinæ, the scaled gena is probably a good generic character. They are present in all species of *Cyllopoda* and *Atyriodes* examined, in *Formiana* and *Xanthiris supergressa* and *flaveolata.* They are absent in *Micropos,* also in *Xanthiris superba,* but the latter is abnormal and perhaps should be transferred to *Micropos.*

In the genera which have been more or less debated between the Hydriomeninæ and Sterrhinæ, *Rhodostrophia* and *Lythria* have the scaling continued down on the side far below the mouth but then ending abruptly. I think part of this area belongs to the gena. *Rhodometra* (three species) totally lacks the scaling, even though the gena is enormous, and the same is true of *Minoa murinata,* which is sometimes associated with *Lythria.*

HYDRIOMENINÆ: In our fauna the scaled gena takes out a clean-cut but heterogeneous list of genera: *Eudule, Trichodezia, Eulype, Epirrhoe, Trichochlamys* and *Psychophora*—all small-eyed with the curious exception of *E. sociata,* which still has scales, though it has large eyes and a linear gena. The scales actually make only a single row. *Scordylia* is also scaled, and may include one or more of the species now standing as *Stamnodes.*

I have not cruised the exotics thoroughly, but note that *E. pulchricolora* is a single exception to the scaling of *Eudule,* but *Mennis* has the scales. The *Pomasia* discussed above has a scaled gena. *Erateina* and *Spiloctenia* have a broad densely scaled gena, absolutely continuous with the front but sharply separated from the occiput, suggesting *Brephos* in this one particular. In the *Trichodezia* group I find that the Japanese *T. kindermanni* agrees absolutely with ours (in spite of Warren's remarks in founding *Neodezia*), but *Polythrena, Trichobaptria* and *Baptria* have naked genæ.

ENNOMINÆ: In this subfamily the distribution of scaled genæ is perhaps even more erratic than in the others, and there are several cases either of variation within a genus, or perhaps where the scales are as deciduous as the wing scales of *Hemaris,* only appearing on an occasional very fresh specimen.

On either interpretation the character must be used with caution. We have two genera where the scaling is definitely present and well attached in the female, and either absent, or more probably extremely deciduous, in the male: *Paleacrita,* the spring canker-worm; and *Cingilia catenaria,* the Chain-dotted *Geometer.* In the former case I have seen only a single male with a considerable number of scales, one of *P. merriccata,* though all the decently fresh females show them. In the latter males with some scaling left are not unusual. It is interesting that the species of *Nepytia,* which are otherwise extremely close to *Cingilia,* do not show the scaling in either sex. In the heavily chitinized black-skinned geometers from South America, also, there are enough cases of just a few scales surviving to suggest that better specimens would show them in more species; but I list the genera as the available material shows them.

Scaled genera are *Fernaldella,* with its close European relative *Narraga fasciolaria;* they are well attached in *Isturgia limbaria* (the genotype) but fugitive in *I. carbonaria,* and I have seen no specimens with the scaling preserved of our *I. truncataria.* Present in *Ematurga* and its very close European relative, *Bichroma famula,* also *Bupalus,* but not *Athroolopha* or *Eurrhanthis,* while *Dasyfidonia* has a few scales at the front. Present in *Anthometra, Pygmœna* and *Psodos,* but not in *Dasydia* and *Acalia,* and generally with a few scales at the front in species of *Gnophos* or none. Of the showy diurnal Old World genera it is present (so far as our specimens are good enough to prove the case) in *Bursada basistriga* Warren and *perdica* Cr., but not several other species of the genus examined, and not in *Milionia* and its close relatives. In the New World it is perhaps fugitive in *Devarodes,* at least I have specimens showing scales in four of six species examined, present in *Melanchroia,* and in the small-eyed species of *Sangalopsis* (where it is probably fugtive again); but it is absent in the large-eyed, blue and red species of *Sangalopsis,* and so far as examined in *Mnesipenthe, Drymœa,* and *Sangala.* Evidently it will have to be used with caution in these brilliant tropical relatives of *Cingilia,* but it appears that the size (width) of the gena and the size of the eye are of more value. But the scaling was not found in any of the more normally colored white or translucent species of this complex.

While the preceding account is based on a large number of genera and species examined, including a great many normal for their groups and therefore not listed here; it cannot be considered in any way exhaustive. The size and shape of the gena itself is not considered, and there are no doubt various other genera not available here; and probably a few interesting structures that have simply been overlooked.

A NEW HOUSE-INVADING ANT FROM MASSACHUSETTS

By Jane Enzmann
North Eastern University, Boston, Mass.

INTRODUCTION

There are but a few species of ants which in our northern climate invade houses and make them their temporary or permanent abodes. The most common of these are the black carpenter ant (*Camponotus herculeanus pennsylvanicus*), *Solenopsis molesta, Tetramorium cœspitum* and a few other species which were introduced into this country through commerce, and flourish in greenhouses. Wheeler, Ants, 1910, cited *Camponotus herculeanus ferrugineus* and *novoboracensis* as house pests, but these forms seem to invade human dwellings rarely and prefer the outdoor life. I have observed *Crematogaster lineolata* nesting beneath the porch of our house for several years, but this ant does not actually invade the house and steal provisions as *Solenopsis* does, or, like *Camponotus,* cause damage to the timbers.

Some time ago a new ant invaded our kitchen, nesting in an inaccessible spot underneath the sink. Closer examination showed that this ant was an unrecorded form of *Myrmica,* a genus which has not been previously observed to invade houses. No measures were taken to exterminate the ants while they were under observation; after several weeks they disappeared without trace, which seems to indicate that the kitchen had been a temporary abode.

Myrmica (Myrmica) brevinodis var **transversinodis**, var nov.
(Figs. 1, 2)

Worker.—Length 3.5 mm. Color dark brown, almost black; thorax barely lighter than the rest of the body; antennæ and legs light brown; mandibles reddish yellow.

Head rectangular; excluding the mandibles barely longer than broad, its sides nearly straight, its posterior border feebly concave. Mandibles strongly longitudinally striated, the cutting edge with two blunt apical teeth and several blunt denticles; the denticles are markedly smaller and there is no gradual decrease in size of the teeth as in most related forms. Clypeus, longitudinally striated, with about 14 striæ. Antennal fossæ finely punctate, not circularly striated. The antennal scapes fail to reach the occipital corners by their thickness at the apex. Antennæ 12-jointed, with

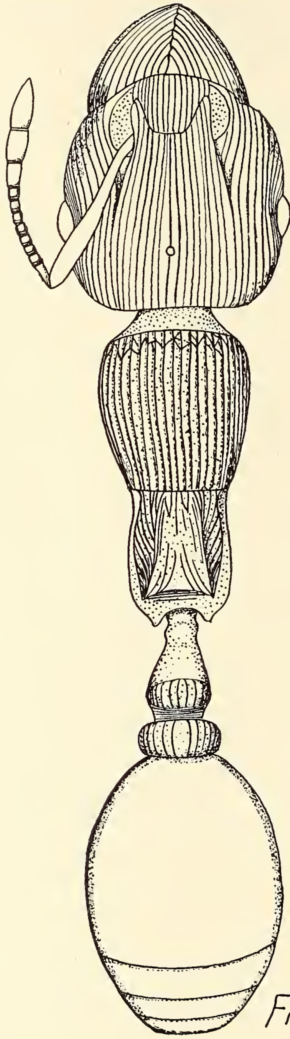


Fig. 1.

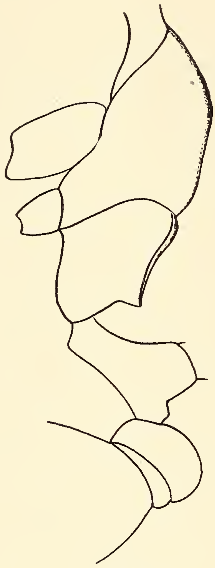


Fig. 2.

FIG. 1. Dorsal view of *Myrmica* (*Myrmica*) *brevinodis* var. *transversinodis*.

FIG. 2. Thorax and petiole in profile of the same.

a distinctly 3-jointed club. Head regularly and rather finely longitudinally striated. Median ocellus present in some workers.

Thorax without promesonotal suture (present in the var. *alaskensis*). Mesepinotal impression very narrow and deep. Epinotal base long, as long as $\frac{3}{5}$ the length of the promesonotum. Epinotal spines shorter than in any of the described forms of brevinodis; much shorter than their distance apart at the base, sharp, triangular, laterally compressed and a little erect. Sculpture of thorax coarsely and irregularly longitudinally rugose, reticulate just behind the neck. The neck is densely punctate. Epinotal declivity transversely striated above and densely punctate.

Petiole with a short peduncle armed below with an anteroventral cone; its sides and the peduncle above densely punctate. Node almost as high as the petiole is long, with weakly convex anterior and posterior slopes and flat summit. Postpetiole globular in profile, its sides densely punctate. Both nodes from above transversely oval, the second node more than the first. Sculpture of the nodes above weakly circularly rugose and densely punctate.

Gaster elliptical, not truncated in front; very finely punctate and very shiny.

Pilosity sparse; a few long white hairs are present on the upper surfaces of the body, more abundant on the gaster. Legs with shorter and adpressed hairs.

Holotype, worker, No. 2, in my private collection. A great many workers were taken from files moving under the kitchen sink near the drain pipe.

Type Locality.—Dedham, Massachusetts, U.S.A.

The new ant is different from all previously recorded forms of *M. brevinodis.* It differs from *alaskensis* by the absence of a promesonotal suture; from *bruesi* by having the prothorax longitudinally sculptured (transversely in *bruesi*); from *sulcinodoides, subalpina kuschei, canadensis* by its very short epinotal spines; its nearest relatives are *brevispinosa, frigida* and *descedens;* it differs from all three by its darker color, very short epinotal spines, presence of a median ocellus at least in some workers, and other characters.

BOOK NOTICE

Brazil. By Mulford B. Foster and Racine Sarasy Foster. The Jaques Cattell Press, Lancaster, Pennsylvania, 1945. 9 x 6 inches. xii + 314 p., illus., blue cloth, $3.50.

This book will please collectors and natural history enthusiasts, regardless of their specialties, because it is a straightforward account of the experiences and explorations of the Fosters in the jungles and highlands of Brazil in their search for bromeliads, orchids and cacti. It embraces their everyday life, including the hard work, the disappointments, the joy of discoveries, the inconveniences of travel, the help of their friends, the amusing incidents, the scenery of the places they visited, the customs of the inhabitants, the occasional dangers to which they were exposed and all that goes with exploration. Most collectors and explorers know that their trips are not a continuous series of thrilling adventures and that the thrills and hair-raising experiences, if they have any, are more than counterbalanced by hard work, disappointments and sometimes severe inconveniences.

This is not to say that the daily happenings described by the Fosters are not without interest. In addition to their absorbing interest in bromeliads and other plant life, the Fosters were keenly aware of everything that was going on and they make you one of their party by their interesting and entertaining descriptions. Even though you are not a botanist, you will like this book because the Fosters are experienced and fascinating travellers and narrators. They do not bore you by dwelling exclusively upon their special interests. You will be pleased with their impressions and knowledge of Brazil and with their numerous and varied experiences involving the exhausting three hours it took Mr. Foster to get a check cashed in a Brazilian city; slow, hot, dirty train rides; a 15 lb. turkey that cost only 45 cents; their discoveries of new species of plants; hungry dogs and thin pigs; bird and animal life; a native dance on cacao beans to give them polish; the difficulty of collecting plants that grow 100 feet from the ground; descriptions of the inhabitants of the country; scenic paradises of colored flowers and foliage; iridescent butterflies; snakes; steep and perilous climbs; torrential rains, and cloudbursts.

The whole book is one of absorbing interest and is enjoyable and informative. Whether you are a botanist or not you should accompany the Fosters on their 12,000 mile trip through Brazil, which is illustrated by 141 photographs and numerous drawings by the authors.—H. B. W.

THE LEPIDOPTERA OF PORTUGAL

BY ALBERT ZERKOWITZ

INTRODUCTION

This paper has been written with the object of providing an analysis of the Portuguese lepidopterous fauna with special regard to the zoogeographical problems connected with the same. Besides the material collected by myself in Portugal I have used the records to be found in the literature as far as I had good reasons to consider them reliable. The policy which I have followed is a very conservative one. Doubtful records have generally been omitted, but wherever there was a special interest in including data, the accuracy of which was somewhat in doubt, I have made an observation to that effect. Species, the occurrence of which is not quite certain, have not been numbered in the systematic list. Fortunately enough, several of the local collectors have been in close contact with internationally known authorities who identified or described a great part of their material. For this reason the entirely reliable records are quite numerous.

This paper does not pretend to be complete. However, if we compare the number of species in well known groups, such as the Rhopalocera, with generally neglected families of Microlepidoptera, we find that the latter are fairly well represented. I have generally found that, in temperate regions, the number of species of Rhopalocera is about one-twelfth of the total number of species of Lepidoptera of all families occurring in the same region. This also holds true for Portugal for with 116 species of Rhopalocera against a total of 1216 species of Lepidoptera of all families, which I am listing, we are not very far from reaching this proportion. There is probably no species of Rhopalocera still unrecorded, and there may not be too many species of Heterocera (including Microlepidoptera) still to be discovered in Portugal.

Due to the war I was not in a position to examine the material of Portuguese origin, still unpublished, which may be found in European collections.

On my first collecting trip in Portugal, I was surprised to note how different the fauna was from that of any other part of the Mediterranean region which I had visited before. This impression was confirmed in the course of later, closer observation. This is the first reason for which I decided to write this paper and a second, but not less important, is as follows: Most surprisingly, Portugal is one of the very few areas in Europe about which no paper dealing with all families of Lepidoptera has yet been published. The existing literature consists mainly of local faunal lists covering the vicinity of the particular place or places where their authors have resided and ignoring the species occurring in the rest of Portugal. Wattison's excellent work (1928–1930) is by far the most complete but unfortunately it deals only with Rhopalocera. In none of these papers are the problems of modern zoogeography elaborated.

Upon consulting the available literature I found that a great many species which I found in Portugal, some of them even common, were not recorded from Portugal so far. Standard works, like those of Seitz and Spuler, give as the distribution of a number of species occurring in Portugal: "in Southern Europe except Spain and Portugal" or they simply omit the entire Iberian Peninsula from the areas which they enumerate. Other species are well known from Spain but were not previously recorded from Portugal. Portugal being the southwesternmost part of the European continent, the new record of the occurrence in Portugal of a given species extends often in a southwestern direction the known area of its distribution.

For all these reasons I thought that the publishing of this paper, incomplete as it may be, was worthwhile. It will be the task of lepidopterists, who may have, in the future, the opportunity to study the fauna of Portugal, to complete our knowledge of the Lepidoptera of this interesting region.

I wish to thank all those from whom I have received suggestions or criticisms in connection with my paper. My greatest debt is to Mr. Herbert F. Schwarz and Mr. William P. Comstock, through whose understanding of my studies the facilities of the American Museum of Natural History were made available to me. Without these facilities this work could not have

been accomplished. Mr. Comstock has also kindly reviewed my manuscript. Mr. E. P. Wiltshire, F.R.E.S., made many valuable suggestions based on his knowledge of the Mediterranean area. Last but not least Senhor Fernando Mendes gave me precious information concerning collecting grounds and local conditions.

HISTORICAL REVIEW

The scientific observation of Lepidoptera started in Portugal apparently around the middle of the 18th century. Linnaeus (1767, p. 773, no. 149) gave Portugal as habitat of *Satyrus hermione.* Fabricius (1781, vol. 2, p. 83, no. 366) described *Satyrus statilinus allionia* from Portuguese specimens and gave D. Gray as his source.

The earliest scientific publication dealing with Lepidoptera, and devoted exclusively to Portugal, is a list of the Portuguese fauna and flora by Dominicus Vandelli who dates his introduction April 1, 1787, but the paper was not published until 1797. In this list 32 species of Lepidoptera are mentioned from Portugal. Some of them are based on misidentifications and the names of others are not used by the generally known authors of the 18th century and can, consequently, hardly be recognized. There are no localities mentioned in this early publication, which has only historical interest.

Count Hoffmannsegg resided in Portugal from 1797 to 1800. He, himself, described new species, such as *Melanargia ines,* and also communicated much of his material to the famous authors of the end of the 18th century and the beginning of the 19th century. New species described at that time from Portuguese specimens include the following Rhopalocera: *Hesperia proto* Esp., *Thecla ilicis esculi* Hbn., *Zizera lysimon* Hbn. (Ochsenheimer, 1807–1816, vol. 1, chapter 2, p. 24, states that this species was discovered by Hoffmannsegg), *Cœnonympha pamphilus lyllus* Esp., *Euchloë belemia* Esp., and gen. æst. *glauce* Hbn. (Ochsenheimer, vol. 1, chapter 2, p. 160 confirms Portugal as habitat), and *Euchloë tagis* Hbn. Most of these species and subspecies were described from material collected by Hoffmannsegg. It is interesting to note that many widely distributed species were first found in Portugal and described from specimens captured there in these early times.

Illiger (1803, p. 184) described the difference between *Thais rumina* L. from Spain and those from Portugal, but did not name the Portuguese form, nor give the name of the collector.

Manoel Paulino d'Oliveira (born 1837, died 1899) was the leading Portuguese entomologist of his times. He devoted his life to the study of several orders of insects and generally sent the Lepidoptera which he collected to foreign specialists. *Symmoca nigromaculella* Rag., *Blastobasis fuscomaculella* Rag., and *Phalonia punctiferana* Rag., are among the species discovered by him. His collection was rather poor as far as Lepidoptera were concerned. It contained very few Microlepidoptera. This collection was acquired by the Museum of the University of Coimbra.

During the last two decades of the 19th century a relatively great number of lepidopterists studied the Portuguese fauna. Rev. A. E. Eaton visited Portugal in 1880 and captured 70 species of Macrolepidoptera, a list of which was published by Staudinger, while Ragonot and Stainton published a list of his 74 species of Microlepidoptera. The Eaton material is of particular interest in view of the fact that it originates in part from almost inaccessible areas of Alentejo and Algarve in southern Portugal. There has been practically no collecting done either before or after Eaton in these regions. *Tortrix œtoniana* Rag., was discovered by this successful collector.

Antonio Augusto de Carvalho Monteiro of Lisbon devoted himself mostly to the study of Rhopalocera and discovered and described *Satyrus actœa mattozi.* This form was named after F. Mattozo Santos, another lepidopterist active during the last two decades of the 19th century. Mattozo Santos made an attempt to publish a list of the Lepidoptera occurring in Portugal, but he reached only a total of 90 species (72 Macrolepidoptera and 18 Microlepidoptera).

The famous collector, Korb, spent some time around 1890 in Portugal and discovered in Algarve *Ptychopoda incisaria* Stgr. Emilio Biel of Pôrto was another collector who sent his material to Staudinger who described *Callimorpha dominula bieli.*

Th. Seebold published in 1898 a list of the Microlepidoptera from the Iberian Peninsula contained in his collection and numbering 683 species, of which only 64 are from Portugal. This disproportion shows how little Portugal was known until the end of the 19th century. Unfortunately Seebold did not give the definite localities whence his Portuguese Microlepidoptera originated.

With the turning of the century, the interest in the exploration of the Portuguese fauna grew rapidly. Rev. Candido Mendes de Azevedo, professor at the famous College of S. Fiel, started in 1894 systematic collecting around his residence of all families of Lepidoptera during all seasons and for a period of eight years. He devoted much time also to the important breeding especially of Microlepidoptera. In 1902 when he left S. Fiel the number of species of Lepidoptera observed by him in this region amounted to 705 (407 Macrolepidoptera and 298 Microlepidoptera). For some species he failed to give the specific name; others are listed as doubtful. Nevertheless it can be said that S. Fiel is the best-explored region of Portugal and the papers published by Mendes are the most valuable contributions to the Portuguese fauna. The accuracy of his observations and the number of details given prove that Mendes was the greatest lepidopterist of all those who have studied the fauna of Portugal. Mendes did not limit his activity to the immediate vicinity of S. Fiel (altitude about 500 m.), but explored also the nearby Serra da Guardunha (1224 m.) and Serra da Estrêla (1991 m.), the latter only on occasional trips.

In 1907 Mendes returned to S. Fiel and found in this region a further 122 species (42 Macrolepidoptera and 80 Microlepidoptera). This brings to a total of 827 the number of species recorded from the region of S. Fiel. In this number are included those of which only the generic name is given and a limited number of doubtful records. The new species described by Mendes from the region of S. Fiel are: *Nepticula ilicis, Nepticula viridella, Coleophora pterosparti* and *Mendesia joannisiella.*

Mendes was in close contact with the leading lepidopterists of the early 20th century to whom he repeatedly sent material and whose comments and identifications are the best guaranty of the accuracy of Mendes' data. Rev. J. de Joannis of Paris was the closest friend of Mendes and certainly the greatest authority in the field of Palæarctic Microlepidoptera of those decades. Several new descriptions were made by de Joannis from Mendes' material, among them the new genus *Mendesia* with its genotype *echiella*. New species described by de Joannis from S. Fiel are *Tortrix nervana* and *Rhyacia fidelis*.

Mendes did not limit his work to the interesting region of S. Fiel. His brother Manuel Mendes d'Azevedo explored in 1902 the region of Torres Vedras. Candido Mendes continued this work in 1906 and 1907 and Philippe Goularte de Souza concluded it in 1907 and 1908. From this region 185 species of Macrolepidoptera and 145 species of Microlepidoptera have been listed.

During a short trip, Mendes collected at Val de Rosal (Caparica do Monte), in the much neglected vicinity of Lisbon, 18 species of Macrolepidoptera and 23 species of Microlepidoptera.

Besides publishing the results of his own collecting, Mendes had also the great merit of studying and publishing the material of other lepidopterists, most of them his disciples. The earliest of these studies is based on the material collected by Rev. Luiz Maria Alves Correia in 1901 and 1902 around Campolide, consisting of 41 species of Macrolepidoptera and 24 species of Microlepidoptera.

In the extreme North of Portugal, near the Spanish border, in the mountains of Gerez (1536 m.), Rev. Joaquim da Silva Tavares (born 1866, died 1931), the great specialist of gall-forming insects, collected Lepidoptera during several seasons. The list published by Mendes enumerates 67 species of Macrolepidoptera and only 6 species of Microlepidoptera. Gerez seems to be the richest region in Portugal as far as the number of specimens of Rhopalocera is concerned. From 1926 to 1929 Maria Amélia de Silva Cruz and J. T. Wattison visited Gerez repeatedly and listed 241 species of Macrolepidoptera and no Microlepidoptera.

M. Rebimbas collected around Setúbal in 1901 and found around 150 species. He was followed by P. Vieilledent, a disciple of Mendes, who found during 1902–1904 a further 265 species in this same region. His list includes 271 species of Macrolepidoptera and 144 species of Microlepidoptera. Setúbal seems to be the second best known region of Portugal. Part of Vieilledent's material was identified by de Joannis of Paris.

Another disciple of Mendes was Julio de Moraes, who collected in the neighborhood of Felgueiras and Guimarães, in the northern district of Minho, 123 species of Macrolepidoptera and 50 species of Microlepidoptera according to the list published by Mendes.

During 1909 the Hon. N. Charles Rothschild paid a short visit to Portugal and found, around Sintra (207 m.), 50 species of Macrolepidoptera and 2 species of Microlepidoptera. H. Rebel described from his material the interesting *Melitœa dejone rosinœ.*

During the revolution of 1910, Mendes was expelled from Portugal and went to Salamanca, Spain, where he lived for a number of years in exile. He has been deprived of his library and collections, the latter having been deposited at the Museum of the University of Coimbra. Mendes continued, during his exile, the study of Portuguese Lepidoptera, but complained bitterly of the loss of his records and collections. His emigration was a great loss for our science.

It was many years after Mendes left Portugal before a new generation of lepidopterists appeared. This new generation was led by J. T. Wattison who not only collected himself, particularly in the northernmost district of Minho, but also published the records of Rothschild and the Rhopalocera to be found in the collections of the Museum of the University of Coimbra and Pôrto and the material of Timóteo Gonçalves. His work, published in 1928–1930, lists 108 species of Rhopalocera found in Portugal, of which he gives descriptions and figures. Besides the region of Gerez, already mentioned, he collected, together with Maria Amélia da Silva Cruz, in the vicinity of Vizela from 1928 to 1930, where they found 217 species of Macrolepidoptera. Unfortunately, no Microlepidoptera have been recorded by them.

The region of Caldelas was explored from 1926 to 1928 by Elisio Ferreira de Sousa, who found only 76 species. From 1930 to 1932 Maria Amélia da Silva Cruz continued the collecting in this region and listed a total of 220 species of Macrolepidoptera. No attention was paid to Microlepidoptera.

Orazio Querci resided in Portugal in 1927 and 1928 and collected Rhopalocera in the districts of Beira, Baixa, Extremadura and Algarve. Unfortunately the dates of capture are not mentioned in his paper. I had an opportunity to see some of his specimens in the Museum Bocage in Lisbon. This museum has been closed to the public for many years and the entomological collections are stored away in large tin containers.

In 1935 O. Lundblad collected in Portugal mainly Hemiptera and only a few Lepidoptera. His material originates from the Extremadura and Alentejo districts. Bryk (1940) has published a list of the 31 species of Macrolepidoptera collected during this trip, including *Cosymbia maderensis* Bethune Baker (1891, Trans. Ent. Soc. London, p. 216, pl. 12, fig. 5) with its ssp. *lundbladi* Bryk, forma *prouti* Bryk and forma *badiaria* Bryk. This interesting species was not found before in Portugal nor anywhere else on the European Continent. Due to wartime conditions I received Bryk's paper after my manuscript had been completed and could therefore not include in my systematic list the above new species, nor the numerous new descriptions of Bryk which refer to species already listed by me from Portugal and cover local races and individual aberrations.

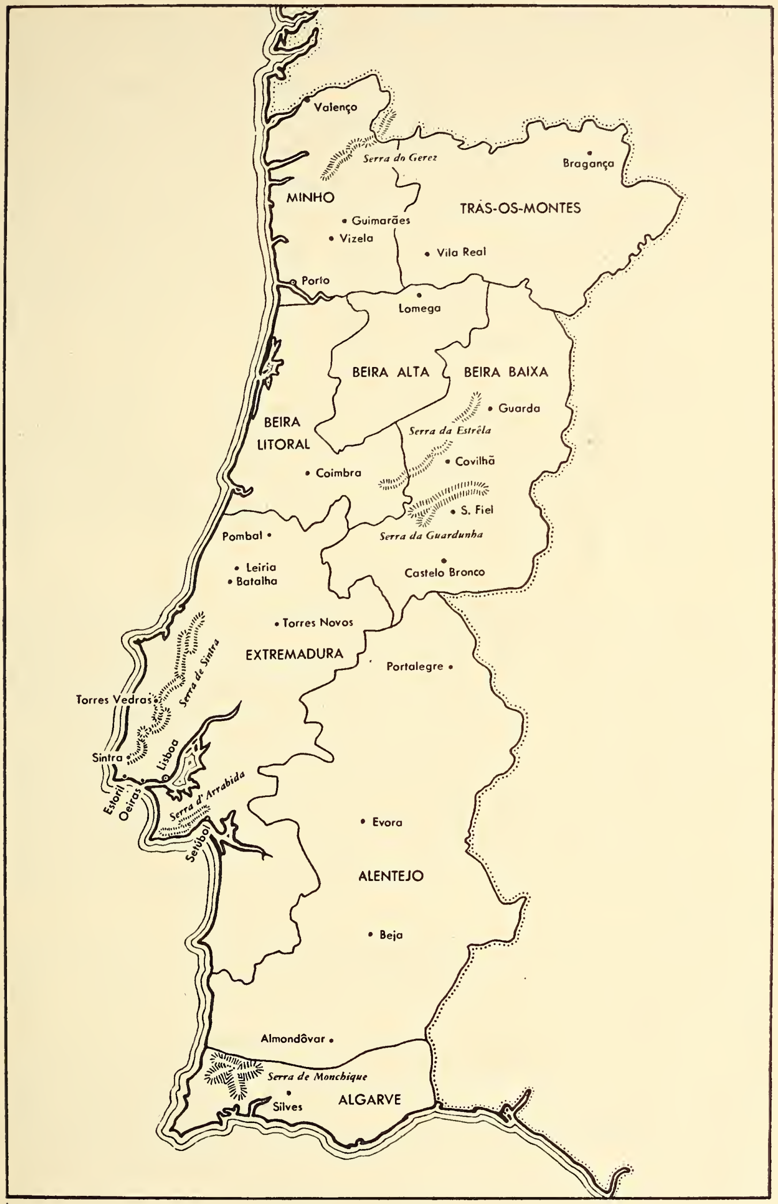
Finally the writer resided in Portugal from 1939 to 1941 and collected in different regions, but mainly in the western part of the Extremadura district, around Estoril, Oeiras, S. Amaro and Sintra. The reader may judge, from the following pages, if his attempt to explore, in such a short time, a good part of the Portuguese lepidopterous fauna, was a success or a failure.

GEOGRAPHY AND GEOLOGY

Portugal is situated at the southwesternmost tip of the Eurasiatic continent and stretches from 42° 9′ to 36° 58′ of northern latitude and from 9° 30′ to 7° of longitude east of Greenwich. It has an area of 89,106 sq. km.

Portugal is popularly divided into 8 districts, which are natural rather than political divisions; their names are used throughout this paper. The locations of these districts are shown on the outline map of Portugal which I am giving. The names of these 8 districts going from north to south are as follows: Minho, Trás-os-Montes, Beira Alta, Beira Litoral, Beira Baixa, Extremadura, Alentejo and Algarve.

The orogenic structure of Portugal is rather complex. Most geological ages are represented. The northern districts, namely



Outline Map of Portugal

Minho, Trás-os-Montes, as well as the districts of Beira Alta and Beira Baixa, are mostly of granite formation, except a large schist area in the southern and eastern part of Trás-os-Montes. The northern part of the Extremadura district is of Secundary origin with the exception of the region of Sintra which was formed by a later volcanic eruption and consists of granitic masses. The region immediately south of the Tagus River was formed in the Tertiary. Cambrian formations occur in the Alentejo district. The greater part of the southernmost Algarve district dates from the Carboniferous, with the exception of the granitoid Serra de Monchique which is due to a more recent volcanic eruption.

Portugal has no high mountains, nor glaciers. The highest elevation is 1991 m., in the Serra da Estrêla. According to Proença, only 0.57 per cent of the total area of Portugal has an elevation exceeding 1200 m.; that is, most of Portugal consists of hilly country and plains.

CLIMATE

The climate of Portugal shows the effects of the low altitude of most of the country and of its proximity to the Atlantic Ocean. The northern part constitutes an Atlantic climatic zone, exposed to the rainy winds coming from the Ocean, with high moisture and little variation in the temperature. The southern part of Portugal is much warmer and dry. From west to east the climate shows an evolution from the oceanic to the continental climate. Near to the Atlantic Coast the climate is under the influence of the Gulf Stream and the maximum daily oscillation does not exceed 20° C.

The yearly average temperature in Guarda, near the Serra da Estrêla is only 10.5° C. It rises to 17.9° C., at Lagos in the Algarve district.

To the south of the Tagus River the temperature rises considerably; in summer up to 50° C. In the same district, the minimum in January is as high as 11.7° C. In the Alentejo district with a more continental climate the daily oscillation is as high as 30° C.

As to the precipitation, which is equally important for the flora as directly for the Lepidoptera, the yearly average according to Proença amounts for all Portugal to 965 mm. It is very unevenly distributed. The highest precipitation exists in the mountainous region. Serra da Estrêla has an annual average of 2464 mm. Going from the mountains to the plain and from the north to the south the precipitation decreases gradually. It amounts in Pôrto, to 1291 mm., Coimbra, 926 mm., Lisbon, 756 mm., and Faro 438 mm. annually. The rainy months are November and December, whereas the whole summer is extremely dry; almost no rain falls from early spring to late fall.

VEGETATION AND BIOTOPES

According to Proença, the number of species of plants known from Portugal exceeds 2700. Compared with the British Isles which have an area 3.5 times larger than that of Portugal and only 1848 species of plants, the Portuguese flora can be considered as rich. Spain is 5.5 times larger than Portugal and is known for its rich flora, which consists of 5089 species of plants.

Of Portuguese plants, 193 species are not known from Spain, but 34 of these occur elsewhere in Europe. There are 15 species occurring only in Portugal and North Africa. Ninety species of Portuguese plants are not known to have been found outside of Portugal and can therefore be considered as really endemic.

For further data concerning the Portuguese flora, I wish to refer to the very rich literature, the papers of Daveau, Pereira Coutinho, Telles Palinha and the serial Boletim da Sociedade Broteriana, Coimbra, which is devoted in great part to this subject.

The rich Portuguese flora is disproportionate if we compare it with the rather poor fauna of Lepidoptera. One of the reasons for this is that many species of Portuguese plants do not have a wide distribution, but are restricted to small areas, and even there some of them do not occur very frequently. Some of these plants are relicts; others are plants with wide distribution outside of Portugal, but rare in Portugal, which country is far removed from their centers of distribution. These plants continue to grow in such small colonies, but the Lepidoptera which once fed upon them may have disappeared, being not able to maintain themselves in such small populations.

Another peculiarity of the Portuguese flora which has a direct adverse effect on the Lepidoptera is the following. For many centuries exotic trees were planted in Portugal. This arborization was perpetuated on a large scale first by religious orders and later through government agencies. It was done in very large areas throughout Portugal. The result was that such exotic trees as *Eucalyptus globulus, Pinus halapensis* Mill., *Psudotsuga douglasi* and many others became acclimated and form at present great forests at many places, as around Bussaco and Sintra, where I observed repeatedly the poorness of the fauna. The aim of these human activities was to transform arid regions into dense forests. The local vegetation gave place to these imported trees, but not a single exotic Lepidopteran has been acclimated with these exotic trees in Portugal, and the species which occurred in Portugal previous to the arrival of these trees could not adapt themselves to the new foodplants. Generally speaking, these forests, particularly the *Eucalyptus* forests, have, besides this, a very poor undergrowth. I have never seen in Portugal areas which were as poor in Lepidoptera as the *Eucalyptus* forests of Sintra.

If we pass in review different parts of the western part of the Palæarctic region, we find that the optimal conditions for the greatest number of species of Lepidoptera exist in regions with a high amount of annual precipitation. The high amount of precipitation is a prerequisite for the existence of forests and the woodlands seem to offer the best biotopes for the greatest number of lepidopterous species. The greatest part of Portugal is rather arid and the woodland is restricted to the smaller part of Portugal. The low amount of precipitation does not permit the growth of large and rich forests composed of the most varied plants which are, in Central Europe, the habitats with the richest fauna of Lepidoptera.

The Portuguese vegetation does not include any of the extremes: there are no high mountains with glaciers and almost without any vegetation, nor do deserts with very little vegetation exist anywhere in Portugal. Swamplands covering large areas are also missing. Nevertheless the biotopes are rather varied. They range from mountain regions with only shrubs and few small trees to dense forests at a few places, to heathery grounds covering large areas and to very dry plains.

We have noted the typical plants only for a very limited number of Portuguese biotopes, which we describe hereafter.

The slopes of the Serra do Gerez are a typical example of the rather rare Portuguese forests. Henriques (1885) wrote that the woodland in the Gerez goes up to a little over 1200 m. The most common trees are *Quercus toza* Bosc. and *Quercus pedunculata* Ehrh. With the oaks, can be found *Acer pseudoplatanus, Arbutus unedo* L., *Prunus lusitanicus, Betula pubescens* Ehrh., *Ilex aquifolium* and *Cratægus monogyna* Jacq. In the vicinity of these forests large areas covered by *Vaccinium myrtillus* can be found. This plant occurs in Portugal only in the Gerez region and in the Serra da Estrêla. A further characteristic plant of the Serra do Gerez is *Amelanchier vulgaris* which climbs to the highest points in this mountain. *Sphagnum* sp. also goes up to the highest elevations. Other typical plants of the Serra do Gerez are: *Vincetoxicum officinale, Eryngium duriacanum* and at higher altitudes, *Allium lusitanicum.* Among the rocks, *Sorbus aucuparia* grows.

The highest zone in the Gerez mountains is over 1200 m., and has no trees, but only a few scrubs. *Sphagnum acutifolium* is abundant. At moist places, *Erica tetralix, Merendera montana* and *Armeria willkommi* are found. Among the dry granitic rocks, *Raconitrium lanuginosum* is abundant and goes up to the summit (1536 m.).

Leaving the Minho district with its Gerez mountain, which is granitic, and with little Mediterranean influence in its floral character, as may be seen from the above, we find other granite formations in the Beira Baixa district. One of them is Serra da Guardunha with its peak of 1224 m. elevation. Here the vegetation is generally poor due to the aridity of the soil. The frequent woodcutting and the activity of the cattle are also unfavorable factors. Predominant plants of this region are *Cytisus albus* Lam., *Cistus ledon* Lam., *Cistus ladaniferus* L., *Lavandula pedunculata* Cav., many Graminaceæ, *Erica arborea* L., *Erica aragonensis* Wk., *Sarothamnus patens* Webb. and *Adenocarpus intermedius* DC. *Genista lusitanica* L. grows at higher altitudes. *Digitalis thapsi* L. is found everywhere on dry meadows.

Only the northern and western slopes of the Serra da Guardunha are of schist formation. Here are to be found *Cistus ladaniferus* L., *Pterospartum cantabricum* Spach., *Calluna vulgaris* Sal., *Erica umbellata* L., *Quercus toza* Bosc., *Arbutus unedo* L. and *Sarothamnus grandiflorus* Webb. The chestnut grows here and there and can be found up to 1070 m. altitude. There are vineyards at over 1000 m. altitude. The forests consist mainly of *Quercus pedunculata* Ehrh., pines and the imported *Eucalyptus globulus.*

Serra da Estrêla in the Beira Baixa district, which is in the vicinity of Serra da Guardunha, has an entirely granite formation and consequently a poor fauna of Lepidoptera.

Nearby Matta do Fundão, still in the Beira Baixa district, on Cambrian formation with large chestnut forests, is the richest spot in the region as far as Lepidoptera are concerned.

Around Torres Vedras, in the Extremadura district there is some woodland, consisting principally of *Quercus lusitanica* Lam. and *Quercus coccifera* L.

In the southernmost Algarve district the picture changes completely. The flora is entirely Mediterranean. *Ficus carica* L. covers large areas, the same as *Amygdalus communis* L., which is in flower in January–February. Other fruit trees, *Magnolia,* orange trees, *Olea europœa* L., *Ceratonia siliqua* L., *Quercus lusitanica* Lam., *Arbutus unedo* L., *Rhododendron* sp., *Platanus* sp. and cork oak are typical for this region.

CHARACTERISTICS OF THE LEPIDOPTEROUS FAUNA

Most families of Lepidoptera occurring in Europe are well represented in Portugal and there is not a single endemic family for this country. The following European families are not represented in Portugal: Phyllocnistidæ, Œnophilidæ, Heliodinidæ, Tinægeriidæ, Ochsenheimeriidæ, Heterogynidæ, Endromididæ, Bombycidæ (*Bombyx mori* L., the only European species of this family, is not cultivated in Portugal), Lemoniidæ.

I have here listed 1216 species of Lepidoptera which compare with the number of species known from other parts of the Western Mediterranean area as follows. According to Zerny (1935) there are 1300 species found in Albarracin, Aragon, Spain, which, however, is a much smaller area than Portugal. I did not find any recent faunal lists from other parts of Spain. As to North Africa, in his excellent work Zerny (1935) lists 684 species from the Great Atlas, Morocco. This covers mostly a mountainous area with much less diversified biotopes than Portugal. Insular faunas are, the same as elsewhere, also in the Western Mediterranean the poorest. Bytinski-Salz (1934) gives a total of about 600 species of Lepidoptera for Sardinia and 875 species for Corsica. As to the Eastern Mediterranean, Ellison and Wiltshire (1939) list 757 species from the Lebanon. According to Amsel (1933), 1335 species occur in Palestine.

If we compare Portugal with the less dry areas in Central Europe, where large forests with rich undergrowth exist, the poorness of the Portuguese fauna becomes evident. Lower Austria has according to Zerny (1935), 3040 species of Lepidoptera, whereas in Hungary (Zerkowitz, 1927) there are 3250 species of Lepidoptera.

FAUNAL REGIONS

Our present knowledge of the distribution of the Lepidoptera over the globe shows that, instead of each species having its particular pattern of distribution, any species follows a pattern of distribution which is shared by a great many other species of diversified taxonomic groups. Each pattern of distribution corresponds to what we call a faunal region and the whole surface of the globe can be divided into a limited number of faunal regions. However, it must be observed that none of the faunal regions can be delineated by a definite straight line on the map because many species would cross such an imaginary line. Various elements penetrate more or less deeply into the main area occupied by the other type, as we will point out in detail on the following pages.

Whereas, all over the Western Hemisphere the principal mountain chains follow a more or less north–southern direction, in the Palæarctic, at least in its western part with which we are here particularly concerned, the higher mountains follow, almost without exception, a west–eastern direction. If we consider high mountains as boundaries of natural regions, this may explain the reason why in the Palæarctic region sharper subdivisions are possible according to the latitude than in America. In fact, it is generally accepted that the western part of the Palæarctic region may be divided into the following subregions, each of which follows a certain degree of latitude and for which the longitudinal range of each is highly different:

Euro-Siberian Subregion
Mediterranean Subregion
Eremic or Desert Subregion

In the North, the Palæarctic region has common boundaries with the Circumpolar region, which has no representatives in Portugal, whereas in a southerly direction the Tropical regions, namely the Ethiopian region and the Indo-Australian region border the Palæarctic region. These two faunal regions have a few representatives occurring in Portugal.

Following the idea of faunal regions and subregions appeared to me as much more reflective of the facts of the actual distribution of any faunal unit than the system followed by a number of modern authors, such as Bates (1935) who, instead of attributing any unit to a particular fauna, examined merely the fact of its occurrence or absence in a number of neighboring areas.

Furthermore I have refrained from using as a unit for my observations the subspecies or race, as suggested by Bytinski-Salz (1934), knowing that the subspecific division of the specific nomenclatorial units is followed through very unevenly by modern taxonomists in the order Lepidoptera. There are many species in such specialized groups as the Rhopalocera which have been divided in a relatively great number of subspecific nomenclatorial units with only very small differences between one and the other, whereas in many families, particularly of the less studied Microlepidoptera, even important differences have not induced any taxonomist so far to describe and name any subspecies. Besides this practical consideration it seems to me that the geographical distribution of a species is a more stable fact than the geographical distribution of various subspecies, some of which may interbreed with others, whereas others cannot, and the genetic value of which is highly different. Furthermore most authors agree about a good species, whereas any given subspecies may be accepted by one author and rejected by another. For the same reasons I disagree with Bates (1935) concerning the term "choromorph," which, however, may have some justification if it is applied to insular faunas.

I have stated, therefore, in my systematic list the particular faunal subregion to which each species (and not subspecies) belongs and was, after careful study, obliged to use terms which in some instances are different from those generally found in the literature. The principal change which I made was subdividing the term "Euro-Siberian" which I have used in all instances. It seems to me that it is hardly possible to speak of a Euro-Siberian species, without using subdivisions. This would mean practically that a species known only from a limited part of Western and Central Europe has to come into the same zoogeographical group as a species distributed all over Europe and Asia, from the Atlantic to the Pacific coast, and known besides this, also from North America and the Tropics. I am surprised that such subdivisions, as I use for the first time here particularly for the Euro-Siberian species, have not been used before by any author.

For the purposes of this study, I was obliged to subdivide other regions also, principally the Western Mediterranean region, or Atlanto-Mediterranean region of Boursin (1943), which I replace by Endemic, Iberian, Atlantic and Western Mediterranean subregions in order to better show the type and extent of distribution of the species involved.

By attributing any given species to a zoogeographical category, I have not considered the hypothetical center of its distribution, but rather the whole area where the species can be regularly found. Areas where the species is found only exceptionally and as a straggler have not been considered.

The list of the terms used in this paper to designate faunal regions and subregions follows with the definition of each of them.

1) *Euro-Siberian.*—Distributed over part or most of temperate Europe and temperate Asia. Some species spread from Europe southward into North Africa, while others do not.

a) *Alpine.*—Restricted in its distribution to the Alps.

b) *Boreo-Alpine.*—Distributed over the Alps and occurring also in Northern Europe. Generally these species occur in Northern Europe at low altitudes or in the plain, whereas in the Alps most of them are found only at a certain altitude, often at considerable altitude.

c) *European.*—Occurring only in Europe, mainly in its temperate regions.

d) *Euroriental.*—Besides temperate Europe found also in Western Asia, some species even in Central Asia.

e) *Euro-Pacific.*—Spreading from Europe eastward as far as the Pacific coastal region of Asia.

f) *Holarctic.*—Widely distributed over the Palæarctic and Nearctic regions.

2) *Mediterranean.*—Distributed over part or most of the areas situated along the Mediterranean Sea. Most of them missing in the areas of desert character, such as Tripolitania, Cyrenaica, and Egypt.

a) *Endemic.*—Found only in Portugal.

b) *Iberian.*—Found only in Portugal and Spain.

c) *Atlantic.*—Spreading from the westernmost part of the Mediterranean area, particularly Portugal and Spain, northward along the Atlantic coast of Europe where the Gulf Stream is felt, the North Sea and sometimes even the Baltic Sea. The particular character of the species pertaining to this group is that they do not spread eastward into the European Continent.

d) *Western Mediterranean.*—Spreading along the European shores of the Mediterranean Sea as far as Southern France, Italy or eventually Dalmatia and along the African shores not beyond Tunisia.

e) *Circum-Mediterranean,* which I have abbreviated in the systematic list into *Mediterranean.*—Occurring in the western and eastern parts of the Mediterranean region.

f) *Ponto-Mediterranean.*—Found in the Mediterranean region and also along the shores of the Black Sea.

3) *Tropical.*—I have used this term irrespectively whether the particular species spreads into Europe from the Ethiopian region or from the Indo-Australian region or from both. The few Neotropical species occurring in Portugal have also been put into this category.—*Tropico-Holarctic* are species which spread from the Tropics not only into the Palæarctic but also into the Nearctic region.

I did not find any species pertaining to the interesting Canarian subregion occurring in Portugal, but found rather that such species can be designated as Mediterranean. Furthermore I did not deem it necessary to attribute any species occurring in Portugal to the Eremic subregion. The influence on Portugal of the North African fauna in general is very light.

On the following pages I have counted the number of species pertaining to the various faunal regions and subregions and have figured the percentage of representation of each of them. I did this for particular reasons. Unfortunately I was not in a position to use geographical maps to illustrate continuous distribution of certain species, disrupted distribution of others and "insular" occurrence of still others. I mean the methods employed by Stegmann (1936) and other modern authors, which I highly appreciate. The limited number of single observations available from Portugal and the small size of the area involved do not justify the use of such maps as those used by Stegmann.

I give in Table I a general faunistic analysis of the Lepidoptera occurring in Portugal, stating for each family the number of species pertaining to each faunal region or subregion. The most characteristic fact that can be observed from this table is that families with numerous Mediterranean representatives are generally well represented in Portugal, whereas families consisting mostly of Euro-Siberian species are generally poorly represented in Portugal.

The Tortricidæ, greatly depending on deciduous trees and consequently with more northern distribution, are poorly represented in Portugal, whereas the Pyralidæ, which are characteristic for the Mediterranean fauna and even for the tropics, are among the well-represented families. Zygænidæ, a family generally well represented in the Euro-Siberian region, in number of species as well as specimens, is particularly poorly represented in Portugal, but the same thing can be said for a great part of the Mediterranean region as far as this particular family is concerned. Geometridæ and Noctuidæ are both well represented with numerous Mediterranean species.

Among the Rhopalocera there are more species of Nymphalidæ listed than Satyridæ, but most Nymphalidæ are only locally distributed or rare, whereas the Satyridæ have a wide distribution in Portugal and many species are very common. One of the most

TABLE I

FAUNISTIC ANALYSIS OF THE LEPIDOPTERA OCCURRING IN PORTUGAL

Families	Euro-Siberian						Mediterranean						Tropical		Total
	Alpine	Boreo-Alpine	European	Eurooriental	Euro-Pacific	Holarctic	Endemic	Iberian	Atlantic	Western Mediterranean	Circum-Mediterranean	Ponto-Mediterranean	Tropical	Tropico-Holarctic	Number of species
Hepialidæ	......	......	......	1	......	......	......	......	......	......	......	......	......	......	1
Micropterygidæ	......	......	2	......	......	......	......	......	......	......	......	......	......	......	2
Eriocraniidæ	......	......	1	......	......	......	......	......	......	......	......	......	......	......	1
Incurvariidæ	......	......	2	1	......	......	......	1	......	1	1	......	......	......	6
Nepticulidæ	......	......	10	2	......	......	3	......	6	5	......	......	......	......	26
Tineidæ	......	......	2	3	......	6	......	1	......	1	2	......	......	......	15
Monopidæ	......	......	......	2	......	......	......	......	......	1	......	......	......	......	3
Talaeporiidæ	......	......	......	......	......	......	......	1	1	......	......	......	......	......	2
Psychidæ	......	......	......	2	1	......	......	1	......	2	3	......	......	......	9
Tischeriidæ	......	......	1	1	......	......	......	......	......	......	......	......	......	......	2
Cemiostomidæ	......	......	1	1	......	......	......	......	......	......	......	......	......	......	2
Lyonetiidæ	......	......	2	......	......	1	......	......	......	3	......	......	......	......	6
Graciliariidæ	......	......	17	12	1	......	2	1	1	5	3	......	......	......	42
Coleophoridæ	......	......	11	3	......	......	1	1	1	......	1	1	......	......	19
Elachistidæ	......	......	1	3	......	......	2	......	......	1	1	......	......	......	8
Heliozelidæ	......	......	2	......	......	......	......	......	......	......	......	......	......	......	2
Scythrididæ	......	......	1	1	......	......	......	2	1	2	2	......	......	......	9
Hyponomeutidæ	......	......	7	......	......	......	......	......	......	1	4	......	......	1	13
Acrolepiidæ	......	......	......	......	......	......	......	......	......	......	1	......	......	......	1
Aegeriidæ	......	......	1	4	1	......	......	......	......	1	1	......	......	......	8
Glyphipterygidæ	......	......	8	......	......	......	......	......	......	1	2	......	......	......	11
Gelechiidæ	......	......	26	29	......	2	2	9	3	11	15	3	......	1	101
Momphidæ	......	......	1	3	......	......	......	......	1	......	2	......	......	......	7
Atychiidæ	......	......	......	......	......	......	......	......	......	......	2	......	......	......	2
Cossidæ	......	......	......	3	......	1	......	......	......	......	......	......	......	......	4
Tortricidæ	......	......	20	29	5	13	1	4	6	5	7	1	......	2	93
Orneodidæ	......	......	......	1	......	1	......	......	......	......	......	......	......	......	2

Families	Euro-Siberian						Mediterranean						Tropical		Total
	Alpine	Boreo-Alpine	European	Euroriental	Euro-Pacific	Holarctic	Endemic	Iberian	Atlantic	Western Mediterranean	Circum-Mediterranean	Ponto-Mediterranean	Tropical	Tropico-Holarctic	Number of species
Pteropheridæ	×	......	2	6	......	1	......	......	......	2	3	......	......	......	14
Pyralidæ	......	1	47	12	1	9	1	2	3	17	45	2	2	7	149
Thyrididæ	......	......	......	......	1	......	......	......	......	......	......	......	......	......	1
Zygaenidæ	......	......	1	4	......	......	......	......	......	......	......	......	......	......	5
Limacodidæ	......	......	......	1	......	......	......	......	......	......	......	......	......	......	1
Geometridæ	......	1	16	73	18	4	......	5	2	45	31	1	1	1	198
Drepanidæ	......	......	......	1	2	......	......	......	......	......	......	......	......	......	3
Cymatophoridæ	......	......	......	1	2	......	......	......	......	......	......	......	......	......	3
Lasiocampidæ	......	......	......	5	2	......	......	2	......	2	......	......	......	......	11
Thaumetopœidæ	......	......	1	......	......	......	......	1	......	......	1	......	......	......	3
Lymantriidæ	......	......	......	......	4	3	......	......	......	1	1	......	......	......	9
Notodontidæ	......	......	......	......	10	......	......	......	......	1	1	......	......	......	12
Noctuidæ	......	......	17	101	44	8	1	9	2	19	25	13	3	2	244
Arctiidæ	......	......	3	11	8	1	......	1	......	2	5	......	1	......	32
Syntomidæ	......	......	......	1	......	......	......	......	......	......	......	......	......	......	1
Saturniidæ	......	......	......	1	1	......	......	......	......	......	......	......	......	......	2
Sphingidæ	......	......	......	7	3	......	......	......	......	......	1	1	2	1	15
Hesperiidæ	......	......	1	4	4	......	......	1	......	3	1	......	......	......	14
Lycænidæ	......	......	1	8	9	......	......	......	......	5	3	......	2	......	28
Erycinidæ	......	......	1	......	......	......	......	......	......	......	1	......	......	......	2
Nymphalidæ	......	......	3	5	13	3	......	......	......	2	2	1	......	1	30
Satyridæ	××	......	2	12	1	......	......	......	......	6	2	1	......	......	24
Danaidæ	......	......	......	......	......	......	......	......	......	......	......	......	......	1	1
Pieridæ	......	......	......	4	4	2	......	......	......	2	2	......	......	......	14
Papilionidæ	......	......	......	1	......	1	......	......	......	1	......	......	......	......	3
Total number of species	......	2	211	359	135	56	13	42	27	148	171	24	11	17	1216

× = *Stenoptilia graphodactyla* Tr. Doubtful.

×× = *Erebia evias* God. Doubtful.

conspicuous facts concerning the composition of the fauna at any given locality in Portugal is the abundance of Satyridæ and the absence or rarity of Nymphalidæ. This fact may be easily explained, the Nymphalidæ being in many instances inhabitants of woodlands or meadows with rich vegetation, whereas Satyridæ occur among rocks and on dry meadows with poor vegetation.

The number of families with only Euro-Siberian species and not a single Mediterranean species is rather large, amounting to 15. The number of families which do not have any Euro-Siberian representative in Portugal, but only Mediterranean or Tropical species is more reduced, being only 4: Talæporiidæ, Acrolepiidæ, Atychiidæ and Danaidæ. These families are rather characteristic for Portugal.

As to the percentage of representation for the various faunal regions and subregions, the following enumeration gives the answer.

Alpine elements	doubtful	
Boreo-Alpine elements	0.2	
European elements	17.4	
Euroriental elements	29.6	
Euro-Pacific elements	11.1	
Holarctic elements	4.6	
Total of Euro-Siberian elements		62.9
Endemic elements	1.1	
Iberian elements	3.4	
Atlantic elements	2.2	
Western Mediterranean elements	12.1	
Circum-Mediterranean elements	14.1	
Ponto-Mediterranean elements	1.9	
Total of Mediterranean elements		34.8
Tropical elements	0.9	
Tropico-Holarctic elements	1.4	
Total of Tropical elements		2.3
Grand total		100.0

ORIGIN AND EVOLUTION OF THE FAUNA

The absence of any substantial number of fossil Lepidoptera makes it very hazardous to risk a positive statement as to the past of any lepidopterous fauna, the known facts about palæobotany, palæoclimatology and geology being definitely insufficient to permit more than speculation in this respect. Therefore I do not expect to prove the veracity of the statements which will follow, nor do I expect that their falseness can be proved.

Portugal being located within an area which is generally considered as forming part of the Mediterranean region, it can be said that its original fauna is represented by Mediterranean elements. As to its age, little can be said. It is, however, generally accepted as a fact by geologists and palæoclimatists that Portugal was not covered during any of the glacial ages by the icecap which protruded from the North. To the contrary, it can be assumed that at a time when a great part of the European continent was covered by ice and the insect populations died or emigrated, the Iberian Peninsula did not suffer from such drastic climatic changes and a great part of the insect fauna continued its existence. It can therefore be assumed that the Mediterranean elements of our fauna are generally of pre-glacial age. However, we do not know if these elements underwent, since the pre-glacial times, changes leading to the formation of new species or subspecies.

It has to be observed here that the Mediterranean area is far from being homogenous. It can be very easily divided into Western and Eastern Mediterranean regions. Not only does the eastern part of the Mediterranean region have a very special fauna (Anatolian-Iranian region) but we find that the Western Mediterranean elements are even more numerous in Portugal than the elements with Circum-Mediterranean distribution. I come to this conclusion if I compare the number of elements in all those faunistic groups which occur only in the western part of the Mediterranean with the number of elements in those faunistic groups occurring equally in the Eastern Mediterranean. This comparison gives the following result in percentages.

	Western Mediterranean	Eastern Mediterranean
Endemic elements	1.1	
Iberian elements	3.4	
Atlantic elements	2.2	
Western Mediterranean elements	12.1	
Circum-Mediterranean elements	....	14.1
Ponto-Mediterranean elements	....	1.9
Total	18.8	16.0

The vegetation and climatic conditions in the western and eastern part of the Mediterranean being very similar, this split in the fauna and the predominance of the Western Mediterranean elements can certainly not be explained by present but only by past conditions.

It is interesting to note how few endemic species are known from Portugal. There are more than three times more Iberian species, that is, species found only in Portugal and Spain, than species found in Portugal only. If we consider that Portugal is separated from Spain by political rather than natural frontiers, this fact is not surprising at all. There is no high mountain, ocean, desert or other impenetrable barrier between Portugal and Spain.

Another interesting fact is the very limited number of both Endemic and Iberian species in comparison with Western Mediterranean species. There are over three times more Western Mediterranean species recorded than Iberian species. This means practically that the Pyrenees with their impenetrable altitudes and the Strait of Gibraltar do not form a barrier to the distribution of a number of species. Over three times more species cross one or both of these barriers than species which do not cross them. This is certainly an interesting fact and any explanation is rather speculative.

If we consider that the most primitive part of the Portuguese fauna is that of Mediterranean origin, we can assume that the additional elements which at present form part of the Portuguese fauna have originated either in the North or in the South. The Euro-Siberian elements have spread from the north whereas the tropical elements have come to Portugal more or less from the south.

It is interesting to note that the Alpine and Boreo-Alpine faunal groups are represented in the Portuguese fauna only by a remarkably low number of elements. This can hardly be attributed to the great distance separating Portugal from the Alps, if we consider the fact that Zerny (1935) found an Alpine species (*Rhyacia helvetina* B.) as far from the Alps as the Great Atlas mountain in Morocco. The scarcity of Alpine and Boreo-Alpine elements in Portugal may be rather due to the low elevation of the Portuguese mountains.

The number of elements pertaining to the other subdivisions of the Euro-Siberian region is relatively high. It can hardly be expected that Portugal, being located within an area that is generally considered as forming part of the Mediterranean region, would have a fauna consiting of only about one-third (34.8 per cent) of Mediterranean elements and almost two-thirds (62.9 per cent) of Euro-Siberian elements. These figures include also Euro-Siberian species which have in Portugal no continuous distribution, being far apart from their center of distribution, but have only an "insular" distribution in Portugal. This means that they are found in Portugal only occasionally and in a limited number of localities. The best example which I can offer to illustrate this "insular" distribution is *Abraxas grossulariata* L., which is certainly one of the commonest and most widely distributed species of the Euro-Siberian region, whereas in Portugal it was found only in one single locality and even there only on one occasion. Such species are hardly an equivalent of certain extremely common Mediterranean species with wide distribution all over Portugal.

We must not overlook, in an endeavor to find an explanation of the above paradoxical ratio between Euro-Siberian and Mediterranean species occurring in Portugal, that the above figures are based on the fauna of Portugal as a whole. Portugal is far from being a homogeneous faunal region. It could rather be divided into small areas, some of them with strong Euro-Siberian characters, whereas others are mostly Mediterranean. Generally speaking, the Euro-Siberian character decreases in north-southern direction while the Mediterranean character increases. We illustrate these facts in Tables II, III and IV.

The percentages of representation of the faunal elements in the districts shown in Tables II, III, and IV are as follows:

	Minho	Alentejo	Algarve
Alpine elements	doubtful	....	....
Boreo-Alpine elements	....	....	doubtful
European elements	10.5	8	13.6
Euroriental elements	37.9	24	25.4
Euro-Pacific elements	21.7	8	3.4
Holarctic elements	6.3	4	3.4
Total of Euro-Siberian elements	76.4	44	45.8

Endemic elements	....	....	1.7
Iberian elements	1.1	....	6.8
Atlantic elements	0.4	....	1.7
Western Mediterranean elements	6.4	28	18.6
Circum-Mediterranean elements	9.7	28	22.0
Ponto-Mediterranean elements	2.2	....	....
Total of Mediterranean elements	19.8	56	50.8
Tropical elements	2.0	....	1.7
Tropico-Holarctic elements	1.8	....	1.7
Total of Tropical elements	3.8	....	3.4
Grand total	100.0	100	100.0

The above figures show clearly that the northernmost Minho district has the most developed Euro-Siberian character with over three-quarters of its species (76.4 per cent) being Euro-Siberian. Less than one-fifth (19.8 per cent) is Mediterranean. In this respect the Minho district is hardly more Mediterranean in its character than many regions in the southern part of Central Europe which are not within the limits of what is generally considered as forming part of the Mediterranean area. The data which I gave in previous chapters, namely, concerning the high precipitation and the dense forests quite unusual in the Mediterranean region, may account for the particular character of Northern Portugal in general and the Minho district in particular.

As to the southernmost Alentejo and Algarve districts, the figures which I gave, show exactly the opposite picture: the percentage of the Euro-Siberian elements (44 per cent and 45.8 per cent) is somewhat less than half of the total, whereas the percentage of Mediterranean elements (56 per cent and 50.8 per cent) is higher than half of the total number of species occurring in these two districts. I have pointed out in the respective chapters the dry climate of these regions and their Mediterranean flora, which may be the explanation of these facts.

NORTH AMERICAN SPECIES OCCURRING IN PORTUGAL

The number of species found in Portugal which also occur in the Western Hemisphere is relatively high. We have mentioned

TABLE II

FAUNISTIC ANALYSIS OF THE LEPIDOPTERA OCCURRING IN THE MINHO DISTRICT

Families	Euro-Siberian					Mediterranean					Tropical		Total
	Alpine	European	Euroriental	Euro-Pacific	Holarctic	Iberian	Atlantic	Western Mediterranean	Circum-Mediterranean	Ponto-Mediterranean	Tropical	Tropico-Holarctic	Number of species
Hepialidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Incurvariidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Psychidæ	......	......	......	......	......	......	......	1	1	......	......	......	2
Gracilariidæ	......	1	......	......	......	......	......	......	......	......	......	......	1
Scythrididæ	......	......	......	......	......	......	......	......	1	......	......	......	1
Hyponomeutidæ	......	......	......	......	......	......	......	......	......	......	......	1	1
Ægeriidæ	......	......	2	1	......	......	......	......	......	......	......	......	3
Glyphipterygidæ	......	2	......	......	......	......	......	......	1	......	......	......	3
Gelechiidæ	......	3	4	......	......	......	......	......	1	1	......	......	9
Momphidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Cossidæ	......	......	1	......	1	......	......	......	......	......	......	......	2
Tortricidæ	......	1	2	2	2	......	......	......	......	......	......	......	7
Pterophoridæ	......	......	2	......	1	......	......	......	......	......	......	......	3
Pyralidæ	......	13	5	1	5	......	......	......	2	......	2	1	29
Thyrididæ	......	......	......	1	......	......	......	......	......	......	......	......	1
Zygænidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Limacodidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Geometridæ	......	9	49	11	3	1	1	10	16	1	1	1	103
Drepanidæ	......	......	1	2	......	......	......	......	......	......	......	......	3

TABLE II—(*Continued*)

Families	Euro-Siberian					Mediterranean					Tropical		Total
	Alpine	European	Eurooriental	Euro-Pacific	Holarctic	Iberian	Atlantic	Western Mediterranean	Circum-Mediterranean	Ponto-Mediterranean	Tropical	Tropico-Holarctic	Number of species
Cymatophoridæ	......	......	......	2	......	......	......	......	......	......	......	......	2
Lasiocampidæ	......	......	5	2	......	......	......	2	......	......	......	......	9
Thaumetopœidæ	......	......	......	......	......	......	......	......	1	......	......	......	1
Lymantriidæ	......	......	......	4	3	......	......	......	1	......	......	......	8
Notodontidæ	......	......	......	10	......	......	......	......	1	......	......	......	11
Noctuidæ	......	11	58	30	8	2	1	5	10	7	2	2	136
Arctiidæ	......	1	8	7	......	1	......	1	2	......	......	......	20
Saturniidæ	......	......	1	1	......	......	......	......	......	......	......	......	2
Sphingidæ	......	......	4	2	......	......	......	......	1	......	2	1	10
Hesperiidæ	......	1	2	4	......	1	......	1	......	......	......	......	9
Lycænidæ	......	1	5	6	......	......	......	2	2	......	2	......	18
Erycinidæ	......	1	......	......	......	......	......	......	1	......	......	......	2
Nymphalidæ	......	3	4	9	3	......	......	1	2	......	......	1	23
Satyridæ	x	1	10	......	......	......	......	5	1	1	......	......	18
Danaidæ	......	......	......	......	......	......	......	......	......	......	......	1	1
Pieridæ	......	......	4	4	2	......	......	......	......	......	......	......	10
Papilionidæ	......	......	1	......	1	......	......	1	......	......	......	......	3
Total number of species	x	48	173	99	29	5	2	29	44	10	9	8	456

x = *Erebia evias* God. Doubtful.

on Table I a total of 56 Holarctic species, *i.e.*, species occurring in the Palæarctic and Nearctic regions, and 17 Tropico-Holarctic species, *i.e.*, species occurring in the Palæarctic and Nearctic regions and also in one or several tropical regions. This represents about 6 per cent of the total number of species occurring in Portugal, which is certainly an unusually high percentage.

TABLE III

FAUNISTIC ANALYSIS OF THE LEPIDOPTERA OCCURRING IN THE ALENTEJO DISTRICT

Families	Euro-Siberian				Mediterranean		Total
	European	Euroriental	Euro-Pacific	Holarctic	Western Mediterranean	Circum-Mediterranean	Number of species
Nepticulidæ	......	......	......	......	1	......	1
Tineidæ	......	......	......	1	......	......	1
Gracilariidæ	......	......	......	......	1	......	1
Scythrididæ	......	......	......	......	......	1	1
Hyponomeutidæ	......	......	......	......	......	1	1
Glyphipterygidæ	......	......	......	......	1	......	1
Gelechiidæ	......	1	......	......	1	1	3
Tortricidæ	1	2	1	......	......	......	4
Pterophoridæ	......	1	......	......	......	......	1
Pyralidæ	1	......	......	......	......	2	3
Geometridæ	......	1	......	......	2	......	3
Hesperiidae	......	......	1	......	......	1	2
Satyridæ	......	1	......	......	1	......	2
Pieridæ	......	......	......	......	......	1	1
Total number of species	2	6	2	1	7	7	25

It may be of interest particularly for the American readers if we examine the zoogeographical significance of these species. Portugal being situated at the westernmost tip of the European continent, we can assume that the relatively high number of species common to Portugal and North America may be explained by the geographical situation of Portugal. This theory may be defended only if we take it for granted that the majority of spe-

TABLE IV

FAUNISTIC ANALYSIS OF THE LEPIDOPTERA OCCURRING IN THE ALGARVE DISTRICT

Families	Euro-Siberian					Mediterranean					Tropical		Total
	Boreo-Alpine	European	Euroriental	Euro-Pacific	Holarctic	Endemic	Iberian	Atlantic	Western Mediterranean	Circum-Mediterranean	Tropical	Tropico-Holarctic	Number of species
Incurvariidæ	......	......	......	......	......	......	......	......	......	1	......	......	1
Nepticulidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Tineidæ	......	......	......	......	......	......	......	......	......	2	......	......	2
Gracilariidæ	......	......	......	......	......	......	1	......	......	......	......	......	1
Coleophoridæ	......	1	......	......	......	......	......	......	......	......	......	......	1
Glyphipterygidæ	......	1	......	......	......	......	......	......	......	......	......	......	1
Gelechiidæ	x	2	1	......	......	......	2	1	......	3	......	......	9
Tortricidæ	......	......	......	......	2	......	......	......	......	1	......	......	3
Pterophoridæ	......	1	......	......	......	......	......	......	......	......	......	......	1
Pyralidæ	......	3	1	......	......	1	......	......	1	1	......	......	7
Geometridæ	......	......	2	......	......	......	......	......	4	1	......	......	7
Noctuidæ	......	......	......	......	......	......	1	......	......	......	......	1	2
Arctiidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Saturniidæ	......	......	1	......	......	......	......	......	......	......	......	......	1
Hesperiidæ	......	......	......	......	......	......	......	......	2	1	......	......	3
Lycænidæ	......	......	4	1	......	......	......	......	2	2	1	......	10
Nymphalidæ	......	......	......	1	......	......	......	......	......	......	......	......	1
Satyridæ	......	......	2	......	......	......	......	......	2	......	......	......	4
Pieridæ	......	2	......	......	......	......	......	......	......	1	......	......	3
Total number of species	x	8	15	2	2	1	4	1	11	13	1	1	59

x = *Gelechia viduella* F. Doubtful.

cies spread from the Old World into the New World over the Atlantic route instead of spreading over the Pacific route.

The spreading of most species took place during past geological ages when the geographical situation of the continents was different from their present situation and even the climates were different from present climates. Without any positive knowledge during which particular age the spreading took place we cannot study the routes over which our species spread in the light of past geological and palæoclimatic facts and have to base our observations on the probable stepping stones where the species involved occur at present.

In the following tabulations I have excluded those species which apparently did not spread due to natural factors, but the spreading of which was directly caused or favored by human interference. We may call the spreading due to natural causes, primary distribution and the spreading caused or favored by human interference, secondary distribution. I give below the names of 18 species which seem to pertain to the latter category with indications concerning the types of human activity that was apparently the cause of their distribution: *Trichophaga tapetiella* L. (human clothing); *Tinea granella* L. (culture of grains); *Tinea cloacella* Hw. (dried fruits); *Tinea fuscipunctella* Hw. (human habitations); *Tinea pellionella* L. (human clothing); *Tineola biseliella* Hummel (human clothing); *Lita solanella* B. (cultivation of potatoes); *Zeuzera pyrina* L. (cultivation of fruit trees); *Sparganothis pilleriana* Schiff. (cultivation of vine); *Carpocapsa pomonella* L. (cultivation of fruit trees); *Achroia grisella* F. (apiculture); *Galleria mellonella* L. (apiculture); *Plodia interpunctella* Hbn. (dried fruits); *Ephestia kuehniella* Z. (stored products); *Ephestia figulilella* Gregson (dried fruits); *Ephestia elutella* Hbn. (stored products); *Pyralis farinalis* L. (stored products); and *Pieris rapæ* L. (cultivation of cabbage).

The above species of secondary distribution are all widely distributed in the Old World as well as in the New World; there is only one of them which is limited in its distribution to the western part of North America, 4 are limited to the eastern part and the great majority of 13 species can be found from the Atlantic to the Pacific coast of North America. These species do not follow natural causes in their distribution, but may occur wherever the human activity which provides them with the food they eat exists. Those living inside of human habitations do even not depend on the natural climate of their area of distribution. For these reasons I exclude them from the following tabulations, because they would certainly distort the picture. The only observations which I want to make in their regard is, that there is only one among these species the spreading of which took place in recent years and where we have the certainty that it spread over the Atlantic route. I mean *Pieris rapæ* L. But even the spreading of this species was rather accidental. As far as the original center of distribution of these 18 species is concerned, we can assume that most of them have spread from the Old World into the New World. They are generally more frequent and have a wider area of distribution in the Palæarctic than in the Nearctic and the human activity which provides their food is older in the Old World than in the New World. There is one exception to this: *Lita solanella* B., the foodplant of which, the potato, originates from the Nearctic region and which may therefore have spread from the Nearctic into the Palæarctic. Nevertheless even in this case we cannot have an absolute certainty because it is quite possible that the foodplant of this species was originally any wild species of the family Solanaceæ growing in the Palæarctic from which the larva may have gone over to the potato after the introduction of that plant in the Palæarctic.

After putting aside the 18 species of secondary distribution which we have discussed above, we have 55 species of primary distribution left. The first question which we have to examine in respect to their zoogeographical status is whether it can be assumed that these species have spread from the Palæarctic into the Nearctic or in the opposite direction.

There is only one species: *Danais plexippus* L., for which we can state with certainty that it has spread from the Nearctic into the Palæarctic. This species is not a regular element of the Palæarctic fauna and in particular of the European continent. It has been found only on very exceptional occasions and mostly only single specimens have been observed. The center of distribution of this species is certainly within the Nearctic and Neotropical regions from which this highly migratory species spreads in western and eastern directions.

There are a few other species which are widely distributed to such an extent that it is hard to say whether the center of their distribution can be found in the Palæarctic or rather in the Nearctic or even in one of the tropical regions where these species of universal distribution occur. The most typical examples of these geopolitan species are *Plutella maculipennis* Curt, which occurs almost everywhere going northward up to Spitzbergen and southward deep into the tropics and *Nomophila noctuella* Schiff., which is also as widely distributed in the temperate and tropical regions of the Old World as it is in both regions of the New World.

It can be said about most or all of the remaining 52 species that they have spread from the Palæarctic into the Nearctic and not in the opposite direction. As to the routes which these species may have followed the following figures of the number of species occurring in various regions may enlighten us:

Species occurring in Northwestern Europe (Scandinavia, Finland, Lapland, etc.)	23
Species occurring on the Southern Atlantic Islands (Maderia, Canaries, etc.)	7
Species occurring in Portugal	52
Species occurring in East Asia (Amurland, Japan, Korea, etc.)	21
Species occurring in Australia and on Pacific Islands, Hawaii, etc.	6

The above figures show that in spite of Portugal being a southern area, the number of the species spreading northward (first and fourth group) is far higher than the number of those spreading southward (second and fifth group). This may be due to the fact that at present, (and probably even more so during the age or ages when these species spread from the Old World into the New World) in the northern regions there are less important barriers between the Palæarctic and the Neartic, than in the south where extensive oceans separate the continents.

If we examine the east-western distribution of our above 52 species, we find that the number of those spreading over the Atlantic route (first and second group) is only slightly higher than the number of those which follow the Pacific route (fourth and fifth group). This seems to be only a coincidence due to the fact that most of the Holarctic species have a very wide distribution over the Palæarctic and occur in its Atlantic as well as Pacific areas and some go even into the tropics. The best proof of our statement that the ratio of the east-western distribution of these species in the Palæarctic region does not have much significance may be found in the distribution in east-western direction of the same 52 species in the Nearctic region, which gives us the following figures:

Species occurring only in the western part of North America	3
Species occurring in the western as well as eastern part of North America	30
Species occurring only in the eastern part of North America	19

These figures certainly show an overwhelming majority of the species occurring in Portugal which are found in North America only in its eastern part, in the Atlantic States. This ratio seems to indicate that the spreading of Portuguese Lepidoptera into North America took place in more numerous instances over the Atlantic route than over the Pacific route. At the same time this may be the explanation of the fact why Portugal, located at the westernmost tip of Europe, has a relatively great number of species occurring in the New World.

If we study the whole area of distribution of the Holarctic and Tropico-Holarctic species occurring in Portugal, we come to the conclusion that they may have followed four routes in their spreading into North America. For several species it is rather easy to follow their route, whereas in a few border cases there may be some doubt as to which route they have followed. Hereafter I give for each of the four routes the most typical species and state the approximate total number of species which may have followed that route. These figures concern the 52 species studied.

1) Northern Atlantic route. Total number of species, 27. Example: *Acalla logiana* Schiff., which occurs in the Palæarctic only in Europe and goes as far north as Lapland. In the Nearctic it occurs only in the Atlantic region. The genus *Acalla* could also serve as an example, all Holarctic species being absent in East Asia, going far into Northern Europe and most of them

restricted in their distribution in the New World to the northeastern part of that hemisphere.

2) Southern Atlantic route. Total number of species, 13. Example: *Bedellia somnulentella* Z., which does not occur in Asia, but is widely distributed in Southern Europe, on Maderia, the Canary Islands, etc., and known from North America only from the Atlantic states.

3) Northern Pacific route. Total number of species, 8. Example: *Papilio machaon* L., which occurs in Alaska and in subarctic America in general, in the form *aliaska* Scudder of which the northeastern Siberian form *orientis* Verity is a synonym, whereas specimens from northern Europe are very different.

4) Southern Pacific route. Total number of species, 4. Example: *Laphygma exigua* Hbn., which has an extremely wide distribution in the Orient, in India, Australia, and has been found even on Hawaii. On the American continent its distribution is rather western: California, Colorado, etc.

SYSTEMATIC LIST

In the following systematic list I have followed the nomenclature of Seitz (1907–1921) for all families contained in that work, whereas for all other families I adhered to the nomenclature of Spuler (1908–1910). Only in the sequence of families have I deviated from these works following a system which corresponds to our present knowledge of the true relationship between families of Lepidoptera according to their evolution. I have started with the most primitive groups and have ended the list with the most specialized families.

The items covered after the designation of the family are ordered as follows: number—genus—species—important synonyms—zoogeographical category—abbreviation of the name of district followed by the name of locality or localities in alphabetical order within such district—month or months in which imago was captured at the respective locality. If several annual broods can be clearly distinguished each brood is separated from the others by semicolon—characteristic environment or peculiarities of habit and remarks—month or months when egg, larva and pupa were observed—food plants—name of collector or identifier whenever of particular interest or bibliographic references—subspecifically named forms.

It was not always possible or necessary to give information on each item as outlined above, but each listing of species follows this general form.

The names of districts have been arranged in geographical succession in north–southern direction and the following abbreviations have been used:

Ale = Alentejo	BL = Beira Litoral
Alg = Algarve	E = Extremadura
BA = Beira Alta	M = Minho
BB = Beira Baixa	T = Trás-os-Montes

It may be seen that whereas some regions of Portugal are relatively well explored, others such as the southern districts Alentejo and Algarve are almost unknown. To my knowledge there was never a resident collector in these districts and all the material was collected on short trips. The time I have spent myself in Portugal was definitely too short to explore under prevailing wartime conditions all 8 districts. I wish to draw particularly to the attention of lepidopterists, who may have the opportunity to explore the Portuguese fauna in the future, these two districts which have a very strong Mediterranean character and where many discoveries can certainly still be made.

As to the phenology, I have stated the months of capture for all specimens collected by myself. As to the records of other collectors, I have given the months wherever available. The dates of capture are given separately for each locality. They are certainly not complete. At some localities only the first annual brood was observed; at others only the second, or the species, has been observed only during part of its period of flight, or only the full-grown larva was collected. Nevertheless the separate listing of the phenology at each locality gives a fair idea of the variations existing within Portugal. Generally in northern Portugal the imago emerges later than in the south. The same thing holds true also for the mountainous areas. Furthermore in the south, some species are on the wing much later during the fall and even in winter. In some instances the number of annual broods is higher in the southern districts than in northern Portugal or in the mountains. A few species are observed, as a consequence of the mild winter, in the imaginal stage practically during the whole year. If we compare the phenology given in the following systematic list with the indications to be found in such handbooks as Seitz and Spuler, we can observe that my data differ considerably from theirs. Most handbooks give the phenology as it can be observed in Central Europe, where many species are found in the imaginal stage later in the spring and summer or earlier in the fall than in Portugal.

The indication of foodplants refers always to Portuguese records, that is plants on which the respective species has actually been observed in Portugal, and not to foodplants on which species are quoted to be found in other regions. The foodplants are therefore not stated for many species, but even with the incomplete data given it can be seen that several species feed in Portugal on a different plant than the one mentioned in the literature from other countries.

(*To be continued*)

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CREMATOGASTER LINEOLATA CERASI, THE CHERRY ANT OF ASA FITCH; (WITH A SURVEY OF THE AMERICAN FORMS OF CREMATOGASTER, SUBGENUS ACROCŒLIA)

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INTRODUCTION

The genus *Crematogaster* seems to be represented in New England by the single species *C. lineolata*. I have collected one of its varieties, "var. *cerasi*" Fitch in various locations in Maine, Massachusetts, and Vermont. I have also found it in New York State and New Jersey, and it has been reported as far west as Dakota. In New England it nests in locations fully exposed to sunshine, and may occasionally seek the shelter of greenhouses or houses, without actually becoming a noxious house ant. A large colony of this ant has been nesting below our sunporch from where the files go out to forage on a large choke cherry tree (*Prunus pennsylvanicus*), where it attends aphids.

In attempting to identify this ant, comparisons were made with specimens from Maine, New Hampshire, Vermont, and localities farther south. It appears that there are a number of intergrading local varieties of which the northern (Maine) are very distinctive and would undoubtedly be listed as separate species, while specimens from more southern localities grade into what might be called the typical *C. lineolata*.

The original description of *C. lineolata* var. *cerasi* Fitch does not designate a type and omits mention of a type locality. It can however be inferred that the original *Myrmica cerasi* (which now bears the name *C. lineolata* var. *cerasi*) was collected in New York State.

Fitch describes in his paper "The Cherry" a form *Myrmica molesta* from that state and mentions *Myrmica cerasi* in the same paragraph. He describes the ant as follows:

"The Cherry Ant (*Myrmica Cerasi*). The neuters are 0.14 long, of dark brown color and slightly translucent, resembling resin; their abdomen is deep black and highly polished, egg-shaped and acutely pointed at its apex, its basal segment covered with minute punctures of an oval form, placed longitudinally, and the remaining segments are similarly punctured upon their apical margins; the head, thorax and anterior sides of the legs are also covered with similar punctures, but more fine; the jaws are reddish-brown and have four teeth of equal size along their inner edge; the antennæ are black, their tips brown and clothed with fine short hairs, the long basal joint punctured; the legs are black, their bases and the tips of the shanks pale brown, and the last joint of the feet brown; a few grey hairs are scattered over head and body."

There is not much in this description to indicate that the described ant is a *Crematogaster;* however, Fitch does not leave any doubt on that score in the next paragraph of his paper, where he describes the habits and especially the characteristic defense mechanism and posture, which is typical of all *Crematogaster*.

Emery (1895, Zool. Jahrb. Syst., 8, 282) redescribed the worker of this ant under the name *C. lineolata* var. *cerasi* Fitch, and listed it under the same name in Gen. Ins., 1923. According to Emery the variety *cerasi* is larger than the typical *lineolata* and has longer epinotal spines; the thorax is punctate with a few longitudinal rugæ, the color is light reddish brown, the gaster piceous black.

Emery's description fits the variety of *C. lineolata cerasi* which is common in New York and New Jesey but not the specimens collected farther north.

This justifies raising *cerasi* to the rank of a subspecies and describing the northern forms as distinct and named varieties. No record has been found of a description of the sexual form of *cerasi*, which is therefore included.

Crematogaster (*Acrocœlia*) *lineolata*
subsp. *cerasi* var. **punctinodis** var. nov.

WORKER.—Length 3 mm. Color dark red; gaster, except at the base, black; appendages lighter red. Head round, broader than long, weakly excised behind. Mandibles sharply longitudinally striated, with four sharp teeth; clypeus round, longitudinally striated, with fine points between the striæ. Antennal scapes surpassing the head by their thickness. Front and vertex very shiny, finely punctate. Cheeks finely longitudinally striated and punctate.

Promesothorax very convex; with a sharp, median carina; humeri prominent; sides of mesthorax sharply marginate; very densely punctate and rugulose, honeycombed in front, longitudinallly behind.

Epinotum narrow at the base, irregularly longitudinally rugulose, and densely punctate; the declivity is shiny; epinotal spines stout, nearly as long as their distance apart at the base, directed backward and outward. Petiole and postpetiole of the usual shape of *lineolata*; upper surface of petiole very finely punctate, sides of petiole and upper surface of postpetiole densely and more coarsely punctate.

Gaster densely and finely punctate, subopaque, not foveolate. Pilosity scant; erect hairs present on prothorax, postpetiole and gastric segments, where they are arranged in straight lines. The postpetiole has a pair of erect hairs, which are backward directed and form a frame for the iridescent stridulatory organ. Scant pubescence present of the head and gaster.

Holotype No. 3, worker, in my private collection. (A large number of workers were collected.)

Type locality Dedham, Massachusetts.

Male.—Length 4 mm. Color black. Head very tiny. Mandibles rudimentary, with four blunt teeth. Clypeus convex. Eyes and ocelli well developed. Antennal scapes short, about twice as long as the first funicular joint; funiculi filiform; 11-jointed; head above finely punctate, shiny; on the cheeks very finely striated and punctate.

Promesothorax very convex, especially the scutellum; Mayrian furrow distinct. Parapsidal furrows absent. Paraptera distinct, narrow anteroposteriorly. Scutellum very convex and highly polished; epinotum unarmed. Pedicel broad, broader behind than in front. Postpetiole shaped as in the worker, without a longitudinal sulcus in the middle; epinotum and pedicel densely striated and punctate. Rest of the thorax, except the scutellum, finely shagreened.

Gaster as in the worker, but non-polished.

Androtype No. 3 B.

Female, winged.—Length 6.5 mm. Color black. Head as in the worker, with straight posterior border. The whole head strongly longitudinally striated, punctate between the striæ. Antennal scapes just reaching the posterior corners of the head.

Thorax very convex, polished, with fine punctation, shiny. Paraptera and scutellum as in the male. Metanotum and epinotum as in the male but the epinotum armed with two blunt teeth. Petiole as in the worker, but postpetiole shaped as in the male.

Gaster very elongate, microscopically punctate, very shiny.

Gynetype No. 3 C (a great number of specimens).

This variety differs from the subspecies *cerasi* (as described by Fitch) by greater length, differently colored body, different sculpture, etc.

Crematogaster (*Acrocœlia*) *lineolata*
subsp. *cerasi* var. **wheldeni** var. nov.

WORKER.—Very similar to *punctinodis*. Differs from it, and from all other forms of *lineolata* by its extraordinary sculpture. The whole body, including legs, antennæ, and mandibles very densely punctate, large and small punctation alternating irregularly. The entire body black to the unaided eyes, under magnification the pedicel, sometimes the whole thorax, blackish red. The sculpture is superficially similar to that of *punctulata* but the general habitus of the insect is more as in *lineolata*. This is also shown by the superimposed sculpture of rugules which is similar to that of *cerasi*. The mandibles and cheeks are longitudinally rugose, the antennal fossæ circularly striated. The neck with faint indications of rugules. All parts of the body are opaque. The humeri are prominent and strongly marginated.

Holotype, worker, No. 4, in my collection.

Type locality New Durham, New Hampshire. Collected by Dr. R. Whelden.

The various forms of the subgenus *Acrocœlia* are closely related and very difficult to tell apart. Most of them occur in North America, and in the Antilles and Central America, only a single species, *clydia*, being listed from South America. Several other South American species have the pedicel shaped somewhat similarly to *Acrocœlia* but are listed by Emery, 1923, under other subgenera of *Crematogaster*.

An attempt was made to find simple criteria for the separation of the North American species, resulting in the following list, which differs considerably from Emery's arrangement, but is close to Wheeler's list, except for the following changes: *coarctata* (listed by Wheeler as species), has been put under *opaca; punctulata* (listed by Wheeler under *opaca*) has been made a species.

I. Forms which have the promesothorax only punctate:
 punctulata Emery 1895. sp.*
  var. *depilis* Wheeler 1908. t.sp.*

II. Forms which have the humeri neatly rounded:
 saussurei Forel 1899.
 ashmeadi Mayr 1886. sp.
  var. *matura* Wheeler 1932. t.sp.
 atkinsoni Wheeler 1919. t.sp.
  var. *helveola* Wheeler 1919. t.sp.
 læviuscula Mayr 1870. sp.
  var. *cubaensis* Mann 1920. t.sp.
  var. *clara* Mayr 1870. sp.
  ss. *californica* Emery 1895. sp.

III. Forms which have the humeri or at least the sides of the mesonotum sharply margined, and the head largely shiny:
 creightoni Wheeler 1933. t.sp.
 kennedyi Wheeler 1930. t.sp.
 sanguinea Roger 1863. sp.
  var. *torrei* Wheeler 1913. sp.
  var. *atavista* Mann 1920. t.sp.
  ss. *lucayana* Wheeler 1905. t.sp.
  var. *etiolata* Wheeler 1905. sp.
 lineolata Say 1836. sp.
  var. *lutescens* Emery 1895. sp.
  var. *subopaca* Emery 1895. sp.
  ss. *coachellai* E. Enz. in lit. t.sp.
  ss. *cerasi* Fitsch 1854. sp.
  var. *punctinodis* var. nov. t.sp.
  var. *wheldeni* var. nov. t.sp.
 pilosa Emery 1895. sp.

IV. Forms which have sharp thoracic margins and opaque heads:
 clydia Forel 1912. sp.

* Explanation of abbreviations: t.sp.—type specimen examined. sp.—specimen examined, which was identified either by Wheeler, Forel or Emery.

opaca Mayr 1870. sp.
var. *dentinoda* Forel 1901. sp.
var. *texana* Santschi 1929. t.sp.
ss. *coarctata* Mayr 1870. sp.
var. *mormonum* Emery 1895. sp.
ss. *cedrosensis* Wheeler 1934. sp.
vermiculata Emery 1895. sp.

In some cases the original description does not fit the specimen studied accurately; the key was therefore made synoptic, and was based on both, specimens and description.

KEY FOR THE IDENTIFICATION OF THE WORKERS OF *ARCOCŒLIA*

1. Promestothorax weakly sculptured or entirely punctate .... 2.
   Promesothorax strongly sculptured .... 12.
2. Promesothorax only punctate .... 3.
   Promesothorax punctate and distinctly rugulose .... 4.
3. Small species; erect hairs present on the body. Mexico. Colorado. (Listed by Emery as species, by Wheeler as variety of *opaca*). Pl. II, Fig. 5 .... *punctulata* Emery, 1895.
   Larger form; intermediate between *opaca* and *punctulata*; pronotum finely rugose and densely punctate; erect hairs absent on body. Del Rio, Texas. (Listed by Wheeler as variety of *opaca*). *punctulata* var. *depilis* Wheeler.
4. Petiole relatively long; length 4.2–4.4 mm.; brown, hardly reddish; first node almost 2 times as long as broad; head and thorax finely and densely reticulate punctate. Mexico .... *saussurei* Forel, 1899.
   Petiole shorter .... 5.
5. Epinotal spines shorter and backward directed .... 6.
   Epinotal spines longer and more obliquely sideways .... 7.
6. Small and light-colored species; length 2.5 mm.; chocolate brown; epinotal spines reduced to incurved teeth. Southern North America .... *ashmeadi* Mayr, 1886.
   Larger form; length 2.3–3.5 mm.; epinotal spines tapering; postpetiole broader, with the dorsal tubercles more separated; color nearly black .... *ashmeadi* var. *matura* Wheeler, 1932.
7. Slender forms with very divergent epinotal spines .... 8.
   Stouter forms with less divergent spines .... 9.
8. Thorax without punctation and rugules; carina on mesonotum less distinct than in *lineolata*. Florida .... *atkinsoni* Wheeler, 1919.
   Differs from the preceding in color; castaneous with black gaster in the species, while in *helveola* the color is brownish yellow. *atkinsoni* var. *helveola* Wheeler, 1919.

9. Color lighter, red or yellow .... 10.
Color darker, more brownish .... 11.
10. Head very shiny, color yellow. Pl. II, Fig. 1 ......*læviuscula* var. *cubaensis*.
Head less shiny, color more reddish; gaster partly black; length 3.5–4 mm. Fort Cobb, Texas .... *læviuscula* var. *clara* Emery.
11. Sculpture less regular on the thorax; nearly smooth, head to pedicel shiny; epinotal spines long and divergent. Fort Cobb, Texas. *læviuscula* Mayr, 1870.
Sculpture more regular and stronger; intermediate between *læviuscula* and *lineolata*. California. Pl. II, Fig. 6. *læviuscula* subsp. *californica* Emery.
12. Head shiny, at least on the vertex .... 13.
Head entirely opaque .... 17.
13. Humeri prominent and angular .... 14.
Humeri less angular .... 15.
14. Head broader .... *kennedyi* Wheeler.
Head narrower; length 5–5.2 mm.; antennal scapes and epinotal spines longer than in *kennedyi* .... *creightoni* Wheeler.
15. First node above with rounded knobs behind .... 16.
First node with elongate processes instead of knobs .... 19.
16. Pronotum very roughly and irregularly sculptured .... 17.
Sculpture less rough and irregular .... 18.
17. Darker colored, nearly black .... *sanguinea* var. *atavista*.
Lighter colored; length 4–4.5 mm.; gaster black; rest of the body deep red; head behind shiny and finely punctate. Cuba. *sanguinea* var. *torrei* Wheeler.
18. A. *sanguinea* Roger, 1863; Pl. I, Fig. 2.—Length 3–4.5 mm.; thorax vermiculate in front; first node trapezoidal. Cuba.
B. var. *lucayana* Wheeler, 1905.—Length 2.7–4 mm.; pedicel as in *sanguinea* but sculpture more as in *vermiculata*, very rough. Bahamas.
C. var. *etiolata* Wheeler, 1905.—Length, 3–4 mm.; color yellow; gaster usually black; body smooth and shiny. Andros Island.
19. Uniformly light colored, yellow. Pl. II, Fig. 3. *sanguinea* subsp. *coachellai* E. Enzmann, in lit.
Darker colored, reddish or blackish .... 20.
20. Light colored, reddish yellow; posterior part of gaster darker. District of Columbia to Virginia .... *lineolata* var. *lutescens* Emery.
Darker colored .... 21.
21. Light brownish; pilosity very long and abundant; head smoother and more shiny than in the type. District of Columbia .... *pilosa* Emery.
Pilosity less abundant .... 22.
22. Sculpture very rough .... 23.
Sculpture finer .... 25.
23. Epinotal spines shorter; larger than the typical *lineolata*; thorax finely

punctate with a few longitudinal rugæ; light reddish brown, gaster piceous black. New York State. New Jersey. Maryland, etc.
lineolata susp. *cerasi* Fitch, 1854.

Color different, either the gaster is not entirely black or the whole insect is black .... 24.

24. Lighter colored, only part of the gaster black; promesothorax with few rugules but rough punctation. Dedham, Massachusetts.
lineolata subsp. *cerasi* var. *punctinodis* var. nov.

The entire insect densely and irregularly punctate and black, except the pedicel and sometimes the thorax. New Durham, New Hampshire.
lineolata susbp. *cerasi* var. *wheldeni* var. nov.

25. Head largely shiny; reddish brown, gaster darker. Eastern United States. (It should be noted that Emery's diagnosis of *lineolata* includes the subspecies and varieties, and that Say's original description is insufficient; I consider as *lineolata* s.str. as contrasted with its forms, those which have the head very lightly sculptured rugulose punctate) .... *lineolata* Say, 1836.

Very similar to the species but from head to pedicel finely punctate and nearly opaque; color as dark as in the species. Virginia.
lineolata var. *subopaca* Emery, 1895.

26. Head nearly smooth but opaque; length 2.7–3 mm.; light rusty red, head darker, gaster brownish behind; pilosity sparse; Los Angeles, California .... *vermiculata* Emery, 1895.

Head opaque; thorax with less vermiculate sculpture (vermiculate in the preceding species) .... 27.

27. Slender form; dark colored; with a lateral tooth on the petiole which is absent in the typical form of *opaca* and *punctulata*.
opaca var. *dentinoda* Forel, 1901.

Stouter forms; node not toothed .... 28.

18. A. *opaca* typical Mayr, 1870.—Similar to *lineolata subopaca* but with shorter epinotal spines; sculpture stronger, head opaque. Mexico.

B. *opaca* subsp. *cedrosensis* Wheeler, 1934.—Very stout form; black of head a little shiny; thorax opaque, faintly rugose; long hairs absent; color deep brown. Cedros Island.

C. *opaca* subsp. *coarctata* Mayr, 1870.—Head subopaque behind and confluently punctate; color dark reddish brown, gaster black; length 4.5 mm. Tucson, Arizona.

D. *opaca* subsp. *coarctata* var. *mormonum* Emery, 1895.—Differs from *coarctata* by its longer scapes which surpass the head by 1½ times their thickness. American Fork Cañon, Utah.

E. *opaca* var. *texana* Santschi, 1929.—Length 2.5 mm.; reddish brown, head and gaster darker; gaster nearly smooth and shiny (not so in the typical form). Texas.

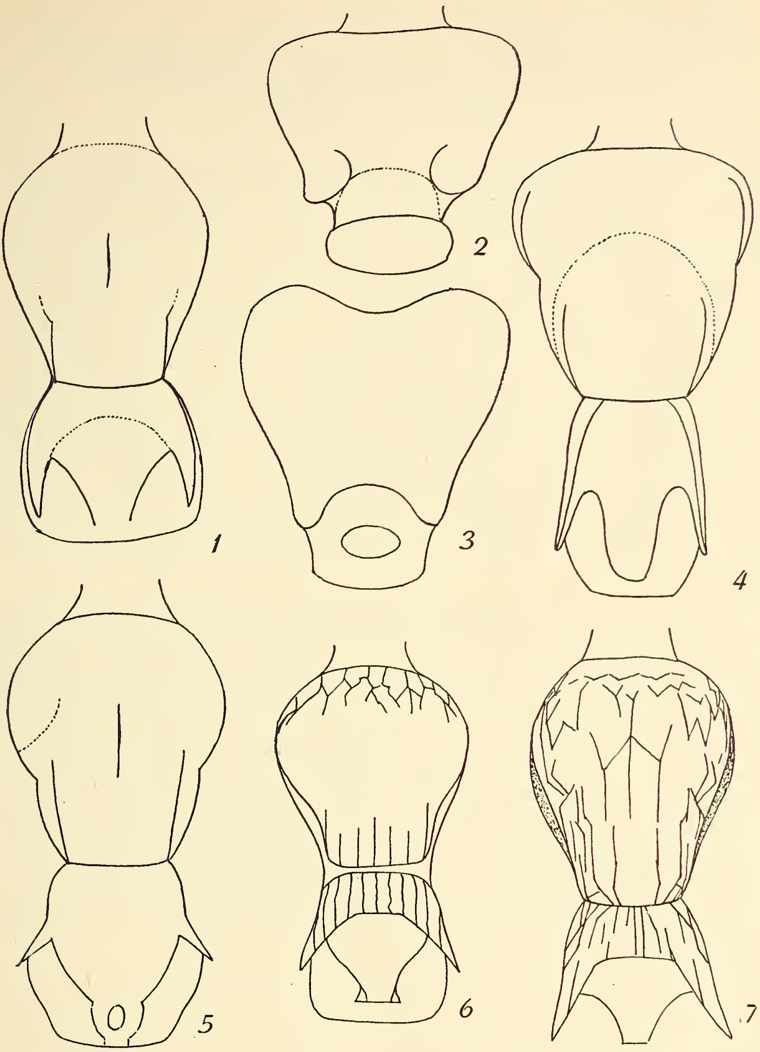

PLATE II

Figure 1. Thorax from above of *Crematogaster lœviuscula cubaensis.*
Figure 2. Petiole, dorsal view, of *C. sanguinea.*
Figure 3. Petiole of *C. lineolata* var. *coachellai.*
Figure 4. Thorax of *C. opaca,* dorsal view.
Figure 5. Thorax of *C. punctulata.*
Figure 6. Thorax of *C. californica.*
Figure 7. Thorax of *C. lineolata* s.s. *cerasi* var. *punctinodis.*

THE MILKY DISEASE OF JAPANESE BEETLE LARVÆ

The Connecticut Agricultural Experiment Station, New Haven, Connecticut, has just published an interesting and important contribution by Raimon L. Beard, entitled "Studies on the Milky Disease of Japanese Beetle Larvæ" (Bulletin 491, August, 1945). In view of the wide distribution of spore dust in a dozen eastern states, by governmental agencies and private individuals and in view of the publicity given to this means of combatting the Japanese beetle, Doctor Beard's studies are significant because they throw much light on the host-parasite relationship, the biological aspects of which, had been largely ignored previously. Because the pathological effects of *Bacillus popillia* are obscure, Doctor Beard believes that greater consideration should be given to it as a bacterial parasite rather than as a disease.

After reading Doctor Beard's account, one has a much better picture than heretofore of the relationship between the Japanese beetle grub and the milky disease organism, such as the effects of the disease on larval mortality, on moulting and metamorphosis, on blood, etc.; on the susceptibility of the grubs; the potency of the spores; transmission; fate of spores in the soil; etc., and of the effect on a grub population. Doctor Beard's bulletin answers many questions, and of course, raises others. But it is a relief to have some of the answers and to have a better appreciation of what is happening and of what the milky disease is actually doing.—ED.

MR. ROSS H. ARNETT'S "REVISION OF THE NEARCTIC SILPHINI AND NICROPHORINI"

By MELVILLE H. HATCH

Mr. Ross H. Arnett, Jr., of Cornell University published in the March 1944 number of this JOURNAL a paper entitled, "A Revision of the Nearctic Silphini and Nicrophorini Based upon the Female Genitalia (Coleoptera, Silphidæ)."[1] In the course of his study, Mr. Arnett has made some noteworthy discoveries. He has, for instance, found morphological bases for the recognition of *Nicrophorus nigritus* Mann. and *N. hecate* Bland. as distinct species. There has probably been no recent student of the group who has not wished that the first of these, at any rate, might be so regarded. Specimens stand out absolutely without suggestion of intergradation in the collection, and both forms, except for traditional conservativeness about recognizing species on exclusively color characters, would long ago have been regarded as of full specific rank. Portevin,[2] in fact, did so recognize *N. hecate* Bland., but I failed to follow him because of the above mentioned prejudice against separating species on color characters, a feeling that Mr. Arnett continues to share.

Furthermore, Mr. Arnett has called attention to Latreille's[3] 1810 selection of generitypes for *Silpha* and *Nicrophorus*. Latreille's citation of *vespillo* L. as the type of *Nicrophorus* is apparently unambiguous, antedating Thompson's[4] designation of *germanicus* L. This requires that *Nicrophorus* s. str. be substituted for the subgeneric name *Necropter* Semenov-Tian-Shanskij,[5] type *Necrophorus investigator* Zett., and that a new name—I propose *Neonicrophorus* nov.—be substituted for Semenov-Tian-Shanskij's *Nicrophorus* s. str.,[6] type *Silpha germanica* L.

[1] JOUR. N. Y. ENT. SOC., LII, 1944, p. 1–25, pl. I–IV.

[2] Bull. Mus. Hist. Nat., Paris, 1924, p. 85; Encycl. Ent., VI, 1926, p. 213, Fig. 176.

[3] Latreille, Considérations Générales sur l'orde Naturel des Animaux, Paris, 1810, p. 426.

[4] Skandinaviens Coleoptera I, 1859, p. 55.

[5] Trav. de l'Inst. Zool. de l'Acad. de Sci. de l'U.S.S.R., I, 1932, p. 154.

[6] *L.c.*, p. 153.

The case of the type of *Silpha* is not so simple. Latreille cites *littoralis,* but adds "ejusd. *obscura.*" According to opinion 136 of the International Commission on Zoological Nomenclature,[7] "Opinion 11 of the International Commission, which directs that the 'table des genres avec l'indication de l'espèce qui leur sert de type,' which is attached to Latreille's *Considérations genérales* of 1810, should be accepted as constituting a designation, under Article 30 of the Code, of the types of the genera in question, applies only to those genera there cited by Latreille, in which he placed one only of the species included in the genus by the original author thereof."

The generitypes of *Silpha* L. and *Necrodes* Leach were set by Leach in 1815.[8] *Necrodes* was established to include *Silpha littoralis* L. and a supposedly newly described species, *N. curtisi* Leach, apparently a synonym of *littoralis.* For *Silpha* s. str. a single species, *S. obscura* L., was cited. This species, therefore, becomes the type of the genus, and was so indicated by me in 1928.[9] Thomson,[10] indicates *S. carinata* "Illig." as the generitype, a species that was not even included in Linnaeus' original description of the genus! The point is of little practical importance at present, however, since both *obscura* and *carinata* belong to the same restricted section of the group.

The status of Mr. Arnett's *Nicrophorus* "*melsheimeri* Kby." is not clear. He includes it among the species with a strongly cordate pronotum without other information than that which pertains to the female genitalia and that the metepimeron is glabrous. LeConte's[11] placing of the type among those species with a transversely oval pronotum has never been challenged previous to the appearance of Arnett's paper.

It is, however, when one turns from the analytic to the synthetic

[7] Opinions Rendered by the International Commission on Zoological Nomenclature. Edited by Francis Hemming. London. Vol. 2, 1939, p. 15.

[8] Article on Entomology in Edinburgh Encyclopedia, 1815, Vol. IX, pp. 57–172, genus LXXXVI (Vol. VIII, pp. 677–678 of pp. 646–758 in the American Edition of 1832).

[9] Hatch, Col. Cat., 95, 1928, p. 78.

[10] Skandinaviens Coleoptera I, 1859, p. 56.

[11] Ann. Mag. Nat. Hist., (4), VI, 1870, p. 398; Proc. Acad. Nat. Sci. Phil., 1873, p. 326.

aspects of Mr. Arnett's work that questions begin to arise. Mr. Arnett assumes (p. 1) that "the genitalia are naturally more constant within a species than other parts and they give the taxonomist a better concept of a species, and its subspecific forms and categories," and concludes (p. 15) that "the female genitalia of Silphini and Nicrophorini present characters which serve to separate the species of the groups." Because the female genitalia present characters that serve to separate certain species it does not follow that all the species are so separated. Nor does it follow that this one set of structures is the all-sufficient criterion for accepting or rejecting all the other systematic categories that it may be convenient to recognize. If present-day systematics has any lesson to teach at all it is that the characters it employs must be drawn from every aspect of the body, of the life history, and of the physiology. Not genitalia, not larvæ, not wing venation, but the organism as a whole must be considered in devising a classification. Each special study has its own contribution to make, but only a synthesis of the whole can hope to give an adequate conclusion.[12]

For over a century continental coleopterists have labored with the classification of the larger Silphidæ, the work culminating in Portevin's great monograph,[13] dividing the group into three tribes, twenty-six genera, and three subgenera. My studies served as little more than footnotes to these European ones. I did reduce Portevin's twenty genera of Silphini to subgenera, but this did not affect the integrity or importance of the groups themselves. No one, I least of all, knows the difference between a genus and subgenus, and my action was predicated on the general assumption of the desirability of keeping down the number of genera and of making use of the subgenus as a category intermediate between the genus and the species. In *Nicrophorus* I did attempt to divide Portevin's nearly unorganized assemblage

[12] The truth of this was borne in on me séveral years ago when, in an unpublished study, I tabulated side by side the innovations in the general classification of beetles that various authors have proposed on the basis of the study of particular parts. The result was that most of the suggested changes were nullified and cancelled out!

[13] Les Grands Necrophages du Globe. Ency. Ent., VI, 1926, 270, pp., 201 figs.

of about 60 species into 7 phyletic groups. The study of the Nicrophorini was continued in 1932 by the Russian coleopterist, A. P. Semenov-Tian-Shanskij, who increased my two genera, one subgenus and 7 phyletic groups to 5 genera and 8 subgenera.[14]

Mr. Arnett reduces some fifteen of Portevin's groups to four, largely because he does not find in the female genitalia characters to correspond with the traditional ones. On the same basis he tells us, (p. 16) "*Nicrophorus* offers no distinct species groups." What reasons are there for supposing that all evolution leaves its imprint on the female genitalia? If the female genitalia offer no distinct clue to species groups, that can only mean that the field is left free for the utilization of characters derived from other parts of the body. It must be shown that these other characters severally are the result of parallel or convergent evolution before they can be disqualified. This Mr. Arnett's study fails to provide.

But the most extreme of Mr. Arnett's innovations are still to be considered. *Silpha aenescens* Csy.[15] is made a synonym of *ramosa* Say (p. 3) without a word of discussion, and *Necrodes* (*Protonecrodes*) *surinamensis* Fab. is made a "form" of *Necrodes* (s. str.) *littoralis* L. (p. 13). *S. aenescens* differs in the secondary sexual characters of the elytra apex of the female[16] and of the tarsi of the male, in the form of the male genitalia, and in color, though this is perhaps the least reliable of its characters. It is in reality a remarkably distinct species, in which the males

[14] Trav. de l'Inst. Zool. de l'Acad. de Sci. de l'U.S.S.R., I, 1932, p. 149–160. Most of the Semenov-Tian-Shanskij's groups were made at the expense of single or small groups of species belonging to the more generalized groups of my classification and segregated out by individual specialized features which I had either deemphasized or overlooked in my treatment. The great majority (43) of the species are left in the subgenus *Nicrophorus* s. str. (*Necropter* Sem.) which may still be subdivided along the general lines of my paper. Of the certainly established Nearctic species, only *americanus* Fab., placed in the subg. *Eunecrophorus* Sem. on the basis of its bicolored pronotum, and *pustulatus Hersch.*, placed in the subg. *Stictonecropter* Sem. on the basis of its elytral margin extending nearly to the humerus, are other than *Nicrophorus* s. str.

[15] Bull. Cal. Acad. Sci., II, 1886, p. 171–173. Both Portevin and I are in error in our previous citations of this species.

[16] Mr. Arnett probably rejects such a character in the light of his sixth conclusion (p. 16): "The form and sculpturing of the elytra of Silphini do not show relationships between the species!"

can scarcely be distinguished from the females, except by dissection.

The case of *Necrodes* (*Protonecrodes*) *surinamensis* Fab., is even more striking. Regarded as generically distinct from *N. littoralis* L. by Portevin, it is reduced to a "form" of that species by Mr. Arnett under the name "*Silpha littoralis,*" on the basis of occasional immaculate specimens and no differences in the genitalia. Mr. Arnett should give careful consideration to Portevin's diagnoses of the categories involved, as given in his monograph. Being so little concerned with elytra, he might well be quite unimpressed by the female secondary sexual characters of the elytral apex that Portevin cites or the striking difference in the structure of the elytral costæ. Perhaps the secondary sexual characters of the legs of the male will seem more important. I do not care to argue whether *surinamensis* is generically or subgenerically distinct from *littoralis,* but that it is at least a distinct species I regard as probable. *Surinamensis* is confined to America east of the Rocky Mountains. *Littoralis* is European. Mr. Arnett should investigate the three other related and geographically intermediate Asiatic "species" before being willing to conclude too much.

Nothing that has been said above about elytra or secondary sexual characters means that I regard these as necessarily primary taxonomic characters. Pehaps it is, as Boving states,[17] "that primary sexual characters . . . offer the more solid bases for a natural and tenable classification." But that does not imply that everything else is to be disregarded, especially where the genitalia are phylogenetically conservative.

Furthermore, nothing that has been said deprecates the central portion of Mr. Arnett's work, his study of the female genitalia. As a result of this he has shown that in certain cases species may be recognized where subspecies have been recognized before. He suggests that certain lines of cleavage in the Silphini and Necrodini are perhaps not entirely as they should be. To this extent his study is a welcome contribution to the study of the larger Silphidæ, but the suggestion that it provides a vantage point for the "revision" of the entire group would seem to be open to question.

[17] Mem. Ent. Soc. Wash., 2, 1942, p. 53.

INSECT DISPERSION

Attention is herewith called to D. O. Wolfenbarger's recent, noteworthy monograph on the dispersion of small organisms. It is entitled "Dispersion of Small Organisms, Distance Dispersion Rates of Bacteria, Spores, Seeds, Pollen and Insects; Incidence Rates of Disease and Injuries," and was published in "The American Midland Naturalist," Vol. 35, No. 1, p. 1–152, January, 1946. Mr. Wolfenbarger combed the literature for records that could be organized for the determination of the dispersion or incidence rates and his work is an important analysis of existing material. As the title indicates, the study includes not only insects, but other small organisms as well. The author has transformed the qualitative information on the subject into quantitative and has presented much that is of significance to those engaged in control measures.

Mr. Wolfenbarger's analysis applies to dispersion defined as "the movements of a species or group through one generation, phase, stage, cycle, or activity and only data from a given cycle are included." The graphic method is used throughout so that comparisons may be readily made.—ED.

THE CARDINI SPECIES GROUP OF THE GENUS DROSOPHILA

By George Streisinger

A study of the relationships among species of the *cardini* group of the genus *Drosophila* was undertaken with the aid of a combination of genetic and morphological methods. A purely morphological analysis of species of *Drosophila* is unsatisfactory. In case of morphologically identical species, or sibling species as Mayr (1942) calls them, morphological analysis is clearly impossible. Many such species are known in *Drosophila,* owing chiefly to the work of Patterson and his school (Patterson 1943, and other work). Dobzhansky and Epling (1944) have described *Drosophila persimilis* Dobzhansky and Epling which is morphologically identical with *D. pseudoobscura* Frolova, and Dobzhansky (in press) describes *D. equinoxialis* Dobzhansky which is morphologically very nearly identical with *D. willistoni* Sturtevant.

The following species of the *cardini* group of *Drosophila* have been described: *Drosophila cardini* Sturtevant (1916) from Cuba, *D. cardinoides* Dobzhansky and Pavan (1943) from southern Brazil, *D. polymorpha* Dobzhansky and Pavan (1943) from southern Brazil, and *D. neocardini* sp. n. described below from Amazonas, Brazil.

The chromosome complements of two strains of *D. cardini* Sturtevant from Cuba (not including, however, the type strain) were described by Metz (1923) as consisting of five pairs of rod-like and one pair of dot-like chromosomes. Dobzhansky and Pavan (1943) found in *D. cardinoides* (type strain) two pairs of V-shaped, one pair of rod-shaped, and a pair of dot-like chromosomes; they recognized the morphological similarity of their material and the description of *D. cardini* given by Sturtevant, but proposed the name *cardinoides* because of the dissimilarity of the chromosomes and of the geographic origin. Patterson (1943) and Wharton (1943) found several strains from Southern United States, Mexico, and Guatemala which have the same chromosome complements as the Brazilian *D. cardinoides* Dobzhansky and Pavan, but classified these strains as *D. cardini* Sturtevant. A strain from Guatemala obtained through the courtesy of Professor J. T. Patterson is morphologically and cytologically similar to, and interbreeds readily with, the Brazilian *D. cardinoides* Dobzhansky and Pavan. The status of the name *D. cardinoides* is, then, in doubt, pending re-examination of the cytology and the breeding behavior of the Cuban representatives of this species group.

The present study is based on the following strains which are maintained in the laboratory: *Drosophila cardinoides* Dobzhansky and Pavan from Iporanga and from Mogi das Cruzes, State of São Paulo, from Teffe, State of Amazonas, from Belem, State of Para, in Brazil, and from Guatemala in Central America. *Drosophila polymorpha* Dobzhansky and Pavan came from Bertioga and from Araras, State of São Paulo, Brazil. *Drosophila neocardini* sp. n., came from Teffe, Amazonas, Brazil.

Although, as shown below, the three species are morphologically distinguishable, the most convincing and conclusive method of classification proved to be their behavior in crosses. After the strains were so classified, it was found that the structure of the male genitalia also furnishes satisfactory criteria for the separation of these three species.

For the initial tests, approximately twenty virgin females of one strain were placed together with twenty freshly hatched males of another strain. If fertile offspring were produced, the strains were considered to belong to the same species. Where no offspring appeared, the flies were transferred to fresh bottles, and after a month had elapsed, the suriving females were dissected and their seminal receptacles were examined under the microscope for the presence of sperm. The data are summarized in Table 1. In Table 1, the crosses of *D. cardinoides* and *D. polymorpha* are placed together as experiment No. 1, those of *D. neocardini* and *D. polymorpha* as experiment No. 2, and of *D. neocardini* and *D. cardinoides* as experiment No. 3. It is clear from the data that cross-insemination between the three species occurs very seldom or not at all, even when females and males of these species remain together for as long as a month. When females and males of the same species are placed together, most females are inseminated within six days.

To discover whether interspecific matings ever take place, a few crosses were attempted using larger numbers of flies and more crowded conditions. In experiment No. 4 (Table 1), 100 virgin females of one species were placed together with 100 males of another species. The flies were transferred to fresh food every three days, and after approximately a month the still surviving females were examined for the presence of sperm in their seminal receptacles. Larvæ appeared in one of the bottles, but further tests proved these to be due to an accidental inclusion of a non-virgin female. (This experimental error is not included in the table.) One female, in the cross of *D. cardinoides* Belem females to *D. polymorpha* Araras males, proved to be inseminated, but no hybrid larvæ were produced by it.

In experiment No. 5 (Table 1), ten virgin females were placed with ten males of a different species in $3\frac{3}{4}'' \times 1''$ vials with food. Altogether about fifteen vials of each cross were set up. Larvæ were produced in two vials, but these again were due to an accidental inclusion of non-virgin females, and are not included in the table. Two females in the cross of *D. cardinoides* Belem females to *D. polymorpha* Araras males were inseminated, as were also two females in the cross of *D. polymorpha* Bertioga females to *D. cardinoides* Guatemala males. No viable hybrid larvæ appeared however in the vials containing these interspecifically inseminated females.

On the basis of our crosses, the strains from Belem, Guatemala, Iporanga, Mogi, and Teffe obviously belong to one species, those from Bertioga and Araras to another, and the second strain from Teffe to a third.

The species so defined show very strong psychological or sexual isolation. Interspecific matings occasionally occur, but in no case are offspring produced.

Four strains of *D. cardinoides* were further tested in order to discover whether an incipient sexual isolation is present within the species. Since the strain from Iporanga differs slightly from the others in coloration (see below) it was thought that this form might be slightly isolated from the others. When males of one

TABLE 1

INTERSPECIFIC MATINGS WITHOUT CHOICE OF MATES

Experiment number	Species	Females	Males	Inseminated	Uninseminated	Males surviving
1.	cardinoides × polymorpha	Araras	Belem	0	14	13
		Belem	Araras	0	27	20
		Araras	Iporanga	0	31	20
		Iporanga	Araras	0	32	24
		Araras	Mogi	0	18	20
		Mogi	Araras	0	15	7
		Araras	Guatemala	0	11	7
		Guatemala	Araras	0	7	16
		Araras	Teffe	0	6	8
		Teffe	Araras	0	7	7
		Bertioga	Belem	0	12	3
		Belem	Bertioga	0	10	10
		Bertioga	Guatemala	0	19	27
		Guatemala	Bertioga	0	12	16
		Bertioga	Iporanga	0	10	26
		Iporanga	Bertioga	0	39	23
		Bertioga	Mogi	0	8	4
		Mogi	Bertioga	0	14	10
		Bertioga	Teffe	0	6	3
2.	neocardini × polymorpha	Araras	neocardini	0	39	27
		neocardini	Araras	0	11	34
		Bertioga	neocardini	0	13	19
		neocardini	Bertioga	0	22	27
3.	cardinoides × neocardini	neocardini	Belem	0	6	17
		Belem	neocardini	0	17	13
		neocardini	Guatemala	0	12	13
		Guatemala	neocardini	0	13	15
		neocardini	Iporanga	0	8	15
		Iporanga	neocardini	0	13	7
		neocardini	Mogi	0	15	15
		Mogi	neocardini	0	16	18
4.	cardinoides × polymorpha	Araras	Belem	0	75	50
		Belem	Araras	1	56	68
		Guatemala	Bertioga	0	54	50
		Bertioga	Guatemala	0	36	42
		Bertioga	Iporanga	0	39	41
		Iporanga	Bertioga	0	43	38
5.	cardinoides × polymorpha	Araras	Belem	0	110	154
		Belem	Araras	2	110	164
		Bertioga	Guatemala	2	70	84

strain of a species of *Drosophila* are given a choice of females of their own and of a foreign strain of the same species, preferential mating sometimes takes place (Dobzhansky and Streisinger 1944). The technique used in the present studies is very similar to that described by Dobzhansky and Streisinger (1944). Virgin females and males were collected. Since three of the strains are indistinguishable in appearance, the left wing of one class of females, the right wing of the other class was clipped. The flies, unlike in the experiments of Dobzhansky and Streisinger were

TABLE 2

Number of Females Dissected (n) and Per Cent Carrying Sperm (Per Cent) in Various Crosses of *D. cardinoides*

Females	Males	Homogamic		Heterogamic		χ^2	Isolation index
		n	Per cent	n	Per cent		
Guatemala, Belem	Belem	30	33.3	42	19.0	1.9	0.27
Guatemala, Belem	Guatemala	29	55.1	29	62.0	0.3	−0.06
Guatemala, Iporanga	Iporanga	57	73.7	57	8.7	49.6	0.78
Guatemala, Iporanga	Guatemala	37	2.7	37	64.9	31.8	−0.92
Guatemala, Mogi	Mogi	50	92.0	46	39.1	30.2	0.40
Guatemala, Mogi	Guatemala	36	63.9	37	37.8	5.0	0.26
Belem, Iporanga	Belem	52	76.9	57	64.9	1.9	0.09
Belem, Iporanga	Iporanga	68	39.7	63	60.3	5.6	−0.20
Belem, Mogi	Belem	78	71.8	72	47.2	9.4	0.21
Belem, Mogi	Mogi	55	40.0	41	80.0	15.7	−0.33
Iporanga, Mogi	Iporanga	51	58.8	58	32.8	7.4	0.28
Iporanga, Mogi	Mogi	74	41.9	64	46.9	0.3	−0.06

aged separately for eight days, after which ten females and ten males of one kind, and ten females of the other kind, were placed into a vial with food. After six hours, by which time about half the total number of flies were usually fertilized, the females were dissected and examined for the presence of sperm.

The results of these experiments are summarized in Table 2. The Isolation Index, proposed by Stalker (1942), represents the differences of the percentages of homogamic and heterogamic females inseminated, divided by the sum of these percentages. The nearer the isolation index is to 1, the greater the preference for matings within the strain. Negative isolation indices show preference for heterogamic matings. The results reported in Table 2 show that representatives of different geographic strains of *D. cardinoides* do not necessarily interbreed at random. Thus, both Guatemala males and Iporanga males inseminate more Iporanga than Guatemala females. Mogi males inseminate more Mogi females than Guatemala females, but the reverse relation does not hold. Belem males, as well as Mogi males, inseminate more Belem

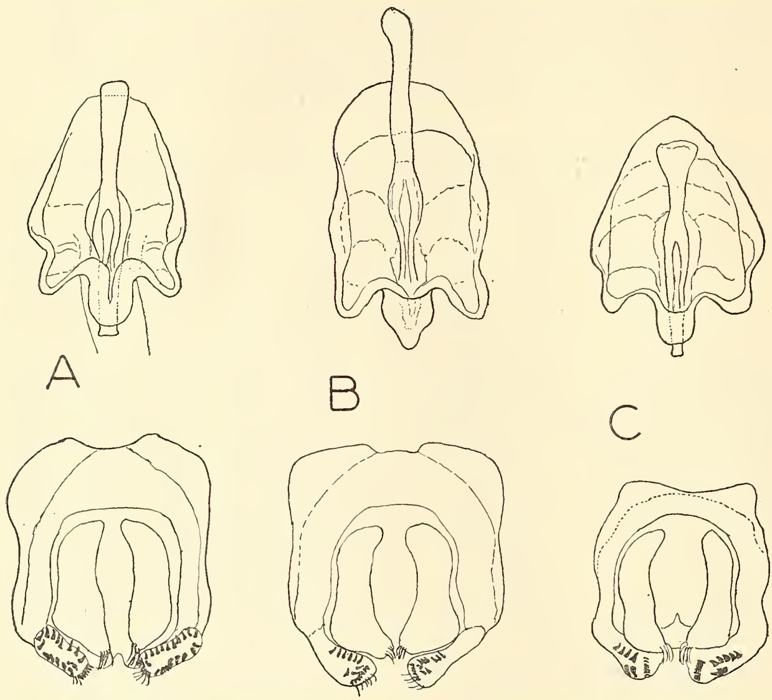

FIG. 1. Camera lucida drawings of the male genitalia of *Drosophila polymorpha* Dobzhansky and Pavan (A), *Drosophila cardinoides* Dobzhansky and Pavan (B), and *Drosophila neocardini* sp. nova (C). In each case, the penis apparatus is shown above and the genital arch and the anal plates below.

than Mogi females. These mating preferences do not seem to be correlated with the geographic origin of the strains. They are of course very much less pronounced than the preferences exhibited by interspecific matings in which only very few heterogamic inseminations occur. All intraspecific matings produce a multitude of larvæ which give rise to fertile adults. Interspecific inseminations seem to produce no larvæ at all.

The externally visible differences between the species are slight. Dobzhansky and Pavan (1943) indicate that *D. cardinoides* has a darker body color than *D. polymorpha.* This difference is indeed pronounced between the Iporanga strain of the former species (from which the type came) and the Bertioga and Araras strains of *D. polymorpha.* However, the Belem, Mogi, and Guatemala strains of *D. cardinoides* are only slightly darker in body color than the *D. polymorpha* strains, and distinctly lighter than the Iporanga strain of *D. cardinoides.* Thus the body color does not suffice to distinguish these species. *D. neocardini* is slightly lighter in body color than *D. polymorpha.* The black abdominal markings vary greatly from specimen to specimen within each strain of *D. polymorpha,* in *D. cardinoides* these markings are less variable and more or less resemble one of the color phases of *D. polymorpha. D. neocardini* has the abdominal black markings much reduced in extent compared to the lightest *D. polymorpha* and *D. cardinoides.*

The most striking differences, which can be used to distinguish the three species without breeding experiments, reside in the structure of the male genital organs, which are illustrated in Figure 1. These were obtained by clearing the whole flies in 10 per cent KOH, then dissecting out the genital organs under a low power microscope. The drawings were made from freshly dissected organs, with the aid of a camera lucida.

A description of *Drosophila neocardini,* made according to the form used in the modern Drosophila systematics, is given below.

Drosophila neocardini, species nova.

♂, ♀. Arista with 8–10 branches. Antennæ yellow, third segment darker. Front velvety yellow, orbits and ocellar triangle rather shiny. Anterior and posterior orbitals equal, middle orbital $\frac{1}{4}$ to $\frac{1}{3}$ of other two, slender. Two prominent equally long oral bristles, occasionally three on one side. Face yellow. Carina large, not sulcate. Cheeks pale yellow, their greatest width about $\frac{1}{8}$ diameter of the eyes. Eyes red with a short light pile.

Achrostical hairs in six rows. No prescutellars. Anterior scutellars convergent. Thorax shiny yellow without pattern. Pleuræ pale yellow. Anterior sternopleural $\frac{1}{2}$ to $\frac{2}{3}$, middle strenopleural $\frac{1}{4}$ to $\frac{1}{3}$ of posterior. Legs yellow, apicals on first and second tibiæ, preapicals on all three.

Abdomen yellow, shiny. Second, third, and fourth tergites with narrow black marginal bands interrupted in the middle, and occasionally expanded on the sides toward the anterior margin which is seldom touched, the bands on the fourth tergite showing a tendency to break into four separate spots.

Wings clear or slightly brownish, crossveins not clouded. One or two prominent bristles at the apex of the first costal section, third costal section with bristles on its basal ⅓. Costal index 3.6 (3.17–3.96), 4th vein index 1.6 (1.44–1.75), 5x index 1.5 (1.20–1.70).

♂. Length of body 2.2 mm. (2.0–2.4 mm.). Length of wing 2.2 mm. (2.0–2.3 mm.).

Testes with 7 outer and 5 inner coils, and a very long, slender vasa efferentia. Sperm pump with two long diverticula. Spermathecæ weakly chitinized, yellow, resembling an inverted flower vase. Ventral receptacle with several dozen slender and thicker coils.

Eggs—four slender acuminate filaments.

Puparia—reddish brown. Horn slender and delicate, frequently glued to the surface of the pupa case. Horn index about six, anterior spiracle with many long and slender branches.

Chromosomes—metaphase plates show two pairs of V's, a pair of rods, and a pair of small dots.

Distribution— collected at Teffe (state of Amazonas), Brazil, by Prof. Th. Dobzhansky.

The type is deposited in the American Museum of Natural History.

ACKNOWLEDGMENTS

The author would like to acknowledge his indebtedness to Professor Th. Dobzhansky for suggestions and criticisms. Thanks are also due to Professor R. L. Cushing, of Cornell University, where part of this work was carried out.

SUMMARY

Three species of the *cardini* group, namely *Drosophila polymorpha* Dobzhansky and Pavan, *D. cardinoides* Dobzhansky and Pavan, and *D. neocardini* sp. n., exhibit nearly complete sexual isolation from each other. When, very rarely, interspecific inseminations do occur, no viable offspring are produced. External morphological differences between these species are slight, but satisfactory differences in the structure of the male genitalia have been found.

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COLONIAL EXTERMINATORS

''James Huthwaite, Upholsterer and Chairstuffer from London. Now living at Mr. M'Mullan's in Hanover Square, New-York; Makes up all Sorts of Beds and Window Curtains in the neatest Manner: Also Mattrasses and Beds for Sea: He likewise undertakes to destroy the Buggs entirely, without damaging the Furniture; And does all sorts of Paper Hangings after the compleatest manner.''—*The New-York Gazette Revived in the Weekly Post-Boy,* June 19, 1749.

''Jack of All Trades.—John Julius Sorge. Very much noted among the nobility in Germany, for divers curious Experiments, lately arrived in this City, hereby gives Notice that, . . .

''He prepares a Spirit which destroys Bugs, and offers any some for Trial. . . .

''N.B. Said Sorge may be spoke with every Afternoon at the House of Mr. Edward Willett, Tavernkeeper at the Sign of the New-York Arms in the Broad-Way, or at Mr. Koch's, where all Gentlemen and Ladies who will please to favour him with their Custom, may depend upon being duly satisfied.''—*The New-York Gazette or the Weekly Post-Boy,* June 16, 1755.

In addition, Mr. Sorge made a hair remover, a lotion to preserve the beauty of ladies, a liquid soap, candles without wax, tallow or fat, Muscadine wine, artificial fruits that looked as good and tasted as well as natural ones, and a spot remover. He also did Japan work and washed gold and silver lace.—Ed.

THE LEPIDOPTERA OF PORTUGAL

BY ALBERT ZERKOWITZ

(*Continued from Vol. LIV, No. 2, p. 87*)

HEPIALIDÆ

1. *Hepialus lupulinus* L.—Euroriental.—M: Gerez. May.

MICROPTERYGIDÆ

2. *Micropteryx mansuetella* Z.—European.—BB: Ceia. June.

3. *Micropteryx aureatella* Sc.—European.—BB: Quinta do Barão. April. On young oak trees.—E: Torres Vedras. April. On an oak tree.

ERIOCRANIIDÆ

4. *Eriocrania subpurpurella* Hw.—European.—BB: S. Fiel.

INCURVARIIDÆ

5. *Meessia vinculella* H.S.—European.—E: Torres Vedras. July. Identified by de Joannis.

6. *Meessia pachyceras* Wlsghm.—European.—BB: S. Fiel. April.

7. *Crinopteryx familiella* Peyer.—Western Mediterranean.—BB: Senhora da Orada, Serra da Guardunha, Sobral do Campo. September–October.—Larva, November–March. Foodplants: *Cistus ledon* Lam., *Cistus ladaniferus* L., and *Helianthemum* sp.

8. *Eriocottis andalusiella* Stgr.—Iberian.—Reported from Portugal only by Seebold, without exact locality. March.

9. *Nemotois latreillellus* F.—Mediterranean.—E: Setubal. May–June. Common. Torres Vedras. June.—Alg: São Marcos. May.

10. *Adelia croesella* Sc.—Euroriental.—M: Gerez.

NEPTICULIDÆ

11. *Nepticula ilicivora* Peyer.—Western Mediterranean.—BB: S. Fiel. May. Larva, January–February. Foodplant: *Quercus ilex* L.

12. *Nepticula pygmæella* Hw.—Atlantic.—E: Torres Vedras. End of January. Larva abundant in December. Foodplant: *Cratægus* sp.

13. *Nepticula atricapitella* Hw.—European.—BB: S. Fiel. May. Foodplant: *Quercus ilex* L.

14. *Nepticula ruficapitella* Hw.—European.—BB: S. Fiel. Second half of April. Larva in November. Foodplants: *Quercus toza* Bosc., *Quercus pedunculata* Ehrh.

15. *Nepticula samiatella* H.S.—European.—BB: S. Fiel. May. Larva in November. Foodplant: *Castanea vulgaris* Lam.

16. *Nepticula basiguttella* Hein.—European.—BB: S. Fiel. May. Larva, end of October–November. Foodplants: *Quercus toza* Bosc., *Quercus pedunculata* Ehrh.

17. *Nepticula viscerella* Stt.—Atlantic.—BB: S. Fiel.

18. *Nepticula auromalella* Goeze.—European.—E: Torres Vedras. January–February. Larva in December. Foodplant: *Rosa* sp. Very abundant.

19. *Nepticula suberivora* Stt.—Western Mediterranean.—BB: S. Fiel. End of March–early April. Larva, first half of January. Foodplant: *Quercus suber* L.

20. *Nepticula fragariella* Heyd.—European.—BB: Castelo Novo. April.

21. *Nepticula aurella* Stt.—European.—BB: S. Fiel. February.—E: Torres Vedras. March. Larva in December–January. Foodplant: *Rubus* sp.

22. *Nepticula ulmivora* Fologne.—Atlantic.—E. Torres Vedras. April–May. Larva very abundant in November. Foodplant: *Ulmus campestris* Sm.

23. *Nepticula alnetella* Stt.—Atlantic.—BB: S. Fiel. May. Larva in November. Foodplant: *Alnus glutinosa* Gärtn.

24. *Nepticula rubescens* Hein.—Atlantic.—BB: S. Fiel. Foodplant: *Alnus glutinosa* Gärtn.

25. *Nepticula plagicolella* Stt.—European.—BB: Quinta dos Fornos. May. Larva in November. Foodplant: *Prunus spinosa* L.

26. *Nepticula salicis* Stt.—Atlantic.—BB: Ribeira da Ocreza. May. Larva in October–November. Foodplants: *Salix fragilis* L., *Salix cinerea* L., *Salix aurita* L.

27. *Nepticula suberis* Stt.—Western Mediterranean.—BB: S. Fiel. End of April–May.—E: Torres Vedras. April.—Ale: Aldeia do Neuves. May. Larva first half of January–February. Foodplants: *Quercus suber* L., *Quercus coccifera* L., *Quercus ilex* L.

28. *Nepticula ilicis* Mendes (1910, Brotéria, 9, p. 164–165, pl. 7, fig. 8).—Endemic.—BB: S. Fiel (type locality). May. Larva very abundant in January. Foodplants: *Quercus ilex* L., *Quercus suber* L.

29. *Nepticula viridella* Mendes (1910, Brotéria, 9, p. 165–166, pl. 7, fig. 9).—Endemic.—BB: S. Fiel (type locality). August–early September.—E: Torres Vedras (type locality). August–early September. Larva in January. Foodplants: *Quercus suber* L., *Quercus ilex* L., *Quercus coccifera* L.

30. *Nepticula septembrella* Stt.—European.—BB: S. Fiel. May, November. Larva in November. Foodplant: *Hypericum undulatum* Schousb.

31. *Nepticula subbimaculella* Hw.—European.—BB: Monte de S. José. May. Foodplant: *Quercus toza* Bosc.

32. *Nepticula cistivora* Peyer.—Western Mediterranean.—E: Val de Rosal. September. Larva abundant from end of January to early February. Foodplants: generally *Cistus ladaniferus* L., rarely *Cistus ledon* Lam.

33. *Nepticula erythrogenella* Joan. (1907, Bulletin Soc. Entom. de France, p. 327; 1908, Annales Soc. Entom. de France, 77, p. 823, fig. 1, 2, pl. 15, fig. 12).—Type locality: Vannes, France.—Western Mediterranean.—BB: Soalheira. June. Larva early January. Foodplant: *Rubus* sp.

34. *Nepticula ladaniphila* Mendes (1910, Brotéria, Série zoológica, 9, p. 102–103, fig. 25, pl. 6, fig. 9).—Endemic.—BB: S. Fiel. June.—E: Near Lisbon. June. Val de Rosal. Larva in February–March (1913, Brotéria, Série zoológica, 11, p. 28, pl. 3, fig. 4) Foodplant: *Cistus ladaniferus* L. Pupation middle of March.

—. *Nepticula* sp.?—BB: Matta do Fundão. September. Larva end of August–early September. Foodplant: *Rosa canina*.—This species is recorded by Mendes and has apparently not been named.

35. *Trifurcula pallidella* Z.—Euroriental.—BB: Soalheira. April.

36. *Opostega crepusculella* Z.—Euroriental.—E: Setúbal. March.—Alg: Monchique, 1200 feet. May.

TINEIDÆ

37. *Melasina lugubris* Hbn. (= *ciliaris* O.).—Euroriental.—BB: Serra da Estrêla. August.—Grown up larva middle of July.

38. *Dysmasia petrinella* H.S.—Iberian.—E: Torres Vedras. July.

39. *Dysmasia parietariella* H.S.—Euroriental.—BB: S. Fiel. May. Common.

40. *Trichophaga tapetiella* L.—Holarctic.—BB: S. Fiel.

41. *Trichophaga abruptella* Woll.—Western Mediterranean?—BB: S. Fiel. June.—E: Torres Vedras. March. July.

—. *Tinea corticella* Curt?—European.—E: Lisboa. November.

42. *Tinea quercicolella* H.S.—Euroriental.—BB: Soalheira.—E: Torres Vedras. July.

43. *Tinea granella* L.—Holarctic.—E: Val de Rosal. April.

44. *Tinea cloacella* Hw.—Holarctic.—E: Setúbal. Common in the interior of houses.—f. *ruricolella* Stgr. June. Listed only by Seebold, without exact locality.

45. *Tinea nigripunctella* Hw.—European.—BB: S. Fiel.

46. *Tinea fuscipunctella* Hw.—Holarctic.—BB: S. Fiel.—E: Lisboa. March–April. Setúbal. April. Torres Vedras. June–July.—Ale: Almondóvar. May.

47. *Tinea pellionella* L.—Holarctic.—BB: Ceia. June. S. Fiel. June. Very common.—E: Setúbal. September–October. Torres Vedras. May, July. Larva, August–May on woolens, furs, etc.

48. *Tinea inquinatella* Z.—European.—E: Torres Vedras. July.

49. *Tinea chrysopterella* H.S.—Mediterranean.—BB: Quinta dos Fornos. July.—Alg: Silves. May.

50. *Tineola crassicornella* Z.—Mediterranean.—BB: S. Fiel, Soalheira. June.—E: Setúbal. August. Torres Vedras. May, July.—Alg: Silves. May.

51. *Tineola biselliella* Hummel.—Holarctic.—BB: S. Fiel. April, June. Very common in houses.—E: Lisboa. May. Setú-

bal. August.—In Lisboa I found also in March a form with a blackish spot on the upperside of the forewings, near the disc.—Larva until May on woolens, furs and feathers.

MONOPIDÆ

52. *Blabophanes imella* Hbn.—Euroriental.—E: Olivaes. April.

53. *Blabophanes nigricantella* Mill.—Western Mediterranean.—BB: Covilhã. August. S. Fiel. April.

54. *Blabophanes ferruginella* Hbn.—Euroriental.—E: Setúbal. April, August.

TALÆPORIIDÆ

55. *Dissoctena granigerella* Stgr.—Iberian.—BB: Serra da Guardunha. August, September.

56. *Bankesia staintoni* Wlsghm.—Atlantic.—E: Torres Vedras. March.

PSYCHIDÆ

57. *Amicta febretta* Boyer (*vetulella* Rbr.).—Mediterranean.—BB: Casal da Serra, S. Vicente, Serra da Estrêla. Larva in April. Foodplant: *Sarothamnus patens* Webb. Serra da Guardunha. Larva in June–July. Foodplant: *Cytisus albus* Lk.

58. *Hyalina albida* Esp.—Western Mediterranean.—M: Gerez. Common by day.—f. *lorquiniella* Brd.—BB: N. Senhora da Orada. Larva in April. Foodplant: *Genista tridentata.* S. Fiel. Larva in May. Foodplant: *Ulex europæus.* Serra da Guardunha. Foodplant: *Cytisus albus* Lk.

59. *Oreopsyche leschenaulti* Stgr.—Iberian.—BB: Serra da Guardunha. March.

60. *Oreopsyche muscella* F.—Euroriental.—BB: Serra da Guardunha. March.

61. *Oreopsyche plumifera* O.—Euroriental.—BB: Serra da Guardunha. March.

62. *Phalacropteryx calberlæ* Heyl.—Mediterranean.—BB: Serra da Estrêla. Larva in April and August. Foodplants: *Erica aragonensis, Erica arborea* and *Juniperus nana.* Serra da Guardunha. Larva in April and August. Foodplants: *Erica aragonensis* and *Erica arborea.* The larva apparently hibernates.

63. *Apterona crenulella* Brd.—Mediterranean.—M: Guimarães.—BB: S. Fiel. May–June. Larva in June. Foodplants: *Cytisus albus* Lk., *Cistus ledon* Lam., and *Helianthemum milleri.* Chrysalid in July in BL: Lousã, on trunks and twigs.

64. *Epichnopteryx pulla* Esp.—Europacific.—E: Sintra. April. Rare. Torres Vedras. March.

65. *Luffia lapidella* Goeze.—Mediterranean.—E: Torres Vedras. July.

TISCHERIIDÆ

66. *Tischeria complanella* Hbn.—Euroriental.—BB: S. Fiel. April–May; August–September.—E: Torres Vedras. June. Foodplants: *Quercus toza* Bosc., *Quercus pedunculata* Ehrh., and *Quercus lusitanica* Lam., in July–August; October–April.—*Castanea vulgaris* Lam., in October–March.—*Quercus suber* L., February–April.

67. *Tischeria marginea* Hw.—European.—BB: S. Fiel. April–May. Foodplant: *Rubus* sp.

CEMIOSTOMIDÆ

68. *Cemiostoma spartifoliella* Hbn.—European.—BB: S. Fiel. May–June. Foodplant: *Sarothamnus patens* Webb.

69. *Cemiostoma scitella* Z.—Euroriental.—E: Torres Vedras. End of July. Larva abundant early July and a second brood in fall. Foodplant: *Pyrus malus* L.

LYONETIIDÆ

70. *Bedellia somnulentella* Z.—Holarctic.—BB: S. Fiel. May.

71. *Bucculatrix cratægi* Z.—European.—E: Torres Vedras. March.

72. *Bucculatrix myricæ* Rag.—Western Mediterranean.—BB: Matta do Fundão.—Pupa end of July on *Polystichum filixmas.* Rht.

73. *Bucculatrix helichrysella* Const.—Western Mediterranean.—BB: Senhora da Orada. May. Larva in April. Foodplant: *Helichrysum stæchas* D.C.

74. *Phyllobrostis daphneella* Stgr.—Western Mediterranean.—BB: S. Fiel. April. Larva in March. Foodplant: *Daphne gnidium* L.

75. *Lyonetia clerkella* L.—European.—BB: S. Fiel. May.—E: Torres Vedras. June–July.—Larva in March–April and during fall. Foodplants: *Cratægus monogyna* Jacq., *Pyrus malus* L., and *Prunus cerasus* L.

GRACILARIIDÆ

76. *Gracilaria alchimiella* Sc.—Eurioriental.—BB: Matta do Fundão. Early May.

77. *Gracilaria falconipennella* Hbn.—European.—M: Guimarães. August.—BB: Ribeira da Ocreza. November.—Larva in October. Foodplant: *Alnus glutinosa* Gärtn.

78. *Gracilaria stigmatella* F.—Mediterranean?—BB: S. Fiel.

79. *Aspilapteryx tringipennella* Z.—Eurioriental.—BB: S. Fiel.

80. *Xanthospilapteryx phasianipennella* Hbn. and f. *quadruplella* Hbn.—European.—BB: Quinta do Barão. November.

81. *Xanthospilapteryx auroguttella* Stph.—Eurioriental.—BB: S. Fiel. March; November. Larva in October. Foodplant: *Hypericum undulatum* Schousb.

82. *Micrurapteryx kollariella* Z.—Eurioriental.—BB: Covilhã. September. Chrysalid on *Sarothamnus grandiflorus* Webb.

83. *Eutrichocnemis scalariella* Z.—Mediterranean.—BB: S. Fiel. February–March; July; November.—E: Torres Vedras. Frequent.—Apparently two broods: larva of the first brood April–July; larva of the second brood September–March. The imago of the second brood emerges in November, or this brood hibernates as pupa in which case the imago emerges in February–March. Nevertheless the two broods cannot be separated very strictly because in January on the same plant larvæ and pupæ were found. Foodplants: *Echium lusitanicum* Brot., and *Echium plantagineum* L.

84. *Coriscium brogniardellum* F.—Eurioriental.—BB: Soalheira. May.—E: Torres Vedras. March; July; November. Very common. From larvæ captured October 6, the imagines emerged November 20.—Foodplant: *Quercus coccifera* L.

85. *Coriscium sulphurellum* Hw.—European.—BB: Matta do Fundão. July. Soalheira. June.

86. *Ornix angelicella* Stt.—Europacific.—BB: S. Fiel. Foodplant: *Cratægus monogyna* Jacq.

87. *Lithocolletis roboris* Z.—Euroriental.—BB: Castelo Novo, Monte de S. José, Quinta dos Carvalhos, S. Fiel. March–April; August–September. Foodplants: *Quercus pedunculata* Ehrh. and *Quercus toza* Bosc.

88. *Lithocolletis hortella* F.—Euroriental.—BB: Soalheira. May.—Foodplant: *Quercus toza* Bosc.

89. *Lithocolletis alnivorella* Rag.—Western Mediterranean.—BB: S. Fiel. Late March–early April; May–June. The larva of the first brood pupates in May–June, the larva of the second brood pupates in September–October, hibernates as pupa and emerges in March–April. Foodplant: *Alnus glutinosa* Gärtn.

90. *Lithocolletis salictella* Z.—European.—BB: S. Fiel. March–April. Larva in October–November. Foodplants: *Salix cinerea* L., and *Salix aurita* L.

91. *Lithocolletis cydoniella* F.—European.—BB: S. Fiel. March. November. Apparently only one brood: a few specimens emerge in November, but most of them hibernate as pupa and emerge in March. Larva in October, November. Foodplant: *Cydonia vulgaris* Pers.

92. *Lithocolletis cerasicolella* H.S.—European.—BB: S. Fiel. April, November. Only one brood. Larva in October–November. Foodplants: *Prunus cerasus* L., *Persica vulgaris* D.C., *Prunus armeniaca* L., and *Prunus insititia* L.

93. *Lithocolletis spinicolella* Z.—European.—BB: S. Fiel. March–April. Larva in October–November. Foodplant: *Prunus insititia* L.

94. *Lithocolletis concomitella* Bnks.—European.—E: Torres Vedras. March. Foodplant: *Pyrus malus* L.

95. *Lithocolletis blancardella* F.—European.—BB: S. Fiel. March, April.—E: Torres Vedras. July.—Larva in October–November. Foodplants: *Pyrus malus* L. and *Pyrus communis* L.

96. *Lithocolletis oxyacanthæ* Frey.—European.—BB: S. Fiel. March, October. Only one brood. Larva in September–October. Foodplant: *Cratægus monogyna* Jacq.

97. *Lithocolletis distentella* Z.—European.—BB: Quinta dos Carvalhos, Soalheira. May; August–September.—Foodplant: *Quercus toza* Bosc.

98. *Lithocolletis ilicifoliella* Z.—European.—E: Val de Rosal. —Foodplant: *Quercus lusitanica* Lam.

99. *Lithocolletis endryella* Mn.—Western Mediterranean.—BB: Sobral do Campo. First half of April.—Foodplant: *Quercus ilex* L.

100. *Lithocolletis ioviella* Const.—Western Mediterranean.—BB: Sobral do Campo.—E: Torres Vedras. End of March. Val de Rosal. April. Larva in December–March. Foodplants: *Quercus coccifera* L., and *Quercus ilex* L.

101. *Lithocolletis cocciferella* Mendes (1910, Brotéria, Série zoológica, 9, p. 164, pl. 7, fig. 4).—Endemic.—E: Torres Vedras (type locality). April; July.—Foodplant: *Quercus coccifera* L.

102. *Lithocolletis belotella* Stgr.—Mediterranean.—E: Torres Vedras. March; May. Common. Larva in October–April. Foodplant: *Quercus lusitanica* Lam.

103. *Lithocolletis scitulella* Z.—European.—Quoted only by Seebold from Portugal, without exact locality. June.

104. *Lithocolletis rebimbasi* Mendes (1910, Brotéria, Série zoológica, 9, p. 163, pl. 7, fig. 5).—Endemic.—E: Torres Vedras (type locality). June. Foodplant: *Quercus coccifera* L.

105. *Lithocolletis quercifoliella* Z.—Euroriental.—E: Torres Vedras. April. Foodplant: *Quercus* sp.

106. *Lithocolletis messaniella* Z.—Euroriental.—BB: S. Fiel. End of November, March–April; September–October.—E: Sintra. April. Torres Vedras. Very common.—Larva in August–September; October–November; February–March.—Foodplants: *Castanea vulgaris* Lam., *Quercus suber* L., *Quercus ilex* L., *Quercus coccifera* L. and *Quercus lusitanica* Lam.

107. *Lithocolletis cerasinella* Reutti.—European.—BB: S. Fiel. March–April; October. Larva in February–March; September. Foodplant: *Pterospartum cantabricum* Spach.

108. *Lithocolletis scopariella* Z.—European.—BB: S. Fiel. April. Serra da Guardunha. June.—E: Sintra. April.—Larva in March–earlyApril.—Foodplant: *Sarothamnus patens* Webb.

109. *Lithocolletis viminiella* Stt.—Atlantic.—E: Torres Vedras. July.

110. *Lithocilletis corylifoliella* Hw.—European.—BB: S. Fiel. June, July.—E: Torres Vedras. End of July.—Foodplants: *Pyrus malus* L. and *Pyrus communis* L.

111. *Lithocolletis froehlichiella* Z.—European.—BB: Ribeira

da Ocreza. March. Larva in October. Foodplant: *Alnus glutinosa* Gärtn.

112. *Lithocilletis klemannella* F.—Euroriental.—BB: Ribeira da Ocreza. March; August.—Larva in July; October.—Foodplant: *Alnus glutinosa* Gärtn.

113. *Lithocolletis schreberella* F.—Euroriental.—BB: Quinta do Barão.—E: Torres Vedras. March.—Larva in June; November.—Foodplant: *Ulmus campestris* Sm.

114. *Lithocolletis trifasciella* Hw.—Euroriental.—BB: S. Fiel. March, April.—Larva during the winter.—Foodplant: *Lonicera periclymenum* L.

115. *Lithocolletis adenocarpi* Stgr.—Iberian.—Alg: Monchique 1500′. May.

116. *Lithocolletis parvifoliella* Rag.—Western Mediterranean. —BL: Lousã.—BB: Matta do Fundão. July. S. Fiel. March; late September. Larva in Lousã and Matta do Fundão in July. Foodplant: *Sarothamnus grandiflorus* Webb. In S. Fiel larva in February–March; August–September. Foodplant: *Adenocarpus intermedius* DC.

117. *Lithocolletis caudiferella* Rag.—Western Mediterranean. —Ale: Aldeia do Neuves. May. São Barnabe. May.

COLEOPHORIDÆ

118. *Coleophora iuncicolella* Stt.—European.—BB: S. Fiel.

119. *Coleophora badiipennella* Dup.—European.—E: Torres Vedras. July.

120. *Coleophora lutipennella* Z.—Euroriental.—BB: S. Fiel. June. Soalheira. June.—Larva in April, May.—Foodplants: *Quercus toza* Bosc. and chestnut.

121. *Coleophora binderella* Koll.—European.—BB: S. Fiel. June.—Larva in April.—Foodplant: *Alnus glutinosa* Gärtn.

122. *Coleophora fuscedinella* Z.—European.—BB: Serra da Estrêla.—Foodplant: *Betula pubescens* Ehrh.

123. *Coleophora alcyonipennella* Koll.—European.—BB: Matta do Fundão. Early May.

124. *Coleophora hieronella* Z.—Mediterranean.—E: Setúbal. September.

125. *Coleophora phlomidella* Chr.—Ponto-Mediterranean.—BB: Quinta do Ribeiro Negro. Early September at light.

126. *Coleophora trifariella* Z.—European.—BB: Castelo Novo, Matta do Fundão, S. Fiel, Soalheira. End of May–early June.—Larva in April, May. Foodplants: *Cytisus albus* Lk. and *Sarothamnus grandiflorus* Webb.

127. *Coleophora pyrrhulipennella* Z.—Euroriental.—BB: Senhora da Orada, Serra da Guardunha.—Larva in April–May.—Foodplants: *Calluna* sp. and *Erica* sp.

128. *Coleophora vibicella* Hbn.—Euroriental.—BB: Castellejo, Souto da Casa. June.—Larva in May.—Foodplant: *Genista triacanthos* Brot.

129. *Coleophora ibipennella* Z.—European.—BB: Castelo Novo, S. Fiel. June.—Larva in May.—Foodplant: *Quercus pedunculata* Ehrh.

130. *Coleophora struella* Stgr.—Iberian.—BB: Castellejo. July. Portas de Ródam. End of May–early June.—Larva in April–May.—Foodplant: *Thymus serpillum* L.

131. *Coleophora conyzæ* Z.—European.—E: Setúbal. September.

132. *Coleophora onosmella* Brahm.—European.—BB: S. Fiel. End of May.—E: Setúbal. April; July–August.—Larva in February–end of April.—Foodplant: *Echium lusitanicum* Brot.

133. *Coleophora calycotomella* Stt.—Atlantic.—BB: S. Fiel, Soalheira. June.—Larva in April–May.—Foodplants: *Sarothamnus patens* Webb, *Adenocarpus intermedius* DC. and *Cytisus albus* Lk.

134. *Coleophora cæspitiella* Z.—European.—E: Setúbal. April.—Alg: Monchique 1500′. May.

135. *Coleophora pterosparti* Mendes (1910, Brotéria, Série zoológica, 9, p. 103–104, fig. 26; pl. 6, fig. 10).—Endemic.—BB: S. Vicente, Sobral do Campo (type localities). June.—Larva early in January–April.—Pupa late April.—Foodplant: *Pterospartum cantabricum* Spach.

136. *Coleophora gnaphalii* Z.—European.—BB: Castellejo, Pardanta.—Larva in May.—Foodplant: *Helichrysum stœchas* DC.

ELACHISTIDÆ

137. *Urodela cisticolella* Stt.—Western Mediterranean.—BB: S. Fiel. End of March–early April.—Larva in January.—Food-

plants: frequently *Cistus ledon* Lam., sometimes *Cistus ladaniferus* L.

138. *Elachista disertella* H.S.—Euroriental.—E: S. Amaro. April.

139. *Elachista pollinariella* Z.—Euroriental.—BL: Lousã. May.—E. Torres Vedras? Frequent in March.

140. *Elachista dispunctella* Dup.—European.—E: Torres Vedras. July; October. Common.

141. *Elachista argentella* Cl.—Euroriental.—BB: S. Fiel.

142. *Elachista megerlella* Stt. (*adscitella* Stt.)—Mediterranean?—BB: S. Fiel.

143. *Mendesia echiella* Joannis (1902, Bulletin Soc. Entom. France, p. 230–232, 6 figs.).—Endemic.—BB: Soalheira (type locality) February–March; early April; July.—Larva in January–February; middle of April.—Pupa end of January–February; middle of June; October. Foodplant: *Echium broteri* Samp. (*lusitanicum* Brot.).

144. *Mendesia joannisiella* Mendes (1909, Brotéria, Série zoológica, 8, p. 65–66, pl. 10, fig. 4).—Endemic.—BB: Serra da Guardunha (type locality). End of March–April.—Larva in January–March.—Foodplant: *Cistus ladaniferus* L.

HELIOZELIDÆ

145. *Heliozela sericiella* Haw.—European.—E: Sintra. April.

146. *Heliozela stannella* F.R.—European.—BL: Lousã.—BB: Castelo Novo.—E: Torres Vedras.—Foodplants: *Quercus lusitanica* Lam. and *Quercus toza* Bosc.

SCYTHRIDIDÆ

147. *Epermenia daucella* Peyer.—Mediterranean.—BB: Covilhã. August. S. Fiel. June.

148. *Epermenia staintoniella* Stt.—Western Mediterranean.—E: Torres Vedras. May.

——. *Scythris productella* Z.—European.—BB: Ceia. June.—Stainton has recorded one rather worn specimen captured by Eaton probably referable to this species. Doubtful.

149. *Scythris fallacella* Schläg.—European.—Recorded only by Seebold without locality. June.

150. *Scythris grandipennis* Hw.—Atlantic.—BB: Senhora da Orada. May.

——. *Scythris senescens* Stt.—European.—BB: Matta do Fundão. June. Recorded as doubtful by Mendes.

——. *Scythris cistorum* Mill.—Western Mediterranean.—BB: Serra da Guardunha. Recorded by Mendes. Doubtful.

151. *Scythris scipionella* Stgr.—Western Mediterranean.—E: Praia de Santa Cruz. April.

152. *Scythris salviella* Stgr.—Iberian.—Mentioned by Seebold. No locality. May.

153. *Scythris chenopodiella* Hbn.—Euroriental.—BB: S. Fiel. July.—E: Bemfica. April.

154. *Scythris insulella* Stgr.—Iberian.—No locality (Seebold). April.

155. *Scythris acanthella* God.—Mediterranean.—M: Guimarães.—BB: Ceia. June. S. Fiel. May–June. Ale: Aldeia do Neuves. May.

HYPONOMEUTIDÆ

156. *Prays curtisellus* Dup.—European.—T: Vila Real. June.

157. *Prays oleellus* F. (*oleæ* Bernard).—Mediterranean.—BB: S. Fiel. April; June; September.—E: Setúbal. June; July.—Larva in March on the leaves; in August on the fallen fruit.—Foodplant: olive tree.

158. *Paradoxus osyridellus* Stt.—Mediterranean.—BB: S. Fiel. September.

159. *Herrichia excelsella* Stgr.—European.—No locality (Seebold). May.

160. *Hyponomeuta egregiellus* Dup.—Western Mediterranean.—BB: Serra da Guardunha. May.—E: Torres Vedras. June.—Larva in great number in January–April.—Foodplants: various species of *Erica*.

161. *Hyponomeuta rorellus* Hbn.—European.—BB: S. Fiel. July.

162. *Swammerdamia lutarea* Hw.—European.—BB: Covilhã. September.

163. *Swammerdamia pyrella* Vill.—European.—BB: S. Fiel. End of June.

164. *Argyresthia gœdartella* L.—European.—BB: Guarda. End of August.

165. *Cerostoma lucellum* F.—European.—BB: Monte de S. José. June.

166. *Cerostoma persicellum* F.—Mediterranean.—BB: Ceia. June. S. Fiel. June.

167. *Plutella maculipennis* Curt.—Tropico-Holarctic.—M: Guimarães.—BB: S. Fiel. May–August.—E: Campolide, Setúbal. May.

168. *Plutella cruciferarum* Z.—Mediterranean?—Ale: Almondóvar. May.

ACROLEPIIDÆ

169. *Acrolepia vesperella* Z.—Mediterranean.—E: Torres Vedras. June–July.

ÆGERIIDÆ

170. *Synanthedon spheciformis* Gerning.—Euro-Pacific.—M: Vizela. July.—BB: Matta do Fundão.

171. *Synanthedon conopiformis* Esp.—Euroriental.—M: Guimarães. June.

172. *Dipsosphecia ichneumoniformis* F.—Euroriental.—M: Gerez, Vizela. July.—BB: S. Fiel. June.

173. *Chamæsphecia chrysidiformis* Esp.—European.—BB: Matta do Fundão. End of May. On an Umbellifera.—E: Setúbal. June.

174. *Chamæsphecia chalcidiformis* Hbn.—Euroriental.—BB: Matta do Fundão. End of May. On an *Umbellifera*.

175. *Chamæsphecia corsica* Stgr.—Western Mediterranean.—BB: Cardigos. Early in May. Serra da Guardunha. May–June.

176. *Chamæsphecia affinis* Stgr.—Euroriental.—T: Vila Real. June.—BB: S. Fiel. June. Serra da Guardunha.

177. *Microsphæcia tineiformis* Esp.—Mediterranean.—E: Setúbal. Common.

GLYPHIPTERYGIDÆ

178. *Simæthis nemorana* Hbn.—Mediterranean.—M: Guimarães. August.—BB: S. Fiel. June–July.—E: Torres Vedras. July. Around fig trees.—Larva in S. Fiel in May–June.—Foodplant: *Ficus carica* L.

179. *Choreutis myllerana* F.—European.—BB: Castellejo. May.

180. *Choreutis bjerkandrella* Thnbg.—European.—M: Guimarães.—BB: Castellejo. May. S. Fiel. July.—E: Torres Vedras. June.

181. *Choreutis pretiosana* Dup.—European.—E: Estoril. June. Lisboa. June.

182. *Milliereia dolosana* H.S.—Mediterranean.—BB: Portas de Ródam. May.

183. *Glyphipteryx fuscoviridella* Hw.—European.—BB: Castellejo. May. Ceia 1700′. Early June. Matta do Fundão. May. Common on the ground under fallen chestnut leaves.—E: Setúbal. May. Sintra. End of April. Torres Vedras. May.

184. *Glyphipteryx thrasonella* Sc.—European.—BB: Matta do Fundão. June. S. Fiel. Early May. Very abundant.

185. *Glyphipteryx equitella* Sc.—European.—M: Guimarães. August.—BB: S. Fiel. April; November.—E: Oeiras. Late April–early May. Very common. Setúbal. June. August–September. Torres Vedras. May–June. Abundant.—Larva, January–March.—Foodplant: *Umbillicus pendulinus* DC.

186. *Glyphipteryx fischeriella* Z.—European.—T: Vila Real. June.—E: Sintra. Late April.—Alg: Silves. May.

187. *Glyphipteryx schœnicolella* Stt.—Western Mediterranean?—Ale: Almondóvar. May.

188. *Douglasia transversella* Z.—European.—E: Torres Vedras. April.

GELECHIIDÆ

189. *Psecadia sexpunctella* Hbn.—Euroriental.—BB: S. Fiel. April.—E: Setúbal. July.

190. *Psecadia pusiella* Roemer.—Euroriental.—BB: S. Fiel. April; June; September.—E: Campolide.

191. *Psecadia bipunctella* F.—Euroriental.—E: Setúbal. May; June; July.

192. *Psecadia funerella* F.—Euroriental.—M: Ruivães. End of June.

193. *Psecadia andalusica* Stgr.—Iberian.—BB: Matta do Fundão. May.

194. *Psecadia aurifluella* Hbn.—Mediterranean.—E: Setúbal. July.

195. *Depressaria assimilella* Tr.—Ponto-Mediterranean.—BB: S. Fiel. July.

196. *Depressaria scopariella* Hein.—European.—BB: S. Fiel. Early June.

197. *Depressaria rutana* F.—Western Mediterranean.—BB: S. Fiel. November.

198. *Depressaria subpropinquella rhodochrella* H.S.—Eurori-ental.—E: Setúbal. June. Torres Vedras. June.

199. *Depressaria yeatiana* F.—European.—E: Torres Vedras. July.

200. *Depressaria alstrœmeriana* Cl.—European.—E: Praia de Santa Cruz. April.

201. *Depressaria lutosella* H.S.—Mediterranean.—E: Setúbal. June.

202. *Depressaria applana* F.—European.—E: S. Amaro. Early May.

203. *Depressaria brunneella* Rag.—Western Mediterranean.—BB: S. Fiel. Early June.

204. *Depressaria tenebricosa* Z.—Mediterranean.—E: Torres Vedras. June.

205. *Depressaria albipunctella* Hbn.—European.—BB: S. Fiel.

206. *Depressaria ululana* Rössl.—European.—BB: Matta do Fundão.

207. *Depressaria nervosa* Hw.—European.—BB: S. Fiel. June.—Mendes found the imago hibernating under the bark of *Eucalyptus*.

208. *Pleurota planella* Stgr.—Mediterranean.—BB: Matta do Fundão. Early June.

209. *Pleurota pyropella* Schiff.—Mediterranean.—E: Torres Vedras. July.

210. *Pleurota schlægeriella* Z.—European.—E: Torres Vedras. July.

211. *Pleurota honorella* Hbn.—Western Mediterranean.—BB: Serra da Guardunha. May–June.—E: Estoril. End of June. Oeiras. End of June. Setúbal. May. Torres Vedras. July.—f. *heydenreichiella* H.S. and f. *nobilella* Rbl.—BB: Serra da Guardunha. May–June.

212. *Pleurota protosella* Stgr.—Iberian.—BB: S. Fiel. Early May.

213. *Pleurota bicostella* Cl.—Eurori ental.—M: Salamonde. End of June.—E: Torres Vedras. End of May.

214. *Pleurota ericella* Dup.—Mediterranean.—M: Guimarães. May.—BB: Pardante. May. S. Fiel. May.—E: Torres Vedras. June.—Ale: Aldeia do Neuves. Early May. Almodóvar. Early May.—Alg: Silves. Middle of May.

215. *Pleurota amaniella* Mn.—Mediterranean.—June. Recorded only by Seebold without definite locality.

216. *Protasis punctella* Costa.—Mediterranean.—E: Torres Vedras. July.

217. *Carcina quercana* Sc.—Euroriental.—M: Guimarães.—BB: Covilhã. August. S. Fiel. June.—E: Setúbal. July.—Foodplant: *Quercus toza* Bosc.

218. *Lecithocera luticornella* Z.—European.—M: Guimarães. August.—BB: Covilhã. August. Monte de S. José. June. Soalheira. June.—E: Torres Vedras. May. July. Frequent.—Alg: Silves. May.—f. *pullicomella* Stgr.—E: Setúbal.

219. *Symmoca signatella* H.S.—Ponto-Mediterranean.—M: Guimarães.—BB: S. Fiel. July.—E: Lisboa. July. Torres Vedras. June.

220. *Symmoca nigromaculella* Rag. (1875, Bulletin Soc. Entom. France, p. 194; 1876, Annales Soc. Entom. France, 6, p. 410, pl. 6, fig. 6).—Endemic.—BL: Coimbra (type locality).—BB: S. Fiel.

221. *Symmoca oxybiella* Mill.—Western Mediterranean.—BB: S. Fiel. June.

222. *Symmoca tofosella* Rbl.—Iberian.—BB: Serra da Guardunha. August. September.

223. *Symmoca griseosericeella* Rag. (1879, Bulletin Soc. Entom France, p. 140).—Endemic.—BL: Coimbra (type locality).—BB: Matta do Fundão. Early May.

224. *Alabonia staintonella* Z.—Euroriental.—Recorded by Seebold without definite locality. June.—? Alg: Picota 1600–1700′. May. Stainton gives this capture made by Eaton as doubtful (1880–1881, Entom. Monthly Magaz., 17, p. 247–248). This observation may pertain to a new species.

225. *Œcophora sulphurella* F.—Euroriental.—BB: S. Fiel. May.—E: Setúbal. February, March.

226. *Œcophora oliviella* F.—Euroriental.—BB: S. Fiel. June.

227. *Borkhausenia detrimentella* Stgr.—Iberian.—Alg: Monchique. Late May.

228. *Borkhausenia angustella* Hbn.—European.—BB: S. Fiel.

229. *Borkhausenia formosella* F.—European.—M: Guimarães.—BB: S. Fiel. August.—E: Torres Vedras. June.

230. *Borkhausenia xenias* Meyrick.—Western Mediterranean.—BB: Matta do Fundão. May. According to Mendes (1935, Brotéria, Série trimestral, 4(31), p. 70) the specimen captured by him has been compared by Meyrick with the type. This species is described from a single specimen from Philippeville, North Africa.

231. *Blastobasis phycidella* Z.—Euroriental.—E: Setúbal. August. Torres Vedras. June. July.

232. *Blastobasis fuscomaculella* Rag. (1879, Bulletin Soc. Entom. France, p. 141).—Western Mediterranean (Canarian).—BL: Coimbra (type locality).—E: Setúbal. March; July–August. Torres Vedras. June–July; November.

——. *Prosthesis exclusa* Wlsghm.—Mediterranean?—BB: Matta do Fundão. May. Found by Mendes, but considered as doubtful. (1913, Brotéria, Série zoológica, 11, p. 22).

233. *Œgoconia quadripuncta* Hw.—Euroriental.—BB: Covilhã. August. Ponte de Morcellos. June. S. Fiel. July.—E: Setúbal. June–July; September. Torres Vedras. June.

234. *Brachmia triannulella* H.S.—Euroriental.—E: Setúbal. July.

235. *Rhinosia formosella* Hbn.—Euroriental.—M: Guimarães.—BB: S. Fiel.

236. *Euteles kollarella* Costa.—Mediterranean.—BB: Matta do Fundão. July–August.—E: Setúbal. June–July. Torres Vedras. July. Frequent.

237. *Euteles ratella* H.S.—Ponto-Mediterranean.—BB: Quinta dos Carvalhos. August. Quinta do Ribeiro Negro. August.—E: Setúbal. July. Torres Vedras. July.

238. *Metanarsia santennæ* Stgr.—Iberian.—April. Recorded by Seebold without definite locality.

239. *Nothris verbascella* Hbn.—Euroriental.—E: Campolide. Setúbal. October.

240. *Nothris limbipunctella* Stgr.—Western Mediterranean.—Ale: Aldeia do Neuves. May.

241. *Holcopogon bubulcellus* Stgr.—Western Mediterranean.—BB: Covilhã. Early September.

242. *Hypsolophus iuniperellus* L.—Euroriental.—BB: Castellejo. May.

243. *Tachyptilia scintilella* F.—Mediterranean.—BB: Serra da Guardunha. June–July.—Larva in May.—Foodplant: flowers of *Cistus ledon* Lam.

244. *Schistophila laurocistella* Chrét.—Western Mediterranean.—BB: Serra da Guardunha. Middle of May–middle of June.—Larva in January–March.—Foodplant: *Cistus ladaniferus* L.

245. *Teleia tamariciella* Z.—Mediterranean.—Alg: Silves. May.

246. *Teleia cisti* Stt.—Western Mediterranean.—BB: Senhora da Orada. June.—Larva in May.—Foodplant: *Halimium occidentale* W.

247. *Teleia triparella* Z.—Euroriental.—BB: Matta do Fundão. Early May.—?E: Torres Vedras. End of July. One worn specimen.

248. *Psoricoptera gibbosella* Z.—European.—BB: Covilhã. Early September.

249. *Platyedra vilella* Z.—Euroriental.—BB: S. Fiel.—E: Setúbal. May. Torres Vedras. End of October.—Ale: Almodóvar. May.

250. *Gelechia spurcella* H.S.—Euroriental.—BB: Ponte de Morcellos. June.

251. *Gelechia distinctella* Z.—European.—M: Guimarães. May.—BB: S. Fiel. July.

252. *Gelechia pascuicola* Stgr.—Iberian.—BB: S. Fiel. March.

253. *Gelechia peliella* Tr.—European.—BB: Quinta dos Fornos. July. S. Fiel. July.

254. *Gelechia ericetella* Hbn.—Euroriental.—E: Val de Rosal. April. Very dark specimens.

255. *Gelechia mulinella* Z.—Atlantic.—E: Setúbal.—Foodplant: *Bartsia aspera* Brot.

256. *Gelechia interruptella* Hbn.—European.—BB: S. Fiel. March.

257. *Gelechia malvella* Hbn.—European.—Alg: Silves. May.

258. *Gelechia solutella* Z.—Euroriental.—BB: Castellejo. May.

259. *Gelechia diffinis* Hw.—European.—BB: Serra da Guardunha. March–April.

——. *Gelechia viduella* F.—Boreo-Alpine.—?Alg: Monchique 2150′. May. One worn specimen found by Eaton and considered by Stainton as "rather allied to *G. viduella.*" (1880–1881, Entom. Monthly Mag., 17, p. 247.)

260. *Lita helotella* Stgr.—Western Mediterranean.—BB: Matta do Fundão. June.—E: Val de Rosal. April.

261. *Lita solanella* B.—Tropico-Holarctic.—BB: Fundão. October. Idanha a Nova. Sobral do Campo. October.—E: Torres Vedras. July.—Larva in August–September. Injurious. —Foodplant: potato.

——. *Lita salinella* Z.—Western Mediterranean.—BB: S. Fiel. April. Very common. Found only by Mendes. Identification doubtful.

——. *Lita iunctella* Dgl.—European.—BB: Serra da Guardunha. April–May. Found only by Mendes. Identification doubtful.

262. *Lita marmorea* Hw.—European.—BB: S. Fiel. May.

——. *Lita cauligenella* Schmid.—European.—BB: Barca d' Alva, Matta do Fundão. Monte S. José. S. Fiel.—Larva in May–June.—Foodplants: *Silene gallica* L., *Silene portensis* Hffg., *Silene inaperta* L., *Silene longicilia* Hoth. Bred by Tavares. Identification doubtful.

263. *Bryotropha figulella* Stgr.—Mediterranean.—BB: S. Fiel.

264. *Bryotropha plebeiella* Z.—Mediterranean.—June. Recorded only by Seebold without definite locality.

265. *Bryotropha similis* Stt.—Atlantic.—BB: S. Fiel.

266. *Bryotropha affinis* Dgl.—Eurooriental.—BL: Lousã. July.

267. *Bryotropha domestica* Hw.—Eurooriental.—BB: S. Fiel. June.—E: Setúbal. August.

268. *Bryotropha basaltinella* Z.—European.—BB: S. Fiel.

269. *Metzneria paucipunctella* Z.—Eurooriental.—April. Recorded only by Seebold, without definite locality.

270. *Metzneria castiliella* Möschl.—Iberian.—Alg: Silves. May.

271. *Metzneria carlinella* Stt.—European.—E: Torres Vedras. July.

272. *Metzneria metzneriella* Stt.—European.—BB: Matta do Fundão. Early May.—E: Torres Vedras. July.

273. *Paltodora striatella* Hbn.—Holarctic.—E: Setúbal. June–July. Torres Vedras. July.

274. *Paltodora anthemidella* Wck.—Euroriental.—E: Setúbal. May.

275. *Paltodora kefersteiniella* Z.—Mediterranean.—E: Setúbal. June.

276. *Paltodora lineatella* Z.—Mediterranean.—BB: S. Fiel. June. Common.—Alg: Silves. May.

277. *Paltodora cytisella* Curt.—European.—BB: Portas de Ródam. May. S. Fiel. June.

278. *Sitotroga cerealella* Olivier.—Holarctic.—BB: S. Fiel. May.

279. *Anacampsis anthyllidella* Hbn.—Euroriental.—BB: Covilhã. End of August–early September.—E: Capuchos. End of August. Torres Vedras. July.

280. *Anacampsis vorticella* Sc.—Euroriental.—T: Vila Real. Late June.—BB: S. Fiel. April–May.—Larva in March–April.—Foodplant: *Adenocarpus intermedius* DC.

281. *Xystophora carchariella* Z.—Euroriental.—BB: S. Fiel.

282. *Xystophora farinosæ* Stt.—European.—BB: S. Fiel. June.

283. *Xystophora tenebrella* Hbn.—European.—BB: S. Fiel.

284. *Apodia bifractella* Dgl.—Euroriental.—E: Setúbal. September.

285. *Ptocheuusa deiectella* Stgr.—Iberian.—BB: S. Fiel.

286. *Ptocheuusa inopella* Z.—Atlantic.—Alg: Silves. May.

287. *Aristotelia ericinella* Dup.—European.—BB: Serra da Estrêla. End of August–early September.—E: Capuchos. End of August. Estoril. July.

288. *Epidola stigma* Stgr.—Iberian.—BB: Covilhã. Early September.

289. *Pterolonche inspersa* Stgr.—Euroriental.—E: Torres Vedras. July.

MOMPHIDÆ

290. *Pancalia leewenhoeckella latreillella* Curtis.—European.—T: Vila Real. 2480′. Late June.

291. *Stagmatophora grabowiella* Stgr.—Mediterranean.—BB: Castellejo. June–July. S. Fiel. June–July.—E: Val de Rosal.—

Larva in March–May.—Foodplants: *Lavandula stœchas* L., *Thymus serpillum* L.

292. *Stagmatophora serratella* Tr.—Mediterranean.—BB: Covilhã. September. S. Fiel. May–June.—Larva in April–May.—Foodplant: *Anarrhinum bellidifolium* L.

293. *Mompha decorella* Steph.—Euroriental.—M: Gerez.—BB: Matta do Fundão. S. Fiel. Late August.—Larva in June.—Foodplant in Matta do Fundão *Epilobium virgatum* Fr., in Gerez *Epilobium lamyi* Fr. Schultz.

294. *Limnœcia phragmitella* Stt.—Atlantic.—E: Torres Vedras. End of July.

295. *Tebenna miscella* Schiff.—Euroriental.—BB: Ceia. Early June. S. Fiel. Late April.—Larva in February.—Foodplant: *Cistus ledon* Lam.

296. *Cosmopteryx eximia* Hw.—Euroriental.—BB: S. Fiel.

ATYCHIIDÆ

297. *Atychia nana* Tr.—Mediterranean.—E: Torres Vedras. July.

298. *Atychia diacona* Ld.—Mediterranean?—BB: S. Fiel.

COSSIDÆ

299. *Cossus cossus* L.—Euroriental.—M: Caldelas. August. Vizela. August.

300. *Cossus terebra* F.—Euroriental.—E: Setúbal. July.

301. *Dyspessa ulula* Bkh.—Euroriental.—E: Lisboa. June. Torres Vedras. June.—f. *marmorata* Rbr. E: Campolide. Setúbal. July.

302. *Zeuzera pyrina* L.—Holarctic.—M: Caldelas. August. Rare. Vizela. June.—BB: S. Fiel. June.—E: Campolide. Setúbal. July. Torres Vedras. July. Foodplants: apple tree (*Pyrus malus* L.) and other fruit trees.

TORTRICIDÆ

303. *Acalla hastiana* L.—Holarctic.—BB: S. Fiel. May.—E: Setúbal. November.—f. *centrovittana* Steph. BB: S. Fiel.

304. *Acalla logiana* Schiff.—Holarctic.—Alg: Picota. 1600–1700′. May.

305. *Acalla variegana* Schiff.—Holarctic.—BB: S. Fiel. June–July; October–November.—E: Lisbon. May; late November. Setúbal. June. Torres Vedras. June.

306. *Acalla permutana* Dup.—European.—BB: Soalheira. October.

307. *Acalla ferrugana* Schiff.—Holarctic.—M: Guimarães. August.—BB: S. Fiel. June; October–November.

308. *Acalla quercinana* Z.—Euroriental.—BB: S. Fiel. August.

309. *Acalla contaminana* Hbn.—Holarctic.—Póvoa. October. The capture of this species has been recorded only by Mendes. There are several localities by the name of Póvoa in Portugal. I do not know which one he meant.

310. *Dichelia hyerana* Mill.—Mediterranean.—BL: Lousã. October.—Larva in May.—Foodplant: *Asphodelus occidentalis.*

311. *Capua angustiorana* Hw.—Holarctic.—BL: Coimbra, Lousã.—BB: Portas do Ródam, S. Fiel, Soalheira, Sobral do Campo. May.—E: Alenquer, Arrabida, Praia de Santa Cruz, Setúbal, Sintra, Torres Vedras. End of June.—Alg: Portimão.—Foodplants: *Quercus ilex* L., *Quercus coccifera* L., and *Quercus suber* L.

312. *Sparganothis pilleriana* Schiff.—Holarctic.—E: Salvaterra de Magos. Injurious to vineyards, according to Seabra (1919).

313. *Cacœcia podana* Sc.—Euro-Pacific.—BB: Matta do Fundão. June.

314. *Cacœcia xylosteana* L.—Euro-Pacific.—BB: Monte de S. José. Middle of June. Common.—Ale: Serpa. Injurious.—Larva in April–May.—Foodplant: *Quercus toza* Bosc.

315. *Cacœcia rosana* L.—Holarctic.—BB: S. Fiel. June.

316. *Cacœcia unifasciana* Dup.—Euroriental.—Recorded by Seebold without definite locality.

317. *Cacœcia semialbana* Gn.—Euro-Pacific.—M: Guimarães. August.

318. *Pandemis heparana* Schiff.—Euro-Pacific.—M: Guimarães. August.—BB: Ribeira da Ocreza. June.—E: Torres Vedras. June.

319. *Tortrix croceana* Hbn.—European?—M: Guimarães. May.—BB: Senhora da Orada. May. Unhais da Serra. Sep-

tember.—E: Val de Rosal. April.—Pupa found on *Halimium occidentale* W.

320. *Tortrix unicolorana* Dup.—European?—BL: Lousã.—BB: Matta do Fundão. April–May.—E: Sintra. April. Val de Rosal. April.—Pupa found in April on *Asphodelus* sp.

321. *Tortrix amplana* Hbn.—European?—BB: S. Fiel. March–early April. Serra da Guardunha.—E: Alcantara. April. Setúbal. April–June.—Larva in December–February.—Foodplant: *Urginea scilla* Steinh.

322. *Tortrix eatoniana* Rag. (1880–1881, Entom. Monthly Mag., 17, p. 231–232).—Western Mediterranean?—BB: Covilhã, Ponte de Morcellos (type locality). June. Ribeira da Ocreza, S. Fiel. End of April–June; August–September.—E: Olivais (type locality). April. Setúbal. June. Torres Vedras. May.

323. *Tortrix conwayana* F.—European.—E: Torres Vedras. May.

324. *Tortrix lœflingiana ectypana* Hbn.—Euroriental.—BB: Monte de S. José. May.

325. *Tortrix viridana* L.—Euroriental.—BB: Castelo Branco, Monte de S. José. Early June.—Ale: Beja, Evora, Portalegre, Serpa, Vila Viçosa.—Larva from early February–May.—The pupa lives an average of 17–18 days.—Seabra and Santos Hall (1924) made an interesting survey of this injurious species, giving detailed account of its distribution and phenology, with comparative data concerning phenology from several other European countries.

326. *Tortrix longana luridalbana* H.S.—Euroriental.—April. Recorded by Seebold without definite locality.

327. *Tortrix wahlbomiana* L.—Euroriental.—BB: S. Fiel. May–June.—E: Campolide. Val de Rosal. April. Abundant on pines.—Larva in April–May.—Foodplant: *Digitalis thapsi* L.—f. *communana* H.S.—Ale: Almodóvar. May.—Ale: SE of Silves. May.

328. *Tortrix chrysantheana* Dup.—Euroriental.—April. Recorded by Seebold without definite locality.

329. *Tortrix abrasana* Dup.—Euroriental.—E: Setúbal. August.

330. *Tortrix nervana* Joannis (1908, Bulletin Soc. Entom.

France, p. 190).—Iberian.—BB: S. Fiel (type locality). Serra da Estrêla. Early September.

331. *Lozopera deaurana* Peyer.—Mediterranean?—BB: S. Fiel.—E: Setúbal.

332. *Phalonia sanguinana* Tr.—Euroriental.—E: Setúbal. May–June.

333. *Phalonia implicitana* Wck.—Atlantic.—E: Oeiras. June.

334. *Phalonia purpuratana roseofasciana* Mn.—European.—BB: Matta do Fundão. June. Soalheira. June.

335. *Phalonia zephyrana* Tr.—Euroriental.—March. Recorded by Seebold without definite locality.

336. *Phalonia nana* Hw.—Holarctic.—BB: S. Fiel.

337. *Phalonia pallidana* Z.—European.—BB: S. Fiel. June.

338. *Phalonia posterana* Z.—Euroriental.—E: Torres Vedras. End of July in vineyards.

339. *Phalonia hybridella* Hbn.—Euroriental.—E: Campolide, Setúbal. July.

340. *Phalonia punctiferana* Rag. (1880–1881, Entom. Monthly Mag., 17, p. 232).—Endemic.—T: Bragança (type locality).

341. *Phalonia reversana* Stgr.—Iberian.—BB: Castellejo. May.—E: Setúbal. May.

342. *Phalonia respirantana* Stgr. (1880, Horæ Soc. Entom. Rossicæ, 15, p. 88).—Mediterranean.—E: Setúbal. June.—Alg: Silves. May.

343. *Phalonia chamomillana* H.S.—Mediterranean.—BB: S. Fiel. May.

344. *Phalonia simoniana* Stgr.—Western Mediterranean.—E: Sintra. April.

345. *Euxanthis lathoniana* Hbn.—Ponto-Mediterranean.—E: Torres Vedras. June.

346. *Euxanthis straminea* Hw.—Euroriental.—BB: Castelo Novo. November.—E: Setúbal. June–July. Torres Vedras. End of July.

347. *Euxanthis hamana* L.—Euroriental.—E: Setúbal. July.

348. *Commophila rugosana* Hbn.—European.—BB: S. Fiel. May.

349. *Hysterosia maculosana* Hw.—Atlantic.—BB: Portas do Ródam. May.

350. *Evetria duplana* Hbn.—Euro-Pacific.—BB: S. Fiel. March.

351. *Evetria buoliana* Schiff.—Holarctic.—BB: Soalheira. June.

352. *Argyroploce ochroleucana* Hbn.—Euroriental.—BB: S. Fiel. May.

353. *Argyroploce oblongana* Hw.—Euroriental.—BB: Senhora da Orada. May.—E: Setúbal. June.

354. *Argyroploce gentiana* Hbn.—European.—E: Setúbal. July.

355. *Argyroploce lacunana* Dup.—Euroriental.—BB: Ceia. June. Matta do Fundão. May–June. Monte de S. José. Ribeira da Ocreza.

356. *Argyroploce rurestrana* Dup.—Mediterranean.—BB: S. Fiel. June.

357. *Ancylis sparulana* Stgr.—Iberian.—April. Recorded by Seebold without definite locality.

358. *Ancylis siculana* Hbn.—Euroriental.—BB: S. Fiel. End of April. Imago found on *Cornus sanguinea.*

359. *Ancylis diminutana* Hw.—European.—BB: Ceia. June.

360. *Polychrosis botrana* Schiff.—Euroriental.—BB: Serra da Guardunha. June.—E: Estoril. Early May. S. Amaro. April. Torres Vedras. March; July.

361. *Polychrosis littoralis* Westwd.—Atlantic.—E: Setúbal. March; August.

362. *Acroclita consequana* H.S.—Atlantic.—E: Torres Vedras.

363. *Crocidosema plebeiana* Z.—Tropico-Holarctic.—BB: S. Fiel. Serra da Guardunha. May.—E: Setúbal. Torres Vedras. End of July.

364. *Bactra lanceolana* Hbn.—Tropico-Holarctic.—BB: S. Fiel. April–May.—E: Setúbal. May. Torres Vedras. June.

365. *Bactra furfurana* Hw.—Holarctic.—E: Val de Rosal. April.

366. *Bactra venosana* Z.—Western Mediterranean.—Recorded by Seebold without definite locality.

367. *Pelatea festivana* Hbn.—Mediterranean.—BB: Covilhã. July.

368. *Epinotia corticana* Hbn.—European.—BB: Monte de S. José. June.—E: Torres Vedras. June.

369. *Epinotia aceriana* Dup.—European.—BB: S. Fiel.

370. *Epinotia incarnana* Hw.—European.—BB: S. Fiel. October.—E: Campolide. Setúbal. October.

371. *Epinotia minutana* Hbn.—European.—BB: S. Fiel.

372. *Semasia seeboldi* Rössl.—Iberian.—BB: Castellejo. May. Pardanta.—E: Val de Rosal. April.

373. *Tmetocera ocellana* F.—Holarctic.—BB: S. Fiel. June.

374. *Notocelia incarnatana* Hbn.—Euroriental.—BB: S. Fiel. —E: Setúbal. September.

375. *Epiblema tripunctana* F.—Euroriental.—BB: S. Fiel. May.—E: Setúbal. April.

376. *Epiblema couleurana* Dup.—European.—E: Setúbal. July.

377. *Epiblema sordicomana* Stgr.—European?—BB: Pardanta. Middle of May.—Ale: Almodóvar. Early May.

378. *Epiblema cana* Hw.—European.—E: Setúbal. July.

379. *Epiblema grammana* Const.—Western Mediterranean.—Recorded by Seebold without definite locality.

380. *Epiblema thapsiana* Z.—Euroriental.—E: S. Amaro. April.

381. *Carpocapsa pomonella* L.—Holarctic.—M: Guimarães. June.—BB: S. Fiel. June–August.—E: Campolide. Lisboa. July. Setúbal. June–August. Torres Vedras. July.—Foodplants: apple and orange.

382. *Carpocapsa grossana* Hw.—European.—E: Torres Vedras. June.—Foodplant: *Quercus coccifera* L.

383. *Carpocapsa splendana* Hbn.—European.—BB: Soalheira. May.—E: Torres Vedras.—Larva until November, pupates in November.—Foodplant: *Quercus* sp.—f. *reaumurana* Hein.—BB: Manteigas. Early September.—Foodplant: chestnut.

384. *Laspeyresia nebritana* Tr.—Euroriental.—BB: Monte de S. José. May.

385. *Laspeyresia gemmiferana* Tr.—Euroriental.—E: Setúbal. April.

386. *Laspeyresia succedana* Froel.—Euroriental.—M: Guimarães. May.—BB: Monte de S. José. May.—E: Torres Vedras. March. Abundant.—f. *ulicetana* Hw.—E: Estoril. Late February–early May. Very common. I did not find any other species in such great number in this area. They were flying literally by

the hundreds. Parque de Pena near Sintra. Late April. Sintra. Early May.

387. *Laspeyresia micaceana* Const.—Mediterranean?—E: Parque de Pena near Sintra. Late April.—Ragonot (1880–1881, Entom. Monthly Mag., 17, p. 233) considers this species as a form of *Laspeyresia succedana ulicetana* Hw.

388. *Laspeyresia adenocarpi* Rag.—Western Mediterranean.—BB: Soalheira. June.—Larva in May.—Foodplant: *Adenocarpus intermedius* D.C.

389. *Laspeyresia cæcana* Schläg.—Euroriental.—Recorded by Seebold without definite locality.

390. *Laspeyresia macrogrammana* Gn.—Euroriental.—E: Setúbal. July.

391. *Laspeyresia pinetana* Schläg.—Atlantic.—E: Val de Rosal. April.

392. *Laspeyresia coniferana* Ratzb.—European.—BB: Ponte de Morcellos. June.

393. *Laspeyresia internana* Gn.—Atlantic.—BB: S. Vicente da Beira on the flowers of *Pterospartum cantabricum* Spach. Serra da Estrêla on *Genista lusitanica* L. July.

394. *Laspeyresia dorsana* F.—Euroriental.—BL: Lousã on *Prunus spinosa* L. May.—E: Setúbal. April. Val de Rosal. April.

395. *Pamene gallicolana amygdalana* Dup.—Euroriental.—M: Gerez. Guimarães. June.—BA: Barrô.—BL: Lousã.—BB: Alpedrinha, Castelo Branco, Castelo Novo, Lardoza, Soalheira, Sobral do Campo.—E: Setúbal, Sintra, Torres Vedras. End of June.—Foodplants: *Quercus toza* Bosc. and *Quercus lusitanica* Lam.

ORNEODIDÆ

396. *Orneodes hexadactyla* L.—Euroriental.—BB: Quinta do Ribeiro Negro. August–September. S. Fiel. July.—E: Setúbal.

397. *Orneodes huebneri* Wallgr.—Holarctic.—BB: S. Fiel. August.—E: Setúbal. Torres Vedras. February–March. June–July. November.

PTEROPHORIDÆ

398. *Agdistis heydeni* Z.—Western Mediterranean.—E: Torres Vedras. July.

399. *Amblyptilia acanthodactyla* Hbn.—Euroriental.—BB: S. Fiel. October.—E: Setúbal. August–September. Torres Vedras. March.—Ale: Almodóvar. May.

400. *Stenoptilia bipunctidactyla* Hw. (*serotinus* Z.)—Mediterranean.—BB: Serra da Estrêla. Early September.—E: Setúbal. July.

——. *Stenoptilia graphodactyla* Tr.—Alpine.—E: Torres Vedras. July. Recorded by Mendes. Identification doubtful.

401. *Oxyptilus tristis* Z.—European.—BB: S. Fiel.—E: Torres Vedras. July.

402. *Oxyptilus distans læta* Z.—Euroriental.—M: Guimarães.—BB: Serra da Estrêla. June. August.—E: Estoril. July–September. Setúbal. June–July. Torres Vedras. July.

403. *Trichoptilus siceliota* Z.—Mediterranean.—BB: Ribeira da Ocreza. May. Serra da Guardunha.—E: Torres Vedras. End of July.

404. *Pterophorus monodactylus* L.—Holarctic.—M: Guimarães.—BB: Soalheira. October.—E: S. Amaro. May. Setúbal. Torres Vedras. End of July. Common.

405. *Pterophorus osteodactylus* Z.—European.—E: Setúbal. April.—Alg: Silves. May.

406. *Pterophorus microdactylus* Hbn.—Euroriental.—M: Gerez.—BB: Covilhã, Matta do Fundão. End of July–August.—E: Setúbal. July.—Larva in June–July.—Foodplant: *Eupatorium canabinum* L.

407. *Alucita icterodactyla* Mann.—Western Mediterranean.—T: Vila Real. June.

408. *Alucita baliodactyla* Z.—Euroriental.—BB: S. Fiel. June.—E: Setúbal. May–June.

409. *Alucita tetradactyla* L.—Euroriental.—BB: S. Fiel.—E: Setúbal. June. Torres Vedras. End of July.—f. *meristodactyla* Hofm.—E: Torres Vedras. July.

410. *Alucita malacodactyla* Z.—Mediterranean.—BB: S. Fiel.

411. *Alucita pentadactyla* L.—Euroriental.—E: Torres Vedras. End of July.

PYRALIDÆ

412. *Achroia grisella* F.—Holarctic.—BB: S. Fiel. End of August.—E: Setúbal. July.

413. *Melissoblaptes bipunctanus* Z.—European.—BB: S. Fiel. August–September.

414. *Aphomia sociella* L.—Holarctic.—M: Guimarães.—BB: S. Fiel.

415. *Galleria mellonella* L.—Holarctic.—BB: S. Fiel.—E: Setúbal. May–June. August.

416. *Lamoria anella* Schiff.—Mediterranean.—BB: S. Fiel.—E: Setúbal. August–September.

417. *Crambus inquinatellus* Schiff.—European.—M: Gerez.—BB: Serra da Estrêla. August. Serra da Guardunha. August–September.

418. *Crambus graphellus* Const.—Western Mediterranean.—E: Setúbal. April; August–September.

419. *Crambus divisellus* Joan.—Mediterranean.—BB: Serra da Guardunha. September.—E: Setúbal. September.

420. *Crambus desertellus* Ld.—Mediterranean?—E: Setúbal. August–September.

421. *Crambus geniculeus* Hw.—European.—BB: Serra da Estrêla, Serra da Guardunha. August–September.—E: Setúbal. July–August. Torres Vedras. October.

422. *Crambus contaminellus* Hbn.—European.—BB: Serra da Estrêla, Serra da Guardunha. August–September.—E: Setúbal. July. Torres Vedras. June.

423. *Crambus matricellus* Tr.—European.—BB: S. Fiel. September–October.

424. *Crambus deliellus* Hbn.—European.—BB: Serra da Estrêla. August–September.

425. *Crambus tristellus* F.—European.—BB: Serra da Estrêla. End of August–beginning of September. Serra da Guardunha. August–October.

426. *Crambus selasellus* Hbn.—European.—BB: S. Fiel. September.

427. *Crambus fulgidellus* Hbn.—European.—BB: Serra da Estrêla. Late August–early September.

428. *Crambus latistrius* Hw.—Atlantic.—BB: S. Fiel. April. September.

429. *Crambus pinellus* L.—European.—BB: Matta do Fundão. July.

430. *Crambus staudingeri* Z.—Western Mediterranean.—BB: Serra da Guardunha. August–September. Abundant.

431. *Crambus craterellus* Sc.—European.—M: Guimarães. May.—E: Setúbal. June. Torres Vedras. June.—f. *cassentiniellus* Z.—BB: S. Fiel. Middle of May on *Cytisus albus* Lk.—Ale: Almodóvar. May.

432. *Crambus hortuellus* Hbn.—European.—BB: S. Fiel.—E: Setúbal. June.

433. *Crambus culmellus* L.—European.—BB: Ribeira da Ocreza. May–June.

434. *Crambus pratellus* L.—European.—BB: Serra da Estrêla. July.—E: Setúbal.—f. *alfacarellus* Stgr.—M: Guimarães. May.—BB: Matta do Fundão. July. Ribeira da Ocreza. June. Serra da Guardunha. May.

435. *Crambus candiellus* H.S.—Mediterranean.—BB: Quinta dos Carvalhos. September. S. Fiel. July. At light.

436. *Crambus malacellus* Dup.—Tropical.—M: Guimarães. August.

437. *Platytes cerussellus* Schiff.—European.—BB: S. Fiel.

——. *Platytes cuneolellus* Chrét.—Western Mediterranean.—Seebold mentioned without definite locality this species. Doubtful.

438. *Platytes alpinellus* Hbn.—European.—Recorded by Seebold without definite locality.

439. *Eromene anapiella* Z.—Western Mediterranean.—BB: S. Fiel.—E: Setúbal. July.

440. *Eromene superbella* Z.—Mediterranean.—E: Setúbal. July. Torres Vedras. July.

441. *Eromene ocellea* Hw.—Mediterranean.—BB: S. Fiel.—E: Lisboa. March. Setúbal. June–July.

442. *Ancylolomia tentaculella* Hbn.—Mediterranean.—BL: Condeixa. September.—BB: Serra da Estrêla. August–September. Serra da Guardunha. September.

443. *Ancylolomia contritella* Z.—Mediterranean.—BB: Quinta dos Carvalhos. Early September. Serra da Guardunha. September–October.—E: Setúbal. September.

444. *Epidauria phœniciella* Rag.—Western Mediterranean?—BB: Covilhã. Late August.—E. Setúbal. August.

445. *Anerastia lotella* Hbn.—European.—Recorded by Seebold without definite locality.

446. *Ematheudes punctella* Tr.—Mediterranean.—BL: Condeixa. August.—BB: S. Fiel.—E: Setúbal. August–September. Torres Vedras. July.

447. *Homeosoma sinuellum* F.—Mediterranean.—BB: S. Fiel. August.—E: Setúbal. June.

448. *Homeosoma exustella* Rag.—Western Mediterranean.—E: Torres Vedras. July.

449. *Homeosoma nimbellum* Z.—Mediterranean.—BB: S. Fiel. April. June.—E: Setúbal. July. Torres Vedras. June. Val de Rosal. April.—Alg: Silves. May.

450. *Plodia interpunctella* Hbn.—Holarctic.—M: Guimarães. —BB: S. Fiel. August. November. In some years very common at places where wheat is stored.—E: Torres Vedras. July.—Foodplants: wheat and fig.

451. *Ephestia kuehniella* Z.—Holarctic.—BB: S. Fiel. October.

452. *Ephestia calidella* Gn.—Mediterranean.—BB: S. Fiel.—Larva in October.—Foodplant: fig.

453. *Ephestia figulilella* Gregson.—Tropico-Holarctic.—BB: S. Fiel. June.

454. *Ephestia afflatella* Mn.—Western Mediterranean.—BB: S. Fiel. June.

455. *Ephestia tephrinella* Ld.—Mediterranean.—E: Torres Vedras. July.

456. *Ephestia disparella* Rag.—Mediterranean?—BB: S. Fiel. May.—E: Setúbal.

457. *Ephestia elutella* Hbn.—Tropico-Holarctic.—BB: Quinta dos Carvalhos. September. S. Fiel. April.—E: Setúbal. June.

458. *Ancylosis cinnamomella* Dup.—Mediterranean.—BB: S. Fiel. April–May.—E: Setúbal. April. Torres Vedras. July.

459. *Heterographis oblitella* Z.—Eurоriental.—E: Setúbal. July.

460. *Oxybia transversella* Dup.—Mediterranean.—E: Setúbal. June.

461. *Psorosa nucleolella* Moeschl.—Ponto-Mediterranean.—BB: S. Fiel.

462. *Pempelia sororiella* Z.—Mediterranean.—M: Guimarães. May.—BB: S. Fiel. June.—E: Val de Rosal. April.

463. *Pempelia subornatella* Dup.—European.—BB: Castellejo. June.—Larva in May.—Fodplant: *Thymus serpillum* L.

——. *Pempelia integrella* Stgr.—European?—M: Guimarães. May. Captured by Moraes. Identification doubtful.

464. *Pempelia satureiella* Mill.—Western Mediterranean?—Alg: Silves. May.

465. *Metallosticha nigrocyanella* Const.—Western Mediterranean.—E: Torres Vedras. End of July.

466. *Euzophera nelliella* Rag.—Western Mediterranean?—E: Setúbal. July.

467. *Euzophera pinguis* Hw.—European.—E: Torres Vedras. July.

468. *Euzophera polyxenella* Mill.—Western Mediterranean.—BB: Ponte de Marcellos. June.

469. *Asarta nigrella* Hampson.—Iberian.—BB: Serra da Estrêla. July.

470. *Asartodes monspessulalis* Dup.—Western Mediterranean.—BB: Serra da Estrêla. July.—f. *rubricosella* Stgr.—T: NW of Vila Real 2480′. Late June. According to Ragonot (1880–1881, Entom. Monthly Mag., 17, p. 230–231) *rubricosella* is not a form of *monspessulalis,* but a valid species.

471. *Etiella zinckenella* Tr.—Tropico-Holarctic.—BB: S. Fiel. April–June. August. October.—E: Campolide. Setúbal. July–August.

472. *Epischnia prodromella* Hbn.—Mediterranean.—BB: Quinta dos Carvalhos. Early September. S. Fiel. August.

473. *Epischnia illotella* Z.—European.—E: Setúbal. August.—Alg: Silves. May.

474. *Alophia combustella* H.S.—Ponto-Mediterranean.—E: Setúbal. September.

475. *Salebria palumbella* F.—European.—M: Guimarães. May.—BB: S. Fiel. April–May; August–September.—E: Setúbal. June–July.

476. *Salebria obductella* Z.—European.—BB: Matta do Fundão. July.—Larva in June.—Foodplant: *Origanum vulgare* L.

477. *Salebria semirubella* Sc. and f. *sanguinella* Hbn.—Euro-

pean.—M: Gerez. Guimarães. June. BB: Serra da Estrêla. June. August. Serra da Guardunha. June. August.—E: Setúbal. August.

478. *Salebria venustella* Rag.—Western Mediterranean?—BB: S. Fiel.—E: Setúbal. July.

479. *Nephopteryx geminella* Ev.—European?—BB: Serra da Guardunha. May–August.

480. *Nephoteryx genistella* Dup.—Atlantic.—E: Torres Vedras. End of June.

481. *Nephopteryx similella* Zk.—European.—BB: S. Fiel. May.

482. *Dioryctria abietella* F.—European.—BB: S. Fiel. September.

483. *Dioryctria pineæ* Stgr.—Western Mediterranean.—BB: S. Fiel. October.

484. *Phycita spissicella* F.—European.—BB: S. Fiel.

485. *Acrobasis obliqua* Z.—Mediterranean.—BB: S. Fiel. April–June.—E: Campolide. Santa Cruz. April–May. Setúbal. August. Torres Vedras. April–May.

486. *Acrobasis porphyrella* Dup.—Western Mediterranean.—E: Campolide. Torres Vedras. June. Abundant.

487. *Acrobasis glaucella* Stgr.—Mediterranean.—E: Santa Cruz. April. Setúbal. June–July.

488. *Acrobasis bithynella* Z.—Mediterranean?—E: Setúbal. September–October.

489. *Acrobasis romanella* Mill.—Western Mediterranean?—E: Setúbal. September–October.

490. *Acrobasis consociella* Hbn.—European.—E: Estoril. May. Val de Rosal.—Larva in April.—Foodplant: *Quercus lusitanica* Lam.

491. *Acrobasis glycerella* Stgr.—Mediterranean?—Ale: Almodóvar. May.

492. *Rhodophæa marmorea* Hw.—European.—BB: S. Fiel. June.—E: Setúbal. June.—Larva in May.—Foodplant: *Cratægus monogyna* Jacq.

493. *Myelois cribrella* Hbn.—Eurooriental.—E: Setúbal. May.

494. *Myelois crudella* Z.—European?—Recorded by Seebold without definite locality.

495. *Cryptoblabes gnidiella* Mill.—Mediterranean.—E: Setúbal. August.

496. *Endotricha flammealis* Schiff.—Euroriental.—M: Gerez, Guimarães.—BB: Matta do Fundão. June. Monte de S. José. June. Ribeira da Ocreza. August.—E: Batalha. August. Campolide. Lisboa. July. S. Amaro. May. Setúbal. September. Torres Vedras. June–July. Common.

497. *Ulotricha egregialis* H.S.—Mediterranean.—E: Setúbal. June.

498. *Aglossa pinguinalis* L.—Euro-Pacific.—M: Guimarães.—BB: S. Fiel. May; September.—E: Setúbal. June.

499. *Aglossa cuprealis* Hbn.—Holarctic.—M: Gerez.—BB: S. Fiel. June–July.—E: Setúbal. May–June. Torres Vedras. July.

500. *Hypsopygia costalis* F.—Holarctic.—BB: S. Fiel. June. —E. Setúbal. September.

501. *Pyralis obsoletalis* Mn.—Mediterranean.—BB: S. Fiel. May–June.—E: Campolide, Torres Vedras. July.

502. *Pyralis farinalis* L.—Holarctic.—M: Guimarães.—BB: S. Fiel. June.—E: Campolide, Lisboa. July. Very small specimen. Wingspread 15 mm. Setúbal. Very common. Torres Vedras. April. June–July.—Alg: Silves. May.

503. *Stemmatophora combustalis* F.—Mediterranean.—BB: S. Fiel.—E. Torres Vedras. July.

504. *Herculia glaucinalis* L.—European.—BB: S. Fiel. June. August.—E: Torres Vedras. June.

505. *Herculia fulvocilialis* Dup.—Mediterranean.—BB: Quinta dos Carvalhos. September.

506.—*Actenia brunnealis* Tr.—European.—M: Guimarães. August.—BB: Covilhã. August.

507. *Actenia borgialis* Dup.—Western Mediterranean.—BB: Serra da Guardunha. June–August.—E: Setúbal. July.

508. *Cledeobia moldavica* Esp.—Mediterranean.—Ale: Almodóvar. May.—f. *diffidalis* Gn.—T: Vila Real. Late June.—BB: Serra da Guardunha. May.—E: Torres Vedras. June–July.

509. *Cledeobia morbidalis* Gn.—Mediterranean?—June. Recorded by Seebold without definite locality.

510. *Cledeobia angustalis* Schiff.—European.—M: Guimarães.

—BL: Condeixa. August.—BB: S. Fiel. July–August.—E: Setúbal. July. Torres Vedras.

511. *Nymphula fluctuosalis* Z.—Mediterranean?—E: Setúbal.

512. *Stenia bruguieralis* Dup.—Mediterranean.—May. Recorded by Seebold without definite locality.

513. *Stenia punctalis* Schiff.—European?—E: Setúbal. June.

514. *Stenia fuscocilialis* Rag. (1880–1881, Entom. Monthly Mag., 17, p. 230).—Endemic.—Alg: São Bartolomeu de Messines (locality of the paratype). May. Silves (locality of the holotype). May.

515. *Stenia flavipunctalis* Hmps.—Mediterranean?—BB: Pardanta. May.—E: Torres Vedras. June. Val de Rosal. April.

516. *Scoparia pyrenœalis* Dup.—Mediterranean.—BB: Matta do Fundão.

517. *Scoparia lineola* Curt.—Atlantic.—E: Campolide, Torres Vedras. June.

518. *Scoparia resinea* Hw.—European.—M: Guimarães. August.—BB: Matta do Fundão. June.—E: Campolide, Setúbal. June.

519. *Scoparia cratœgella* Hbn.—Euroriental.—BB: S. Fiel.—E: Torres Vedras. End of June.

520. *Scoparia frequentella* Stt.—European.—M: Guimarães. August. December. January.—T: Vila Real. June.—BB: S. Fiel. From late October on during the entire winter.—E: Setúbal. June–July. Torres Vedras. July. November.

521. *Scoparia angustea* Stph.—Mediterranean.—M: Guimarães.—BB: S. Fiel. April. June.—E: Alcantara. April. Setúbal. March. Torres Vedras. Early January.

522. *Ercta ornatalis* Dup.—Mediterranean.—BB: Quinta dos Carvalhos. September.—E: Campolide.

523. *Agrotera nemoralis* Sc.—European.—M: Guimarães. August.

524. *Sylepta ruralis* Sc.—European.—M: Guimarães.—BB: S. Fiel. June.

525. *Glyphodes unionalis* Hbn.—Tropical.—M: Guimarães.—BL: Condeixa. August.—BB: S. Fiel. June–September. November.—E: Campolide. Estoril. November. Lisbon. September. Oeiras. September. Setúbal. March–August.

526. *Hellula undalis* F.—Tropico-Holarctic.—BL: Condeixa. August.—BB: S. Fiel. June.

527. *Euergestis frumentalis* L.—Euroriental.—BB: S. Fiel. April–May.

528. *Euergestis politalis* Schiff.—European.—BB: S. Fiel. April–June.—E: Setúbal. May.

529. *Nomophila noctuella* Schiff.—Tropico-Holarctic.—M: Guimarães.—BB: S. Fiel. April–September.—E: Campolide, Oeiras. June. Setúbal. Very common. Sintra. Late May. Torres Vedras. July.

530. *Phlyctænodes palealis* Schiff.—European.—E: Setúbal. May–July.

531. *Phlyctænodes nudalis* Hbn.—Mediterranean.—E: Setúbal. July.

532. *Diasemia litterata* Sc.—Euroriental.—M: Gerez.—BB: Pardanta, S. Fiel. April–May. July.—E: Setúbal. May.

533. *Diasemia ramburialis* Dup.—Tropico-Holarctic.—BL: Condeixa. Rare.—BB: S. Fiel. May; late October.—E: Setúbal. May–August. Torres Vedras. July.

534. *Antigastra catalaunalis* Dup.—Tropico-Holarctic.—BB: S. Fiel.—E: Setúbal. End of June.

535. *Mecyna polygonalis* Hbn.—Euroriental.—BB: S. Fiel. July–September.—E: Campolide. Setúbal. August. Torres Vedras. July.—f. *gilvata* F.—E: Praia das Maçãs.—f. *meridionalis* Wk.—BB: S. Fiel. July–September.—f. *extinctalis* Stgr.—Recorded by Seebold without definite locality.

536. *Cynæda dentalis* Schiff.—Euroriental.—BB: S. Fiel. June.—Larva in April–May.—Foodplant: *Echium broteri* Samp. (*lusitanicum* Brot.).

537. *Titanio pollinalis* Schiff.—Holarctic.—M: Guimarães. May.—BB: Castellejo, S. Fiel. May.—E: Santa Cruz. April.—f. *guttulalis* H.S.—M: Guimarães.—BB: Ceia. June.—E: Setúbal. July.

538. *Titanio schrankiana* Hochenw.—Boreo-Alpine.—BB: Serra da Estrêla. July.

539. *Titanio sericatalis* H.S.—European?—BB: Serra da Estrêla. July.

540. *Metasia suppandalis* Hbn.—Mediterranean.—E: Setúbal. August–September.

541. *Metasia cuencalis* Rag.—Mediterranean?—E: Torres Vedras. End of July. Abundant.

542. *Metasia ibericalis* Rag.—Iberian?—BL: Lousã. July.

543. *Pionea ferrugalis* Hbn.—Euroriental.—M: Guimarães.—BL: Condeixa. August.—BB: S. Fiel. May. August. October–November.—E: Campolide. Capuchos. August. Estoril. February–April. June. October. Common. Oeiras. May. August–September. Setúbal. Common during the entire year. Torres Vedras. January.—Alg: Silves. May.

544. *Pionea silvalis* Joannis.—Mediterranean.—BL: Lousã.—BB: Portas do Ródam, Soalheira. May.

545. *Pionea verbascalis* Schiff.—Eurioriental.—M: Guimarães.—BB: S. Fiel. June.

546. *Pionea forficalis* L.—European.—M: Guimarães.

547. *Pionea numeralis* Hbn.—Mediterranean.—E: Setúbal. July. Torres Vedras. June–July.

548. *Pyrausta repandalis* Schiff.—European.—BB: S. Fiel. May.

549. *Pyrausta nubilalis* Hbn.—European.—M: Guimarães.—BL: Condeixa. August.—BB: S. Fiel. May–August.—E: Campolide. Setúbal. June–July.—Foodplants: *Zea mais* L. and *Panicum miliaceum* L.

550. *Pyrausta asinalis* Hbn.—Mediterranean.—E: Campolide. Parque da Pena near Sintra. April. Setúbal. June. Torres Vedras. June.

551. *Pyrausta scutalis* Hbn.—Western Mediterranean.—E: Setúbal. Val de Rosal. April. Very abundant.

552. *Pyrausta cespitalis* Schiff.—European.—M: Guimarães.—BB: S. Fiel. August.—E: Batalha. August. Torres Vedras. July.—f. *intermedialis* Dup.—Recorded by Seebold without definite locality.

553. *Pyrausta sanguinalis* L.—Eurioriental.—BB: S. Fiel. April; July.—E: Campolide. Santa Cruz. April. Setúbal. Very common. Val de Rosal. April.—f. *hæmatalis* Hbn.—Recorded by Seebold without definite locality.

554. *Pyrausta purpuralis* L.—Eurioriental.—M: Guimarães. August.—BB: Castelo Novo. June.—E: Torres Vedras. End of July.

555. *Pyrausta aurata* Sc.—European.—BB: S. Fiel. March.—E: Batalha. August. Campolide. Estoril. July. Oeiras. June. Setúbal. May–July. Torres Vedras. May–July.—Alg: Silves. May.—f. *meridionalis* Stgr.—BB: S. Fiel. June–July.

556. *Pyrausta albofascialis minutalis* Spr.—European.—E: Val de Rosal. April. Common.

557. *Pyrausta acontialis* Stgr.—Mediterranean?—BB: S. Fiel. April. On *Lavandula stœchas* L.—E: Setúbal. Val de Rosal. April.

558. *Noctuelia floralis stygialis* Tr.—Mediterranean.—Recorded by Seebold without definite locality.

559. *Noctuelia isatidalis* Dup.—Mediterranean.—BB: S. Fiel. March.

560. *Eurycreon consortalis* H.S.—European?—Recorded by Seebold without definite locality.

THYRIDIDÆ

561. *Thyris fenestrella* Sc.—Euro-Pacific.—M: Vizela. July.

ZYGÆNIDÆ

562. *Procris tenuicornis* Z.—European.—BB: Castelo Novo. May.

563. *Procris globulariæ notata* Z.—Euroriental.—BB: Soalheira. May.

564. *Procris statices* L.—Euroriental.—BB: Soalheira. May–June.

——. *Zygæna scabiosæ nevadensis* Rbr.—Euroriental.—BB: Matta do Fundão. Late May. Specimens collected by Mendes were considered by J. de Joannis as doubtfully belonging to this form.

565. *Zygæna trifolii syracusiæ* Z.—Euroriental.—M: Caldelas. Common. Gerez, Guimarães.

566. *Zygæna lonicerœ* Scheven.—Euroriental.—BB: Matta do Fundão. June. S. Fiel. Senhora da Orada. May.—f. *lusitaniæ-mixta* Verity (1930, Mem. Soc. Entom. Ital., 9, p. 25).—BB: Serra da Estrêla. 800–1500 m. (type locality). Middle of June. Verity assumes that this race is a transition between *Zygæna lonicerœ* Scheven and *Zygæna trifolii* Esp.

LIMACODIDÆ

567. *Cochlidion limacodes* Hufn.—Euroriental.—M: Caldelas. August. Rare. Gerez. May. Vizela. June.—E: Setúbal.

GEOMETRIDÆ

568. *Aplasta onoraria* Fuesl.—Euroriental.—BB: Matta do Fundão, Quinta dos Fornos, on *Ononis spinosa.* July.—E: Setúbal. July.—f. *fœcataria* Hon.—BB: Matta do Fundão, Quinta dos Fornos, on *Ononis spinosa.* July.

569. *Odezia atrata* L.—Euroriental.—BB: Matta do Fundão. June.

570. *Pseudoterpna coronillaria* Hbn.—Mediterranean.—M: Caldelas. July–August. Guimarães. Vizela. May–June. August. October.—BB: S. Fiel. May; September.—E: Setúbal. June–July.—Larva in February–March.—Foodplant: *Adenocarpus intermedius* D.C.

571. *Comibœna pustulata* Hufn.—Euroriental.—BB: Monte de S. José. June. On *Quercus* sp.

572. *Hemithea æstivaria* Hbn.—Euro-Pacific.—M: Vizela. June.

573. *Chlorissa viridata* L.—Euroriental.—M: Caldelas. July–August. Gerez. Vizela. May–June. August.

574. *Chlorissa cloraria* Hbn. (*porrinata* Z.).—Mediterranean. —M: Salamonde. Late June.

575. *Chlorissa pulmentaria* Guen.—Euroriental.—BB: S. Fiel. May–June; September–October.—E: Setúbal. June.

576. *Chlorissa faustinata* Mill.—Mediterranean.—BB: S. Fiel. —Torres Vedras. October.

577. *Microloxia herbaria* Hbn.—Mediterranean.—BB: S. Fiel. June–July; September.—E: Setúbal. June–July. Torres Vedras. May.

578. *Hemistola chrysoprasaria* Esp. (*vernaria* Hbn.).—Euroriental.—E: Setúbal. July.

579. *Iodis lactearia* L.—Euro-Pacific.—M: Caldelas. August. Rare. Vizela. June. August.

580. *Xenochlorodes beryllaria* Mn.—Mediterranean.—M: Caldelas. July.—E: Torres Vedras. July.

581. *Rhodostrophia calabra* Petagna (*calabraria* Z.).—Medi-

terranean.—M: Gerez. Very common by daylight. Vizela. May–June.—BB: S. Fiel. May–June.—E: Setúbal. May–June. Torres Vedras. June.—f. *tabidaria* Z.—M: Guimarães.

582. *Rhodostrophia sicanaria* Z.—Western Mediterranean.—BL: Coimbra. June.

583. *Timandra amata* L.—Euro-Pacific.—M: Caldelas. July–August. Gerez, Guimarães, Vizela. May–June.—BL: Condeixa. August.—BB: S. Fiel. April; July–September.—E: Setúbal. July. Torres Vedras.

——. *Acidalia rubellata* Rbr.—Iberian.—BB: S. Fiel. May–July; end of August–September. Larva in May–July; September–October. Foodplant: *Polygonum aviculare* L. This species is recorded only by Mendes, who considers it as synonym of *Acidalia beckeraria* Ld., which is wrong.

584. *Acidalia rubiginata* Hufn.—Eurooriental.—M: Caldelas, Gerez. May. Guimarães. May–June. The groundcolor of the wings of most specimens is dark brownish red, only one specimen has lighter ground color. Vizela. June.—T: Vila Real. June.

585. *Acidalia turbidaria* Hbn.—Mediterranean.—BL: Lousã. July.—E: Setúbal. August–September.

——. *Acidalia minorata* Bdv. (*consentanea* Wlk.).—Tropical.—BB: S. Fiel.—E: Setúbal. August–September.—Prout suggests (in Seitz, 16, p. 73) that this Ethiopian species may be conspecific with *Acidalia ochroleucata* H.S. (Mediterranean).

586. *Acidalia marginepunctata* Goeze.—Eurooriental.—M: Caldelas. July–August. Guimarães.—BB: S. Fiel. April–June; September–October.—E: Campolide. Setúbal. March–July. Torres Vedras. March. July.

587. *Acidalia submutata* Tr.—Mediterranean.—M: Gerez. May.—BB: S. Fiel. June–July.—E: Setúbal. June–August.

588. *Acidalia nigropunctata* Hufn. (*strigilaria* Hbn.).—Eurooriental.—M: Caldelas. August–September. Gerez. May at light. Guimarães. Vizela. June. Rare.

589. *Acidalia emutaria* Hbn.—European.—M: Guimarães. August. Vizela. June.—BB: S. Fiel. May–July.—E: Setúbal. September. Torres Vedras. July.

590. *Acidalia imitaria* Hbn.—Eurooriental.—M: Caldelas. July. Gerez. At light. Guimarães. May. Vizela. May–June.

August.—BB: S. Fiel. April–June; September–October.—E: Setúbal. April–July. Torres Vedras. March–June.

591. *Acidalia ornata* Sc.—Euro-Pacific.—BL: Condeixa. August.—BB: Covilhã, Monte de S. José, S. Fiel. May; August–September.—E: Campolide, Oeiras. April. June. August. Setúbal. April–July. Torres Vedras. March; July.—f. *badiaria* Sgtr.—E: Torres Vedras. December.—f. *gyrata* Hbn.—E: Torres Vedras. March.—f. *nolaria* Hbn.—E: Torres Vedras. July.

592. *Acidalia decorata violata* Thnbg.—Euroriental.—BB: Quinta do Ribeiro Negro. August. S. Fiel. June.—Larva in May. Foodplant: *Thymus serpillum* L.

593. *Glossotrophia rufomixtata* Rbr.—Western Mediterranean.—BB: S. Fiel.

594. *Anthometra plumularia* Bdv.—Western Mediterranean.—BB: Ponte de Morcellos. June. Serra da Guardunha. June.

595. *Clete ramosaria* Vill. (*vittaria* Hbn.).—Western Mediterranean.—E: Oeiras. April–May. Sintra. April.

596. *Ptychopoda ochrata* Sc.—Euroriental.—M: Caldelas. July. Vizela. June.—BB: S. Fiel. June.—E: Setúbal. June. August. Torres Vedras. July.

597. *Ptychopoda rufaria* Hbn.—Euroriental.—E: Estoril. June. Oeiras. June.

598. *Ptychopoda consanguinaria* Ld.—Mediterranean.—M: Gerez. May. Vizela. May–June. August.—BB: Covilhã, S. Fiel. May–July; September.—E: Setúbal.

599. *Ptychopoda macilentaria* H.S.—European.—M: Guimarães.—BB: Monte de S. José. June.

600. *Ptychopoda litigiosaria* Bdv.—Western Mediterranean.—BB: Monte de S. José. June.

601. *Ptychopoda lambessata* Obth.—Western Mediterranean.—BB: S. Fiel.

602. *Ptychopoda sericeata* Hbn.—Euroriental.—BB: S. Fiel. June.—E: Setúbal.

603. *Ptychopoda moniliata* Schiff.—Euroriental.—M: Caldelas. July.—BB: Matta do Fundão. June.—E: Torres Vedras. June.

604. *Ptychopoda nexata* Hbn.—Western Mediterranean.—E:

Santa Cruz. April. Setúbal. April–May. Val de Rosal. April. Very common.—Ale: Almodóvar. May.

605. *Ptychopoda serpentata* Hufn.—Euroriental.—M: Caldelas. July. Vizela. June.

606. *Ptychopoda dimidiata* Hufn.—Euroriental.—M: Caldelas. July. Vizela. June. Rare.

607. *Ptychopoda subsaturata* Guen.—Western Mediterranean.—E: Torres Vedras. End of June–July.

608. *Ptychopoda eburnata* Wocke. (*contiguaria* Hbn.).—European.—M: Caldelas. July–August. Common. Gerez. July. At light. Guimarães. May. Vizela. June; October.—BB: S. Fiel. May; September.—E: Setúbal. June–July. Torres Vedras. June.

609. *Ptychopoda incisaria* Stgr.—Western Mediterranean.—M: Vizela. June.—Alg: (type locality, collected by Korb).

610. *Ptychopoda camparia* H.S.—Mediterranean.—E: Olivais. April.

611. *Ptychopoda sodaliaria* H.S.—Mediterranean.—E: Setúbal. May–June.

612. *Ptychopoda seriata* Schrank. (*virgularia* Hbn.).—European.—BB: Ponte de Morcellos. June. S. Fiel. June.—Lisboa. April. Setúbal. April–July.—f. *australis* Z. (*canteneraria* Mill., nec Bdv.).—E: Sintra. April. At light. Torres Vedras. End of February–April.—f. *canteneraria* Bdv.—M: Caldelas. July.—E: Torres Vedras. June–end of July.

613. *Ptychopoda longaria* H.S.—Western Mediterranean.—BB: S. Fiel. May; September–October.—Larva in May–August; October–end of April. Foodplant: *Polygonum aviculare* L.

614. *Ptychopoda subsericeata* Hw.—Euroriental.—M: Caldelas. July. Guimarães. Vizela. June.—BB: S. Fiel. April. June.—E: Setúbal. April–June. Torres Vedras. May. Val de Rosal. April.

615. *Ptychopoda lævigata* Sc.—Euroriental.—BB: S. Fiel. July.

616. *Ptychopoda extarsaria eriopodata* Grasl.—Western Mediterranean.—E: Torres Vedras. July.

617. *Ptychopoda infirmaria* Rbr.—Western Mediterranean.—BB: Covilhã. August. Serra da Guardunha. June–July.—E:

Setúbal. July. Torres Vedras. July.—f. *aquitanaria* Const.—BB: Covilhã. August. Serra da Guardunha. June–July.—E: Torres Vedras. July.

618. *Ptychopoda obsoletaria* Rbr.—Mediterranean.—BB: S. Fiel. June.

619. *Ptychopoda incarnaria* H.S.—Mediterranean.—E: Setúbal. July. October.—f. *ruficostata* Z.—BB: S. Fiel. October.

620. *Ptychopoda eugeniata* Mill.—Western Mediterranean.—M: Gerez.—Setúbal. April. June–July. Sintra. April. At light. Torres Vedras. End of July.

621. *Ptychopoda helianthemiata* Mill.—Western Mediterranean.—BB: S. Fiel.

622. *Ptychopoda ostrinaria* Hbn.—Western Mediterranean.—M: Caldelas. July. Rare. Vizela. June. Rare.—BB: Matta do Fundão. July. S. Fiel. June.—E: Setúbal. June. Torres Vedras. End of June–July.—Alg: no definite locality.

623. *Ptychopoda circuitaria* Hbn.—Mediterranean.—E: Setúbal. April–July.

624. *Ptychopoda herbariata* F.—Euroriental.—BB: S. Fiel. May–June.—E: Setúbal. November.

625. *Ptychopoda calunetaria* Stgr.—Western Mediterranean.—M: Caldelas. July.

626. *Ptychopoda elongaria* Rbr.—Mediterranean.—BL: Condeixa. August.—BB: Covilhã. August.—E: Campolide. Very abundant. Setúbal. Torres Vedras. July.

627. *Ptychopoda biselata* Hufn.—Euroriental.—M: Caldelas. July–August.

628. *Ptychopoda belemiata* Mill.—Iberian.—BB: S. Fiel. July–August.—E: Torres Vedras. End of July.

629. *Ptychopoda politata* Hbn.—Mediterranean.—E: Torres Vedras. July.

630. *Ptychopoda rusticata* Schiff.—Euroriental.—M: Caldelas. July–August.—BB: S. Fiel. July.—E: Campolide. Setúbal. August.—f. *mustelata* Rbr.—M: Vizela. June.

631. *Ptychopoda robiginata* Stgr.—Atlantic.—M: Caldelas.

632. *Ptychopoda lutulentaria* Stgr. and f. *aurata* Mendes (1912, Brotéria, Série zoológica, 10, p. 175, pl. 3, figs. 18–20).—Iberian.—M: Guimarães. June.—BB: Matta do Fundão, Monte

de S. José, Soalheira. June–July.—E: Estoril. June. Oeiras. June. Torres Vedras. June.—Larva in May–June. Foodplant: *Sarothamnus patens* Webb.

633. *Ptychopoda dilutaria* Hbn.—Mediterranean.—M: Caldelas. July.

634. *Ptychopoda fuscovenosa* Goeze. (*interjectaria* Bdv.).—Euroriental.—M: Gerez. August. At light. Guimarães. June. Vizela. June.—BB: Matta do Fundão. July. Monte de S. José, Soalheira. June.—E: Setúbal. May–August. Very common. Torres Vedras. June–July. Very abundant.

635. *Ptychopoda humiliata* Hufn.—Euroriental.—E: Setúbal. June–July.

636. *Ptychopoda degeneraria* Hbn.—Euroriental.—M: Caldelas. June–August. Common. Vizela. May–June. August. Common.—BB: S. Fiel. May–June.—E: Setúbal. June–July.

637. *Ptychopoda inornata* Hw.—European.—BB: S. Fiel.

638. *Ptychopoda deversaria* H.S.—Euroriental.—BB: Matta do Fundão. June.

639. *Ptychopoda aversata* L.—Euroriental.—M: Caldelas. July. Rare. Vizela. June. Only one specimen.—f. *remutata* L.—Caldelas. June–July. More frequent than the nomotypical form. Vizela. May–June. August. Very abundant.

640. *Ptychopoda emarginata* L.—Euroriental.—M: Guimarães.

641. *Cosymbia pendularia linearia* Lamb.—Euroriental.—M: Gerez. May.

642. *Cosymbia albiocellaria* Hbn.—Euroriental.—M: Vizela. May.

643. *Cosymbia pupillaria* Hbn.—Mediterranean.—M: Caldelas. July. Vizela. May.—BL: Condeixa. September.—BB: S. Fiel. April–July. Serra da Estrêla. August.—E: Campolide. Setúbal. June–August.—Alg: Silves. May.—f. *badiaria* Stgr.—M: Caldelas. July.—f. *gyrata* Hbn.—M: Caldelas. August.—BB: S. Fiel. April–July. Serra da Estrêla. August.—E: Setúbal. July. Sintra. April.—f. *nolaria* Hbn.—BB: S. Fiel. April–July. Serra da Estrêla. August.

644. *Cosymbia porata* F.—Euroriental.—M: Caldelas. July–August. Gerez. May.—BB: S. Fiel.—E: Torres Vedras. July.

645. *Cosymbia punctaria* L.—Euroriental.—M: Caldelas.

July–August. Gerez. June. Guimarães. Vizela. June. August.—BB: Soalheira. June.

646. *Cosymbia linearia* Hbn.—Euroriental.—M: Vizela. May.—BB: Castelo Novo, Soalheira. April. June.

647. *Rhodometra sacraria* L.—Tropical.—M: Caldelas. August. Guimarães.—BL: Condeixa. August.—BB: S. Fiel. June–August.—E: Campolide. Estoril. August. Oeiras. September. A female has the bright pink line from apex to hindmargin of the forewings almost obsolete. Setúbal. July–October. Torres Vedras. July.—f. *labda* Cram. (*atrifasciaria* Stefan.).—M: Vizela. October.—BB: Louriçal do Campo. November.—E: Setúbal. September–October.—f. *sanguinaria* Esp.—BB: S. Fiel. October.—E: Lisboa. November. Setúbal. September.

648. *Lythria purpurata sanguinaria* Dup.—European.—M: Gerez. May. Guimarães. May. Vizela. June. August.—BB: S. Fiel. May–June.—E: Setúbal. April–May.—gen. vern. *vernalis* Stgr.—T: Vila Real.—BB: S. Fiel, Serra da Guardunha. February–March; September–October.—E: Setúbal. May; September–October. The first brood of early spring has the same wingpattern as the third brood which emerges in late fall.—f. *rotaria* F.—M: Caldelas. July.

649. *Larentia clavaria* Hw. (*cervinata* Schiff.).—Euroriental.—BB: S. Fiel.

650. *Ortholitha mucronata* Sc. (*plumbaria* F.).—Euroriental.—M: Gerez. Common.—E: Santa Cruz. April.

651. *Ortholitha chenopodiata* L. (*limitata* Sc., *mensuraria* Schiff.).—Euro-Pacific.—BB: Ponte de Morcellos. June.

652. *Ortholitha peribolata* Hbn.—Western Mediterranean?—BB: S. Fiel. September–October.—E: Setúbal. September–October. Common. Torres Vedras. July.

653. *Anaitis plagiata* L.—Euroriental.—M: Caldelas. July. Gerez. Common. Guimarães. June. Vizela. May–June; August.—BB: S. Fiel. April; July–November.—E: Setúbal. February–April. Sintra. April. Torres Vedras. June–July.—Larva in June. Foodplant: *Hypericum undulatum* Schousb.

654. *Chesias legatella* Schiff. (*spartiata* Herbst).—European.—M: Vizela. May. June.—BB: S. Fiel. March; October–November.—Larva in March–April. Foodplant: *Cytisus albus* Lk.

655. *Chesias rufata* F.—Euroriental.—M: Caldelas. August.—BB: S. Fiel. March.—E: Sintra. April.—f. *linogrisearia* Const.—E: Val de Rosal. April.

656. *Lygris populata dotata* L.—Euro-Pacific.—BB: Matta do Fundão. July.

657. *Cidaria ocellata* L.—Euroriental.—M: Caldelas. July–August. Gerez. Vizela. June. August. October.—BB: Matta do Fundão. June.

658. *Cidaria miata* L.—Euroriental.—BB: S. Fiel.

659. *Cidaria fluctuata* Hbn.—Euroriental.—M: Caldelas. July–August. Gerez. May. Guimarães. February. Vizela. June.—BB: S. Fiel. March–April; November–December.—E: Campolide. Setúbal. March. Sintra. April. Torres Vedras. January–April.

660. *Cidaria ferrugata* Cl.—Holarctic.—M: Caldelas. July–August. Gerez. May.—f. *unidentaria* Haw.—M: Caldelas July–August. Guimarães. February. Vizela. June. Rare.

661. *Cidaria obstipata* F. (*fluviata* Hbn.).—Tropico-Holarctic.—M: Gerez. June. Guimarães. Vizela. June. August. Rare.—BB: S. Fiel. April. June–July. September.—E: Lisboa. June. Santa Cruz. End of April. Setúbal. February–June.

662. *Cidaria pectinaria* Knoch. (*viridaria* F.).—Euroriental.—M: Gerez. On sugar. Rare. Vizela. May–June.—BB: Matta do Fundão. End of May.

663. *Cidaria salicata* Hbn.—Euroriental.—BB: S. Fiel. May.—E: Setúbal.

664. *Cidaria flavolineata* Stgr.—Iberian.—BB: Serra da Guardunha. September. On rocks turned toward the north.

665. *Cidaria multistrigaria* Haw.—Atlantic.—E: Setúbal. March.

666. *Cidaria cœruleata* Guen.—Western Mediterranean.—BB: Serra da Estrêla. August.

667. *Cidaria alfacariata* Rbr. (*ibericata* Stgr.).—Mediterranean.—E: Setúbal.

668. *Cidaria malvata* Rbr.—Western Mediterranean.—E: Setúbal. October.

669. *Cidaria cupreata* H.S.—Mediterranean.—E: Sintra. April. At light.

670. *Cidaria basochesiata* Dup.—Western Mediterranean.—E: Setúbal. February–March. Torres Vedras. January. At light.

671. *Cidaria bilineata* L.—Eurooriental.—M: Caldelas. August. Gerez. Guimarães. Vizela. June. August.—BL: Coimbra. June. Condeixa. August.—BB: Matta do Fundão. May–July.—E: Setúbal. May–September. Torres Vedras. Very common.—f. *infuscata* Gmpbg.—BB: Matta do Fundão. May–July.—f. *testaceolata* Stgr.—M: Vizela. May–June.—BB: Matta do Fundão. May–July.—E: Setúbal. May–September.

672. *Cidaria polygrammata* Bkh.—Eurooriental.—BB: S. Fiel. —E: Setúbal. January–November. Torres Vedras. January.

673. *Cidaria galiata* Schiff.—Eurooriental.—M: Gerez. Vizela. May–June. October.

674. *Cidaria alternata* Müll. (*sociata* Bkh.).—Holarctic.—M: Gerez. May. Guimarães.—BB: Matta do Fundão. June. Serra da Estrêla. July.

675. *Cidaria bifasciata unifasciata* Haw.—European.—E: Setúbal. October.

676. *Cidaria flavofasciata* Thnbg. (*decolorata* Hbn.).—European.—BL: Lousã. May.—E: Sintra. April.

677. *Cidaria ruberata* Frr.—Holarctic.—M: Vizela. June.

678. *Cataclysme dissimilata* Rbr. (*uniformata* Bell.).—Western Mediterranean.—BB: S. Fiel.

679. *Eupithecia pulchellata* Steph.—Eurooriental.—M: Caldelas. July. Vizela. June.—BB: S. Fiel. April–May.—E: Sintra. April.—Larva in June. Foodplant: *Digitalis thapsi* L.

680. *Eupithecia laquæaria* H.S.—European.—E: Setúbal. May–June.

681. *Eupithecia liguriata* Mill. (*rœderaria* Stndf.).—Western Mediterranean.—BB: S. Fiel. May.

682. *Eupithecia venosata* F.—Eurooriental.—BB: S. Fiel. April–May.

683. *Eupithecia centaureata* Schiff. (*oblongata* Thnbg.).—Eurooriental.—M: Vizela. June. August.—BB: Ceia. June. S. Fiel. September.—E: Setúbal. September–October. Torres Vedras. May–July.

684. *Eupithecia gratiosata* H.S.—Mediterranean.—BB: S. Fiel. June.

685. *Eupithecia breviculata* Donz.—Mediterranean.—BB: S. Fiel.—E: Setúbal. June–July.

686. *Eupithecia scopariata* Rbr.—Mediterranean.—BB: Pardanta. May.—E: Sintra. April. Rare. Val de Rosal. April. Common.

687. *Eupithecia pimpinellata* Hbn.—Euroriental.—E: Torres Vedras. July.

688. *Eupithecia nanata* Hbn.—Holarctic.—BL: Condeixa. August.

689. *Eupithecia innotata* Hufn.—Euroriental.—M: Caldelas. July.—BB: S. Fiel. May.

690. *Eupithecia abbreviata* Steph.—Euroriental.—BB: S. Fiel. February.

691. *Eupithecia cocciferata* Mill. (*semitinctaria* Mab.).—Mediterranean.—BL: Lousã. February.—Larva in April–May. Foodplant: *Quercus ilex* L.

692. *Gymnoscelis pumilata* Hbn.—Euroriental.—M: Caldelas. August. Gerez. May. August. Guimarães. November–December. Vizela. June. October. Common.—BB: S. Fiel. February. April–July. November.—E: Campolide. Lisboa. June. December. Santa Cruz. April. Setúbal. May. July. October. Sintra. April. Torres Vedras. November–February; July. At light.—f. *parvularia* H.S.—BB: S. Fiel. July–August.—f. *tempestivata* Z.—BB: S. Fiel. February. April–July. November.

693. *Chloroclystis coronata* Hbn.—Euro-Pacific.—M: Caldelas. June–August.

694. *Abraxas grossulariata* L.—Euro-Pacific.—M: Gerez.

695. *Abraxas pantaria* L.—Mediterranean.—M: Guimarães. May. Vizela. August.—BB: S. Fiel. August.—E: Setúbal. September. Torres Vedras. August.

696. *Lomaspilis marginata* L.—Euro-Pacific.—M: Caldelas. July. Rare. Guimarães. Vizela. June. Rare.—f. *pollutaria* Hbn.—M: Caldelas. July–August. Gerez. August. Vizela. May–June.

697. *Bapta distinctata* H.S. (*pictaria* Curt.).—European.—BB: S. Fiel. March.—E: Torres Vedras. March.

698. *Bapta bimaculata subnotata* Warr.—Euro-Pacific.—M: Caldelas. July–August. Rare.

699. *Lomographa trimaculata* Vill.—Mediterranean.—M: Caldelas. July–August. Gerez. May. Guimarães. April. Vizela. May–June. August.—BB: S. Fiel. April–May; September.—E: Torres Vedras. April.—f. *cognataria* Led.—M: Caldelas. July–August. Vizela. August.—BB: S. Fiel. June. August.

700. *Cabera pusaria* L.—Euro-Pacific.—M: Caldelas. August. Rare. Gerez. August. Guimarães. Vizela. June. August.—BB: Matta do Fundão. May–June.

701. *Cabera exanthemata* Scop.—Eurorienta1.—M: Guimarães.

702. *Campæa margaritata* L.—Eurorienta1.—M: Gerez. May. Vizela. May–June. August. Rare.—BB: Matta do Fundão. June. S. Fiel. September.

703. *Campæa honoraria* Schiff.—European.—E: Sintra. April. Rare at light. Torres Vedras. July. Only two specimens.

704. *Ennomos quercinaria* Hufn.—Eurorienta1.—BB: S. Fiel. June.—E: Setúbal. September–October.

705. *Ennomos alniaria* L.—European.—BB: Castelo Novo. June.

706: *Ennomos fuscantaria* Haw.—European.—M: Caldelas. August. Rare.—BB: S. Fiel. June.—E: Setúbal. July.

707. *Ennomos erosaria* Schiff.—Eurorienta1.—BB: S. Fiel. Only one specimen.—Foodplant: *Quercus* sp.

708. *Selenia bilunaria* Esp.—Euro-Pacific.—M: Vizela. August.

709. *Colotois pennaria* L.—Eurorienta1.—M: Gerez. Only one specimen.—BB: S. Fiel. End of October. Apparently only stragglers of this species, which is so common in Central Europe and which does not seem to have been found anywhere else on the Iberian Peninsula.

710. *Crocallis tusciaria* Bkh.—Eurorienta1.—E: Setúbal. November.

711. *Crocallis elinguaria* L.—Euro-Pacific.—BB: Serra da Estrêla. August.

712. *Plagodis dolabraria* L.—Euro-Pacific.—M: Caldelas. June–August. Frequent. Gerez. May. Vizela. May. August.—BB: Covilhã. August. Matta do Fundão. May. Only one specimen recorded from each of the last two localities.

713. *Opisthograptis luteolata* L.—Eurorienta1.—M: Gerez.

May. Vizela. May.—BL: Condeixa. August.—BB: Quinta do Ribeiro Negro, S. Fiel. August. Senhora da Orada. April.—E: Campolide. Setúbal. February. April. July. September. Torres Vedras. September.

714. *Pseudopanthera macularia* L.—Euroriental.—M: Gerez. —BB: Matta do Fundão. Early May.—E: Setúbal. April. Sintra. April.

715. *Eilicrinia cauteriata* Stgr.—Western Mediterranean.— E: Setúbal. February–March. Torres Vedras. March–April. In houses, abundant.—Foodplant: *Quercus coccifera* L.

716. *Macaria notata* L.—Euroriental.—M: Caldelas. July. Rare. Gerez. May.—BB: Matta do Fundão. August.—E: Setúbal. August.

717. *Erannis leucophœaria* Schiff.—Euro-Pacific.—BB: S. Fiel. February.—Larva in May. Foodplant: *Quercus toza* Bosc.

718. *Lycia hirtaria* Cl.—Euroriental.—M: Gerez. May.

719. *Biston strataria* Hufn.—Euroriental.—M: Gerez. May.

720. *Nychiodes obscuraria* Vill. (*lividaria* Hbn.).—Euroriental.—BB: Serra da Estrêla. End of August.

721. *Hemerophila japygiaria* Costa. (*fractaria* Stgr.).—Western Mediterranean.—BB: S. Fiel. April–July.—E: Campolide, Setúbal. April–May. July. Torres Vedras.—f. *fidelensis* Mendes (1909, Brotéria, Série zoológica, 8, p. 72, pl. 13, figs. 1, 5, 6).— BB: S. Fiel (type locality).

722. *Hemerophila abruptaria* Thnbg.—Euroriental.—M: Caldelas. August. Gerez. May. Guimarães. June; December–January. Vizela. May–June; October. Very common.—BB: S. Fiel. April. July.—E: Setúbal. July–September. Sintra. April. Very common. Torres Vedras. January. April. June–July. At light.

(*To be continued*)

BED BUGS IN COLONIAL AMERICA

"Oyl of Turpentine, aetherial spirit of turpentine, best varnish for chairmakers, and the finest amber-coloured rosin, are made and sold by John Braser, living back of Trinity-Church burying ground, near the North-River, either large or small quantities . . . N.B. The spirit of turpentine applied to bed-steads and those places where bugs breed, and lodge, effectually destroys them, and prevents them from harbouring those places where it is applied; especially if they should be fresh drawn, and a few drops will effectually take out greasy spots from cloaths, or on floor.—Also the best Pot-Ash."—*The New-York Mercury,* February 23, 1756.

AN OLD USE FOR COCKROACHES

Dr. Samuel X. Radbill in his paper on "Child Hygiene Among the American Indians," (Texas Reports on Biology and Medicine, Vol. 3, No. 4, p. 419–512, Winter, 1945) states that among the Nanticoke Indians, various methods were in use to avert or cure whooping cough. One of these involved the use of cockroaches. As many cockroaches were collected as there were children afflicted with the whooping cough. Each cockroach was named after a child and each child placed a roach in a bottle and kept it tightly corked. When the roach died, the sickness was believed to disappear. During this period the child's bowels were kept open so that the charm would not react and kill him.

A city dweller having whooping cough was advised to put a cockroach in a thimble, to tie it up in a cloth and wear it around the neck. This was supposed to stop the whooping.—ED.

17–YEAR CICADA NOTES FOR 1945

By Fred M. Schott

October 9 and 10, 1944. Clear and mild. Several heard calling. A freshly emerged female and the shell found near base of birch in the Tenafly Cliffs area, N. J. These were probably forerunners of the large brood 2 of 1945.

April 10, 1945. Numerous pupæ found near surface in burrows under logs at Englewood Cliffs, N. J. The pupæ, when exposed, retire backward into the holes with some speed.

May 2 (1), 7 (2), 24 (1), adults emerged from terrarium in house, from a dozen pupæ taken on the foregoing date. All males.

May 25. Clear and cool. Heard a single cicada at Alpine, N. J.

May 26. Cloudy, warm and humid. First swarm, largely males, in dry woods near the Morrow estate, Englewood, N. J. *Calosoma wilcoxi* also abroad in numbers. One of these beetles observed chewing away the anal portion of a male cicada, which was disturbed only to the extent of a slow, alternate raising of its front legs.

May 28. Cloudy, cool and windy. Thunderstorms at night. Many pupæ emerging between 6 and 7 P.M. on the western slope of the palisades at Cresskill, N. J. Thousands of adults already out of their "armor." *Calosoma wilcoxi* and *frigidum* present and feeding on cicadas. Two pupæ taken home emerged at 8 P.M. Watched one emerge from its turret. It made one complete turn on reaching the surface, then headed straight for the trunk of a black oak, fifteen inches away. The pupæ, going up tree trunk, cover about seven inches per minute. Most of those observed stopped within fifteen feet, under leaves or lateral branches.

May 29. Clear and cool. Thousands of now matured cicadas at the stand visited yesterday evening to observe emerging pupæ. Evidently the night's rain and wind had deterred the insects not the least. The glint of the wings in the early morning sun, as many clung to seed pods of sumac, made a novel and very pretty spectacle. The number of those that fail to entirely extricate themselves from the shells is considerable. A guess of five per cent is probably conservative.

May 30. Clear and cool. Numerous along the shore of Hessian Lake and a large swarm along the base of high ground north of Bear Mountain, N. Y. Here the smaller variety *cassinii* was first observed, in small numbers.

June 1. A few at Alpine Cliffs, N. J. Moderately abundant at Coytesville, N. J. Sluggish and quiet due to the low temperature. Many cripples noted here. Possibly such weather conditions account for so many unable to extricate their bodies from the shell.

June 2, 3, 4 and 5. Period of subnormal temperatures, with winds and rain. Few cicadas seen or heard.

June 6. A few emerging in the early afternoon at Alpine, and at Fort Lee a large swarm had been and was emerging. Some pupæ found under logs.

June 11. Cloudy and humid. Many emerging and singing north of Popolopen Creek and in the Queensboro area back of Bear Mountain, N. Y.

June 14. Clear and warm. Countless thousands, male and female, dead on the ground at Crystal Lake near Hammonton, N. J. Others singing and ovipositing. Egg-laying about finished here. A few at Pennypot in the same sector. We were accosted by a native of this tumultuous burg with a question—in all seriousness—as to whether the W in the 17-year cicada's wing would change to P when the war is over. We suggested that Homo, having been and, in his present state, still being the ''fightingest'' of animals, there is no likelihood of any alphabetical change in *Magicicada's* wing pattern.

June 18. Very warm and humid. Very abundant in the Little Falls and Verona, N. J., areas. Singing loudly and occurring mostly high in trees. At Fort Lee they swarmed this day. Much egg-laying had been done. They were hanging in the low tree growth everywhere but ash sprouts appear to be a favorite resting place. Every one of these contained dozens of cicadas. Saw and heard here the first *cassinii*, a few, singing the totally different song, a quickly repeated *tzik-tzik-tzik*.

June 19. Cloudy and humid. Large numbers near the N. Y.–N. J. state line, north of Alpine, N. J. Several groups of *cassinii* heard. These remain higher up than the typical form.

June 22. Clear and warm. A large colony of *cassinii* located off Route 29 at Boundbrook, N. J. Only a few of the larger ones present. Several hundred were singing in unison in the top of a grove of young oaks. The combined sound is entirely different from that of the larger cicada, being a high-pitched, shrill buzz with a rising and falling cadence. Neither does it bear the remotest resemblance to the *tzik, tzik* of individual *cassinii*. It is very much like the August song of *Neoconocephalus robustus* without the rising and falling effect. *Cassinii* also showed here a preference for ash. Many females were on this plant, and ovipositing, while nearby vegetation showed but few. They were not easy to catch, even with a net, being much more wary than their larger brethren.

June 27. At Fort Lee in diminishing numbers. Mostly females ovipositing.

July 1. A few still laying eggs. The ground is strewn with dead.

July 14. No living cicadas observed. The big show is over. The oaks, hung with brown tassels, resemble, from a distance fruiting *Ailanthus* trees. Another installment of one of Nature's most amazing serial stories is ended. After a few weeks in the light of day this extraordinary insect is impelled to undergo a talpidian existence lasting seventeen years! Maybe those that "died aborning" were the lucky ones.

FRED M. SCHOTT, 1887–1946

Mr. Fred M. Schott, long associated as an entomologist with the New Jersey State Department of Agriculture, and an active member of the New York Entomological Society, died suddenly on January 6, 1946, at Bergenfield, N. J., and was cremated on January 9. Mr. Schott was born in Brooklyn, N. Y., on May 31, 1887, and attended the public schools there, including the evening high school. At the age of 15 he was employed as a clerk by the Worcester Salt Company of New York. From 1917 to 1919 he was employed as a concrete construction foreman by Castle Brothers, of Flatbush, Brooklyn. From 1920 to 1922 he was a real estate agent. On August 21, 1922, he was appointed temporarily on the Gipsy Moth project of the New Jersey Department of Agriculture, and after passing the civil service examination he was given a permanent appointment on November 21, 1922. Entomology had long been an avocation with Mr. Schott, and a few years later he was transferred to nursery inspection work, where his wide knowledge of insects was utilized to better advantage. He moved from Brooklyn to Bergenfield in 1928 and until his death, had charge of the nursery inspections in the northeastern section of New Jersey. In addition, he participated in special departmental surveys involving farm taxation, the fruit industry of New Jersey, the abundance of certain insects injurious to agriculture and other surveys of agricultural interest.

In Circular 106, entitled "Insects Captured in the Lookout Stations of New Jersey," published by the department in 1927, Mr. Schott arranged and identified, with the help of some specialists, the detailed records of captures. In departmental Circular 137, "Insects Captured in Five Lookout Stations in New Jersey During 1927," published in 1928, Mr. Schott was the author of the "Detailed Records of Captures." He was also co-author of "Anton Hochstein, Illustrator of Trimble's Insect Enemies of Fruit and Fruit Trees," published in *Entomological News*, 38 (1) : 1–4, 1927. And in "A List of the Insects of New York," Memoir 101, Cornell Agricultural Experiment Station, Ithaca, N. Y., 1928, Mr. Schott is listed as one of the cooperators and authorities. His last paper "Seventeen-year Cicada Notes for 1945" appears in another part of this JOURNAL. The late William T. Davis of Staten Island was his life-long friend and Mr. Schott spent many pleasant hours with Mr. Davis on Staten Island.

Mr. Schott's chief interests were his books on entomology and his collections of moths and beetles. He was well known to many members of the New York and Brooklyn entomological societies and to the numerous nursery interests in northern New Jersey. During his long years with the New Jersey Department of Agriculture, his entomological knowledge was extensively utilized and appreciated. And his work was always ably and conscientiously performed. Mr. Schott is survived by his sister, Matilda Schott.—H. B. WEISS.

A SATURNIID FROM THE BAHAMAS (LEPIDOPTERA)

BY WILLIAM P. COMSTOCK
RESEARCH ASSOCIATE OF
THE AMERICAN MUSEUM OF NATURAL HISTORY

One of the curiosities of animal distribution is the absence of moths of the family Saturniidæ in the islands of the West Indies. Although much collecting has been done in the Greater and Lesser Antilles over a long period of years (more than a century and a half) no captures of any of these moths have heretofore been recorded.

Dr. Forbes,[1] in discussing the origin of the fauna of the Antilles, comments on the Saturniidæ as follows: "A curious feature is the complete absence [from the Antilles] of several dominant families, most notably the . . . Saturniidæ. . . . They are strong flyers, and they are an ancient group which must have existed in South America for an enormous length of time, as a whole group of primitive genera (*Automeris, Dirphia,* etc.) are dominant there. . . . As *Coloradia* and *Hemileuca* are endemic in North

[1] Scientific Survey of Porto Rico and the Virgin Islands, Vol. 12, Part 1, pp. 8–9. New York Academy of Sciences.

America, we have the Antilles completely surrounded with primitive saturnid genera, which could have entered from any of the three directions.''

Mr. Arthur S. Vernay, collecting near his home at Los Cayos, Nassau, Bahamas, on December 3, 1944, captured a much flown female of *Automeris io lilith* Strecker. This specimen, because of its worn condition, was originally regarded as an adventitious arrival from Southern Florida, where it commonly occurs. This was nevertheless the first record of a representative of the Saturniidæ in the Antilles, considering that the Bahama Islands form a part of that great group.

Recently, Mr. Brian K. West of Dartford, Kent, England, furnished more information. He was stationed at Nassau, Bahamas from May 1945 until April 1946 and had the opportunity to do some collecting. He regularly observed specimens of *lilith* from June until September and again in early March. Fresh specimens were reasonably common at lights, especially the males.

There seems little doubt that *Automeris io lilith* is established as a breeding population in the area of Nassau. There is no means of determining how it arrived there but, considering the absence of Saturniidæ elsewhere in the Antilles, the most plausible theory would seem to be that it was brought in by some human agency, rather than wind blown in a natural way.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of January 2, 1945

The Annual Meeting of the New York Entomological Society was held on January 2, 1945, in the American Museum of Natural History. President Teale in the chair; thirteen members and three visitors were present. Miss Sordillo was excused from duty because of bad laryngitis, and John C. Pallister was appointed Secretary *pro tem.*, by President Teale. Mr. Pallister then presented six proxies by the following members: Leonard J. Sanford, Margaret L. Guy, Herbert A. Schwarz, Willis J. Gertsch, Annette L. Bacon and Alice Gray. With more than sufficient members and proxies present to constitute a quorum the meeting proceeded.

Mr. Comstock reported that the Zoological Record Fund had reached a total of $117.00 with an additional $10.00 promised.

Mr. Edward D. Quirsfeld, 67 Patterson St., Hillsdale, N. J., was proposed for membership.

A motion was made and approved to suspend the rules and elect Dr. Heber C. Donohoe, Research Director, William Peterman, Inc., 411 Wilson Avenue, Newark, N. J., as a member.

In the absence of the Treasurer, Mr. Comstock read the Treasurer's Report for 1944, and also reported that the Auditing Committee had found the treasurer's books in good order.

The Nominating Committee's recommendations for the elective officers of the Society, for the year 1945, were read as follows, by Mr. Sherman:

President—George G. Becker
Vice-President—Dr. Stanley W. Bromley
Secretary—John C. Pallister
Assistant Secretary—Lina Sordillo
Treasurer—Dr. Willis J. Gertsch
Assistant Treasurer—Margaret L. Guy

Trustees—George G. Becker, Edwin W. Teale, Dr. S. W. Bromley, Wm. P. Comstock, Ernest L. Bell.

Publication Committee—Harry B. Weiss, T. C. Schneirla, John D. Sherman, Jr.

There were no further nominations from the floor. A motion was made and passed that the Secretary cast one ballot and elect the above proposed officers of the Society for the year 1945.

Mr. Teale then turned the meeting over to the new President, George G. Becker.

Mr. Comstock was given a vote of appreciation for his good work and the fine services of Mr. Teale were similarly recognized.

The speaker of the evening was Dr. Heber C. Donohoe, Research Director, William Peterman, Inc., Newark, New Jersey, who spoke on "Methyl Bromide Fumigation, its History and Current Status." He told of the early discovery and rise of methyl bromide as a fumigant. It was first put into extensive use during the Japanese beetle quarantine. It can be used to treat a greater variety of commodities than can cyanide gas. Dried fruits and grain are treated almost exclusively by methyl bromide. Used very successfully for delousing. Although the research into its use has advanced tremendously since 1935, the speaker also warned of its dangers, because it is odorless, and there is still not enough known about its reactions.

Considerable discussion followed.

JOHN C. PALLISTER, *Secretary*

MEETING OF JANUARY 16, 1945

A regular meeting of the New York Entomological Society was held on January 16, 1945, in the American Museum of Natural History. President George G. Becker in the chair; with eleven members and five visitors present.

Mr. Edward D. Quirsfeld, 67 Patterson St., Hillsdale, New Jersey, was elected a member of the Society.

Mrs. Patricia Vaurie, 231 E. 76th St., New York 21, N. Y., Mr. Howard M. Schiff, 43–30—44th St., Long Island City 4, N. Y., and Mr. J. M. Singleton, Hoboken, New Jersey, were proposed for membership.

President Becker appointed a Program Committee of the following members: Mr. Wm. P. Comstock, Dr. R. G. Oakley, and Mr. E. I. Huntington, and a Field Committee of Miss Lucy W. Clausen and Mr. Chris E. Olsen.

Mr. Sherman read a short letter from Mr. Mutchler, and Mr. Teale reported on the condition of Mr. Davis.

The speaker of the evening was Dr. Clarence J. Goodnight who spoke on "Problems in Phalangid Taxonomy," illustrated with lantern sldes.

Dr. Goodnight discussed the taxonomic position of the phalangids, showing that they appear to be most closely related to the mites. The orders, suborders, and families are well defined. Subfamilies are fairly well defined, but intermediate forms do appear. The main problems are generic and specific. Genera are based on the position of tubercles and spines, their presence or absence, tarsal segments numbers, position of eye tubercle, etc. Specific characters are based on color patterns, numbers of tubercles, spination of legs, etc. Subspecies based on color and pattern variation are also recognized.

JOHN C. PALLISTER, *Secretary.*

MEETING OF FEBRUARY 6, 1945

A regular meeting of the New York Entomological Society was held on February 6, 1945, in the American Museum of Natural History. President George G. Becker in the chair; with fifty members and visitors present.

The Secretary read a report of the meeting of the Trustees of the Society, at which Mr. Wm. P. Comstock was appointed Delegate to the New York Academy of Sciences.

Mrs. Patricia Vaurie, Mr. Howard M. Schiff, and Mr. J. M. Singleton were elected to membership in the Society.

Dr. R. B. Swain, U. S. Bureau of Entomology and Plant Quarantine, was proposed for membership.

The Society learned with regret from President Becker of the death of Mr. Wm. T. Davis.

Mr. Schwarz then told of his personal acquaintance with Mr. Davis and of Mr. Davis' great interest in entomology.

Mr. Sherman spoke of Mr. Davis' careful attention to the details of managing the Society.

Mr. Weiss told of Mr. Davis' carefully prepared manuscripts and reports written in longhand, his great reluctance to traveling at high speed in an auto, and his ability as an all around naturalist.

Mr. Olsen related Mr. Davis' fatherly interest in young folks and in trying to encourage their interest in entomology, and how when he, Mr. Olsen, was a young man, Mr. Davis purchased a microscope for him to use while making a series of drawings.

Mr. Teale told of the last field trip Mr. Davis made 21 days before he went to the hospital, how Mr. Davis enjoyed life, and was always trying to help some one else. The interesting thoughts and sayings that he was continually expressing, was illustrated in a short poem by Mr. Davis which Mr. Teale read.

The program of the evening was a talk entitled "The Adventures of a Naturalist Around Lake Erie," by John C. Pallister. The talk was illustrated with over 130 colored slides. Mr. Pallister told of the insects, birds, animals, wild flowers, and fungi, as well as other forms of wild life, to be found in the various types of country, such as sand dunes, marshes, prairies, woodland, and glacial bogs in this area, along the southern shore of Lake Erie, where the northern zones meet the southern zones and the western praries meet the foothills of the Appalachian Mountains.

JOHN C. PALLISTER, *Secretary.*

MEETING OF FEBRUARY 20, 1945

A regular meeting of the New York Entomological Society was held on February 20, 1945, in the American Museum of Natural History. President George G. Becker in the chair; sixteen members and seven guests were present.

Dr. R. B. Swain, U. S. Plant Quarantine Station, 209 River Street, Hoboken, New Jersey, was elected to membership.

A motion was made and approved to suspend the rules and elect Mr. Kent H. Wilson, 430 Ridgewood Rd., Fort Worth, Texas, for membership.

Mr. Edward Parr Wiltshire, Apt. 18c, One Fifth Avenue, New York 3, N. Y., was proposed for membership.

Mr. Comstock explained that the Society had received contributions of one hundred fifty-one dollars ($151.00) toward the Zoological Record Fund. A motion was made and approved that the Society instruct the Treasurer to send this amount to the Zoological Society of London.

Mr. Comstock outlined an interesting program for the successive meetings.

The Secretary read a letter of thanks from Roswell S. Coles, Director, The Staten Island Institute of Arts and Sciences, for the flowers, the New York Entomological Society sent to the funeral of Mr. William T. Davis.

Doctor James C. King, the speaker of the evening presented an interesting talk on ''Kodachrome Records of Sphingid Larvæ.'' The talk was illustrated with a series of excellent kodachrome slides of the larvæ and their food plants. Dr. King discussed his methods of working with the larvæ and of the advantages of photographing them with kodachrome in preference to the old methods of drawing, painting or photographing them in black and white.

JOHN C. PALLISTER, *Secretary.*

MEETING OF MARCH 6, 1945

A regular meeting of the New York Entomological Society was held on March 6, 1945, in the American Museum of Natural History. President George G. Becker in the chair; fifteen members and nineteen visitors were present.

The minutes of the previous meeting were accepted as read, after an amendment, prepared by Mr. Comstock, was made as follows: ''A motion was made and approved that the Society instruct the Treasurer to send this amount to the Zoological Society of London.''

Mr. Comstock informed the Society that Mr. Nicolay was in a hospital and read parts of a letter he had received.

Mr. Horsfall made a motion to have the Secretary write a letter to Mr. Nicolay expressing the Society's best wishes.

Mr. Edward Parr Wiltshire, Apt. 18c, One Fifth Avenue, New York 3, N. Y., was elected a member of the Society.

Mr. George Huddell Beatty, III, Merion, Pa., was proposed for membership by Mr. Comstock.

Mr. Howard H. Laucks, 50 West Grove Ave., Maywood, N. J., and Mr. Harold B. Girth, 33 White Horse Ave., White Horse, Trenton, New Jersey, were proposed for membership by the Secretary.

The paper of the evening, ''The Cauca Valley, Colombia,'' was presented by Mr. E. Irving Huntington, illustrated with motion pictures. It was the account of a trip Mr. Huntington and Mr. Schwarz made to this interesting region in 1935. The Cauca River is a large river flowing northward through Colombia into the Caribbean Sea. High mountains hem the valley to the east and to the west. The floor of the valley at this part is about 3,000 feet above the sea. The rainfall is quite variable, reaching its greatest maximum of 400 inches at a point near Buenaventura. The main wet season occurs from March to May. They found collecting difficult in many of the sections because of the excessive rainfall. This was particularly true of the coastal rain-forest country. Cali was their headquarters during a large part of their stay. From here they made frequent trips by car to various places even crossing the Western Andes. Popayan, a nearby city, was the center of a large gardening region where tropical fruits flourished.

The motion pictures illustrated well the different types of country; the natives at home and at their markets in their villages and towns.

Considerable discussion followed.

JOHN C. PALLISTER, *Secretary.*

MEETING OF MARCH 20, 1945

A regular meeting of the New York Entomological Society was held on March 20, 1945, in the American Museum of Natural History. In the absence of the President and Vice-President, Mr. Comstock took the chair to call the meeting to order and was selected as temporary chairman. Seventeen members and eleven guests were present.

Mr. Arthur Blum, 1337 St. Lawrnce Ave., Bronx, New York, was proposed for membership by the Secretary.

The Secretary read a report of the meeting to be held in connection with the New Jersey Mosquito Control Association.

The paper of the evening, ''Collecting Lepidoptera in the Dismal Swamp and North Carolina Lowlands,'' was presented by Mr. Otto Buchholz.

Mr. Buchholz, who has been an ardent collector of Lepidoptera since 1891, heard first about the Dismal Swamp area from Dr. Austin H. Clark. He told of his numerous collecting trips to this region and described the swamp as an area fifty miles wide and sixty miles long extending from the sea to Albemarle Sound. The rivers flow through the area toward the northeast and as they approach the ocean broaden out to several miles in width. Only a few highways cross the swamp, and these, together with an abandoned lumber railroad right-of-way, are the best collecting places because they are the only easily accessible open areas. Some of the higher places around the edge of the swamp are cultivated, and corn, peanuts, tobacco and cotton thrive.

Mr. Buchholz showed specimens of a number of the butterflies to be found in the swamp. He explained the best method of collecting *Papilios* was to sweep them into the net head first in order not to break their tails. *Argynnis diana* is rather common and is frequently seen around the butterfly weed. The Creola satyrid, *Enodia creola,* is also found here, but perfect specimens are difficult to find. The males, however, were in better condition than the females. The Bulenta Skipper, *Problema bulenta* Bdv. and Lec., a long-lost species was rediscovered in the region south of Wilmington, and in the Fear River Swamp.

Discussion followed with Mr. Comstock asking about sugaring. This had never proved very successful.

Mr. Schwarz asked more in detail about the collecting, and, at the request of Mr. Wiltshire, Mr. Buchholz told of the mosquito conditions which at times became quite troublesome.

The dominant trees of the swamp are bays, laurels, gums, and cypress, while on the higher ground the pines take over.

Mrs. Vaurie asked about the snakes in the swamp. Mr. Buchholz said the largest he had ever seen was a seven-foot blacksnake; turtles were everywhere, and alligators were occasionally seen.

Mr. Comstock introduced a question about a gregarious sphingid larva, with a flexible horn. Dr. King named several species with flexible horns but knew of no gregarious species.

JOHN C. PALLISTER, *Secretary.*

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NOTES ON THE HABITS OF SOME PANAMANIAN STINGLESS BEES (HYMENOPTERA, APIDÆ)

By Charles D. Michener[1]
Associate Curator, American Museum of Natural History

The purpose of this paper is to report some more or less miscellaneous observations on stingless bees (Meliponini) made during a fourteen-month period in Panama. A total of 169 nests of twelve species were examined.

OLD PANAMA

A particularly favorable locality for the study of these bees was found in the ruins of Old Panama, located on the Pacific coast of Panama a few miles east of Panama City. These ruins consist of more or less crumbling stone walls and buildings in which there are many crevices, holes, and openings of various sorts where stingless bees nest. A total of 141 meliponine nests were found among the ruins. This is obviously an incomplete count, especially for the Meliponas whose nest openings are small and inconspicuous. Many nests of other species must also have been missed, especially where there are high walls still standing.

[1] The author is much indebted to Mr. Herbert F. Schwarz of the American Museum of Natural History for the opportunity to read a portion of his forthcoming treatise on the genus *Trigona*, and for identifying all the bees discussed in this paper. Thanks are due to Dr. Herbert C. Clark, Director of the Gorgas Memorial Laboratory, Panama City, R. P., for the use of facilities of that Laboratory. Many of the observations on the nests among the ruins of Old Panama were made and recorded by my wife, Mary H. Michener.

The ruins studied are all within an area of about one quarter of a square mile, but do not occupy the whole of a square of that size, being scattered, for the most part, along two sides of the square.

Most of the nests found were in the masonry walls erected several centuries ago. However, the single nest of *Trigona fulviventris,* two of the nests of *Trigona pachysoma,* and one of the nests of *Trigona jaty* were in the trunks of trees growing among the ruins.

The distribution of the various species among the ruins is by no means uniform. In order to show this, the ruins were divided into five areas (lettered A to E) each having approximately the same amount of wall space. The number of nests of the various species found in these areas are shown in Table I.

TABLE I

NUMBER OF NESTS OF VARIOUS SPECIES OF MELIPONINI FOUND IN FIVE AREAS AT OLD PANAMA

	A	B	C	D	E	Total
Melipona favosa phenax	3	4	0	3	1	11
Melipona interrupta triplaridis	1	1	0	0	0	2
Trigona testaceicornis perilampoides	26	20	1	2	0	49
Trigona jaty	6	3	3	11	6	29
Trigona testacea subsp.	11	6	0	19	0	36
Trigona nigra paupera	0	4	0	3	0	7
Trigona pachysoma	1	0	0	4	0	5
Trigona fulviventris fulviventris	0	0	0	1	0	1
Trigona corvina	0	0	0	1	0	1
	48	38	4	44	7	141

Areas A and B are adjacent to a rather large mangrove swamp, a small cocoanut grove, and a considerable area covered with brush and small trees. Area D contains a considerable number of trees and is adjacent to some partly wooded land. It is suspected that the sources of food thus provided explain the large number of nests in these areas. The other areas are largely surrounded by grasslands with few trees.

In addition to species considered below, several species of

Trigona have been collected on flowers at Old Panama, but since their nests were not found, they are not discussed here.

FLOWER VISITING HABITS

Perhaps because of the need by these colonial bees for a continuous food supply in a region where very few plants bloom continuously throughout the year, the species of meliponine bees are not oligolectic. However, among the flowers available at any one time, they do have very definite preferences. Furthermore, different species have different preferences. The following examples illustrate this point:

On March 15, 1945, a nest of *Melipona favosa phenax* was found at Old Panama within ten feet of a blooming *Solanum* bush and about 150 feet from a small tree of *Dalbergia brownii,* both of which attracted *Melipona interrupta triplaridis* which was collecting pollen from the *Solanum.* Yet no *Melipona favosa phenax* were seen on these flowers. This species was flying 200 or more feet to flowers of an unidentified herbaceous plant. In January *Melipona favosa phenax* had been feeding chiefly on *Simsia grandiflora,* plants of which were dead in March.

In January, 1945, on Ancon Hill, Canal Zone, *Trigona testaceicornis perilampoides* was abundant on *Simsia grandiflora. Trigona fulviventris* was visiting flowers of *Mentzelia aspersa* a couple of feet away. *Trigona testacea* subsp. was visiting the *Mentzelia* as well as *Ipomoea triloba,* growing equally close to the other plants, but only rarely did it visit *Simsia.* The few *T. jaty* seen were on none of these plants but on flowers of a small weed growing about five feet away.

At Old Panama *T. fulviventris* was never seen visiting flowers of herbaceous plants growing near its nest, although these same plants were visited regularly by *T. jaty* and *T. nigra paupera.*

Also at Old Panama specimens of *Trigona nigra paupera* were seen visiting flowers of an herbaceous plant growing about four feet from a wall containing nests of *Trigona testaceicornis perilampoides.* The latter species was absent from these flowers, but was collecting from flowers of unidentified trees growing at the edge of a tidal swamp 200 feet away.

LONGEVITY OF COLONIES

It was impossible to make direct observations on the longevity of colonies of stingless bees during a period of only fourteen months since most colonies apparently live for several years. However, some observations were made which have some bearing on studies of longevity.

A number of nests of *Trigona testaceicornis perilampoides, T. jaty,* and *T. testacea* subsp., and one of *T. pachysoma* were found abandoned, the colonies evidently extinct, after having been earlier observed in an active condition. One nest of *T. t. perilampoides* was observed and found active on March 23, April 9, 20, and 23, and June 30, 1945. On September 28 no bees were seen at the nest entrance, and the entrance tube was weathered and broken. The colony was obviously extinct. On December 31 the same nest entrance was repaired, looked quite normal, and an active colony of the same species was present. Apparently the nest was reoccupied by another colony. This is good evidence that the observation of bees in a given nest at widely separated dates is not proof of continuous occupancy, nor do such observations necessarily shed light on the longevity of colonies.

Even more striking is the single *Trigona* nest which was observed almost daily. This nest of *T. jaty,* located in the Gorgas Memorial Laboratory building in Panama City, was occupied by three different colonies of this species in fourteen months! This was the only nest found in the vicinity. In December, 1944, large male swarms were around this nest. As they were present day after day beside the main entrance of the Laboratory, someone sprayed them with insecticide and then opened the small valve box in which the nest itself was located, and sprayed the bees and the nest. Later the nest, including the entrance tube, was removed from the valve box, but some of the wax remained.

For several months no bees were seen in the vicinity. However, about April 25, 1945, about one hundred *T. jaty* arrived at the old nest site. Two days later they had built a small entrance tube and some sheets of wax in the valve box (which could be opened slightly without seriously disturbing the bees). From May 2 to 8, males swarmed in front of the nest each day. Obviously these males had not been reared in this nest, which contained no brood cells. Honey pots were being constructed on May 5, and on May 15 some honey was found in them. By May 20, a single small brood comb was being built. No queen was ever seen with this colony, and it became progressively smaller, until by July, 1945, is was extinct.

Again no bees were seen near this nest until about October 15, 1945, when a new and large colony suddenly appeared in the valve box and built a nest. In December, 1945, and January, 1946, this nest would not have been distinguishable from the nest in the same place in December, 1944. Male swarms were never seen about this last colony. A physogastric queen was noted in it in January.

It would be interesting to know why this same cavity (valve box) was selected repeatedly for a nest site, when there was an abundance of other, presumably suitable, similar cavities in the vicinity. Possibly a lingering nest odor attracted new occupants to this site.

Melipona favosa phenax Cockerell

Eleven nests of this species were found, all in the crumbling masonry walls of Old Panama. Nest openings were observed from 2 to 20 feet above ground. The openings are typically round, 6 to 7 mm. in diameter, but in one instance where the entrance was in a narrow crevice, the opening was 4 mm. in vertical diameter by 8 mm. in horizontal diameter. Inside the relatively small entrances the passage ways enlarge to 10 or 15 mm. in diameter if space between stones permits.

The entrances do not project in tubular fashion from the walls as with many of the species of *Trigona*, but are flush with the surfaces of the walls. In one nest the passage way extending from the entrance into the nest was exposed for the outer two inches, being attached to the upper surface of a large horizontal crevice.

The material of which the nest entrances are made looks like dried mud, often with some groups of short brown fibers scattered about. The mud-like substance is from 3 to 5 mm. or even more in thickness. Its origin has not been determined. It may come in part from old termite nests which are numerous within the walls. One *Melipona* nest was obviously built, at least in part, in a small termite nest and the others might well reach termite nests and passages deep within the walls. Material to repair a damaged nest entrance was brought, as moistened pellets, from within the nest.

Bees pass in and out of the nests of this *Melipona* in rather small numbers. The impression is of very small colonies. The nest openings are quite constantly guarded during the day. The head of a worker bee is almost always to be seen blocking the nest entrance. At the approach of another *Melipona,* either from the outside or inside, the guard backs into the larger part of the passage behind the opening and allows the other bee to pass. One nest examined after dark was open and apparently unguarded.

Groups of from twenty-five to seventy males of this species were several times observed, either buzzing around or more often resting in a more or less dense mass on the walls at Old Panama. At no time was a nest opening discovered close to such a group. Male swarms[2] of this nature were observed on March 25 and 27 and December 20, 1945. One such swarm noted on March 25 at 2:00 P.M. was in the same location on March 27 at 9:45 A.M. The significance of this activity is not clear.

Melipona interrupta triplaridis Cockerell

Only two nests of this species were found, both in the walls of Old Panama. The nest entrances are distinguishable from those of *M. favosa phenax* only by slightly larger size (nearly 12 mm. in diameter). They are guarded in the same way as those of that species.

Trigona testaceicornis perilampoides Cresson

Fifty-two nests of this species were examined, forty-nine of them in the walls of Old Panama, three in the bases of large trees at Quarry Heights, Ancon Hill, Canal Zone. Nests were found from 1 to 20 feet above the ground. The entrance tube of each

[2] The term, swarm, in this paper is used for aggregations, commonly entirely of males but sometimes of workers, which are found most often in front of nest entrances. The individuals in such a swarm commonly remain in flight for long periods, sometimes giving an impression similar to that of a swarm of chironomids. Dispersal swarms such as occur in *Apis,* consisting of a queen and group of other individuals, are well known in the Meliponini but were not observed by me.

nest is made of a thin, rather soft and pliable brown wax or wax-like material, usually with some small holes toward the apex so that the wall of the entrance tube sometimes appears almost lace-like. The tubes project from 3 to 20 mm., the distance as measured on different sides of any one tube often varying greatly because of the irregularities of the rocks in the walls at Old Panama. The average of the measurements of the longest sides of 18 tubes was 10 mm. In diameter the tubes ranged from 5 to 15 mm., the mean of the maximum diameters of 19 tubes being 12 mm. Usually the entrance tubes are not quite circular, the maximum diameter commonly being 2 mm. greater than the minimum. One entrance having maximum and minimum diameters of 15 and 5 mm. was located in a crevice between two rocks. One tube was found which projected straight upward from the top of a wall instead of horizontally from the side as usual.

This is a timid bee. Throughout the day mouths of the entrance tubes are lined with bees facing outward in a guard-like manner, but at any rapid movement of an observer within several feet of the nest they quickly withdraw. Because of the small size of the bees in comparison to the nest opening, the "guards" do not nearly fill the entrance, as with several of the other species. They move to one side and inward to allow passage of other bees in and out of the nest, but do not back in out of sight.

Both at night and in the day time, a steady humming sound can usually be heard from any nest of this species. This seems to indicate that there are fanners inside the nest. The individuals visible around the nest entrance do not fan, however, as in the case of *Trigona fulviventris.* Salt (1929) has noted fanning in *T. capitata zexmeniæ* Cockerell.

Trigona testaceicornis perilampoides is the only meliponine that I have observed to close its nest at night. Evening activities of eight nests were observed between March 17 and April 10, 1945. The pattern was the same in all cases. Sometime before 6:00 P.M. the regular diurnal foraging flights ceased. Considerable activity continued, however, bees flying from the nest opening for a few feet, apparently dropping waste of some sort, and then returning to the nest. At 6:25 or 6:30 P.M., these short flights stopped. The inner wall of the entrance tube, at the outer end, was lined at this time with bees manipulating the edge of the entrance tube with their mandibles, gradually drawing it out, without the use of additional wax, into anastomosing processes and arms which by 6:50 or 7:00 P.M. formed a more or less lace-like covering at the apex of the entrance tube. At this time it was almost dark and the bees withdrew out of sight from the nest opening. The largest perforations in the "lace" were in the center, and sometimes a hole nearly one-third as large as the day-time diameter of the opening was allowed to remain.

Males have been seen swarming[2] in front of nests at all times of day, and at all seasons of the year. Perhaps because swarming usually occurs on sunny days, many more swarms were seen in the dry season (January to April) than during the wet season. On windy days some of the swarming males frequently clung to plants if there were any present in front of the nest. In the evening swarms disappear between 4:30 and 6:00 P.M. The swarms are often large, consisting of hundreds of individuals, and produce a surprisingly strong buzzing sound for such small bees. So far as has been observed, only a small percentage of the colonies swarm at any one time. Thus on March 25 there were swarms in front of only 3 out of 30 nests examined. A week later these three nests were quiet, but five others had swarms. Sometimes a nest with a large swarm will have a neighbor only a few feet away whose activities are apparently uninfluenced. A single nest has been observed with a swarm on ten different days during a year, and doubtless actually swarmed many more times. Other nests apparently produced swarms only rarely. While Salt (1929) records swarms of workers in another form of this species, workers were never found in swarms in Panama.

On one occasion a single worker was seen removing wax from the entrance tube of an abandoned nest. It worked with its mandibles removing small pieces of the material of which the tube is made. After a few minutes it flew away. Later the same or another worker was again removing material from the same abandoned nest.

The relation of this species to *Lestrimelitta limão* will be discussed under the latter species.

Trigona jaty Smith

Thirty-four nests of this species were observed. Of these, twenty-eight were in the stone walls of Old Panama; one in a tree trunk at the same place; one in a building in Panama City; two in tree trunks at Pacora, Panama Province; one in a large wooden fence post at Guayabalito, Colon Province; and one in the stone walls of the ruins of Fort San Lorenzo, Colon Province.

Nests were found from 1 to 22 feet from the ground. The entrances are tubular, as a rule more slender than those of *Trigona testaceicornis perilampoides* and are made of soft, light brown wax, about half of them tinged with yellow at the apices. The tubes usually have a few small holes in the sides toward the apices. They projected from 5 to 30 mm., the average of the lengths of the longest sides of nineteen tubes being 11 mm. The entrances are only roughly circular. A particularly large one had maximum and minimum diameters of 14 and 12 mm., but several had corresponding measurements of 6 and 5 mm., and the average of the maximum diameters of eighteen nest entrance tubes was only 7 mm.

The nest entrances of this species are not guarded by bees which stay in the entrance tubes, as with *T. testaceicornis perilampoides.* The only bees ordinarily seen in the entrance tube of a nest are those actually passing in or out. However, outside of the opening of almost any nest, and within a few inches or a foot of it, one to eight or ten worker bees hover and dance in the air, in a manner suggesting swarming males. These bees remain in the air for long periods without alighting. At the approach of an observer, they often disperse but soon return and resume their dancing. Since other workers passing in and out of the nest are not approached by the dancing individuals, it does not seem probable that they function as guards.

Numerous nests of this species observed at night were open, and the bees out of sight within.

Males swarm in front of the nests frequently, sometimes in immense numbers. Swarms have been observed at all times of the day on sunny days during the months from December to May. Unlike the swarms of other species studied, those of *T. jaty* quickly disperse if disturbed, but reassemble in a few minutes.

A few workers are often present in collections made from swarms. It is probable that these are the hovering workers previously discussed, which at times of swarming, become mixed with the males. At times most of the members of a swarm are gathered together in a more or less compact mass resting near the nest. This phenomenon was observed particularly when the nest entrance and vicinity were in the shade. At Pacora a large swarm of workers was observed in front of a nest entrance in February.

Additional observations on *T. jaty* are described in the section on longevity of colonies.

Trigona nigra paupera Provancher

Seven nests of this species were observed, all in the walls of Old Panama. They were found from 2 to 12 feet above the ground. The entrances do not project in tubular fashion although in two cases a collar about 1 mm. high surrounded part of the opening. These collars and the linings of the openings consist of a somewhat shining, hard, dark brown or blackish material. The openings were circular, or one diameter was at most 1 mm. shorter than another. The maximum diameters of the seven nests ranged from 6 to 8 mm. Colonies of this species appear to be small, not more than two or three individuals usually being in sight at a time.

At most times during the day one or two bees can be seen partially filling the nest entrance and facing outward. One of these "guards" backs out of sight into the nest to allow the passage of other bees. Returning bees fly around near the nest opening as though seeking the hole, seldom plunging directly into it. At the approach of an observer the "guards" usually disappear into the nest, not reappearing for some time. The presence of an observer near the nest also interferes with the return of foraging bees, which hover at a distance from the nest or slowly work their way toward it.

One nest observed at night was not closed, nor were any bees visible at the entrance.

All individuals seen at the nests in Old Panama had black abdomens. However, all individuals collected for me by Dr. Harold Trapido from a nest between the walls of a house at Juan Mina, Canal Zone, had the abdomen whitish above. Those having the latter coloration are commonly considered callows. However, it seems possible that there is a genetic basis for the color differences, some colonies consisting wholly of black specimens, some consisting wholly of individuals with white, and some colonies being mixed (Salt, 1929).

Trigona pachysoma Cockerell

Five nests of this species were studied at Old Panama. Three were in the stone walls, two in trunks of large trees. They ranged from two to thirty-five feet above the ground. The entrances in this species are tubular, 25 to nearly 100 mm. long, nearly 20 mm. in diameter, of thin, rather soft, gray, wax-like material.

Workers from one nest, which was disturbed, attacked after the manner of *T. corvina* and *T. testacea* subsp. The same nest observed at night was not closed, nor were any bees visible. This nest was observed as active several times from March to July, 1945. However, on November 10 the entrance was in poor repair and only two or three bees were seen going in and out. Two phorid flies were seen to enter the nest, suggesting that there was decomposing matter within. Two weeks later no sign of life was seen at this nest.

Trigona fulviventris fulviventris Guérin

Two nests of this species were observed. One was at ground level at the base of a large buttressed tree at Old Panama. The entrance tube, of an exceedingly hard dark brown material, was about 25 mm. in length with a vertical diameter of 40 mm., and a horizontal diameter of 50 mm. The other was about a foot above the ground in a tree at Pueblo Nuevo, near Panama City. The nest entrance was similar to that described above but somewhat smaller.

After the destruction of the entrance tube at the Old Panama nest, it was slowly rebuilt and did not reach its previous size for more than six weeks. The entrance tubes of other species studied, particularly those utilizing soft wax, are rebuilt in a very few days.

The colonies of this species which were observed were apparently very large, many bees being visible at one time. In contrast to other species studied, the nest entrance is lined during the day with many bees constantly fanning the air with their wings. The noise from nests of *T. testaceicornis perilampoides* suggests that fanners may be present but they are not at the nest entrances. In *T. fulviventris* the fanners do not move to make way for bees returning to the nest, as the entrance is large enough that the latter can fly directly in. Many of the bees leaving the nest, however, fan as they move outward along the inner walls of the entrance tube. It is possible that all the fanners are merely individuals on the way out of the nest. Some, however, fan for long periods of time, others for only a moment before flying away, and still others fly without stopping to fan at all.

Regardless of how much their nest is disturbed, these bees do not attack. However, they tend to go about their activities in an apparently normal fashion in the presence of an observer, unlike some of the timid species.

This was the only species noted at Old Panama which remained active during a light rain. Some workers were leaving the nest, and others, many of them laden with pollen, were returning in spite of the rain.

Males were noted at both nests of this species, at one on February 22 and at the other on July 23. The swarms consisted of only twenty-five to fifty males, and of these only about half were flying about at any one time. The remainder were scattered about resting on leaves, twigs, and tree trunks within eighteen inches of the nest entrance.

Trigona testacea subsp.[3]

Forty-four nests of this bee were examined. Thirty-six of them were on the walls of Old Panama; four on the similar old walls of Fort San Lorenzo, Colon Province; and four at Juan Mina, Canal Zone.

Nests of this species, like those of *T. corvina*, are built more or less exposed, rather than completely enclosed in a cavity (except for the entrance tube) as with the other species discussed in this

[3] Mr. Herbert F. Schwarz tells me that this is an undescribed variety of *T. testacea*. It is the form previously called *T. testacea cupira* Smith by Schwarz (1934).

paper. Unlike the nests of *T. corvina,* those of *T. testacea* are rather delicate and are usually not built where fully exposed to the weather. At Old Panama and Fort San Lorenzo a few nests were located in the open on the sides of walls, but most were under overhanging ledges or in holes, of which there are many, in the walls. At Juan Mina one was under the eaves of the dock, two were inside a chicken house, attached to the roof; and one was attached to small branches of a grapefruit tree. Orchid roots formed a dense mass on top of the latter nest, protecting it from the weather.

Nests were observed from 5 to 22 feet above the ground. The nests are irregularly shaped gray masses resembling certain termite nests[4] attached on one or two sides to stones or other surfaces. On one side of each nest, usually near the lowest part of the nest, is the broadly funnel-shaped entrance. The funnel and indeed the entire outer wall of the nest is made of a hard, slightly brittle material, dark gray in color. The flaring edges of the funnel are sometimes flush with the surface of the nest, but usually project 5 or 10 mm., and occasionally as much as 15 mm. The outer end of the funnel is from 25 to 40 mm. in diameter. It is ordinarily round except for small irregularities and sometimes many slender processes and projections on the margin. The opening in the throat of the funnel is small, 8 to 12 mm., in largest diameter, usually somewhat elongated in the horizontal diameter.

Two nests which were opened are described in greater detail. One from under the eaves of the river dock at Juan Mina was constructed as usual in this species, being very irregular and flattened against the surfaces to which it was attached. The main portion of the nest was on top of a more or less horizontal rafter. A smaller portion extended thence downward on the side of the rafter. The nest opening was near the lower end of this vertical portion. The vertical portion of the nest consisted mainly of passageways and honey pots. Many of the latter were represented by bulges visible from the outside. Some of the pots were full of solid pollen, others contained very thin, clear honey. The horizontal portion of the nest on top of the rafter contained no

[4] Nests of this species have often been described as being in termite nests. The bees themselves clearly built the nests studied by me.

pots. In its center was the brood chamber, containing five or six horizontal combs. The material used for the outside of the nest and for the passage ways was rather thin, hard, and brittle. That used for the brood combs and the honey and pollen pots was soft and pliable. The queen was found at the edge of the brood chambers.

Another nest, the largest that I have seen of this species, was irregularly spherical in shape and attached to two small branches of a grapefruit tree. These branches were about three inches from one another, and passed through the upper portion of the nest, so that the nest hung down beneath them. A twig from one of the branches passed through the center of the nest. A dense mass of orchids grew on top of the nest and their roots formed a mass an inch thick covering the entire top of the nest and protecting it from weathering. Many orchid roots extended down through the nest.

The nest was about eight inches in diameter. Its entrance was in the lower part of one side. Hanging down beneath the entrance was a nodulose mass consisting of a large number of empty chambers, connecting with one another and with the interior of the nest. The entire outer surface of the nest, but especially that of the lower half of the nest, was nodulose. Inside of each nodule was a chamber, connected with the interior, and empty except sometimes for a few bees. Pots, made of thin soft wax, were mostly located just outside of the brood chamber and contained either clear liquid honey or solid pollen. In the spherical brood chamber were thirteen horizontal combs. The types of wax used were the same as those found in other nests of this species.

The nest contained about 2900 bees (2876 by count, but a few escaped) and weighed four pounds.

When nests of this species are disturbed, workers swarm out in great numbers and attack the intruder. *Trigona pachysoma* and *T. corvina* are the only other species studied having similar behavior.

Throughout the day several bees can always be observed, facing outward, only their heads and forelegs visible, in the throat of the funnel-shaped entrance. When a foraging bee is leaving the nest or returning, one of the guards backs into the nest to make way for it.

This species is chiefly active in the morning and evening, continuing activity later than other species, or until about 6:45 P.M. (March). At midday, at least on hot days, no bees can be seen entering or leaving the nests. At night the nest entrances are not closed, nor are "guards" in evidence. However, if the nest is disturbed, bees will swarm out and attack as in the day time.

I have not seen males swarming in front of the nests of this species and suspect that they may not do so. On April 9, 1945, at 11:00 A.M. several males were found resting on the rocks within about 6 inches of a nest. When disturbed they buzzed about but did not attack as the workers do.

Trigona corvina Cockerell

Seven nests of this species were examined, one at Old Panama, one in Panama City, four at Juan Mina, Canal Zone, and one at Santa Rosa, Colon Province. All were built around, and supported by, branches of trees and were from eight to forty feet above the ground. In external features all agreed with the single nest which is described below.

This nest was cut down from a grapefruit tree at Juan Mina on April 27, 1945. It was ovoid, dark gray, twenty-two inches high and seventeen to eighteen inches in horizontal diameter, and weighed sixty-nine pounds. It was built around an approximately vertical branch about two inches in diameter which passed through the nest near its center and gave off several smaller branches which issued from the sides of the nest.

The entrance was about an inch in diameter and located near the lower end of the nest. Beneath the entrance was a beard of small gray filaments 2 to 4 mm. in diameter and 10 to 40 mm. long.

The outer layer of the nest was brittle, 1 or 2 or sometimes 3 mm. in thickness. This layer was supported by many small columns, sometimes irregular but often round in cross-section and 2 to 5 mm. in diameter. Thus there were extensive interconnecting passageways beneath this outermost layer. Inside of these subsurface passages the nest material was thick, not at all brittle, and required a hatchet and considerable prying to cut and remove large pieces. This thick wax was to some extent in distinct layers, but the layers differed in number, thickness, and distinctness in different areas. Where distinct they were connected by irregular columns and the spaces between layers were connected by holes through the layers. The layers were one-fourth to three-fourths of an inch thick, or when not distinct formed a total thickness of two and one-half to three inches. Many holes penetrated the outermost layer of strong material to make connection with the space beneath the outer skin of brittle material.

This arrangement must serve a useful purpose for at the attack of an enemy (e.g., the author) the outer thin coating is promptly broken and bees can swarm out from many parts of the nest to attack the intruder. Yet because of the very thick and strong wax inside, the nest as a whole is very strong and would not be seriously damaged by storms.

Among the inner layers of hard wax was much yellowish solid material, apparently pollen, so that in cross-section some parts appeared stratified or laminated with it. This material was firm although not so strong as the wax, and some of it looked as though it had been in the nest for a long time. Inside of the layers of strong hard material were one to four (in different areas) irregular layers of honey pots, made of soft dark brown wax, and almost all sealed and completely full of dark-colored honey.

Inside of the honey pots was the brood chamber, an ovoid space about fourteen inches high and nine inches in horizontal diameter. This space was filled with horizontal combs of brood cells. These combs were irregular, so that no one completely crossed the chamber; some were very small, and many had holes in them. Thus there was ample opportunity for passage up and down among the combs. An imaginary vertical line through the brood chamber passed through about thirty combs. The margins of the combs were connected at various points with the walls of the brood chamber, and there were occasional vertical supports between combs. The cells of the combs were 3 mm. in diameter, 5 to 6 mm. high, and although round in cross-section, were arranged in definite regular rows as if the cells were six-sided. It was estimated that there were 82,000 brood cells in this nest.

Here and there in irregular portions of the combs, especially near the edges of the brood chamber, was a queen cell. These were paler than other cells, 9 mm. long by 6.5 mm. wide, often somewhat irregular in shape.

A total of 6529 adult bees were taken from this nest. (The number that escaped is unknown.) Of the 5201 retained for study, two were virgin queens, 417 males, and 4782 workers.[5] The physogastric queen, if present, was not found.

Trigona corvina is often a serious pest of citrus trees in Panama. The workers gather on the tender growing leaves and cut the margins with their mandibles. Then they apparently collect the liquid exuding from the damaged leaf margins. Such damage is sometimes so continuous as to almost prevent the growth of an orange tree.

This species and *T. testacea* subsp. are known as zagañas by the Panamanians.

Trigona pallida pallida Latreille

One nest of this species was found on the Rio Pescado arm of Gatun Lake, near Mendoza. It was in a dead log, thoroughly infested with termites, which was lying on the ground beneath some bushes. The nest entrance was a round tube about an inch in diameter, projecting about an inch from the log, and made of rather hard grayish black material.

Trigona latitarsis Friese

One nest was found at an altitude of 2000 feet on Cerro Campana, Panama Province. The bees' nest was in a large termite nest full of living termites, located about ten feet above the ground on a small tree. Male bees were swarming in great numbers in front of the nest opening when the nest was found on August 5, 1945, at about 3:00 P.M.

The nest entrance consisted of a tube of soft, delicate yellow wax projecting about 60 mm. from the wall of the termite nest, and enlarged near its base on the lower side to form a large pouch.

Trigona clavipes dorsalis Smith

One nest of this species was found about one foot above the ground level in the trunk of a tree on Barro Colorado Island, Canal Zone. Another was found about ten feet above the ground

[5] These counts were made by Mr. Herbert F. Schwarz.

in a tree trunk near Juan Mina, Canal Zone. Nest entrances in both instances were quite long (in one about 75 mm. long), tubular, about 10 mm. in diameter, brown basally but soft and yellow apically. The walls were thin and provided with numerous small perforations toward the tip of the tube.

Lestrimelitta limão (Smith)

Although no nests of this species were found, some information concerning its nest-robbing activities at Old Panama seems worth recording. The species was observed on ten occasions (in the months of March, April, May, July, and December) in the mornings between 9:00 A.M. and 11:30 A.M., apparently robbing nests of *Trigona testaceicornis perilampoides*. It was not observed to molest any other species.

The arrival of a group of *L. limão* at a nest of *T. t. perilampoides* was never observed. On April 1, however, a group of workers estimated at 50 specimens was observed flying around a small area of wall and the base of an adjacent tree. It was suspected that this represented a group searching for a nest to rob.

On other occasions nests of the *Trigona* were observed as they were being robbed by *L. limão*. The entire process of robbing a nest of *T. t. perilampoides* evidently requires two or three hours. A nest being robbed is full of workers of *L. limão*. Only very rarely is a *Trigona* seen among them at the nest entrance. The *Lestrimelitta* workers line the entrance tube, much as the *Trigona* do normally, except that the individuals of *Lestrimelitta* chew at the wax of the entrance tube, so that by the time they have left, the tube is shortened and irregular. None were actually observed to fly away with wax. These individuals of *Lestrimelitta* also act as guards, keeping out returning *Trigona* workers. At the approach of a *Trigona*, one or more of the *Lestrimelitta* guards rears up and opens its mandibles in a threatening manner. The *Trigona* flies away and hovers near the nest, often trying several times, only very rarely successfully, to enter the nest. As a result, a considerable swarm of workers, many of them carrying pollen, usually develops outside of a nest being robbed. Such a swarm often has the appearance of a swarm of males.

During the period when the *Lestrimelitta* are in the *Trigona* nest, some individuals of the former can be seen going in and out.

During the last half hour that the robbers are there many more go out than come in. Although as many as thirty have been seen to leave in two minutes, there is no group or mass exodus. Finally only one *Lestrimelitta* is left in the nest entrance, keeping the *Trigona* from entering. At this stage the remaining *Lestrimelitta* spends almost its entire time lunging with open mandibles at Trigonas which are trying to get in their nest. When all the *Lestrimelitta* are gone, the Trigonas return quickly to seemingly normal activity, and within a day or two the entrance tube is rebuilt to normal size and shape.

Unfortunately the nature of the activity within the *Trigona* nest during robbing is unknown.

On one occasion two *Trigona* nests only about a foot apart were robbed at the same time. On all other occasions when observations were made, nests near the robbed nest were undisturbed. One nest was observed being robbed on March 26, and again the same nest was robbed on May 20.

There has been considerable discussion of the habits of *Lestrimelitta*. From the observations here recorded, combined with those of others, it seems probable that *L. limão* builds nests of its own, such as that recorded by Schwarz (1934). While it may be that under some conditions the *Lestrimelitta* usurp and live in nests of Trigonas, as recorded by Müller (1874) and Friese (1931), it is evident that much robbing it done without destroying the colonies of the species which are robbed. At least at Old Panama, it seems probable that the *Lestrimelitta* get most if not all of their food, and perhaps their wax, from the nests of *Trigona*. It is highly important evidence that while much collecting was done on flowers at Old Panama, not a single *Lestrimelitta* was ever found on a flower. This, combined with the absence of the usual pollen collecting structures in *Lestrimelitta*, strongly suggests that these bees are habitual if not obligate robbers.

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A MONOGRAPH OF THE AMERICAN AEGERIIDÆ (LEP.)

The Smithsonian Institution has just published as United States National Museum Bulletin 190, the late George P. Engelhardt's monograph on "The North American Clear-Wing Moths of the Family Aegeriidæ." Mr. Engelhardt, a member of the New York Entomological Society for many years, worked on this family during a good portion of his life and hoped to publish a reclassification based on structural characters coordinated with biological habits and host associations. Although he died before this could be accomplished, his manuscript was complete so far as the treatment of the genera and species was concerned. Mr. August Busck put Mr. Engelhardt's manuscript into shape for publication shortly before his own death on March 7, 1944, and we now have, for the use of all types of entomologists, a comprehensive account of a family that is of considerable economic importance.

According to Carl Heinrich, author of the "Foreword" to Mr. Engelhardt's monograph, the cost of engraving and publishing the 16 plates of colored figures, which add to the excellence and utility of the study, was borne entirely by Mr. Engelhardt's wife, Mrs. Edith F. B. Engelhardt, and his son, George Bliss Engelhardt, to whom all students of the group should be grateful.

Many entomologists will be pleased with Mr. Engelhardt's monograph, not entirely because it is a scientific contribution of merit, but because it is a fitting memorial to an entomologist and student of nature whom they liked, and admired, and whom they respected for his knowledge and ability.—ED.

SOME CORRECTIONS TO THE "STUDIES IN THE PYRRHOPYGINÆ"

By E. L. Bell

Several years ago the writer published a series of papers under the title ''Studies in the Pyrrhopyginæ'' which appeared in the Journal of the New York Entomological Society in 1931, 1933 and 1934. Since that time further information, particularly through the work of Brigadier W. H. Evans with the type material, in the British Museum, has resulted in necessary changes regarding some of the species treated in those papers.

In correspondence Evans has stated that the insect determined as *Jemadia gnetus* Fabricius is not that species but *menechmus* Mabille. He also states that *gnetus* Fabricius and *suzetta* Mabille and Boullet are conspecific. Thus *gnetus* and *menechmus* are to be listed as follows:

Jemadia gnetus Fabricius

1781. *Papilio gnetus* (Fabricius), Spec. Ins., ii, p. 135.
1819. *Erycides megalesius* (Huebner), Verz. bek. Schmett., p. 110.
1908. *Jemadia suzetta* Mabille & Boullet, Ann. Scie. Nat., Paris, ser. 9, vol. vii, pp. 193, 194, 196. Bolivia.
1933. *Jemadia suzetta*, Bell, Jour. New York Ent. Soc., xli, p. 507, Pl. 33, Fig. 35 genitalia, Pl. 38, Figs. 49, 50 male, 51 female.

Jemadia menechmus Mabille

1878. *Pyrrhopyga menechmus* (Mabille), Ann. Soc. Ent. Belg., xxi, pp. 17, 18, 21.
1779. *Papilio vulcanus* (Cramer), Pap. Exot., iii, p. 87, pl. 245, Figs. C, D. (Homonym of *Papilio vulcanus* Fabricius, Syst. Ent., p. 519, 1775. *Lycænidæ*.)
1908. *Jemadia menechmus,* Mabille & Boullet, Ann. Scie. Nat., Paris, ser. 9, vii, pp. 195, 197.
1933. *Jemadia gnetus,* Bell (not Fabricius), Jour. New York

ENT. SOC., xli, p. 490, Pl. 32, Fig. 26 genitalia, Pl. 35, Fig. 42, Pl. 36, Fig. 43.

In the paper dealing with the *Jemadia* the identification of *azeta* Hewitson and *patrobas* Hewitson followed that of Godman & Salvin in the Biologia Centrali-Americana as they had the Hewitson types before them; however, they appear to have figured the genitalia of other specimens which they thought agreed with the types, as Evans has examined the genitalia of the types themselves and he states that the actual identity of the two species is exactly the reverse of that in the Biologia. Evans also says that *patroclus* Ploetz is a synonym of *azeta* Hewitson. *Azeta* and *patrobas* are to be listed as follows:

Jemadia azeta Hewitson

1866. *Pyrrhopyga azeta* (Hewitson), Trans. Ent. Soc., London, p. 479.

1879. *Pyrrhopyga patroclus* (Ploetz), Stett. Ent. Zeit., xl, p. 522. Peru.

1893. *Jemadia patrobas,* Godman & Salvin (not Hewitson), Biol. Centr.-Amer., Rhopal., ii, p. 263; iii, Pl. 74, Figs. 13, 14, 15 genitalia.

1933. *Jemadia patrobas,* Bell (not Hewitson), JOUR. NEW YORK ENT. SOC., xli, p. 501, Pl. 33, Fig. 30 genitalia.

Jemadia patrobas Hewitson

1857. *Pyrrhopyga patrobas* (Hewitson), Exot. Butt., ii, Pyrrhopyga, Pl. 1, Fig. 1 (as *vulcanus*); *patrobas,* loc. cit. text partim.

1893. *Jemadia azeta,* Godman & Salvin (not Hewitson), Biol. Centr.-Amer., Rhopal., ii, p. 264; iii, Pl. 74, Figs. 16, 17 genitalia.

1933. *Jemadia azeta,* Bell (not Hewitson), JOUR. NEW YORK ENT. SOC., xli, p. 500, Pl. 32, Fig. 29 genitalia.

Evans also says that *Jemadia fallax* Mabille is the species treated by the writer as *zonara* Hewitson and that Hewitson's *zonara* is the species described by Mabille as *perplexus* and later placed in the genus *Nosphistia* by Mabille & Boullet. *Fallax* and *zonara* are to be listed as follows:

Jemadia fallax Mabille

1878. *Pyrrhopyga fallax* (Mabille), Ann. Soc. Ent. Belg., xxi, pp. 17, 22. Brasil.
1908. *Jemadia fallax,* Mabille & Boullet, Ann. Scie. Nat., Paris, ser. 9, vii, pp. 194, 195, 197.
1933. *Jemadia fallax,* Bell, Jour. New York Ent. Soc., xli, p. 494.
1933. *Jemadia zonara,* Bell (not Hewitson), Jour. New York Ent. Soc., xli, p. 506, Pl. 33, Fig. 34 genitalia.

Nosphistia zonara Hewitson

1866. *Pyrrhopyga zonara* (Hewitson), Trans. Ent. Soc., London, p. 480.
1871. *Pyrrhopyga zonara* (Hewitson), Exot. Butt., iv, Pyrrhopyga Pl. 2, Fig. 10.
1878. *Pyrrhopyga perplexus* (Mabille), Ann. Soc. Ent. Belg., xxi, pp. 17, 20.
1908. *Nosphistia perplexa* Mabille & Boullet, Ann. Scie. Nat., Paris, ser. 9, vii, pp. 197, 198.
1912. *Nosphistia perplexa* Mabille & Boullet, Ann. Scie. Nat., Paris, ser. 9, xvi, Pl. 1, Fig. 2.
1933. *Nosphistia perplexus,* Bell, Jour. New York Ent. Soc., xli, p. 509, Pl. 33, Fig. 36 genitalia.

THE COLEOPTERA OF ALABAMA

The Geological Survey of Alabama (University, Alabama) has recently published as Monograph 11, a "Catalogue of the Beetles of Alabama" by the late Henry Peter Löding. Mr. Löding began his catalogue many years ago and at the time of his death, February 26, 1942, it was practically finished. The species are numbered to correspond with the Leng Catalogue and the distribution, for most of the species, appears to be on a state and county basis. According to the introduction, a lack of time and space prevented the inclusion of information on feeding habits, economic importance, etc., of most of the species, but food plants and habits are recorded for some. At the end of the catalogue there is a summary of habits, by principal families, a tabular summary of families, genera and species, indexes of families, genera, common names, and collectors.

The Löding Catalogue lists 2,770 species and varieties, in 1,041 genera and 88 families. Smith's New Jersey List (1910) contains 3,092 species of Coleoptera, and Leonard's New York List (1928) contains 4,546. However, recent supplements to these two lists have increased these totals. Students of animal distribution and coleopterists will welcome the Löding Catalogue as a contribution to the more exact recording of coleopterous species in the United States.—ED.

NEW SPECIES AND SUBSPECIES COLLECTED IN A MONTH IN GUATEMALA

By T. D. A. Cockerell

In the winter of 1912, my wife (Wilmatte P. Cockerell) had her first visit to the tropics, which was made possible by Dr. Edgar L. Hewett, who was in charge of the excavations at Quirigua, Guatemala. She was absent six weeks of which two were taken by the voyages back and forth, leaving a month for her work in Guatemala. I give here a list of the new species and subspecies (or varieties) which she found. It seems worth while to print it, as it is perhaps not equalled by any other similar record, and because it shows the extreme richness of Central America in interesting and hitherto unknown forms of life. The list may yet be increased, as various specimens placed in museums get worked up. A good collection of millipedes and centipedes was sent to be studied by a well-known authority, but it apparently got lost. In addition to the species listed, a consignment of cacti, sent to the New York Botanical Garden, included a new genus (or as some have it, subgenus) *Wilmattea* Britton and Rose, but the species was not new. The species are listed under the localities in which they were collected.

Quirigua

Protozoa: (Gregarinidæ) found in Arthropods brought home alive:

- *Stenophora cockerellæ* Ellis
- *Stenophora elongata* Ellis
- *Stytocephalus ensiferus* Ellis
- *Greganina guatemalensis* Ellis
- *Stephanophora crassa* Ellis

Mollusca:

- *Thysanophora cockerellæ* Pilsbry
- *Thysanophora cockerellæ minima* Pilsbry
- *Agriolimax guatemalensis motaguensis* Ckll.

Orthoptera:

- *Mayacris* (n. gen.) *bruneri* Ckll.

Diptera:
Teucholabis cockerellæ Alexander
Coleoptera:
Lybas cruentissimus Casey
Tachymenis ocularis Casey
Ichneumonidæ:
Polycyrtus cockerellæ Viereck
Crypturopsis microgaster Viereck
Eiphosoma motaguense Ckll.
Wasps:
Microbembex tarsalis Rohwer
Notoglossa pyrura Rohwer
Rhopalum opacum Rohwer
Bees:
Melipona solani Ckll.
Trigona ziegleri mayarum Ckll.
Trigona jatiformis Ckll.
Trigona argyrea Ckll.
Trigona zexmeniæ Ckll.
Ceratina wilmattæ Ckll.
Ceratina amabilis rhodochrysea Ckll.
Ptiloglossa mayarum Ckll.
Colletes motaguensis Ckll.
Megachile zexmeniæ Ckll.
Megachile aurantipennis Ckll.
Tetrapedia mayarum Ckll.
Augochlora gemmella Ckll.
Augochlora quiriguensis Ckll.
Augochlora quiriguensis sidæfoliæ Ckll.
Halictus hewetti Ckll.

Guatemala City

Diptera:
Chironomus guatemaltecus Ckll.
Ichneumonidæ:
Callicryptus magnificus Viereck
Chalcididæ:
Eustypiura rodriguezi Ckll.
Wasp:
Pedinaspis margaritella Rohwer

Bees:

Bombus neotropicus Frison
Psithyrus guatemalensis Ckll.
Xylocopa wilmattæ Ckll.
Agapostemon proscriptus Ckll.
Dialictus onustulus Ckll.

Amatitlan

Wasps:

Tachysphex cockerellæ Rohwer
Nysson guatemalensis Rohwer

Bees:

Augochlare amatitlana Ckll.
Cœnohalictus wilmattæ Ckll.
Halictus adustipennis Ckll.

Antigua

Beetle:

Leptinotarsa undecimlineata guatemalensis Ckll.

Wasp:

Stictia guatemalensis Rohwer

Bees:

Ceratina quinquemaculata Ckll.
Colletes antiguensis Ckll.
Bombus wilmattæ Ckll.
Anthophora usticauda Ckll.

Gualan

Plants:

Phyllocarpus septentrionalis Smith (a large tree, now cultivated in Florida)
Senegalia cockerellæ Britton and Rose (an *Acacia*)

Diptera:

Eucordylidexia (n. gen.) *ategulata* Townsend
Apinocryptera (n. gen.) *signata* Townsend

Wasps:

Arachnophroctonus cockerellæ Rohwer
Silaon iresinides Rohwer
Notogonidea sternalis Rohwer
Cerceris iresinoides Rohwer

Bees:

Xylocopa wilmattæ gualanensis Ckll.
Xylocopa fimbriata motaguensis Ckll.
Agapostemon nasutus gualanicus Ckll.
Ceratina regalis Ckll.
Ceratina xanthostoma Ckll.
Ceratina xanthostoma rufipennis Ckll.
Dianthidium gualanense Ckll.
Perdita tropicalis Ckll. (the southernmost member of this large genus)
Prosopis gualanica Ckll.
Prosopis quadratifera Ckll.
Mesoplia azurea guatemalensis Ckll.
Centris inermis gualanensis Ckll.
Cœlioxys sanguinosus Ckll.
Megachile gualanensis Ckll.
Melissodes tepaneca aschenborniana Ckll.
Exomalopsis callura Ckll.

The total number is 78. Our interest in this region is just now revived because on the invitation of Wilson Popenoe we are to spend some months next winter on the staff of the Escuela Agricola Panamericana, near Tegucigalpa, Honduras, for the purpose of studying the insect fauna. We anticipate many interesting discoveries. The insects of Honduras are apparently little known. Thus in R. E. Blackwelder's Check-list of the Coleopterous Insects of Mexico, Central America, The West Indies and South America many beetles are recorded from Guatemala but hardly any from Honduras. Thus in the large family Coccinellidæ only seven (*Hippodamia convergens* Guér., *Cycloneda hondurasica* Casey, *Azya luteipes* Muls., *Epilachna borealis* Fabr., *E. defecta* Muls., *Hyperaspis sexverrucata* Fabr., *Brachyacantha bistripustulata* Fabr.), are listed from Honduras. In the Erotylidæ (generally conspicuous in the Central American fauna) only two (*Ægithus rhombifer* Casey, *Erotylus involutus* Kuhnt.).

ON THE SELECTION OF A GENOTYPE FOR A GENUS IN WHICH NO NAMED SPECIES WAS AT ANY TIME INCLUDED BY ITS AUTHOR

By J. E. Collin, F.R.E.S.
Newmarket, England

Opinion 46 promulgated by the Zoological Commission in 1912 was intended to show how and when the above problem could be solved. Unfortunately this Opinion appears to be particularly liable to misinterpretation, and for this reason a critical analysis was made and published in the Entomologist's Monthly Magazine for May, 1942, p. 97–103. Some additional notes on the problem submitted to the Commissioners may be of some help in arriving at a clear conception of the probable reasons why they dealt with it in the way they did.

This problem demanded that two fundamental facts of Zoological Nomenclature should be borne in mind, viz.,

1. That a named species is the foundation of the structure of Zoological Nomenclature.
2. That the use of a generic name is governed by the selection of a species as genotype, *and this genotype must be one of the originally included named species.*

It follows that a generic name given to the definition or description of the presumed group (*i.e.*, generic) characters of species not mentioned by name is a *genus dubium* until at least one originally included species has been identified.

The Commissioners were therefore required to arrange for the selection of a named species, which could not on facts be excluded from being one of the original species not mentioned by name, and the establishment of its identity with this latter.

A generic description gives the characters by which its author maintains that a species, or group of species, differs from all others. One can disagree with the author on the limits of the genus and include species which do not possess all the characters quoted, but if you are asked to select a species as one originally placed in that genus by its author but not named by him, *you must select one which answers accurately to ALL the facts given in the original publication about the included species.* If the species you select does so answer it has been "recognized" on facts, *though not identified;* it cannot, on facts, be denied that it *may be one* of the originally included species; if it does *not* so answer its supposed recognition is a matter of opinion and is open to challenge. There can be no doubt therefore that the Commissioners in making it an essential condition that "*No species is available as genotype unless it can be recognized from the original generic publication*" intended the recognition to be incapable of being challenged on facts.

The use, in the essential condition quoted above, of the phrase "generic publication" and not "generic diagnosis" proves that the Commissioners realized that an author might include facts additional to those given in the generic diagnosis, for instance, a note on the larval habits, a general statement that the species were all European, or that they were those in the author's collection only, facts with which it was equally necessary for a selected species to be in agreement before it could be considered that an originally included species had been "recognized" on facts.

It is evident that the Commissioners also realized that it might often be impossible to recognize in this maner one of the original un-named species, and ruled that under these circumstances the generic name should remain a *genus dubium.*

As it remained impossible to prove that a species "claimed to be recognized" as one originally included, was in fact one so included it was necessary for the Commissioners to rule, as they did, that such a claim should be accepted as correct, *but the addition of the words "until proved incorrect"* makes it certain that the claim was to be one incapable of being challenged *because the only possible proof of incorrectness is non-agreement with all the published facts.*

Unfortunately this "claim to recognize" if not read in conjunction with the rest of the Opinion may, quite incorrectly, be taken as *the* Opinion, and it may be argued that selection of a genotype in such cases is quite simple, one "claims to recognize" one of the un-named species and this claim must be accepted as correct.

Those who hold this view are obliged to admit that many points in the Opinion (including the Summary) thereby become contradictory, or (*e.g.*, the words "until proved incorrect") unnecessary. This is an indictment for incapacity against Stiles who drew up the whole of the Opinion, and against the Commissioners who approved it, an indictment wholly unjustified when an interpretation *is* possible by which the various statements in the Opinion and Summary become co-ordinated and comprehensible.

The above incorrect interpretation is useful however in clearly exposing the "crux" of the whole matter, viz., did the Commissioners include a provision in the Opinion that a claim to recognize one of the un-named species cannot be accepted as correct if it can be proved that recognition is impossible? That they did include such a proviso is proved by the following facts:

1. The essential feature of the Opinion is given in the Summary as "No species is available as a genotype unless it can be recognized from the original generic publication." *There is no mention of the "claim to recognize."* It is inconceivable that the Commissioners would omit this from the Summary if it constituted the basis of the Opinion.
2. The inclusion of the word "however" in the last paragraph under Category 3. That is, after mentioning the power to claim to recognize an original species comes the proviso: "if, *however,* the species taken by an author as basis of a genus of the third category is not recognizable the genus in question becomes a *genus dubium.*"
3. The use of the word "becomes" in the last paragraph under both Categories 3 and 4. For instance in Category 4, after mentioning the power to claim to recognize one of the original species, and select it as genotype, thereby *temporarily* validating the genus, comes the proviso: "if it is impossible to recognize any one of the original species, the genus *becomes* a *genus dubium.*" This use of the word "becomes" proves that the proviso under both Category 3 and 4 must apply to a temporarily validated genus otherwise "remains" would be used instead of "becomes."

When it is remembered that a genotype must be a species originally included in a genus, it must be conceded that in dealing with generic names such as those under discussion, no other course could be adopted than to impose the restriction on the selection of a genotype quoted in the Summary of Opinion 46.

Finally, no excuse is needed for bringing this particular Opinion to the notice of American Dipterists because unfortunately it is one of great importance to students of Dipterological Nomenclature, greater indeed than its intrinsic merits actually deserve.

THE LEPIDOPTERA OF PORTUGAL

BY ALBERT ZERKOWITZ

(Concluded from Vol. LIV, No. 2, p. 165)

723. *Hemerophila nycthemeraria* Hbn.—Western Mediterranean.—Alg: São Marcos da Serra. Only one specimen, captured by Eaton and recorded by Staudinger (1880–1881, Entom. Monthly Mag., 17, p. 184). Algarve is one of the least known districts of Portugal, where only very few collectors have ever been.

724. *Synopsia sociaria* Hbn.—Euroriental.—E: Setúbal. May.

725. *Boarmia occitanaria* Dup.—Western Mediterranean.—BB: S. Fiel. September–October.—E: Setúbal. October–November.

726. *Boarmia rhomboidaria* Schiff.—Euroriental.—M: Caldelas. August. Gerez. May. Vizela. May–June. October.—Alg: Picota, near Monchique. May.

727. *Boarmia manuelaria huebneri* Prout. (*ilicaria* Hbn. G.).—Western Mediterranean.—BB: S. Fiel. May–June; September.—E: Setúbal. May; September–October. Torres Vedras. May–June.

728. *Boarmia umbraria* Hbn.—Mediterranean.—M: Gerez. May. Vizela. May.—BB: S. Fiel. June.

729. *Boarmia lichenaria* Hufn.—Euroriental.—M: Vizela. June.

730. *Boarmia atlanticaria* Stgr.—Iberian.—E: Setúbal. May–June.

731. *Boarmia punctinalis* Scop. (*consortaria* F.).—Euroriental.—M: Caldelas. August. Gerez. Guimarães. Vizela. May–June. August.

732. *Tephronia cremiaria* Frr.—Mediterranean.—M: Caldelas. August. Rare.—BB: Covilhã. August.

733. *Mannia oranaria castiliaria* Stgr.—Western Mediterranean.—BB: S. Fiel.

734. *Pachycnemia hippocastanaria* Hbn.—European.—M: Caldelas. July–August. Gerez. May. Vizela. June. August.

October.—BB: S. Fiel. April–May; October–November.—E: Setúbal. May; October–November. Sintra. April. Torres Vedras. March. May–June. Val de Rosal. April.

735. *Rhoptria asperaria* Hbn.—Mediterranean.—M: Caldelas. June. August. Gerez. Guimarães. Vizela. June. August.—BB: Serra da Guardunha. September.—E: Setúbal. April–June. Sintra. April. Rather common. Val de Rosal. April.—f. *pityata* Rbr.—M: Gerez.—BB: Ponte de Morcellos. June. Serra da Guardunha. May.—E: Val de Rosal. April.

736. *Gnophos stevenaria* Bsd.—Ponto-Mediterranean.—M: Gerez.—BB: S. Fiel. April–May.

737. *Gnophos perspersata* Tr. (*respersaria* Hbn.).—Western Mediterranean.—BB: Portas do Ródam. Middle of May.—Alg: Silves. May.

738. *Gnophos obscurata* Schiff.—Eurooriental.—M: Gerez.—BB: Matta do Fundão. September.

739. *Gnophos onustaria* H.S.—Mediterranean.—M: Gerez. August. Vizela. May.—BB: S. Fiel. April–May; September.—E: Setúbal. March–May.—f. *serraria* Guen.—BB: S. Fiel. April–May; September.—Larva from May–end of July; September–end of April.—Foodplants: *Polygonum aviculare* L. and *Rumex acetosella* L.

740. *Gnophos variegata* Dup.—Mediterranean.—M: Gerez. May. August. Vizela. June.—E: Torres Vedras. March.

741. *Gnophos mucidaria* Hbn.—Western Mediterranean.—M: Caldelas. July–September. Common. Guimarães. April. June. Vizela. May–June. August. Abundant.—BB: S. Fiel. February–March; May–June; October–November. Very common.—E: Setúbal. May. Sintra. April. Torres Vedras. October.—Foodplant: *Linaria* sp.—f. *grisearia* Stgr.—BB: S. Fiel. March–April; November.—f. *lusitanica* Mendes (1903, Brotéria, 2, p. 67; 1909, Brotéria, Série zoológica, 8, p. 71, pl. 12, figs. 21, 22, 23).—BB: S. Fiel (type locality). March–April; November.—f. *ochracearia* Stgr.—BB: S. Fiel.

742. *Gnophos tibiaria* Rbr.—Western Mediterranean.—BB: Serra da Guardunha. September.

743. *Gnophos myrtillata obfuscaria* Hbn.—Boreo-Alpine.—BB: Serra da Estrêla. 1700 m. August.

744. *Bichroma famula* Esp.—European.—M: Gerez. May.—BB: Ceia. June. S. Fiel. April. Very common.—Larva end of May. Foodplant: *Sarothamnus patens* Webb.

745. *Fidonia pennigeraria* Hbn.—Western Mediterranean.—M: Gerez. Salamonde. June.—BB: Senhora da Orada. May–June. Serra da Estrêla. 1000 m. July.—Larva in March–April.—Foodplant: *Halimium occidentale* W.

746. *Fidonia plummistaria* Vill.—Western Mediterranean.—M: Gerez. May.—BB: Serra da Guardunha. March–April.—E: Sintra. April. Common.—f. *albosignata* Neuburger.—BB: Serra da Guardunha.

747. *Ematurga atomaria* L.—Euroriental.—M: Caldelas. August. Gerez. Common. Vizela. May.—E: Santa Cruz. April.—f. *ochrearia* Rbl.—M: Caldelas. July.

748. *Selidosema plumaria* Schiff. (*ericetaria* Vill.).—Euroriental.—M: Gerez.—BB: Serra da Estrêla, 1000 m. August–early September. Serra da Guardunha, 900–1000 m. September.—f. *pyrænæaria* Bsd. and f. *pallidaria* Stgr.—BB: Serra da Estrêla.—f. *oliveirata* Mab.—BB: Serra da Estrêla, Serra da Guardunha.

749. *Selidosema tæniolaria* Hbn.—Western Mediterranean.—BB: S. Fiel. August–September. Serra da Estrêla. Serra da Guardunha.

750. *Itame vincularia* Hbn.—Western Mediterranean.—BB: Ponte de Morcellos. June. Serra da Estrêla. August.—E: Setúbal. March–October. Very common. Torres Vedras. April. June.

751. *Itame gesticularia* Hbn.—Western Mediterranean.—BB: S. Fiel. March. May.—E: Sintra. April.—Ale: Almodóvar. Early May.—Larva in May–July. Foodplant: *Quercus ilex* L.

752. *Diastictis artesiaria* Schiff.—Euro-Pacific.—BB: S. Fiel.

753. *Lithina chlorosata* Scop. (*petraria* Hbn.).—Euro-Pacific.—M: Gerez.—E: Sintra. April. Common.

754. *Lithina convergata* Vill. (*scutularia* Dup.).—Western Mediterranean.—BB: S. Fiel. October.—E: Setúbal. November.

755. *Lithina partitaria* Hbn.—Western Mediterranean.—E: Setúbal. October.

756. *Chiasma clathrata* L. and f. *cingularia* Hbn.—Euro-Pacific.—E: Setúbal. March–April.

757. *Enconista miniosaria* Dup.—Western Mediterranean.—M: Gerez. September. Vizela. October.—BB: Serra da Guardunha. End of September–early October.—E: Torres Vedras.—Larva in March–May. Foodplants: *Cytisus albus* Lk., *Sarothamnus patens* Webb and *Genista tridentata*.—f. *duponcheli* Prout (*perspersaria* Dup.).—BB: Serra da Guardunha. End of September–early October.—J. de Joannis gave an interesting account of the variability of this species from the above locality. (1900, Bull. Soc. Entom. France, p. 189–191, figs. 1–4).

758. *Enconista oberthueri* Vazquez (1905, Bol. de la Real Soc. Esp. de Hist. Nat., 5, p. 119, pl. 1, fig. 3).—Iberian.—BB: S. Fiel.—f. *inclarata Joann.* (1912, Brotéria, Série zoológica, 10, p. 26).—BB: Quinta de S. Fiel. September. Serra da Guardunha. Up to 1000 m.

759. *Enconista agaritharia* Dardoin.—Western Mediterranean.—BB: Serra da Guardunha. Middle of October. Recorded only by Mendes, who writes that this species is very rare. He found only two specimens.

760. *Dyscia penulataria* Hbn. (*rubentaria* Rbr.).—Western Mediterranean.—M: Gerez.—BB: S. Fiel. October.—E: Setúbal. March–April. Identified by J. de Joannis.

761. *Scodiona lentiscaria distinctaria* Bang-Haas (1910, Iris, p. 49).—Western Mediterranean.—M: Gerez.—BB: S. Fiel. Late March–early April.—E: Setúbal.—Larva from May–March.—Foodplants: *Helianthemum guttatum, Cytisus ledon* Lam. and *Cytisus albus* Lk.

762. *Aspilates ochrearia* Rossi.—Euroriental.—M: Vizela. May–June.—BB: S. Fiel. April–May; September. Serra da Guardunha, 900 m. September.—E: Campolide. Oeiras. May. Santa Cruz. April. Setúbal. March. September. Sintra. April.—Ale: Almodóvar. May.—Alg: Picota near Monchique. May.—f. *unicolorata* Seeb.—E: Setúbal. March. September.—f. *æstiva* Schawerda.—E: Oeiras. June.

763. *Compsoptera opacaria* Hbn.—Western Mediterranean.—M: Gerez.—E: Torres Vedras. January.—Larva in April. Foodplant: *Cytisus albus* Lk.—f. *rubra* Stgr.—BB: S. Fiel. September—October.

764. *Compsoptera jourdanaria* Vill.—Western Mediterranean.—BB: S. Fiel. September–October. Serra da Guardunha.

765. *Chemerina caliginearia* Rbr.—Western Mediterranean.—BB: S. Fiel. January. March–April.—E: Setúbal. March. Torres Vedras. January–March. At light.

DREPANIDÆ

766. *Drepana curvatula* Borkh.—Euro-Pacific.—M: Caldelas. June–July. Rare. Gerez. Rare. Vizela. May. August. Only two specimens.

767. *Drepana binaria* Hufn.—Euroriental.—M: Caldelas. July–August. Rare. Gerez. By day, rare.—BB: S. Fiel. April. June; August.—E: Setúbal. July–August. Sintra. April. Common at light. Torres Vedras. October.—f. *uncinula* Bkh.—M: Vizela. May–June. August. October.

768. *Cilix glaucata* Scop.—Euro-Pacific.—M: Gerez. Rare, by day. Vizela. May. Rare.—BB: S. Fiel. April–June; August.—E: Setúbal. May.

CYMATOPHORIDÆ

769. *Thyatira batis* L.—Euro-Pacific.—M: Caldelas. July–August. Vizela. May–June.—E: Sintra. April. Rare.

770. *Cymatophora ocularis* L. (*octogesima* Hbn.).—Euro-Pacific.—M: Caldelas. July. Vizela. May–June. Rare.—BB: S. Fiel. Only one specimen.

771. *Polyploca diluta* F.—Euroriental.—E: Campolide.

LASIOCAMPIDÆ

772. *Chondrostega vandalicia* Mill.—Iberian.—BB: S. Fiel. August–September. Serra da Guardunha.—Larva in October–April. Never found below 800 m. Foodplants: *Nardus stricta, Hypochœris radicata, Authoxanthum aristatum* Bois. and *Festuca (Vulpia) myuros* Gm.

773. *Malocosoma neustria* L.—Euro-Pacific.—M: Gerez. Rare.—BB: S. Fiel. June.—f. *flavescens* Grünberg.—M: Gerez. Rare.

774. *Trichiura ilicis* Rbr.—Iberian.—E: Sintra. April. Only one female.

775. *Lasiocampa quercus* L.—Euroriental.—M: Caldelas. August. Common. Gerez. Common, by day. Vizela. August.

Only one specimen.—BB : Covilhã. August.—E : Torres Vedras. August.—f. *catalaunica* Stgr.—M : Guimarães.

776. *Lasiocampa trifolii* Esp.—Euroriental.—M : Caldelas. September. Gerez. Frequent, at light. Vizela. August–September.—BB : S. Fiel. August–September.—Larva in March–April. Pupation end of April. Foodplant : *Cytisus albus* Lk.—f. *iberica* Guen.—BB : S. Fiel.—f. *ratamæ* H.S.—BB : S. Fiel.—E : Torres Vedras.

777. *Macrothylacia rubi* L.—Euroriental.—M : Caldelas. June. Gerez. Abundant, by day. Vizela. June. Only one specimen.—E : Sintra. Torres Vedras. June.—Larva early April.—f. *digramma* Meade-Waldo.—E : Sintra. April.

778. *Diplura loti* O.—Western Mediterranean.—M : Gerez. Rare, at light. Vizela. June. August.—BB : Covilhã. August. S. Fiel. May ; August–September. Vale de Prazeres and Alcaide near Matta do Fundão.—E : Setúbal. July.—Larva in April ; end of July–early August, the second brood being less common.

779. *Epicnaptera ilicifolia* L.—Euro-Pacific.—M : Gerez. Rare.

780. *Epicnaptera tremulifolia* Hbn.—Euroriental.—M : Caldelas. July. Common.

781. *Epicnaptera suberifolia* Dup.—Western Mediterranean.—M : Caldelas. August.—BB : Sobral do Campo. October.—E : Louriçal.

782. *Odonestis pruni prunoides* Stgr.—Euroriental.—M : Caldelas. September. Only one specimen.

THAUMETOPŒIDÆ

783. *Thaumetopœa processionea* L.—European.—BB : Covilhã. August.—E : Setúbal. August.

784. *Thaumetopœa pityocampa* Schiff.—Mediterranean.—M : Caldelas. July–August. Very common. Gerez. Very common, by day and at light. Vizela. June ; August.—BB : S. Fiel. August.—E : Setúbal. August–September.—In S. Fiel larva in September–March. Foodplant : *Pinus maritima.* Attacks and destroys with preference the young trees.—In Setúbal the foodplants are : *Pinus pinea* L., *Pinus pinaster* Soland and *Pinus halepensis* Mill.

785. *Thaumetopœa herculeana* Rbr.—Iberian.—E : Setúbal. August.

LYMANTRIIDÆ

786. *Dasychira pudibunda* L.—Euro-Pacific.—M: Gerez. May. On sugar.

787. *Orgyia antiqua* L.—Holarctic.—M: Gerez.—Foodplant: *Rosa* sp.

788. *Arctornis l-nigrum* Müll.—Euro-Pacific.—M: Caldelas. September. Gerez. At light. Only one specimen from each of the above two localities.

789. *Lymantria dispar* L.—Holarctic.—M: Caldelas. Gerez. Guimarães. Vizela. July–August.—BB: S. Fiel. July–August.—E: Setúbal. July. Torres Vedras. July.—Foodplants: chestnut and *Quercus* sp.

790. *Lymantria monacha* L.—Euro-Pacific.—M: Gerez. Only one specimen.

791. *Lymantria atlantica* Rbr.—Western Mediterranean.—E: Setúbal. July–September.

792. *Ocneria rubea* F.—Mediterranean.—M: Gerez. Rare, at light.—E: Setúbal. August–September.

793. *Porthesia similis* Fuessly.—Euro-Pacific.—M: Gerez. Rare, at light. Guimarães. Vizela. May–June. August.—BL: Condeixa. August.

794. *Euproctis chrysorrhœa* L.—Holarctic.—M: Gerez. Rare, at light.—BB: S. Fiel. June–July.

NOTODONTIDÆ

795. *Cerura verbasci* F.—Western Mediterranean.—BB: Ribeira da Ocreza and affluents. June; July.—According to Mendes there are two broods: the larva of the first brood is found in June and the imago emerges middle of July. The larva of the second brood is found in October–November and the imago emerges in June of the following year. Foodplants: *Salix aurita* L. and *Salix cinerea* L.

796. *Cerura furcula* Cl.—Euro-Pacific.—M: Gerez. May.—BB: S. Fiel. May.—Larva in October–November.

797. *Dicranura vinula* L.—Euro-Pacific.—M: Gerez. Common, at light. Vizela. May–June.—BB: S. Fiel. April.—Larva found in June.

798. *Stauropus fagi* L.—Euro-Pacific.—M: Gerez.

799. *Hoplitis milhauseri* F.—Euro-Pacific.—M: Caldelas. Rare. Vizela. May–June. Rare.—BB: Soalheira.—Larva in November.—Foodplant: *Quercus ilex* L.

800. *Drymonia querna* F.—Mediterranean.—M: Caldelas. August. Rare. Vizela. June. August.—BB: Ribeira da Ocreza. May. S. Fiel.—E: Torres Vedras. June. Inside of buildings.—Larva found in November.

801. *Drymonia chaonia* Hbn.—Euro-Pacific.—M: Gerez. May. At light. Vizela. May.—f. *lunula* Grünberg.—M: Gerez. May.

802. *Notodonta ziczac* L.—Euro-Pacific.—M: Gerez.—BB: S. Fiel. September.—Larva in June. Foodplants: *Salix cinerea* L. and *Salix aurita* L.

803. *Notodonta anceps* Goeze.—Euro-Pacific.—M: Gerez. Vizela. May–June. Rare.

804. *Pterostoma palpina* L.—Euro-Pacific.—M: Caldelas. July. Rare. Gerez. At light. Vizela. June. Rare.—BB: S. Fiel. April–May; July.—E: Setúbal. May.

805. *Phalera bucephala* L.—Euro-Pacific.—M: Caldelas. July. Only two specimens. Gerez. At light, rare. Vizela. May–June.—BB: S. Fiel. July.—Larva in June–July. October–November. Foodplant: chestnut.

806. *Pigæra pigra* Hufn.—Euro-Pacific.—M: Gerez. May.—BB: S. Fiel. March–April; June.

NOCTUIDÆ

807. *Diphtera alpium* Osbeck.—Euro-Pacific.—M: Caldelas. June. September. Gerez. Guimarães. Vizela. May–June. August. Common.

808. *Colocasia coryli* L.—Euroriental.—M: Caldelas. June–August. Gerez. May. Vizela. May–June.—BB: S. Fiel. May.

809. *Acronicta aceris* L.—Euroriental.—M: Caldelas. June–August. Common. Gerez. Rare. Vizela. May–June.—BB: S. Fiel. May.

810. *Acronicta leporina bradyporina* Tr.—Euro-Pacific.—M: Caldelas. Only one specimen. July.—BB: S. Fiel.

811. *Acronicta ligustri* F.—Euro-Pacific.—M: Caldelas. September.

812. *Acronicta megacephala* F.—Euroriental.—M: Guimarães.

813. *Acronicta pontica* Stgr.—Ponto-Mediterranean.—M: Caldelas. July. Rare.—E: Campolide.

814. *Acronicta psi* L.—Euro-Pacific.—M: Caldelas. July–August. Common. Vizela. May–June.—BB: S. Fiel. May.—E: Setúbal. May. Torres Vedras. May.—Larva in November.

815. *Chamæpora auricoma* F.—Euroriental.—BB: S. Fiel. May. Serra da Guardunha.—Larva in January, pupates in February. Foodplant: *Erica aragonensis.*

816. *Chamæpora euphorbiæ* F.—Euroriental.—M: Vizela. June.—BB: S. Fiel.

817. *Chamæpora rumicis* L.—Euro-Pacific.—M: Caldelas. July–August. Gerez. May. Guimarães. Vizela. May–June; October.—BB: S. Fiel. April. June; August.—E: Setúbal. July. Torres Vedras. March. June.—Larva in October. Foodplants: *Lonicera* sp., *Mentha* sp., and *Rubus* sp.

818. *Metachrostis rapticula* Hbn., f. *deceptricula* Hbn. and f. *oxybiensis* Mill.—Euroriental.—BB: S. Fiel. June; September.—f. *striata* Stgr.—BB: S. Fiel. End of July.

819. *Metachrostis ravula* Hbn.—Mediterranean.—F: Guimarães.—BB: S. Fiel. June; September.—E: Campolide.—f. *ereptricula* Tr.—M: Caldelas. July–August. Gerez. Vizela. May–June. August.—BB: S. Fiel. June; September.—f. *andalusiæ* Dup.—M: Caldelas. August. Rare.

820. *Metachrostis algæ* F.—European.—M: Caldelas. August. Vizela. June.—BB: Covilhã. July–August. S. Fiel.—E: Lisboa. August.—f. *lusitanica* Draudt.—The type locality of this form is Portugal, without more definite indication.

821. *Metachrostis muralis* Forst. (*glandifera* Hbn.).—European.—M: Caldelas. August. Guimarães. Vizela. May; August.—BL: Condeixa. August.—BB: Castelo Branco. July. S. Fiel. Serra da Estrêla. August. Serra da Guardunha.—E: Lisboa. September. Torres Vedras.—f. *par* Hbn.—E: Batalha. August.

822. *Metachrostis perla* F.—European.—M: Gerez. Rare.—BB: S. Fiel. September.

823. *Metachrostis perloides* Guen.—Iberian.—BB: S. Fiel. September.

824. *Euxoa obesa* Bsd.—Euroriental.—M: Gerez. On sugar. May.—E: Setúbal.

825. *Euxoa crassa* Hbn.—Euroriental.—M: Caldelas. September. Rare. Vizela. August. October.—BB: Covilhã. August. S. Fiel. September.—E: Setúbal. October–November.—f. *lata* Tr.—BB: S. Fiel.

826. *Euxoa chretieni* Dum.—Iberian.—M: Guimarães. April.

827. *Euxoa segetum* Schiff.—Euro-Pacific.—M: Caldelas. July–August. Gerez. On sugar. Guimarães. Vizela. July.—BB: S. Fiel. March–April.—E: Lisboa. August. Setúbal. September–October. Torres Vedras. March.

828. *Euxoa spinifera* Hbn.—Tropical.—E: Campolide. Santa Cruz. April. Setúbal. October.

829. *Euxoa obelisca* Schiff.—Euroriental.—BB: S. Fiel.

830. *Euxoa puta* Hbn.—Euroriental.—M: Caldelas. July.—BB: S. Fiel. March–April; September–October. Very common.—E: Setúbal. February–April; September–November. Sintra. April. Torres Vedras. April.—f. *lignosa* God.—BB: S. Fiel. March–April; September–October.—E: Torres Vedras. March–April.

831. *Euxoa trux* Hbn.—Ponto-Mediterranean.—M: Vizela. October.—BB: S. Fiel. September.

832. *Euxoa conspicua* Hbn.—Euroriental.—BB: S. Fiel. May.

833. *Euxoa tritici* L.—Euroriental.—M: Guimarães. August.—BB: S. Fiel. November–December.—f. *eruta* Hbn. and f. *seliginis* Dup.—BB: Serra da Estrêla. August.

834. *Euxoa exclamationis* L.—Euroriental.—M: Caldelas. July–August. Gerez. Guimarães. Vizela. May–June.—BB: Covilhã. May. August. S. Fiel.—E: Campolide. Setúbal. May.

835. *Rhyacia vestigialis* Rott.—Euroriental.—M: Caldelas. Common.

836. *Rhyacia ypsilon* Rott.—Holarctic.—M: Caldelas. July–August. Guimarães. Vizela. June. August.—BB: Ribeira da Ocreza. August.

837. *Rhyacia faceta* Tr.—Western Mediterranean.—M: Gerez. March. Guimarães. January.—BB: February–March. December.—E: Setúbal. November–April. Sintra. April. Torres Vedras. January–April. Often found inside of houses.

838. *Rhyacia molothina* Esp.—European.—M: Caldelas. June.

839. *Rhyacia glareosa* Esp.—European.—M: Gerez.—BB: S. Fiel. October.—E: Torres Vedras. October.

840. *Rhyacia castanea* Esp.—European.—M: Gerez. March.—f. *neglecta* Hbn.—BB: S. Fiel.

841. *Rhyacia fidelis* Joan. (1903, Bull. Soc. Entom. France, p. 29–30).—Endemic.—BB: Quinta da Serra. May. S. Fiel. May.

842. *Rhyacia porphyrea* Schiff.—European.—M: Caldelas. July. Only one specimen.

843. *Rhyacia orbona* Hufn. (*comes* Hbn.).—Eurorienta1.—M: Caldelas. Rare. Gerez. On sugar. Guimarães. Vizela. June.—BB: Matta do Fundão, S. Fiel. June–August.—E. Setúbal. May–July. Torres Vedras. June–July. Often under fallen leaves.

844. *Rhyacia pronuba* L.—Euroriental.—M: Caldelas. July. Gerez. On sugar. Guimarães.—E: Louriçal. May. Santa Cruz. April. Setúbal. May. Torres Vedras. May.

845. *Rhyacia c-nigrum* L.—Holarctic.—M: Caldelas. July. August. Common. Vizela. June.—BB: S. Fiel. May.—E: Setúbal. Torres Vedras. March; end of July. At light.

846. *Rhyacia flammatra* Schiff.—Euroriental.—BB: S. Fiel. May.

847. *Rhyacia plecta* L.—Holarctic.—M: Caldelas. Common.—f. *unimacula* Stgr.—M: Caldelas. June–August. Vizela. June; October.

848. *Rhyacia leucogaster* Frr.—Mediterranean.—M: Caldelas. June–August. Gerez. Guimarães. August.—BB: S. Fiel. May. August.—E: Setúbal. May–June. August.

849. *Rhyacia xanthographa* F.—Euroriental.—E: Setúbal. May. Torres Vedras. October.—f. *cohæsa* H.S.—BB: S. Fiel.

850. *Rhyacia putris* L.—Euro-Pacific.—M: Caldelas. June–September. Very common. Vizela. May–June.

851. *Rhyacia saucia* Hbn.—Holarctic.—M: Caldelas. June–August. Very common. Gerez. August. On sugar. Guimarães. Vizela. June. August. October.—BB: S. Fiel. May; November.—E: Campolide. Lisboa. August. Setúbal. October–April. Very common. Torres Vedras. April.—Larva in October–November. Foodplant: *Sonchus oleraceus* L.

852. *Cerastis rubricosa* F.—Euroriental.—E: Torres Vedras. March.

853. *Triphæna fimbria* L.—Euroriental.—M: Caldelas. August. Only one specimen. Guimarães.

854. *Triphæna janthina* Esp.—Euroriental.—M: Gerez. On sugar. August. Guimarães.—BB: S. Fiel.—E: Setúbal. May–June. Torres Vedras. July.—f. *rufa* Tutt.—M: Gerez. On sugar. Vizela. August.

855. *Eureretagrotis agathina* Dup.—Atlantic.—BB: Serra da Estrêla. August.

856. *Actinotia hyperici* F.—Euroriental.—M: Caldelas. August. Only one specimen. Vizela. July.—BB: S. Fiel. March–April; June; August.

857. *Barathra brassicæ* L.—Euroriental.—M: Caldelas. June–September. Very common. Gerez. Guimarães. May. Vizela. June; August.—BB: S. Fiel. May; July. September.—E: Campolide. Estoril. March. Setúbal. April–May; September–October.—f. *albidilinea* Haw.—M: Caldelas. July.

858. *Scotogramma trifolii* Rott.—Holarctic.—M: Caldelas. September.—BB: S. Fiel. April. June; September–October.—E: Setúbal. August–September.

859. *Polia luteago argillacea* Hbn.—Euroriental.—BB: S. Fiel.

860. *Polia genistæ* Bkh.—Euroriental.—M: Caldelas. June–July. Gerez. September. Vizela. June. Very abundant.

861. *Polia persicariæ* L.—Euro-Pacific.—M: Vizela. June.

862. *Polia oleraceæ* L.—Euroriental.—M: Caldelas. July–August. Common. Gerez. September. On sugar. Vizela. May–June. August.—BB: S. Fiel. May. September.—E: Setúbal. April.

863. *Polia nana* Hfngl.—Euroriental.—M: Vizela. June.

864. *Polia spinaciæ* View. (*chrysozona* Bkh.).—Euroriental.—M: Caldelas. July–August. Vizela. June.—BB: S. Fiel. April–May.—E: Campolide. Lisboa. August.—f. *caduca* H.S.—M: Caldelas. July. Rarer than the typical form.—E: Campolide.

865. *Harmodia rivularis* F.—Euro-Pacific.—M: Caldelas. July.

866. *Harmodia bicruris* Hfngl. (*capsincola* Esp.).—Euro-Pacific.—M: Caldelas. July.—BB: S. Fiel. April.—E: Setúbal. March–April.

867. *Harmodia lepida* Esp. (*carpophaga* Bkh.).—Eurorien-

tal.—M: Caldelas. July–August.—BB: S. Fiel.—E: Campolide. Setúbal. April–May.

868. *Harmodia magnolii* Bsd.—Ponto-Mediterranean.—M: Vizela. May–June. Frequent.—BB: S. Fiel. May.

869. *Harmodia xanthocyanea* Hbn.—Euroriental.—M: Vizela. May–June. Abundant.

870. *Harmodia albimacula* Bkh.—Euroriental.—M: Vizela. May. Rare.—BB: S. Fiel. June.—E: Setúbal. May. Torres Vedras. May.

871. *Harmodia nana* Rott. (nec Hfngl.).—Euroriental.—M: Gerez. May. On sugar and at light. Vizela. May–June.

872. *Tholera popularis* F.—Euroriental.—BB: Serra da Estrêla. August.

873. *Tholera cespitis* F.—Euroriental.—BB: S. Fiel. October.—E: Setúbal. October.

874. *Trichoclea albicolon* Sepp.—Euroriental.—M: Guimarães.—BB: S. Fiel. May.

875. *Monima stabilis* View.—Euroriental.—BB: S. Fiel. March.—Larva in April–May. Foodplant: *Quercus* sp.

876. *Monima pulverulenta* Esp.—Euroriental.—BB: S. Fiel. March.—Larva in May. Foodplant: *Quercus* sp.

877. *Monima incerta* Hfngl.—Euro-Pacific.—E: Setúbal. April.—f. *fuscatus* Haw.—M: Gerez. May.

878. *Monima gracilis* F.—Euro-Pacific.—BB: S. Fiel. April.—E: Setúbal. February–April.

879. *Hyphilare lithargyria grisea* Haw.—Euroriental.—M: Caldelas. August. Only one specimen.

880. *Hyphilare albipuncta* F.—Euroriental.—M: Caldelas. July–August. Vizela. June.—BB: S. Fiel. May–June. September.—E: Campolide. Setúbal. February–March. September–October. Very common. Torres Vedras. July. Frequent at light.

881. *Hyphilare argyritis* Rbr.—Western Mediterranean.—BB: Covilhã, S. Fiel. September.—E: Setúbal. September. Torres Vedras.

882. *Hyphilare loreyi* Dup.—Tropical.—M: Guimarães.—BB: S. Fiel. October.—E: Torres Vedras. July. October.

883. *Hyphilare L album* L.—Euroriental.—M: Caldelas.

July–August. Common. Guimarães. Vizela. May–June.—BB: S. Fiel. May–September.—E: Lisboa. August. Setúbal. February; November. Sintra. April.

884. *Sideridis vitellina* Hbn.—Euroriental.—M: Caldelas. June. Gerez. August. On sugar. Vizela. June. August.—BB: S. Fiel. April–June; September.—E: Lisboa. May. Setúbal. September. Torres Vedras. June.

885. *Sideridis sicula* Tr.—Western Mediterranean.—M: Caldelas. July.

886. *Sideridis putrescens* Hbn.-G.—Euroriental.—BB: S. Fiel. September.—E: Setúbal. April. September.

887. *Sideridis scirpi* Dup.—Euroriental.—M: Caldelas. July–August. Vizela. June.—BB: Covilhã, S. Fiel. April–May; September.—E: Setúbal. September.—f. *dactylidis* Bsd.—E: Torres Vedras. May.—f. *montium* Bsd.—E: Torres Vedras. April.

888. *Sideridis unipuncta* Haw.—Tropico-Holarctic.—M: Caldelas. August–September. Gerez. August. On sugar. Guimarães. May. Vizela. June. August.—E: Batalha. August. Campolide. Lisboa. June. August. Setúbal. February. April. Torres Vedras. February.

889. *Cucullia chamomillæ* Schiff.—Euroriental.—BB: S. Fiel. April.—E: Torres Vedras. March.

890. *Cucullia tanaceti* Schiff.—Euroriental.—BB: S. Fiel.—E: Setúbal. End of August.—Foodplant: *Achillea ageratum* L.

891. *Cucullia santolinæ* Rbr.—Western Mediterranean.—BB: S. Fiel. November.

892. *Cucullia blattariæ* Esp.—Euroriental.—M: Gerez. May. Vizela. June. Rare.

893. *Cucullia verbasci* L.—Euroriental.—M: Gerez. May.—BB: S. Fiel. April–May.—E: Setúbal. April–May.—Larva in May–June. Foodplant: *Verbascum thapsus.*

894. *Lophoterges millieri* Stgr.—Iberian.—BB: S. Fiel. May.

895. *Metopoceras felicina* Donz.—Western Mediterranean.—BB: S. Fiel. April–June.—E: Setúbal. March; July. Torres Vedras. May.

896. *Cleophana bœtica* Rbr.—Mediterranean.—BL: Lousã.—BB: S. Fiel. April–May.—E: Setúbal. May.

897. *Cleophana diffluens* Stgr.—Iberian.—M: Caldelas. July–August. Gerez. May. Vizela. May–June. Very common.—E: Sintra. April. At light.—f. *lusitanica* Culot.—Alg: Caldas de Monchique (type locality).

898. *Cleophana yvanii* Dup.—Western Mediterranean.—M: Gerez. At light, abundant.—BB: S. Fiel. April–June.—f. *korbi* Stgr.—BB: S. Fiel. Common.

899. *Amephana aurita* F. (*dejeanii* Dup.).—Mediterranean.—E: Setúbal. April–May.

900. *Omphalophana serrata* Tr.—Western Mediterranean.—E: Setúbal. April.

901. *Calophasia lunula* Hfngl.—Euro-Pacific.—M: Vizela. June.

902. *Calophasia almoravida* Grasl.—Iberian.—BB: S. Fiel. April–May.—Larva in May–June. Foodplant: *Linaria spartea.*

903. *Calophasia hamifera* Stgr.—Iberian.—BB: S. Fiel. April–May; July.—Foodplant: *Linaria spartea.*

904. *Calophasia platyptera* Esp.—Eurooriental.—M: Gerez. July. At light.—BL: Condeixa. July–August.—BB: S. Fiel. May. Serra da Estrêla. August.

905. *Leucochlœna oditis* Hbn. (*hispida* Hbn.G.).—Mediterranean.—BB: S. Fiel. September–October.—f. *hispanica* Warren.—M: Vizela. October.

906. *Derthisa trimacula hispana* Bsd.—Mediterranean.—E: Setúbal. October.

907. *Dasypolia templi* Thnbg.—Eurooriental.—M: Guimarães. February.

908. *Aporophila lutulenta* Bkh.—European.—BB: S. Fiel. October.

909. *Aporophila nigra* Haw.—Eurooriental.—M: Gerez. Rare. On Sugar. Vizela. June.—BB: S. Fiel. October–November.—E: Setúbal. October–November. Torres Vedras. December.—Larva in March–April. Foodplant: *Cytisus albus* Lk.

910. *Lithophane semibrunnea* Haw.—European.—BB: S. Fiel. December.—E: Setúbal. February–March.

911. *Xylina vetusta* Hbn.—Eurooriental.—BB: S. Fiel. October.

912. *Xylina exoleta* L.—Eurooriental.—BB: S. Fiel.—Larva in May. Foodplant: *Cytisus albus* Lk. Pupates in June.

913. *Dichonia areola* Esp.—Euroriental.—M: Gerez. May.—BB: S. Fiel. February. April. November.—E: Setúbal. February. November–December.

914. *Dryobota furva* Esp.—Euroriental.—BL: Lousã. November.—BB: Soalheira.—Larva in May. Foodplant: *Quercus ilex* L.

915. *Meganephria oxyacanthæ* L.—Euroriental.—BB: S. Fiel. November.—E: Setúbal. October–November.

916. *Eumichtis lichenea* Hbn.—Western Mediterranean.—BB: S. Fiel. October.

917. *Crino solieri* Bsd.—Ponto-Mediterranean.—E: Campolide. Setúbal. October–November. Torres Vedras. Frequent.

918. *Dryobotodes monochroma* Esp.—European.—BB: S. Fiel. May.

919. *Dryobotodes roboris* Hbn.G.—Euroriental.—BL: Lousã. November.—BB: Soalheira. November.—Larva in April–May. Foodplant: *Quercus ilex* L.

920. *Dryobotodes protea* Esp.—Euroriental.—BL: Lousã. November.—BB: Soalheira.—Larva in May. Foodplant: *Quercus ilex* L.

921. *Valeria jaspidea* Vill.—European.—BB: S. Fiel. March–April.—E: Torres Vedras. March.

922. *Antitype flavicincta* F.—Euroriental.—BB: S. Fiel.—E: Setúbal. October. December. Torres Vedras.—Larva in April. Foodplant: *Cytisus albus* Lk.—f. *meridionalis* Bsd.—BB: S. Fiel. October–November.

923. *Antitype rufocincta* Hbn.—Mediterranean.—M: Gerez. September.

924. *Antitype argillaceago* Hbn.—Ponto-Mediterranean.—M: Vizela. May. Only one specimen.

925. *Antitype canescens* Dup.—Mediterranean.—BB: S. Fiel. October.

926. *Antitype xanthomista* Hbn.—European.—BB: S. Fiel. July. September.—E: Setúbal. January. May. October. December.—f. *nigrocincta* Tr.—BB: S. Fiel. July. September.

927. *Rhizotype flammea* Esp.—European.—M: Gerez. Rare.—BB: S. Fiel. October.—E: Campolide. Setúbal. October–November. Common. Torres Vedras. October.

928. *Rhizotype iodea* Guen.—Western Mediterranean.—BB: S. Fiel. October.

929. *Xantholeuca croceago corsica* Mab.—Euroriental.—BB: S. Fiel. October.—Larva in May. Foodplant: *Quercus toza* Bosc.

930. *Conista rubiginea* F.—Euroriental.—M: Gerez. March.—BB: S. Fiel. December.

931. *Conistra staudingeri* Grasl.—Western Mediterranean.—BB: S. Fiel. December–March.—f. *uniformis* Stgr.—BB: S. Fiel. March.—f. *scortina* Stgr.—E: Sintra. April. At light, only one specimen.—f. *lusitanica* Spul.—Described from Portugal without more definite locality.

932. *Omphaloscelis lunosa* Haw.—Atlantic.—M: Gerez. October. Guimarães.—BB: S. Fiel. October.—f. *olivacea* Vázquez.—BB: S. Fiel. October.—f. *rubra* Vázquez.—S. Fiel. October.

933. *Spudea ruticella* Esp.—Euroriental.—BB: S. Fiel. March.—E: Setúbal. February–March. Torres Vedras. End of February–March.

934. *Spudea witzenmanni* Stndfs.—Western Mediterranean.—E: Torres Vedras.

935. *Amathes lychnidis pistacina* F.—Euroriental.—BB: S. Fiel. October–November.—E: Setúbal. October–November. Torres Vedras. January.—f. *canaria* Esp.—BB: S. Fiel. October–November.—f. *rubetra* Esp.—BB: S. Fiel. October–November.—E: Setúbal. October–November. Torres Vedras.

936. *Amathes circellaris* Hfngl.—Euroriental.—M: Vizela. May–June. August.

937. *Amathes helvola* L.—Euroriental.—BB: S. Fiel. November.—E: Torres Vedras. November.

938. *Amathes litura* L.—Euroriental.—BB: S. Fiel. October.—f. *meridionalis* Stgr.—BB: S. Fiel. November.

939. *Athetmia xerampelina unicolor* Stgr.—Euroriental.—BB: S. Fiel.—E: Campolide, Torres Vedras.

940. *Cosmia gilvago* Esp.—Euroriental.—E: Campolide.

941. *Amphipyra pyramidea* L.—Euro-Pacific.—M: Gerez. August. On sugar.

942. *Stygiostola umbratica ferruginea* Steph.—Euroriental.—M: Gerez. Rare.

943. *Mania maura* L.—Euroriental.—M: Gerez.—BB: S. Fiel. August.—f. *striata* Tutt.—M: Gerez. At light.

944. *Dipterygia scabriuscula* L.—Holarctic.—M: Gerez. May. At light. Guimarães.

945. *Oligia strigilis* Cl.—Euroriental.—M: Guimarães. May. Vizela. May–June.—BB: S. Fiel. June.—E: Setúbal. April. Torres Vedras. October.

946. *Eremobia ochroleuca* Esp.—Euroriental.—BB: S. Fiel. June.

947. *Pseudohadena halimi* Mill.—Western Mediterranean.—BB: S. Fiel.

948. *Luperina testacea* Hbn.—Euroriental.—BB: S. Fiel. September.

949. *Luperina nickerlii* Frr.—European.—BB: S. Fiel.

950. *Trachea atriplicis* L.—Euro-Pacific.—M: Caldelas. August. Common. Gerez. Rare. At light.—BB: Covilhã. August.

951. *Euplexia lucipara* L.—Euro-Pacific.—M: Caldelas. July–August. Gerez. Rare. Vizela. May–June. Rare.

952. *Trigonophora meticulosa* L.—Euroriental.—M: Caldelas. August–September. Vizela. May.—BB: S. Fiel. April; September–October.—E: Campolide. Setúbal. April–May; October—November. Torres Vedras.—Larva in January. Foodplant: *Umbilicus pendulinus* D.C.

953. *Eriopus juventina* Cram. (*purpureofasciata* Piller).—Euro-Pacific.—M: Caldelas. June–September. Very abundant. Gerez. September. At light. Vizela. May–June. August.—BL: Lousã.—BB: Castelo Novo, S. Fiel. June–July. September.

954. *Eriopus latreillei* Dup.—Euroriental.—BB: S. Fiel. February; May; August.

955. *Polyphœnis sericata* Esp.—Euroriental.—M: Gerez. August.—E: Setúbal. July–August. Torres Vedras. October.

956. *Thalpophila vitalba* Frr.—Western Mediterranean.—BB: S. Fiel.—E: Torres Vedras.—f. *amathusia* Ramb.—M: Vizela. August.

957. *Stilbia anomala* Haw.—Euroriental.—M: Vizela. October.—BB: Serra da Guardunha. September.

958. *Laphygma exigua* Hbn.—Tropico-Holarctic.—M: Caldelas. July. Seixas.—BB: S. Fiel. June–September.—E: Cam-

polide. Lisboa. June–September. Frequent at light. Setúbal. July. September–October.—Alg: observed by Tavares without definite locality.—Larva in July–first half of August. Hibernates as pupa. Foodplant: *Zea mais* L. Causes extensive damages according to Tavares (1928, Brotéria, Série zoológica, 25, p. 153–158).

959. *Athetis ambigua* Schiff.—Euroriental.—M: Caldelas. July–August. Guimarães. Vizela. June.—BB: S. Fiel. May.—E: Campolide. Santa Cruz. April. Setúbal. September. Torres Vedras. May–June.

960. *Athetis superstes* Tr.—Euroriental.—M: Caldelas. July–August. Vizela. June.

961. *Athetis respersa* Schiff.—Euroriental.—BB: Matta do Fundão. End of June.

962. *Athetis selini* Bsd.—Euroriental.—BB: S. Fiel. October.—f. *noctivaga* Bell. (*infusca* Const.).—BB: S. Fiel. May.—E: Setúbal.

963. *Athetis clavipalpis* Scop. (*quadripunctata* F.).—Euroriental.—BL: Condeixa. August.—BB: S. Fiel. March. May. August.—E: Campolide. Setúbal. September–October.

——. *Athetis grisea* Ev. (*cinerascens* Tgstr.).—European.—BB: S. Fiel. Recorded by Mendes. This species occurring only in Scandinavia, Finland and the Ural Mountains, its capture in Portugal certainly is doubtful.

964. *Athetis terrea* Frr.—Euro-Pacific.—M: Gerez.

965. *Athetis proxima* Rmb.—Euro-Pacific.—BB: S. Fiel. June.—*proxima* Rmb. is a valid species, distinct from *A. kadeni* Frr. and from *fuscicornis* Rmb. according to Boursin (1936).

966. *Athetis germainii* Dup.—Western Mediterranean.—BB: S. Fiel.—E: Setúbal. September.

967. *Petilampa palustris* Hbn.—Euro-Pacific.—BB: Ribeira da Ocreza. August. October. S. Fiel. June.

968. *Calymnia affinis* L.—Euro-Pacific.—E: Lisboa. End of June.

969. *Calymnia pyralina* View.—Euro-Pacific.—M: Vizela. June. Only one specimen.

970. *Dicycla oo* L. and f. *renago* Haw.—Euroriental.—BB: S. Fiel. June.

971. *Enargia ulicis* Sgtr.—Iberian.—E: Torres Vedras. November.

972. *Enargia regina* Stgr.—Ponto-Mediterranean.—M: Vizela. October.

973. *Arenostola pygmina fulva* Hbn.—Eurorienta1.—BB: S. Fiel. September–October.

974. *Cœnobia rufa* Haw.—European.—BB: S. Fiel. October.

975. *Oria musculosa* Hbn.—Eurorienta1.—E: Campolide. Setúbal. August–September. Torres Vedras. July.

976. *Orio myodea* Rmb.—Iberian.—BB: S. Fiel. October.

977. *Semasia vuteria* Stoll. (*nonagrioides* Lef.).—Mediterranean.—M: Caldelas. July–September.—BB: S. Fiel. May–July; September–October.—E: Setúbal. September–October. Torres Vedras. May; July.—Larva in May–June. Foodplant: *Zea mais* L. This species never occurs in such great number as to cause extensive damage according to Tavares (1928, Brotéria, Série zoológica, 25, p. 160).

978. *Calamia virens* L.—European.—BB: Serra da Estrêla. End of August.

979. *Synthymia fixa* F. (*monogramma* Hbn.).—Mediterranean.—E: Setúbal. April–May.

980. *Ægle vespertalis* Hbn.—Ponto-Mediterranean.—BB: S. Fiel. June.—E: Setúbal. July.

981. *Chloridea dipsacea* L.—Euro-Pacific.—BB: S. Vicente da Beira. May.—E: Setúbal. May.

982. *Chloridea peltigera* Schiff. (*armigera* Hbn.).—Eurorienta1.—M: Caldelas. July. Vizela. June.—BB: Covilhã. August. S. Fiel. June; September. Serra da Estrêla. August. Serra da Guardunha. September.—E: Campolide. Lisboa. August. Setúbal. March; August–November. Torres Vedras. June.

983. *Rhodocleptria incarnata* Frr.—Ponto-Mediterranean.—BB: Serra da Guardunha. May.—E: Santa Cruz. April. Setúbal. April; June.

984. *Cladocera optabilis* Bsd.—Western Mediterranean.—BB: S. Fiel. October.

985. *Anarta myrtilli* L.—European.—M: Vizela. June. August. Rare.—E. Sintra. April. Common.—f. *peralbata* Warren.—M: Gerez. By day.—f. *citrina* Warren.—E: Sintra (type locality).

986. *Leptosia dardouini* Bsd.—Mediterranean.—BB: S. Fiel. June; September.

987. *Eublemma arcuinna* Hbn.—Euro-Pacific.—BB: S. Fiel.—f. *blandula* Rbr.—BB: Serra da Guardunha. September.

988. *Eublemma suava* Hbn.—Mediterranean.—BB: S. Fiel. September. Serra da Guardunha.

989. *Eublemma jucunda* Hbn.—Western Mediterranean.—E: Oeiras. June. Setúbal. July. Torres Vedras. June–July.

990. *Coccidiphaga scitula* Rbr.—Mediterranean.—BB: S. Fiel. June.—E: Setúbal. August.

991. *Porphyrinia ostrina* Hbn.—Euroriental.—M: Caldelas. July. Vizela. June.—BB: S. Fiel. June.—E: Batalha. August. Setúbal. August. November. Torres Vedras. March.—f. *carthami* H.S.—BB: Serra da Estrêla. August. Serra da Guardunha. August.—E: Torres Vedras. July.—f. *æstivalis* Guen.—E: Torres Vedras. June.

992. *Porphyrinia parva* Hbn.—Ponto-Mediterranean.—M: Caldelas. July. Rare.—BB: Quinta dos Carvalhos. September. S. Fiel. July.—E: Estoril. September. Very small specimen. Wingspread 12 mm. Setúbal. July–September. Torres Vedras. End of June–July.

993. *Porphyrinia candidana* F.—Mediterranean.—BB: S. Fiel. May. Soalheira.—E: Setúbal. May–June.

994. *Porphyrinia respersa* Hbn.—Mediterranean.—M: Vizela. June.

995. *Porphyrinia purpurina* Schiff.—Ponto-Mediterranean.—BB: Serra da Guardunha. June. Only one specimen, bred from larva.

996. *Porphyrinia polygramma* Dup.—Mediterranean.—M: Vizela. June.—E: Setúbal. June–July.—f. *pudorina* Stgr.—BB: Serra da Guardunha. June.—E: Setúbal. July.

997. *Porphyrinia pura* Hbn.—Western Mediterranean.—E: Oeiras. August. Torres Vedras. End of March.

998. *Lithacodia fasciana* L.—Euro-Pacific.—M: Caldelas. July–August. Gerez. May. Vizela. June; August.

999. *Tarache lucida* Hufn.—Euroriental.—BB: S. Fiel. April; June; September.—E: Setúbal. June–September.—f. *albicollis* F.—E: Oeiras. June. Setúbal. September.

1000. *Tarache luctuosa* Esp.—Euroriental.—BL: Lousã. May.—BB: Covilhã. September. S. Fiel. June; September. —E: Campolide. Very abundant. Oeiras. June. Setúbal. May–September. Torres Vedras. June–July.

1001. *Eutelia adulatrix* Hbn.—Ponto-Mediterranean.—BB: S. Fiel.—E: Setúbal. July–August.

1002. *Sarrothripus revayana* Scop. (*undulana* Hbn.) and f. *dilutana* Hbn., f. *degenerana* Hbn.—Holarctic.—M: Vizela. August.—BB: S. Fiel. June–July; October.—f. *glaucana* Lampa.—M: Vizela. June.—f. *ilicana* F.—M: Caldelas. July.—BB: S. Fiel. June–July; October.

1003. *Earias vernana* Hbn.—European.—M: Caldelas. July–August. Rare.—BB: S. Fiel. End of May.

1004. *Hylophila prasinana* L.—Euro-Pacific.—M: Caldelas. July–September. Very common. Gerez. May. Guimarães. Vizela. May–August; October. Rare.—BB: S. Fiel. June–July.

1005. *Hylophilina bicolorana* Fuessl.—Euroriental.—M: Gerez.—BB: Monte de S. José. S. Fiel. May–August.—Larva in May. Foodplant: *Quercus toza* Bosc.

1006. *Mormonia dilecta dayremi* Oberth.—Euroriental.—M: Gerez. On sugar.

1007. *Mormonia sponsa* L.—Euroriental.—BB: Casal da Serra, Covilhã. July–September. On the trunks of chestnut trees.—E: Louriçal. Setúbal. July–August.

1008. *Catocala nupta* L.—Euro-Pacific.—M: Gerez. On sugar.—E: Louriçal. July–August.

1009. *Catocala elocata* Esp.—Euroriental.—M: Caldelas. August. Common on old walls. Gerez. On sugar. Guimarães. November. Vizela. August. October.—BL: Condeixa. August.—BB: Quinta dos Carvalhos. August. Quinta dos Fornos. July. Serra da Estrêla. On WSW slopes. August.—E: Setúbal. July–September.

1010. *Catocala promissa* Esp.—Euroriental.—M: Gerez. On sugar.—BB: Quinta dos Fornos. July.

1011. *Catocala conjuncta* Esp.—Mediterranean.—BB: Quinta dos Fornos. July.

1012. *Catocala optata* God.—Western Mediterranean.—M: Caldelas. July–August. Rare. Gerez. On sugar.—BB: S. Fiel. September. Serra da Estrêla. WSW slopes. August.

1013. *Catocala nymphagoga* Esp.—Mediterranean.—BL: Lousã. June.—BB: Castelo Novo. Monte de S. José. June. On trunk of oak trees.—E: Setúbal. May.

1014. *Catocala conversa* Esp.—Mediterranean.—BB: Quinta dos Fornos, S. Fiel. June–August.—E: Setúbal. June. Torres Vedras. July.

1015. *Ephesia nymphæa* Esp.—Mediterranean.—M: Gerez. August. By daylight.—BB: S. Fiel. July.

1016. *Minucia lunaris* Schiff.—Mediterranean.—E: Setúbal. Sintra. April. Torres Vedras. May.—f. *olivescens* Warren.—E: Sintra (type locality).

1017. *Anua tirhaca* Cram. (*thirræa* Auct.).—Eurorieutal.—E: Serra da Arrabida. February. Setúbal. May.

1018. *Ophiusa algira* L.—Euro-Pacific.—M: Caldelas. July–August. Common. Gerez. By daylight. Guimarães. Vizela. May–June. October.—BL: Condeixa. August.—BB: Covilhã, S. Fiel. June–September.—E: Setúbal. June. September–October. Torres Vedras.

1019. *Grammodes stolida* F.—Mediterranean.—E: Setúbal. September.

1020. *Cerocala scapulosa* Hbn.—Western Mediterranean.—E: Santa Cruz. End of April. Setúbal. April–May.

1021. *Gonospileia mi* Cl.—Euro-Pacific.—M: Gerez. By daylight.—f. *aurantiaca* Warren.—Described from Portugal, without more definite locality.

1022. *Gonospileia glyphica* L.—Euro-Pacific.—M: Gerez. May.—BB: Monte de S. José. May. Sabugueiro. Early June.—E: Setúbal.

1023. *Phytometra festucæ* L.—Euro-Pacific.—M: Caldelas. July. Rare. Vizela. May. Only one specimen.—E: Campolide.

1024. *Phytometra chrysitis* L.—Euro-Pacific.—M: Caldelas. July–August. Rare.—f. *aurea* Huene.—BB: Matta do Fundão. June.

1025. *Phytometra orichalcea* F. (*aurifera* Hbn.).—Tropical.—M: Vizela. October.—BL: Condeixa. August.—BB: Quinta do Ribeiro Negro. September.—E: Setúbal. July–August; December.

1026. *Phytometra chalcytes* Esp.—Mediterranean.—M: Caldelas. August–September.—BL: Condeixa. July–August.—BB: S. Fiel. August.—E: Setúbal. September–March. Torres Vedras. October.—Larva in October–November. Foodplants: *Coleus* sp. and *Solanum nigrum* L.

1027. *Phytometra deaurata* Esp.—Euroriental.—BB: S. Fiel.

1028. *Phytometra gamma* L.—Euroriental.—M: Caldelas. June; August. Very common. Guimarães. June. August. October. Very common.—BL: Condeixa. July–September. Very common.—BB: S. Fiel. April. June. August. October.—E: Campolide. Oeiras. May–June. Setúbal. From February on. Sintra. April. Torres Vedras. January. April.—Foodplants: *Verbascum* sp. and *Solanum nigrum* L.

1029. *Phytometra accentifera* Lef.—Mediterranean.—M: Caldelas. July. Rare.—BL: Condeixa. August.—BB: S. Fiel. September.—E: Setúbal. August–September.

1030. *Phytometra confusa* Stph. (*gutta* Guen.).—Euro-Pacific.—M: Caldelas. July–August. Guimarães. Vizela. May–June. October.—BL: Condeixa. August. Rare.—BB: S. Fiel. June. August. October.—E: Setúbal. June–August.

1031. *Phytometra ni* Hbn.—Euro-Pacific.—BB: S. Fiel. July–August.—E: Lisboa. August. Setúbal. August. Torres Vedras. End of July.

1032. *Abrostola triplasia* L.—Euro-Pacific.—M: Caldelas. July. Rare. Vizela. October.—E: Setúbal. June–July.

1033. *Abrostola ascelepiadis* Schiff.—Euro-Pacific.—BB: S. Fiel. April.—E: Setúbal. April–May. Torres Vedras. March.

1034. *Scoliopteryx libatrix* L.—Holarctic.—M: Vizela. June. Rare.

1035. *Apopestes spectrum* Esp.—Euro-Pacific.—BB: S. Fiel. February–March; September. Inside of houses, at dark and moist places.—E: Setúbal. August.

1036. *Autophila dilucida* Hbn.—European.—BB: S. Fiel.—E: Setúbal. March–April.

1037. *Autophila cataphanes* Hbn.—Euroriental.—M: Vizela. May. Only one specimen.—BB: S. Fiel. March; June–September. Inside of houses.

1038. *Toxocampa pastinum* Tr.—Euro-Pacific.—BB: S. Fiel. June.

1039. *Catephia alchymista* Schiff.—Euroriental.—M: Caldelas. August. Only one specimen. Vizela. June. Rare.

1040. *Aleucanitis cailinio* Lef.—Ponto-Mediterranean.—BB: S. Fiel, S. Vicente da Beira. April–May.—E: Setúbal. May.

1041. *Prothymnia viridaria* Cl.—Euroriental.—M: Caldelas. July. Rare. Gerez.—E: Setúbal. June–July. Sintra. April.—f. *fusca* Tutt.—M: Caldelas. August. Rare.

1042. *Prothymnia sanctiflorentis* Bsd.—Iberian.—E: Val de Rosal. April.

1043. *Rivula sericealis* Scop.—Euro-Pacific.—M: Caldelas. August. Rare. Vizela. May–June. October.

1044. *Zanclognatha nemoralis* F.—European.—M: Caldelas. June–July. Rare.

1045. *Herminia crinalis* Tr.—Euroriental.—BB: S. Fiel. June. Serra da Estrêla. August.—E: Setúbal. May. Torres Vedras. June.

1046. *Hypena proboscidalis* L.—Euro-Pacific.—M: Vizela. May.—BB: Matta do Fundão. End of May.

1047. *Hypena rostralis* L.—Euro-Pacific.—M: Guimarães. August.—BB: S. Fiel. April; October. Common inside of houses.—E: Campolide. Setúbal. February. May–June. Torres Vedras.

1048. *Hypena obsitalis* Hbn.—Mediterranean.—M: Caldelas. July. Rare.—BB: S. Fiel. May; December.—E: Lisboa. November–December. Frequent inside of houses. Setúbal. September–October.

1049. *Hypena lividalis* Hbn.—Ponto-Mediterranean.—M: Guimarães.—BB: Covilhã. September. S. Fiel. September. Serra da Estrêla. August.—E: Lisbôa. November. Common by daylight. Setúbal. August. September.

1050. *Hypenodes costæstrigalis* Stph.—Euroriental.—M: Caldelas. July. Rare.

ARCTIIDÆ

1051. *Miltochrista miniata* Forst.—Euro-Pacific.—M: Caldelas. One specimen only. Gerez. Frequent at light.

1052. *Apaidia mesogona* God.—Western Mediterranean.—E: Setúbal. April–May. Torres Vedras. End of June.

1053. *Paidia murina* Hbn.—Euroriental.—M: Caldelas. July–August. Common. Gerez. Common by day and at light. Guimarães. Vizela. June. At light.—BB : S. Fiel. July–August.—E : Campolide. Setúbal. July. Torres Vedras. June–July. Frequent at light.

1054. *Lithosia griseola* Hbn.—Euroriental.—E : Setúbal. June–July.

1055. *Lithosia lurideola* Zinck.—Euroriental.—M : Gerez. Common at light.—E : Setúbal. September–October.

1056. *Lithosia complana* L.—Euroriental.—M : Caldelas. July. September. Gerez. Common at light. Vizela. June–July. October. At light.

1057. *Lithosia caniola* Hbn.—European.—BB : S. Fiel. October.—E : Setúbal. April. August.

1058. *Lithosia lutarella* L.—Euro-Pacific.—E : Setúbal. April–May.

1059. *Lithosia pallifrons marcida* Mann.—Mediterranean.—E : Torres Vedras. Middle of July.

1060. *Lithosia sororcula* Hufn.—Euroriental.—M : Vizela. May–June. Rare. At light.

1061. *Coscinia striata* L.—Euro-Pacific.—M : Gerez. Common by day.—BB : Serra da Estrêla, 1600 m. July.—f. *pallida* Butl.—M : Gerez.

1062. *Coscinia cribaria* L. (*cribum* L.).—Mediterranean.—M : Gerez. Common by day.—f. *candida* Cyr.—BB : Serra da Estrêla, Serra da Guardunha. August–September.—f. *punctigera* Frr.—M : Caldelas. July.—f. *chrysocephala* Hbn.—BB : Serra da Estrêla, WSW slopes.—E : Campolide. In two broods. Lisboa. First brood : wingspread 42 mm., second brood : wingspread 30 mm. Torres Vedras. June; October. No typical *cribaria* L. have been found in Extremadura; all specimens are of f. *chrysocephala* Hbn.

1063. *Utetheisa pulchella* L.—Tropical.—BB : Portas do Rodam. April. S. Fiel. End of May.—E : Setúbal. Torres Vedras. May.

1064. *Ocnogyna latreillei* God.—Iberian.—M : Gerez.—BB : Monte de S. José. S. Fiel.—E : Sintra. April. Only one specimen.—Larva in May, pupates in June and hibernates as pupa.—Foodplant : *Cytisus albus* Lk.

1065. *Phragmatobia fuliginosa* L.—Euroriental.—M : Caldelas.

July–September. Common. Gerez. Common. Guimarães. Vizela. May–June; October. Very abundant.—BB: S. Fiel. April; July.—E: Setúbal. February.

1066. *Euprepia pudica* Esp.—Mediterranean.—M: Caldelas. September. Gerez. Rare. Vizela. August; October.—BB: S. Fiel. September.—E: Torres Vedras.—Mendes has observed the larva feeding in March. It goes under earth early in April, without pupating and stays there without feeding until August. Pupates end of August and the imago emerges end of September. Foodplant: Graminaceæ.

1067. *Spilarctia lubricipeda* L.—Euro-Pacific.—M: Caldelas. June–August. Gerez. Common. Vizela. May–June.

1068. *Spilosoma menthastri* Esp.—Euro-Pacific.—M: Caldelas. July–August. Common. Gerez. Very common. Guimarães. Vizela. May–June; August. Common.—BB: Quinta do Ribeiro Negro, S. Fiel. May; July–August.—E: Setúbal. May.

1069. *Diaphora mendica* Cl.—Euroriental.—M: Gerez. Frequent.—BB: Matta do Fundão. Late April. Only one specimen.—E: Setúbal. February–March.

1070. *Rhyparia purpurata* L.—Euro-Pacific.—M: Gerez. Bred from larva.

1071. *Diacrisia sannio* L.—Euro-Pacific.—M: Gerez. Frequent by day.

1072. *Arctia fasciata* Esp.—Western Mediterranean.—M: Gerez. At light. Guimarães.—BB: Serrá da Guardunha. May.—Larva in March–April. Foodplants: Graminaceæ.—f. *gratiosa* Hbn.—M: Gerez. Only one specimen. At light.—f. *esperi* Stgr.—M: Gerez. Frequent at light.

1073. *Arctia caja lusitanica* Spul.—Holarctic.—This form has been described from Portugal, without more definite locality. End of June–August. There is no record of the occurrence of typical *caja* L. from Portugal.

1074. *Arctia villica* L.—Euroriental.—M: Gerez. Very common at light.—E: Setúbal. February–April. Torres Vedras. May.—f. *angelica* Bsd.—BB: S. Fiel. May. Only one specimen observed.

1075. *Callimorpha dominula* L.—European.—M: Gerez. One specimen only.—f. *bieli* Stgr. (1894, Iris, 7, p. 255).—M: Gerez (type locality).—f. *lusitanica* Stgr. (1894, Iris, 7, p. 255).—M: Gerez (type locality).

1076. *Callimorpha quadripunctaria* Poda.—Euroriental.—M: Caldelas. July–August. Common. Gerez. Very common by day. Guimarães. Vizela. August–September.—BB: Castelo Novo. August. Matta do Fundão, Quinta do Ribeiro Negro. August. On the trunk of chestnut trees. Serra da Estrêla. August.—E: Setúbal. October.

1077. *Hipocrita jacobææ* L.—Euroriental.—Alg: São Marcos da Serra. May.

1078. *Nola cucullatella* L.—European.—BB: S. Fiel. May; July; September.—E: Setúbal. June–July.

1079. *Rœselia togatutalis* Hbn.—Euroriental.—E: Setúbal. Torres Vedras. June–July.

1080. *Celama confusalis* H.S.—Euro-Pacific.—M: Caldelas. July. Only one specimen.—BB: S. Fiel. September. Only one specimen. Very dark.

1081. *Celama cristatula subchlamydula* Stgr.—Mediterranean.—BB: S. Fiel. April; June.—E: Setúbal. July. Torres Vedras. March.

1082. *Celama chlamitutalis* Hbn.—Mediterranean.—E: Setúbal. June.

SYNTOMIDÆ

1083. *Dysauxes punctata* F. and f. *servula* Berce.—Euroriental.—BB: Monte de S. José. May.

SATURNIIDÆ

1084. *Saturnia pyri* Schiff.—Euroriental.—M: Gerez. Frequent at light. Vizela. May. Only one specimen.—BB: S. Fiel. April.—E: Setúbal. April.—Alg: Serra de Monchique.—Larva in June–July. Foodplants: fruit trees and *Ulmus campestris* L.

1085. *Eudia pavonia* L.—Euro-Pacific.—M: Gerez. Vizela. May. Only one specimen. At light.—E: Sintra. April. Common.

SPHINGIDÆ

1086. *Acherontia atropos* L.—Tropical.—M: Vizela. May. At light. Rare.—BB: S. Fiel. May; August–September.—E: Setúbal. October.—Larva in May–June; October–November.—Foodplants *Solanum tuberosum* and *Olea europæa*.

1087. *Herse convolvuli* L.—Tropical.—M: Caldelas. August–September.—BL: Condeixa. August. Common.—BB: S. Fiel.—E: Lisboa. Setúbal. September.—Larva in October. Foodplant: *Convolvulus arvensis* L.

1088. *Sphinx ligustri* L.—Euroriental.—BB: S. Fiel.—Larva in October.

1089. *Marumba quercus* Schiff.—Mediterranean.—M: Gerez. Vizela. June. Only one specimen. At light.—BB: S. Fiel. Late June. Only one specimen.—Foodplant: *Quercus* sp.

1090. *Mimas tiliæ* L.—Euroriental.—M: Caldelas. July–August. Gerez.—BB: Castelo Novo. June. Ribeira da Ocreza. July. S. Vicente. May.—E: Torres Vedras. April. At light.—Foodplant: *Tilia* sp.—f. *brunnea* Bartel.—M: Caldelas. August.

1091. *Smerinthus ocellata* L.—Euroriental.—M: Gerez. May. Only one specimen.—BB: S. Fiel.—Larva in June. Foodplant: *Salix cinerea* L.

1092. *Hæmorrhagia fuciformis* L. (*bombyliformis* O.).—Euro-Pacific.—M: Caldelas.—BB: Matta do Fundão. May.

1093. *Proserpinus proserpina* Pallas.—Euroriental.—BB: Matta do Fundão. June.

1094. *Macroglossum stellatarum* L.—Euroriental.—M: Caldelas. July–August. Gerez. Frequent. Guimarães. Vizela. May–June; October.—Common.—BL: Coimbra. Condeixa. August. Very common.—BB: S. Fiel. May–October. Serra da Estrêla. August.—E: Alfeite. Setúbal. According to Vieilledent, on wing during the entire year, even in winter, when it has a tendency to enter in houses. He found this species hovering around flowers even in rain. Torres Vedras.

1095. *Celerio euphorbiæ* L.—Euroriental.—BL: Coimbra. Condeixa. August. In great number.—E: Torres Vedras. August.—f. *grentzenbergi* Stgr.—E: Torres Vedras. July.

1096. *Celerio nicæa* Prun.—Ponto-Mediterranean.—E: Setúbal. September.

1097. *Celerio lineata livornica* Esp.—Tropico-Holarctic.—M: Caldelas. July–August. Rare.—BB: S. Fiel. May; July.—E: Setúbal. May.—Mendes writes that a larva which pupated on July 6 emerged on July 20.—Other larvæ in July–August. Foodplant: *Linaria spartea.*

1098. *Pergesa porcellus* L.—Euroriental.—M: Caldelas. July. Gerez. Only one specimen from each of the above localities.

1099. *Pergesa elpenor* L.—Euro-Pacific.—M: Caldelas. August. Vizela. June. Only one specimen from each of the above localities.—BL: Condeixa. August. Very common.—E: Torres Vedras. August.

1100. *Hippotion celerio* L.—Euro-Pacific.—BL: Condeixa. August. Abundant.—BB: S. Fiel. October.—E: Serra da Arrábida. Setúbal. June; September–October.

HESPERIIDÆ

1101. *Carcharodus alceæ* Esp.—Euroriental.—M: Caldelas. August. Gerez. May. Frequent. Porto.—T: Pedras Salgadas.—BL: Condeixa.—BB: Casal da Serra. Covilhã. September. Gouveia. Matta do Fundão. August. Sabugueiro. June.—E: Alcácer do Sal. Estoril. August. Near to *tripolina* Vrty: the contrast between the dark bands and the pale reddish ground-color is more conspicuous. Paço d'Arcos. February. Santa Cruz. April. Setúbal. June–July.

1102. *Carcharodus bæticus* Rmb.—Western Mediterranean.—BB: Serra da Estrêla, 1500 m.—E: Alcácer do Sal.

1103. *Hesperia sao* Hbn. and gen. æst. *eucrate* O.—European.—M: Gerez. May. Rare.—T: Pedras Salgadas.—BA: Aregos.—BL: Bussaco. Coimbra. Condeixa. July–August.—BB: Covilhã. Manteigas. August. Senhora da Orada. May. Serra da Estrêla. August.—E: Alcácer do Sal. Setúbal. July–August. Sintra. Late April. Torres Vedras. April.

1104. *Hesperia proto* Esp.—Mediterranean.—E: Alcácer do Sal. Setúbal. July.—Ale: Almodóvar.—Alg: Silves. May.

1105. *Hesperia alveus* Hbn.—Euro-Pacific.—M: Caldelas. July–August. Gerez. May–August. Frequent. Porto.—BL: Coimbra.

1106. *Hesperia onopordi* Rbr.—Western Mediterranean.—BB: S. Fiel.—E: Alcácer do Sal.—Alg: Silves. May.

1107. *Hesperia fritillum* Hbn.—Iberian.—M: Caldelas. August.

1108. *Hesperia malvoides* Elwes.—Western Mediterranean.—M: Caldelas. July–August. Gerez. Porto.—T: Pedras Salgadas.—E: Grandola.—Alg: Serra de Monchique.

1109. *Thanaos tages cervantes* Grasl.—Euro-Pacific.—M: Gerez. May. This species, which is common in many European countries, has been recorded from Portugal only by Silva Cruz who found one specimen, which he has figured (1936, Brotéria, Série trimestral, Ciências naturais, 5(32), p. 80). There is no doubt as to the identification. This species was found in Spain in Andalusia by Ribbe.

1110. *Adopæa lineola* O.—Euro-Pacific.—T: Vila Real. June.—BL: Coimbra. June. Pampilhosa.—BB: S. Fiel. June.—E: Alcácer do Sal.—Ale: Beja.

1111. *Adopæa acteon* Rott.—Eurorieutal.—M: Caldelas. August. Only one specimen. Gerez. July. Common. Guimarães. Vizela. June.—BB: Covilhã. S. Fiel. July.—E: Alcácer do Sal. Setúbal. July; September. Torres Vedras. July.

1112. *Adopæa thaumas* Hufn.—Euroriental.—BL: Coimbra.—BB: Covilhã. Gouveia. S. Fiel. May.—E: Alcácer do Sal. Estoril. June–July. Leiria. Oeiras. June. Setúbal. April–May. Torres Vedras. July.

1113. *Augiades sylvanus* Esp.—Euroriental.—M: Caldelas. July–August. Gerez. May. Frequent. Porto. Vizela. June.—BB: S. Fiel. June.

1114. *Erynnis comma* L.—Euro-Pacific.—M: Caldelas. July–August. Very common. Gerez. May. Frequent. Porto. Vizela. August.—BL: Lousã.—BB: Covilhã. Matta do Fundão. Serra da Estrêla. August. Serra da Guardunha. August.

LYCÆNIDÆ

1115. *Læosopis roboris lusitanica* Stgr. (1891, Iris, 4, p. 232.)—Western Mediterranean.—BA: Aregos.—BL: Coimbra. Pampilhosa. Silva Escura. Soure.—BB: Alpedrinha. Ponte de Morcellos. June. Portas de Ródam. June. In chestnut forests. S. Fiel.—E: Alcácer do Sal. Lisboa (type locality). June. Setúbal. May. Torres Vedras. June.—Alg: (mentioned in original description, without more definite locality).

1116. *Callophrys rubi* L. and f. *fervida* Stgr.—Euroriental.—M: Gerez. May. Vizela. May.—BB: Senhora da Orada. April–May.—Alcácer do Sal. Setúbal. February–April. Sintra. April. Common. Torres Vedras. April. Val de Rosal. April. Abundant.—Alg: recorded by Mendes, without more definite locality.—f. *inferopunctata* Tutt.—E: Estoril. March-April.

1117. *Callophrys avis* Chapm. (1909, Entom. Record, 21, p. 130).—Western Mediterranean.—M: Gerez. May.—BA: Ucanha.—BL: Bussaco.—See: Chapman in Transact. Entom. Soc. London, 1910, p. 85–106, with 30 pl., Entom. Record, 1910, 22, p. 245–248 and Mendes in Brotéria, Série zoológica, 1910, 9, p. 67 and p. 172.

1118. *Thecla spini* Schiff.—Euro-Pacific.—M: Gerez. July. Porto.—BB: Portas de Ródam. May.—E: Alcácer do Sal. May. Setúbal. May.—Alg: Silves. May.—f. *lynceus* Hbn.—BB: Portas de Ródam. May.

1119. *Thecla ilicis* Esp.—Euroriental.—M: Gerez. July. Porto.—T: Pedras Salgadas.—BL: Coimbra.—BB: Matta do Fundão. June–July. Monte de S. José.—E: Leiria. Setúbal. May–June.—f. *esculi* Hbn.—BB: Matta do Fundão. June–July. Monte de S. José. Serra da Estrêla.—E: Alcácer do Sal. Torres Vedras. June–July.—Alg: Silves. May.—f. *cerri* Hbn.—BB: Matta do Fundão. June–July. Monte de S. José.—f. *mauretanica* Stgr.—E: Torres Vedras.

1120. *Zephyrus quercus* L.—Euroriental.—BB: Monte de S. José. Quinta dos Fornos. June–July.—E: Setúbal. May–June.

1121. *Thestor ballus* F.—Western Mediterranean.—BA: Lamego. Ucanha.—BL: Coimbra.—BB: S. Fiel. Late February. S. Vicente. March–April.—E: Paço d'Arcos. March. Setúbal. March–April. Sintra. April.—Alg: Portimão.

1122. *Chrysophanus hippothoë* L.—European.—M?: Caramulo.—I could not find this locality on any map. It may be located in Minho. This species has been recorded only by Biel, who was in correspondence with Staudinger and whose identifications are generally reliable.

1123. *Chrysophanus alciphron gordius* Sulzer.—Euroriental.—M: Caldelas. July. Gerez. July. Frequent. Porto. Vizela. June.—T: Vila Real. June.—BL: Bussaco. Coimbra.—BB: Covilhã. Gouveia. Matta do Fundão. June–July. Serra da Estrêla. August. Common.

1124. *Chrysophanus phlœas* L.—Euro-Pacific.—M: Caldelas. July–August. Common. Gerez. May; July. Guimarães. May.

Vizela. June; August.—BL: Coimbra. Condeixa. August.—BB: S. Fiel. From March on. Serra da Estrêla. August.—E: Estoril. July; October. S. Amaro. June. Setúbal. March; July. Sintra. April–May. Torres Vedras. March–April; July.—f. *cœruleopunctatus* Stgr.—BB: S. Fiel.—E: Torres Vedras. July.

1125. *Chrysophanus dorilis* Hufn.—Eurorieutal.—M: Caldelas. August. Abundant. Gerez. May. Rare. Guimarães. Porto. Vizela. July.—T: Pedras Salgadas.

1126. *Polyommatus bœticus* L.—Tropical.—M: Caldelas. August. Common. Gerez. May. Guimarães. Vizela. June.—BL: Condeixa. August.—BB: Ceia. June. S. Fiel. July–October.—E: Estoril. August. Rare. Oeiras. June. Rare. Setúbal. May–June. Torres Vedras. July–November.

1127. *Tarucus telicanus* Lang.—Mediterranean.—M: Caldelas. July. Common. Gerez. May–July. Very common. Guimarães. Vizela. June. August.—BL: Coimbra. Condeixa. August. Luso. August.—BB: Ceia. June. S. Fiel. June–August. Serra da Estrêla. August.—E: Estoril. October. Frequent. Setúbal. April–June. Torres Vedras. July. November.—Alg: recorded only by Querci without more definite locality.

1128. *Zizera lysimon* Hbn.—Tropical.—M: Porto.—BL: Pampilhosa.—BB: Covilhã. June–end of October. Gouveia. Ribeira da Ocreza. August.—E: Alcácer do Sal. Batalha. August. Leiria. August. Santa Cruz. April; August. Setúbal. July–September. Torres Vedras. July.—Alg: Portimão.

1129. *Zizera minima* Fuessly.—Euro-Pacific.—T: Bragança? Recorded by Wattison, whose identification is rather doubtful. The description which he gives fits fairly well to the following species.—BB: Matta do Fundão. April.—E: Setúbal. April. July–August. Torres Vedras. May.

1130. *Zizera lorquinii* H.S.—Western Mediterranean.—E: Oeiras. May. Sintra. May. The above records refer to specimens captured by myself. I did not find any records in the literature concerning the occurrence in Portugal of this species, except the doubtful record given under the preceding species. Mendes writes (1915, Brotéria, Série zoológica, 13, p. 60) that he recorded this species from Salamanca, Spain, only and to his knowledge it has never been found anywhere else on the Iberian Peninsula. It is surprising that even in a such well-studied family as the Lycænidæ there are species not recorded before from Portugal.

1131. *Lycæna argus* L. (*ægon* Schiff.).—Euro-Pacific.—M: Caldelas. August. Rare. Gerez. May; August. Guimarães. May–June. Porto. Vizela. June.—BL: Coimbra. Luso. August.—BB: Ceia. June. Covilhã. Gouveia. Ponte de Morcellos. June. Senhora da Orada. Serra da Estrêla. May; July–August.—E: Torres Vedras. June.—f. *hypochiona* Rbr.—BB: Matta do Fundão.—f. *casaiacus* Chapm. (1907, Transact. Entom. Soc. London, p. 158, Pl. 5, figs. 16, 17).—E: Torres Vedras.

1132. *Lycæna baton panoptes* Hbn.—Euroriental.—M: Caldelas. August. Porto. Pousada.—T: Pedras Salgadas.—BL: Sobrado de Paiva.—E: Alcácer do Sal. April. Only one specimen, found among numerous *L. abencerragus* Pierret. Setúbal. April–May. Val de Rosal. April.

1133. *Lycæna abencerragus* Pierret.—Mediterranean.—BB: Serra da Estrêla. June.—E: Alcácer do Sal. April.—Alg: recorded by Elwes without definite locality.

1134. *Lycæna atrarche calida* Bell.—Euro-Pacific.—M: Caldelas. July–August. Very abundant. Gerez. May; August. Frequent. Guimarães. Vizela. June.—BL: Condeixa. September.—BB: S. Fiel. Serra da Estrêla. August.—E: Alcobaça. August. Aljubarrota. August. Estoril. July–August. Oeiras. June; August; September. Common. Setúbal. From March on. Torres Vedras. July. Val de Rosal. April.

1135. *Lycæna icarus* Rott. and f. *celina* Aust.—Euro-Pacific.—M: Caldelas. July–August. Common. Gerez. May. Common. Guimarães. July. Porto. Vizela. June; August.—BB: Gouveia. S. Fiel. July. Common. Serra da Estrêla. August.—E: Alcobaça. August. Capuchos. August. Estoril. August. Oeiras. September. Common. Setúbal. April–May. Sintra. Late April. Torres Vedras. Val de Rosal. April.—f. *cærulea* Fuchs.—M: Guimarães. Vizela. June.—BB: Matta do Fundão. July.—E: Val de Rosal. April.—f. *cærulescens* Wheel.—E: Oeiras. September. Praia das Maçãs.—f. *icarinus* Scriba.—E: Estoril. May; August. Oeiras. June. Sintra. April.

1136. *Lycæna thersites* Cantener (see: Chapman, Transact. Entom. Soc. London, 1912, p. 662).—Euroriental.—E: Belém. March.—Alg: Serra de Monchique.

1137. *Lycæna escheri* Hbn.—Mediterranean.—M: Guimarães. April.

1138. *Lycæna bellargus* Rott.—Euroriental.—BA: Aregos.—BL: Coimbra. Pampilhosa.—BB: Portas de Ródam. May.—E: Alcácer do Sal. Setúbal. June.—Alg: Alferce. May. Serra de Monchique.—f. *punctifera* Obth.—E: Torres Vedras. June.

1139. *Lycæna semiargus* Rott.—Euro-Pacific.—BA: Ucanha. May.—BB: S. Romão. June.

1140. *Lycæna cyllarus* Rott.—Euro-Pacific.—T: Pedras Salgadas. May. Rare.

1141. *Lycæna melanops* Bsd.—Western Mediterranean.—M: Caldelas. Rare. Gerez. May. Frequent. Guimarães. April. Pôrto. Vizela. June.—T: Vila Real. June.—BL: Coimbra.—BB: Covilhã. Gouveia. Ribeira d'Alpreada. May.—E: Setúbal. May.

1142. *Cyaniris argiolus* L. and gen. æst. *parvipuncta* Fuchs.—Euro-Pacific.—M: Caldelas. Very abundant. Gerez. July. Frequent. Guimarães. Vizela. July.—BL: Condeixa. August.—BB: Covilhã. S. Fiel. April; July–August.—E: Setúbal. February–April; July–September. Sintra. April. Common. Torres Vedras. July.

ERYCINIDÆ

1143. *Libythea celtis* Fuessly.—Mediterranean.—M: Caldelas. July. Abundant on humid ground. Guimarães.—BL: Coimbra.

1144. *Nemeobius lucina* L.—European.—M: Gerez. May. Rare.

NYMPHALIDÆ

1145. *Apatura iris* L.—Euroriental.—M: Felgueiras. Gerez. July–August. Rare.

1146. *Apatura ilia* Schiff.—European.—M: Caldelas. July. Only one specimen. Gerez. July–August. Rare. Guimarães. August. Taipas.—f. *clytie* Schiff.—M: Guimarães.—f. *lusitanica* Stichel.—M: Pôrto (type locality).

1147. *Charaxes jasius* L.—Mediterranean.—M: Caldelas. Common. Gerez. August. Common.—E: Alcácer do Sal. Louriçal.

October. Setúbal. August–October.—Foodplant: *Arbutus unedo* L.

1148. *Limenitis camilla* Schiff.—European.—M: Gerez. Guimarães. Vizela. June. Rare.—BB: Covilhã. June–August. Matta do Fundão. Val de Prazeres.

1149. *Limenitis rivularis* Scop.—Euroriental.—M: Caldelas. July. Only one specimen. Gerez. Guimarães. Vizela. June. Rare.—T: Pedras Salgadas.—BL: Coimbra.—BB: Covilhã. Matta do Fundão. Val de Prazeres.

1150. *Pyrameis atalanta* L.—Holarctic.—M: Caldelas. Common. Gerez. May–September. Frequent. Guimarães. Vizela. June; October.—BL: Condeixa. September.—BB: Covilhã. S. Fiel. Practically during the entire year.—E: Estoril. May. Small specimen. Wingspread: 43 mm. Paço d'Arcos. Setúbal. Torres Vedras. April; October.—Larva in May; August; October. Foodplant: *Urtica* sp.

1151. *Pyrameis cardui* L.—Tropico-Holarctic.—M: Caldelas. Abundant. Gerez. July–August. Guimarães. Vizela. July.—BL: Condeixa. July–August.—BB: S. Fiel. During the entire year according to Mendes. No migration observed.—E: Estoril. March; November. Paço d'Arcos. February. Santa Cruz. April; June; August. Setúbal.—Larva in October–November. Foodplants: *Malva* sp. and *Urtica* sp.—ab. *priameis* Schultz.—E: Oeiras. May.

1152. *Vanessa io* L.—Euro-Pacific.—M: Gerez.—T: Pedras Salgadas.—BA: Aregos. Ucanha.—BB: Guarda. Matta do Fundão. June. Only one specimen. Serra da Estrêla.

1153. *Vanessa urticæ* L.—Euro-Pacific.—T: Bragança.—BL: Bussaco. Coimbra.—BB: Gouveia. Guarda. Manteigas. Nave de S. Antonio. Senhora do Destêrro. Serra da Estrêla. July–August. Very common.

1154. *Vanessa polychloros* L.—Euroriental.—M: May; July–August. Guimarães. June. Pôrto.—T: Pedras Salgadas.—BA: Aregos.—BL: Coimbra.—BB: S. Fiel. March; July.—E: Setúbal. March–April; October. Tapada da Ajuda. Torres Vedras. June.

1155. *Vanessa antiopa* L.—Holarctic.—M: Gerez. May; August. Recarei.—T: Pedras Salgadas.—BL: Coimbra.

1156. *Polygonia c-album* L.—Euro-Pacific.—M: Caldelas. August. Abundant. Gerez. July. Guimarães. Matozinhos. S. Tirso. Vizela. June.—T: Pedras Salgadas.—BA: Aregos.—BL: Coimbra. June. Lousã.—BB: Gouveia. S. Fiel. March; July–August.—f. *pallidior* Tutt.—M: Caldelas. August.

1157. *Araschnia levana* L. and gen. æst. et aut. *prorsa* L.—Euro-Pacific.—Wattison states that specimens of Portuguese origin are in the Museum of the University of Coimbra. No other records.

1158. *Melitæa aurinia iberica* Obth.—Euro-Pacific.—M: Caldelas. July. Abundant. Gerez. May–September. Abundant. Guimarães. May. Vizela. June.—BB: Covilhã. Matta do Fundão. April–June. Senhora da Orada.—E: Alcácer do Sal. Setúbal. March–April. Sintra. Torres Vedras. April.—Larva until April. Foodplant: *Lonicera* sp.—f. *desfontainii* God.—BB: Ceia. June. S. Romão. June.—E: Sintra. April.—Alg: Monchique. May.

1159. *Melitæa cinxia* L.—Eurioriental.—T: Pedras Salgadas. May.

1160. *Melitæa ætherie* Geyer.—Western Mediterranean.—E: Val de Rosal. April.

1161. *Melitæa phœbe occitanica* Stgr.—Euro-Pacific.—M: Caldelas. August. Very abundant. Gerez. May. Vizela. June.—T: Vila Real. June.—BB: Covilhã.—E: Grândola. Louriçal. May.

1162. *Melitæa didyma* O. and f. *occidentalis* Stgr.—Euro-Pacific.—T: Bragança. Pedras Salgadas. Vila Real. June.—BA: Ucanha.—BL: Coimbra.—BB: Casal da Serra. Covilhã. Gouveia. Matta do Fundão. May; July–August. Ponte de Morcellos. June. S. Vicente. Serra da Estrêla. August.—E: Alcácer do Sal.—f. *meridionalis* Stgr.—E: Setúbal. May; August–September.

1163. *Melitæa trivia* Schiff.—Ponto-Mediterranean.—T: Pedras Salgadas.—BA: Ucanha.—BL: Coimbra.—BB: Covilhã. Gouveia. Matta do Fundão. May.

1164. *Melitæa athalia helvetica* Rühl.—Euro-Pacific.—BB: Covilhã. June–early July.

1165. *Melitœa dejone rosinœ* Rebel. (1910–1911, Ann. K. K. Naturhist. Hofmuseum. Wien, 24, p. 375–378, 1 pl.).—Western Mediterranean.—M: Caldelas. June–August. Very abundant. Gerez. May. Common. Guimarães. Vizela. May.—BB: Covilhã. Matta do Fundão. April–June; July–August. Senhora da Orada. May.—E: Oeiras. May–June. Sintra (type locality). Early June. The imago of the second brood is larger than that of the first brood.—Larva until April. Foodplant: *Antirrhinum* sp.

1166. *Melitœa parthenie* Brkh.—European.—M: Caldelas. August. Vizela. July.—BL: Coimbra.—BB: Gouveia.—Larva in June. Foodplant: *Antirrhinum majus.*

1167. *Argynnis selene* Schiff.—Euro-Pacific.—M: Caldelas. August. Rare. Gerez. May; August. Guimarães.—BB: Gouveia.

1168. *Argynnis euphrosyne* L.—Holarctic.—M: Gerez. May. Guimarães. Ruivães.—BL: Coimbra.—BB: Gouveia.

1169. *Argynnis lathonia* L.—Eurorienta1.—M: Caldelas. Rare. Gerez. May; August. Guimarães.—BB: Covilhã. March. Matta do Fundão. July–August. S. Fiel. Serra da Estrêla. August–September.

1170. *Argynnis aglaja* L.—Euro-Pacific.—M: Gerez. August.—BL: Coimbra.

1171. *Argynnis niobe* L. and f. *eris* Meig.—Euro-Pacific.—M: Gerez.—BA: Ucanha.—BB: Covilhã.

1172. *Argynnis adippe* L., f. *cleodoxa* O., f. *chlorodippe* H.S. and f. *cleodippe* Stgr.—Euro-Pacific.—M: Caldelas. July–August. Gerez. August. Guimarães. Pôrto.—T: Pedras Salgadas.—BL: Coimbra.—BB: Capinha. May. Covilhã. Gouveia. Matta do Fundão. June–July. S. Fiel. Serra da Estrêla.

1173. *Argynnis paphia* L.—Euro-Pacific.—M: Caldelas. July. Very abundant. Gerez. July–August. Guimarães. August. Pôrto. Vizela. June.—T: Pedras Salgadas.—BA: Arêgos.—BL: Coimbra.—BB: Gouveia.

1174: *Argynnis pandora* Schiff.—Mediterranean.—M: Caldelas. Common. Gerez. August. Pôrto.—T: Pedras Salgadas.—BA: Arêgos.—BL: Coimbra.—BB: Covilhã. Gouveia. Matta do Fundão. May–September. Serra da Estrêla. August. Imago frequently seen on *Carduus* sp.

SATYRIDÆ

——. *Erebia evias* God.—Alpine.—M: Gerez. Recorded by Tavares, who found one specimen only, which was identified by Mendes. This would be the only record of the occurrence in Portugal of a representative of the large genus *Erebia*. I consider this record as doubtful. Most species of *Erebia* are found in large numbers. Therefore it is surprising that only one specimen has been found and no new records exist. Should this record be confirmed, it will be of great interest as proof of the occurrence in Portugal of Alpine species.

1175. *Melanargia lachesis* Hbn.—Western Mediterranean.—M: Caldelas. June–August. Gerez. July–August. Guimarães. Pôrto. Vizela. July.—T: Vila Real.—BL: Oliveira d'Azemeis.—BB: Covilhã. June–September. Matta do Fundão. June. Ponte de Morcellos. June.—E: Oeiras. June. Common. Sintra. Torres Vedras. June. Frequent.—f. *canigulensis* Obth.—M: Caldelas. July–August.—f. *geresiana* Ferreira de Sousa (1929, Mem. e Estudos do Museu Zoolog. da Univ. de Coimbra, Série 1, No. 31, p. 1–2, 1 fig.—M: Caldelas (type locality). June–July.

1176. *Melanargia japygia cleanthe* Bsd.—Eurioriental.—M: Marco de Canaveses.—BB: Serra da Estrêla near Gouveia. August.

1177. *Melanargia syllius* Hbst.—Western Mediterranean.—M: Gerez.—BL: Coimbra. Pampilhosa.—BB: Covilhã. Mação.—E: Alcácer do Sal. Campolide. Estoril. April–May; July. Oeiras. May–June. Queluz. Setúbal. April–May. Sintra. Torres Vedras. June. Val de Rosal. April.

1178. *Melanargia ines* Hfsg.—Western Mediterranean.—M: Gerez. May.—T: Vila Real.—BL: Coimbra. June.—BB: Matta do Fundão. Portas de Ródam. May. Ribeira d'Alpreada.—E: Alcácer do Sal. Leiria. Pombal. S. Amaro. May.—Ale: Evora.—Alg: Monchique. May.

1179. *Satyrus circe* F.—Eurioriental.—T: Bragança. Pedras Salgadas.—BL: Lousã.—BB: Castelo Branco. Castelo Novo. Covilhã. July–August. Gouveia. Matta do Fundão. Quinta dos Carvalhos.

1180. *Satyrus hermione* L.—European.—BB: Serra da Estrêla. August–September.

1181. *Satyrus alcyone* Schiff.—Eurooriental.—M: Guimarães.—BB: Matta do Fundão. July. Serra da Estrêla.—f. *vandalusica* Obth.—M: Gerez. July–September. Very common in pine forests.

1182. *Satyrus semele* L.—Eurooriental.—M: Gerez. July–September. Common. Guimarães. June. Salamonde. June. Vizela. June.—BB: Covilhã. S. Fiel. July–August. In the mountains on rocks, in the woods on tree trunks.—f. *occelarum* Mattozo (1884–1885, Journal de Scienc. Mathem., Physic. e Naturaes de Lisbôa, 10).—BB: Serra da Estrêla. August.

1183. *Satyrus arethusa* Esp.—Ponto-Mediterranean.—M: Gerez.—BA: Ucanha near Lamego.—f. *dentata* Stgr.—M: Gerez. July–August. Common.

1184. *Satyrus statilinus allionia* F. and f. *cæca* Hannemann.—European.—M: Caldelas. August. Rare. Gerez. July–September. Common in pine forests. Guimarães. Vizela. August.—BL: Condeixa. August.—BB: Covilhã. S. Fiel. July–August. Serra da Estrêla. August.—E: Alcobaça. August. Batalha. August. Estoril. July–August. Leiria. August. Oeiras. August. Santa Cruz. August. Setúbal. July–September.

1185. *Satyrus fidia* L.—Western Mediterranean.—M: Gerez. July–September. Common in pine forests.—BL: Condeixa. August.—BB: Covilhã. Monsanto. Sobral do Campo. July–September.—E: Alcobaça. August. Estoril. July–August. Leiria. August. Louriçal. Oeiras. August. At the same places where the preceding species flies, but less frequent. Setúbal. July–August. Torres Vedras. Middle of July. Early October.

1186. *Satyrus actæa monteiroi Mendes* (1910, Brotéria, Série zoológica, 9, p. 63, Pl. 2, Fig. 2, 5–12). f. *podarce* O., f. *mattozi* Monteiro (1882, Jornal de Sciencias Mathem., Physic. e Natur. de Lisbôa, 9, No. 34, p. 107), and f. ♀ *herminia* Mendes (1910, Brotéria, Série zoológica, 9, p. 65, Pl. 2, Figs. 9–11).—Eurooriental.—BB: Serra da Estrêla, 1200–1600 m. (type locality of *monteiroi, mattozi* and ♀ *herminia*). The form occurring in Portugal is a well-defined geographical race. Any of the Portuguese specimens can be easily distinguished from typical *actæa* Esp., particularly by the smaller size (wingspread 40–47 mm.) and the underside of the hindwings. The median white band not well developed.

Numerous small white and fuscous spots. Subterminal white band wide and conspicuous. On a few specimens the white marks almost obsolete.—The names *podarce* O., *mattozi* Monteiro and ♀ *herminia* Mendes designate only minor individual aberrations of *monteiroi* Mendes. It may be of interest to note that Serra da Estrêla is the only known locality in Portugal where this species occurs. This may explain that a local form has developed, interbreeding with populations from nearby localities being impossible.

1187. *Pararge ægeria* L.—Euroriental.—M: Caldelas. July–August. Very common. Gerez. May–September. Very common. Guimarães. February; April; June; November. Vizela. July.—BL: Coimbra. June. Condeixa. August.—BB: S. Fiel.—E: Estoril. February–March; May. Frequent. Leiria. August. Setúbal. March. Sintra. March–April. Common. Torres Vedras. April–July. Common.

1188. *Pararge megera* L.—Euroriental.—M: Caldelas. August. Abundant. Gerez. July. Rare. Guimarães. April. Vizela. July.—BL: Condeixa. August.—BB: Sabugueiro. June. S. Fiel. April–May; July. Serra da Estrêla, WSW slopes. August.—E: Batalha. August. Estoril. February–March; July–August. Leiria. August. Paço d'Arcos. January. S. Amaro. May. Setúbal. April–May. Sintra. April. Common. Torres Vedras. June–July.

1189. *Pararge mæra* L.—Euroriental.—M: Caldelas. Not as frequent as the preceding species. Gerez. July. Rare. Vizela. May.—BB: Covilhã. S. Fiel. May. Serra da Estrêla. August.—E: Grândola. Setúbal.—f. *adrasta* Hbn.—M: Caldelas. July.—BB: S. Fiel. July–August.

1190. *Epinephele passiphaë* Esp.—Western Mediterranean.—BL: Coimbra. June. Pampilhosa.—BB: Covilhã. Matta do Fundão. June–July.—E: Alcácer do Sal. Estoril. April–May. Leiria. Oeiras. May–June. Pombal. Setúbal. June–July. Torres Vedras. June–July.—Alg: Monchique. May.—f. *dosmanchas* Rbb.—E: Estoril. May. Oeiras. May.

1191. *Epinephele ida* Esp.—Mediterranean.—M: Caldelas. July–August. Common. Gerez. July–September. Very common. Guimarães. Vizela. June–July.—BL: Condeixa. September.—BB: Covilhã. Ponte de Morcellos. June. S. Fiel.

June–August.—E: Alcácer do Sal. Alcobaça. August. Estoril. June–August. I have repeatedly observed that the ♂ emerges earlier than the ♀. In 1941 I captured a large series and came to the following conclusion: both sexes were found from June 15 on, but, whereas the last ♂ was captured on July 20, there were many ♀♀ to be found much later, until August 17. This means that practically during an entire month numerous ♀♀ fly when not a single ♂ is on the wing. Leiria. August. Oeiras. June. Pé da Serra. July. Setúbal. April–August. Torres Vedras. June–July.—f. *dosojos* Rbb.—E: Estoril. June.

1192. *Epinephele tithonus* L.—Eurooriental.—M: Caldelas. July–August. Very abundant. Gerez. July–September. Frequent. Vizela. June.—BB: Covilhã. S. Fiel. June–August. Serra da Estrêla, WSW slopes. August.—E: Pé da Serra. July. Rare. Setúbal. June–August. Torres Vedras. June–July.

1193. *Epinephele jurtina* L., f. *hispulla* Hbn. and f. *fortunata* Alph.—Eurooriental.—M: Caldelas. August. Very abundant. Gerez. July–September. Common. Guimarães. Vizela. May–June.—BL: Condeixa. August.—BB: Ponte de Morcellos. June. S. Fiel. May–August. Serra da Estrêla. August.—E: Capuchos. August. Estoril. April; June; July–August. Oeiras. June; August–September. Pé da Serra. July. Praia das Maçãs. Setúbal. June–September. Torres Vedras. End of May–July.—Alg: Silves. May.—The mountain race from Serra da Estrêla forms a transition between typical *jurtina* L. and *hispulla* Hbn., whereas the form of the plain is nearer to *fortunata* Alph.

1194. *Epinephele lycaon* Rott.—Euro-Pacific.—BB: Covilhã. Gouveia. August. Serra da Estrêla. Serra da Guardunha. August.

1195. *Epinephele lupinus* Costa. (*rhamnusia* Freyer).—Mediterranean.—BB: Covilhã.—E: Alcácer do Sal.

1196. *Cœnonympha arcania* L.—Eurooriental.—M: Gerez. August. Frequent.

1197. *Cœnonympha dorus* Esp.—Western Mediterranean.—M: Gerez. May–September. Very common. Pôrto. Vizela. July.—BL: Condeixa. August–September.—BB: Matta do Fundão. June–July. Serra da Estrêla, 700–1000 m. August. Serra da Guardunha.—E: Setúbal. June–July. Torres Vedras. July.—

f. *bieli* Stgr.—M: Caldelas. Common. Gerez.—BL: Sobrado de Paiva.—BB: Covilhã. Matta do Fundão. Serra da Estrêla, 700–1000 m. Serra da Guardunha. July.—*bieli* Stgr. is a race distributed over northern and central Portugal only, whereas *dorus* Esp., in its nomotypical form, occurs also in the southern part of Portugal. In BB. the two forms can be seen flying together.

1198. *Cœnonympha pamphilus* L.—Euroriental.—M: Caldelas. July–August. Common. Gerez. May–September. Guimarães. April. Vizela. May–June.—BB: S. Fiel. From March on.—E: Setúbal. March–April. July. Torres Vedras. July.—Ale: Almodóvar. May.—Alg: Monchique. May.—f. *marginata* Rühl. —BB: S. Fiel. From March on.—E: Setúbal. June.—f. *lyllus* Esp.—M: Gerez.—T: Pedras Salgadas.—BL: Condeixa. August. Sobrado de Paiva.—BB: Covilhã. June–end of October. Serra da Estrêla.—E: Alcácer do Sal. Alcobaça. August.—Alg: Portimão. Serra de Monchique.

DANAIDÆ

1199. *Danais plexippus* L.—Tropico-Holarctic.—M: Miramar. October 2, 1932. Only one ♀. Identified and figured by Maria Amélia da Cruz, in Brotéria, Série trimestral, Ciências naturais, 1936, 5(32), p. 81. This is the only reliable record of capture in Portugal of this species. In any case it is extremely rare that it reaches, during its migrations, Portuguese territory. I have never seen it.

PIERIDÆ

1200. *Aporia cratægi* L.—Euro-Pacific.—M: Gerez. May. Common.—T: Pedras Salgadas.—BB: Mação. May.—Foodplants: *Cratægus* sp. and fruit trees.

1201. *Pieris brassicœ* L., gen. vern. *chariclea* Steph. and gen. æst. *lepidii* Röber.—Euroriental.—M: Caldelas. June–August. Abundant. Gerez. August. Guimarães. Vizela. July.—BB: S. Fiel. February–March.—E: Alcácer do Sal. Estoril. February. Lisboa. March; October–November. Paço d'Arcos. Setúbal. Sintra. April. Torres Vedras. April; July; November. Val de Rosal. April. Abundant.—Alg: Silves. May.—f. *venata* Verity.—BB: S. Fiel.—This species is on the wing the whole year; seen commonly even in winter on sunny days. There is hardly any difference between the early spring brood of February–March and the late fall form of October–November. Both agree with *chariclea* Steph.—Pupates often on doors and windows. Foodplant: cabbage. Injurious.

1202. *Pieris rapæ* L.—Holarctic.—M: Caldelas. June–July. Very common. Gerez. May–September. Guimarães. Vizela. July.—Condeixa. July–September.—BB: Matta do Fundão (1 specimen has only 50 mm. wingspread). S. Fiel. Serra da Estrêla. August.—E: Estoril. July–August. Leiria. August. S. Amaro. May–June. Setúbal. Torres Vedras. July. Val de Rosal.—f. *leucotera* Steph.—M: Guimarães.—BB: S. Fiel. February. Serra da Guardunha. February–March.—gen. vern. *metra* Steph. and f. *debilis* Alph.—BB: S. Fiel.—E: Lisboa. March.—f. *immaculata* Ckll.—M: Gerez.—gen. aut. *ultima* Rocci. —E: Lisboa. October–November.—This form hardly differs from *metra* Steph. The same as in *brassicæ* L., here too the early spring and late fall forms are almost alike.—f. *flavida* Petersen is mentioned by Wattison without more definite locality.

1203. *Pieris napi* L., gen æst. *napææ* Esp., and f. *immaculata* Strand.—Holarctic.—M: Caldelas. June–August. Gerez. May. Abundant. Guimarães. April. Vizela. July.—BB: Alpedrinha. February–April; May–June. Ceia. June. Covilhã. Matta do Fundão. February–April; May–June. S. Fiel. June.—E: Sintra. April.—f. *lusitanica* Oberth.—M: Caldelas. June–July. Very abundant.—f. *tricircummaculata* Ferreira de Sousa (1929, Memor. e Estudos do Museu zool. da Univ. de Coimbra, Série 1, No. 31, p. 2, Fig. 2). This is an insignificant aberration. No locality given in the original description.

1204. *Leucochloë daplidice* L.—Eurooriental.—M: Caldelas. July–August. Gerez. May–September. Common. Guimarães. Vizela. May–June. Frequent.—BL: Coimbra. June. Condeixa. June–August.—BB: Matta do Fundão. S. Fiel. From the end of May on. Serra da Estrêla. August. Serra da Guardunha. September.—E: Batalha. August. Setúbal. July–September. Torres Vedras. July–August.—gen. vern. *bellidice* O.—M: Gerez. Pousada.—T: Pedras Salgadas.—BL: Coimbra. Pampilhosa. S. Fiel. February–March. Sobrado de Paiva.—Mendes points out (1912, Brotéria, Série zoológica, 10, p. 166) the similarity between the spring form *bellidice* O. and a specimen captured at S. Fiel in September.

1205. *Euchloë belemia* Esp. and gen. æst. *glauce* Hbn.—Mediterranean.—BL: Coimbra.—BB: Covilhã. March. Ribeira da Ocreza. February–March; May. S. Fiel (wingspread 40 mm.).—E: Alcácer do Sal. Belem (type locality). Paço d'Arcos. S. Amaro. May. Setúbal. April–May.—Ale: Almodóvar. May.

1206. *Euchloë belia* Cr. and gen. æst. *ausonia* Hbn.—Euro-Pacific.—M: Gerez. May. Vizela.—T: Bragança. Pedras Salgadas.—BL: Coimbra. Pampilhosa. Sobrado de Paiva.—BB: Portas de Ródam. May. S. Fiel. March–April. Serra da Estrêla.—E: Abrantes. Alcácer do Sal. Paço d'Arcos. Setúbal. March–April.

1207. *Euchloë tagis* Hbn. and f. *lusitanica* Oberth. (Etudes Lépid., Comp. 3, p. 145).—Western Mediterranean.—E: Almada. Casilhas. Margens do Sado. Piedade near Lisboa (type locality). February–April. Serra da Arrábida near Setúbal. March–April. Serra de S. Luiz. Val de Rosal. April. This species is extremely local. All above localities are situated within a very small area. They are located near the southern bank of the Tagus river. Surprisingly enough it never crosses the river. No records are known of its occurrence from the north bank of the Tagus river. Vieilledent mentions that he never found this species at less than 300 m. altitude.

1208. *Anthocharis cardamines* L.—Eurooriental.—M: Gerez. May. Rare.—T: Pedras Salgadas.—BL: Coimbra.—BB: Matta do Fundão. May. Senhora da Orada. May.—E: Arrabida. Oeiras. May. Setúbal. March–May. Sintra. April.

1209. *Anthocharis euphenoides* Stgr.—Western Mediterranean.—T: Pinhão. Régua.—BL: Coimbra.—BB: Guarda. Pinhel.—E: Serra da Arrábida near Setúbal. April.

1210. *Gonepteryx rhamni* L.—Euro-Pacific.—M: Caldelas. July. Rare. Gerez. August. Guimarães. April–June.—BB: Ceia. June. S. Fiel. March–April; July. Serra da Estrêla.—E: Setúbal. Sintra. April. Common. Torres Vedras. June.

1211. *Gonepteryx cleopatra* L.—Mediterranean.—BL: Coimbra. Condeixa. August–September. Figueira da Foz. Pampilhosa.—BB: Portas de Ródam. April–May. According to Mendes common at places where *Rhamnus alaternus* grows in abundance. Serra da Estrêla.—E: Abrantes. Alcácer do Sal. Batalha. August. Estoril. June. Leiria. August. Paço d'Arcos. February. Setúbal. February–July. Sintra. April. Torres Vedras. June–July.—Alg: Silves. May.—f. *maderensis* Fldr.—BL: Coimbra. One ♂.—f. *italica* Gerh.—?M: Pôrto. Stefanelli (1903, Bull. Soc. Entom. Ital., 35, p. 82) states having received specimens from above locality from Staudinger. There is no other record that this species occurs in the northernmost province of M. Most probably Staudinger, who received most of his Portuguese material from Biel who lived in Pôrto, assumed that it was captured there, whereas in reality these specimens originate from a more southern locality.

1212. *Colias croceus* Fourcr. (*edusa* F.) and f. ♀ *helice* Hbn.—Euroriental.—M: Caldelas. July–August. Very abundant. Gerez. May–September. Common. Guimarães. May–June. Vizela. May–July.—BL: Coimbra. Condeixa. July–September.—BB: Ceia. June. Quinta da Anta. May. S. Fiel. March–September. Serra da Estrêla, up to the summit, according to Wattison. August.—E: Oeiras. June. Santa Cruz. April. Setúbal. March–October. Torres Vedras. June; end of July–August.—Alg: Monchique. May.

1213. *Lepidia sinapis* L., f. ♀ *erysimi* Bkh., f. *diniensis* Bsd. and gen. æst. *lathyri* Hbn.—Euro-Pacific.—M: Caldelas. June–August. Gerez. May–July. Guimarães. June. Vizela. May–June.—BL: Coimbra.—BB: Castelo Novo. July. Covilhã. Matta do Fundão. June. Ribeira da Ocreza. May; July–August. S. Fiel. March. Senhora da Orada. Serra da Estrêla. August.—E: Serra da Arrábida. July–August. Setúbal. April–May; July–August. Sintra. April. Torres Vedras. April; June–July.—One specimen from BB. has only 26 mm. wingspread.

PAPILIONIDÆ

1214. *Papilio machaon* L. and gen. æst. *sphyroides* Verity.—Holarctic.—M: Caldelas. August. Rare. Gerez. August–September. Guimarães. August. Pôrto. Vizela. August.—BL: Condeixa. August.—BB: S. Fiel. July–September. Serra da Estrêla. August.—E: Belem. February. Setúbal. March–April; July–October. Wingspread 72 to 89 mm. Torres Vedras. July. Val de Rosal. April.—Larva in June. Foodplants: *Fœ-*

niculum officinale, Fœniculum vulgare, Fœniculum piperitum H.C. and *Ruta angustifolia* Pers.

1215. *Papilio podalirius* L.—Euroriental.—gen. vern. *miegii* Th. Mieg.—Wingspread 55 to 65 mm.—M: Gerez. May. Guimarães. April.—BB: S. Fiel. April.—E: Alcácer do Sal. Santa Cruz. End of April. Setúbal. End of February–April. Sintra. April. Rare. Val de Rosal. April.—gen. æst. *feisthamelii* Dup.—Wingspread 65 to 82 mm.—M: Caldelas. Late July–August. Gerez. July–September. Guimarães. August. Vizela. June; August.—BL: Condeixa. August–September. Common.—BB: Covilhã. S. Fiel. July–September. Serra da Estrêla. August.—E: Setúbal. June–September. Sintra. July. Torres Vedras. July.—Foodplants: *Cratœgus* sp. and *Prunus spinosa* L.

1216. *Thais rumina* L.—Western Mediterranean.—Wingspread 48 to 58 mm.—M: Guimarães. May. Leça da Palmeira. Matozinhos. Valongo.—T: Pedras Salgadas.—BL: Coimbra. Lousã. Pampilhosa.—BB: Castelo Novo. Covilhã. March. Matta do Fundão. Portas do Ródam. S. Fiel. March–April. Senhora da Orada.—E: Estoril. Late February–March. Paço d'Arcos. Pombal. Setúbal. March–April. Sintra. April. Tapada da Ajuda. Torres Vedras. End of March. Val de Rosal. April. The Portuguese race has the ground color darker than that of any other European race of which I know, a rather brownish yellow. Black and red spots well developed. Resembles f. *africana* Stichel.—f. *canteneri* Stgr.—M: Leça da Palmeira. Pôrto.—BB: S. Fiel, through breeding only.—E: Lisboa.—f. *tristis* Verity.—M: Matozinhos.—BB: S. Fiel.—Larva in May–June. Foodplant: *Aristolochia longa.*

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BOOK NOTICE

Check List of the Cicadellidæ (Homoptera) of America, North of Mexico. By Dwight M. DeLong and Dorothy J. Knull. Graduate School Studies. Biological Science Series No. 1. 102 pages, 6 × 9 inches, paper bound, 1945. The Ohio State University Press, Columbus, Ohio.

This publication, a revision of the DeLong and Caldwell list issued in 1937, is a great improvement over the previous volume with respect to format, printing, arrangement of species lists, and general accuracy. The reviewer feels certain that the present list will be welcomed by all general workers, for whom it is apparently primarily intended. The most important changes in the basic information, as contrasted with the 1937 list, are the inclusion of genotypes of the listed genera and the alphabetical arrangement of species within the various genera. Errors in bibliographic citations and spelling of scientific names are few.

The reviewer recognizes that the supergeneric classification of a group, especially the arrangement of genera, is to some extent a matter of individual opinion. It is felt that the arrangement followed in the present list will not have wide acceptance by workers in the group, and it seems fairly clear that the groupings used have resulted from unfamiliarity with related exotic forms or from lack of critical analysis of structural characters of the North American representatives. For example, the placement of *Nionia* in the subfamily Eurymelinæ is in itself somewhat startling, but to place that genus between *Macropsis* and *Oncopsis* can be supported on no other grounds than that of an alphabetical arrangement. Similarly, the interposition of *Kinonia* between *Pedumella* and *Gladionura* in the *Athysanella* complex seems without justification; on the basis of structural characters of the head *Kinonia* logically belongs with *Gillettiella, Stirellus,* and *Penestirellus,* none of which are closely related to *Athysanella.*

These items, *i.e.,* the sequence of genera and the supergeneric classification, are of particular interest only to the specialist in the group and should not detract from the value of the publication to the general worker. However, there are a few faults that may lead to difficulties for users of the list and to which it seems worth while to call attention.

In several instances the authors have quite properly adopted different generic names than have been in current use in the group. Unfortunately, generic synonymy is not indicated and in those instances in which new generic synonymy is involved the change is not indicated except by the inclusion of the genotype of the rejected name among the species listed under the name adopted. Thus it is assumed that *Cyperana* DeLong is suppressed as a synonym of *Cicadula* Zetterstedt, *Conodonus* Ball suppressed as a synonym of *Colladonus* Ball, *Drionia* Ball suppressed as a synonym of *Cochlorhinus* Uhler, and so on. It would have been much better had such changes been clearly indicated in the accepted manner. With respect to names formerly given subgeneric status it is impossible to know whether they are considered as straight synonyms in this list, or whether they are simply omitted from the scheme of classification. The omission of subgeneric names and generic synonyms detracts from the value of the list for future bibliographic work.

The authors state in the introduction that ''An asterisk placed before a name indicates a new combination or arrangement not previously published.'' This appears to have been an optional procedure that was very sparingly exercised. A careful examination of the list reveals the use of an asterisk in ten places, but in only two instances is the meaning of the asterisk clearly indicated. In those two instances it indicates new synonymy. In other places it is used to indicate a new combination and status, new usage of a supergeneric category, new combination, new synonymy, new status for a generic name, or a new group designation. A large proportion of the changes, particularly new combinations and new synonymy, are not indicated as such.

In spite of the criticisms indicated in this review, the ''Check List of the Cicadellidæ'' should fill a useful place in the literature of the group as a handy reference work for both specialists and general workers.—P. W. Oman, Division of Insect Identification, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of Aril 3, 1945

A regular meeting of the New York Entomological Society was held on April 3, 1945, at the American Museum of Natural History; President George G. Becker in the chair; twenty-one members and thirty-five guests were present.

Mr. Arthur Blum, 1334 St. Lawrence Ave., The Bronx, New York, was elected to membership.

Mr. Comstock called attention to two styles of used insect boxes available to members at a cost of 50c and $2.50 each.

The secretary read a letter from Mrs. Margaret Betz, 662½ South 14th St., Newark, New Jersey, in regard to her father's collection of some 3,000 specimens of butterflies, moths, and a few other insects, which she is offering for sale.

Mr. Chris Olsen, reporting for the Field Committee, announced that a field meeting of the society would be held Saturday, May 27, at his place in West Nyack, New York. Details of the trip would be announced later and members would be notified.

Dr. Tomaz Borgmeier, of Rio de Janeiro, and publisher of "Reviste de Entomologia," told of some of his entomlogical experiences and mentioned his plan for a Pan American Entomological Society; this society to be, not a society of meetings, but for the purpose of publishing papers relating to the insects of the Western Hemisphere, and to develop a closer relation.

The speaker of the evening, Dr. Raymonde Adair Albray, told of his experiences and the methods used in making his pictures entitled "Intimate Motion Pictures in Color of Butterflies and Moths."

Dr. Albray's pictures showed most of the common, as well as many of the more unusual, butterflies and moths to be found in the New York district. His films represented the results of work that was started four years ago. The first films were exposed at the rate of 16 frames per second, but subsequent exposures were 32 frames per second, which slowed down the movements of the insects making them more easily observed. He uses no tripod, holds the camera in his hands and works frequently at a distance of one foot from the insect. The camera used was a Bell and Howell, with a one inch lens.

Mr. Comstock called attention to the way motion pictures were an aid in the study of the movements of insects.

John C. Pallister, *Secretary.*

Meeting of April 17, 1945

A regular meeting of the New York Entomological Society was held on April 17, 1945, at the American Museum of Natural History. In the absence of the president and vice-president, Mr. William Comstock was appointed temporary chairman. Fifteen members and seven visitors were present.

The name of Mr. Addis E. Kocher, Reserve Street, Boonton, New Jersey, was presented for membership by the secretary.

The secretary read a letter from the Zoological Society of London acknowledging and thanking the New York Entomological Society for their contribution of $150.00 towards the cost of production of the Zoological Record.

The speaker of the evening, Dr. Elsie B. Klots, spoke on a "Brief History of the Classification of the Odonata" and the basis of the long accepted division of the order into three suborders.

Dr. Klots then showed how the interpretation of wing veins as presented by Martynov and by Lamur, an interpretation based upon the alternation of convex and concave veins, has been supported by a study of Permian fossils, and necessitates a change in the terminology of the veins.

Fossils collected by A. B. Klots, U. S. L. Pate, and W. D. Sargent in Elma, Kansas, and now in the Museum collection show the presence of oblique veins and an intercalary sector at the fork of media 1 and media 2, corresponding to the subnodal and oblique vein and the bridge of modern dragonflies. The position of these veins precludes the possibility of the radial sector having crossed over media phylogenetically.

With our increased knowledge of fossil forms it seems evident that the Protodonata can be distinguished from the Odonata only in having a complete posterior media and cubital anal; therefore the Meganeuridæ and Typidæ as well as the orders Protozygaptera and Protanisaptera are now classified as suborders of the order Odonata.

Meeting adjourned at 9:15 to examine the fossils of the wings of Odonata.

JOHN C. PALLISTER, *Secretary*.

MEETING OF MAY 1, 1945

A regular meeting of the New York Entomological Society was held on May 1, 1945, in the American Museum of Natural History; President George B. Becker in the chair, with twelve members and seven guests present.

Mr. Addis E. Kocher, Reserve Street, Boonton, New Jersey, was elected a member.

Mr. Comstock mentioned that complete sets of the Journal were still available for purchase from the society, and suggested that this be advertised in the Journal. Considerable discussion followed by various members as to the best way of disposing of these sets.

The paper of the evening, "Control of Several Insects by the Use of Parasites," was presented by Dr. B. F. Driggers, of the New Jersey Agricultural Experiment Station.

Dr. Driggers used two species of insects, the Oriental fruit moth and the Comstock mealy bug to illustrate his talk. The Oriental fruit moth, an introduced pest, is preyed upon by nearly 100 species of insects. The most successful parasite a native Macrocentrus, usually parasitic on the strawberry leaf-roller, has become the best parasitic control of the Oriental fruit moth.

The control, through parasites, of the Comstock mealy bug was also carefully explained. Dr. Driggers also called attention to the use of DDT as a control for the Oriental fruit moth as well as of the Japanese Beetle.

JOHN C. PALLISTER, *Secretary.*

MEETING OF MAY 15, 1945

A regular meeting of the New York Entomological Society was held on May 15, 1945, at the American Museum of Natural History; President George G. Becker in the chair; seventeen members and eleven guests present.

Mr. Chris Olsen, reporting for the Field Committee, announced that a field trip of the society would be held Sunday, May 27, at his place in West Nyack, New York. Members would be notified as to the details of this trip.

The paper of the evening was delivered by Mr. George G. Becker, ''The Favorite Host.'' Mr. Becker's paper dealt with the significance of host relationships as a possible index in determining the native range of an insect.

It was emphasized that the favorite host of an insect was the one host least likely to be one of its native hosts. The apple wooly aphis was cited as an example. Before the life cycle of this insect was thoroughly understood, it was considered as indigenous to the home of the apple; the resistance of our native Cratægus was at that time not considered significant.

Mr. Becker discussed the varying susceptibility of a number of species of Prunus from various parts of the world to the attacks of *Lepidosaphes halli.* On a basis of host susceptibility studies, various geographical areas were eliminated as areas to which the insect might be native until the decision narrowed down to Central Asia as its probable home.

While resistance to insects *per se* is no indication that an insect is native to the range of the resistant host, the reverse, namely extreme susceptibility to attack, is at least reasonably good negative evidence that the insect is not native to the range of the susceptible host.

LINA SORDILLO, *Assistant Secretary.*

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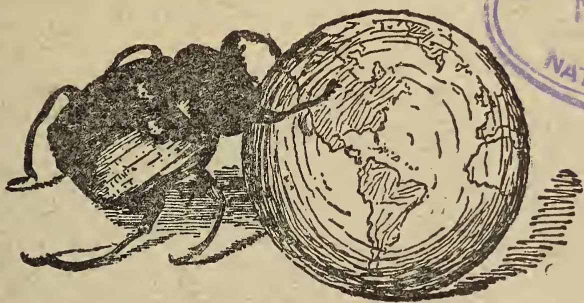

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REVISION OF THE NORTH AMERICAN SPECIES OF THE GENUS PENTANEURA [TENDIPEDIDÆ: CHIRONOMIDÆ, DIPTERA]

BY O. A. JOHANNSEN
ITHACA, N. Y.

The generic name *Pentaneura*, introduced by Philippi (1865), was not recognized by subsequent workers until it was revived by the late Dr. F. W. Edwards, a few years ago, who found in Patagonia and Chile a species which he believed to be *P. grisea*, the genotype.

As restricted by Edwards (1929) it forms a natural and rather sharply marked group of the subfamily Pelopiinæ (Tanypodinæ) readily distinguished from related genera in both immature and adult stages. The adult stage is characterized as follows:

Wings densely hairy; costa not or only very indistinctly produced beyond the tip of the posterior branch of the radius; the second radial branch normally present; the medio-cubital cross-vein placed immediately beyond the fork of the cubitus. Antennæ of the female with 12, rarely with 13 segments. Pronotum more reduced than in other genera of the subfamily. Tarsal spurs lacking; pulvilli usually absent.

Until comparatively recent years the species of *Pentaneura*, together with those species having a produced costa and now placed in other genera (*Anatopynia*, *Podonomus*, *Lasiodiamesa*), were grouped either under the generic name of *Ablabesmyia* (Johannsen, 1905) or under the name of *Tanypus* (Malloch, 1915; Walley, 1925, 1928). Recently Goetghebuer (1936), being in doubt as to the soundness of Edwards' conclusions, reverted to the name *Ablabesmyia,* using it however in the restricted sense of *Pentaneura* of Edwards.

These facts should be kept in mind when referring to the papers of Edwards (1929), Goetghebuer (1936), Johannsen (1905), Malloch (1915) and Walley (1925, 1928). For more detailed descriptions of both males and females of the species than given in this paper the foregoing works should be consulted. The earlier descriptions are reproduced in Bulletin 86, N. Y. State Museum (Johannsen, 1905).

In the differentiation of species the structure of the ædeagus of the male hypopygium offers features that are important but which heretofore have rarely been used in this group of insects. Whether some of the variations that exist always represent specific distinctness or whether they may in some cases merely indicate examples of polymorphism of a single variable species only further study will demonstrate. Rearing experiments under varying conditions of light, temperature, and food, may be necessary to determine the influence of these factors on both color and structural characters. Recent European writers have stressed the variability in coloring of the abdomen of some species. The leg ratios (ratio of length of basitarus to tibia) and antennal ratios (ratio of the length of segments 14–15 to 2–13) though of taxonomic importance, are also subject to some variation.

This paper is therefore to be regarded as a preliminary report only, to direct attention of workers to certain taxonomic factors afforded especially by the structure of the ædeagus. By reason of the complexity and minuteness of this organ it may be necessary to employ the more precise methods of dissecting and staining used by recent students of the Ceratopogonidæ and the Culicidæ (Cf. Komp, 1942).

I am indebted to the authorities of the United States National Museum for the privilege of examining a considerable collection of undetermined material, which together with that of the Cornell University collection form the basis of this study.

Edwards (1929) divided the British species of *Pentaneura* into six groups as follows, a grouping which serves equally well for the North American species.

1. Wings with markings, even if faint; legs sometimes ringed .... (2).
   Wings quite unmarked, except rarely for a darkened crossvein; legs light or dark, but usually without darker rings, even at tips of femora... (4).
2. A dark ring near middle of each tibia, in one case with three intermediate rings .... Group A.
   No such rings present .... (3).
3. Wings dark with light spots .... Group B.
   Wings light with dark bands, spots, or clouds .... Group C.
4. Wings usually 3.5 mm. long or more; second radial vein distinctly present and forked .... Group D.
   Wing 3 mm. long or less; second radial branch faint, fork indistinct or absent .... (5).
5. Third radial branch ending beyond or above the level of the tip of the anterior branch of the cubitus .... Group E.
   Third radial branch ending before the level of the tip of the anterior branch of the cubitus .... Group F.

GROUP A

Legs whitish, with numerous dark rings, one (rarely more) in the middle section of each tibia, others at tips of femora, tibiæ, and most of the tarsal segments, and at the bases of the tibiæ. Thorax usually gray pollinose, with variegated dark vittæ on the dorsum. Abdomen whitish with dark markings; in some varieties it is mainly dark. The dististyles of the hypopygium terminate in a constricted and darkened tip, with an articulated stylet inserted well before the apex (Figs. 5 and 7). Wings hyaline with a number of irregular, oval blotches which are arranged in two or three, more or less irregular, transverse broken fasciæ.

The above mentioned articulated stylet in some forms is straight and ends acutely (Fig. 7); in others it has a somewhat enlarged and bent apex (Fig. 5). The structure of the ædeagus having rarely been previously mentioned in taxonomic literature dealing with the species of the *monilis* group, and slide mounts of the hypopygium of the male of type or paratypes being available in but few cases, the identification of the specimens used in constructing the following key is based in large part on color and other characters given in the original description, while the characteristics of the ædeagus are drawn from the specimens so determined. This analysis is therefore tentative.

A key to the females of this group cannot be made at this time for lack of sufficient material of mated pairs.

PENTANEURA MONILIS (LINN.), VARIETIES, AND RELATED SPECIES

MALES

1. Fore tarsi bearded .... *prudens* Walley.
   Fore tarsi with short hairs only .... (2).
2. Femora, in addition to the dark base, with a median and preapical band; fore tibiæ with sub-basal, apical, and three median bands. Limbs of ædeagus (Fig. 2) of hypopygium not twice as long as the narrowed tip of the dististyle; the stylet straight and acute at apex (Fig. 7) .... *cinctipes* n. sp.
   Femora lacking a median band; tibiæ with but one median band .... (3).
3. Median band of fore tibia near the apical fourth; abdominal tergites, except the last two or three, each with a narrow dark sub-basal fascia; limbs of ædeagus with accessory lobe (Fig. 4). (*P. monilis* of Malloch, not Linn.) .... *annulata* Say.
   Median band of tibiæ only slightly beyond middle .... (4).
4. Basistyle of hypopygium outwardly near the base with a distinct swelling or bulge; anterior abdominal tergites largely pale; limbs of ædeagus robust (Fig. 1) .... (?) *basalis* Walley.
   Swelling at base of basistyle vestigial or wanting .... (5).
5. Limbs of ædeagus ending in a brush (Fig. 6) .... *monilus* Var. 1.
   Limbs of ædeagus not ending in a brush .... (6).
6. Accessory lobes of ædeagus broad and elongate, margin feebly serrate (Fig. 3) .... *monilis* Var. 2.
   Accessory lobes of ædeagus not as shown in Figure 3 .... (7).
7. First tarsal segment of fore leg slightly longer than the second and third combined; stylet of antenna straight and acute as in *P. cinctipes* (Fig. 7) .... *illinoensis* Malloch.
   First tarsal segment of fore leg shorter or at least not longer than the second and third combined .... (8).
8. Ædeagus short, less than twice as long as the narrowed apex of the dististyle .... (9).
   Ædeagus more than twice as long as the narrowed apex of the dististyle; articulated stylet with enlarged and bent apex (Fig. 5). *monilis* Linn.
9. Stylet of dististyle straight and acute resembling that shown in Figure 7 .... (10).
   Stylet of dististyle with enlarged and bent apex, resembling that shown in Figure 5; dark tibial bands narrow .... (11).
10. Abdominal segments 1–3 wholly white; dark tibial bands narrow; ædeagus (Figs. 10, 11) .... *peleensis* Walley.
    Abdominal tergites except the first, largely dark; dark tibial bands usually more than a third as wide as the adjacent white bands. *illinoensis* and varieties.

11. Abdominal tergites 2, 3, and 4, each with a pair of slender longitudinal lines or dashes; tibial bands narrow .... *mallochi* Walley.
Abdominal tergites 2, 3, and 4, each with a dark basal mark or fascia. *mallochi*, Var. (Cf. *idei* Walley.).

Pentaneura prudens (Walley)

(*Tanypus prudens* Walley. Canad. Ent., 57: 275. 1925)

MALE.—This species shares with the European *P. phatta* the characteristic of having long hairs on the front tarsi. The wing markings are about as with the typical *monilis*. Apical fourth of each abdominal tergite white. Walley states that the hypopygium is rather like that of *illinoensis* Malloch. Length 6 mm. Delta, Man. July.

Pentaneura cinctipes, new species

MALE.—Head, palpi, and antennæ brown, the large basal segment of the latter, blackish. Mesonotum gray pollinose with a fine, brown, median line ending posteriorly in a brown spot just in front of the scutellum; two rows of three oval, usually dark brown, spots on each side of the median line, as well as several irregular spots on the pleura. In some specimens, or as seen by oblique light, the dorsal spots appear as four broad longitudinal vittæ. Scutellum pollinose with a pair of brown spots. Metanotum dark brown, pollinose on the sides; sternum dark, pollinose. In less mature specimens the background may be yellowish, the spots pale brown.

Markings of the abdomen rather variable; the ground color whitish, segments 2 to 5 each with dark sub-basal band, produced in the middle, the remaining segments largely darkened. In well-colored specimens there may be on each intermediate tergite a narrow preapical band interrupted in the middle. The wing markings resemble those of a typical *monilis* about as shown in figure 6, plate 27 (Johannsen, 1905), but with a spot distad of the crossvein as in figure 3, plate 32, of Walley (1928) though less distinct. Legs whitish; all femora with dark basal, median, and pre-apical bands, the median band on the fore femora slightly nearer to the basal than to the pre-apical band. Fore tibiæ with five bands, there being three between the narrow sub-basal and the somewhat broader apical band; middle band smallest and slightly before the middle, the three proximal bands narrower than the other two. Second and third tibiæ and the basitarsi each with three bands, remaining tarsal segments dark apically. Ratio of fore basitarsus to tibia 0.79; first tarsal segment of fore leg shorter than tarsal segments 2 and 3 combined. Styles of the hypopygium about as those of a typical *monilis* except that the articulated pre-apical stylet is straight and acute at apex (Fig. 7); limbs of the ædeagus claw-like (Fig. 2), not twice as long as the constricted apical part of the dististyle. Length 2.8 mm.; of wing 2.2 mm. Miami, Florida, XII:19, 1912. F. Knab, collector.

Holotype and allotype in the U. S. National Museum; paratypes in the U. S. National Museum and in the Cornell University Collection.

Pentaneura annulata (Say)

(*Tanypus annulatus* Say. Journ. Acad. Nat. Science. Phil., 3: 15, 1823. *Tanypus monilis* Malloch, nec Linn. Ill. State Lab. N. H. Bull., 10: 375, 1915).

MALE.—Resembles *monilis,* differs chiefly in having the median brown rings of the tibiæ far beyond the middle, that of the fore legs being on the apical fourth instead of near the middle, and the dark sub-basal fascia of the abdominal tergites being narrow and nearly of uniform width on segments 2 to 5. The wing markings are as shown in Malloch's figure on plate 27. The hypopygium resembles that of *monilis* but the ædeagus is less than twice as long as the narrow apical constriction of the dististyle, the limbs gently curved, acute, and with rounded inner lobe; the accessory lobes about as long as the limbs (Fig. 4). Length 3 to 4 mm., wing, 3.2 mm.

Penn., Ill. Plummer's Isl., Md., IV: 25; V: 26. H. S. Barber, Collector.

Pentaneura basalis (Walley)

(*Tanypus basalis* Walley. Canad. Ent., 57: 273, 1925)

MALE.—This species is characterized as having a large swelling or bulge outwardly on the base of the basistyle. This character seems to be a rather subtile one and subject to variation. A study of specimens of the *monilis* group from various localities reveals that the basal swelling is present in a number in various degrees of development. In one of these, from Forest Glen, Maryland, taken May 18th, this structure is about as shown in Walley's figure of *basalis.* The Maryland specimen has a typical *monilis* hypopygium except that the limbs of the ædeagus are distinctly more robust (Fig. 1). The anterior abdominal tergites each have paired lateral longitudinal lines; posterior tergites are dark. Length 3 to 3.5 mm.; wing 2.75 mm. Canada, United States.

Pentaneura monilis Var. 1

MALE.—Thorax marked as in the typical form; anterior abdominal tergites marked with a pair of longitudinal lines. The hypopygium as usual for *monilis* with similar pre-apical stylet on the dististyle but the ædeagus has a more or less elongate lateral lobe, which ends in a brush-like expansion (Fig. 6); basistyle without swelling at base. Dark bands of the fore tibia are narrow and subequal, the median one midway between the sub-basal and the apical. Length 3.3 mm., wing 2.6 mm. A single specimen from Plummer's Isl., Md., V: 23, 1914.

Pentaneura monilis Var. 2

MALE.—Thoracic and wing markings like those of a typical *monilis,* but differs in having a nearly uniform dark brown abdomen, and with rather wide dark leg bands. The ædeagus is as shown in Figure 3, not twice as long as the narrowed apical part of the dististyle, with a broad, flat, feebly serrated accessory lobe. Stylet of dististyle enlarged at apex. Length 3 mm., wing 2.2 mm. A single specimen collected by W. A. Nason at Algonquin, Ill., V: 31, 1913.

Pentaneura illinoensis (Malloch)

(*Tanypus illinoensis* Malloch. Ill. State Laboratory of N. H. Bull., 10: 376, 1915)

MALE.—According to Malloch this form differs from *monilis* in having the basal segment of the fore tarsus slightly longer than the next two segments taken together. It shares with some forms of the group, in being generally paler, the light-colored parts almost white, and in having the articulated pre-apical stylet of the dististyle ending acutely. Some specimens from Virginia and answering this description show a variation in the relative lengths of the first three fore-tarsal segments; in some the first segment is fully as long as the combined lengths of segments 2 and 3 but in others the first is slightly shorter. Other specimens, agreeing in structural characters with the Virginia specimens, but all with a shorter first tasal segment were collected in various localities. In these the articulated stylet of the dististyle is straight and acute, the ædeagus short, not twice as long as the constricted part of the dististyle, and the base of the basistyle not swollen outwardly. Anterior part of tergites 2 to 5 dark, posterior tergites largely dark. Median dark band of fore tibia about half way between the sub-basal and apical bands; fore tarsi not bearded. Length 3.5 to 4 mm.; wing 2.8 mm. Mound, La., G. H. Bradley, collector; Washington, D. C., VII:7, 1925, J. M. Aldrich, collector; Albany, N. Y., VI:22, 1920; Ithaca, N. Y., IX:12, 1916, O. A. Johannsen, collector; Grassymead, Va., VII:31, 1924, H. G. Dyar, collector.

Pentaneura monilis (Linnaeus)

(*Tipula monilis* Linnaeus. Syst. Nat., Edition 10: 587, 1758)

MALE.—Specimens from N. Y., D. C., and other parts of the country agree with specimens from England determined by F. W. Edwards, and from Franzenbad, Austria, determined by F. Kowarz, in structural and color characters as described by Edwards (1929). In all the fore tarsi are not bearded, the basistyle lacks a basal outward swelling, the narrow medium dark tibial ring of the fore legs is about midway between the sub-basal and apical rings, first tarsal segment of fore leg about 0.85 as long as its tibia, and shorter than segments 2 and 3 combined. The hypopygium is as figured (Fig. 5) with the limbs of the ædeagus slightly flexed and more than three times as long as the constricted apical part of the dististyle, the articulated pre-apical stylet bent at apex where it is slightly enlarged. The abdominal markings vary somewhat, usually tergites 2 to 5 are each marked with a pair of dark longitudinal dashes which in some cases may be connected by a more or less distinct anterior transverse line. Thoracic markings are as described above for *P. cinctipes*. The dark leg bands are much narrower than the adjacent white bands. A common and widely distributed species. Length 3.5 to 4.5; wing 2.5 to 3.5.

Pentaneura peleensis (Walley)

(*Tanypus peleensis* Walley. Canad. Ent., 57: 273, 1925)

MALE.—As characterized by Walley, this form has abdominal tergites 1, 2, 3, and basal part of 4 usually white, often with a trace of fuscous; remaining tergites usually uniformly fuscous. The tibiæ are marked with three black bands of equal width, the median midway between the sub-basal and apical. Wing markings as figured by Walley (1928) differing from a typical *monilis* in having fewer and smaller spots in the anal region. Specimens from Austria agreeing with Walley's description have a type of hypopygium resembling that of *mallochi* with short ædeagus (Figs. 10, 11) not twice as long as the constricted part of the dististyle, the articulated pre-apical stylet straight and acute as in *P. cinctipes* (Fig. 7). Length 3.5 mm.; wing 2.7 mm. Walley's specimens are from Pt. Pelee, Ont., collected VI:10, 1925. Other specimens from Washington, D. C., IV; VII.

Pentaneura mallochi (Walley)

(*Tanypus mallochi* Walley. Canad. Ent., 57: 273, 1925)

Male.—The hypopygium of a paratype specimen from Quebec has the articulated stylet of the dististyle enlarged at apex, the the ædeagus not twice as long as the constricted apical part of the dististyle. Abdomen grayish white, second to fifth tergites with a rather elongate brown line on each side, remaining tergites brown, gray pollinose. Basistyle of fore leg a fifth shorter than the tibia and almost a fifth shorter than the following two segments combined. Length 3.5 mm., wing 2.8 mm.

Walley states that the paired longitudinal lines of the abdomen are in a few cases fused in front.

Pentaneura mallochi Var.

Male.—Some specimens with hypopygium as noted differ only in having the basal part of the anterior tergites darker. Length 3.5 mm.; wing 2.4 mm. This form may possibly be *P. idei* (Walley). These specimens are from the following localities: Springfield, Mass., VIII:21, 1903, F. Knab, collector; Sandpoint, Id., VIII:3, 1917, H. G. Dyar, collector; Washington, D. C., X:11, 1912, R. C. Shannon, collector; McLean, N. Y., VIII:17, 1925, C. K. Sibley, collector; Billy's Isl., Georgia, 1912, J. C. Bradley, collector.

Pentaneura idei (Walley)

(*Tanypus idei* Walley. Canad. Ent., 57: 272, 1925)

This form is not included in the key unless *P. mallochi* Var. is the same. Walley (1928) indicates that *idei* is related to the three forms *illinoensis, mallochi,* and *peleensis,* from which it differs slightly in wing pattern, the subapical spot between the media and the anterior branch of the cubitus being small and fused with the large quadrate spot between the posterior branch of the radius and the media. The spot at the apex of the anterior branch of the cubitus is very faint. Length 5 mm. Ottawa, Can., VIII:1, 1924.

GROUP B

This group is characterized by having numerous whitish hyaline spots on a gray ground. Represented in the European fauna by *P. guttipennis* VdW. Only one described North American species, *P. multipunctata* (Curran).

Pentaneura multipunctatus (Curran)

(*Tanypus multipunctatus* Curran. Bull. Amer. Mus. N. H., 61: 29, 1930)

FEMALE.—Dull brown species, the mesonotum vittate; posterior margins of the tergites more or less grayish. Legs yellowish; broad apex of femora, broad sub-basal band on the tibiæ and broad apices of the tibiæ, brown; apical segment of four anterior tarsi pale brown. Wings gray, posterior radial cell with four, medial and first cubital cells each with three or four rather large, more or less round sub-hyaline spots; behind the cubitus are three larger hyaline spots; basal cells clear. Halteres yellow. Length 1.5 mm., wing 2.4 mm. Tuxedo, N. Y., July; Ithaca, N. Y., June, July.

GROUP C

This group includes all species with wings having gray, brown, or black spots or bands on a whitish hyaline background. These spots in some cases may be quite faint, best observed by oblique light. Legs with or without dark pre-apical bands on femora. No median band on tibiæ. Fore basitarsus usually bearded in the male. Wing length 3 to 4 mm.

1. Wing with numerous brown spots, some more or less coalescent; legs bicolored .... (2).
   Wing with two to four large spots or two or three transverse bands ...... (3).
2. Abdominal tergites of male with dark basal bands; of the female dark brown, hind margins of tergites whitish; vittæ of mesonotum black. Length 4 mm., male; 3 mm., female. N. M. .... *barberi* (Coq.).

Abdominal tergites of female pale, tergites 3 to 5 each with a brown, rectangular basal spot; vittæ of mesonotum brown. Length 2.5 mm. Male unknown. P. R. .... *marmorata* Joh.

3. Femora, and usually tibiæ also, with one or two dark bands; or dark with white bands .... (4).
   Legs not banded .... (6).
4. Tarsi dark except first and second segments; two broad wing bands, the first over the crossveins; vittæ of mesonotum buff, fuscous anteriorly. Length 4.5 mm. Male unknown. Quebec .... *apicalis* Walley.
   Tarsi largely of wholly pale, or otherwise differing .... (5).
5. Legs pale except for a pre-apical band on femora and extreme tip of tibiæ: fore tarsi of male bearded; pulvilli nearly as long as the claws in both sexes. Length of male 5 mm. N.Y., Col. ...... *ornata* (Meigen).
   Legs brown; tibiæ and tarsi white annulate; abdomen brown. Wing with two fascia-like and two longitudinal dark spots. Length 3.5 to 5.5 mm. Male and female. Greenland ....*pulchripennis* (Lundbeck).
6. First wing fascia beyond the crossvein; humeral crossvein not darkened. Length 4 mm., male; 2.5 mm., female. N. Y., Mass. *bifasciata* (Coquillett).
   First wing fascia lies over or before the crossveins .... (7).
7. Mesonotum uniformly brownish yellow; wing with three fuscous fasciæ; crossveins dark; abdominal tergites 2 to 5 dark anteriorly, 6 to 8 dark. Length of male 3 mm. Ontario .... *fragilis* (Walley).
   Mesonotum with buff or dark vittæ .... (8).
8. Fore tarsi of male not bearded. Abdominal tergites with dark *posterior* margins, the second and third in addition with broad basal fasciae. Wings with a dark spot covering the crossveins, another larger spot behind this, and a transverse band half way between the crossvein and the wing tip reaching from the posterior branch of the radius to the posterior wing margin; humeral crossvein dark. Length 3 mm. Wisconsin. .... *futilis* (Van der Wulp)
   Male tarsi bearded. Abdominal tergites with dark *anterior* fasciæ ...... (9).
9. Mesonotal vittæ buff, reddish, or brownish, not margined with black. Male and female. Length 3 mm. Northeast U. S. *carnea* (Fabricius).
   Vittæ of mesonotum yellowish or reddish, margined with black. Length, 3 mm. Male and female. N. Y., N. H. ....*sinuosa* (Coquillett).

Pentaneura marmorata Johannsen

(*Pentaneura marmorata* Johannsen. Journ. Agr. Univ. P. R., 22: 219, 1938)

The male of this species has not been described. Rio Cidra, Puerto Rico, III: 23, 1935, Dr. Julio Garcia-Diaz, collector.

Pentaneura ornata (Meigen)

(*Tanypus ornatus* Meigen. System. Beschr., VII: 7, 1838)

This European species occurs also in America. Pulvilli, rare in members of this genus, in both sexes of this species are well developed, nearly as long as the claws. Ithaca, N. Y., July, August; Florissant, Col., August.

Pentaneura futilis (Van der Wulp)

(*Tanypus futilis* Van der Wulp. Tijdschrift voor Entomologie. 2: 130, 1868)

Through the kindness of Dr. G. Kruseman of Amsterdam I recently received information concerning the type of this species which is in the Zoological Museum of Leiden, Netherlands. This information confirms my assumption that the species is properly placed in the genus *Pentaneura.* The figure furnished by Dr. Kruseman shows that in addition to the dark posterior margins of the abdominal tergites there is a broad basal fascia on each of tergites two and three. The tip of the posterior branch of the radius ends distad of the level of the tip of the anterior branch of the cubitus. The hairs on the fore tarsi are very short. The wing markings are as described in the key. Wisconsin.

Pentaneura carnea (Fabricius)

(*Chironomus carneus* Fabricius. Syst. Antl., 41: 16, 1805)

MALE.—Specimens of *P. carnea* received from the late Dr. F. W. Edwards and collected in England agree in coloring and structural characters with specimens collected in various parts of the United States. The dististyle is of the simple type (Fig. 8), distinctly curved and tapering. In some females the coloring is more extended around the tip of the wing. Maine, N. H., Mass., Conn., N. Y., N. J., D. C., Md., Ill., Cal., April to September.

Pentaneura sinuosa (Coquillett)

(*Tanypus sinuosus* Coquillett. Journ. N. Y. Ent. Soc., 13: 65, 1905)

This species is apparently closely related to the European *P. carnea,* var. *festiva* (Meigen). Center Harbor and Franconia,

N. H., July 2, Mrs. Slosson, collector; Ithaca, N. Y., July 15, 1920, O. A. Johannsen, collector.

GROUP D

This group includes species that have unmarked wings, which measure 3 mm. or more in length, the crossveins not noticeably darker than the other veins, and the fork at the tip of the second branch of the radius distinct. The fore tarsi of the males are at least sparsely bearded in the species included in the key given below.

1. Thorax dull black, abdomen and legs wholly yellow. Female. Male unknown. Length 2.5 mm.; wing about 3 mm. Kansas...... *aurea* (Joh).
   Not so marked .... (2).
2. Thorax chiefly dark .... (3).
   Thorax chiefly pale; with or without dark dorsal vittæ .... (4).
3. Abdomen black; vittæ of mesonotum separated by gray lines; dististyle angulate, similar to that shown in Figure 15. Length of male 5 mm. Greenland .... *melanosoma* Goetghebuer.
   Lateral posterior angles of abdominal tergites yellowish; legs brownish yellow, tips of femore darker. Length of male 3 to 3.5 mm. Dististyle curved and tapering. Illinois .... *inconspicua* Malloch.
4. Dististyles strongly curved, slender, apex widened, excavated, and with pre-apical tubercle (Fig. 14) .... (5).
   Dististyle gently curved or angulate (Figs. 8 and 15), apex acute...... (6).
5. Eighth abdominal segment of male bearing a cluster of converging golden brown hairs on each side. Body whitish, mesonotum with three buff colored vittæ; abdomen more or less brownish fasciate. Length of male 5 to 6 mm. Ottawa, Quebec, Ithaca, N. Y. *cornuticaudata* (Walley).
   Eighth abdominal segment of male bearing a tuft of dense diverging hairs. Abdominal markings darker. Ottawa. *pilicaudata* (Walley).
6. Abdominal tergites of male with distinct dark anterior fasciæ .... (7).
   Abdomen of male almost white, tergites 1 to 5 without distinct fasciæ .... (9).
7. Mesonotal vittæ, metanotum, and sternum, brown; dististyles of hypopygium angulate (Fig. 15); ædeagus (Fig. 12) with pectinate limbs. Widely distributed .... *flavifrons* (Johannsen).
   Mesonotal vittæ buff or lacking .... (8).
8. A small dense tuft of converging hairs arise on each side near base of hypopygium resembling that of *cornuticaudata*. Lake Okoboji, Iowa .... *okoboji* (Walley).
   Hair tuft near base of hypopygium lacking; dististyle broad and angulate resembling that shown in Fig. 15. Ædeagus as figured (Fig. 13). Conn., Col. .... *vitellina* (Kieffer).

9. Third segment of middle tarsus of male with a dense fringe of longish yellow hairs on apex in front. Ottawa, Quebec .... *currani* (Walley).
   Third segment of middle tarsus without such fringe .... (10).
10. Dististyle stout, angulate, resembling that of Figure 15; ædeagus with limbs that terminate in a tuft of a few long bristles that project at an angle to the axis (Fig. 9). Widely distributed species. *melanops* (Wiedemann).
   Dististyle narrower, tapering apically. Ottawa .... *senata* (Walley).

Pentaneura aurea (Johannsen)

(*Ablabesmyia aurea* Johannsen. Kansas Univ. Science Bull., 4: 110, 1907)

FEMALE.—Thorax dull black; abdomen wholly golden yellow; legs pale yellow. Second basal cell of the wing, measured from the arculus, five-eighths as long as the distance from the posterior crossvein to the wing tip. Length 2.5 mm.; wing about 3 mm. Male unknown. Kansas, July.

Pentaneura flavifrons (Johannsen)

(*Ablabesmyia flavifrons* Johannsen. N. Y. State Mus. Bull., 86: 150, 1905)

MALE.—Related to *melanops* but with darker markings. Antennal segments 2 to 13 combined less than half as long as 14 and 15 combined. Fore basitarsus about 0.75 as long as the tibia; pulvilli vestigial; fore tarsi sparsely bearded. Wing length 3.5 mm.; length of second basal cell measured from the arculus to the posterior crossvein, about half as great as the distance from this crossvein to wing tip. Dististyle of hypopygium broad and strongly arcuate (Fig. 15); limbs of ædeagus outwardly ciliate with spines (Fig. 12).

FEMALE.—Coloring as in the male except for the dusky yellow abdomen. Ithaca, N. Y., IV: 10; Orono, Me. (O. A. Johannsen). California: San Diego, V: 11, 1916; Tohoe City, VI: 18, 1925; Virginia Creek, VI: 21, 1916 (H. G. Dyar). Colorado: Boulder, X: 1915; Florissant, X: 1915. Tiffany, VIII: 28, 1941, (B. Rolger). Nevada: Steamboat, IX: 3, 1915 (H. G. Dyar). Utah: Logan, VI: 24, (G. F. Knowlton).

Pentaneura cornuticaudatus (Walley)

(*Tanypus cornuticaudatus* Walley. Canad. Ent., 57: 277, 1925)

MALE.—The dististyle of the hypopygium is slender, strongly arcuate, and grooved on the convex side; just proximad of the apex there is a distinct tubercle (Fig. 14). Ottawa, Ont.; July, Aug.; Quebec, July. Ithaca, N. Y., July.

Pentaneura melanops (Wiedemann)

(*Tanypus melanops* Wiedemann in Meigen. Syst. Beschr., 1: 65, 18, 1818)

MALE.—This species resembles *P. flavifrons* and *P. vitellina* in most structural features but differs in the form of the ædeagus in which the limbs terminate in a tuft of a few long bristles that project at an angle to the axis (Fig. 9). The figure was drawn from an English specimen determined by the late F. W. Edwards. Maine, N. H., Vt., Mass., Conn., N. Y., N. J., Ind., Ill., Mich., Nebr.

Pentaneura melanosoma (Goetghebuer)

(*Ablabesmyia melanosoma* Goetghebuer. Skr. Svalbard og Ishavet., 53: 20, 1933)

MALE.—A black species with an antennal ratio of 1.8; a leg ratio of 0.65; fore tarsi densely bearded. Diststyle similar to that of *P. melanops*. East Greenland.

Pentaneura vitellina (Kieffer)

(*Pelopia melanops,* var. *vitellina* Kieffer. Arch. Hydrobiol., 9: 520, 1916)

MALE.—In structural features resembling *melanops* but differing in having dark abdominal fasciæ and in the structure of the ædeagus (Fig. 13). Antennal ratio 2; fore leg ratio 0.8; wing length 3 mm. Suffield, Conn., V: 20, 1903. Tiffany, Col., VIII: 23, 1941, B. Rolger, collector.

First American record of this European species.

GROUP E

Wings unmarked; second radial branch faint, the fork usually indistinct or absent; posterior branch of the radius ending as usual above or beyond the level of the tip of the anterior branch of the cubitus. The basal cells in both sexes usually short, especially those of the female, in which, in some species the second cell, measured from the arculus, may not be more than a third as long as the distance from the posterior crossvein to the wing tip. Wing length 2 to 3 mm. The small size and the more or less uniformity in structural characters of this group make these midges rather difficult to separate.

1. Brownish species with pale brown halteres and legs. Length 1 mm., wing, 1 mm. Male. Hudson Bay .... *fimbriata* (Walker).
   Larger species; wing length 1.4 mm. or greater .... (2).
2. Thorax light brown with greenish pruinescence; abdomen yellow with brown fasciæ; basistyle yellow; halteres yellow with black knob; tibiæ yellow with narrow dark apices. Length 2.5 to 3 mm. Moneague, Jamaica .... *brooksi* (Gerry).
   Thorax without greenish pruinescence, and otherwise differing .... (3).
3. Basitarsus of middle legs longer (1.1) than the corresponding tibia; thorax yellow, vittæ brown; abdomen yellow with brown basal fasciæ. D. C., Fla., Puerto Rico .... *pilosella* (Loew).
   Basitarsus of middle leg shorter than the corresponding tibia .... (4).
4. Antennal segments of male 14 and 15 combined half as long as segments 2 to 13 combined; basitarsus of fore leg three-fourths as long corresponding tibia. Yellow species, mesonotum with buff colored vittæ. Length 1.5 to 2 mm. Puerto Rico and (?) St. Vincent Isl.
   (?) *flaveola* (Williston).
   Segments 14 and 15 of male combined equal or greater than segments 2 to 13 combined .... (5).
5. Crossvein darker than adjacent veins; second basal cell, measured from the arculus to the posterior crossvein about half as long as the distance of this vein to the wing tip; posterior branch of the radius ends noticeably (by 0.1 mm.) beyond the level of the tip of the anterior branch of the cubitus. Thorax whitish, vittæ of mesonotum buff yellow; abdomen yellow with brownish fasciæ. Male. Texas.
   planensis n. sp.
   Crossvein not darker than adjacent veins and otherwise differing .... (6).
6. The posterior crossvein lies proximad of the level of the base of the radial sector by a smaller distance than the length of this crossvein (*i.e.*, the apex of the first posterior cell lies distad of the apex of the second basal cell by a distance less than the length of the posterior crossvein.) Thorax reddish yellow with dark brown vittæ; abdomen fasciate. Antennal ratio of male 1.33; middle leg ratio 0.88; second basal cell measured from the arculus to the posterior crossvein 0.43 as great as the distance from this crossvein to wing tip. Length 2.25 mm.; wing 1.7 mm. St. Vincent Isl. Male .... *indecisa* (Williston).
   With another combination of characters .... (7).
7. Thorax whitish with dark yellow vittæ; abdomen yellow with pale brown fasciæ in the male, wholly yellow in the female; male fore tarsi bearded; middle leg ratio 0.57. N. M. .... *pallens* (Coquillett).

Thoracic vittæ brown or black and otherwise differing. Several undescribed species, chiefly western, now in the United States National Museum collection and resembling each other more or less in color but differing in antennal and leg ratios require a careful comparative study of hypopygial characters to be properly described. They are apparently closely related to the European *P. cingulata* (Walker).

Pentaneura pilosellus (Loew)

(*Tanypus pilosellus* Loew. Berl. Ent. Zeitschr., 7 : 5, 1866)

MALE.—Head and palpi yellow, occiput, vertex, and basal antennal segment brown, flagellum yellowish brown. Mesonotum and scutellum yellow, the three broad mesonotal vittæ, the sternum, and postnotum brown. Abdomen yellow, including hypopygium; the anterior third to half of the second, fourth, and sixth tergites, and most of the third, fifth, seventh and eighth tergites except the narrow posterior borders, brown. The extent of the darker coloring somewhat variable. Legs pale yellow, tips of femora and tibiæ in some cases slightly darker. Wings hyaline, veins pale yellow. Halteres yellow.

Antennal ratio 1.2; palpi 0.7 as long as flagellum; fore leg ratio 0.6, middle leg, 1.12, hind leg, 0.82. Second basal cell, measured from the arculus to the posterior crossvein 0.37 as long as the distance from this crossvein to the wing tip; posterior branch of the radius ends very slightly distad of the level of tip of first branch of the cubitus; the apex of the second posterior cell lies proximad of the apex of the first posterior cell by a distance greater than the length of the posterior crossvein. Wing length 1.75 mm. Basistyle of hypopygium slender, gently curved, tapering. Length of fly 2.25 mm.

FEMALE.—Coloring of head and thorax as with the male. Tergites of abdomen brown, the posterior margins more or less yellowish, especially those of the second and fourth segments; venter and first tergite yellow. Legs yellow, tips of femora and tibiæ in some cases faintly brownish. Halteres yellow. Space between the eyes about three times as great as the width of the dorsal extension of the eye. Palpi a quarter longer than the flagellum of the antenna. Leg ratios approximately those of the male. Venation similar to that of the male excepting the basal cells are slightly shorter. Length of wing 1.3 mm.; of fly 1.4 mm.

Described by Loew from the District of Columbia. Specimens from Yunez R. and Tanama R., Puerto Rico, collected by Dr. J. Garcia-Diaz do not differ from specimens collected by me at Winter Park, Florida, during the late winter months, except in being slightly smaller and slightly darker yellow.

Pentaneura flaveola (Williston)?

(*Tanypus flaveolus* Williston. Trans. Ent. Soc. London, 1896: 275)

MALE.—Antennæ, palpi, and legs yellow. Thorax yellow, with the mesonotal vittæ, sternum, and pleura, buff colored. Abdomen pale yellow. Wings hyaline, veins yellow. Length of fly 1.8 mm.

Antennæ short, length 0.5 mm., segments 14 and 15 combined about half as long as segments 2 to 13 combined. Leg ratios respectively 0.77; 0.8; 0.72. Second basal cell of wing measured from the arculus to posterior crossvein 0.4 as long as the distance from this crossvein to the wing tip; distance between the posterior crossvein to the level of the base of the radial sector is greater than the length of this crossvein. Wing length 1.35 mm. Dististyle simple, tapering, and gently curved.

Two specimens collected by Dr. J. Garcia-Diaz on El Yunque Trail, Puerto Rico. VII: 10, 1935. Mounted on slides. These specimens agree well with the brief description by Dr. S. W. Williston (1896) of *Tanypus flaveolus* from St. Vincent Isl.

Pentaneura planensis new species

MALE.—A specimen collected by E. S. Tucker in Plano, Texas, and now in the U. S. National Museum, agrees well with the color description of Coquillett (1902) of *P. pallens* except that the Plano specimen has darkened crossveins. The latter species may be further characterized as follows: Antennal length 0.9 mm.; antennal ratio 1.35. Leg ratios respectively 0.75; 0.65; 0.7. Hairs on fore tarsi distinctly longer than the diameter of the member. Second basal cell measured from the arculus to the posterior crossvein 0.485 as long as the distance from this crossvein to the wing tip; distance between the posterior crossvein and the level of the base of the radial sector less than the length of this crossvein; posterior branch of the radius ends 0.1 mm. beyond the level of the tip of the anterior branch of the cubitus; crossveins darkened. Dististyle gently curved and tapering. Length 2.5 mm.; of wing 1.8 mm. Holotype in the U. S. National Museum.

Pentaneura indecisa (Williston)

(*Tanypus indecisus* Williston. Trans. Ent. Soc. London, 1896: 276)

Male.—A co-type male specimen in the Cornell University Collection may be characterized as follows: Head and basal antennal segment reddish yellow, palpi and antennal flagellum brownish yellow. Thorax reddish yellow, pollinose, vittæ brown, slightly pollinose; scutellum and pleura yellow, metanotum brownish. Abdomen pale yellowish, tergites 2 to 5 with broad, dark brown basal fasciæ which are somewhat broadened in the middle, tergites 7 and 8 brown; terminalia paler.

Front about three times as wide as the width of the dorsal eye extension. Antennal ratio 1.33. Leg ratio of the fore leg less than one; of the middle leg, 0.88; of the hind leg, 0.675. Wing length, 1.7 mm.; second basal cell measured from the arculus to the posterior crossvein 0.43 as long as the distance from the posterior crossvein to the wing tip; the posterior crossvein is less than its length proximad of the level of the base of the radial sector, i.e. the first basal cell extends but very slightly distad of the distal end of the second basal cell. Length of fly 2.25 mm. St. Vincent Isl.

Williston states that the female is 1.5 mm. in length.

Pentaneura pallens (Coquillett)

(*Tanypus pallens* Coquillett. Proc. U. S. Nat Museum, 25: 91, 1902)

Male.—Thorax whitish, three vittæ on mesonotum, metanotum, spots on pleura, and sternum, dark yellow. Abdomen pale yellow, a band near base of segments 2 to 5 and nearly the whole of the following segments pale brownish. Legs and halteres whitish. Length 2.5 mm.

Female.—Abdomen wholly yellow, otherwise as in the male. Length slightly over one mm.

Dr. Alan Stone of the U. S. National Museum states (in litt.) that the fore leg ratio is 0.75, mid leg 0.57; fore basitarsus bearded; second basal cell of wing measured from the arculus to the posterior crossvein 0.445 as long as the distance from this crossvein to the wing tip; posterior branch of the radius produced well beyond the level of the tip of the anterior branch of the cubitus; crossveins not clouded. Las Vegas, Hot Springs, N. M.

Group F

The species of this group are characterized by their small size; the posterior branch of the radius ends distinctly before the level of the tip of the anterior branch of the cubitus; first segment of the middle tarsus longer than the corresponding tibiæ; eyes pubescent.

Pentaneura dubia (Meigen)

(*Tanypus dubius* Meigen. Klass., 1: 25, 1804; Syst. Beschr., 1: 49, 1818)

This European species is the only one of the group known to occur in North America also. It is a small black fly with a wing length of 1.5 to 2 mm. The first segment of the middle tarsus is about a half longer than the corresponding tibia. Ithaca, N. Y.; Jackson Isl., Md., VI: 30, 1914.

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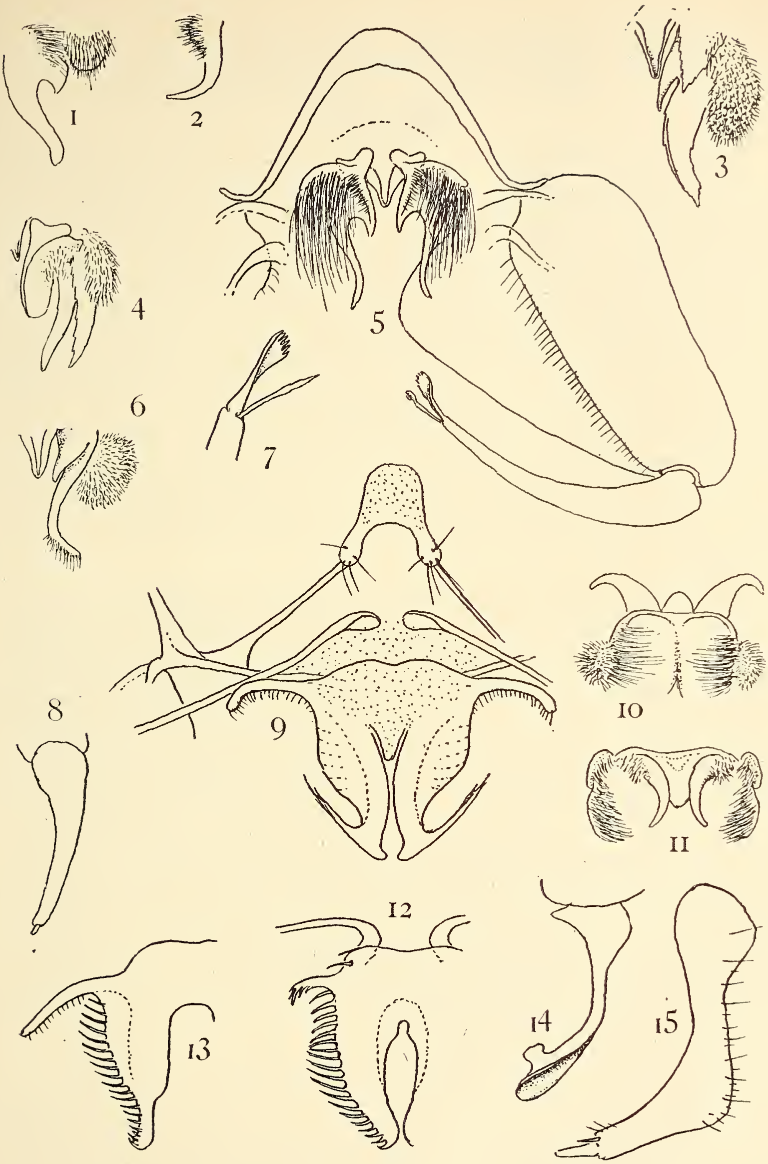
PLATE III

Magnification × 225 except where otherwise noted

1. *Pentaneura basalis* (Walley)? Part of ædeagus.
2. *Pentaneura cinctipes* n. sp. Part of ædeagus.
3. *Pentaneura monilis,* Var. 2. Part of ædeagus.
4. *Pentaneura annulata* (Say). Part of ædeagus.
5. *Pentaneura monilis* (Linn.). Dorsal aspect of half of hypopygium.
6. *Pentaneura monilis,* Var. 1. Part of ædeagus.
7. *Pentaneura cinctipes* n. sp. Apex of dististyle. × 450.
8. *Pentaneura carnea* (Fabr.). Dististyle.
9. *Pentaneura melanops* (Wied.). Dorsal aspect of ædeagus and accessory structures.
10. *Pentaneura peleensis* (Walley). Expanded ædeagus.
11. *Pentaneura peleensis* (Walley). Relaxed ædeagus.
12. *Pentaneura flavifrons* (Johannsen). Part of ædeagus.
13. *Pentaneura vitellina* (Kieffer). Part of ædeagus.
14. *Pentaneura cornuticaudata* (Walley). Dististyle. × 90.
15. *Pentaneura flavifrons* (Johannsen). Dististyle.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JOHN WATSON ANGELL

1885–1946

John Watson Angell, for over 30 years a prominent member of the NEW YORK ENTOMOLOGICAL SOCIETY and son of one of the founders and the first president of this society, passed away on July 29, 1946, after a lingering illness due to cancer. His fortitude and cheerfulness during the long period he was incapacitated was indeed remarkable. Even his closest friends did not know the nature of his complaint but all were buoyed up by the hope that his illness was of a temporary nature and that he would soon be well again. Although Jack, as he was known to his friends, was too ill to serve his country by joining any active service, he did extremely valuable espionage work, connected with the F. B. I., which was not generally known but for which we were all proud.

Mr. Angell was an indefatigable collector and possessed one of the best collections of the Lucanidæ in the world. His father before him had been a coleopterist. Both his father's collection and his own were willed to the Academy of Natural Science of Philadelphia. Two of his papers were published in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY. These are in volume 28, pp. 89–90 and volume 33, p. 216. Born in New York City on May 10, 1885, he spent most of his life in this city. He was a large handsome man and an athlete of note having played on the Princeton football team in his college days. He is survived by a daughter, Mrs. Yvonne Kenward now in England, and a sister, Mrs. Gladys A. Fry, 262 North Mountain Avenue, Upper Montclair, N. J. He will be missed for a long time by his large circle of friends.—STANLEY W. BROMLEY.

CHECK-LIST OF PSYCHODIDÆ OF THE PHILIPPINE AND HAWAIIAN ISLANDS[1]

Sixth contribution to a Check-list of Psychodidæ of the World.

By William F. Rapp, Jr., and Janet L. C. Rapp

The two archipelagoes have an indigenous fauna as well as cosmopolitan species. As yet the psychodid fauna from both of these archipelagoes is poorly known. The student is referred to Williams'[2] paper on the Hawaiian species and to del Rosario's[3] on the Philippine species.

PSYCHODA Latreille

Psychoda alabangensis del Rosario. Philipp. Jour. Sci., vol. 59 (1936), p. 566–567.
Luzon, Rizal Province, Alabang, Philippine Island.

Psychoda alternata Say. Long's Expedition St. Peter's River, App. p. 358, 1824.[4]
Hawaii Archipelago.
Manilla, Philippine Island.

Psychoda baguioensis del Rosario. Philipp. Jour. Sci., vol. 59 (1936), p. 560–562.
Luzon, Mountain Province, Baguio.

Psychoda banksi del Rosario. Philipp. Jour. Sci., vol. 59 (1936), p. 563–564.
Luzon, Laguna Province, Mount Maquiling.

Psychoda inornata Grimshaw. Fauna Hawaiiensis, Diptera, p. 6, 1911.
Kona, T. H. This may be the same as Williams' species 2.

Psychoda makati del Rosario. Philipp. Jour. Sci., vol. 59 (1936), p. 568–569.
Luzon, Rizal Province, San Pedro, Makati.

1 Contribution No. 264 from the Department of Entomology, University of Illinois, Urbana, Illinois.

2 Williams, F. X., Proc. Haw. Ent. Soc., vol. 11 (1943), pp. 324–338.

3 del Rosario, F., Philippine Jour. of Sci., vol. 59 (1936), pp. 553–571.

4 See Rapp, W. F., Jr., Jour. N. Y. Ent. Soc., vol. 52 (1944), p. 204, for synonyms.

Psychoda manilensis del Rosario. Philipp. Jour. Sci., vol. 59 (1936), p. 567.
Luzon, Manilla.

Psychoda muscæ del Rosario. Philipp. Jour. Sci. vol. 59 (1936), p. 564–566.
Luzon, Rizal Province, Alabang.

Psychoda phalaenoides (Linn.). Syst. Nat., ed. 10, no. 32, p. 588, 1758. Tonnoir, Ann. Soc. Ent. Belgique, vol. 62 (1922), p. 67–68.
Luzon, Rizal Province, Alabang.

Psychoda pseudalternata Tonnoir. This is a *nomen nudum,* but Williams has published the name together with a drawing of the terminalia.
Honolulu (?), T. H.

Psychoda zigzagensis del Rosario. Philipp. Jour. Sci., vol. 59 (1936), p. 562–563.
Luzon, Mountain Province, Baguio.

TELMATOSCOPUS Eaton

Telmatoscopus albipunctatus (Williston).

Psychoda albipunctata Williston.[5] Ent. News, vol. 4 (1893), p. 113.
Oahu, T. H.
Luzon, Manilla, Philippine Island.

[5] *Ibid.,* p. 203.

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), XXI

BY CHARLES P. ALEXANDER
AMHERST, MASSACHUSETTS

The previous part under this title was published in December, 1945 (JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY 53 (4): 279–291). The majority of the species discussed at this time were taken in Dutch Guiana by Dr. D. C. Geijskes and in Bolivia by Mr. Francisco Steinbach. A few additional species from other sources are mentioned in the text. I wish to acknowledge my appreciation and deepest thanks to all of the entomologists and collectors who have aided so materially in making known the rich Tropical American crane-fly fauna. The types are preserved in my large collection of World Tipulidæ.

Genus *Holorusia* Loew

Holorusia (Holorusia) luteivena new species.

Size large(wing, male, 27 mm.); mesonotum light brownish yellow, the præscutum with four scarcely darker brown stripes that are narrowly margined brown; dorsopleural region light yellow, margined beneath by a more brownish stripe; antennæ relatively short and stout, obscure yellow; wings dirty yellow and gray, restrictedly patterned with darker, the veins and adjacent membrane restrictedly yellow; vein R_3 with macrotrichia; *Rs* elongate, exceeding twice *m–cu*; M_{3+4} short, less than *r–m*; abdomen almost uniformly brown, without a darkened subterminal ring; male hypopygium with the caudal margin of the ninth tergite four-lobed; outer dististyle broadly flattened, near apex with numerous small denticles; inner dististyle with the blackened peglike spines relatively few in number.

MALE.—Length about 25 mm.; wing 27 mm.; antenna about 5 mm.

Frontal prolongation of head obscure yellow, sparsely pruinose, especially at base, nearly equal in length to the remainder of head; nasus stout, darkened; palpi dark brown, the terminal segment a trifle paler. Antennæ obscure yellow, relatively stout; second flagellar segment a little bulging on proximal half; succeeding segments subcylindrical; outer three or four segments strongly narrowed, all but the last a little dilated at base. Head light brown, the anterior vertex with indications of a narrow darker line.

Pronotal scutum darkened medially, the remainder of notum yellow. Mesonotum light brownish yellow, with four scarcely indicated darker stripes, differentiated chiefly by narrow and inconspicuous brown margins; cephalic and humeral portion of præscutum narrowly brownish black; transverse suture narrowly blackened, especially at the point; scutal lobes weakly darkened, the median area broadly pale; scutellum brownish gray, with indications of a capillary median brown line, parascutella more darkened; mediotergite obscure yellow, more infuscated laterally with a capillary brown median line; pleurotergite chiefly obscure yellow. Pleura with a broad dorsal yellow stripe extending from the pronotum over the extensive dorsopleural membrane to the wing-base; immediately below this stripe with a brown longitudinal stripe, its ventral portion merging into the more grayish ventral pleurites. Halteres obscure yellow, knob darker, the apex pale. Legs with the coxæ brownish gray, with long pale setæ; trochanters obscure yellow; femora light brown; tibiæ and proximal segments of tarsi paler, outer tarsal segments passing into brownish black; claws (male) bidentate, the basal spine small and slender. Wings with the ground color of the cephalic half dirty yellow, of the posterior half more grayish; a restricted darker pattern, including the cephalic prearcular field and bases of cells *R*, *M* and Cu_1; a small but darker brown spot at origin of *Rs*; stigma paler brown; veins at and near cord, together with the posterior wing margin narrowly seamed with brown, the latter interrupted by yellow spots at end of vein *1st A* and again just beyond vein *2nd A*; similar whitish spots before stigma and at base of cell *1st* M_2; veins and the membrane immediately adjacent restrictedly yellow, contrasting with the ground. Base of vein R_{1+2} and about the proximal two-thirds of R_3 with macrotrichia, the latter totalling about 18; remaining veins behind *R* glabrous. Venation: *Rs* elongate, exceeding twice *m–cu* and more than three times R_{2+3}; veins R_3 and R_{4+5} only slightly sinuous, cell R_3 at mid-length about two-thirds as wide as at base; petiole of cell M_1 slightly more than one-half *m*; M_{3+4} short, less than the oblique *r–m*, *m–cu* at the fork.

Abdomen almost uniformly light brown, without a darkened subterminal ring. Male hypopygium with the ninth tergite broad, its caudal margin conspicuously four-lobed, the lateral lobes small and narrow, the submedian pair shorter but broader, all lobes with blackened spinous setæ. Outer dististyle broadly flattened, more or less scoop-shaped, the tip obtuse; outer surface with abundant long dark setæ; apical border of the outer scooplike portion with numerous small points or denticles. Inner dististyle not much more extensive than the outer style; beak stout, obtuse at apex; areas of peglike spines unusually reduced, both in area and number of spines.

Holotype, ♂, Chapare, Cochabamba, Bolivia, November 1934 (Francisco Steinbach).

Holorusia (*Holorusia*) *luteivena* is quite distinct from other large regional species. The nearest relatives seem to be forms such as *H.* (*H.*) *flavicornis* Alexander and *H.* (*H.*) *lassula* Alexander, which differ in the coloration of the body and wings, structure of the antennæ, and details of the male hypopygium.

Holorusia (Holorusia) cristobtusa new species.

Size relatively large (wing, male, 23 mm. or more); mesonotal præscutum with four grayish stripes that are narrowly bordered by brown; thoracic pleura striped longitudinally with brown; femora brownish yellow, the tips conspicuously blackened; wings with the cells basad of cord chiefly yellowed, beyond cord weakly infuscated; a restricted brown and pale pattern; male hypopygium with the caudal margin of tergite bilobed, the lobes broad, with long black setæ; outer dististyle broad; inner dististyle with the dorsal crest low and broadly obtuse, with scattered pale setæ.

Male.—Length about 19–20 mm.; wing 23–24.3 mm.; antenna about 7–8 mm.

Female.—Length about 20–22 mm.; wing 25–26 mm.; antenna about 4 mm.

Dorsal half of frontal prolongation of head yellow, including the elongate simple nasus, the sides dark brown; palpi brownish black, the extreme bases of the more proximal segments pale; terminal segment elongate, basal half brownish black, the apical half pale yellow. Antennæ of male relatively long; scape yellow, pedicel testaceous yellow, flagellum black, segments nearly cylindrical, elongate; antennæ of female much shorter and paler, the flagellum very weakly bicolored, the bases of the segments being a trifle darker than the tips. Head obscure yellow in front, more infuscated on vertex, all heavily light gray pruinose.

Pronotum pale yellow, whitish pruinose, narrowly darkened medially above. Mesonotal præscutum with the ground color obscure brownish yellow, the posterior interspaces before the suture restrictedly yellow; four gray stripes that are narrowly bordered by brown, the mesal edges of the intermediate pair confluent in front to form a broader median brown vitta; scutum with the median region and the posterior portions of the lobes obscure yellow, the remainder of lobes with two relatively small gray areas that are narrowly bordered by brown; scutellum infuscated, sparsely pruinose, parascutella obscure yellow, the mesal ends more darkened; mediotergite pale brown, its posterior portion more yellowed. Pleura with a broad dorsal yellow stripe, the ventral sclerites more grayish yellow, with a broad but relatively inconspicuous reddish brown longitudinal stripe, narrower and darker on the cervical region and propleura, most extensive on the anepisternum, becoming narrowed and finally obsolete behind. Halteres yellow, the knobs weakly darkened. Legs with the coxæ and trochanters yellow, the extreme bases of the former a trifle darker; femora obscure brownish yellow, the tips rather broadly and conspicuously blackened; tibiæ brown with the tips more narrowly blackened; tarsi brownish black; claws (male) bidentate. Wings with the ground color before cord extensively yellowed, beyond the cord weakly infuscated, with a restricted dark pattern; prearcular area and cell *Sc* pale brown; stigma, a small spot over origin of *Rs* and broad continuous seams along veins *Cu* and *m–cu* darker brown; paler brown clouds over anterior cord and outer end of cell *1st* M_2; cells beyond cord with vague yellowed areas, with similar brightenings in the anal cells, extensively so on more than the basal halves of the cells; veins brown. Three or four scattered trichia on vein R_3. Venation: *Rs* nearly twice *m–cu*; cell R_3 only moderately constricted at midlength; cell *1st* M_2 pentagonal, pointed at its outer end.

Basal abdominal tergites of male obscure orange yellow, with vague indications of a median brown stripe; basal lateral portions of segments more yellowed, the posterior lateral angles weakly darkened; basal sternites chiefly orange-yellow; subterminal segments blackened to form a broad ring; hypopygium obscure yellow. In female, tergites more heavily trivittate with darker brown. Male hypopygium with the posterior margin of tergite produced into two large lobes that are separated by a V-shaped notch, the vestiture of the lobes consisting of long black setæ, not at all modified into spines, denser near tips of lobes. Outer dististyle broad, pale, the apex directed laterad and strongly truncated at apex but not toothed. Inner dististyle much larger, the short beak squarely truncated at apex, the widely separated lower beak more obtuse; both beaks with extensive groups of small blackened peglike spines or knobs that extend backward onto the face of style; dorsal crest very low and broadly obtuse, entirely pale, provided with scattered pale setæ.

Holotype, ♂, Buenavista, Santa Cruz, Bolivia (Francisco Steinbach). Allotype, ♀, Chapare, Cochabamba, Bolivia, November 1934 (Steinbach). Paratopotype, 1 ♂; paratype, 1 ♀, 1 broken ♂, with the allotype.

The present fly appears closest to species such as *Holorusia* (*Holorusia*) *flavicornis* Alexander, *H.* (*H.*) *lassula* Alexander, and others, differing markedly in the pattern of the body and wings, and, especially, in the structure of the male hypopygium.

Holorusia (Holorusia) cristalta new species.

Size medium (wing, male, about 15 mm.); mesonotal præscutum almost uniformly light brown, virtually unpatterned; pleura and pleurotergite uniformly yellow; wings with the cephalic half and cells beyond cord more infuscated than the posterior basal cells; a small quadrate brown spot at near midlength of cell *M*; *m–cu* at near midlength of M_{3+4}; abdominal tergite reddish brown, with a subterminal dark brown ring involving most of segments six to eight; male hypopygium with the tergal lobes large, the median lobule lacking or virtually so; outer dististyle elongate, simple; inner dististyle with the beak cultriform; dorsal crest very high.

MALE.—Length about 12–13 mm.; wing 15–16 mm.; antenna about 3–3.1 mm.

Frontal prolongation of head brownish yellow; nasus very long and slender; palpi brownish yellow. Antennæ moderately long; basal three segments yellow; succeeding segments bicolored, brown basally, with about the outer half obscure yellow; outer segments broken. Head brown.

Thoracic dorsum almost uniformly light brown, the præscutum virtually unpatterned; scutum slightly darker on central portion and the outer edges of the lobes, the centers of the latter slightly paler; scutellum with a slight basal darkening; mediotergite with a more or less distinct darkening on either side of the broad paler central area. Pleura and pleurotergite uniformly yellow, unpatterned. Halteres infuscated, the base of stem narrowly yellow; remainder of legs light brown or yellowish brown, the outer tarsal segments passing into black; claws (male) bidentate. Wings with about the cephalic half and the cells beyond the cord weakly infuscated, the posterior cells before cord paler, this including most of *M* and the remaining basal cells; prearcular field and costal border, especially cell *Sc*, darker brown; stigma dark brown; a relatively conspicuous brown cloud at near midlength of cell *M*; veins dark brown. Veins beyond cord glabrous. Venation: *Rs* relatively long, strongly arcuated at origin, about one-third longer than *m–cu*; cell R_3 constricted at near midlength; *m–cu* at near midlength of M_{3+4}.

Basal abdominal tergites reddish brown, more darkened sublaterally; segments six to eight more darkened, to form a more or less distinct subterminal ring, the bases of tergites six and seven narrowly yellow, the apex of sternite eight similarly patterned; hypopygium yellow. Male hypopygium relatively large. Ninth tergite with the caudal margin produced into large and conspicuous lateral lobes but with the median area only slightly produced, not forming a central lobule as in allied species; setæ of lobes relatively long and slender, scarcely spinous; extreme central portion of notch without setæ. Outer dististyle elongate, particularly on the outer two-fifths, not provided with lobes or projections. Inner dististyle with the beak cultriform, the extreme lower apical angle a trifle decurved; dorsal crest unusually high, its apex truncated; cephalic portion of crest with numerous setæ, these sparse or lacking on the posterior border; blackened spinous points in two areas, the outer larger and with the spicules more numerous.

Holotype, ♂, Buenavista, Santa Cruz, Bolivia (Francisco Steinbach). Paratopotype, ♂.

This fly is most similar to species such as *Holorusia* (*Holorusia*) *lævis* Alexander, *H.* (*H.*) *ringens* Alexander, *H.* (*H.*) *tarda* Alexander, and allies, differing from all in the structure of the male hypopygium, especially the tergite and inner dististyle.

Genus *Pectinotipula* Alexander

Pectinotipula boliviensis new species.

Size large (wing, 20 mm. or more); antennal flagellum strongly bicolored; head and thorax with a continuous dorsomedian brown stripe; wings fulvous brown, variegated with darker brown and pale yellow areas, the latter including a conspicuous post-stigmal band extending from costa obliquely backward through cell *1st* M_2 into the base of M_3; male hypopygium with the appendage of the eighth sternite unusually large and broad, approximately four times as long as the greatest width.

MALE.—Length about 17–18 mm.; wing 20–21 mm.; antenna about 7 mm.

FEMALE.—Length about 26–27 mm.; wing 22–23 mm.; antenna about 4 mm.

Frontal prolongation of head above yellow, including nasus; sides of prolongation weakly more infuscated; palpi black. Antennæ of male with basal three segments yellow, succeeding segments bicolored, the base and branches black, the stems yellow, the terminal segment paler yellowish brown; branches subequal to or a trifle longer than the segments; in female, antnnæ simple; basal four segments yellow, succeeding segments bicolored, dark on basal half or less, the apex yellow. Head above buffy yellow, sides of the posterior vertex weakly darkened; a capillary dark brown median vitta.

Pronotum buffy, narrowly darkened medially, more extensively so on the sides. Mesonotal præscutum chiefly covered by four buffy gray stripes, the intermediate pair separated by a continuous median dark brown line; interspaces with conspicuous brown setigerous punctures; humeral and lateral portions of præscutum less strongly infuscated, the latter with a few setigerous punctures; scutal lobes chiefly gray, the median line narrowly dark brown; posterior sclerites of notum gray, the scutellum at base extensively infuscated; mediotergite with a narrow brown central vitta. Pleura and pleurotergite yellow. Halteres infuscated, base of stem yellow. Legs yellow, the femora with a nearly terminal brown ring, the tibiæ with the tips weakly infuscated; tarsi yellowish brown, passing into dark brown or brownish black; claws simple. Wings chiefly fulvous brown, variegated with darker brown and pale yellow areas; the darker clouds include the stigma and two areas in the subcostal cell, the outermost at origin of *Rs*; other brown clouds at arculus, in basal half of cell *Cu*, in outer half of cell *M* adjoining vein *Cu*, and as a seam along the distal section of vein *Cu*; the yellow areas occur as a post-stigmal band extending through cell *1st* M_2 into the base of cell M_3, more conspicuous in female; basad of cord these areas more extensive, especially in cells *M*, *Cu* and *1st A*; in male, outer cells uniformly darkened; in female, outer end of cell R_5 more or less brightened; veins brown, yellow in the pale portions. Venation: R_{1+2} entire; *Rs* more than one-half longer than *m–cu*; petiole of cell M_1 subequal to or shorter than *m*.

Abdominal tergites fulvous yellow, more darkened on sides; subterminal segments more darkened to form a narrow ring; sternites and hypopygium more uniformly yellow. Ovipositor with cerci slender, long and straight. Male hypopygium of the usual type of the genus, differing in details of the inner dististyle, gonapophyses and appendage of the eighth sternite. Inner dististyle large and ample, the margin of the beak and the outer crest heavily blackened. Gonapophyses of distinctive shape, each profoundly bilobed, the outer lobe an irregularly flattened yellow blade, the inner lobe a slender arm that is slightly expanded at outer end. Appendage of eighth sternite an unusually large and conspicuous depressed-flattened lobe, its length about four times the greatest width.

Holotype, ♂, Chapare, Cochabamba, Bolivia, November 1934 (Francisco Steinbach). Allotopotype, ♀. Paratopotypes, 1 ♂, 3 ♀♀, with the type; paratypes, 2 ♂♂, 2 ♀♀, Buenavista, Santa Cruz, Bolivia, February 1929 (Steinbach).

The species is quite distinct from the other members of the genus in the pattern of the wings and in the details of structure of the male hypopygium. It should be emphasized that the wing pattern in the female is much more variegated than in the male.

Pectinotipula tucumana new species.

MALE.—Length about 17 mm.; wing 18 mm.; antenna about 6.2 mm.

Characters generally as in *argentina*. Antennæ with the outer two or three flagellar segments uniformly darkened. Head above, with the dorsal half of the frontal prolongation, clear light gray, the ventral portion of the latter more infuscated; palpi black; capillary darkening on vertex so reduced as to be virtually lacking.

Mesonotum with the median brown vitta conspicuous, the lateral præscutal stripes very reduced. Halteres with stem yellow, knob infuscated. Legs with the femoral tips narrowly dark brown, apical in position. Wings chiefly brownish yellow, very weakly patterned with darker and whitish subhyaline; the former includes the stigma, a seam over the anterior cord, and tiny brown areas at origin of *Rs* and the end of *Sc*; darkenings in cell *Sc* reduced to virtually lacking; the whitish marks are fully as restricted, including the distal half of cell R_5, very narrow obliterative lines before stigma and across cell *1st* M_2; an oblique line at near two-thirds the length of cell *M*, and vague brightenings in bases of cells *Cu* and *1A*; veins brown, more brownish yellow in the subcostal field. Venation: R_{1+2} entire; *Rs* about twice *m–cu*; petiole of cell M_1 somewhat longer than *m*.

Abdomen yellow, the tergites narrowly trivittate with brown, the sublateral stripes extensively interrupted at the incisures; the broader median vitta very narrowly broken by pale caudal borders to the segments. Male hypopygium with the outer dististyle slender, narrowed outwardly and here with long yellow setæ. Inner dististyle with the margins of the dorsal and posterior crests narrowly blackened, the latter conspicuously produced. Gonapophyses distinctive, each dilated at outer end. Appendage of eighth sternite unusually narrow, broadest on less than the basal half, thence abruptly narrowed to approximately one-half the width across base (extreme tip of appendage broken).

Holotype, ♂, Quebrada Famaillá, Tucuman, Argentina, altitude 1600 meters, October 15, 1920 (Vladimir Weiser).

The present fly differs from what I have determined as being *Pectinotipula argentina* (van der Wulp), in the details of coloration of the body and wings and in the structure of the male hypopygium, particularly the inner dististyle, gonapophysis and appendage of the eighth sternite.

Genus *Limonia* Meigen

Limonia (Limonia) pugnax new species.

Size medium (wing male, 7 mm.); general coloration obscure yellow, the præscutum and scutal lobes conspicuously polished black; antennal flagellum black, the segments with obscure yellow glabrous apical stems; femora obscure yellow, the tips narrowly darkened; wings with a weak brownish tinge, very restrictedly patterned with darker; *Sc* relatively long, Sc_1 ending about opposite three-fifths *Rs*; *m–cu* about one-fourth its length before the fork of *M*; male hypopygium very large and complex; ninth tergite shield-shaped in outline, its outer median portion produced caudad into a setiferous lobe; dististyle very complex, consisting of an outer pale lobe and two inner blackened lobes.

MALE.—Length about 7 mm.; wing 7 mm.

Rostrum brownish black, relatively short; palpi black. Antennæ black, the stems of most of the flagellar segments obscure yellow to produce an inconspicuous bicolored appearance; apical stems glabrous, more abrupt in the proximal segments; longest verticils subequal in length to the segments. Head above gray, the anterior vertex reduced to a capillary line that is only about as wide as a single row of ommatidia; eyes correspondingly large, the ommatidia coarse.

Pronotum infuscated above, obscure yellow on sides, the setæ long and conspicuous. Mesonotum chiefly yellow, the surface more or less polished; præscutum with a polished black median triangle on the cephalic half, lateral præscutal borders more weakly infuscated; scutal lobes conspicuously blackened. Pleura, especially the propleura, more or less darkened. Halteres blackened, base of stem restrictedly yellow. Legs with the coxæ yellow, the fore pair a trifle darker; trochanters yellow; femora obscure yellow, the tips narrowly and inconspicuously darkened, the amount subequal on all legs; tibiæ and basitarsi yellowish brown to light brown, the outer tarsal segments blackened. Wings with a weak brownish tinge, very restrictedly patterned with darker, including the small oval stigma; very inconspicuous darkened clouds over origin of *Rs*, cord and outer end of cell *1st* M_2; veins brownish yellow, macrotrichia black. Venation: Sc_1 ending about opposite three-fifths the length of *Rs*, Sc_2 near its tip; *Rs* relatively long, about two and one-half times the basal section of R_{4+5}; cell *1st* M_2 small, short-rectangular, about equal to the distal section of vein M_3; *m* arcuated, shorter than the straight basal section of M_3; *m–cu* about one-fourth its length before the fork of *M*.

Abdominal tergites weakly infuscated, basal sternites more yellowed; outer segments, including the hypopygium, chiefly brownish yellow, the dististyles more blackened. Male hypopygium very large and conspicuous. Ninth tergite suboval or shield-shaped in outline, the caudal border truncate, its median portion further produced caudad into a conspicuous depressed-flattened lobe that is tufted with long yellow setæ. Basistyle large, closely applied or fused to the tergite; ventromesal lobe subapical in position, tufted with setæ. Dististyle very complex, consisting of an outer oval pale lobe, provided with abundant setæ, about six at and near apex much larger; inner portion of style produced into two separate blackened lobes, the outer with very appressed retrorse teeth along its face; lower or more cephalic lobe similarly blackened, its outline irregular. Gonapophysis with mesal-apical lobe unusually long and straight, the extreme outer lateral angle pointed but pale.

Holotype, ♂, Dutch Guiana, Sectie O, in bush, June 7, 1944 (Geijskes). Sectie "O" is on the railroad line some 30 miles south of Paramaribo.

Limonia (*Limonia*) *pugnax* is a very distinct fly that cannot be confused with any other. Of all the described species, the only one that at all resembles this fly is *L.* (*L.*) *somnifica* Alexander, of southern Ecuador, which has certain features of the dististyle of the male hypopygium somewhat as in the present insect but which is entirely distinct in the other structures of the hypopygium and of the antennæ.

Limonia (Rhipidia) surinamica new species.

Allied to *pallatangæ*; general coloration of thorax pruinose, the central stripe of the præscutum and the scutal lobes more chestnut brown; antennæ (male) with flagellar segments relatively short-unipectinate, the branches shorter than the segments; thoracic pleura dark brown, pruinose, with a narrow, darker brown, dorsolongitudinal stripe; legs with the femora and tibiæ more or less blackened, the amount of yellow differing on the various legs; all outer segments of all tarsi blackened; wings narrow, pale brown, conspicuously patterned with darker brown and whitish subhyaline areas; *Sc* relatively short, Sc_1 ending about opposite two-fifths the length of *Rs*; *m–cu* about two-thirds its length before the fork of *M*; male hypopygium with two short rostral spines.

Male.—Length about 7.5 mm.; wing 8.1 × 1.8 mm.

Rostrum dark brown; palpi black. Antennæ black, the terminal flagellar segments broken (before breaking it was observed that the entire organ, including the apical stems of all flagellar segments, was black); flagellar segments relatively short-unipectinate; first flagellar segment produced into a broad lobe that is about one-half the length of segment; succeeding segments with the branch a little shorter than the segment, the glabrous apical stem elongate; each flagellar segment with a single unusually long seta on outer face at base, this about twice the segment. Head above gray, slightly impressed medially; anterior vertex obliterated for a considerable extent, the eyes contiguous or virtually so.

Cervical sclerites light brown; pronotum darker brown medially, paler and more pruinose on sides. Mesonotal præscutum gray pruinose, with a dark chestnut brown median stripe, this in turn narrowly more darkened, especially on anterior portion; lateral borders darkened, the broad interspaces obscure yellow, the whole surface excepting the median stripe more or less pruinose, especially conspicuous when viewed from above; scutal lobes extensively chestnut brown, still darker on the cephalic and lateral portions; median region of scutum and scutellum more testaceous yellow, the lateral portions of the latter darker; parascutella yellow, the posterior margin narrowly more darkened; postnotum brown, pruinose. Pleura dark brown, gray pruinose, with a narrow but conspicuous blackened longitudinal stripe extending from the sides of the pronotum across the dorsal pleurites to the base of the abdomen, passing above the root of the halteres. Halteres infuscated, apex of knob obscure yellow. Legs with coxæ chestnut brown, the posterior pair darker; trochanters yellow; femora blackened, the bases more or less yellow; all legs are detached but one pair, presumably the fore legs, has the femora almost uniformly darkened, with only the bases narrowly yellow; remaining legs with femora chiefly yellow, with about the distal fourth blackened; the assumed fore leg with the tibiæ and basitarsi obscure yellow, the tips blackened; remaining tibiæ darker, those of the assumed posterior legs almost uniformly blackened; terminal tarsal segments of all legs blackened. Wings unusually narrow, as shown by the measurements; ground color pale brown, conspicuously variegated by darker brown and whitish subhyaline or cream-colored areas; the darker markings include three or four areas in the costal field, the largest at and beyond the level of the arculus, the one above the origin of *Rs* small; fourth spot at fork of *Sc*; stigma darkened, the center restrictedly paler; narrow brown seams along cord, outer end of cell *1st* M_2 and as small marginal markings at ends of the longitudinal veins, especially R_3 and the anals; the cream-colored areas are spread over much of the wing, especially in the costal interspaces and at the wing apex to beyond the actual tip; axilla and posterior prearcular field conspicuously whitened; veins pale brown, darker in the patterned areas, yellow in the pale markings, the latter including the conspicuously brightened costa and the interspaces of *Sc* and *R*. Venation: *Sc* relatively short, Sc_1 ending about opposite two-fifths the length of *Rs*, Sc_2 at its tip; *Rs* relatively long, nearly twice R_{2+3}; cell *1st* M_2 elongate, nearly equal to the distal section of M_{1+2}; *m–cu* about two-thirds its length before the fork of *M*.

Abdominal tergites brown, the basal segment brighter, the outer segments somewhat paler brown; sternites yellow; hypopygium brownish yellow. Male hypopygium with the tergite relatively large, narrowed outwardly, the posterior margin convexly rounded or very shallowly emarginate medially. Basistyle with ventromesal lobe of moderate size, provided with long pale setæ. Dorsal dististyle very gently curved, the tip suddenly narrowed into a long straight black spine. Ventral dististyle of moderate size fleshy, its area about twice that of the basistyle; rostral prolongation relatively long and slender; rostral spines two, placed at near midlength, short, slightly separated from one another; apex of prolongation beyond the outermost spine nearly twice the length of the latter; apex of prolongation obliquely truncated, the lower angle more or less produced; near apex with two strong curved yellow setæ. Gonapophysis with mesal-apical lobe elongate, gently curved, the tip blackened and subacute; lateral margin back from the apex with small denticles.

Holotype, ♂, Brownsberg, Dutch Guiana, altitude 400 meters, September 16, 1938 (Geijskes). Brownsberg is about 50 miles south of Paramaribo, near the railroad line.

The most similar species is evidently *Limonia* (*Rhipidia*) *pallatangæ* (Alexander), which has the wings much broader, distinctively patterned, and differs further in the coloration of the body and legs and in the details of structure of the male hypopygium.

Limonia (Peripheroptera) lankesteri new species.

Size relatively large (wing, male, over 11 mm.); general coloration of thorax fulvous yellow, patterned with black, especially on the mesoscutal lobes; legs yellow, the tips of the femora and tibiæ blackened; wings rich yellow, the costal fourth even more saturated, the disk with a conspicuous dark brown pattern including the cord and seams along the outer veins; R_1 unusually elongate; cell *1st* M_2 long and narrow, the second and third sections of vein M_{1+2} subequal in length.

Male.—Length about 7 mm.; wing 11.5 mm.

The type is badly crushed and the thoracic coloration can be described in general terms only.

Rostrum and palpi black. Antennæ black throughout; flagellar segments elongate-oval to subcylindrical, with verticils that exceed the segments. Head silvery gray pruinose.

Thorax chiefly fulvous yellow, patterned with black on the scutal lobes above the wing root and less evidently darkened elsewhere. Halteres yellow, knobs brownish black. Legs with the coxæ infuscated; trochanters obscure yellow; femora yellow, the tips broadly and conspicuously blackened, the amount subequal on all legs; tibiæ more obscure yellow, the tips more narrowly blackened; tarsi short, black. Wings with the ground color rich yellow, the costal fourth more saturated fulvous yellow; wing-base narrowly but conspicuously dark brown; a further dark brown pattern, as follows: At arculus, the color continued distad in cell R for nearly one-third the length of vein *M*; a cloud over the interanal crossvein; markings over Sc_2, free tip of Sc_2, and a common cloud over R_2 and the surrounding membrane; cord and outer end of cell *1st* M_2 seamed with brown; certain of the veins beyond the cord, especially R_{4+5}, distal sections of M_{1+2}, M_3 and M_4 similarly bordered; veins light brown, darker in the patterned areas, more fulvous brown in the costal interspaces. Venation: Sc_2 at near mid-distance between arculus and origin of *Rs*; free tip of Sc_2 transverse, far before R_2; vein R_1 only a little shorter than the section of vein M_{1+2}; cell *1st* M_2 unusually long and narrow, the second and third sections of M_{1+2} subequal; *m–cu* about one-third its length beyond the fork of *M*; cell *2nd A* long and narrow, the narrowest point about one-half that of the widest.

Abdomen with the tergites weakly bicolored, black, the caudal borders of the segments obscure yellow; sternites more uniformly obscure brownish yellow; hypopygium and preceding segment yellow, the ventral dististyle abruptly dark brown.

Holotype, a badly crushed ♂, Hacienda "Las Cóncavas," Cartago, Costa Rica, altitude 1360 meters, May 19, 1945 (C. H. Lankester); picked from flowers of *Cattleya Dowiana* Batem. (Orchidaceæ).

This attractive fly is named for the collector, Mr. C. H. Lankester. The species is very different from the other regional members of the subgenus so far described, including *Limonia* (*Peripheroptera*) *atrosignata* Alexander. The large size, coloration of the body and wings, and the venation, as the unusually long vein R_1 and cell *1st* M_2, provide strong characters.

Genus *Ctenolimnophila* Alexander

Ctenolimnophila (Ctenolimnophila) fuscoanalis new species.

Allied to *decisa*; general coloration of the entire body brownish black; tarsi very short, only about one-sixth the length of tibiæ; wings infuscated, patterned with darker brown and pale yellow areas, the latter appearing as four marginal marks from beyond the fork of *Sc* to the wing-tip in cell R_4; darker spots over the cord; outer end of cell *1st* M_2 and elsewhere; conspicuous darkened areas at ends of both anal veins; a supernumerary crossvein in cell R_3 near outer end; cell *1st* M_2 irregularly elongate; *m–cu* about three-fourths its length beyond the fork of *M*; both anal veins curved strongly into the margin, *2nd A* tending to be angulated and weakly spurred near tip.

FEMALE.—Length about 5.5–6 mm.; wing 4.8–5 mm.

Rostrum and palpi black. Antennæ with scape and pedicel black; first flagellar segment yellow, remainder of flagellum pale brown; flagellar segments short-oval, the outer ones a little more elongate. Head dark brown; anterior vertex (female) broad, about four times the diameter of scape.

Thorax almost uniformly brownish black, the pronotal scutellum restrictedly paler; upper portion of dorsopleural membrane slightly paler brown. Halteres with stem obscure brownish yellow, knob blackened. Legs with coxæ dark brown; trochanters yellow; remainder of legs yellow, the outer tarsal segments a little darker; tarsi very short, the basitarsi only about one-half longer than the second segment, the entire tarsus only about one-sixth as long as the tibia; tibial spurs present. Wings with the ground infuscated, patterned with darker brown and pale yellow or whitish areas, the latter occurring as four marginal marks just beyond the fork of *Sc*, in cell R_2 in cell *2nd* R_3 and a very small apical area in cell R_4; the darker markings include a postarcular area and spots at origin of *Rs*, cord, stigma, fork of R_{2+3+4}, tip of R_3 and over the supernumerary crossvein in cell R_3, tip of R_4, both outer elements closing cell *1st* M_2 and spots at ends of both anal veins; slightly paler washes in cell *R* before origin of *Rs* and again before the cord; in base of cell R_1, most of cell *1st* M_2 and bases of cells *2nd* M_2 and M_3; prearcular field chiefly darkened; a restricted brightening at the arculus; veins brown, *Sc* somewhat paler. Venation: Sc_1 ending immediately before fork of *Rs*, Sc_2 at its tip; *Rs* angulated and spurred at origin; a supernumerary crossvein in outer end of cell R_3; cell *1st* M_2 irregularly elongate, basal section of M_3 about three times *m*, the cell much longer than any of the veins beyond it; *m–cu* about three-fourths to four-fifths its length beyond the fork of *M*; both anal veins curved strongly into the margin, *2nd A* tending to be angulated and weakly spurred near tip.

Abdomen brownish black, the outer segments, including the genital shield, a little brighter. Ovipositor with the cerci elongate, dusky on proximal half, the distal portion yellow, upcurved.

Holotype, ♀, Pratá, Pará, Brazil, June 30, 1919 (H. S. Parish); previously recorded (Proc. Acad. Nat. Sci. Philadelphia 1921: 62; 1921) as *decisa*. Paratype, 1 alcoholic female, Wilhelmina Gebirgte, Dutch Guiana, lȳn II, km. 5.7, along creek, September 15, 1943 (Geijskes).

Ctenolimnophila (*Ctenolimnophila*) *fuscoanalis* is allied to *C.* (*C.*) *decisa* (Alexander) yet is quite distinct in the venation and pattern of the wings, as described. The shortness of the tarsi is to be emphasized.

Genus *Sigmatomera* Osten Sacken

Sigmatomera (Sigmatomera) geijskesana new species.

Allied to *apicalis*; general coloration of thorax fulvous-yellow; antennæ black, the more proximal flagellar segments with the tips light yellow; femora yellow, each with two broad brownish black rings, one before mid-length, the second being the slightly narrower apex; tibiæ obscure yellow, the tips darkened, tarsi brownish black; wings light yellow, with three entire dark crossbands, the apical one paler; band at and beyond arculus more intense in cells *C* to *M* inclusive; band at cord very irregular in outline due to the short spurs along the various veins entering the cord.

FEMALE.—Length about 17 mm.; wing 13 mm.

Rostrum and palpi obscure yellow, the terminal segment of the latter a trifle darker and more slender. Antennæ black, the extreme apex of the flagellar segments light yellow to produce a very weak bicolored effect; the pale color decreases on the outer segments, becoming obsolete on about the seventh to eighth flagellar segment; segments moderately incised on lower face, the upper face nearly straight to very insensibly emarginate, the sigmoid effect thus being very slight. Head obscure yellow.

Prothorax and mesothorax almost uniformly fulvous yellow, the surface nitidous; præscutum with the three fulvous stripes narrowly separated by yellow interspaces; scutal lobes similarly fulvous. Halteres yellow. Legs with the coxæ and trochanters fulvous yellow; femora yellow, each with two broad conspicuous brownish black rings, the outer one being the broad apex; second dark ring about one-third wider, before midlength of the segment; tibiæ obscure yellow, the tips darkened; tarsi brownish black. Wings light yellow, handsomely patterned with brown, appearing chiefly as three dark crossbands; basal band at and beyond the level of arculus, completely crossing the wing, darkest in cells *C* to *M*, inclusive, much paler but wider in the anal cells; second band at cord, completely traversing the wing, its outline very irregular because of short seams along all of the veins constituting the cord; third band apical, paler brown, connected with the second area by seams in the costal portion and in the anal field, isolating a large yellow ground area beyond the cord; veins light yellow in the ground areas, slightly darker in the patterned fields. Venation: Sc_1 ending beyond midlength of R_{2+3+4}, the latter simple on one wing of type, angulated and spurred at near one-third the length on the opposite wing, Sc_2 exactly opposite the spur; basal section of R_5 longer than *r–m*; *m–cu* at or immediately beyond the fork of *M*.

Basal four abdominal tergites clear light yellow, the succeeding four tergites light chocolate-brown; sternites similarly colored but the dark ground of the outer segments more or less interrupted by a yellowish central stripe. Genital shield blackened, yellow at tip; cerci chestnut brown, the dorsal margin blackened; apex of cercus conspicuously trifid.

Holotype, ♀, Paramaribo, Dutch Guiana, August 30, 1940, at light (Geijskes).

I take great pleasure in naming this interesting crane-fly for the collector, Dr. D. C. Geijskes, to whom we owe most of our recent knowledge of the insect fauna of Surinam and to whom I am personally indebted for the presentation of numerous interesting Tipulidæ. The species is most similar to *Sigmatomera*

(*Sigmatomera*) *apicalis* Alexander, still known only from British Guiana, the two species differing conspicuously in the pattern of the legs and wings. In *apicalis,* there are no basal black rings on the femora while the wing pattern is quite distinct, the basal dark area not reaching the costa, the band at the cord narrow and regular in outline and the darkened apex not connected with the central area along the posterior margin.

Osten Sacken considered that the genus *Furina* Jaennicke was a synonym of *Gnophomyia* Osten Sacken. However, there can be no question but that this group actually falls within the present complex and would be the oldest name except for the fact that *Furina* Jaennicke is preoccupied by the same name *Furina* Dumeril. I herewith propose the name *Eufurina* to replace *Furina* Jaennicke. There are three subgeneric groups in *Sigmatomera,* the synonymy being as follows:

1. *Sigmatomera* Osten Sacken, 1869.
2. *Austrolimnobia* Alexander, 1922 (syn. *Astelobia* Edwards, 1923).
3. *Eufurina* new name (syn. *Furina* Jaennicke, 1867; nec *Furina* Dumeril, 1853).

BOOK NOTICE

Biological Survey of the Mount Desert Region, Part VII, The Insect Fauna. By William Procter, D.Sc. The Wistar Institute of Anatomy and Biology, Philadelphia, 1946. 10 × 7 in. 566 p. 1 map, 10 illus.

This stately and well printed volume is a new check list of the insect fauna of Mount Desert Island. It supersedes Part VI of the Survey, that was noted in this Journal in 1939, vol. 47, page 56. In Part VI, issued in 1938, the list comprised, exclusive of the Arachnida, 297 families, 2,203 genera and 5,352 species and varieties. The present list, exclusive of the 200 Arachnida, covers 327 families, 2,547 genera and 6,367 species and varieties, or slightly more than 1,000 additional species. During the eight years between the two lists, additional collecting and study have increased the Lepidoptera from 1,374 to 1,479, the Diptera from 1,370 to 1,626, the Hymenoptera from 1,008 to 1,107 and the Coleoptera from 888 to 1,175. In the 16 remaining Orders of insects the number of species increased from 712 to 980.

In addition to the list, there is a description of the Island flora, and a numerical summary of the species, genera and families by Orders, a list of 421 field stations and an index. I agree with Doctor Procter that a faunal list should not be a mere catalogue and in the present list are found notes on host plants, habits, and methods of capture, all of which make it readable and informative. This list is certainly not a lifeless collection of names and symbols. Doctor Procter who is both a patron and student of entomology, has adequately fulfilled his purpose in this list, by adding to our knowledge of the insect fauna of Mount Desert Island, and by producing a record that is a pleasure to consult.—H. B. WEISS.

THE CONTRIBUTIONS OF PHYSICIANS TO ENTOMOLOGY IN THE UNITED STATES FROM 1723 TO 1865

By Harry B. Weiss

Few entomologists are aware of the contributions made by physicians to the early science of entomology in this country. These range from a few observations by some to numerous and outstanding contributions by others. In fact, a few physicians apparently were more interested in entomology than in medicine. Some of the physicians were quite versatile. In addition to their interest in entomology, such subjects as botany, silk culture, herpetology, ichthyology, helminthology, paleontology, conchology, geology, biography, the history of science and natural history in general engaged their attention.

Approximately 40 physicians each contributed from one to many papers to the literature of entomology from 1723 to 1865. These papers dealt with the Hessian fly, the silkworm, honeybees, the periodical cicada, blister beetles, fruit and vegetable insects, nettling hairs, animal parasites, the tent caterpillar, mimicry, cankerworms, the light of fireflies, insect anatomy, life history and control studies, descriptions of new species of Lepidoptera, Neuroptera and Coleoptera, lists of insects, insect larvæ in the human body, the development of aphids, the medicinal qualities of insects, the fauna of the intestines of insects, and entomological history and bibliography.

Of the 40 physicians, 17 were residents of Pennsylvania, 7 of Massachusetts, 5 of New York and the remaining 11 were scattered among 10 other states in the east, middle west and California. Pennsylvania, and Philadelphia in particular, was the center of entomologically inclined physicians. Here were established the American Philosophical Society and the Academy of Natural Sciences of Philadelphia.

In the accompanying list wil be found the names of the physicians and brief mention of their activities. Only American physicians, or those who resided in this country are included.

Much more extended accounts of these men may be found in the books referred to under "references."

Apparently the first physician to write of insects in the United States was Dr. John Brickell, who stressed the supposed medicinal importance of certain species in his book "The Natural History of North Carolina," published in Dublin in 1723. Brickell's work was based mainly upon John Lawson's "Journal of 1000 miles. . . . With a Description of North Carolina," published in London in 1700. The end of the period under consideration is closed by Dr. George H. Horn, who was just getting under way, with the publication of 5 systematic papers on the Coleoptera between 1860 and 1865. Dr. Horn's extensive descriptive work continued for many years after 1865. Of the 38 physicians who lived and wrote between the time of Brickell and Horn, the outstanding ones are the well known Thaddeus William Harris, John Lawrence LeConte, Asa Fitch, and A. S. Packard, Jr., of whom numerous biographical accounts are available.

Even after 1865 and up to the present time, entomology has continued to be enriched by the activities of physicians who preferred entomology to medicine, or a combination of both.

PHYSICIANS WHO CONTRIBUTED TO ENTOMOLOGY 1723–1865

SAMUEL AKERLY. New York. In 1817, wrote a paper on the Hessian fly and suggested various remedies.

BENJAMIN SMITH BARTON. 1766–1815. Pennsylvania. One of America's early leading botanists. Wrote upon the introduction of the honeybee in America; poisonous honey; insects injuring crops, particularly fruits and vegetables; silkworms, etc.

HANS HERMAN BEHR. 1818–1904. California. Published on California Lepidoptera. Had an extensive collection of Lepidoptera. Described new species in this order.

EDWARD L. BLASCHKE. Colonial physician employed by the Russian American Company in Alaska and California. Collected many insects about Ross and Sitka.

JOHN BRICKELL. North Carolina. Author of a work entitled "The Natural History of North Carolina." This was published in Dublin first in 1723. Some 8 or 9 pages are devoted to such insects as bees, silkworms, butterflies, moths, grasshoppers, cicadas, fireflies, crickets, hog-lice, ladybird beetles, ants, blister beetles, roaches, sand flies, wasps, mosquitoes, fleas, lice, etc., the accounts being mostly descriptive of their habits. In addition, the supposed medicinal qualities of the insects are stressed.

Brickell's work was based mainly upon John Lawson's "Journal of 1000 Miles! Travel Among the Indians, with a Description of North Carolina," London, 1700. John Brickell settled at Edentown, N. C., in the early half of the 18th century.

WALDO IRVING BURNETT. 1828–1854. Massachusetts. Wrote upon the hibernation of insects (1848); parasites of animals (1850–51); seventeen-year cicada (1851); the fauna of the intestines of insects (1853); development of aphids (1856).

ISAAC CHAPMAN. Pennsylvania. In the "Medical Repository" of 1798 Dr. Chapman wrote about the medicinal qualities of a species of blister beetle, and described it. This is one of the earliest insect descriptions published in America.

BRACKENRIDGE CLEMENS. 1830–1867. Pennsylvania. Author of a synopsis of North American Sphingidæ (1859). Described 200 new species of microlepidoptera, in 17 papers published in the Proceedings of the Academy of Natural Sciences of Philadelphia, with notes on larval habits.

BENJAMIN HORNOR COATES. 1797–1881. Pennsylvania. Was interested in the Hessian fly. Wrote a biographical sketch of Thomas Say. A widely informed physician who was closely identified with the development of Philadelphia medicine.

FRANK COWAN. 1844–1905. Pennsylvania. Author of "Curious Facts in the History of Insects," published in 1865. This consists mainly of entomological folklore.

JOHN B. DAVIDGE. Maryland. Author of a paper published in 1807 on "Experiments and Observations on the Caterpillar which Infests the Lombardy Poplar," in which he takes exception to the work of another physician who claimed that the poplar caterpillar bit a cat, causing its death.

NATHANIEL DWIGHT. 1770–1831. Massachusetts, Connecticut, Rhode Island. Wrote about blister beetles.

Asa Fitch. 1809–1879. New York. Famous for his classic reports upon the "Noxious, Beneficial and Other Insects of the State of New York," 14 in all, published between 1855 and 1872. Dr. Fitch was an untiring student of insects injurious to horticulture and agriculture and in addition described some new species.

William Gibbons. 1781–1845. Delaware. Was interested in silkworm culture. Wrote in 1834 on the tent caterpillar and the periodical cicada.

Charles Girard. 1822–1895. A naturalized Frenchman, interested specifically in herpetology, ichthyology and helminthology. Described 4 species of Orthoptera and compiled the first annual scientific bibliography issued in 1852 by the Smithsonian Institution.

Augustus A. Gould. 1805–1866. Massachusetts. Conchologist, contributor to medical science and collaborator with Prof. Agassiz in "Principles of Zoology" (1846); published on the Cicindelidæ in 1834. This is a synopsis of the group in Massachusetts.

Hermann August Hagen. 1817–1893. Massachusetts. A notable student of the Neuroptera of North and South America. Author of "Bibliotheca Entomologica." Published on the Neuroptera, color mimicry of insects, psocids, the genus *Colias*, etc.

Amos Hamlin. 1766–1843. New York. Wrote about horse-bots.

Thaddeus William Harris. 1795–1856. Massachusetts. An outstanding figure in entomological and natural history circles during the first half of the 19th century. Described new species, studied life histories of insects. His "Catalogue of Insects of Massachusetts" (1831) was the first attempt in this country to enumerate and classify American insects on a large scale. His "Report on the Insects of Massachusetts Injurious to Vegetation" (1841) was without a rival for many years. All his leisure time was given to the study of natural history.

C. A. Helmuth. Illinois. Described new species of Mordellidæ in 1865.

Samuel Prescott Hildreth. 1783–1863. Ohio. Published on the periodical cicada in 1830 and 1847.

George H. Horn. 1840–1897. Pennsylvania. A born systematist. Wrote 265 papers from 1860 to 1896, in which he described 1,582 new species of Coleoptera. His descriptions are models of clarity. He worked with Dr. LeConte.

Charles T. Jackson. 1805–1880. Massachusetts. Discovered that a yellow dye could be made from the cotton "red-bug." Account published in 1858.

John Lawrence LeConte. 1825–1883. Pennsylvania. On outstanding and remarkable student whose extensive systematic work in the Coleoptera had a great influence on entomological progress, especially his analytical studies which were spread over a wide field.

Joseph Leidy. 1823–1891. Pennsylvania. Famous paleontologist and comparative anatomist. Published (1847) on the history and anatomy of *Belostoma;* described (1849) nematoid entozoa infesting insects; reported upon insects injurious to shade trees in 1862.

F. E. Melsheimer. 1783–1873. Pennsylvania. A country physician who described new species of Coleoptera in 1846–1848. Wrote a "Catalogue of the Described Coleoptera of the United States."

Samuel L. Mitchell. 1764–1831. New York. One of the pioneers in the promotion of natural sciences and medicine in America. Wrote upon cankerworms and their control and also upon *Melolontha* infested with *Cordyceps.*

Samuel G. Morton. 1798–1851. Pennsylvania. A successful Philadelphia physician and one-time president of the Academy of Natural Sciences. Was interested in the periodical cicada and reported his observations to the Academy in 1843.

Josiah Clark Nott. 1804–1873. Alabama. In 1848, he wrote a paper on yellow fever and thought that its cause existed in "some form of insect life."

A. S. Packard, Jr. 1831–1905. Maine, Massachusetts, Rhode Island. Celebrated investigator and teacher. Author of 579 entomological contributions including books. These deal with evolutionary processes, classification, descriptions of new species, economic application of entomological knowledge. Was particularly interested in the Lepidoptera. Author of many well-known monographs.

W. S. W. RUSCHENBERGER. 1807–1895. Pennsylvania. Wrote "Elements of Entomology," published in 1845.

JOHN T. SHARPLESS. Pennsylvania. Published on the silkworm in 1826 and was greatly interested in the possibilities of silk culture in America.

HENRY SHIMER. 1828–1895. Pennsylvania. Described new species of *Chrysops, Aleyrodes, Cecidomyia,* plant lice and mites and wrote upon gall insects from 1865 on.

DAVID HUMPHREYS STORER. 1804–1891. Massachusetts. Interested in entomology and gave popular lectures on insects.

JAMES TILTON. 1745–1822. Pennsylvania. Wrote about the plum curculio. Recommended the boring of holes in infested trees and filling them with mercurial ointment or spirits of turpentine, for destroying insects generally.

ISAAC PIM TRIMBLE. 1804–1890. Pennsylvania, New York, New Jersey. Author of "A Treatise on Insect Enemies of Fruits and Fruit Trees" (1865). Entomologist to the American Institute and to the State Agricultural Society of New Jersey. Wrote nine other papers on insects. Was a keen observer.

JEREMIAH VAN RENSSELAER. 1793–1871. New York. Published in 1828 a paper on larvæ in the human body.

THOMAS WALMSLEY. 1781–1806. Pennsylvania. Was interested in the light of fireflies and conducted experiments by immersing fireflies in various liquids and gases.

HUGH WILLIAMSON. New Jersey. Described the mayfly "*Ephoron leukon*" and noted some of its habits. This was published in 1802.

JAMES WOODHOUSE. Pennsylvania. Dr. Woodhouse, a physician and professor of chemistry in the University of Pennsylvania from 1795 to 1809 wrote "Of American Blistering Flies" in the Medical Repository (1800), and his descriptions are among the earliest printed in America.

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HOWARD, L. O. A History of Applied Entomology. Smith. Misc. Coll., vol. 84. 1930.

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WEISS, HARRY B. The Pioneer Century of American Entomology. New Brunswick, New Jersey, 1936.

LIST OF SPIDERS TAKEN IN CHAMPAIGN COUNTY, ILLINOIS, DURING THE FALL AND WINTER OF 1944–45[1]

By Janet L. C. Rapp

The spiders listed in this paper were taken in connection with the author's thesis problem[2] concerning the habitats of insects in their hibernating state. The actual territory studied lay within an approximate eleven-mile radius of Urbana, Illinois, and included as stations only the six communities of Bondville, Champaign, Mahomet, Mayview, St. Joseph, and Urbana. The spiders were not included in the thesis. A few of them, for which no habitat notes are given, were taken in the early fall by sweeping. The majority were taken with the use of a Jacot[3] apparatus, a modification of that originally proposed by Berlese. Any type of litter, such as river debris or fallen leaves, was collected, bagged, and brought back to the laboratory where it was placed in the apparatus. This essentially consisted of a large funnel of sheet steel or copper with a sieve at the bottom and a 300 watt bulb suspended within an inch over the sample. The principle involved was that of driving the specimens downward by application of light, heat and desiccation. At the base of the funnel a beaker of 70 per cent alcohol was placed to catch the specimens as they fell through the sieve. A sample was left in the apparatus for at least 24 hours.

The spiders were later sorted out and sent to Dr. W. J. Gertsch, of the American Museum of Natural History, to whom I am greatly indebted for identifying the specimens. The spiders are all in the American Museum of Natural History.

Alphabetical list of spiders taken in Champaign County, Illinois, during the fall and winter of 1944–45:

[1] Contribution No. 261 from the Entomology Department of the University of Illinois, Urbana, Illinois.

[2] "Insect Hibernation Studies in Champaign County, Illinois, During the Winter of 1944–45." Unpublished manuscript in the library of the University of Illinois.

[3] Jacot, A. P., 1936. Soil structure and soil biology, Ecology, 17: 359–379.

Acanthepeira stellata Walckenaer. Champaign, Oct. 15, 1944, 3 im.

Agelenopsis pennsylvanicus Koch. Bondville, Oct. 29, 1944, 6 ♀.

Aranea foliata Fourcory. Bondville, Oct. 29, 1944, 2 ♂.

Argiope trifascia Forskal. Champaign, Oct. 15, 1944, 2 ♀.

Ceraticelus sp. Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 ♀.

Cicurina sp. Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 im.

Circurina arcuata Keyserling. Champaign, Oct. 21, 1945, 1 ♀; Urbana, Oct. 22, 1944, 1 ♂, 1 im.; Mahomet, Nov. 20, 1944, 1 ♀; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 1 ♀.

Clubiona sp. Champaign, Oct. 15, 1944, 1 im.; St. Joseph, Dec. 24, 1944, 1 im.; Mahomet, Dec. 31, 1944, 1 jur.; Champaign, Jan. 21, 1945, debris under pine tree, 1 im.; Urbana, Feb. 7, 1945, loose leaves with some underlying unfrozen soil near building, 1 im.; Mahomet, March 4, 1945, litter from forest floor of flood plain, 1 im. ♀.

Clubiona abboti Koch. Champaign, February 5, debris from under small pine, 3 jur.; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 1 ♀, 1 ♂, 13 im.

Clubiona pallens Hentz. Champaign, Jan. 21, 1945, debris from the base of a cedar tree, 1 im.

Coras lamellosus Keyserling. Mahomet, Nov. 20, 1944, 1 ♂.

Cornicularia sp. Urbana, Feb. 25, 1945, loose leaves from sheltered hollow on ground, 1 ♀.

Dictyna sp. St. Joseph, Dec. 24, 1944, 1 jur.

Dictyna bicornis Emerton. Urbana, Jan. 25, 1945, loose leaves and warm damp soil near building, 5 im.; Urbana, Feb. 6, 1945, loose leaves near building, 4 im.

Dictyna foliacea Hentz. Mahomet, Dec. 31, 1944, leaves under fallen tree trunk, 2 im. ♀; Urbana, Feb. 18, 1945, leaves and loose frozen soil from forest floor where there was little protection, 1 im. ♂; Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 2 im. ♂; Mahomet, March 4, 1945, litter from forest floor of flood plain, 1 im. ♀.

Dictyna frondea Emerton. St. Joseph, Dec. 24, 1944, under paper in rubbish heap, 1 jur.; Champaign, Jan. 21, 1945, debris at the base of a cedar tree, 11 im.; Champaign, Feb. 5, 1945, debris from under small pine in nursery, 3 im.

Dictyna longispina Emerton. St. Joseph, Dec. 24, 1944, flood plain debris, 1 im. ♂, 1 jur.; Jan. 25, 1945, loose leaves and warm damp soil near building, 1 im. ♀; Urbana, Feb. 6, 1945, loose leaves near building, 1 ♂, 1 ♀, 2 im.; Urbana, Feb. 7, 1945, loose leaves with some underlying unfrozen soil near building, 1 ♀, 14 im.; Urbana, Feb. 18, 1945, river debris taken from base of tree near water, 1 im. ♀.

Dolomedes sp. Bondville, Oct. 29, 1945, 1 im.

Dolomedes tenebrosus Hentz. Champaign, Oct. 21, 1944, 1 im. ♀.

Drassyllus sp. Bondville, Oct. 29, 1944, 1 im.; Champaign, Jan. 21, 1945, debris under pine tree, 1 im.; Urbana, Feb. 25, 1945, broken pieces of old log, 7 im.; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 2 im.

Drassyllus virginianus Chamberlin. Bondville, Oct. 29, 1944, 1 ♀.

Eperigone sp. Mahomet, March 4, 1945, litter from forest floor of flood plain, 1 im.

Eperigone maculata Banks. Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 ♂.

Eperigone trilobata Emerton. Urbana, Jan. 25, loose leaves and warm damp soil near building, 1 ♂, 1 ♀, 2 jur.

Eridantes erigonoides Emerton. Champaign, Jan. 21, 1945, debris under pine tree, 1 ♂; Urbana, Feb. 6, 1945, loose leaves near building, 1 ♀; St. Joseph, Feb. 11, 1945, loose leaves at base of willow tree, 1 ♂; Urbana, Feb. 25, 1945, broken pieces of old log, 1 ♀.

Erigone blaesa Crosby & Bishop. Urbana, Feb. 7, 1945, loose leaves with some underlying unfrozen soil near building, 1 ♂.

Grammonota sp. Champaign, Jan. 21, 1945, debris at the base of a cedar tree, 1 im. ♂.

Habrocestum pulex Hentz. Urbana, Feb. 25, 1945, broken pieces of old log, 2 im.

Haplodrassus sp. St. Joseph, Dec. 24, 1944, 1 im.; Jan. 21, 1945, debris under pine tree, 2 im.

Hyctia bina Hentz. Urbana, Feb. 18, 1945, leaves and debris from eroded area along brook, 1 im. ♀.

Islandiana longisetosa Emerton. Mahomet, Dec. 21, 1944, interior of gum tree hollow at base; Champaign, Jan. 21, 1945, interior of gum tree hollow at base, 1 ♂; Urbana, Feb. 14, 1945, loose leaves and some underlying damp soil near building, 1 ♂, 1 ♀; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 1 ♀.

Lycosa avida Walckenaer. Champaign, Oct. 21, 1944, 2 im.; Urbana, Jan. 25, 1945, loose leaves and warm damp soil near building, 2 im.; Urbana, Feb. 6, 1945, loose leaves near building, 2 im.; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 2 im.; Mahomet, March 4, 1945, litter from forest floor of flood plain, 1 im.

Memetus sp. Bondville, Oct. 29, 1944, 1 im.

Micaria aurata Hentz. Urbana, Feb. 18, 1945, leaves and debris from eroded area along brook, 1 im. ♀.

Microneta sp. Mahomet, Dec. 31, 1945, 1 im.; Urbana, Feb. 6, 1945, loose leaves near building, 2 jur.; Urbana, Feb. 7, 1945, loose leaves with some underlying unfrozen soil near building, 2 im.; Urbana, Feb. 14, 1945, loose leaves and some underlying damp soil near building, 2 ♀, 3 im., 1 jur.; Urbana, Jan. 25, 1945, loose leaves and warm damp soil near building, 5 im.; Mahomet, March 4, 1945, hole in base of sycamore tree, 1 im. ♂; Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 ♀.

Microneta cornupalpis Emerton. Champaign, Jan. 21, 1945, 1 ♀; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 2 ♂; Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 ♂.

Neonnelli sp., Peckham. Champaign, Feb. 5, 1945, debris from under small pine, 2 subadult ♂'s.

Oxyptila sp. Urbana, Feb. 18, 1945, leaves and loose frozen soil from forest floor where there was little protection, 1 im. ♀; Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 im. ♂, 1 im. ♀.

Pardosa sp. Urbana, Oct. 22, 1944, 2 im.; Bondville, Oct. 29, 1944, 3 im.; Urbana, Feb. 7, 1945, loose leaves with some underlying unfrozen soil near building, 1 im.; Urbana, Feb. 14, 1945, loose leaves and some underlying damp soil near building, 1 im.

Phidippus audax Hentz. Bondville, Oct. 29, 1944, 1 im. ♂.

Philodromus sp. Mahomet, Dec. 31, 1944, interior of gum tree hollow at base, 1 im. ♀; Champaign, Jan. 21, 1945, debris under pine tree, 1 im.; Champaign, Jan. 21, 1945, debris from the base of a cedar tree, 1 im. ♀; Champaign, Feb. 5, 1945, debris from under small pine, 1 im.; Urbana, Feb. 6, 1945, loose leaves near building, 1 im.; Urbana, Feb. 18, 1945, river debris taken from base of tree near water, 1 im. ♀.

Phrurotimpus borealis Banks. Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 ♀.

Phrurolithus redemptus Gertsch. Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 ♂, 2 ♀.

Pirata sp. Mahomet, Nov. 20, 1944, 1 im.; Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 2 im.; Mahomet, March 4, 1945, litter from forest floor of flood plain, 2 im.

Pisaurina vira Walckenaer. Bondville, Oct. 29, 1944, 1 im.

Sergiolus sp. St. Joseph, Dec. 24, 1944, flood plain debris, 1 im. ♀; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 1 im.; Mahomet, March 4, 1945, loose dirt with a few leaves from open ground under sycamore, 1 im. ♂.

Stemonyphantes Lineatus Linn., Bondville, Oct. 29, 1944, 1 ♀.

Tegenaria sp., Urbana, Feb. 6, 1945, loose leaves near building, 2 jur.

Tennesseelum formicum Emerton. Mahomet, Dec. 31, 1944, debris under snow, 1 im.; Champaign, Feb. 4, 1945, loose leaves, 1 im. ♂, 1 im. ♀; Urbana, Feb. 7, 1945, loose leaves with some underlying unfrozen soil near building, 2 im.

Tetragnatha laboriosa Hentz. Bondville, Oct. 29, 1944, 5 im.

Theridion sp. St. Joseph, Dec. 24, 1944, 16 im.; Mahomet, Dec. 31, 1944, bird's nest, 1 jur.

Wala plamarum Hentz. Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 1 im. ♂.

Xysticus ferox Hentz. Champaign, Oct. 21, 1944, 1 im.; Champaign, Jan. 21, 1945, debris under pine tree, 2 im.; Urbana, Feb. 25, 1945, loose leaves from sheltered hollow in ground, 2 im.

FIVE ICHNEUMONIDÆ REARED FROM COCOONS OF THE EUROPEAN PINE SAWFLY, NEODIPRION SERTIFER (GEOFF.)

BY H. B. GIRTH AND E. E. McCOY

The European pine sawfly *Neodiprion sertifer* (Geoff.) has been causing severe damage to red and Scotch pine in New Jersey since 1938.

In an attempt to control this pest the New Jersey Department of Agriculture has reared and liberated the parasitic chalcid *Microplectron fuscipennis* in large numbers during the period 1939–1945. The rearing technique employed is basically that previously employed in rearing the same parasite for use against the spruce sawfly in New England. The method was developed by the staff of the U. S. Department of Agriculture's Forest Insect Laboratory at New Haven, Conn.

The method requires that large numbers of healthy sawfly cocoons be collected from infested plantings and stored under refrigeration for use during the rearing period. A supply of such cocoons was collected in June 1944 from a stand of red pine near Kingston, Middlesex County, N. J.

During the winter of 1944–45 several hundred of these stored cocoons were placed in individual vials with ventilated stoppers and held in a chamber with a relative humidity of 60 per cent at 75° F.

Many healthy sawfly adults emerged from the cocoons, and five species of ichneumonids were also recovered and later identified as *Exenterus canadensis* (Prov.), *Mastrus neodiprioni* (Vier.), *Endasys subclavatus* (Say), *Agrothereutes lophyri* (Nort), and *Euceros neodiprioni* (Wally).

BRITISH INSECTS*

By T. D. A. Cockerell

The new list of British Insects, compiled with great care, with the aid and advice of numerous specialists, is of interest to all entomologists. I find it remarkably accurate and up to date; the only serious error I have found is in the Coccidae, where the common *Orthezia insignis* has for no assignable reason got transferred to *Matsucoccus,* which it does not at all resemble. Some of the modern revisions are startling, and as in all such cases, there is a tendency to take the latest proposals as valid, though some of them may not stand the test of time. The most alarming is in *Drosophila.* What will the geneticists say to this?

Drosophila fenestrarum Fallén, 1823.
 syn. *melanogaster* Meigen, 1830.
Drosophila fasciata Meigen, 1830.
 syn. *cameraria* Haliday, 1833.
 syn. *ampelophila* Loew, H. 1862.
 syn. *melanogaster* auctt., nec Meigen, 1830.

In every case the date of publication is given; a very valuable feature. Subgenera are frequently cited, but in a good many cases names given as synonyms are really those of subgenera. The lists of synonyms are sometimes very long; for instance, the aphid *Brachycaudus helichrysi,* Kaltenbach, 1843, appears to have 23 synonyms. Ten are by Theobald, seven by Walker (three of these doubtful), five by Buckton, and one by Koch. One wonders what were the characters by which all these were supposed to be distinguished, and whether they are actually all alike.

In the case of the Lepidoptera, in particular, the specific names are cited, but the very numerous varietal names are omitted. It was obviously impracticable to list all the variations which have been described, but one of the chief problems for the British

* A Check List of British Insects. By George Sidney Kloet and Walter Douglas Hincks. Published by the authors at Stockport, Cheshire, December 1945. 483 pages.

entomologist, as it is for the British ornithologist, is to recognize the various insular subspecies, which are far more numerous than was formerly suspected. In the present state of the nomenclature, it is not easy to separate the subspecies from the mutants, but at least some of the subspecies might have been cited.

Among the parasitic Hymenoptera, there are evidently many species to be discovered. Thus Nixon, who is a very careful and accurate worker, has in recent years described 62 new species of the Braconid genus *Dacnusa,* and we are informed that his revision is not yet completed. But the hundreds of parasitic Hymenoptera (for instance, about 128 in *Tetrastichus*) described by Walker, cannot be taken seriously, and if they are ever revised, much synonymy will result. I believe most of the specimens are in the British Museum. On account of these Walker names, the list of Hymenoptera is swollen beyond reason, but the authors are justified in citing all published names, leaving it for the future to determine their true significance.

I naturally compared the list with that of the State of New York, edited by M. D. Leonard and published in 1928. New York has 47,654 square miles; the British Islands (including Ireland) have 121,396. New York has the advantage of being in the latitude of the northern Mediterranean region, and having no sea boundary cutting it off from the regions to the south.

If we omit the spiders, centipedes and millipedes, which are listed by Leonard, New York has (or had at the time the list was published) 4,574 genera, and 15,949 species. The British Islands have 4,714 genera and 20,024 species. I thought I should find that New York had been much less investigated than the British Isles, but allowing for the difference in area, its list shows up very well in comparison.

The following groups are better represented in the British Isles than in New York:

Collembola	N. Y. 71	Brit. Is. 261
Thysanoptera	N. Y. 77	Brit. Is. 183

But in the following groups N. Y. takes the lead:

Orthoptera	N. Y. 136	Brit. Is. 38
Odonata	N. Y. 159	Brit. Is. 42
Coleoptera	N. Y. 4,546	Brit. Is. 3,690

In the Lepidoptera, the British Isles have 657 genera and 2,187 species; New York has 800 genera and 2,439 species. With the number of species not far from equal, the smaller number of British genera appears characteristic of an island fauna, where additional generic types have not arrived in great numbers, while those already present had the opportunity to expand. The Hawaiian fauna illustrates this in a striking manner. But whereas the numerous species in the Hawaiian Islands are endemic, those of the British Islands are, with few exceptions, common to the continent of Europe or only racially distinct. It must be supposed that the peculiar genera of the countries to the south could not easily establish themselves in the British Islands, or perhaps there has been a greater tendency to divide genera in America.

On comparing particular groups, the differences are striking. The British Islands have only one species of Saturniidæ; New York has eight in seven genera, but one genus and species is introduced. In the butterflies, which are well known in both regions, New York has about 114. The British Islands have 68. Britain has only one *Papilio;* New York has seven swallow-tails, arranged in three genera. *Parnassius,* though a circumpolar genus, is absent from both lists. In the Hymenopterous family Mutillidæ, the British Islands have only two species; New York has 23. In the ants, the British Islands have 36; New York has 63 species, and many subspecies.

BOOK NOTICE

Insect Microbiology—An Account of the Microbes Associated with Insects and Ticks with Special Reference to the Biologic Relationships Involved. By Edward A. Steinhaus. Ithaca, New York. Comstock Publishing Company, Inc., 1946. $9\frac{1}{2} \times 6\frac{1}{4}$ in. XIV + 763 p. 250 figs. $7.75

I have been waiting for this book for many years, particularly within recent ones because of the presence of a protozoan in *Macrocentrus ancylivorus* and in its host, the potato tuber worm which interfered seriously with the production of *M. ancylivorus* for liberation in peach orchards infested with the Oriental fruit moth. What I needed was an adequate and general consideration of the entire field of insect microbiology, which could be used as a basis for more intensive work with particular organisms and which introduced one to the literature of the subject. The present work supplies these needs completely. As a group entomologists have paid little attention to insect microbiology, due probably to the specialization required in bacteriology, mycology, protozoology, etc. However, over the years, various studies and observations have been made and the author has organized this information and presented it as a reference work and textbook. This is the first time this has been done and the student now has basic information that should stimulate more research in a field that has been greatly neglected in favor of "practical" studies. Professor Steinhaus' book has been greatly needed for a long time.

There is a chapter on extracellular bacteria and insects; a long chapter on specific bacteria associated with insects, which is really an annotated and systematic catalogue of great value to investigators; a chapter on intracellular bacterium-like and rickettsia-like symbiotes, which live in tissue cells and usually are not harmful to them; and remaining chapters, on Rickettsiæ, yeast and insects, fungi and insects, viruses and insects, spirochetes associated with insects, protozoa and insects, protozoa in termites, immunity in insects which is practically a new field, and methods and procedures. The references number 1,739 of which 577 are in foreign languages. Author and subject indexes conclude the volume.

Professor Steinhaus covers the relationships and associations between microbes and insects wherever these are known, although the gaps in our knowledge are enormous, and his book is a stimulating approach to a subject that will be new to many entomologists and of practical interest to many in the field of biological control where frequently the production of parasitic species falls off due to the presence of microorganisms that sometimes cause no end of trouble. The author has made a notable contribution in a field that should be cultivated for the sake of the basic knowledge that will result.

The future of insect microbiology is not so much in the hands of entomologists as it is in the hands of the entomicrobiologists and these in turn are in the hands of our colleges and universities. —H. B. WEISS.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of October 2, 1945

A regular meeting of the New York Entomological Society was held on October 2, 1945, at the American Museum of Natural History. President George G. Becker was in the chair. Seventeen members and twelve guests were present.

This meeting was devoted to the discussion of summer activities by members.

Mr. Comstock exhibited some butterflies from the southwest Pacific collected by soldiers stationed on these islands.

Mr. Pallister showed some insects both local and exotic recently acquired by the museum.

Dr. Becker spoke of the plant material, particularly orchids, passing through his station.

Dr. Bromley told of a number of serious outbreaks of insects during the year. That of the fall canker worm, which was as bad as in 1936, together with the scarcity of *Calosoma* beetles to feed upon the worms, was the worst of the outbreaks. The elm leaf beetle also was a serious pest during the year.

Mr. Schiff told of his summer work in mosquito control.

Dr. Schneirla reported the unusual activity of the red slave making ant and the great distances to which they travel, frequently 60 to 80 yards, but sometimes as much as 150 yards.

Dr. Swain told of his recent work in Florida, and called attention to the extensive fires which prevailed this year.

Mr. Laucks mentioned the mosquito sound records by Dr. Morton Kahn and the members thought they should try to get Dr. Kahn on the program for a future meeting. Mr. Huntington, who is well acquainted with Dr. Kahn, said he would try to get him.

Mr. Teale told of his observations on the movements of the dragon fly, *Anax junius*, and the monarch butterfly at Fire Island. He also reported on the activities of his colony of rat-tailed maggots.

Mr. Comstock spoke of the monarch butterfly found in the South Pacific Islands, and of the South American monarch reaching the southern part of the United States.

The rest of the meeting was devoted to a general discussion of insect flights.

John C. Pallister, *Secretary*

Meeting of October 16, 1945

A regular meeting of the New York Entomological Society was held Tuesday evening, October 16, 1945, in the American Museum of Natural History. In the absence of the President, the Vice-President, Dr. S. W. Bromley, was in the chair. Fifteen members and 25 guests were present.

The secretary read a letter from Dr. M. D. Leonard asking the members of the Society to send in records of insects collected in New York State so as to make the contemplated list as complete as possible. This request was commented upon by both Dr. Bromley and Mr. Comstock.

Mr. Comstock reported upon the program for the November and December meetings.

The talk of the evening, "A Naturalist Goes to Florida," illustrated with colored lantern slides, was given by Mr. John C. Pallister. He outlined the various regions of this unique state and described some of the plant and animal life to be found there.

Dr. Bromley, formerly a resident of Florida, spoke of some of the distinctive trees of that state.

Upon complaint of several members of the Society that they were not receiving their notices of meetings, the Secretary said he would take the matter up with the New York Academy of Sciences to correct this condition.

JOHN C. PALLISTER, *Secretary*

MEETING OF NOVEMBER 20, 1945

A regular meeting of the New York Entomological Society was held Tuesday evening, November 20, 1945, in the American Museum of Natural History. President George G. Becker was in the chair. Twenty members and twenty-five visitors were present.

Mr. Teale proposed for membership, Mr. Roman Vishniac, 105 West 72nd Street, New York City, and because the proposal had been delayed, he made a motion that the by-laws be suspended and Mr. Vishniac be elected to membership at this meeting. The motion being carried, Mr. Vishniac was duly elected a member.

Mr. Comstock presented the following resolution:

Resolved that paragraph two of Article X of the by-laws of the New York Entomological Society be and hereby is suspended as effective only for the year 1946.

Be it resolved further that the Annual Meeting shall be held at the American Museum of Natural History on December 15, 1945, at 8:00 P.M.

Be it resolved further that, as provided by paragraph six of Article X of the by-laws, due notice of this meeting shall be given by publication in the Bulletin of the New York Academy of Sciences.

Mr. Edward Parr Wiltshire, Vice Consul with the British Consulate in New York City, presented the paper of the evening, "Insect Ecology in the Middle East," illustrated with lantern slides.

Mr. Wiltshire gave us many an interesting glimpse of plant and insect distribution throughout this varied region. The region covered extended from the coastal plains of the Mediterranean Sea, across the different mountain ranges, plateaus, and river valleys to the Caspian Sea.

Dr. King inquired as to the affinities of the fauna of the Middle East with the European fauna.

Dr. Forbes asked about the presence of the swallowtails, which do not seem to endure desert conditions, and called attention to the numbers of blues which inhabit this area.

Mr. Teale asked if the grasshoppers took up a position in relation to the direction of the sun.

Mr. Comstock inquired about the presence of parasites which seem to be quite prevalent.

The president appointed a nominating committee of Mr. Teale, chairman, Mr. Huntington and Mr. Weiss.

JOHN C. PALLISTER, *Secretary*

MEETING OF DECEMBER 4, 1945

A regular meeting of the New York Entomological Society was held Tuesday evening, December 4, 1945, in the American Museum of Natural History. President George G. Becker was in the chair. Fifteen members and fifteen guests were present.

Dr. George W. Rawson, The Borden Co., 350 Madison Avenue, New York, was proposed for membership by the secretary. Mr. William T. M. Forbes of Cornell University requested by letter that Mr. R. H. Arnett, of the Department of Entomology, New York State College of Agriculture, Ithaca, New York, be proposed for membership.

The President requested the Secretary to reread a resolution presented by Mr. Comstock to change the date of the annual meeting. A motion was made and seconded to approve this resolution and it was so voted.

Dr. T. C. Schneirla presented the paper of the evening. It was "Studies of Mexican Army Ants in the Dry Season," illustrated with lantern slides.

Dr. Schneirla made his studies in five different areas of Mexico, from the lower wet coastal regions, to the higher and more arid places. In all the colonies observed there was a direct relation in the life cycle to the nomadic and statary periods. The activities of the colonies were largely governed by the seasonal weather conditions. The dry season is the greatest enemy of the army ant, much more so than the anteater, the so-called ant eating birds, and even parasites.

After considerable discussion the meeting adjourned.

JOHN C. PALLISTER, *Secretary*

MEETING OF DECEMBER 18, 1945

The Annual Meeting of the New York Entomological Society was held on December 18, 1945, in the American Museum of Natural History. President Becker in the chair. Nineteen members and six guests were present.

In the absence of the Treasurer his report was read by the Secretary.

Mr. Teale reported the Nominating Committee's recommendations for elective officers for the year 1946 as follows:

President—Stanley W. Bromley
Vice-President—Harold R. Hagan
Secretary—John C. Pallister
Assistant Secretary—Lina Sordillo
Treasurer—James C. King
Assistant Treasurer—Leonard J. Sanford
Editor—Harry B. Weiss

Trustees—Stanley W. Bromley, Chairman; George G. Becker, J. L. Horsfall, Harold R. Hagan, Herbert Ruckes.

Publication Committee—Harry B. Weiss, Chairman; John D. Sherman, Jr., T. C. Schneirla.

There being no further nominations from the floor a motion was made and approved that the Secretary cast one ballot and elect the above proposed officers of the Society for the year 1946.

Dr. Becker then turned the meeting over to Dr. Bromley, the new president.

Dr. L. G. Gemmell, American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y., was proposed for membership.

Mr. Ross H. Arnett and Dr. George W. Rawson were elected members.

Mr. Comstock as delegate to the New York Academy of Science reported that nothing concerning the Society had come before the Academy.

Mr. Zerkowitz reported on collecting Lepidoptera in Portugal, while Mr. Wiltshire compared the collecting of similar Lepidoptera in Persia.

Dr. Bromley read a letter from Harry B. Weiss addressed to the Trustees in regard to publishing an index for the first fifty volumes of the Journal which Mr. Weiss had recently prepared. After much discussion, *pro* and *con*, a motion was made and approved for the Secretary to notify Mr. Weiss to solicit the subscription list for possible subscribers to the publications by means of a return postcard; this return postcard to be in the form of an order; the price of the publication not to exceed five dollars ($5.00).

JOHN C. PALLISTER, *Secretary*

MEETING OF JANUARY 15, 1946

A regular meeting of the New York Entomological Society was held January 15, 1946, in the American Museum of Natural History. President Bromley was in the chair. Sixty-nine members and visitors were present.

The Secretary reported the deaths of two entomologists. Mr. Rumell, an ardent lepidopterist and collector, and Mr. F. M. Schott of Bergenfield, N. J., a member of long standing of the New York Entomological Society. It was thought advisable that Mr. Weiss write obituaries, for publication in the JOURNAL, about these two men.

Dr. L. G. Gemmell was elected to membership.

The President appointed a program committee of Mr. Wm. P. Comstock, chairman; Mr. E. I. Huntington and Dr. Mont Cazier, and a field committee of Miss Lucy Clausen, chairman; Mr. Chris Olsen, and Mr. Edwin Way Teale.

The paper of the evening, "Sounds Produced by Certain Disease-carrying Mosquitoes and Their Possible Significance in Control," was given by Dr. Morton C. Kahn, Cornell University Medical School, in association with Mr. Wm. Offenhauser and Mr. Wm. Celestin.

Dr. Kahn described recent experiments which he had been conducting at Cornell Medical School, on the sounds produced by various species of mosquitoes. These sounds are too low in volume to be heard by human ears. Therefore Dr. Kahn and his associates devised apparatus to amplify these sounds. Recordings of these amplifications showed marked differences in the sounds produced by different species as well as between males and females.

Following Dr. Kahn's talk, Mr. Offenhauser explained the apparatus and methods used, and played recordings of three species of mosquitoes, *Anopheles quadrimaculata, Aedes aegypti,* and *Aedes albopictus.*

JOHN C. PALLISTER, *Secretary*

MEETING OF FEBRUARY 5, 1946

A regular meeting of the New York Entomological Society was held February 5, 1946, in the American Museum of Natural History. In the absence of President Bromley, the Vice-President, Dr. Hagan, was in the chair. Twenty-two members and visitors were present.

The Secretary reported the condition of President Bromley, who is in Doctors Hospital, as very favorable. A motion was made and approved that the Secretary send flowers from the Society to Dr. Bromley.

Mr. Teale reported that the programs for the meetings through May were all arranged.

Mr. Teale called attention to the next meeting of the Brooklyn Entomological Society to be held February 14 at the Brooklyn Museum at which Mr. Buckholtz was to describe and demonstrate some of his collecting apparatus.

Mr. Teale also reported that Dr. Clarence Goodnight, a member of the Society, and Mrs. Goodnight, who are well known for their work on the phalangids, were leaving for Lafayette, Indiana, where Dr. Goodnight will take over his duties as Assistant Professor at Purdue University.

The paper of the evening, "Interspecific Relationships within the *Guarani* Group of Neotropical *Drosophila*" was presented by Dr. James C. King.

Dr. King has been conducting extensive experiments in hybridization among six species of the *Guarani* group of *Drosophila* which occur in Mexico, Boliva, and southeastern Brazil. Only among three species did he obtain any hybridization effective both ways. Dr. King showed bottles of living specimens of some of these species.

JOHN C. PALLISTER, *Secretary*

MEETING OF FEBRUARY 19, 1946

A regular meeting of the New York Entomological Society was held February 19, 1946, in the American Museum of Natural History. In the absence of President Bromley, the Vice-President, Dr. Hagan, was in the chair. Forty-two members and visitors were present.

Mr. Walter R. Gusciora, 21 Fournier-Cresent Street, East Paterson, New Jersey, was proposed for membership.

Dr. Donohoe proposed for membership Mr. Edwin J. Sameth, Western Exterminating Co., Newark, New Jersey.

The Secretary read a short letter from President Bromley, thanking the Society for the flowers sent to him.

The paper of the evening "The White Fringed Beetle," illustrated by sound motion pictures, was presented by Dr. R. B. Swain of the U. S. Plant Quarantine Station, Hoboken, New Jersey.

Dr. Swain gave an interesting account of the appearance of these beetles in the southern states and their advance throughout six of the states bordering the Gulf of Mexico. They were probably introduced by means of ships stores arriving from Chile or Argentina.

Dr. Swain described the curious life history of the beetles of which no males have ever been found. The talk was followed by excellent motion pictures of the beetle and methods for its control.

JOHN C. PALLISTER, *Secretary*

MEETING OF MARCH 5, 1946

A regular meeting of the New York Entomological Society was held March 5, 1946, in the American Museum of Natural History. Vice-President Hagan was in the chair. Thirty-two members and visitors were present.

Mr. Walter R. Gusciora and Mr. Edwin J. Sameth were elected to membership.

At the request of Mr. George J. Rau, a motion was made and passed to accept his resignation from the Society.

The program of the evening, "Animals and Insects in the Rural Garden," illustrated by colored motion pictures provided an evening of entertainment. The pictures were of insects and other wild life to be seen in a rural garden which Mr. Comstock discussed very entertainingly.

Mr. Paul Richards, a member of the New York Entomological Society, took the kodachrome motion pictures about his home and garden. The camera he used was a cinekodak special. A number of the shots were quite unusual. The remarkable motion of the wings of a peacock fly were well shown, as was also the leg movement of several species of butterflies.

JOHN C. PALLISTER, *Secretary*

INDEX TO NAMES OF INSECTS AND PLANTS IN VOLUME LIV

Generic names begin with capital letters. New genera, subgenera, species, varieties and new names are printed in italics.

The
New York Entomological Society

Organized June 29, 1892—Incorporated February 25, 1893

Reincorporated February 17, 1943

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 79th St., & Central Park W., New York 24, N. Y.

Annual dues for Active Members, $3.00; including subscription to the Journal, $4.50.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

A set of the Journal, volumes I to L inclusive, unbound, $90.00.

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President, DR. STANLEY W. BROMLEY....Bartlett Tree Research Lab., Stamford, Conn.

Vice-President, HAROLD R. HAGAN....College of the City of New York, New York 31, N. Y.

Secretary, JOHN C. PALLISTER....American Museum of Natural History

Assistant Secretary, LINA SORDILLO....American Museum of Natural History

Treasurer, DR. JAMES C. KING....American Museum of Natural History

Assistant Treasurer, LEONARD J. SANFORD....American Museum of Natural History

Editor, HARRY B. WEISS....Highland Park, N. J.

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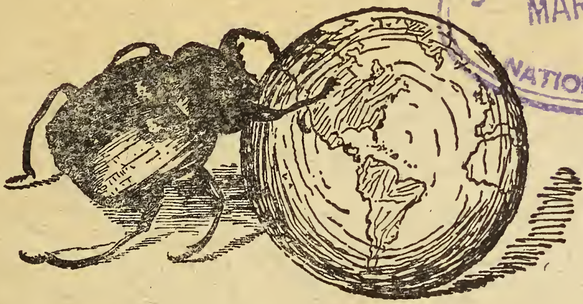

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THE NORTH AMERICAN SPECIES OF THE SUBGENUS BOTANOPHILA LIOY, GENUS HYLEMYIA SENS. LAT. (DIPTERA, MUSCIDÆ)

By H. C. Huckett

Riverhead, N. Y.

The species dealt with in this paper belong to the *varicolor* segregate within the genus Hylemyia *sens. lat.* The group is represented in North America by the following described forms, *Hylemyia varicolor* (Meigen), *H. inornata* Stein, *H. marginata* Stein, *H. spiniventris* Coquillett, *H. setigera* (Johannsen), *H. spinidens* Malloch, *H. marginella* Malloch, *H. piloseta* Malloch, *H. robusta* Stein, *H. brevipalpis* Huckett. Two names have been applied to the group, namely Botanophila Lioy and Euryparia Ringdahl.

The genus *Botanophila* was erected by Lioy (1864)[1] for the reception of the single nominal species *Botanophila varicolor* (Meigen). Coquillett (1910) later designated *Anthomyia varicolor* Meigen as the genotype of Lioy's genus. There would be little need for further comment on the validity of Coquillett's action were it clear that Lioy's species had been correctly named. Unfortunately there has been considerable confusion in the literature concerning the identity of *Anthomyia varicolor* Meigen, and so far as I am aware there has been no attempt to elucidate the nature of the species recorded by Lioy. Collin (1927) has guard-

[1] Figures in parenthesis refer to literature cited in the synonymies according to date of publication.

edly remarked that *Chortophila varicolor* (Meigen) of Macquart should be considered the type of Lioy's genus. This approach to the problem is made possible on the grounds that Lioy had drawn considerably on the information contained in Macquart's (1835) prior writings for the completion of his own studies, to which Lioy himself had testified. In view of this attempt to clarify the issue it is regrettable to find that there has been little comment in the literature concerning the identity of Macquart's *varicolor*. What information is available has been usually presented by way of synonymy to the effect that Meigen's and Macquart's treatment of *varicolor* may be regarded as indicating the same species. There seem to be no stronger clues that might lead to a different understanding of the matter. I have concluded therefore that the identity of Macquart's species, if it is to survive, should be deduced largely from the information at hand pertaining to the identity of Meigen's *varicolor*.

The species *Anthomyia varicolor* Meigen was, in my opinion, first correctly diagnosed by Villeneuve (1899), when on examining Meigen's types in Paris he pointed out that *Chortophila trapezina* (Zetterstedt) and *C. impudica* Rondani were synonyms of Meigen's species. This observation was supported by Pandellé (1900) and later was more fully substantiated by Schnabl and Dziedzicki (1911). Stein (1916) on monographing the European Anthomyiidæ redescribed *varicolor* (Meigen) in greater detail, and helped further to delimit the identity of that species by excluding from consideration Rondani's mistaken concept. Ringdahl (1939) on studying Zetterstedt's collection at Lund cited *Aricia trapezina* Zetterstedt as a synonym of *varicolor* (Meigen). Schiner's[2] early reference to *varicolor*, like that of Rondani's, may be regarded as an error in identification, as at first sensed by Stein (1900) on examining Meigen's collection in Paris and as later concluded by both Schnabl and Villeneuve.[3] Stein (1907) and Séguy (1937) in their catalogues to palearctic and world species of Muscidæ have maintained *trapezina* and *varicolor* (Meigen) as distinct species. That Stein in later years may have

[2] Schiner, J. R. 1862. Die Fliegen (Diptera). Fauna Austriaca. I: 637–638.

[3] Schnabl, J. 1911. Dipterologische Sammelreise nach Korsika (Dipt.). Deutsch. Ent. Zeitschr., heft 6, p. 74.

modified his views is indicated by the fact that although *varicolor* was the name employed by Stein (1920) in recording the species from North America yet the specimens on which the record is based were labelled by Stein as *trapezina* Zett. In the light of these considerations relative to the status of Lioy's genus *Botanophila* I have concluded that *Anthomyia varicolor* Meigen may be regarded as available for purposes of type fixation. Thus Coquillett's action to that effect may be accepted as valid.

The monobasic subgenus *Euryparia* was proposed by Ringdahl (1929) for the reception of *Hylemyia varicolor* (Meigen), which species he named as type. I have refrained from applying Ringdahl's subgeneric name to the group in deference to considerations relative to the prior claims of Lioy's generic name Botanophila.

The group may be distinguished from allied subgenera on the basis of the following male characters: Prebasal sclerite of hypopygium (tergum 6 of Crampton) bristled along caudal margin (not bare); anal sclerite (tergum 9) roundish, appressed and largely secluded when in repose, weakly bristled; processes of fifth abdominal sternum armed with submarginal spines, which may be strongly or weakly developed; cerci (superior forceps) tapered sharply distad to a stylelike process; gonostyli (inferior forceps) lamellate, furrowed and extensively incised on apical region (except in *fibulans*); outer pair of lobes (gonapophyses) of genitalia much reduced, and each armed with two coarse flagellate setæ. In the male the acrostical bristles are short, fine and slender, except the caudal pair, and in female they are notably weak or absent; the mesopleura are armed with one or more bristlelike setæ on upper border adjacent anterior notopleural bristle; occipital areas immediately below postocular series of setulæ are not bare but possess several setulæ.

The species are predominantly western and northern in distribution, being most abundant in mountainous regions, where herbage, meadows and woodland characterize the terrain. Two of these forms occur commonly in eastern sections from whence they were originally described, namely, *Hylemyia inornata* Stein and *H. setigera* (Johannsen). The species *Hylemyia spinidens* Malloch has also been recorded by Ringdahl (1930) from Eastern Siberia.

EXPLANATION OF KEY TERMS

Width of frons between eyes is measured at narrowest dimension; height of cheek at shortest distance between eye margin and ventral border of cheek when head is viewed in profile. The length of aristal hairs implies the longest; length of proboscis denotes the distal or haustellate portion of that appendage. Processes refer to the copulatory lobes of fifth abdominal sternum in male, and they should be viewed in profile laterally when measured for purposes of comparison. Femoral width signifies the distance from ventral to dorsal surface.

KEYS TO SPECIES

MALES

1. Hind tibia with a robust apical posteroventral bristle 2
   Hind tibia with apical posteroventral bristle lacking or weakly developed, setulose 11
2. Processes armed with a series of robust spines from base to preapical region, tips prolonged into filaments (Figs. 39, 40) 3
   Processes with robust spines restricted to proximal half, those on distal half, if present, are weak, or spines all short, tips not prolonged into filaments (Figs. 36, 42, 44) 4
3. Longest spines on processes exceeding width of hind femur at middle; outer series of bristles confined largely to distal half of process (Figs. 23, 39) ..... *spiniventris* Coq.
   Longest spines on processes not exceeding width of hind femur at middle; outer series of bristles extending to basal region of process (Figs. 33, 40) ..... *subspinata* n. sp.
4. Stronger spines of processes longer or coarser developed than apical setæ on hind metatarsus; processes proportionately broad and stoutish (Figs. 35–38), except in *spinidens* 5
   Stronger spines of processes spinulose and not coarser than apical setæ on hind metatarsus; processes proportionately narrow beyond basal region (Figs. 43, 44) 10
5. Wings yellowish basad ..... *inornata* Stein
   Wings brownish tinged or darker 6
6. Hind tibia with a robust apical posterodorsal bristle; aristal hairs not longer than half width of third antennal segment; antennæ not separated basad by a pronounced facial carina 7
   Hind tibia with a weak apical posterodorsal bristle; aristal hairs longer than half width of third antennal segment; antennæ separated basad by a pronounced facial carina ..... *spinidens* Mall.
7. Cerci divided distad into three denticulate projections (Fig. 9); parafacials at narrowest not as broad as width of third antennal seg-

ment; border of upper calyptra usually richly yellowish. *trifurcata* n. sp.

Cerci narrowing distad to a single stylelike process (Figs. 3, 6, 7); parafacials at narrowest slightly wider than breadth of third antennal segment; border of upper calyptra not notably yellowish. 8

8. Cerci angulate in outline cephalad (dorsad), apex sharply formed, (Fig. 7) .... *acuticauda* n. sp.

Cerci broadly transverse along cephalic (dorsal) margin, (Figs. 3, 6). 9

9. Inner margin of outer digit of gonostyli (inferior forceps) armed with a sharp firm tooth (Fig. 3) .... *piloseta* Mall.

Inner margin of outer digit of gonostyli with a stumpy short tooth, or only trace of such (Fig. 6) .... *varicolor* (Meig.)

10. Wings yellowish basad .... *setigera* (Joh.)

Wings brownish tinged or darker basad .... *marginella* Mall.

11. Eyes separated by a distance equal to length of third antennal segment; frons and vertex with bristling as in female; interfrontalia uniformly broad throughout .... *brevipalpis* Huck.

Eyes separated by a distance less than length of third antennal segment; frons and vertex with malelike bristling; interfrontalia narrowed caudad 12

12. Processes armed with a series of robust spines from base to preapical region, tips prolonged into filaments (Figs. 39, 40) 3

Processes with robust spines restricted to proximal half, those distad if present are weak, tips not prolonged noticeably into filaments. 13

13. Wings yellowish basad 14

Wings brownish tinged or darker basad 15

14. Processes proportionately stout with width well maintained on distal half, length about equal to twice average width; spines coarser than setæ at apex of hind metatarsus; hind tibia with apical posterodorsal bristle seldom shorter than apical anteroventral bristle. *inornata* Stein

Processes not stout, narrower distad, length nearly three times average width; spines not coarser than setæ at apex of hind metatarsus; hind tibia with apical posterodorsal bristle seldom as long as apical anteroventral bristle .... *setigera* (Joh.)

15. Antennæ separated by a pronounced facial elevation; vibrissal angle protruded cephalad beyond a level with base of antennæ, axis of head from oral margin to occipital foramen nearly equal to height of head .... *spinidens* Mall.

Antennæ separated basad by an inconspicuous facial carina 16

16. Aristal hairs not longer than half width of third antennal segment ... 17

Aristal hairs longer than half width of third antennal segment 19

17. Hind tibia with a robust apical posterodorsal bristle; proboscis short, not as long as height of eye; processes stout with width well maintained on distal half, slightly wider than mid femur near apex. *fibulans* n. sp.

Hind tibia with a weak apical posterodorsal bristle; proboscis longer, at least equal in length to height of eye; processes narrower distad, not wider than breadth of mid femur near apex 18

18. Parafacials slightly narrower ventrad, at narrowest not equal to width of third antennal segment; processes with a short series of blackish spines which are more robust than apical setæ on hind metatarsus. *hedleya* n. sp.

Parafacials slightly wider ventrad, at narrowest wider than breadth of third antennal segment; processes armed with spinules which are not coarser than apical setæ on hind metatarsus ...... *marginella* Mall.

19. Eyes separated by a distance not exceeding that between posterior ocelli exclusive, interfrontalia at narrowest not wider than diameter of anterior ocellus; cheeks scarcely as high as length of third antennal segment; vibrissal margin armed with fine slender bristles; proboscis slender; *m-cu* cross vein narrowly sigmoid; processes with a conspicuous fringe of fine hairs on inner margin, which become notably long on distal half and are directed mesad and basad. *marginata* Stein

Eyes separated by a distance slightly greater than that between posterior ocelli exclusive, interfrontalia at narrowest much wider than diameter of anterior ocellus; vibrissal margin armed with coarse stout bristles; proboscis not slender; *m-cu* cross vein broadly sigmoid; cheeks as high as length of third antennal segment 20

20. Process short and stout, about twice as long as average width, clothed with numerous long bristles, many of which are longer than process; apex of veins R_{4+5} and M_{1+2} not divergent at wing margin. *robusta* Stein

Processes elongate and narrower distad, about three times as long as average width, armed with few bristles that are longer than process; apex of veins R_{4+5} and M_{1+2} divergent at wing margin. *formiceps* n. sp.

FEMALES

1. Hind tibia with a robust apical posteroventral bristle 2

Hind tibia with apical posteroventral bristle weakly developed or setulose 9

2. Hind tibia with a robust apical posterodorsal bristle 3

Hind tibia with apical posterodorsal bristle weaker developed, usually not longer than width of tibia at apex 6

3. Shortest distance from base of oral vibrissæ to eye margin equal to half height of eye; narrowest width of parafacials slightly greater than breadth of third antennal segment; aristal hairs usually not longer than basal diameter of arista .... *varicolor* (Meig.)
piloseta Mall.
acuticauda n. sp.

Shortest distance from base of oral vibrissæ to eye margin usually less than half height of eye; narrowest width of parafacials usually not greater than breadth of third antennal segment 4

4. Proboscis laterally compressed and moderately slender 5

Proboscis not laterally compressed nor proportionately slender; fore tibia with apical posterodorsal bristle well developed. *fibulans* n. sp.

5. Oral margin of face flexed forward rather abruptly, extending slightly cephalad of a vertical line drawn from base of antennæ; veins $R._{4+5}$ and $M._{1+2}$ and *r-m* cross vein largely brownish; aristal hairs usually not longer than basal diameter of arista .... *trifurcata* n. sp.

Oral margin not noticeably curved forward, not extending cephalad of a vertical line drawn from base of antennæ; veins $R._{4+5}$ and $M._{1+2}$ and *r-m* cross vein largely yellowish; aristal hairs usually slightly longer than basal diameter of arista .... *inornata* Stein

6. Aristal hairs at least as long as half width of third antennal segment, longer than setulæ on first antennal segment; length of proboscis from base of palpi to apex slightly longer than twice length of palpus; oral margin of face curved abruptly cephalad. *subspinata* n. sp.

Aristal hairs not as long as half width of third antennal segment; proboscis not longer than twice length of palpus 7

7. Wing membrane extensively yellowish tinged, veins largely yellowish; abdomen densely pale gray or yellowish gray pruinescent 8

Wing membrane not extensively yellowish tinged exclusive of basal region, veins largely brownish; mid femur with one or two bristles on median third of anteroventral surface .... *marginella* Mall.

8. Cheeks about as high as distance across oral margin; abdomen with no dark dorsocentral streak .... *setigera* (Joh.)

Cheeks not as high as distance across oral margin; abdomen with a dark dorsocentral streak or stripe .... *inornata* Stein

9. Aristal hairs not as long as half width of third antennal segment 10

Aristal hairs at least as long as half width of third antennal segment, longer than setulæ of first antennal segment, if about equal facial elevation extensive and broadly separating the respective antennæ from one another, cf. *spinidens* Mall. 13

10. Proboscis compressed laterally, and moderately slender 11

Proboscis moderately short and thickened, not compressed laterally. *fibulans* n. sp.

11. Wing membrane and veins extensively yellowish tinged; abdomen densely pale gray or yellowish pruinescent 8

Wing membrane not extensively yellowish tinged exclusive of basal region; veins largely brownish; mid femur with one or two bristles on middle third of anteroventral surface 12

12. Parafacials slightly wider ventrad, at narrowest wider than breadth of third antennal segment; discal area of fifth abdominal tergum devoid of bristlelike setæ laterad; costal thorn robust. *marginella* Mall.

Parafacials slightly narrower ventrad, at narrowest not equal to width of third antennal segment; discal area of fifth abdominal tergum with several erect bristlelike setæ laterad; costal thorn not robust. *hedleya* n. sp.

13. Proboscis longer than height of head; vibrissal angle prominently projected cephalad; oral margin flexed forward cephalad of apices of antennæ; length of head at greatest diameter exceeding height, interfrontalia at narrowest width scarcely broader than parafrontal at same plane; hairs of arista slightly longer than width of third antennal segment .... *brevipalpis* Huck.

Not so in all characters 14

14. Proboscis proportionately short and stoutish, not longer than length of face from oral margin to lunule; cheeks fully as high as length of third antennal segment, nearly equal to half height of eye. *formiceps* n. sp.

Proboscis moderately slender, longer than height of face; cheeks scarcely as high as length of third antennal segment, shorter than half height of eye 15

15. Facial elevation very pronounced, widely separating antennæ throughout their length; vibrissal angle notably projected, distance from oral margin to eye margin equal to length of second and third antennal segments .... *spinidens* Mall.

Facial elevation less pronounced, antennæ not widely separated, distance from oral margin to eye margin less than length of second and third antennal segments 16

16. Aristal pubescence featured by alternately arranged long and short hairs, the longest equal to width of third antennal segment; cheeks seldom higher than one third height of eye .... *marginata* Stein

Aristal pubescence more uniformly developed; longest hairs not equal to width of third antennal segment; cheeks usually slightly higher than one third height of eye .... *spiniventris* Coq.

Hylemyia (*Botanophila*) *spiniventris* (Coquillett)

Hylemyia spiniventris Coquillett, 1900, Proc. Wash. Acad. Sci., 2: 449. Aldrich, 1905, Misc. Coll. Smithsn. Inst., 46: 553. Malloch, 1918, Trans. Amer. Ent. Soc., 44: 311. Stein, 1919, Arch. f. Naturgesch., (1917) 83, Abt. A, heft 1, p. 151. Stein, 1920, Arch. f. Naturgesch., (1918) 84, Abt. A, heft 9, p. 75, 83. Malloch, 1920, Ohio Jour. Sci., 20: 274. Séguy, 1937, Gen. Insect., Fasc. 205, p. 114. Strickland, 1938, Can. Jour. Res., Sect. D, 16: 211.

Hylemyia spinilamellata Stein, 1904, Ann. Nat. Hist. Mus. Hungar., 2: 476.

The male of *spiniventris* possesses an extensive series of robust spines along nearly the entire length of processes of fifth abdominal sternum. The tips of many of the spines, when not broken off, terminate in filaments. The aristal hairs in both sexes seem to vary in length within the species, the longer hairs being scarcely to distinctly longer than setulæ on first antennal segment. There is also considerable variation in the degree to which the apical posteroventral bristle of hind tibia may be developed. The species is allied to *marginata* and *subspinata* in habitus.

ALASKA: ♂, ♀, Popoff Island, July 10, 1899 (T. Kincaid), types, ♀, Hurricane, July 11, 1921, 2 ♀ Seward, July 24–25, 1921 (J. M. Aldrich) [U. S. N. M.].

ALBERTA: ♂, Nordegg, July 21, 1926, ♀, Jasper, July 23, 1938, ♀, Waterton, June 19, 1923 (E. H. Strickland) [Univ. Alberta]. ♂, ♀, Lake Louise, Banff, July 27, 1917 [Mus. National d'Hist. Nat.].

BRITISH COLUMBIA: ♂, Hedley, July 4, 1923 (C. B. D. Garrett).

CALIFORNIA: 4 ♂, Mammoth Lakes, July 29, 1940 (R. H. Beamer [Univ. Kansas]. ♂, Tuolumne Meadows, Yosemite Park, July 4, 1927 (J. M. Aldrich) [U. S. N. M.]. 2 ♂, ♀, Siberian Outpost, Tulare County, 9500–10500 ft., July 31, 1915.

COLORADO: 2 ♂, ♀, Tennessee Pass, 10240 ft., July 16–17, 1930, (J. M. Aldrich) [U. S. N. M.]. ♂, Pingree Park, Aug. 16–21, 1925 (C. L. Fluke), 2 ♀, Cuchara, 9000 ft., Aug. 7, 1940 (F. M. Snyder), 2 ♀, Lake City, 8700 ft., Aug. 8–15, 1936 (C. L. Fluke) [F. M. Snyder]. 3 ♂, ♀, Summit, Gore Mts., Toponas, July 10, 1927 (J. C. Bradley) [C. U.]. ♂, Science Lodge, 9500 ft., July 19, 1932 (M. T. James) [Colo. State Coll.]. ♂, Gothic, 9500 ft., July 5, 1934 (C. P. Alexander) [Mass. State Coll.].

IDAHO: ♀, Salmon River, Aug. 25, 1927 (G. Cady) [Univ. Kansas].

MONTANA: ♀, Crazy Mts., 8800 ft., Aug. 8, 1916, 2 ♀, Beaver Creek, 6300 ft., Aug. 1913 (S. J. Hunter), ♀, Bighorn Mts., Aug. 20, 1926 (G. Cady) [Univ. Kansas].

NEW MEXICO: 2 ♂, ♀, Top of Las Vegas Range, June 28, 1902 (Cockerell) [U. S. N. M.]. ♀, Red River, Aug. 14, 1940 (F. M. Snyder).

OREGON: 3 ♂, Aneroid Lake, Blue Mts., 7500 ft., July 23, 1929,

♀, Cornucopia, Lookout Trail, 5900 ft., July 24, 1936, ♀, Anthony Lake, Blue Mts., 7500 ft., July 23, 1929 (H. A. Scullen) [Ore. State Coll.].

UTAH: ♂, Park City to Silver Lake, Sept. 11, 1917 (R. C. Shannon). ♂, Spanish Fork, July 11, 1935. ♀, Tryol Lake, Uintah Mts., ♀, Mirror Lake, Uintah Mts., (D. E. Hardy). ♀, Blue Lake, La Sal Mts., 9500 ft. (V. M. Tanner). ♂, Heber, July 23, 1939 (G. F. Knowlton) [Utah State Coll.].

WASHINGTON: ♀, Mt. Rainier, White River, July 19, 1924 (A. L. Melander).

WYOMING: 18 ♂, 8 ♀, Yellowstone Park, Apollinaris, July 8, 1923, ♂, Yellowstone Park, Indian Creek, July 8, 1923, ♀, Yellowstone Park, 6 mi. So. Thumb, July 17, 1923 (A. L. Melander) [A. L. Melander]. 5 ♂, ♀, Yellowstone Park, Sylvan Pass, Aug. 17, 1927 (J. M. Aldrich) [U. S. N. M.]. ♀, Yellowstone Park, Lower Geyser Basin, ♂, Yellowstone Park, Lewis Lake, (V. M. Tanner). 3 ♂, 2 ♀, Univ. Wyoming Campus, Aug. 15, 1938 (M. T. James) [Colo. State Coll.].

Hylemyia (Botanophila) subspinata new species

MALE, blackish; thorax with three ribbonlike blackish vittæ, more distinct on presutural region; abdomen with broad subtriangular marks and incisures on terga 1 to 4, the fifth largely infuscated; halteres yellowish, calyptræ slightly so, wings blackish basad, and extensively tinged.

Interfrontalia complete to ocellar callosity, broadly so in type; parafacials as wide as breadth of third antennal segment, width well maintained ventrad; cheeks slightly higher than width of parafacials; aristal hairs about as long as half width of third antennal segment, fully as long as setulæ on first antennal segment; proboscis slender, palpi about half as long as proboscis; processes of fifth abdominal sternum with a series of strong spines from basal to preapical region, length of longest not exceeding width of hind femur at middle, outer bristles extending to basal region of processes; copulatory appendages as in Figures 10, 12, 33. Bristling of legs as in *spiniventris;* mid tibia usually with more than one anterodorsal bristle; hind tibia with apical posterodorsal bristle usually weak, apical posteroventral bristle setulose or weakly developed.

FEMALE, paler than male, similar to female of *spiniventris,* from which it differs in possessing less dense pruinescence.

Length 7–8.5 mm.

Holotype and allotype: ♂, ♀, Siberian Outpost, Tulare County, California, 9500–10500 ft., July 31, 1915, [U. S. N. M.]. Paratypes: ♂, same data as holotype. ♂, Mammoth Lakes, California, July 29, 1940 (R. H. Beamer), ♂, ♀, Beaver Creek, Montana, 6300 ft., August, 1913 (S. J. Hunter) [Univ. Kansas]. ♂, Tuolumne Meadows, Yosemite Park, California, July 4, 1927 (J. M. Aldrich) [U. S. N. M.].

The species *subspinata* is closely allied to *spiniventris*, from which it differs in the male by the shorter spines arming the processes, and by the different structure of the copulatory appendages (Figs. 10, 33, 40). In the female the abdomen is less densely pruinescent than in *spiniventris*, and apical posteroventral bristle on hind tibia may be stronger developed.

Hylemyia (*Botanophila*) *inornata* (Stein)

Hylemyia inornata Stein, 1898, Berl. Ent. Zeitschr., (1897) 42, heft 3 & 4, p. 220. Aldrich, 1905, Misc. Coll. Smithsn. Inst., 46: 552. Stein, 1919, Arch. f. Naturgesch., (1917) 83, Abt. A, heft 1, p. 151. Stein, 1920, Arch. f. Naturgesch., (1918) 84, Abt. A, heft 9, p. 75. Huckett, 1924, N. Y. (Cornell) Agr. Exp. Sta., Mem. 77 (1923), p. 28. Johnson, 1925, Occ. Pap. Boston Soc. Nat. Hist., 7: 234. Johnson, 1927, Insect Fauna, Biol. Surv. Mt. Desert Region, p. 210. Leonard, 1928, N. Y. (Cornell) Agr. Exp. Sta., Mem. 101, p. 838. Séguy, 1937, Gen. Insect., Fasc. 205, p. 97.

The species *inornata* and *setigera* may invariably be distinguished from others in the group by the brighter yellowish tinge exhibited by the wings. In *inornata* the processes of the male are stouter than those of *setigera*, and the spines are more coarsely developed, conforming in these respects to *varicolor*. In the female of *inornata* the cheeks are usually narrower than in *setigera*, and the abdomen usually has a dark dorsocentral streak, which is lacking in *setigera*. Females of *inornata* differ typically from those of *trifurcata* by the broader interfrontalia and slightly longer aristal hairs.

ALBERTA: ♀, Banff, June 23, 1922 (C. B. D. Garrett) [C. N. C.].

GEORGIA: 2 ♂, Clayton, April 15–22, 1940 (H. C. Huckett).

MARYLAND: ♂, Beltsville, May 28, 1916 (W. L. McAtee).

MASSACHUSETTS: ♂, New Bedford, May 24, 1896 (Hough) type [Chicago Nat. Hist. Mus.].

New York: 2 ♂, Whiteface Mt., Adirondacks, 3800 ft., July 4, 1921 (J. M. Aldrich) [U. S. N. M.]. ♂, Top Mt. Marcy, Adirondacks, July 13, 1928. ♀, Ithaca, May 28, 1922, ♀, 6-mile Creek, Ithaca, May 27, 1922, ♀, Coy Glen, Ithaca, May 23, 1922, ♂, ♀, Southold, Long Island, June 13, 1926 (H. C. Huckett).

Hylemyia (*Botanophila*) *spinidens* (Malloch)

Hylemyia spinilamellata Malloch, 1918, Trans. Amer. Ent. Soc., 44: 312. Frison, 1927, Bull. Ill. Nat. Hist. Surv., 16, Art. 4, p. 203.

Hylemyia nigribasis Stein, p. p., 1920, Arch. f. Naturgesch., (1918) 84, Abt. A, heft 9, p. 78.

Hylemyia spinidens Malloch, 1920, Trans. Amer. Ent. Soc., 46: 194. Ringdahl, 1930, Ark. Zool., 21A, heft 20, p. 5. Séguy, 1937, Gen. Insect., Fasc. 205, p. 114.

The species *spinidens* is notable on account of the pronounced facial elevation arising between the antennæ, and for the marked protruded development of the vibrissal region. These characters serve to distinguish the species from other forms which by other means are less readily separated. The processes in the male are comparatively narrow in profile, and the spines are grouped basad (Fig. 42). In habitus the species may be associated with *spiniventris* and *marginata*, from which it differs as indicated in keys.

I have seen the Marshall Pass series of specimens deposited in the collections of the Zoological Museum of the University of Berlin, on which Stein based his description of *nigribasis*. In the material were seven males belonging to *spinidens* and six belonging to *marginella*.

Alaska: 5 ♂, Kodiak, June, 1917, ♂, Snug Harbor, June 8, 1919 (J. S. Hine).

Alberta: ♂, 2 ♀, Waterton, July 12, 1923 (H. L. Seamans), ♂, ♀, Banff, July 20, 1922 (C. B. D. Garrett) [C. N. C.]. ♀, Moraine, Aug. 17, 1927 (E. H. Strickland).

British Columbia: ♂, Lillooet, June 25, 1917 (J. D. Tothill), ♂, Atlin (E. M. Anderson), ♂, Hedley, July 3, 1923 (C. B. D. Garrett), ♂, Glacier, Aug. 21, 1902, ♂, Mt. McLaine, July 12, 1926 (E. R. Buckell), ♂, ♀, Revelstoke Mt., 6000 ft., Aug. 12, 1923 (P. N. Vroom), ♂, Mt. Cheam, Aug. 7, — (Fletcher) [C. N. C.].

5 ♂, London Hill Mine, Bear Lake, 7000 ft., July 21, 1903, 3 ♀, Kokanee Mt., 8000 ft., Aug. 10, 1903 (R. P. Currie), ♀, Kaslo, Aug. 16, — (A. N. Caudell) [U. S. N. M.].

California: ♂, Bishop, July 28, 1940 (L. J. Lipovsky) [Univ. Kansas]. 4 ♂, Tuolumne Meadows, Yosemite Park, July 4, 1927 (J. M. Aldrich) [U. S. N. M.]. 2 ♂, ♀, Huntington Lake, Fresno County, 7000 ft., July 7, 1919 (E. P. Van Duzee).

Colorado: 2 ♀, Cameron Pass, 9500 ft., Aug. 18–21, 1940 (G. F. Knowlton), ♂, ♀, Cuchara, 10–12000 ft., Aug. 7–8, 1940 (F. M. Snyder), ♀, Pingree Park, 9000 ft., Aug. 20, 1935 (R. Bushnell) [F. M. Snyder]. ♀, Tennessee Pass, 10240 ft., July 17, 1930 (J. M. Aldrich), ♂, Platte Canyon, near Idlewild, June 10, 1927, 2 ♀, Berthoud Pass, Sept., 1926 (T. D. A. Cockerell) [U. S. N. M.]. ♂, Loch Vale, Rocky Mountain National Park, July 16, 1940 (M. E. Smith), ♀, Red Mt., 11000 ft., July 22, 1934 (C. P. Alexander) [Mass. State Coll.].

Idaho: ♀, Hoodoo Meadows, Aug. 11, 1938 (W. P. Nye).

Montana: ♂, 3 ♀, Gallatin County, 6500 ft., July 15, 1913, ♂, Summit Station, 5200 ft., July 25, — (J. M. Aldrich) [U. S. N. M.]. ♂, Beaver Creek, 6300 ft., Aug., 1913 (S. J. Hunter) [Univ. Kansas].

New Mexico: ♂, Top of Las Vegas Range, June 28, 1902. ♀, Beulah, June 28, 1902, paratype [A. N. S. P.].

Nevada: 3 ♂, Ormsby County, July 6, — (Baker) [U. S. N. M.].

Oregon: 2 ♂, 3 ♀, Aneroid Lake, Blue Mts., 7500 ft., July 23–24, 1929, ♀, Horseshoe Lake, Blue Mts., 7500 ft., July 26, 1929, 2 ♀, Crater Lake Park, Sun Creek Meadows, 6500–7000 ft., Sept. 3, 1930, ♀, Sparks Lake, Deschutes County, 5428 ft., Aug. 8, 1935, ♂, ♀, Frog Camp to White Bridge Meadow, near McKenzie Pass, 4700–5675 ft., Aug. 6, 1935 (H. A. Scullen) [Ore. State Coll.]. 2 ♂, Lost Lake, Wallowa County, 6000 ft., Aug. 3, 1941, 4 ♂, 2 ♀, Hat Point, Wallowa County, 7000 ft., Aug. 4, 1941 (M. & R. Rieder).

Utah: ♂, Mt. Logan, June 24, 1938 (G. F. Knowlton, R. E. Nye), ♀, Blacksmith Fork Canyon, Sept. 4, 1938 (W. P. Nye) [Utah State Coll.].

Washington: ♀, Mt. Baker, Skyline Ridge, Aug. 10, 1925, 2 ♂, ♀, Mt. Rainier, Narada Falls, Aug. 16, 1917, ♂, ♀, Mt. Rainier, White River, July 20, 1924 (A. L. Melander) [U. S. N. M.]. ♂, Mt. Rainier, Yakima Park, July 25, 1932, ♂, Mt. Rainier, Silver Springs Camp, July 17, 1932 (C. H. & D. Martin), 2 ♂, ♀, Mt. Rainier, Sunrise Trail, 6380 ft., July 27, 1932 (J. & I. Wilcox).

WYOMING: 2 ♂, Yellowstone Park, 4 mi. So. Thumb, July 17, 1923, ♂, Yellowstone Park, Clematis Creek, Aug. 9, 1923, 4 ♀, Yellowstone Park, Apollinaris, Aug. 8, 1923, ♀, Yellowstone Park, Spring Creek, July 15, 1923 (A. L. Melander) [A. L. Melander]. 2 ♂, ♀, Yellowstone Park, Sylvan Pass, Aug. 17, 1927 (J. M. Aldrich) [U. S. N. M.]. ♂, Yellowstone Park, Lake Hotel, 2 ♀, Yellowstone Park, Black Sands Basin, (V. M. Tanner). ♂, Yellowstone National Park, June 28, 1912 (R. C. Osburn).

Hylemyia (Botanophila) trifurcata new species

MALE, blackish; mesonotum with three bandlike stripes and broadly infuscated along declivities, scutellum blackish; abdomen with large subtriangular truncated marks, which successively become larger and less well defined caudad, anterior incisures well formed; chitin at base of processes more or less reddish tinged; wings more or less grayish, more densely so basad; halteres yellow, calyptræ and calyptral hairs yellowish.

Eyes separated by not more than distance between posterior ocelli, interfrontalia uninterrupted to ocellar callosity, reduced to lineal dimensions caudad; parafacials and cheeks not broadly formed, at narrowest not as wide as breadth of third antennal segment; bristles on parafrontals, cheeks and vibrissal angles slender; aristals hairs not longer than basal diameter of arista; proboscis slender. Processes broad and stout, armed with several longish bristles on the greater part of outer surface, with a submarginal series of shortish coarse spines on proximal half; copulatory appendages as in Figures 9, 30. Legs bristled as in *varicolor*. Cross vein *m-cu* at most slightly sinuate. Length 7 mm.

FEMALE, paler than male, more densely grayish pruinescent on thorax and abdomen, markings less distinctly apparent; wings yellowish tinged; *m-cu* cross vein more erect and costal setulæ slightly stronger than in male. Length 6 mm.

Holotype and allotype: ♂, ♀, Nahcotta, Washington, May 24, 1917 (A. L. Melander) [U. S. N. M.].

The species *trifurcata* superficially resembles *varicolor*. The males differ essentially in the structure of the cerci and genitalic appendages. In the female of *trifurcata* the parafacials and vibrissal region of the head are usually of smaller proportions than in *varicolor*.

Alberta: ♂, Banff, July 20, 1922 (C. B. D. Garrett) [C. N. C.].

California: ♂, ♀, Humboldt County, May 10, 1911 (Oldenberg).

Idaho: ♀, Mt. Moscow, summit, July 1, 1932 (J. M. Aldrich) [U. S. N. M.].

Oregon: 2 ♂, Bellfouatain, May 27, 1922 (A. L. Lovett). 2 ♂, Waldport, June 7, 1942 (R. E. Rieder). ♂, Detroit, Marion County, May 24, 1942. ♀, 30 mi. W. of Prineville, June 27, 1935 (Joe Schuh) [Ore. State Coll.]. ♂, Eagle Creek, Forest Reserve, July 1, 1917 (A. L. Melander) [A. L. M.].

Utah: 4 ♂, Salt Lake, 6–7000 ft., June 24, 1922 (A. L. Lovett).

Washington: ♂, Nahcotta, May 24, 1917 (A. L. Melander) [A. L. M.]. 2 ♂, Mt. Spokane, July 2, 1930 (J. M. Aldrich) [U. S. N. M.]. 2 ♂, Mt. Rainier, Sunrise Trail, 6400 ft., July 29, 1933, ♂, Mt. Rainier, Shadow Lake, 6500 ft., Aug. 15, 1932, ♂, Rainier National Forest, Sawmill Flat, May 31, 1935, ♂, Puyallup, June 4, 1933 (J. Wilcox), ♂, Olympia, May 8, 1935 (W. W. Baker).

Hylemyia (*Botanophila*) *varicolor* (Meigen)

Anthomyia varicolor Meigen, 1826, Syst. Beschr., 5: 167.

Chortophila varicolor Macquart, 1835, Hist. Nat. d. Ins., Dipt., 2: 325. Villeneuve, 1899, Ann. Soc. Ent. France, 68: 83. Stein, 1900, Ent. Nachr., 26: 156. Pandellé, 1900, Rev. ent. France, 19: 262. Stein, 1920, Arch. f. Naturgesch., (1918) 84, Abt. A, heft 9, p. 86, 93. Collin, 1927, Ent. Month. Mag. 63: 130.

Aricia trapezina Zetterstedt, 1845, Dipt. Scand., 4: 1513.

Aricia odontogaster Zetterstedt, 1845, Dipt. Scand., 4: 1519.

Anthomyia trapezina Schiner, 1862, Faun. Austr., 1: 638.

Botanophila varicolor Lioy, 1864, Atti Inst. Veneto, 9, ser. 3, p. 990.

Chortophila impudica Rondani, 1866, Atti Soc. Milano, 9: 173. Rondani, 1877, Dipt. Ital., Prodr., 6: 323. Meade, 1882, Ent. Month. Mag., 19: 146. Meunier, 1893, Bull. Soc. Ent. France, 62, p. LXV.

Chortophila trapezina Meade, 1882, Ent. Month. Mag., 19: 147. Meade, 1887, Ent. Month. Mag., 24: 54. Strobl, 1893, Verh.

K. K. zool.-bot. Ges. Wien, 43: 254. Meade, 1897, Descr. List Brit. Anth., 2: 45. Wingate, 1906, Trans. Nat. Hist. Soc. Northumb., 2: 273. Stein, 1907, Kat. Paläark. Dipt., 3: 724.

Hylemyia (*Pegohylemyia*) *varicolor* Schnabl and Dziedzicki, 1911, Abh. K. Leop.-Carol. Deutsch. Akad. Naturforsch., 95, Nr. 2, p. 99.

Hylemyia varicolor Stein, 1916, Arch. f. Naturgesch., (1915) 81, Abt. A, heft 10, p. 155. Séguy, 1925, Encycl. Ent., B. Dipt., 2: 102. Ringdahl, 1928, Trømso Museums Årshefter, (1926) 49, heft 3, p. 39. Ringdahl, 1939, Opusc. Entomol., 4, heft 3–4, p. 150, 152.

Chortophila (*Egeria*) *varicolor* Karl, 1928, Tierwelt Deutschlands, 3, Pt. 13, p. 155.

Hylemyia (*Euryparia*) *varicolor* Ringdahl, 1929, Ent. Tidskr., 51: 269. Ringdahl, 1931, K. Svensk. Vetenskapsakad. Skrift Naturskyddsärenden, Nr. 18, p. 19. Tiensuu, 1935, Acta Soc. Faun. Flor. Fenn., 58: 19.

The species *varicolor*, as it occurs in North America, is one of three very closely allied forms, which may be distinguished from one another by differences in the structure of the copulatory appendages as given in the key to males and as illustrated in Figures 6, 15, 25. The females apparently do not possess any marked distinctive characters. Those belonging to *varicolor* have the abdomen more densely brownish yellow pruinescent as compared to the darker blackish caste in *piloseta* and *acuticauda*. In addition the wings are paler tinged and the palpi are slightly shorter and less slender. The females of *piloseta* and *acuticauda* are usually more robust, particularly in the bristling of the legs.

Stein (1920) based his record of the species in North America on specimens collected at Juliaetta, Idaho, and on the Sierra Morena Mountains in California. Through the courtesy of Doctor Muesebeck at the United States National Museum I was able to reexamine two males from the Juliaetta series which had been mislaid on the occasion of my study of the Stein collection at Berlin. These specimens, in my opinion, are not conspecific with the male from California, deposited in the Zoological Museums of the University of Berlin. In both cases Stein had written the name *trapezina* Zett. on labels attached to specimens for purposes of recognition.

ALBERTA: 2 ♂, ♀, Banff, June 21–23, 1922, 2 ♂, same locality, June 26, 1922 (C. B. D. Garrett) [C. N. C.].

BRITISH COLUMBIA: ♂, Okanagan Lake, April 23, 1914 (Tom Wilson).

IDAHO: 2 ♂, Juliaetta, May 3, 1901 (J. M. Aldrich) [U. S. N. M.].

WASHINGTON: ♀, Spanaway, May 9, 1935 (J. Wilcox). ♀, Almota, May 20, 1923 (A. L. Melander) [A. L. M.].

Hylemyia (*Botanophila*) *piloseta* (Malloch)

Hylemyia piloseta Malloch, 1918, Trans. Amer. Ent. Soc., 44: 313. Cole and Lovett, 1921, Proc. Cal. Acad. Sci., 11: 312. Frison, 1927, Bull. Ill. Nat. Hist. Surv., 16, Art. 4, p. 202. Séguy, 1937, Gen. Insect., Fasc. 205, p. 107.

The male of *piloseta* possesses a sharp tooth-like process on the inner margin of outer digit of gonostylus (inferior forceps) as illustrated in Figure 3. The drawings of *piloseta* were made from Malloch's paratype deposited in the collections of the Illinois Natural History Survey. The hypopygium had been cleared and preserved in alcohol, and was kindly forwarded by Doctor Ross for purposes of comparative study.

CALIFORNIA: ♂, San Francisco, March 16, 1913 (Bridwell) [U. S. N. M.]. ♂, Del Norte County, May 26, 1910 (Oldenberg), ♀, Marin County, April 4, 1909.

COLORADO: ♂, Tennessee Pass, 10240 ft., July 7, 1930 (J. M. Aldrich) [U. S. N. M.].

OREGON: ♂, Marys Peak, Benton County, June 28, 1942 (R. E. Rieder), ♀, Salem, May 2, 1924 (Ore. Exp. Sta.), ♀, Corvallis, April 18, 1935 (G. Ferguson), ♀, Alsea Mount, May 9, 1931 (J. Wilcox). ♂, Corvallis, April 26, 1908, holotype, ♂, St. Mary's River, no date (Webster), paratype [Ill. Nat. Hist. Surv.].

WYOMING: ♂, ♀, Yellowstone Pass, Clematis Creek, July 8, 1923 (A. L. Melander) [A. L. M.].

Hylemyia (Botanophila) acuticauda new species

MALE, blackish, with whitish gray pruinescence; mesonotum with three blackish vittæ, lateral declivities and scutellum considerably infuscated; proboscis subshining; abdominal terga with well formed, rather narrow subtriangular marks, and anterior incisures; wings densely tinged basad, otherwise with little trace of infuscation; halteres yellow, calyptræ slightly yellowish tinged.

Eyes separated by a distance equal to that between posterior ocelli inclusive, interfrontalia uninterrupted to ocellar triangle, broader than parafrontal at plane of measurement; cheeks and parafacials usually slightly wider than breadth of third antennal segment; processes of fifth abdominal sternum broad and stout, with short coarse spines stronger developed than apical setæ on hind metatarsus; cerci (superior forceps) extending angularly cephalad (dorsad), apex sharply formed; inner margin of outer digit or extension of gonostylus (inferior forceps) armed with a diminutive bluntish process, Figures 7, 17. Fore tibia with 1 or 2 medial anterodorsal and posteroventral bristles; mid femur with 2 or 3 bristles on proximal half of anteroventral surface, mid tibia with 1 weak medial anteroventral, 2 anterodorsal, 3 posterodorsal and 3 or 4 weaker posterior bristles; hind femur with a series of bristles on entire anteroventral surface and on proximal half of posteroventral surface, those on proximal region more robust and less curved than those on distal region, hind tibia with 3 anteroventral and 4 or more bristles on anterodorsal and on posterodorsal surfaces, with a few setulæ on proximal half of posteroventral surface, apical posterodorsal and posteroventral bristles robust.

FEMALE, paler than male, thorax more densely cinereous pruinescent, markings less distinct and largely restricted to a brownish median stripe; abdomen subshining with silky grayish pruinescence; wings yellowish or light brownish tinged. Legs bristled as in male; mid femur with 3 or more strongish bristles on anteroventral surface; hind femur with bristles less robust than in male, hind tibia devoid of posteroventral setulæ.

Length 7–8 mm.

Holotype and allotype: ♂, ♀, Rainier National Forest, Sawmill Flat, Washington, May 26, 1935 (J. Wilcox) [U. S. N. M.].

The males of *acuticauda* may be distinguished from associated forms by the angular extension of the cerci cephalad (dorsad), and in addition the gonostylus (inferior forceps) lacks the sharp tooth-like process on inner margin of outer digit exhibited by *piloseta*, Figure 3. These differences though small and seemingly inconsequential for diagnostic purposes have been found to be surprisingly constant in twenty-four males of the *varicolor* complex that have been examined.*

ALBERTA: ♂, ♀, Waterton, June 19, 1923 (E. H. Strickland) [Univ. Alberta].

* I am deeply indebted to Dr. C. H. Curran for preparing these specimens for study of the terminal appendages of the hypopygium.

British Columbia: ♂, Lillooet, June 23, 1917 (J. D. Tothill), 2 ♀, Chilcotin, June 18, 1920, ♀, Vernon, May 20, 1925 (E. R. Buckell), 2 ♀, Hedley, 7000 ft., July 23, 1923 (C. B. D. Garrett) [C. N. C.].

California: ♂, Fallen Leaf Lake, June 21, 1915 (A. K. Fisher), 3 ♂, Tuolumne Meadows, Yosemite Park, July 4–5, 1927 (J. M. Aldrich) [U. S. N. M.].

Colorado: 2 ♂, 4 ♀, Grand Mesa, July 7–8, 1938 (U. Lanham) [Univ. Colo. Mus.]. ♂, Steamboat Springs, May 27, — (Cockerell), ♀, Pingree Park, Aug. 20, 1923 (A. L. Lovett), ♀, Elk Creek, Fraser, Grand County, July 7–9, 1927 (J. C. Bradley), 2 ♀, Tennessee Pass, July 24–26, 1917 (J. M. Aldrich) [U. S. N. M.].

Montana: ♀, Gallatin County, 6800 ft., June 27, 1900 (R. Cooley), ♀, Florence, June 1, 1912 (Mont. Exp. Sta.).

New Mexico: ♂, Jemez Springs, June, 1928 (J. Woodgate). ♂, Jemez Mts., June 28, 1874.

Oregon: ♀, The Dalles, April 30, 1938, 2 ♀, Mosier, May 5, 1938 (K. Gray, J. Schuh), ♀, Meacham, 3680 ft., May 8, 1927, ♀, Aneroid Lake, Blue Mts., 7500 ft., July 23, 1929 (H. A. Scullen) [Ore. State Coll.].

Saskatchewan: ♀ Cypress Hills, near Maple Creek, June 26, 1926 (C. R. Young) [C. N. C.].

Utah: ♀, Glendale, July 13, 1938 (G. F. Knowlton, F. C. Harmston).

Washington: 4 ♀, Rainier National Forest, Sawmill Flat, June 26, 1935 (J. Wilcox).

Wyoming: ♂, Yellowstone Park, 6 mi. So. Thumb, July 17, 1923, 2 ♀, Yellowstone Park, Thumb Sta., July 16, 1923 (A. L. Melander) [A. L. M.].

Hylemyia (*Botanophila*) *setigera* (Johannsen)

Hammomyia setigera Johannsen, 1916, Trans. Amer. Ent. Soc., 42: 387.

Hylephila setigera Johnson, 1925, Occ. Pap. Boston Soc. Nat. Hist., 7: 236.

Hylemyia setigera Huckett, 1924, N. Y. (Cornell) Agr. Exp. Sta., Mem. 77 (1923), p. 32. Leonard, 1928, N. Y. (Cornell) Agr.

Exp. Sta., Mem. 101 (1926), p. 839. Séguy, 1937, Gen. Insect., Fasc. 205, p. 113. Strickland, 1938, Can. Jour. Res., 16, Sect. D, p. 211. Brimley, 1938, Ins. North Carol., p. 376.

The species *setigera* and *marginella* are structurally closely allied. They differ superficially in that the wings of *setigera* are decidedly more yellowish tinged and the abdomen has paler marks than in *marginella*. The female of *setigera* may be confused with that of *inornata*, from which it differs structurally in the wider development of the cheeks.

ALBERTA: ♀, Bearberry Creek, near Sundre, July 23, 1926 (C. H. Young), ♀, Mtn. Vieu, June 20, 1923 (H. L. Seamans) [C. N. C.]. ♀, St. Paul, June 22, 1938, ♀, Gull Lake, June 14, 1929 (E. H. Strickland) [Univ. Alberta].

CONNECTICUT: ♂, Redding, May 31, 1931 (A. L. Melander) [A. L. M.].

MASSACHUSETTS: ♂, N. Amherst, May 30, 1922.

MICHIGAN: ♂, Lake County, June 8, 1940 (R. R. Dreisbach), ♀, Cusino, June 26–27, 1940 (T. F. Boyce).

MONTANA: ♀, Bozeman, 4800 ft., June 30, 1900 (E. Koch).

NEW HAMPSHIRE: ♀, Franconia (A. T. Slosson).

NEW YORK: ♂, Laborador Lake, Cortland County, June 9, 1921, ♂, Lake Charlotte, June 26, 1920, ♀, Herkimer, Aug. 8, 1921 (M. D. Leonard). ♂, Rock City, Cattaraugus County, June 9, 1915. ♂, Ithaca, May 23, 1936 (H. C. Hallock). 3 ♂, ♀, Taughanic, near Ithaca, May 8, 1921, ♀, Harman, May 7, 1926, ♂, Valley Stream, Long Island, April 27, 1921, 2 ♀, Lakeville, Long Island, May 22, 1921, ♂, Glen Head, Long Island, May 19, 1921, 2 ♂, 2 ♀, Hicksville, Long Island, June 3–12, 1944 (H. C. Huckett).

ONTARIO: ♂, Burke Falls, July 12, 1926 (F. P. Ide) [C. N. C.].

QUEBEC: ♂, Maniwaki, June 28, 1925 (C. H. Curran).

SASKATCHEWAN: ♂, Farewell Creek, S. Sask., July [C. N. C.].

SOUTH DAKOTA: 5 ♀, Custer, July 17, 1924.

WYOMING: ♂, near Lander, 5000–8000 ft., June (R. Moodie).

Hylemyia (Botanophila) fibulans new species

MALE, blackish; cheeks and parafacials densely pruinescent; thorax with trace of three vittæ and fuscous markings along lateral declivities of mesonotum; abdomen lightly grayish pruinescent, with large subtriangular marks and dark incisures along cephalic margin of terga; wings brownish tinged, deeply so basad; calyptræ yellowish tinged, halteres yellow.

Eyes separated by about distance between posterior ocelli; parafacials at narrowest about equal to width of third antennal segment; cheeks higher than maximum width of parafacials at base of antennæ, broadly maintained caudad, vibrissal angle not prominently developed; hairs of arista not longer than setulæ on first antennal segment; proboscis not flattish laterally, scarcely longer than length of eye at greatest diameter; processes of fifth abdominal sternum proportionately broad and large, with weak bristling except apicad, stronger spines stouter than setæ at apex of hind metatarsus, inner margin fringed with a series of minute spinules; cerci and gonostyli slender, the latter stylelike in form and not incised on apical region (Fig. 4). Mid femur with weak inconspicuous bristles on anteroventral surface; mid tibia with 1 anterodorsal, 2 posterodorsal and 2 posteroventral bristles; hind femoral bristles not notably strong, extending along entire length of anteroventral surface and on proximal two-thirds of posteroventral surface; hind tibia with 3 anteroventral, 4 anterodorsal, 4 posterodorsal bristles, and with 2 or 3 setulæ on proximal half of posteroventral surface, apical posterodorsal about as long as apical mid dorsal bristle and apical posteroventral bristle weak or lacking.

FEMALE, paler than male, more densely grayish pruinescent, thorax opaque, abdomen decidedly subshining with silky sheen, markings indefinite or absent; wings yellowish brown tinged. Fore tibia with a robust apical posterodorsal bristle, mid femur devoid of bristles on anteroventral surface, mid tibia with an anteroventral, 1 or 2 anterodorsal, 2 posterodorsal, and 2 or 3 weaker bristles on posterior and posteroventral surfaces; hind legs bristled as in male except that the posteroventral surface of hind tibia is devoid of setulæ and the apical posteroventral bristle may be well developed.

Length 9–10 mm.

Holotype: ♂, Mt. Moscow, Idaho, June 10, 1930 (J. M. Aldrich). Allotype: ♀, Marys Peak, Benton County, Oregon, June 28, 1942 (R. E. Rieder) [U. S. N. M.].

The species *fibulans* unlike the majority of forms belonging to the group has the proboscis shorter and laterally less flattened. In the male the gonostyli are peculiar in their simple style-like and unincised character: likewise the cerci are reduced to slender proportions for the greater part of their length (Fig. 4). The aristal hairs are only slightly longer than basal diameter of arista, as in *inornata* and *setigera*, but from both of these forms the male of *fibulans* may be readily separated by the brownish tinge of the wings. In the female this character is not so useful for separating the species.

ALBERTA: ♂, Banff, June 30, 1917 [C. N. C.].

IDAHO: ♂, Mts. Moscow, July 10, — (R. C. Shannon).

OREGON: 2 ♂, Aneroid Lake, Blue Mts., 7500 ft., July 23, 1929 (H. A. Scullen). ♀, Marys Peak, Benton County, June 28, 1942, ♀, Silver Creek Falls, Marion County, June 7, 1940 (R. E. Rieder) [Ore. State Coll.].

WYOMING: ♂, ♀, Yellowstone Park, Spring Creek, July 15, 1923 (A. L. Melander) [A. L. M.].

Hylemyia (Botanophila) hedleya new species

MALE, blackish, lightly grayish pruinescent; thorax with trace of vittæ; abdomen with broad subtriangular marks and anterior incisures; wings brownish tinged, blackish basad.

Eyes separated by a distance equal to that between posterior ocelli exclusive, interfrontalia complete to ocellar triangle, reduced to lineal dimensions caudad; parafacials and cheeks at narrowest scarcely as wide as third antennal segment; arista with hairs not as long as setulæ on first antennal segment; proboscis slender. Mid femur with a series of weak short bristles on proximal half of anteroventral surface; mid tibia with 1 anterodorsal, 2 posterodorsal and 2 posteroventral bristles, none of which are robust; hind femur with a full series of anteroventral bristles, the stronger of which are situated on distal half, and with 2 or 3 diverse slender posteroventral bristles; hind tibia with 2 or 3 anteroventral, 4 anterodorsal and 4 or 5 posterodorsal bristles, with 2 or 3 posteroventral setulæ, apical posterodorsal and posteroventral bristles weak. Processes of fifth abdominal sternum narrow, and with weak slender bristles on outer surface, armed with a single series of 3 or 4 spines on proximal half, the stronger of which are longer than apical setæ on hind metatarsus, inner margin of processes fringed with short hairs; wings with *m-cu* cross vein straight.

FEMALE, more densely grayish pruinescent than male; abdomen with silky pruinescence, subshining, markings indistinct; tergum 5 with several erect slender bristles laterad on discal surface; mid femur with 1 or 2 bristles on basal third of anteroventral surface, mid tibia with a medial anteroventral bristle; hind tibia devoid of setulæ on posteroventral surface, otherwise bristling of legs as in male; wings yellowish brown tinged, and with weak costal thorns.

Length 7–8 mm.

Holotype: ♂, Hedley, British Columbia, July 20, 1923 (C. B. D. Garrett). Allotype: ♀, Waterton, Alberta, June 19, 1939 (E. H. Strickland) [C. N. C.].

The species *hedleya* runs down with *marginella* in both keys on the strength of the short haired arista and absence of a robust bristle at apex of posterodorsal and posteroventral surfaces of hind tibia. The male of *hedleya* possesses stronger spines on processes, and in both sexes the parafacials and cheeks are not so broadly formed as in *marginella.*

Hylemyia (*Botanophila*) *marginella* (Malloch)

Hylemyia marginella Malloch, 1918, Trans. Amer. Ent. Soc., 44: 311. Frison, 1927, Bull. Ill. Nat. Hist. Surv., 16, Art. 4, p. 202. Séguy, 1937, Gen. Insect., Fasc. 205, p. 102.

Hylemyia nigribasis Stein, p. p., 1920, Arch. f. Naturgesch., (1918) 84, Abt. A, heft 9, p. 78.

The males of *marginella* may be distinguished from those of *varicolor* and related forms by the narrower proportions of the processes of fifth abdominal sternum and by the much weaker spines (Fig. 44). In these respects *marginella* agrees with *setigera,* but from the latter *marginella* may be distinguished by the darker brownish tinge exhibited by the wings. The females of *marginella* may invariably be separated from those of *varicolor* and related forms by the weaker developed apical posterodorsal bristle on hind tibia, a character that I find is not quite so dependable for purposes of distinction among males.

ALBERTA: ♂, Vermilion, June 23, 1938, ♂, Edmonton, July 13, 1929 (E. H. Strickland).

BRITISH COLUMBIA: ♂, Lillooet, June 25, 1917 (J. D. Tothill) [C. N. C.].

COLORADO: ♂, Tennessee Pass, July 24, 1917 (J. M. Aldrich) type [Ill. Nat. Hist. Surv.]. ♂, Marshall Pass, July 28, 1908 (J. M. Aldrich) [U. S. N. M.]. ♂, Cuchara, 12000 ft., Aug. 8, 1940 (F. M. Snyder), ♂, 3 ♀, Lake City, 9000 ft., Aug. 8–21, 1938 (C. L. Fluke), ♂, 4 ♀, Pingree Park, Aug. 15, 1932 [F. M. Snyder]. ♀, Ward, Aug. 14, 1939 (M. T. James) [Colo. State Coll.]. ♂, Spring Creek, Pass, June 29, 1937 (C. L. Johnston), 3 ♂, Slumgullion Pass, June 29, 1937 (R. H. Beamer) [Univ. Kansas]. ♂, Grant, Geneva Park, 10000 ft., Aug. 16, 1914 (E. C. Jackson).

MONTANA: ♀, Summit Station, 5200 ft., July 25, — (J. M. Aldrich) [U. S. N. M.].

NEW MEXICO: 2 ♂, Top of Las Vegas Range, Beulah, June 28, 1902, paratypes [A. N. S. P. & Ill. Nat. Hist. Surv.].

OREGON: ♂, Breitenbush Lake, Marion County, June 23, 1940

(R. E. Rieder), ♀, Lost Lake, Wallowa County, 6000 ft., Aug. 6, 1941 (M. & R. E. Rieder), ♂, Izee, Keerin's Ranch, June 25, 1935 (Joe Schuh), ♀, Strawberry Lake, Grant County, 6400 ft., July 17, 1936, ♀, Cornucopia, 7250 ft., July 24, 1936, ♀, Kelsey Valley G. Sta., Douglas County, 4100 ft., Aug. 17, 1935 (H. A. Scullen) [Ore. State Coll.].

WASHINGTON: ♀, Calfax (J. M. Aldrich) [U. S. N. M.]. ♂, Mt. Rainier, Paradise Park, Aug. 1917 (A. L. Melander) [A. L. M.]. 2 ♀, Mt. Rainier, Paradise Inn, July 20, 1930.

WYOMING: ♂, ♀, Yellowstone Park, Apollinaris, Aug. 8, 1923, ♂, Yellowstone Park, Clematis Creek, July 9, 1923, 2 ♀, Yellowstone Park, Spring Creek, July 15, 1923 (A. L. Melander) [A. L. M.].

Hylemyia (*Botanophila*) *brevipalpis* (Huckett)

Hylemyia brevipalpis Huckett, 1929, Can. Ent., 61: 180. Séguy, 1937, Gen. Insect., Fasc. 205, p. 80. Strickland, 1938, Can. Jour. Res., 16, Sect. D, p. 210.

The male of *brevipalpis* may be readily distinguished from all others in the group by the broad female-like frons. In both sexes the head is longer than high owing to the protuberance of the vibrissal angle and oral margin. The longest aristal hairs are equal to width of third antennal segment.

ALBERTA: 2 ♀, Waterton, Aug. 18, 1939 (E. H. Strickland) [Univ. Alberta].

BRITISH COLUMBIA: ♀, Mt. Cheam, Aug. 6, 1903.

WYOMING: ♂, ♀, Sylvan Pass, Yellowstone Pass, Aug. 17, 1927 (J. M. Aldrich) [U. S. N. M.].

Hylemyia (*Botanophila*) *marginata* (Stein)

Hylemyia marginata Stein, 1898, Berl. Ent. Zeitschr., (1897) 42, heft 3–4, p. 221. Coquillett, 1900, Proc. Wash. Acad. Sci., 2: 448. Aldrich, 1905, Misc. Coll. Smithsn. Inst., 46: 553. Stein, 1919, Arch. f. Naturgesch., (1917) 83, Abt. A, heft 1, p. 151. Stein, 1920, Arch. f. Naturgesch., (1918) 84, Abt. A, heft 9, p. 76. Malloch, 1920, Ohio Jour. Sci., 20: 274. Séguy, 1937, Gen. Insect., Fasc. 205, p. 102. Strickland 1938, Can. Jour. Res., 16, Sect. D, p. 211.

The species *marginata* comes closest to *spiniventris* in habitus. In the male of *marginata* the processes of fifth abdominal sternum are comparatively narrow in profile when viewed laterally, and are armed for much of their length with a series of spines, the tips of many of which tend to become filamentous (Fig. 41). The inner margin of processes has a prominent series of fine longish hairs which are at least as long as the spines; those distad are directed slightly basad. The bristles along the cheeks and vibrissal margin are more slender than in many related forms. In both sexes of *marginata* the pubescence of the arista is featured by a rough series of alternately arranged long and short hairs, the longer ones being equal to width of third antennal segment.

ALBERTA: ♂, Jasper, July 21, 1938; ♂, Moraine, Aug. 17, 1927 (E. H. Strickland). ♂, Lake Louise, Banff, July 27, 1917. ♀, Waterton, July 17, 1923 (H. L. Seamans).

BRITISH COLUMBIA: ♂, Hedley, Aug. 29, 1923 (C. B. D. Garrett) [C. N. C.].

CALIFORNIA: ♂, 3 ♀, Santa Cruz Mts., Santa Cruz, June 8, 1940 (M. T. James) [Colo. State Coll.]. 2 ♂, Lone Pine, July 28, 1940 (D. E. Hardy), 2 ♂, Bishop, July 28, 1940 (L. J. Lipovsky) [Univ. Kansas].

COLORADO: 3 ♂, ♀, No. 1582, no data (Hough), cotypes [Chi. Nat. Hist. Mus.]. ♂, No. 1581, no data, cotype [Z. M. U. B.]. ♂, Marshall Pass, July 28, 1908 [Z. M. U. B.]. ♀, Cameron Pass, 10285 ft., Aug. 21, 1940 (G. F. Knowlton) [Utah State Coll.]. ♀, Berthould Pass, Aug. 22, 1936 (C. W. Sabrosky) [Mich. State Coll.]. ♀, Lake City, 8700 ft., Aug. 8–15, 1936 (C. L. Fluke) [F. M. Snyder]. ♂, ♀, Red Mt., 11000 ft., July 22, 1934 (C. P. Alexander) [Mass. State Coll.].

IDAHO: ♂, ♀, Moscow Mt., July 4–8, 1911 (M. A. Yothers), ♂, Lake Waha, July 22, 1927 (J. M. Aldrich) [U. S. N. M.].

MONTANA: ♂, Glacier Park Station, 4800 ft., July 24, —, (J. M. Aldrich), ♀, Gallatin County, 6500 ft., July 15, 1913 [U. S. N. M.].

OREGON: ♂, Aneroid Lake, 7500 ft., Aug. 1, 1941 (M. & R. E. Rieder).

UTAH: ♀, Card Canyon, Logan Canyon, July 24, 1938 (W. P. Nye).

WASHINGTON: ♂, Naches, July 7, 1935 (R. H. Beamer) [Univ.

Kansas]. ♂, Mt. Rainier, Summerland, July 24, 1924, ♂, Mt. Rainier, Glacier Sta., Aug. 15, 1917, ♂, Mt. Rainier, Yakima Trail, July 22, 1924, ♀, Mt. Rainier, Van Trump Creek, Sept. 1, 1917 (A. L. Melander) [A. L. M.].

WYOMING: ♂, Yellowstone Park, Larva Creek, July 5, 1923 (A. L. Melander) [A. L. M.]. ♂, Sylvan Park, Yellowstone Park, Aug. 17, 1927 (J. M. Aldrich) [U. S. N. M.]. ♀, Dunraven Pass, Aug. 31, 1924 (N. Criddle) [C. N. C.]

Hylemyia (*Botanophila*) *robusta* (Stein)

Hylemyia robusta Stein, 1920, Arch. f. Naturgesch., (1918) 84, Abt. A, heft 9, p. 76.

The name *robusta* was included by Stein in his key to Hylemyia published in the paper cited above, but the species was not further described. In studying Stein's North American material deposited at the Zoological Museum of the University of Berlin in 1932 I came across two males placed under the name *robusta* Stein which evidently was the material used by Stein in preparing his key. One male possessed the locality label, "Moore's Lake, Idaho, July 10, 1907," the other male specimen, "Moscow Mt., Idaho, June 3, 1911." I have seen a third male specimen, which I regard as conspecific, bearing the label, "Glenwood, Washington, May 6, 1923 (A. L. Melander)."

The species, as the name implies, is notable for the robust form of the thorax and abdomen, both of which are stouter than in other species belonging to the group. The eyes possess a few hairs and are separated by a distance about equal to that between posterior ocelli; the interfrontalia is uninterrupted caudad. Aristal hairs are slightly longer than half width of third antennal segment; cheeks are fully as wide as parafacials; proboscis not longer than height of eye. The thorax is trivittate, and abdominal marks broadly subtriangular. Processes of fifth abdominal sternum are armed with a series of spines on proximal half, the latter are about half as long as width of processes where situated, when the processes are viewed laterally in profile. The sternopleural bristles are arranged 2 : 2. The ninth tergum of abdomen (anal sclerite) has numerous curling bristles. The wings are slightly tinged, denser so basad; *m-cu* cross vein is oblique and notably sinuate. Fore tibia has a setulose apical posterodorsal and posteroventral bristle; mid femur has a series of weak anteroventral bristles, mid tibia with 2 anterodorsal, 2 posterodorsal and 2 posterior bristles; hind femur has a series of 7 to 9 anteroventral and 5 or 6 posteroventral bristles, of which the stronger are situated on median third; hind tibia has 5 anteroventral, 4 to 6 anterodorsal, 4 or 5 posterodorsal bristles, 4 or 5 posterior setulæ, apical posterodorsal bristle weak, and apical posteroventral setulose. Length 10 mm.

Hylemyia (Botanophila) formiceps new species

MALE, blackish; thorax subshining, with traces of vittæ; abdomen with dense grayish pruinescence and with well marked subtriangular marks and anterior incisures; wings infuscated, densely so basad.

Eyes separated by a distance equal to that between posterior ocelli inclusive; interfrontalia complete, broadly ribbonlike caudad; parafacials and cheeks broadly developed, the former wider at narrowest than breadth of third antennal segment, the latter is as high as length of third antennal segment; ventral border of cheeks with numerous longish bristles; aristal hairs nearly as long as width of third antennal segment; proboscis not long and slender. Processes of fifth abdominal sternum narrow, armed with a series of 5 or 6 spines on proximal half, the stronger being about equal to or slightly longer than apical setæ on hind metatarsus. Wings with *m-cu* cross vein oblique and sinuate; apex of veins $R._{4+5}$ and $M._{1+2}$ slightly divergent at wing margin. Mid femur with a series of weak short bristles on proximal half of anteroventral surface; mid tibia with one anterodorsal, 2 posterodorsal and 2 posterior bristles; hind femur with a full row of robust anteroventral bristles, the stronger extending to proximal region, and with several bristles on proximal two-thirds of posteroventral surface; hind tibia with 3 or 4 anteroventral, 4 or 5 anterodorsal, 3 or 4 posterodorsal bristles, and with 2 or 3 setulæ on proximal half of posteroventral surface, apical posterodorsal bristle weak, and apical posteroventral lacking.

FEMALE, paler than male; thorax and abdomen densely grayish pruinescent, parafacials and cheeks very broadly developed, as wide as length of third antennal segment; wings yellowish brown tinged. Mid tibia with one anteroventral, 2 anterodorsal, 2 posterodorsal and 2 weaker posteroventral bristles; hind tibia with 2 anteroventral, 4 anterodorsal, 4 posterodorsal bristles, setulæ on posteroventral surface lacking, apical posterodorsal bristle weak, apical posteroventral not developed; *m-cu* cross vein straighter and costal thorn more robust than in male.

Length 9–10 mm.

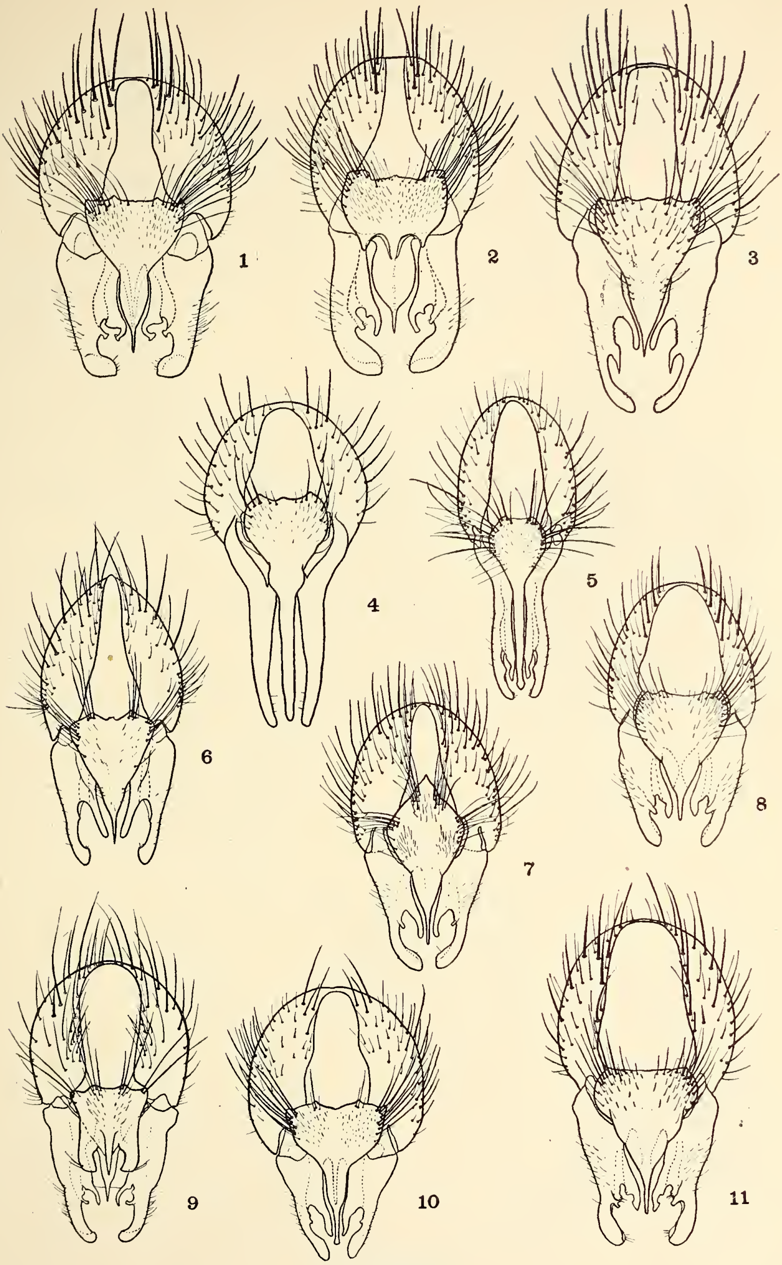
Holotype: ♂, Mt. Home Canyon, California, September 20, 1922. Allotype: ♀, same locality, September 22, 1923 (F. R. Cole) [U. S. N. M.].

The species *formiceps* may be distinguished from related forms having longish hairs on arista by the broadly formed parafacials and cheeks. In certain respects the species resembles *robusta,* the male of which is only known to me and from which *formiceps* may be distinguished by the more slender proportions of processes.

PLATE I

Dorsal or caudal aspect of male copulatory appendages

Figure 1. *H.* (*Botanophila*) *spiniventris* (Coquillett).
Figure 2. *H.* (*Botanophila*) *marginata* (Stein).
Figure 3. *H.* (*Botanophila*) *piloseta* (Malloch).
Figure 4. *H.* (*Botanophila*) *fibulans* new species.
Figure 5. *H.* (*Botanophila*) *spinidens* (Malloch).
Figure 6. *H.* (*Botanophila*) *varicolor* (Meigen).
Figure 7. *H.* (*Botanophila*) *acuticauda* new species.
Figure 8. *H.* (*Botanophila*) *marginella* (Malloch).
Figure 9. *H.* (*Botanophila*) *trifurcata* new species.
Figure 10. *H.* (*Botanophila*) *subspinata* new species.
Figure 11. *H.* (*Botanophila*) *setigera* (Johannsen).

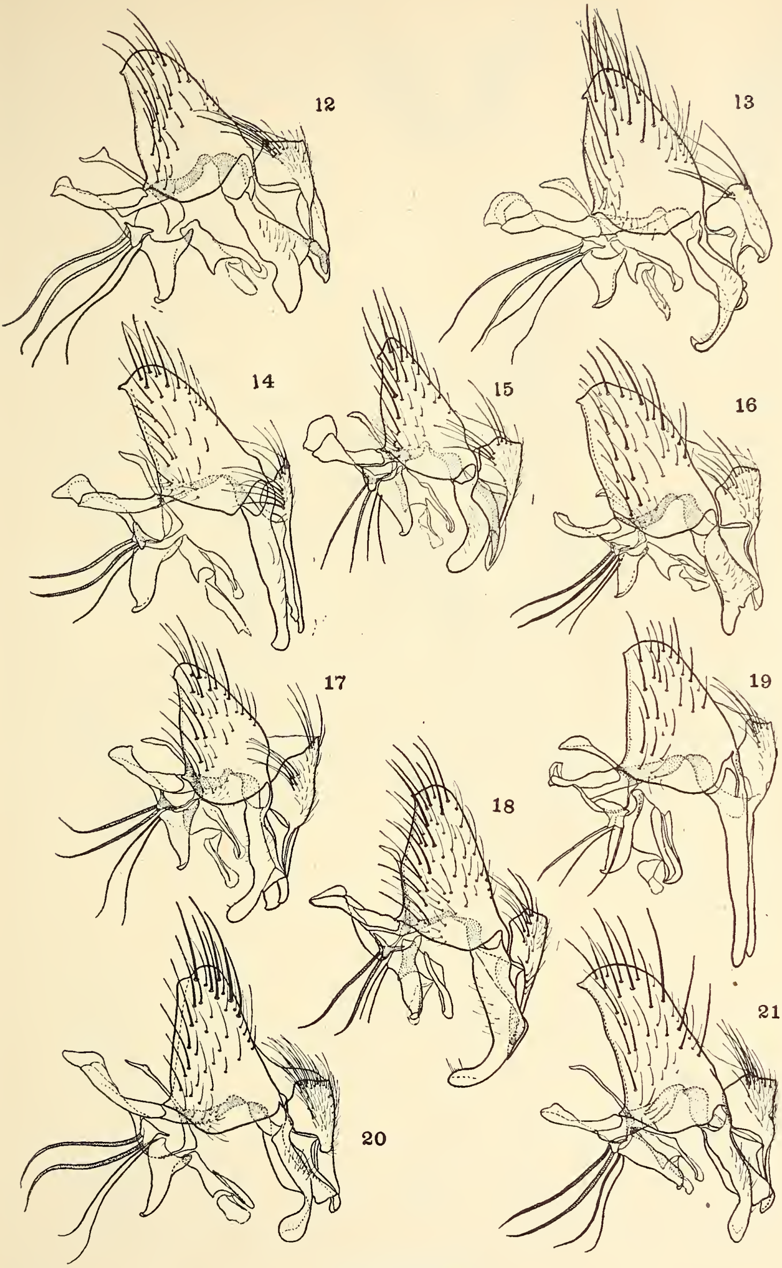


HYLEMYIA

PLATE II

Lateral aspect of male copulatory appendages

Figure 12. *H.* (*Botanophila*) *subspinata* new species.
Figure 13. *H.* (*Botanophila*) *trifurcata* new species.
Figure 14. *H.* (*Botanophila*) *spinidens* (Malloch).
Figure 15. *H.* (*Botanophila*) *varicolor* (Meigen).
Figure 16. *H.* (*Botanophila*) *marginella* (Malloch).
Figure 17. *H.* (*Botanophila*) *acuticauda* new species.
Figure 18. *H.* (*Botanophila*) *piloseta* (Malloch).
Figure 19. *H.* (*Botanophila*) *fibulans* new species.
Figure 20. *H.* (*Botanophila*) *marginata* (Stein).
Figure 21. *H.* (*Botanophila*) *setigera* (Johannsen).



HYLEMYIA

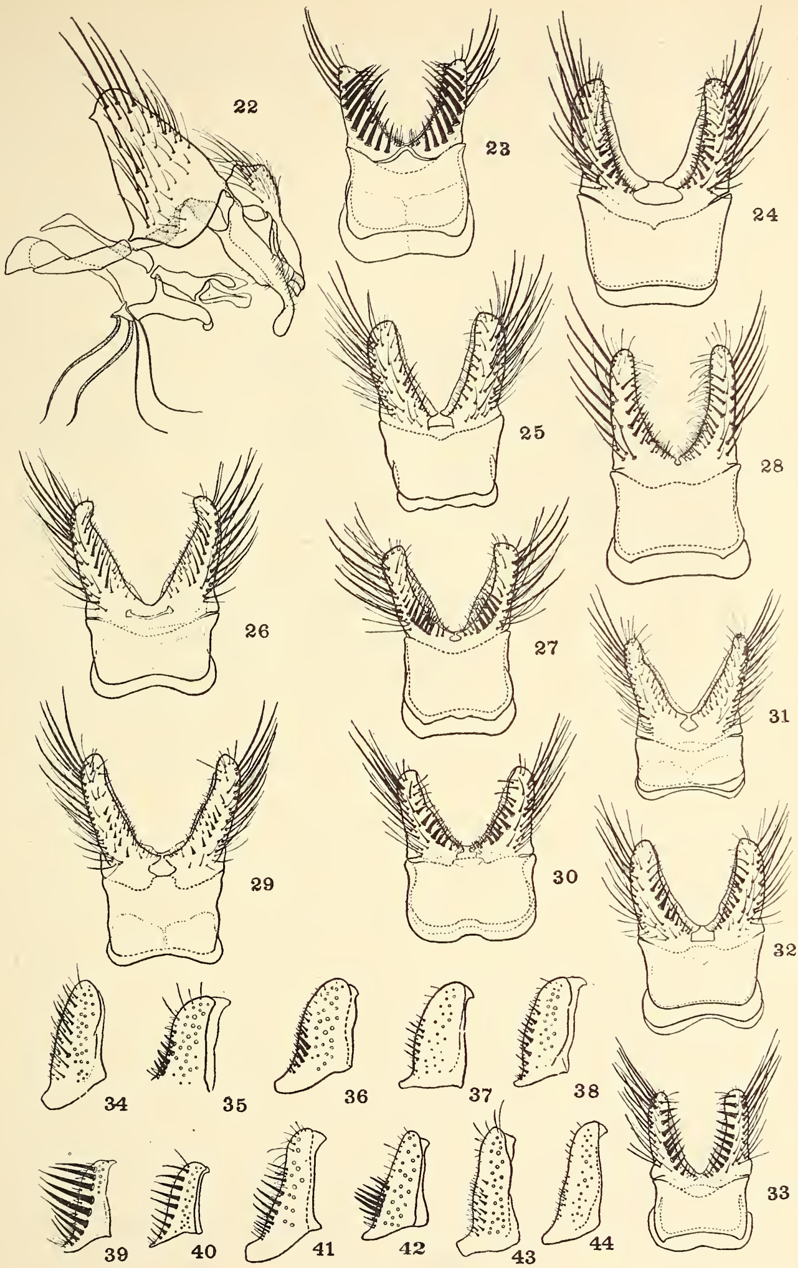
Plate III

Lateral aspect of male copulatory appendages

Figure 22. *H.* (*Botanophila*) *spiniventris* (Coquillett).

Ventral aspect of fifth abdominal sternum in male, and lateral view of processes with bristles removed

Figures 23, 39. *H.* (*Botanophila*) *spiniventris* (Coquillett).
Figures 24, 36. *H.* (*Botanophila*) *piloseta* (Malloch).
Figures 25, 37. *H.* (*Botanophila*) *varicolor* (Meigen).
Figures 26, 34. *H.* (*Botanophila*) *fibulans* new species.
Figures 27, 42. *H.* (*Botanophila*) *spinidens* (Malloch).
Figures 28, 41. *H.* (*Botanophila*) *marginata* (Stein).
Figures 29, 43. *H.* (*Botanophila*) *setigera* (Johannsen).
Figures 30, 35. *H.* (*Botanophila*) *trifurcata* new species.
Figures 31, 44. *H.* (*Botanophila*) *marginella* (Malloch).
Figures 32, 38. *H.* (*Botanophila*) *acuticauda* new species.
Figures 33, 40. *H.* (*Botanophila*) *subspinata* new species.



HYLEMYIA

RESEARCH REQUEST

I am interested in obtaining reprints, copies of unpublished manuscripts and results or observations made in connection with the biological control of mosquitoes.

I want to bring this information together in the form of annotated bibliographies.

J. B. Gerberich
Department of Biological Science
Michigan State College
East Lansing, Michigan

AN EXAMPLE OF SUBSPECIATION IN THE PHALANGIDA

BY CLARENCE J. AND MARIE L. GOODNIGHT[1]

Recently the opportunity was presented to the authors to study a long series of specimens of the species described by Banks as *Cynorta obscura* from Puerto Rico. This series revealed interesting variations of the characters of Banks's species. It also showed the close affinity of a species described by Roewer as *Neocynortoides dorsalis* from the Virgin Islands. Further, the variations suggested a possible relationship to another species described by Roewer, *Proerginus lineatus,* from Haiti.

In 1912 Roewer placed Banks's species in the genus *Metacynortoides* with the generic characters as follows: first and second areas each with median paired tubercles; third and fourth areas each with median paired spines; fifth area without armature; tarsal segments 6-remainder more than 6, distitarsus of first with 3 segments, 2nd with 3. In this same genus, he has also placed *Metacynortoides scabrosa* (Banks) of Cuba.

In 1916 Roewer described *Neocynortoides dorsalis* from St. Thomas, one of the Virgin Islands. This differed from the above genus (*Metacynortoides*) by having paired tubercles on the fifth area.

Among the many specimens of *Metacynortoides obscura* (Banks) studied, all had a row of tubercles across the fifth area; however, in some the median pair of this row was enlarged into paired tubercles. In other individuals, these median tubercles were so slightly enlarged as not to suggest paired armature. Thus it seems to be a matter of degree. Since practically all animals studied showed some increase in the size of these median tubercles, it is believed that the characters of this species should be amended to include paired tubercles on the fifth area. This would unite generically Banks's and Roewer's species. The types of Banks's animals were studied through the courtesy of the National Museum. They all proved to be females and none showed much enlargement of the tubercles of the fifth area.

[1] Department of Biology, Purdue University.

For this reason it is proposed here to unite the two species into one in the genus *Neocynortoides,* and to consider the two forms as subspecies of the species *obscura. Metacynortoides scabrosa* (Banks) which has no median armature on the fifth area would thus remain the type of the genus *Metacynortoides.*

The main distinguishing features observed between the two subspecies are these: *N. obscura obscura* is smooth while *N. obscura dorsalis* is tuberculate on the dorsal scute; the tuberculations of the fourth leg are somewhat larger in *dorsalis;* and in general *obscura* has the spines of the third area larger than those of the fourth while *dorsalis* has those of the fourth larger than those of the third. Individual variations do occur which prevent this from being a universal difference.

Specimens studied from Culebra Island showed an intermediate set of characters. They were more granulate than the Puerto Rican form (*N. obscura obscura*), but not so granulate as the Virgin Island form (*N. obscura dorsalis*). The spines of the third and fourth areas were very nearly equal in size.

Here is presented a problem in insular evolution. Two species are apparently in the process of forming; but still clearly show their close affinity. This fact is further verified by the Culebra Island specimens which show characters intermediate in appearance between the two subspecies.

DESCRIPTION OF SPECIES

Suborder Laniatores Thorell

Cosmetidæ Simon

Cosmetinæ Cambridge

Neocynortoides obscura (Banks)

Cynorta obscura Banks, 1901, Proc. United States Nat. Mus., vol. 27, p. 226, pl. 15, fig. 5; Banks, 1903, Proc. Acad. Philadelphia, vol. 55, p. 342.

Metacynortoides obscura Roewer, 1912, Arch. Naturg., vol. 78, sect. A, no. 10, p. 66; Roewer, 1923, Die Weberknechte der Erde, p. 338.

Neocynortoides dorsalis Roewer, 1916, Arch. Naturg., vol. 81, sect. A, no. 12, fig. 3; Roewer, 1923, Die Weberknechte der Erde, p. 340, fig. 384.

Eye tubercle in median portion of cephalothorax, low, with a few granulations over each eye. Posterior to the eye tubercle, small granulations are present on the cephalothorax. Dorsum with paired tubercles on the first, second, and fifth areas, paired spines on the third and fourth areas. A few small tubercles laterad to the median armature. A row of small tubercles across the posterior margin of the fifth area and each free tergite. Anal operculum tuberculate, free sternites, each with a transverse row of small granulations, enlarged into tuberculations at the lateral margin. Venter and coxæ smooth except for scattered hairs, first coxa with a transverse row of tuberculations. Third coxa with a few anterior and posterior teeth, fourth coxa with a lateral and dorsal surface covered with tuberculations. These are quite conspicuous from above. Fourth coxa with one or two dorsal apical spines.

Legs with scattered hairs. Third and fourth trochanters each with an apical-retrolateral spine, tuberculations on the femora. Fourth femora slightly enlarged, with many small tuberculations. Fourth patella and tibia likewise with tuberculations. Tarsal segments: 6–14–9–9. Distitarsus of first tarsus with 3 segments, second with 3.

Palpus characteristically flattened, with a row of teeth on the ventral margin of the femur.

Chelicera with scattered hairs. Tuberculations on the first segment, second greatly enlarged in male.

Entire body reddish brown, lighter markings bound the areas. Appendages light.

Neocynortoides obscura obscura (Banks)

Cynorta obscura Banks, 1901, Proc. United States Nat. Mus., vol. 27, p. 226, pl. 15, fig. 5; Banks, 1903, Proc. Acad. Philadelphia, vol. 55, p. 342.

Metacynortoides obscura Roewer, 1912, Arch. Naturg., vol. 78, Sect. A, no. 10, p. 66; Roewer, 1923, Die Weberknechte der Erde, p. 338.

MALE.—Total length of body, 4.6 mm. Cephalothorax, 1.7 mm. Width of body at widest portion, 3.7 mm.

	I	II	III	IV
Trochanter	0.6 mm.	0.6 mm.	0.6 mm.	0.7 mm.
Femur	2.2 mm.	4.7 mm.	3.3 mm.	4.2 mm.
Patella	0.7 mm.	1.3 mm.	1.0 mm.	1.5 mm.
Tibia	1.5 mm.	3.6 mm.	2.0 mm.	2.7 mm.
Metatarsus	2.4 mm.	4.6 mm.	3.5 mm.	5.0 mm.
Tarsus	1.7 mm.	3.7 mm.	2.0 mm.	2.3 mm.
Total	9.1 mm.	18.5 mm.	12.4 mm.	16.4 mm.

Dorsum of entire animal smooth. First and second areas with median paired tubercles. Third and fourth areas with median paired spines, those of the third being larger. Fifth area with median paired tubercles. First to third free tergites each with a transverse row of low tubercles; free sternites, each with a transverse row of small granulations.

Legs with scattered hairs. Fourth femur slightly enlarged, covered with low tuberculations.

Palpus: trochanter 0.8 mm. long, femur, 1.3 mm.; patella, 0.7 mm.; tibia 1.0 mm.; and tarsus, 0.6. Total length, 4.4 mm.

Entire body reddish brown; lighter markings as in Figure 2.

FEMALE.—Total length of body, 4.5 mm. Cephalothorax, 1.7 mm. Width of body at widest portion, 4.0 mm.

Identical in appearance with male, but with the fourth leg much less tuberculate and not nearly so heavy.

Type locality: female types from Bayamon, Puerto Rico, January, 1899 (Busch). National Museum number 5794.

Records: Aibonito, Puerto Rico, June 24, 1914; Mandios Slope, Puerto Rico, March 17, 1906 (W. M. Wheeler); between Arecibo and Uduado, Puerto Rico, March 13, 1906 (W. M. Wheeler); and Culebra Island, March 6, 1906 (W. M. Wheeler).

Neocynortoides obscura dorsalis (Roewer)

Neocynortoides dorsalis Roewer, 1916, Arch. Naturg., vol. 81, sect. A, no. 12, fig. 3; Roewer, 1923, Die Weberknechte der Erde, p. 340, fig. 384.

MALE.—Total length of body, 4.6 mm. Cephalothorax, 1.6 mm. Width of body at widest portion, 4.0 mm.

	I	II	III	IV
Trochanter	0.4 mm.	0.5 mm.	0.5 mm.	0.6 mm.
Femur	2.2 mm.	5.0 mm.	3.5 mm.	4.8 mm.
Patella	0.8 mm.	1.2 mm.	1.1 mm.	1.3 mm.
Tibia	1.6 mm.	3.8 mm.	2.1 mm.	3.0 mm.
Metatarsus	2.3 mm.	4.8 mm.	3.4 mm.	4.9 mm.
Tarsus	1.6 mm.	4.0 mm.	1.9 mm.	2.2 mm.
Total	8.9 mm.	19.3 mm.	12.5 mm.	16.8 mm.

Dorsum of entire animal tuberculate. First and second areas with median paired tubercles. Third and fourth areas with median paired spines, those of the fourth being larger. Fifth area with median paired tubercles.

Legs with scattered hairs. Fourth femur with somewhat larger tuberculations which stand out prominently from the leg.

Palpus: trochanter, 0.7 mm. long; femur, 1.3; patella, 0.6; tibia, 0.8; and tarsus, 0.5. Total length, 3.9 mm.

Entire body reddish brown; lighter markings as in Figure 1.

FEMALE.—Total length of body, 4.7 mm. Cephalothorax, 1.6 mm. Width of body at widest portion, 4.5 mm.

Identical in appearance with male, but with the fourth leg much less tuberculate and not nearly so heavy.

Type locality: female holotype from Island of St. Thomas, Virgin Islands, in the collection of the Berlin Museum.

Record: St. Croix, Virgin Islands, March 9, 1925.

PLATE IV

Figure 1. *Neocynortoides obscura dorsalis* (Roewer), dorsal view of male from Virgin Islands.

Figure 2. *Neocynortoides obscura obscura* (Banks), dorsal view of male from Puerto Rico.

Figure 3. *Neocynortoides obscura dorsalis* (Roewer), dorsal view of left fourth leg of male.

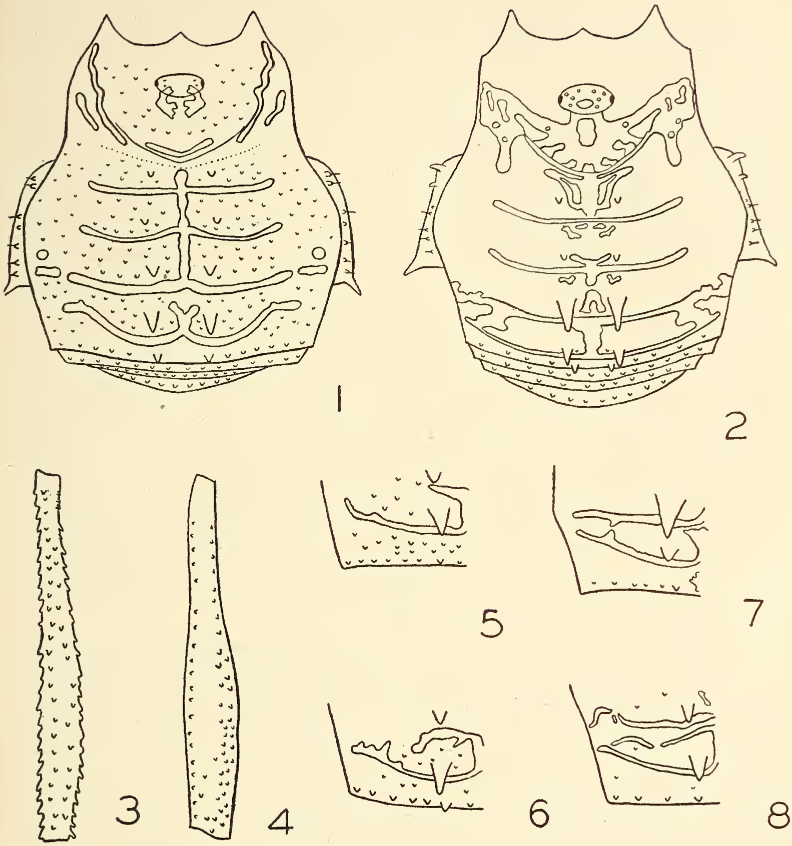
Figure 4. *Neocynortoides obscura obscura* (Banks), dorsal view of left fourth leg of male.

Figure 5. *Neocynortoides obscura dorsalis* (Roewer), dorsal view of fourth and fifth areas of male from the Virgin Islands.

Figure 6. *Idem,* dorsal view of fourth and fifth areas of female from Puerto Rico.

Figure 7. *Neocynortoides obscura obscura* (Banks), dorsal view of fourth and fifth areas of female from Puerto Rico.

Figure 8. *Idem,* dorsal view of fourth and fifth areas of male from Culebra Island.



NEOCYNORTOIDES

MOTHS CONGREGATING AROUND THE NEST OF POLISTES WASPS

During the morning of September 6 while searching for *Catocala,* I noticed a *polistes* sp. (probably *pallipes*) nest suspended from the under surface of a 2 × 4 which helped to support a corrugated tin roof of an open lean-to shed attached to the end of a barn. This shed was situated at the edge of a second growth hardwood forest on the summit of a small mountain (Second Watchung) about one mile south of Mt. Bethel, Somerset County, New Jersey. Congregated around the nest were a dozen or more noctuids *Amphipyra pyramidoides* Gr. in a quiescent resting position. Some were almost touching the nest yet the wasps in attendance appeared to pay no attention to the moths or vice versa. The next day I noticed that some moths were present in a similar position although in smaller numbers. Several days later no moths were present. As I had not noticed such an event before it caused me to speculate as to the reason why the moths had congregated in such an unusual place. This particular species of moth is very common and is strongly attracted to light as well as to sugar or other sweets as every lepidopterist knows who has "sugared" for moths at night.

It does not seem likely that the moths congregated around the wasp nest for protection and I understand that *Polistes* wasps; as far as is known, furnish their larvæ with masticated caterpillars and flies and not with honey. In this case the moths could not have been attracted by honey in the cells. One of my friends, namely David G. Shappirio of Washington, D. C., who is a keen student of Hymenoptera suggested to me in a letter that the wood the *Polistes* used in making paper for their nest may have contained sweet sap which might have attracted the moths. If any entomologists reading this "note" have had similar experiences or can offer an explanation of this phenomenon it would be very interesting if they would publish their comments or observations. —G. W. RAWSON.

HERCYNIA, A NEW GENUS OF MYRMICINE ANTS

By Jane Enzmann
Department of Biology, Northeastern University,
Boston, Massachusetts

Among the ants sent to me from Panama there were two workers and a deälated female representing a new genus of the subfamily *Myrmicini* Lepeletier. Unfortunately only these three specimens were taken. The nest was under a stone; no other habit notes were given by the collector, who has promised to obtain more specimens if possible, and to study the habits of the new ant in greater detail.

The systematics of ants have been studied very thoroughly by Mayr, Forel, Emery, Wheeler, Santschi, and others, and it is not often that a new genus is found by modern collectors. In publishing on the new ant at this time the hope is entertained that others possessing material from Panama may find this ant among their unidentified specimens and may be able to add to the present scanty observations.

Hercynia, gen. nov.

(Plate V, Figs. 1, 2, 3, 4)

Genus diagnosis, workers and female,—

1. Clypeus prolonged between the frontal carinæ.
2. Median spurs of the middle and hind tibiæ not pectinate.
3. Head not distinctly cordate.
4. Frontal carinæ distant from each other.
5. Postpetiole articulated as usual, not as in the tribe *Crematogastrini*.
6. Thorax of the workers without sutures but impressed in front of the epinotum; in the female the thoracic sclerites are well separated by sutures.
7. Antennæ 11-jointed in both the workers and female.
8. Antennal scrobe shallow, bordered medially by the frontal carinæ.
9. Funiculi with a club; scrobes not shaped as in the *Cryptocerini* F. Smith.
10. Scrobe bordered laterally by a distinct carina passing above the eyes.
11. Antennal club 2-jointed with the last two joints prominent. Workers monomorphic.

(This diagnosis was drawn up with the distinguishing characters in the same order as given in Wheeler's key 1922.)

The new genus is close to the new world genera *Ochetomyrmex* Mayr and *Wasmannia* Forel, of the tribe *Ochetomyrmicini*. The new genus differs from the other two genera of the tribe by having the antennal club 2-jointed and the carinæ of the cheeks placed differently. It resembles the genus *Wasmannia* in the conformation of the clypeus which, however, is bicarinate in *Wasmannia*, and the female of the latter is not much larger than the worker.

The definition of the tribe *Ochetomyrmicini* must be amended so it will include the new genus, by changing the old wording "antennal club 3-jointed" to the new wording "antennal club 2- or 3-jointed." The alternative to the amending of the tribus definition would be to erect a new tribe for the aberrant genus.

Hercynia panamana, spec. nov.

WORKER.—Length 1.6 mm. Monomorphic; color uniformly pale yellow. Head oval, with feebly excised posterior edge. Clypeus elevated in the middle, the elevated portion hillock-shaped, its flat anterior part with a rounded projection anteriorly. Frontal triangle absent. Frontal carinæ far apart and continued backward to the occipital corners, forming the upper border of a shallow scrobe on each side. Lower border of the scrobe formed by a carina on the cheeks, which runs above the relatively large compound eyes. Antennal scapes slender, curved at the base, reaching the posterior edge of the head. Antennal funiculus slender, with 10 joints, the first and last two joints larger than the remaining ones. Joints 2–8 small, as long as broad. The last two joints forming a two-jointed club. The surface of the head is longitudinally rugulose punctate above, reticulate on the fundus of the scrobe and sharply longitudinally striated on the cheeks. The posterior edge of the head appears straight from above but deeply excavated at the junction of the head and neck.

Thorax without sutures but shallowly and widely impressed in front of the epinotum. Prothorax broad and set off from the neck by a sharp transverse edge. Laterally the thorax is much narrowed in the mesonotal region. The epinotum is armed with two oblique slender spines nearly twice as long as their distance apart at the base. The entire thorax is strongly punctate and the pronotum has in addition a few irregular rugæ. The petiole is about twice as long as broad with a long slender peduncle in front and is surmounted by a rectangular node. The postpetiole is as long as broad, broader than the petiole and nearly hemispherical in outline from above. Both the petiole and the postpetiole are unarmed below. The sculpture of the pedicel consists of dense punctation.

The gaster is oval, microscopically punctate and very transparent. Head, thorax and pedicel are opaque, the gaster very shiny. The pubescence is absent from the entire body. Long erect hairs are present but sparse. All the hairs appear as if they were sculptured with punctation.

Described from two workers taken near the volcano Chiriqui on the west coast of Panama.

Holotype No. 5a in my collection.

Female.—The single deälated female is considerably larger than the worker, measuring about 4.5 mm. in length. Color light brown, the gaster a little darker. Head broader than long (longer than broad in the worker), with a straight posterior border. Mandibles triangular, with 4 teeth, the apical tooth larger than the others; strongly longitudinally rugose. Clypeus as in the worker. Antennal scrobes much more marked than in the worker and deeper. Head above strongly longitudinally rugose and punctate. Fundus of the scrobe punctate (reticulate in the worker). Cheeks and temples strongly longitudinally rugose punctate. Ocelli well developed, the anterior one placed in a smooth pit.

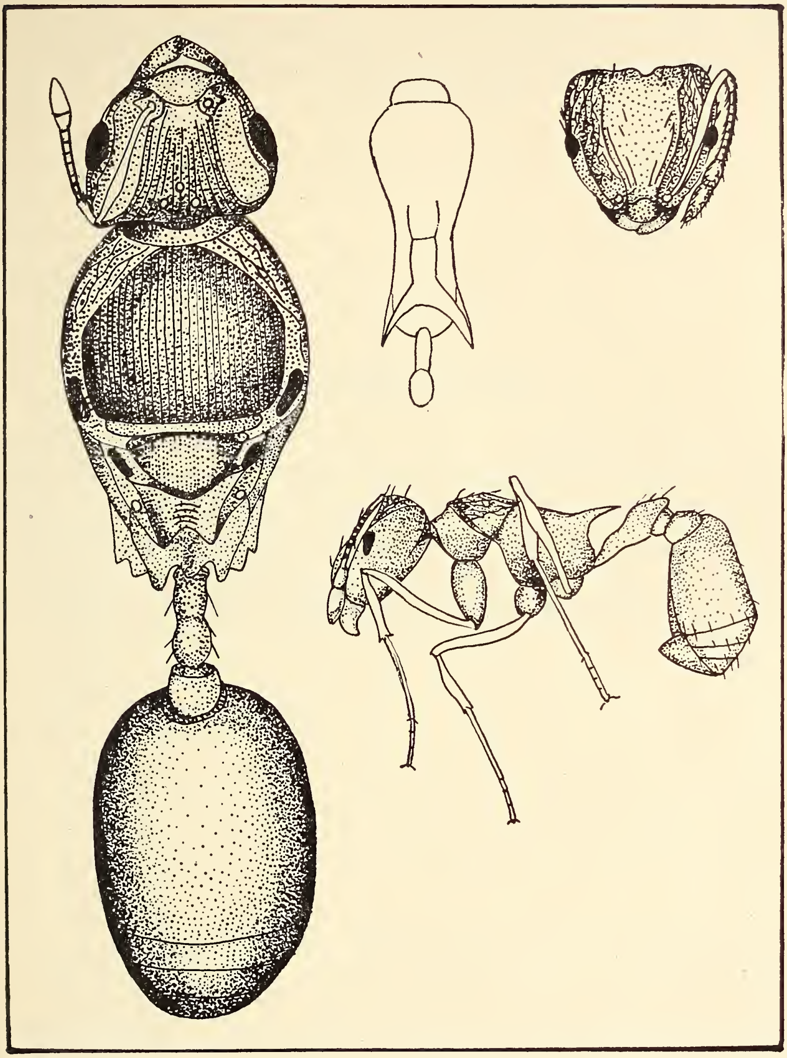
Thorax in profile arched, the pro and mesothorax together forming an elevated hump. The epinotal declivity is long and bears above a pair of flat short, pointed spines and below near the articulation with the peduncle a flat lamella on each side. Dorsally the sclerites are well marked off by sutures. The pronotum is reduced to a narrow ring behind the neck, while the scutum is very large and arched. The paraptera are represented by small lateral triangles joined by a transverse ridge. The scutellum is a small transverse oval. The metanotum is prominent. The epimerites and sternites are also well marked off by sutures. The entire thorax is strongly rugulose and punctate. The space between the epinotal spines is transversely rugulose. The space between the lower lamellæ is longitudinally striated.

The pedicel and gaster are shaped much as in the worker, but the first node is transverse in the female. The base of the gaster is finely shagreened. Pubescence absent as in the worker but the erect hairs are more numerous especially on the thorax and gaster.

Gynetype No. 5b in my collection.

PLATE V

Left: Female of *Hercynia panamana,* dorsal view.
Upper right: Head of the worker from the front.
Upper center: Thorax of the worker seen from above.
Lower right: Worker in profile.



HERCYNIA PANAMANA

INDEX TO JOURNAL

THE NEW YORK ENTOMOLOGICAL SOCIETY has just published an "Author and General Subject Index to Volumes 1 to 50 of the Journal of the New York Entomological Society." It consists of 135 pages in 8-point type and bound copies may be purchased for $5.00 each from the treasurer of the Society, Dr. James C. King, American Museum of Natural History, New York 24, N. Y.

SOME OBSERVATIONS ON LASIOGLOSSUM (HEMIHALICTUS) LUSTRANS (HYMENOPTERA, HALICTIDÆ)

BY CHARLES D. MICHENER
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The only known species of the subgenus *Hemihalictus, Lasioglossum lustrans* (Cockerell),[1] hitherto known only from females, was described in 1897 from specimens collected near Silver City, New Mexico, on flowers of *Pyrrhopappus,* probably *P. rothrockii,* and was recorded by Cockerell in 1900[2] from Las Vegas, New Mexico, on flowers of *Pyrrhopappus.* In 1938 it was recorded by Brimley[3] from Raleigh, North Carolina, on flowers of cucurbits. It is of interest that the species is widespread in the territory intervening between New Mexico and North Carolina, and occurs to the northward at least as far as Michigan.

Unlike most species of Halictinæ, *L. lustrans* is oligolectic. During eighteen months at Hattiesburg and Camp Shelby, Mississippi, the author obtained only two specimens (both females) on flowers other than those of *Pyrrhopappus carolinianus,* and these two were on another yellow composite of the chicory tribe. Seventy-nine specimens of both sexes were collected on *Pyrrhopappus carolinianus.* Since the flowers of this plant close soon after the sun strikes them in the morning, all were collected in the early morning hours. Dates of collection range from April 15 to August 26. Males were collected only from June 28 to July 29, 1944.

The species was also collected by the author from April 7 to 12, 1946, on flowers of a yellow composite similar to *Pyrrhopappus,* at Jefferson, Texas; Shreveport, Louisiana; Texarkana, Fulton, Prescott, and Brinkley, Arkansas; and Oakland and Bolivar, Tennessee. All these specimens were females, the season probably being too early for males. Mr. P. H. Timberlake sends me a

[1] Cockerell, 1897, Trans. Am. Ent. Soc., 24: 147.
[2] Cockerell, 1900, Ann. Mag. Nat. Hist., (7) 5: 416.
[3] Brimley, 1938, Insects of North Carolina, p. 456.

record of a specimen collected at Nottawa, Michigan, May 30, 1941 (R. R. Dreisbach).

It is interesting that the male is fully as rigidly oligolectic as the female. This is not always the case among bees.

The male is remarkable (although not unique in the genus) for its short broad body and short antennæ, so that it looks like a female. The male is described as follows:

Length 7 to 8 mm. Black, mandibles reddish medially, under side of flagellum brown, distitarsi rufescent, posterior margins of abdominal terga often narrowly and feebly brown. Pubescence short, sparse, whitish, not forming abdominal bands. Sculpturing fine and weak; clypeus smooth between widely separated punctures; supraclypeal area with widely separated small punctures, area between tessellated; paraocular areas with rather fine close punctures, vertex with fine sparse punctures, surface between smooth; supra-antennal area finely and closely punctured; mesoscutum and mesoscutellum with widely separated fine punctures, surface between tessellated; enclosure of propodeum much wider than metanotum, not definitely margined, with fine radiating rugæ laterally, medially with the rugæ irregularly anastomosing; abdomen with very fine punctures. Head approximately round seen from front, the eyes very widely separated. Clypeus low and broad, truncated anteriorly; labrum produced to median apical process similar to but shorter than that of female, and margined with long setæ; mandibles very long, slender, pointed, when closed apex of one reaches base of other; flagellum short and robust, all segments except first and last broader than long. Eighth abdominal (seventh metasomal) tergum with pygidial plate clearly defined posteriorly; posterior margin of sixth abdominal sternum nearly straight; gonocoxites each with thin flat apical process arising laterad to base of gonostylus, and directed forward beneath gonocoxite, ending near base of latter; gonostylus small, simple, blunt.

Among the numerous specimens examined, all had only two submarginal cells. In view of this and the rather unusual male characters (mandibles, antennæ, and genitalia) it is evident that *Hemihalictus* can be retained as a distinct subgenus.

ELIMINATION OF A MICROSPORIDIAN PARASITE IN THE MASS REARING OF MACROCENTRUS ANCYLIVORUS

By E. E. McCoy

In 1944 Allen (1) noted the presence of a microsporidian parasite in adult *Macrocentrus ancylivorus* reared in the laboratory using the potato tuber moth (*Gnorimoschema operculella*) as a host insect. Since October, 1943, the New Jersey Department of Agriculture has been engaged in rearing *Macrocentrus* using the tuber moth as a host. Increasing difficulties in obtaining a satisfactory yield of insects were encountered. The abnormal condition noted by Allen was recognized as being general in the insects reared in our laboratory, and an investigation was begun to determine whether or not this protozoan parasite was responsible for the failure to develop a satisfactory procedure for rearing *Macrocentrus.*

It was soon evident that this microsporidian is in reality a parasite of the various developmental stages of the potato tuber moth, and that its presence in *Macrocentrus* is fortuitous. In tuber moth cultures where no *Macrocentrus* was introduced, spores of the protozoan were found in every developmental stage of the moths, from the egg stage to the adult moths. In some cultures 100 per cent of the emerging moths were found diseased. As high as 20 per cent of the eggs deposited by diseased female moths were infected by the spore stage of the protozoan. The larva of the Oriental fruit moth was found to be not susceptible to infection by this organism, and when heavily infected adult *Macrocentrus* were introduced in Oriental fruit moth cultures, all the resultant emerging parasites were found free of infection. No evidence of infection by the microsporidian could be found in any developmental stage of *Macrocentrus* when reared on the Oriental fruit moth. Further, the disease incidence found in *Macrocentrus* reared on the tuber moth as host was always found correlated with the disease incidence in the host insect.

The presence of the protozoan has serious primary effects in this method of rearing *Macrocentrus* because of adverse effects on the tuber moths which must be reared to supply hosts. Diseased female moths are not as prolific as healthy moths. The development of infected moths is retarded, and a considerable proportion of the more heavily infected moth larvæ never reach maturity under the routine followed when producing *Macrocentrus.*

The secondary effect of the protozoan in cultures of moths to be used for the propagation of *Macrocentrus* is even more serious. The female *Macrocentrus* repeatedly oviposit in the smaller tuber moth larvæ which have been repressed in their development by the microsporidian. This results in a decided reduction in the potential reproductive capacity of the insect parasite. Finally, in the more lightly infected moth larvæ which are able to develop at a normal or nearly normal rate, the protozoan eventually invades the developing insect parasite. Under routine conditions from 40 per cent to 60 per cent of the maturing *Macrocentrus* were so weakened that they were unable to complete development, and never emerged from their cocoons as adult insects. As pointed out by Allen, a fairly high proportion of the emerging adult *Macrocentrus* may be affected by the protozoan. Such individuals have a reduced life span, are not normally active, and the reproductive rate is greatly reduced.

It was decided in October, 1945, to attempt the elimination of the microsporidian from the tuber moth. The similarity of the organism and its biology to the pebrine disease (*Nosema bombycis*) in silk worms suggested that methods used to combat the ravages of pebrine might be applicable in the present instance. Pasteur (2) invented "grainage cellulaire" by which silkworm moths are confined by pairs and eggs obtained from pairs, found healthy by later microscopic examination, used as a breeding source.

The rate of infection in our adult moths was so high that it was decided to begin the isolation work with eggs, since the initial rate of infection is then much lower. The eggs were obtained in an oviposition box similar to that described by Marvin (3). The tuber moth eggs can be readily detached from the egg sheet and separated from one another by treating the sheet for a few minutes with 1 normal sodium hydroxide solution (40 gm. NaOH per liter of solution). The solution with the separated eggs is poured through a fine screen (80 mesh per inch) which retains the eggs, and the latter are then thoroughly washed with tap water. Finally, the eggs are placed with a small volume of water in a sterile Petri dish. They may then be transferred individually using a pipette drawn to a long, rather fine (1 mm.) point.

Specimen vials, 50 × 25 mm., covered with fine gauze retained over the mouth of the vials by means of rubber bands make excellent isolation cells. This assembly is sterilized by autoclaving at 15 lb. pressure for 10 minutes. When cool and dry, pieces of white potato are introduced in each vial as food for the developing larva. The separated tuber moth eggs are then introduced using the pipette, and placing one egg in each cell. It is best to prepare at least 100 cells, so that later no difficulty will be found in mating a reasonable number of moths. The cells are then incubated for about 25 days at 78–80° F.

When moth emergence begins the moths are lightly anæsthetized using ether vapor. The sexes are readily separated by a glance at the abdomen, and one male and one female placed in a 50 × 25 mm. specimen vial which has been previously prepared and sterilized. These vials, which serve as mating and oviposition cells, are covered by squares of marquisette held in place by rubber bands. Over each cell a clean circular micro cover glass (18 mm.) is placed, and a small weight (about 10 gm.) used to press the glass evenly against the cloth. After mating the female moths deposit their eggs on the glass, which may then be marked and placed under refrigeration until the moths are examined. Usually the moths will oviposit on the second and third day after being placed in the cells. The moths are then anæsthetized, the abdomens removed, and examined individually under the compound microscope using the high power dry objective lens. If none of the characteristic microsporidian spores are found in either moth in a pair, the eggs obtained from that cell may be used to begin a stock of disease-free moths. In the initial stages, glass beakers or crystallizing dishes containing ground sphagnum moss or sand make excellent culture vessels since they are readily sterilized and the progress of the cultures may be easily followed. Later the moths are reared in the manner described by Finney (4).

When the available source of *Macrocentrus* to be used as breeding stock has been reared on infected tuber moth hosts, it is further necessary to eliminate this source of infection, or the disease may be reintroduced. *Macrocentrus* is at best a poor carrier of the microsporidian, and the disease will disappear within 3 generations provided healthy moths are used throughout, and any emerging moths escaping the insect parasite are destroyed. The microsporidian is thus eliminated from *Macrocentrus* by dilution, and any opportunity for it to increase in the host insect is forestalled by the destruction of all possibly diseased moths. Starting with a *Macrocentrus* stock in which visual examination indicated approximately 20 per cent affected by the protozoan and with no attempt to separate these, the following generation contained less than 1 per cent abnormal individuals, and in the third generation no disease was found in over 9,000 individuals examined. The disease did not reappear subsequently. It is necessary to initially segregate these cultures from the healthy moth stock to prevent the possibility of reinfection through larval tuber moth migration. Also, unparasitized moths emerging from cages in which diseased *Macrocentrus* are known to be must be destroyed or a reintroduction of the disease may occur. When once the disease has been eliminated these precautions may be relaxed.

Where possible, all equipment was sterilized by autoclaving. The wooden rearing cages were hot-air sterilized at 165° C. for 30 minutes just prior to use. Emergence cages were not sterilized, but had been out of use for about six months since last containing any diseased insects. Our experience leads us to believe that this microsporidian is easily controlled. There seems to be no danger of air-borne contamination. The organism does not have much resistance to heat, and apparently can exist in viable condition for only a short time when not in the living insects. The major mode of transmission from one generation of moths to the next is through internal infection of the egg, and cross-infection between developing larvæ under the crowded conditions existing in routine laboratory rearing. Its presence in the *Macrocentrus* parasite is not as a true disease, but more by accident, and it is readily eliminated from *Macrocentrus* by two or three generations reared in disease-free hosts.

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BOOK NOTICE

Fleas of Western North America. Their Relation to the Public Health. By Clarence Andresen Hubbard. The Iowa State College Press, Ames, Iowa, 1947. $9\frac{1}{4} \times 6\frac{1}{4}$ in. ix + 533 p. illus. $6.00.

In 1940, the Iowa State College Press did a service to entomologists by publishing "Fleas of Eastern United States" by Irving Fox. This service has now been expanded greatly by their present publication, which covers 236 species and subspecies of western fleas. The first chapter is an interesting one about the early and present day siphonapterists (with photographs) and their research contributions to the subject. Chapter 2 deals with the medical importance of fleas in connection with bubonic plague and typhus and also with fleas as household and farm pests. Detailed directions for field collecting and laboratory technique appear in chapter 3. The anatomy of the flea in relation to its taxonomy occupies chapter 4. These four chapters make up part I of the volume. Part II, which occupies 331 pages, covers the systematic classification of 236 species and subspecies and includes keys to the families, genera and species. Diagnostic characters are given for each genus and for each species together with information on the range of the species, hosts, medical importance and records of distribution. This part is abundantly supplied with drawings of anatomical details to facilitate identification.

Part III of 120 pages is an extensive, annotated host index which includes much useful information about the habits and ranges of the hosts and the best ways to take them. The balance of the volume is occupied by a bibliography, a synonymic index, a rapid index to western fleas, a flea index according to authors and a general index. At the end of part II there is a geographical index of both western and eastern fleas, which shows clearly where future flea research is needed.

This book is a clear, well written, satisfying work on the western species. The future student, western or eastern, now has before him a relatively easy approach to the subject, due to the knowledge and research of Doctor Hubbard not only on fleas but on their hosts as well and on all ramifications of the subject. The author has produced a gratifying and excellent piece of work.—H. B. W.

NOTES ON THE ECOLOGY OF HYDROPORUS RUFIPLANULUS FALL (COLEOPTERA, DYTISCIDÆ)

BY K. F. CHAMBERLAIN
ASSISTANT STATE ENTOMOLOGIST, NEW YORK STATE MUSEUM
ALBANY, N. Y.

Hydroporus rufiplanulus was described in 1923 by the late Dr. H. C. Fall on pages 53–54 of his "Revision of the North American Species of Hydroporus and Agaporus." The original type series contained only seven specimens, six of which had been collected by the late Wm. T. Davis at Rock City, Cattaraugus Co., N. Y., while the seventh specimen came from Peekskill, N. Y. (Sherman Coll.). Inasmuch as no information regarding the habitat of this species appears to be available, the following notes may prove of interest to students of the *Dytiscidæ*.

On August 16, 1940, the writer collected about a dozen specimens of *H. rufiplanulus* in water-soaked moss at the margin of a small spring in New Lebanon, N. Y. The town of New Lebanon is located in Columbia County, N. Y., and its eastern boundary lies along the New York–Massachusetts state line. This region is intersected by the Taconic Mountains and the topography is rough and hilly, with numerous springs scattered along the hillsides.

The particular spring in which the specimens of *rufiplanulus* were collected, was located near the foot of a long, sloping meadow about a dozen yards above the margin of a densely wooded area. The beetles were not found in water, but were secured by pressing firmly down upon the moss until the water was forced to the surface. After the pressure was released the small reddish beetles appeared crawling upon the surface of the moss.

Later, after the specimens had been identified,[1] the importance

[1] In November, 1945, through tthe kindness of Dr. Joseph Bequaert, of the Museum of Comparative Zoology, Cambridge, Mass., I was able to verify this identification by comparison with the Fall types.

of recording the conditions under which they were found became apparent. Several subsequent trips were made to the spring but no additional specimens of *rufiplanulus* were found until July 24, 1946. On this date nine additional specimens were collected under precisely the same conditions as those described above. At this time there was a sedge intermingled with the moss, and this has been identified through the kindness of Dr. H. D. House, State Botanist, as *Juncus canadensis* J. Gay. Likewise, through the cooperation of Dr. House, the moss has been identified by Dr. A. J. Grout of Newfane, Vermont, as *Bryum pseudotriquetrum* (Hedw.) Schwaeger. The temperature of the water on July 24 was 52 degrees Fahrenheit.

The following Coleoptera were collected in association with *Hydroporus rufiplanulus* on the latter date: *Dytiscidæ: Hydroporus filiolus* Fall, 3 specimens; *Hydrophilidæ: Cymbiodyta blanchardi* Horn, 21 specimens; *Cymbiodyta vindicata* Fall, 1 specimen; *Anacæna limbata* Fab., 6 specimens; and *Paracymus subcupreus* Say, 10 specimens.

MISCELLANEOUS NOTES ON CICADELLIDÆ (HOMOPTERA)

By P. W. Oman

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The information here presented was assembled during the process of reviewing the "Check List of the Cicadellidæ (Homoptera) of America North of Mexico" by DeLong and Knull, 1945. All specific synonymy indicated is based upon a study of holotypes of the respective names, except that of *Euscelis schenkii* (Kbm.).

Phlepsius personatus Baker

Phlepsius personatus Baker, Canad. Ent., 30: 30, 1898.
Phlepsius cinerosus Osborn and Lathrop, Ann. Ent. Soc. Amer., 16: 347, 1923. New synonymy.

DeLong and Knull place *cinerosus* as a synonym of *spatulatus* Van Duzee, 1892.

Lævicephalus acus (Sanders and DeLong)

Deltocephalus acus Sanders and DeLong, Pa. Dept. Agr., Gen. Bul. 346, U. S. Bur. Plant Indus., Tech. Ser. Bul. 1: 10, 1920.
Lœvicephalus rotundens DeLong and Davidson, Canad. Ent., 67: 167, 1935. New synonymy.

Lævicephalus helvinus (Van Duzee)

Thamnotettix helvinus Van Duzee, Proc. Calif. Acad. Sci., 7: 300, 1917.
Lœvicephalus flabellum DeLong, Ohio Jour. Sci., 38: 217, 1938. New synonymy.

Lævicephalus lenis (Van Duzee)

Thamnotettix lenis Van Duzee, Proc. Calif. Acad. Sci., 14: 423, 1925.
Lœvicephalus wilsoni Oman, Proc. Ent. Soc. Wash., 34: 91, 1932. New synonymy.

Lævicephalus auratus (Gillette and Baker)

Deltocephalus auratus Gillette and Baker, Colo. State Agr. Col., Agr. Expt. Sta. Bul., 31: 85, 1895.

Lævicephalus exectus DeLong, Ohio State Univ., Studies 2: 78, 1926. New synonymy.

Lævicephalus subrutilus DeLong and Sleesman, Ann. Ent. Soc. Amer., 22: 103, 1929. New synonymy.

The holotype of *exectus* is a typical *auratus* female, that sex normally lacking the orange-yellow color of the males. The male holotype of *subrutilus* is *auratus* but all other specimens in the type series of *subrutilus,* consisting of 4 females and 1 male, are *Lævicephalus perpusillus* (Ball and DeLong, 1926). Sanders and DeLong (Pa. Dept. Agr., Gen. Bul. 346, U. S. Bur. Plant Indus., Tech. Ser. Bul. 1: pl. 3, fig. 5a, 1920) and DeLong (Ohio State Univ. Studies 2: pl. 16, fig. 5a, 1926) illustrated the female of *perpusillus* as *auratus.* DeLong and Sleesman's illustrations (Ann. Ent. Soc. Amer., 22: pls. 5 and 8, 1929) of the male genitalia of *subrutilus* are from the above-mentioned male paratype, an example of *perpusillus.*

Lonatura salsura Ball

Lonatura salsura Ball, Canad. Ent., 31: 310, 1899.

Deltocephalus turbineus DeLong and Davidson, Canad. Ent., 67: 171, 1935. New synonymy.

The female holotype of *turbineus* is a long-winged specimen of *salsura.*

Exitianus picatus (Gibson)

Athysanus picatus Gibson, Proc. Biol. Soc. Wash., 32: 26, 1919.

Athysanus miniaturatus Gibson, *l.c.*

E. picatus is not a synonmy of *obscurinervis* (Stal), as indicated by DeLong and Knull, but a distinct species, primarily tropical in distribution and occurring as far north as southern Arizona.

Ollarianus kinoanus (Ball), new combination

Exitianus kinoanus Ball, Bul. Brooklyn Ent. Soc., 31: 71, 1936.

Ballana vesca (Ball)

Thamnotettix atridorsum var. *vesca* Ball, Canad. Ent., 42: 302, 1910.
Ballana gruis DeLong, Ohio Jour. Sci., 37: 114, 1937. New synonymy.

Spathanus acuminatus (Baker)

Athysanus acuminatus Baker, Psyche 7, Suppl. 1: 25, 1896.
Scaphoideus mirus Van Duzee, Proc. Calif. Acad. Sci., 14: 419, 1925. New combination, new synonymy.

DeLong and Knull place *mirus* in the genus *Osbornellus* but examination of Van Duzee's type shows it to be merely a highly colored example of *acuminatus*.

Empoasca denticula Gillette

Empoasca denticula Gillette, Proc. U. S. Nat. Mus., 20: 734, 1898.

This species has long been considered a synonym of *maligna* Walsh and is so listed by DeLong and Knull. Gillette's description of *denticula,* based upon 3 males and 1 female from Colorado, deals with a species easily separable from *maligna* on the basis of the characters of sternite VII of the female. Two of the 3 males in the original type series are properly associated with the female described, and one of these, to which Gillette attached his determination label, is here designated lectotype. This specimen bears the pin-label data "Colo. 1741, Co-type No. 3426 U. S. N. M."

Psammotettix Haupt

Psammotettix Haupt, Zool. Jahrb., 58: 262, 1929. Type, by original designation, *Athysanus maritimus* Perris, 1857.
Ribautiellus Zachvatkin, Mem. Soc. Ent. Ital., 12: 268, 1934. Type, by original designation, *Cicada striata* Linnæus, 1758.

This genus is represented in the Nearctic Region by the *striatus* group of species included in the genus *Lævicephalus* by DeLong and Knull. *Lævicephalus cicatrix* DeLong and Sleesman, 1929, and *evansi* (Ashmead, 1904), included in the *striatus* group by DeLong and Knull, do not belong in *Psammotettix* but will remain in *Lævicephalus.* The revised list of species, representing new combinations with *Psammotettix* except for *striatus,* is as follows:

affinis (G. & B., 1895)
amplus (DeL. & D., 1935)
attenuens (DeL. & D., 1935)
cahuillus (Van D., 1925)
excavatus (Oman, 1931)
ferratus (DeL. & D., 1935)
harrimani (Ashm., 1904)
latipex (DeL. & D., 1935) = *striatus* (L., 1758)
shoshone (DeL. & D., 1934)
striatus (L., 1758)
latipex (DeL. & D., 1935)
totalus (DeL. & D., 1935)

Dikraneura subgenus Notus Fieber

Notus Fieber, Zool.-Bot. Gesell. Wien, Verhandl., 16: 508, 1866. Type, by subsequent designation of McAtee (Proc. Zool. Soc. London, p. 114, 1934), *Cicada flavipennis* Zetterstedt, 1828.
Dikraneura subgenus *Curta* DeLong and Caldwell, Proc. Wash. Ent. Soc., 39: 30, 1937. Type, by original designation, *Dikraneura* (*Curta*) *alta* DeLong and Caldwell, 1937. New synonymy.

Representatives of the subgenus *Notus* may be differentiated from typical *Dikraneura* by the large, quadrangular valve and the two openings of the ejaculatory duct in the male sex. The following two North American species are referred to the subgenus *Notus:*

alta (DeL. & C., 1937), new combination
sitka (DeL. & C., 1937), new combination

The following records are of apparently introduced forms which should be added to the list of Nearctic species.

Idiocerus albicans Kirschbaum

A European species collected from cottonwood (*Populus trichocarpa*) at Nicolaus, Calif., and Puyallup, Wash., in 1935 (Oman).

Macropsis tiliæ (Germar)

A European species collected at New Haven, Conn., in 1934 (Oman).

Agallia albidula Uhler

A Neotropical species formerly recorded with some doubt from Mount Desert Island, Maine. It was collected in numbers at La Belle, Fla., in 1939 (Oman).

Athysanus argentatus (Fabricius)

A European species now well established in New England. Specimens from Crawford Notch, Willey House, and Bath, N. H.; Waterville, Maine; and Holliston and Monterey, Mass., have been examined. Earliest North American record, 1934.

Euscelis schenkii (Kirschbaum)

Jassus (*Athysanus*) *Schenkii* Kirschbaum, Nassau. Ver. f. Naturk. Jahrb., 21 and 22: 111, 1868.

Euscelis maculipennis DeLong and Davidson, JOUR. N. Y. ENT. SOC., 42: 221, 1934. New synonymy.

A European species now widely distributed in Idaho, western Washington, and northwestern Oregon. Earliest collection record for North America, 1927.

Paramesus nervosus (Fallén)

A European species collected at Rigaud, Quebec, by J. Ouellet. Year of collection not indicated.

Baldulus elimatus (Ball)

A Sonoran species collected at Patagonia, Ariz. (Kusche), and at El Paso, Tex. (Turner). Earliest record from the United States, 1927.

Empoasca punctum Haupt

A European species collected from elm at Chestnut Hill, Pa., in 1930, by F. F. Smith, and at Roosevelt, Utah, in 1937, by G. F. Knowlton. Knowlton reported the Utah specimens to be injuring Siberian elms.

THE ELECTRORETINOGRAM OF CYNOMYA

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The electroretinogram (ERG) of vertebrates obtained in response to a flash of light (one-half second or longer) consists of a complex wave in which there are usually four distinct peaks known as the a-, b-, c-, and d-waves (Fig. 1). This complex change of electrical potential is commonly regarded as the algebraic sum of the EMF from three sources, all of which are located in the retina. The EMF from each source is considered to be a component produced by a particular process. The a-wave is the result of the timing of components II and III (referred to as P II and P III) P III rising faster than P II. The b-wave is the peak of P II, and the c-wave is the sum of P I, P II and P III, but its magnitude is determined largely by P I. The d-wave (or "off effect") occurs after the flash is terminated and results from the fact that P III declines more rapidly than P I and P II (Granit, 1933, 1935, 1938; Therman, 1938; Bernhard, 1940, 1942).

It has been pointed out previously (Jahn and Crescitelli, 1938, 1939, 1940; Jahn and Wulff, 1942) that the ERG of insects may consist of four major waves which in general form are quite similar to the a-, b-, c-, and d-waves of vertebrates. It is also known that in *Trimerotropis* the wave form is the result of summation of at least two components, one of which arises in the eye and one in the optic ganglion (Jahn and Wulff, 1942). The nomenclature of the vertebrate ERG has been adopted for insects as a matter of convenience and without assuming that the two wave forms arise in the same way or are strictly comparable to each other.

It is the purpose of the present paper to present strictly comparable records of the ERG of *Cynomya cadaverina* taken at two temperatures, at various intensities and durations of flash, and at slightly different stages of adaptation, and to examine these records in view of the possibility that the wave form might be interpreted in the same manner as those taken from vertebrate eyes.

The effect of temperature, of intensity, of duration of flash and of adaptation have been studied separately on other insects, but there is no published set of records in which these four factors

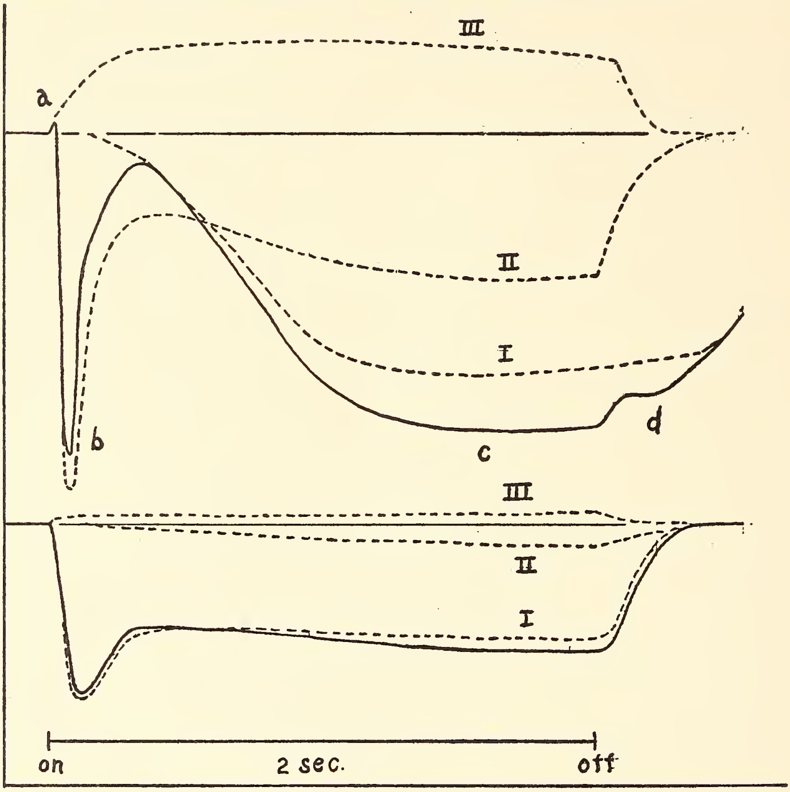

FIG. 1. A diagram showing the analysis of a composite retinal electric response of a dark adapted cat's eye at two intensities of illumination, 14 ml. (upper) and 0.14 ml. (lower), of an area of 1661 sq. mm. viewed at a distance of 70 mm. The continuous line is the composite or recorded response; the broken lines represent the various components. The duration of the light stimulus is 2 seconds. (From Granit, 1933)

have been varied in an otherwise strictly comparable series of experiments.

MATERIAL AND METHODS

The flies were collected locally and used immediately. After temporary inactivation by low temperature the fly was mounted in the electrode chamber, and electrical contact was made with the cornea of the eyes by means of chambers containing salt solution. One eye only was exposed to the stimulating light of 10,000 foot-candles (unit intensity), and the responses were recorded with a condenser-coupled high-gain amplifier, cathode ray oscillograph and camera.

A double wall around the electrode chamber permitted changing the chamber temperature by passing hot or cold air between the walls. The temperature was frequently recorded by means of a resistance thermometer placed in the chamber near the animal.

Numerous records were made from twelve animals. All the records shown in Figure 2 were made from the same animal on the same day and at the same amplification. Therefore they are strictly comparable. Records from other animals were similar, and those presented comprise the most typical of the complete series obtained. In order to facilitate the dicussion certain records have been copied and are shown enlarged with the waves labelled in Figure 3. In Figure 2, responses to the first four exposures at the rate of one per second are shown in each column. Records from further stimulation showed few differences from those of the fourth stimulus, and no differences which would affect the following discussion.

In referring to the records the following system is used. The row, column, and number of exposures are given successively, *e.g.*, 4C3 refers to row 4, column c, exposure 3. The same system is used for the enlargements shown in Figure 3. Three seconds elapsed between records 7D1 and 7D2, and 7D2 is in response to a 350 msec. stimulus; in several other series one or two flashes were omitted.

RESULTS

I. The Electroretinogram of *Cynomya* at Room Temperature (26–28° C.)

A. Changes produced by intensity at short exposure.

With a light stimulus of unit intensity (10,000 foot-candles) and 17 msec. exposure, the response of the eye is a negative wave which consists of a sharp downward deflection, the b-wave, followed by a slow c-wave on which there is a negative peak, the

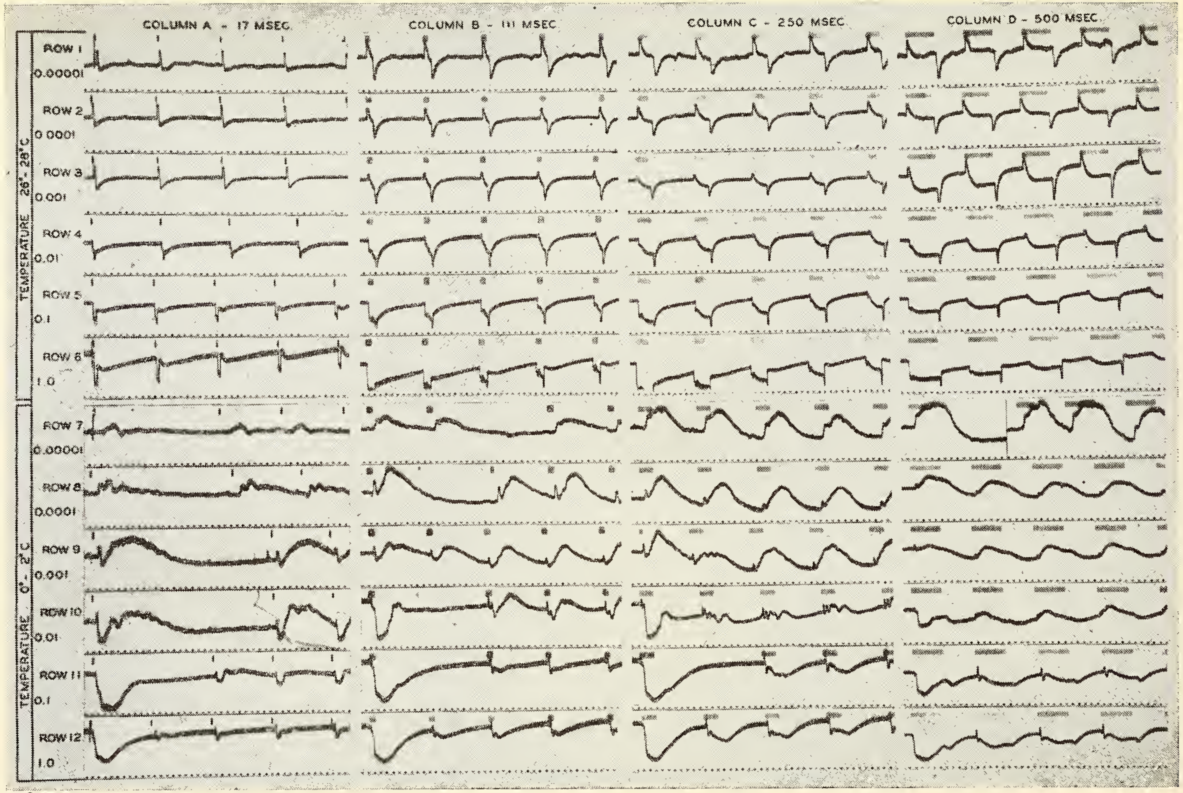

FIG. 2. Photographs of electric responses obtained from the photoreceptor of Cynomya. The responses have been arranged in columns (A through D) according to the duration of the light stimulus, in rows (1 through 12) according to the intensity of the light stimulus and in two blocks according to the temperature of the eye. Records in rows 1 through 6 were obtained with the eye at 26–28° C.; records in rows 7 through 12 were obtained with the eye at 0–2° C. The intensity is given as fractions of unit intensity, which is approximately 10,000 foot candles. Time lapse is indicated by the dots at the bottom of each record; the distance between consecutive dots represents 0.1 second.

d-wave. Following the d-wave there is a slow return to the base line. The b-wave is sometimes preceded by an a-wave, but the a-wave is usually seen as a notch on the b-wave. (record 6A, Figure 2). Upon light adaptation the magnitude of this response decreases slightly, the a-wave notch becomes more prominent, and the return to the base line is more rapid.

When the stimulus is similar to the above but of a low intensity (0.00001 unity) the electrical response consists of an a-wave, followed by a small negative deflection which is probably a d-wave (record 1A, Figure 2). This response changes a little upon light adaptation.

As the intensity of the stimulating light is increased, the exposure and temperature remaining constant, the positive a-wave spike gradually diminishes, eventually becoming a notch on the b-wave which increases in magnitude as the intensity approaches unity and becomes distinct from the d-wave at 0.1 unit intensity (records 2A, 3A, 4A, and 5A).

B. Changes produced by intensity at long exposures.

The response of the eye to a half-second light stimulus of unit intensity is a rather complex negative wave (record 6D, Figure 2). The wave starts with a downward deflection, the b-wave, on which there is an a-wave notch. There is a c-wave which is followed by a spike-like d-wave, and the response is terminated by a slow return to the base line. Upon light adaptation the magnitude of the b-wave decreases, and the response begins with a small positive deflection or a-wave. The d-wave also increases in size as light adaptation proceeds.

When the stimulus is similar to the above but of a low intensity (0.00001 unity) the response consists of two spikes, an initial positive a-wave spike and the terminal negative d-wave spike. The intermediate b- and c-waves are entirely absent (record 1D, Figure 2).

As the intensity of the stimulus is increased the c-wave makes its appearance (record 3D, Figure 2) and the a-wave becomes smaller and disappears (records 3D and 4D, Figure 2). The b-wave is seen as a slight hump on the c-wave (3D1) and later as a distinct peak (4D1 and 6D1). The d-wave is persistent throughout the intensity changes and becomes more spike-like at the higher intensities (compare records of column D, 1 through 6).

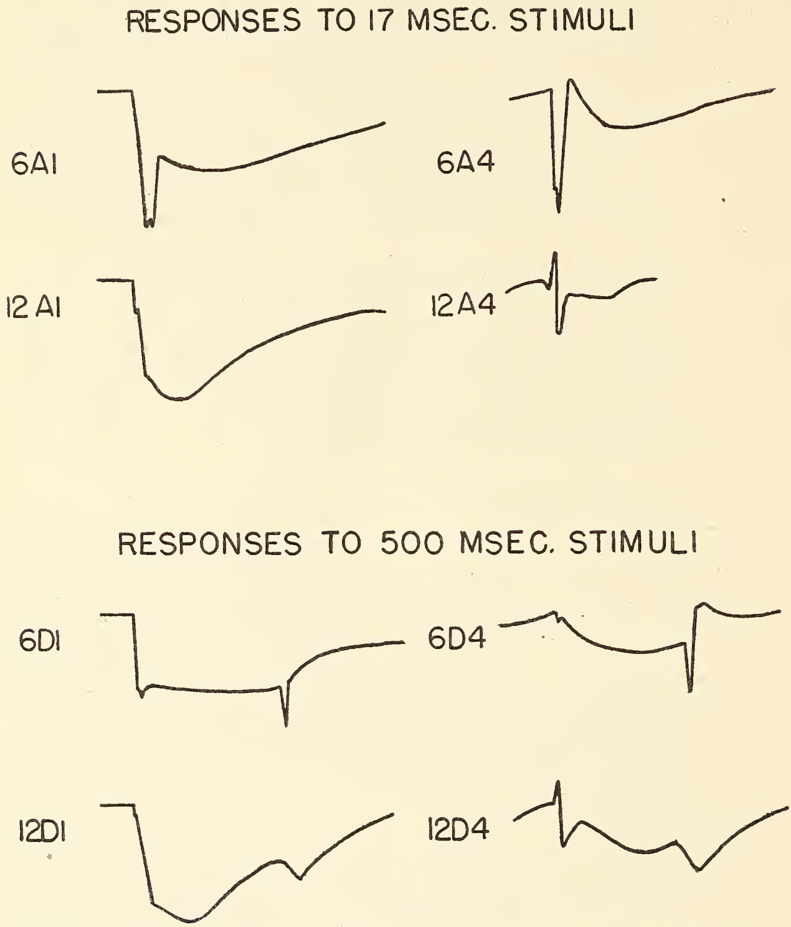

FIG. 3. Enlarged drawings of records selected from Figure 2. The numbers refer to the original records in Figure 2.

C. Changes produced by intensity at intermediate exposures.

The wave form of the electroretinogram elicited by stimuli of exposure of 111 and 250 msec. is similar to those already discussed and hence needs little further elaboration. The d-wave which is very small at 17 msec. is as large as the a-wave at 111 msec. (1A and 1B, Figures 2) and changes little as the duration of flash is increased. The b-wave gradually replaces the a-wave with increasing intensity as in 17 or 500 msec. exposures.

II. THE ELECTRORETINOGRAM OF *Cynomya* AT LOW TEMPERATURE (0–2° C.)

A. Changes produced by intensity at short exposures.

With a short (17 msec.) exposure of unit intensity the initial response of the dark-adapted eye near zero ° C. is a negative wave consisting of a sharp b-wave, bearing a notch, which is presumably the a-wave, and a rather slow c-wave. The response is terminated by a slow return to the base line (record 12A, Figure 2). This response is strikingly modified by light adaptation, as can be seen from the succeeding responses on the same record. These are characterized as consisting of an a-wave spike, a small b-wave and a small c-wave. This type of response is perhaps better illustrated in the responses of record 12B, Figure 2, in which the c-wave is better developed.

With a short exposure of low intensity (0.00001 unity) the response consists of a slow and relatively long positive wave (record 7A, Figure 2) which undergoes little modification upon repetitive stimulation. As the intensity increases this slow positive wave is differentiated into an a-wave spike and a slow positive component whose classification is uncertain. Further increases in intensity result in a reduction of the a-wave, the appearance of a b-wave and an increase in the magnitude of the slow positive component (record 9A, Figure 2). As the intensity approaches unity the a-wave completely disappears and the slow positive component is replaced by a slow negative component as seen in the first response of record 12A, Figure 2.

B. Changes with intensity at long exposures.

When the light stimulus is of unit intensity and 0.5 seconds long, the initial response is a negative wave similar to that initiated by the short stimulus. The response consists of a b-wave which bears the a-wave as a notch near the top, an atypical c-wave and a much reduced d-wave or off effect. The succeeding responses are very much modified and exhibit an initial a-wave spike (probably arising from the notch on the b-wave), a small b-wave and a c-wave. The d-wave is present but is not spike like (record 12D, Figure 2).

At low intensity (0.00001 unity) the half-second exposure elicits a large slow positive wave which bears a number of irregularities difficult to identify (record 7D, Figure 2). In record 8D, Figure 2, it can be seen that the first of these irregularities has been slightly isolated from the rest of the response and is probably the a-wave. In record 9D, Figure 2, the a-wave is still more prominent, and the slow wave has decreased in magnitude. These tendencies are accentuated as the intensity is further increased (record 10D, 11D, and 12D, Figure 2), and the slow positive wave is gradually replaced by the slow negative wave. The d-wave does not become typical until the intensity is 0.1 unity (record 11D, Figure 2).

C. Responses at intermediate exposures.

The changes resulting from intensity differences at exposures of 111 and 250 msec. are essentially similar to those already discussed. It is perhaps necessary only to point out the responses of records 10B and 10C, Figure 2, which attain a considerable complexity which is quite constant for this intensity, exposure and temperature. It is not proposed at present to identify the numerous spikes which are present in this response.

III. THE EFFECT OF TEMPERATURE ON LATENT PERIOD

In general, the latent period of the electrical response of the eye is greater the lower the temperature. It is, however, also quite apparent that the latency varies with the intensity of the stimulating light. Latencies measured on records 7A, 12A, 1A and 6A are given in Table I.

TABLE I
LATENCY OF ERG

	Low intensity (0.0001)	High intensity (1.0)
0– 2° C.	0.18 sec.	0.045 sec.
26–28° C.	0.03 sec.	0.015 sec.

DISCUSSION

In previous publications from this laboratory the variation in wave form and magnitude of the ERG has been described for several insects under a variety of conditions, and it has been stated that most of these variations could be explained as the resultant of three components. However, no overt attempt was made to do so except in *Trimerotropis* where the ganglion potential is measured as part of the ERG (Jahn and Wulff, 1942), but even in that publication no effort was made to carry the three component theory to its logical conclusion for the various peaks of the ERG. *Cynomya* seems to be very favorable material for the study of the component hypothesis because of the presence of all four of the peaks (a-, b-, c-, and d-waves) recorded from other eyes and an additional prolonged positive wave which might be homologized with P III.

Therefore, in the present discussion it is proposed to assume that the insect ERG is the sum of three components similar to those assumed for the vertebrate eye (Granit, 1933) and to make an unbiased examination of the difficulties to which this assumption leads us. The variations and possible origins of each wave will be considered individually.

The a-wave

In the response of *Melanoplus* to very low intensities, the a-wave appears as a typical positive spike. As the intensity is increased the combined b- and c-waves become prominent and the a-wave becomes a notch on the front of the b-wave. When the intensity is greater than fifty foot-candles the a-wave notch is usually imperceptible (Jahn and Crescitelli, 1938; Crescitelli and Jahn, 1939). In *Trimerotropis* there is a notch on the b-wave, but the possible presence of a typical a-wave has not been investigated. This b-wave notch increases with slight light adaptation but disappears if light adaptation is prolonged (Jahn and Wulff, 1942).

In cecropia and polyphemus moths the a-wave is present in the response of the dark-adapted but not of the light-adapted eye. During dark adaptation the a-wave appears first as a notch on the descending phase of the b-wave and migrates forward over the b-wave until it becomes the initial wave. In Hydrous a-waves have not been detected. In *Chlœnius* the a-wave is absent in the day phase, and is present in the night phase only when the eye is dark adapted. In *Dytiscus* the a-wave is quite prominent at both low and high intensity during both the day and night phases, and during light adaptation it first decreases and then increases in prominence (Wulff and Jahn, 1943).

In the present data on *Cynomya* at 26–28° C., the a-wave is typically present at low intensities and becomes a notch on the b-wave at high intensities (as in *Melanoplus*), and it also becomes more prominent with light adaptation (3D, 4D, 5D, 5C, Figure 2). At 0–2° C. the a-wave is prominent, especially at low intensities. At high intensities in the dark-adapted eye it is a notch on the b-wave, but it becomes a prominent and typical a-wave as a result of light adaptation (rows 11 and 12, Figure 2).

In vertebrates the a-wave is supposed to result from the sharp rise of P III. In *Trimerotropis* the notch on the b-wave arises from the ganglion potential. If, for purpose of discussion, we consider this notch the equivalent of an a-wave, we may then consider the a-wave to result from the ganglion potential. The ganglion potential, then, must rise more sharply than the eye potential when the eye is stimulated with low intensities and also when partially light adapted. If one assumes that the magnitude of the recorded ganglion potential varies much less with intensity and slight adaptation than the EMF in the eye, then this explanation becomes plausible. If the EMF of the sense cells is a measure of the amount of photochemical product present (Peskin, 1942; Wulff, 1943; Jahn and Wulff, 1943, Jahn, 1944) then it should be greater in response to high intensity in the dark-adapted eye than in response to low intensity under any condition of adaptation or to high intensity in the light-adapted eye. Under either of these latter conditions, the relative magnitude of the ganglion potential would be greater. This explanation would fit the present data, and that for *Melanoplus,* but not that for *Samia cecropia* and *Polyphemus* where the a-wave increases with dark adaptation. The explanation of the behavior of the a-wave of *Dytiscus* and *Chlœnius* is also apparently complex.

The b- and c-waves

The b- and c-waves are consistently present in the ERG of all insects so far studied. In *Melanoplus* the major wave in response to a short flash on the dark-adapted eye is the combined b- and c-waves, and these may be separated by light adaptation (Jahn and Crescitelli, 1938), especially if the exposure is prolonged and made repetitive (*e.g.,* half-second flashes, one per second). These waves are greatly prolonged and decreased in voltage by low temperatures (especially below 10° C.), and the c-wave is also decreased by temperatures above 25° C. so that at 40° C. the response to a brief flash consists only of a b-spike. In *Trimerotropis* and in *Basilarchia* the b- and c-waves are quite prominent (Jahn and Wulff, 1942; Crescitelli and Jahn, 1942) and distinct from each other. In *Cecropia* and *Polyphemus* and in *Chlœnius* and other beetles, the b-wave may consist of two peaks (Jahn and Crescitelli, 1939).

In all species studied the b- and c-waves are decreased in voltage by light adaptation. In *Melanoplus* the wave form is not appreciably changed by removal of the optic ganglion (Jahn and Wulff, 1942), and it has been assumed that at least in *Melanoplus* the b- and c-waves are closely linked with the photochemical reaction (Wulff and Jahn, 1943; Wulff, 1943). The effect of temperature (*i.e.,* the variation of temperature coefficients with adaptation and temperature range) can be explained by assuming the photochemical product is the catalyst for the potential producing reaction. In species where the wave form is more complex, and especially when the ganglion potential may be recorded from the front of the eye (*e.g., Trimerotropis,* Jahn and Wulff, 1942) the measured voltage may not be directly related to the photochemical reaction.

In the present data the b- and c-waves are typical of those for the diurnal insects studied in that the magnitude increases with intensity and decreases with light adaptation. This decrease with light adaptation is especially prominent at low temperature where the recovery process should be greatly retarded. At low temperature the c-wave is greatly prolonged as in *Melanoplus.* One outstanding feature of the present records is the apparent reversal in polarity of the c-wave at low temperature and low intensity (rows 7, 8, and 9, Figure 2). This prolonged positive wave which is not considered to be the c-wave, will be discussed below.

On the theory of three components the b-wave is caused by the spike of P II and the c-wave by P I. These components, then, especially P I, may be considered to decrease with light adaptation and to increase with intensity.

The d-wave

The d-wave occurs after the cessation of illumination and is usually detectable as a distinct wave only if the flash is one-half second or more in duration. The d-wave is absent from the dark-adapted eye of *Melanoplus* but is present in the light-adapted eye (Jahn and Crescitelli, 1938; Crescitelli and Jahn, 1939). It is quite prominent in the dark-adapted eyes of *Trimerotropis* (Jahn and Wulff, 1942) and *Basilarchia* (Crescitelli and Jahn, 1942) but seems to be completely absent in *Samia cecropia* and *Dytiscus* (Jahn and Crescitelli, 1939; Jahn and Wulff, 1943a) and in all other moths and beetles studied. In *Trimerotropis* the d-wave disappears with removal of the optic ganglion as does the notch on the b-wave.

In the vertebrate eye the occurrence of a d-wave is closely associated with the occurrence of an a-wave, and both are supposed to be the result of rapid changes in the voltage of P III. The factors which control the occurrence of the d-wave are more complex than those which control the a-wave in that the former is the result of summation of three components rather than of only two as is the a-wave. In *Trimerotropis* the d-wave and the notch on the b-wave are also associated in that they result from the summation of the voltage from the ganglion and that from the eye.

In *Cynomya* at 26–28° C. the d-wave is more prominent than in any of the other insects studied, even *Trimerotropis.* Its voltage is only slightly affected by intensity, becoming somewhat smaller and more spike-like at high intensities (colums C and D, Figure 2), and slightly larger with adaptation (6C, 6D). At low intensities the a- and d-waves (rows 1 and 2, columns B, C, and D) are of approximately equal voltage and of very similar waveform. At 0–2° C. the d-wave is present but of decreased voltage and increased duration (5D and 6D).

The prolonged positive wave

The most unusual characteristic of the present records of *Cynomya* is the prolonged positive (*i.e.*, front of the eye becomes positive) wave found at low temperature and low intensity (rows 7 and 8, Figure 2). The only other prolonged positive wave we have ever recorded from insects was from injured eyes of *Trimerotropis* (Jahn and Wulff, 1942) and because of the conditions of the experiment these have so far been disregarded. The prolonged positive wave of *Cynomya* is quite constant in its occurrence and was found in every animal examined at low temperature and low intensity. The effect of low temperature is reversible; if the animals are again placed at 26–28° C. records similar to rows 1–6 are obtained. In vertebrate eyes P III, whenever it occurs alone, is supposed to constitute a "negative" wave. Since in the vertebrate literature the voltage change is considered in relation to the back of the eye (*i.e.*, back of the eye becomes negative) the negative wave of vertebrates has the same polarity as the positive wave of *Cynomya*. Therefore, we may tentatively consider the prolonged positive wave to represent P III.

Since the normal ERG is assumed to be composed of three components we must consider that components I and II are affected more by temperature than component III. The difference, for instance, between record 7D1 and record 1D1 would be explained by a decrease in record 7D1 of components I and II, especially of P I. Since the prolonged part of P II is of low voltage, the level of the measured voltage a quarter of a second after beginning of illumination is mostly a balance between I and III. At 26–28° C. this balance occurs at intensities of 0.00001 and 0.0001 units; at 0–2° C. the balance is about 0.001 for the first flash and between 0.001 and 0.01 for later flashes. If P III is only slightly affected by intensity and partial light adaptation, then P I must increase with intensity and decrease with light adaptation, as has been assumed above (section on the b- and c-waves). It also seems necessary to assume that P III is affected only slightly by temperature. Components I and II are apparently decreased in voltage by low temperature but are also somewhat prolonged (*e.g.*, 9D, where the increase of negativity continues after cessation of stimulation). This is in accordance with the behavior of the c-wave of *Melanoplus* (Crescitelli and Jahn, 1939).

A prolonged "negative" wave (P III) has been recorded numerous times from vertebrate eyes (literature cited by Kohlrausch, 1931; Granit, 1933, 1938; Therman, 1938). It occurs under conditions of etherization, asphyxiation, high concentration of potassium ions, low temperature, and in isolated retinas during degeneration. The effect of low temperature is strictly reversible in the frog eye (Nikiforowsky, 1912), and for many years this was one of the major items of evidence that P III is a normal component. Crescitelli and Jahn (1939a) made an unsuccessful attempt to produce a pure "negative" wave with the eye of *Melanoplus.* At zero ° C. the ERG became reduced in voltage and prolonged, but the polarity was never reversed. In contrast to these results on *Melanoplus,* the polarity of the ERG of *Cynomya* has been reversed in every animal examined. However, in *Cynomya* the reversal occurred only at intensities considerably below the range used by Crescitelli and Jahn on *Melanoplus.*

Applicability of the three-component theory

It seems apparent that if one assumes three components similar in wave-form to those assumed for the vertebrate eye, the present records on *Cynomya* and also other published records from *Melanoplus, Trimerotropis,* and *Basilarchia* can be explained on a logical basis. The next consideration is whether or not these components have a real existence in the insect eye, and if so, whether or not they are homologous to the components of the vertebrate eye. This leads us directly to the question of where the components originate in the insect eye.

In *Trimerotropis* there are at least two components: one positive and one negative. In *Melanoplus* the positive component is greatly reduced. In *Cynomya* the reversal of polarity at low temperatures is best explained by assuming two opposed components, and the changes in the b- and c-waves make the assumption of three components seem plausible.

The alternative explanation to the three-component theory would be that one process may produce a potential of different wave form as the intensity, temperature, and state of adaptation are varied. For purposes of experimental treatment it is easier to consider only changes in magnitude or duration for each of several processes.

If P III is considered to be the ganglion potential, then it undoubtedly makes a considerable contribution to the ERG of *Trimerotropis* and presumably at low intensities (especially when the temperature is low) to the ERG of *Cynomya.* In *Melanoplus* the ganglion potential apparently contributes little to the ERG at high intensity but might be the cause of the a-wave at low intensity.

In the vertebrate eye P III is the least affected by most chemical agents and low temperature. However, it is the most susceptible of the components to ethyl alcohol (Bernhard and Skoglund, 1941). The action of these agents on the ganglion potential is unknown. Furthermore, the experiments of Granit and Eccles (1932, unpublished) and of Granit and Helme (1939) that antidromic impulses in the nerve do not affect the ERG indicate that no component originates in the ganglionic layer of the retina. Therefore it seems best to reserve judgment on the possible homology of the positive wave of *Cynomya,* the ganglion potential, and P III.

Another disturbing thing about the possible homology of P III and the ganglion potential is that the ganglion potential would be less sensitive to low temperatures than the components which we have assumed above to be catalyzed by the photochemical product (*i.e.*, P I and P II). If a ganglion potential can exist when the b- and c-waves are undetectable, then the theory that the electrical change in the eye initiates the nerve impulse should be re-examined. One possibility which has not been investigated is that low temperature may produce a positive wave in the deganglionated eye and that the positive wave of *Cynomya* does not arise in the ganglion.

Another group of data which at present can not be explained on the tricomponent theory are those in which the c-wave is greatly prolonged (moths, and beetles during the night phase of a diurnal rhythm). The origin of this large and greatly prolonged c-wave has not been determined, but its presence clearly separates the electroretinograms into two groups—those with and those without the prolonged c-wave, the former being nocturnal and the latter diurnal. The animals with a long c-wave may also have a double spiked b-wave of unknown origin.

From the foregoing analysis it is clear that apparently insurmountable problems present themselves in any attempt to homologize the components of vertebrate and insect electroretinograms. We may consider, then, that the components of the insect eye may have quite different origins from components of similar sign and wave form in the vertebrate eye.

The next question is, "Where do the components originate?" For the insect eye the only evidence is that obtained by Jahn and Wulff (1942) who found that both the eye and the ganglion contributed to the ERG. Although this same question cannot be answered yet with any certainty for vertebrates, there are several lines of research which seem promising.

The complexity of the retinal action potential increases with increasing complexity of the retina and with increasing complexity of the receptor-conductor relationships. For example, the electrical response obtained from the eye of *Limulus* (Hartline, 1927–28), which has a single layered receptor and a simple ganglion free retina-nerve relation, is a simple monophasic negative potential. Other arthropods, such as the grashopper *Trimerotropis* (Jahn and Wulff, 1942) perhaps possessing a dual retina (Hanstrom, 1928) exhibit more complex responses. However, upon removal of the optic ganglion *Trimerotropis* exhibits a response similar in simplicity to that obtained from *Limulus*. Most vertebrates, possessing dual retinas of variable rod-cone composition, exhibit a characteristic complex retinal action potential. However, in the tortoise, *Testudo grœca,* which has almost no rods, Bernhard (1941) has shown that P III dominates the ERG and that P III is correlated with cone vision. In complex retinas P III is correlated with pre-excitatory inhibition which is supposed to be a feature of the synaptic organization of the cones (Granit, 1944). Furthermore, Adrian (1944) has demonstrated that the wave form of the ERG of man varies with wave-length of the stimulating light, depending upon whether rods, cones, or both are stimulated.

It seems likely that some of the complexity of the vertebrate and some invertebrate electroretinograms may be attributed to the involved structural (Walls, 1942) and functional (Adrian and Matthews, 1927, 1927a, 1928) receptor-conductor relationships. The researches of Adrian (1931, 1937) and Eccles (1943) and others adequately describe the occurrence of slow negative potentials in all ganglia and synapses which are excited by nerve impulses. In fact, to quote Eccles (1943), "It has been shown that synaptic transmission may be mediated by the local negative potential (the synaptic potential) which is set up by a nerve impulse incident upon a nerve cell." In view of the intricate receptor, nerve, ganglia and synaptic relationships of the vertebrate photoreceptor, it is probable that slow negative potentials of retinal neurones and synapses play a part in the slow action potential obtained from the eye. This view has also been expressed by Adrian and Matthews (1928) in a discussion of their work on the eel, *Conger vulgaris.*

The latent period

In *Cynomya* the latent period of the ERG increases with lowering of the temperature; a similar effect is found for *Melanoplus* (Crescitelli and Jahn, 1939). The present data also show that the latent period of *Cynomya* decreases with increasing intensity; this is also true for *Melanoplus* (Crescitelli and Jahn, 1939, and unpublished data; this effect is not shown in the published records of Jahn and Crescitelli, 1938, because of errors introduced in the process ot engraving). However, no careful study of the variation in latent period under various conditions has been made for any of the insects studied.

SUMMARY

The electroretinogram of *Cynomya* was studied at two temperatures over a wide range of intensity and flash duration of the stimulating light. At 26–28° C. and low intensity the response to a 17 msec. flash is a sharp a-wave (positive). As the intensity is increased the response becomes diphasic and then becomes a typical complex b-c-wave (negative). As the flash duration is increased these same changes occur and in addition a spike-like d-wave appears, even at the lowest intensity used. At 0–2° C. the low intensity brief flash resulted in a prolonged positive

wave. As the intensity is increased the response becomes diphasic and then complex and negative. As the duration is increased the positive wave at low intensities is prolonged and the complex negative wave at high intensities becomes somewhat similar to that at 26–28° C. except that the d-wave is less pronounced and the a-wave much more pronounced.

The existence of these complex wave-forms is discussed from the viewpoint of the tricomponent theory. It is concluded that although a three component theory might explain the results it is not possible that the components could have the same significance as those of the vertebrate eye.

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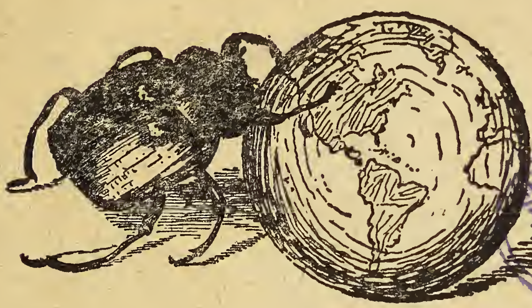

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A REVISION OF THE SPECIES OF EXOMALOPSIS INHABITING THE UNITED STATES (HYMENOPTERA, APOIDEA)[1]

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The genus *Exomalopsis* comprises mostly small anthophorids of neotropical origin. Species of this genus are distributed from Nebraska, Colorado, and central California in the United States southward to Argentina. In this paper the species inhabiting the United States are tabulated and ten new species from southern California and Arizona are described, as well as another new species from Mississippi. The types of the new species are deposited in the entomological collection of the University of California Citrus Experiment Station, Riverside, except that the types of *E. micheneri* have been returned to the collector.

KEY TO THE SPECIES OF *EXOMALOPSIS* OF THE UNITED STATES

Females

1. Hind knee-plate very large, stigma generally large (*Exomalopsis,* s. str., clypeus of male dark) 2
   Hind knee-plate small; stigma small (subg. *Anthophorula,* clypeus of male yellow) 5
2. Abdomen with a narrow, white, fringe-like, apical band on tergites 2 to 4; face gently convex; ocelli small, widely separated from eyes; posterior half of mesoscutum polished, impunctate 3

[1] Paper No. 556, University of California Citrus Experiment Station, Riverside, California.

Abdomen with a broad band at apex of tergites 3 to 5, and an oblique line of pubescence on each side of tergite 2; face very flat; ocelli large; mesoscutum closely punctured, except a transverse area at base (Texas) .... 1. *zexmeniæ* Ckll.

3. Larger species, 8–9 mm. long; black hair on mesoscutum scanty; middle joints of flagellum longer than wide 4

About 7 mm. long; black hair around margins of nude area on mesoscutum more pronounced; mesopleura closely punctured; middle joints of flagellum no longer than wide (New Mexico, Arizona, California) .... 3. *solidaginis* Ckll.

4. Hair of legs light, the scopa pale ochreous or yellowish white, brighter on basitarsus, the hair on inner side of latter ferruginous (Arizona, New Mexico, Texas, Colorado) .... 4. *solani* Ckll.

Hair of middle tibiæ fuscous; scopa pale rufo-fulvous, deepening in color on the basitarsus; hair of thorax tinged with fulvous (Texas). 5. *birkmanni* Ckll.

5. Mesoscutum with posterior half nude and impunctate 6

Mesoscutum punctured all over or with a small impunctate area on posterior middle 11

6. First tergite with a strong arcuate carina at summit of the basal declivity 7

No carina at summit of basal declivity, the disk of first tergite with minute sparse pubescence at base; lobes of maxillæ very long and hairy; hair on inner side of hind basitarsus fuscous; length, 6.5 mm. (California) .... 22. *chionura* Ckll.

7. Tergites 2 to 4 covered with whitish pubescence, thinner at the base, the base of 2 more or less nude 8

Base of tergites 2 to 4 with black pubescence, the apical bands dense, pale ochreous or whitish and distinctly broader in middle than at the sides; length, about 6.5 mm. (California) .... 7. *albicans* (Prov.)

8. Anterior third or fourth of mesoscutum punctate and conspicuously hairy 9

Mesoscutum almost entirely nude and impunctate, being minutely punctate and thinly provided with very short, fine, appressed hair on anterior margin, narrowly at sides and more broadly in the middle; length, about 6 mm. (California, Arizona) .... 8. *albata* n. sp.

9. Stigma larger, three times, or a little more, longer than wide; hair of anterior part of mesoscutum long and erect 10

Stigma about two and one-half times longer than wide; hair of anterior part of mesoscutum short (California) .... 9. *eriogoni* n. sp.

10. About 5.5–6 mm. long; punctured area of mesoscutum broadened in middle, the punctures extending to tip of the median impressed line (California) .... 10. *deserticola* n. sp.

About 6.5 mm. long; punctured area of mesoscutum more transverse, its hairs as long as those on apical margin of scutellum (Arizona). 12. *gutierreziæ* n. sp.

11. Abdomen red 12
Abdomen black 14
12. Smaller species, 3.5–4.5 mm. long; hair of mesoscutum and scutellum, except marginal bands, mainly fuscous or black; first tergite with a carina at summit of basal declivity. 13
About 6 mm. long; mesoscutum almost nude, very finely and rather sparsely punctured; abdomen shining, impunctate, the first tergite without a carina (New Mexico) .... 21. *sidæ* Ckll.
13. Three submarginal cells; mesoscutum finely and closely punctured; hair on inner side of hind basitarsus black; length, 4.5 mm. (Arizona, Texas) .... 19. *rufiventris* n. sp.
Two submarginal cells; mesoscutum a little more sparsely punctured; hair on inner side of hind basitarsus ferruginous; length, 3.5–4 mm. (Arizona) .... 20. *euphorbiæ* n. sp.
14. Mesoscutum strongly and densely punctured throughout, first tergite with a strong carina, behind which the disk is trenchantly divided into the apical depression and elevated basal area 15
Mesoscutum less closely punctured, sometimes with an impunctate area on posterior middle; carina of first tergite generally weak or absent, and apical depression more or less weakly impressed 17
15. Three submarginal cells 16
Two submarginal cells; hair of mesoscutum short, mosslike, mainly light; hair on inner side of hind basitarsus ferruginous (black in female, from Bexar Co., Texas); wings slightly darker at apex; length, 6–7 mm. (Texas, New Mexico, Arizona).
14. *compactula* (Ckll.)
16. Hair of mesoscutum longer, less mosslike than in *compactula,* more tinged with brown; hair of scopa mostly tinged with fuscous and black on inner side of basitarsus; wings hardly darker at apex; length, about 6 mm. (New Mexico, Texas) .... 15. *completa* Ckll.
Hair of mesoscutum pale fuscous, longer than in *completa;* scopa ochreous white, tinged with fuscous on outer base of tibia and sometimes on outer side of basitarsus, the simple hairs on inner side of latter more ferruginous; wings small, almost uniformly dusky; length, 6–7 mm. (California) .... 16. *torticornis* Ckll.
17. Band on first tergite broadly interrupted in middle; carina at summit of basal declivity rather weak or vestigial 18
Band on apical depression of first tergite complete, although thinner at middle where it recedes from margin; carina of first tergite well developed; punctures of mesoscutum moderately close, with a small impunctate space on posterior middle; length, about 6 mm. (California) .... 18. *cerei* n. sp.
18. Tergite 1 distinctly punctured on each side of disk, or on the basal elevated area 19
Tergite 1 shining, with apical depression very weak, the punctures sparse and extremely faint, and the carina vestigial; punctures of meso-

scutum very fine, leaving an impunctate area on posterior middle; length, about 5 mm. (Texas) .... 23. *texana* Friese

19. Punctures of mesoscutum close or moderately close, usually about two to three puncture-widths apart 20

Mesoscutum sparsely punctured, the punctures on posterior half of disk scattered and remote; scopa of hind tibia ochreous, more or less brown on the basitarsus, and on the base of tibia above; simple hairs on inner side of basitarsus ferruginous; length, about 7 mm. (California) .... 24. *nitens* Ckll.

20. Stigma comparatively large, about four times longer than wide 21

Stigma small; small species about 6 mm. long 22

21. Larger species, 7–8 mm. long; mesoscutum rather sparsely punctured, the puncture mostly three to four puncture-widths apart, and fine and sparser on the posterior middle of disk; stigma and nervures ferruginous (Nebraska, Colorado, Texas) .... 25. *pygmæa* (Cress.)

Small species about 6 mm. long; mesoscutum closely punctured, the punctures hardly sparser on posterior middle; stigma and nervures brown, tinged with fuscous (Mississippi) .... 26. *micheneri* n. sp.

22. Wings slightly reddened, stigma and nervures ferruginous; scopa pale ochreous, becoming fuscous on base of tibia above and tinged with fuscous on posterior side of basitarsus; simple hairs on inner side of basitarsus ferruginous (New Mexico) .... 27. *chlorina* Ckll.

Wings dusky grayish, the stigma and nervures dark; hair on inner side of basitarsus fuscous (Texas) .... 28. *morgani* (Ckll.)

MALES

1. Face entirely dark (*Exomalopsis*, s. str.) 2

Clypeus, labrum, and usually base of mandibles, yellow or whitish 5

2. Hair of hind basitarsi almost as long on anterior as on posterior side 3

Hair on posterior side of hind basitarsi distinctly longer, denser and more plumose than that on anterior side 4

3. Posterior disk of mesoscutum and middle of tergite 1 with black hair; wings dusky, darker at apex, the nervures piceous, the stigma more reddened; length, about 7 mm.; anterior wing, 6.1 mm. (Texas, New Mexico, Arizona) .... 4. *solani* Ckll.

Similar but smaller, wings clearer, with reddish brown stigma and nervures; tegulæ rufo-testaceous; flagellum a little shorter, more ferruginous; length, about 6 mm.; anterior wing, 5.2 mm. (New Mexico, Arizona, California) .... 3. *solidaginis* Ckll.

4. Antennæ, legs, tegulæ, stigma, nervures, and sides of first tergite ferruginous; pubescence ochreous, rather dense, the hair on posterior side of hind basitarsus mainly fuscous; length, 7 mm. (Texas). 2. *snowi* Ckll.

Scape, legs, and sides of first tergite dark; hair of hind basitarsus light; wings dusky hyaline, with dull ferruginous stigma and nervures; length, about 6 mm. (Texas) .... 1. *zexmeniæ* Ckll.

5. Flagellum slender, simple (*Anthophorula*) 6
Flagellum thickened, the middle segments a little serrate beneath, the apical joint flattened and curved; scape yellow, long and rather thick; length, about 5 mm. (Arizona).
6. (*Pachycerapis*) *cornigera* Ckll.
6. Flagellum rather stout, bulging at base on lower side, where it is excentrically joined with pedicel 7
Flagellum generally longer and more slender and normal at base 10
7. Joints of flagellum, except the first one or two joints, each with a black spot behind 8
A black spot at apex of the last joint only 9
8. Hind basitarsus, triquetrously expanded toward apex (with three faces), about thrice as long as wide; scape yellow beneath; black spots of flagellum smaller, triangular; wings with two submarginal cells; length, 5.5–6 mm. (Texas, New Mexico, Arizona).
14. *compactula* (Ckll.)
Hind basitarsus normal, about four times as long as wide; scape black; flagellum stouter, a little thickened toward base, the black spots large and transverse; wings with three submarginal cells (New Mexico, Texas) .... 15. *completa* Ckll.
9. Apical depression of tergites moderately wide, deeply impressed, closely punctate, that of first tergite reaching not quite halfway in middle to basal carina of disk; length, 5–5.5 mm. (California).
16. *torticornis* Ckll.
Apical depression of tergites broad, shining, feebly punctate, with broad impunctate apical margin, that of first tergite reaching a little more than halfway in middle to basal carina of disk; length, 5.5 mm. (California) .... 17. *palmarum* n. sp.
10. Abdomen red 11
Abdomen black 12
11. Mesoscutum finely, densely punctured; apical depressions and hair-bands of abdomen narrow; scape yellow beneath, hind tarsi and middle basitarsi dark; wings with three submarginal cells; length, 4 mm. (Arizonia, Texas) .... 19. *rufiventris* n. sp.
Mesoscutum more sparsely punctured; tarsi ferruginous; wings with two submarginal cells; length, about 3 mm. (Arizona).
20. *euphorbiæ* n. sp.
12. First tergite with a carina at summit of basal declivity; apical process of stipites slender 13
First tergite with carina very weak or absent; apical process of stipites broad, dilated, with a more or less quadrate area beneath at end, which is enclosed by carinæ and often set with short, stiff, erect hairs 18
13. Flagellum slightly crenulate on lower posterior margin, ferruginous, becoming brownish above and on the last three joints all around; hind

basitarsus armed with a group of long black bristle-like hairs near apex beneath 14
Flagellum not crenulated; hair on inner side of hind basitarsus light. 15

14. Abdomen distinctly banded, with hair at base of tergites 2 to 5 black; scape dark; length, 5–6 mm. (California) ...... 7. *albicans* (Prov.)
Hair of abdomen white, a little thinner at base of segments; scape more or less yellow beneath; length, 5 mm. (California, Arizona). 8. *albata* n. sp.

15. Mesoscutum with minute sparse punctures, more widely separated on posterior half 16
Punctures of mesoscutum comparatively coarse and close, becoming slightly sparser on posterior middle; pubescence white and dense; length, 5 mm. (California) .... 13. *albovestita* n. sp.

16. Hair of mesoscutum longer, erect, strongly plumose, but not tomentum-like, hardly concealing surface; hind basitarsus four to five times longer than wide 17
Hair of mesoscutum short, tomentum-like, mainly concealing the surface; hind basitarsus broadened, scarcely more than three times as long as wide; length, about 5 mm. (California) ...... 9. *eriogoni* n. sp.

17. Stigma of anterior wing about four times as long as wide; hair of abdomen entirely white; length, about 5 mm. (California). 10. *deserticola* n. sp.
Nervures nearly piceous, the stigma reddened, about three times as long as wide; hair at base of tergites brownish or fuscous; length, 5 mm. (California) .... 11. *varleyi* n. sp.

18. Mandibles without a yellow spot 19
Mandibles with a yellow spot at base 22

19. Head hardly broader than long, the eyes strongly converging below; mandibles comparatively small; hair of venter abundant and long 20
Head considerably broader than long, the inner margins of eyes parallel; mandibles long, stout, tapering; hair of venter rather sparse and short, becoming longer at sides of apical segments; length, 6–7 mm. (New Mexico) .... 21. *sidæ* Ckll.

20. Clypeus and labrum entirely yellow 21
Labrum and a triangular spot on middle of clypeus pale yellow; stigma rather large, about four times longer than wide. (Mississippi). 26. *micheneri* n. sp.

21. Base of tergites 2 to 6 with fuscous hair, the apical bands composed of thin, white, appressed plumose hair; wings dusky, nervures piceous; length, 6.5 mm. (Texas) .... 28. *morgani* (Ckll.)
Hair at base of tergites hardly darkened, the apical bands ochreous; wings hyaline, the stigma and nervures ferruginous; length, 7–8 mm. (Nebraska, Colorado, Texas) .... 25. *pygmæa* (Cress.)

22. Hair at base of tergites light or inconspicuously dusky 23
Hair at base of tergites 2 to 5 distinctly black, that on 6 and 7 entirely brownish fuscous; apical band on 1 to 5 dense, pale ochreous, and entire; length, 6–7.5 mm. (California) .... 24. *nitens* Ckll.

23. Apical bands of abdomen thin, ochreous, broadly interrupted medially on tergites 1 and 2; venter with a long preapical fringe on segments 3 and 4; wings clear, stigma and nervures ferruginous; length about 5 mm. (Texas) .... 23. *texana* Friese.
Apical bands of abdomen broad, dense, white and interrupted only on tergite 1, fringes of venter less developed; wings dusky hyaline, the stigma and nervures nearly black, length, 5.5–6.5 mm. (California) .... 22. *chionura* Ckll.

1. *Exomalopsis zexmeniæ* Cockerell.

Cockerell, 1912, Ent. News, XXIII, p. 447. Female.

This is a neotropical species that has been found at Point Isabel, Texas.

2. *Exomalopsis snowi* Cockerell.

Cockerell, 1906, Ann. and Mag. Nat. Hist., (7) XVIII, p. 73. Male.

This is known only in the male from Brownsville, Texas. It is undoubtedly a neotropical species and should occur in Mexico.

3. *Exomalopsis solidaginis* Cockerell.

E. solidaginis Cockerell, 1898, Ann. and Mag. Nat. Hist., (7) II, p. 452. Male.

E. verbesinæ Cockerell, 1904, Ann. and Mag. Nat. Hist., (7) XIV, p. 21. Female. (New synonymy.)

Although I know of no cases where the sexes have been taken together, the very close resemblance to *E. solani* Ckll. in both sexes makes it practically certain that *verbesinæ* is the female of *solidaginis,* and I report the synonymy with confidence. The type locality for both names is the Mesilla Valley, New Mexico. I collected females at flowers of *Gutierrezia,* Petrified Forest, Arizona, August 27, 1931, and Cockerell took one at Tempe, on *Heterotheca,* in October. On October 5, 1934, A. J. Basinger collected two females at flowers of *Gutierrezia lucida* at Yucca Valley, San Bernardino County, California, and on September 28 and 30, 1940, I found females rather common on *Gutierrezia* at the same locality. The species is new to California.

4. *Exomalopsis solani* Cockerell.

Cockerell, 1896, Canad. Ent., XXVIII, p. 25. Female.

The type locality is Albuquerque, New Mexico. It has been reported from Colorado (Pueblo), Texas (Brewster County), and from numerous localities in New Mexico and Arizona. The flower visits recorded are to *Solanum elæagnifolium, Verbesina, Isocoma wrightii, Chrysothamnus graveolens, Flaveria, Sphæralcea,* and *Cassia.* I have taken it in New Mexico and Arizona at flowers of *Cleome, Croton, Eriogonum, Larrea, Acacia, Verbesina, Baileya,* and *Petalostemon.*

5. *Exomalopsis birkmanni* Cockerell.

Cockerell, 1922, Ann. and Mag. Nat. Hist., (9) X, p. 265. Female.

This is known from a single female taken at Fedor, Texas, at flowers of *Antigonon leptopus,* in November. It may possibly prove to be only a race of *solani.*

6. *Exomalopsis* (*Pachycerapis*) *cornigera* Cockerell.

Cockerell, 1922, Amer. Mus. Novitates, XLVII, p. 5. Male.

This little-known species was taken in the Santa Catalina Mountains, Arizona, in July.

7. *Exomalopsis* (*Anthophorula*) *albicans* (Provancher).

Synhalonia albicans Provancher, 1896, Nat. Canad., XXIII, p. 27. Male.

Diadasiella coquilletti Ashmead, 1899, Trans. Amer. Ent. Soc., XXVI, p. 64. Male. (New synonymy.)

Michener examined Provancher's type and reported the above synonymy to me some years ago. With the correct generic position of *albicans* known, Provancher's description also indicates this synonymy.

The species is common in the cismontane area of southern California. It has been taken at the flowers of *Eriogonum fasciculatum, E. gracile, Hugelia virgata, Cryptantha intermedia, Trichostema lanceolatum, Frankenia grandifolia, Eschscholtzia californica, Stephanomeria virgata,* and *Brassica incana.* It flies at Riverside from May 30 to October 5. It extends northward along the coast at least to Monterey County, where it was taken by Michener in June and August, 1938, at the Hastings Natural History Reservation, Santa Lucia Mountains.

8. **Exomalopsis (Anthophorula) albata** new species.

Allied to *albicans* but differs in having no black or dusky pubescence on tergites and mesonotum. In the male of both species there is a group of coarse black bristles near apex of hind basitarsus, beneath. In *albata* these bristles are shorter, more equal in size, and arranged in a more or less arcuate row near the tip of the segment.

Female.—Black, the basal half of mandibles, labrum, margin of clypeus rather broadly, and venter, reddish ferruginous. Flagellum, tarsi, and hind tibiæ ferruginous. Tergites, tubercles, and legs sometimes a little reddened or brownish. Tegulæ testaceous brown. Wings clear hyaline, nervures piceous, the stigma reddened. Venation as in *albicans*. Frons shining, with minute scattered punctures normally concealed by the pubescence. Mesoscutum and disk of scutellum polished and impunctate, except for minute punctures on anterior margin of scutum, the punctures extending sparsely back in middle to the center of disk. Mesopleura finely punctured, the punctures about two puncture-widths apart on the upper anterior part and disappearing toward the middle coxæ. Abdomen virtually impunctate. Pubescence white, dense on face, cheeks, pleura and hind margin of pronotum. Mesoscutum nude except for extremely short appressed hair on anterior margin. Hind margins of scutellum and middle of metanotum with short, erect, coarse hair. Tergum of abdomen nearly uniformly covered with white tomentum, except a semioval, nude, shining space on apex of tergite 1 and a small, partially nude spot on each side of the base of 2. Hair on the basal declivity of tergite 1 rather short and erect. Tomentum on middle of apical margin of tergite 5, and at apex of 6, ferruginous. Hair of inner side of tarsi ferruginous, a little tinged with brown on hind basitarsi. Scopa of hind legs white. Length, 5.75–6.25 mm.; anterior wing, 4–4.2 mm.

Male.—Similar to female. Mandibles, except tips, labrum, clypeus and under side of scape more or less, pale yellow. Flagellum ferruginous, becoming brown above, the last three joints entirely brown. Small spot at base of front and middle tibiæ yellowish. Tarsi ferruginous. Apical tergite ferruginous, and margin of preceding segment ferruginous or testaceous. Mesoscutum polished, with minute, moderately close punctures, except for a small impunctate area on posterior middle. Disk of tergites, excepting most of apical depression, with fine close punctures. Pubescence white, much as in female, except that disks of mesoscutum and scutellum are covered with a short tomentum-like pubescence. Tergum of abdomen in contracted condition, nearly uniformly covered with white plumose hair, which is dense on the apical depressions. Hair of legs white, becoming ferruginous on inner side of hind basitarsi. Of the coarse black bristles at apex of hind basitarsus beneath, the fourth one from anterior margin is much thickened and strongly curved. Length, 4.5–5 mm.; anterior wing, 3.5 mm.

Holotype female, allotype and 2 males (paratypes), taken 4 miles south of Palm Springs, California, the female on *Eriogonum reniforme*, the males flying over ground or at rest on *Dicoria*, June 25 and 28, 1941; 1 male (paratype) 6 miles south of Palm Springs, on *Eriogonum trichopes*, June 8, 1937; 1 male, 2 females (paratypes), Beaver Dam, Mohave County, Arizona, on *Eriogonum trichopes*, June 20, 1939 (Timberlake); and 1 female (paratype), Victorville, California, July 4, 1937 (G. C. Varley). Also 2 females (paratypes) taken in quarantine from Blythe, California, July 7, 1937, in collection of C. D. Michener.

9. **Exomalopsis (Anthophorula) eriogoni** new species.

This and the next four species are allied to *albicans* (Prov.) but differ in having no black hair at base of tergites in the female. The males (that of *gutierreziæ* not known) differ in lacking the tuft of coarse black bristles on the hind basitarsus beneath, and in other small ways. The female of *eriogoni* hardly differs from that of *albata* except in having a larger, hairy, and more closely punctate area on anterior part of mesoscutum.

FEMALE.—Black, the mandibles except tips, labrum and margin of clypeus dark reddish. Venter ferruginous brown. Flagellum clear ferruginous. Tarsi, especially the hind pair and hind tibiæ in part, ferruginous, and often whole abdomen and legs more or less tinged with reddish. Tegulæ brownish testaceous. Wings clear hyaline, nervures and stigma dull ferruginous. Stigma small, hardly more than twice as long as wide. Frons polished, with very fine, moderately close punctures. Vertex impunctate. Mesoscutum and scutellum polished, the former with close fine punctures on middle of anterior half and scattered ones to each side. Mesopleura moderately closely punctured. Abdomen impunctate. Apical depression of tergites very broad, that on the first tergite twice as broad in middle as space intervening between it and carina at summit of basal declivity. Pubescence white, dense on face, cheeks, and pleura. Hair of disk of mesoscutum short and restricted to punctured area. Lateral margins of scutum and hind margin in front of scutellum with a line of very short erect hairs, which appear coarse because of their short, dense plumosity. Hind margin of scutellum and middle of metanotum, with similar, much longer hairs. Tergum of abdomen nearly uniformly covered with whitish, appressed, tomentum-like hair, but apical depression of tergite 1 is nude, except its basal margin, and the hair is thinner on the raised area of following segments, especially on that of tergite 2. Hair on each side of pygidium, and narrowly at apex of tergite 5, ferruginous. Hair of legs white, that on inner side of hind basitarsi, ferruginous. Length, 5.5–6 mm.; anterior wing, 4 mm.

MALE.—Similar to female, but smaller and more uniformly covered with white pubescence. Black, the mandibles except reddish tips, labrum, and clypeus, yellow. Tarsi ferruginous. Hind basitarsus broadened, about three times longer than wide. Flagellum clear ferruginous, more or less brownish behind, the joints not crenulated beneath and about one and one-half times longer than wide. Mesoscutum shining, minutely and moderately sparsely punctured. Mesopleura with coarse, close punctures, which are hardly more than a puncture-width apart. Elevated base of tergites very finely and rather closely punctured. Pubescence white, short, plumose and covering most of head, thorax and abdomen. Hair on posterior part of mesoscutum, on disk of scutellum and on elevated part of disk of tergite 2, thinner. Apical process of stipites (genitalia) slender, clavate and a little curved. Eighth ventrite with a small medio-apical plate, that is attached to base of segment by a short stalk. This plate about one and one-half times longer than wide, with sides converging to the stalk on basal third and less strongly converging beyond to apex. Apical half of disk of plate with the margins strongly elevated in a curve, then apically produced to form two appressed laminate lobes that are held vertical to plane of the disk, these parts forming a cavity with a circular opening. Length, about 5 mm.; anterior wing, 3.5 mm.

Holotype female and allotype collected 6 miles south of Palm Springs, California, at flowers of *Eriogonum trichopes,* May 30, 1930. Paratypes as follows: 2 males, 13 females, same data as types; 15 males, 4 females, 5 to 6 miles south of Palm Springs, June 8, 1930, on *Eriogonum* or resting on under side of leaves of *Dicoria* in heat of midday; 2 males, 12 females, same locality, June 8, 1937, on *Eriogonum* and *Hugelia virgata,* from both of which the females were collecting pollen; 1 female, on the same *Eriogonum,* 4 miles south of Palm Springs, June 25, 1941; 2 females, near Cathedral City, on *Pectis papposa,* November 11, 1939; 1 male, Thousand Palms, on *Eriogonum reniforme,* April 10, 1937; 1 male, 11 females, Yermo, all on *Cleomella obtusifolia,* except one on *Heliotropium spathulatum,* July 9, 1938; 5 females Yermo, on *Cleomella,* June 19, 1939 (all Timberlake), and 1 male, Mojave, California, June 8, 1938 (F. T. Scott).

Two females from Thousand Palms, April 10, 1937, are difficult to place. Both have the hair of anterior part of mesoscutum long, as in *deserticola,* and in one of them the stigma approaches the size seen in *deserticola.* The male taken with them definitely is *eriogoni.* Possibly the hair on anterior part of mesoscutum in the types of *eriogoni* is worn short throughout the series, and one of the females taken very early in the season at Thousand Palms may represent the normal condition, the other one possibly being referable to *deserticola.*

10. **Exomalopsis (Anthophorula) deserticola** new species.

Very similar to *E. eriogoni* but distinguishable by the larger stigma, the long erect hair on anterior part of mesoscutum in the female, and by differences in the tarsi and genitalia of the male.

FEMALE.—Agreeing with female of *eriogoni* in virtually all respects except that the hair on anterior part of mesoscutum is nearly as long as the erect hair on apex of scutellum, and stigma larger, about three times longer than wide. Length, 5.5–6 mm.; anterior wing, 4.3 mm.

MALE.—Agreeing closely with male of *eriogoni*. Flagellum more slender and slightly longer, the middle joints about twice as long as wide. Stigma larger. Basitarsi of middle and hind legs hardly widened, those of hind legs between four and five times as long as wide, and those of middle legs about six times as long as wide (in *eriogoni* these parts, respectively, about three and four times as long as wide). Pubescence of mesonotum, longer, plumose, but hardly tomentum-like. Apical process of stipites as seen from side rather broad basally, tapering apically to an acute point and about three times longer than wide; as seen from above rather slender and blunt at apex. Apical plate of eighth ventrite of the same style as in *erigoni*, but the apical lobes are held in a horizontal plane with the plate and are nearly semicircular in shape, with their inner edges almost touching each other. Surface of apical lobes covered with a very fine, short pubescence. Length, 4.75–5.5 mm.; anterior wing, 3.5–3.6 mm.

Holotype female and allotype collected at Cronise, Mojave Desert, California, at flowers of *Heliotropium spathulatum*, July 9, 1938 (Timberlake). Paratypes as follows: 2 males, 3 females on *Heliotropium*, 5 males, 1 female on *Chilopsis linearis*, and 2 males on *Asclepias erosa*, at Cronise, July 7 and 9, 1938; 2 females on *Heliotropium* and 3 males on *Cleomella obtusifolia*, Yermo, Mojave Desert, July 9, 1938; and 1 female on *Eriogonum reniforme*, at Yermo, June 2, 1941 (all Timberlake).

11. **Exomalopsis (Anthophorula) varleyi** new species.

Similar to *eriogoni*, but the male differs in the comparatively slender basitarsi of middle and hind legs, in the stouter flagellum, and in the apical appendages of the eighth ventral plate.

MALE.—Agreeing in most respects with the male of *eriogoni*, but differing in following characters: Flagellum a little stouter, the middle joints about one and one-fourth times as long as wide. Basitarsi of middle and hind legs considerably less broadened and virtually as in *deserticola*. The fine punctures of mesoscutum a little sparser and more uniformly scattered over the disk. Punctures on the elevated part of disk of tergites 1 to 3 a little closer and more distinct, although still very minute. Wings a little grayer, the nervures almost piceous, the stigma reddened in middle. Genitalia similar, but apical process of stipites more slender and less clavate. Apical lobes of the eighth ventral plate slender, linear, lying close together in a horizontal plane with disk of plate, and having their bases curved around the outer margins of plate. Length, 5 mm.; anterior wing, 3.5 mm.

The male differs from *deserticola* in the small stigma as well as in the characters of the genitalia and eighth ventral plate. The pubescence of type is badly worn but presumably agrees closely with *deserticola.* The tomentum, however, on the base of tergites 2 and 3, seems to be tinged with brownish, and the abdomen, therefore, in a perfect specimen may appear more banded than in *eriogoni* and *deserticola.*

One male (holotype) collected at Warren's Well, Mojave Desert, California, June 1, 1937 (George C. Varley).

12. **Exomalopsis (Anthophorula) gutierreziæ** new species.

The female agrees closely with *deserticola* in size of stigma and in having light hair at the base of tergites, but differs in larger size and in having punctures and pubescence of mesoscutum confined to a transverse band at anterior end of disk, and hair on each side of pygidial plate fuscous.

FEMALE.—Black, the middle of mandibles broadly, and labrum, reddened. Small joints of tarsi and flagellum ferruginous, the latter a little dusky above. Spurs pale testaceous. Tegulæ testaceous brown. Wings nearly clear hyaline, the stigma and nervures ferruginous. Stigma nearly three times as long as wide. Frons with minute scattered punctures. Mesoscutum polished, the anterior third of disk finely, moderately closely punctate, the punctured area in middle not extending back as far as the end of the median impressed line. Scutellum impunctate, except apical margin. Punctures of mesopleura much coarser than those of mesoscutum, mostly about one to two puncture-widths apart. Abdomen almost impunctate, except for minute punctures on each side of base of the disk of tergite 1. Pubescence white, moderately dense, and fairly long on face, cheeks, pleura, punctured area of mesoscutum, apex of scutellum, and middle of metanotum. Hair of basal declivity of tergite 1 erect, that of rest of abdomen mainly appressed and tomentum-like. Apical depression of tergite 1 very broad and nude except at each side. Elevated portion of following segments with thin light hair, the apical depressions broad and densely covered with hair. Hair on apical margin of tergite 5 brown, that on each side of pygidial plate of tergite 6 fuscous, or brown changing at apex to fuscous. Hair of legs whitish, changing to ferruginous on inner side of tarsi. Scopa of hind legs pale ochreous, slightly tinged with brown in part, especially on the basitarsus, the hair on inner side of latter inclining to fuscous on anterior side. Length, about 6.5 mm.; anterior wing, 4.6 mm.

Two females (holotype and paratype) collected at flowers of *Gutierrezia* at southern entrance to the Petrified Forest, Arizona, August 27, 1931 (Timberlake).

This species has about the size and general appearance of *E. albicans* (Prov.), but differs in the larger stigma, more strongly punctured mesopleura, and in lacking dark hair at base of the intermediate tergites. When the male becomes known, it will be interesting to discover whether its characters agree with those of the *albicans* or the *eriogoni* group of species.

13. **Exomalopsis (Anthophorula) albovestita** new species.

Allied to *eriogoni,* from which it differs, as well as from *deserticola* and *varleyi,* in having the punctures of mesoscutum comparatively coarse, close, and nearly uniformly distributed over the disk.

Male.—Like *eriogoni,* but differing, or agreeing, in following characters: Antennæ virtually the same. Middle and hind basitarsi comparatively slender, about as in *deserticola* and *varleyi.* Puncturation of mesoscutum and scutellum much coarser and closer, about like that of mesopleura, the punctures of mesoscutum mainly about one to two puncture-widths apart. Elevated portion of disk of tergites densely punctured, the punctures only a little finer than those of mesoscutum and about one puncture-width apart, but becoming finer and more separated on apical segments. Wings virtually as in *eriogoni,* the stigma small. Pubescence short, dense and white, tomentose-plumose on mesonotum and abdomen so that the surface is almost concealed. Genitalia similar, with apical process of stipites slender, terete, hardly clavate. Apical lobes of eighth ventral plate much broader than in allied species, oblong-oval in shape, extending backward in same plane as the plate, although recurved, and with the inner margins overlapping. Length, 5.5–6 mm.; anterior wing, 3.5 mm.

Three males (holotype and paratypes) collected 4 miles south of Palm Springs, California, the holotype on *Eriogonum trichopes,* June 25, 1941, one paratype on same day on *Petalonyx thurberi,* the other on *Cryptantha barbigera,* June 28, 1941 (Timberlake).

14. *Exomalopsis* (*Anthophorula*) *compactula* (Cockerell).

Anthophorula compactula Cockerell, 1897, New Mexico Agr. Expt. Sta. Bull. 24, p. 44. Female.

Exomalopsis (*Anthophorula*) *compactula* Cockerell, 1935, Amer. Mus. Novitates, 766, p. 5. Female, male.

This species has been reported from Texas and New Mexico. The type locality is near Las Cruces, New Mexico. The only flower visits reported are to *Dithyrea wislizeni* and *Convolvulus hermannioides.* I have collected it at flowers of *Verbesina* and *Aplopappus spinulosus* in southern Arizona (10 miles south of Tucson, 8 miles northeast of Douglas, 10 miles west of Bisbee, 12 miles southwest of Apache and near Tombstone) in August. On September 1–3, 1935, Michener found it at Albuquerque, New Mexico, at flowers of *Grindelia.*

This species has only two submarginal cells and is the type of the subgenus *Anthophorula*. The male of this, and of the three following species, has the flagellum curiously bulging at base beneath and excentrically attached to the pedicel.

15. *Exomalopsis* (*Anthophorula*) *completa* Cockerell.
Exomalopsis (*A.*) *compactula*, var. *completa* Cockerell, 1935, Amer. Mus. Novitates, 766, p. 5. Female, male.

Although described as a variety of *compactula,* with three submarginal cells, I find other good structural characters in the male, and it must rank as a distinct species. The type locality is near San Antonio, Texas, where it was taken by H. B. Parks at flowers of *Convolvulus hermannioides* in company with *compactula.* It has also been taken at La Cueva, Organ Mountains, New Mexico, on *Phacelia congesta,* September 2, 1898 (Townsend). I have examined a female from this locality, and a male from Val Verde County, Texas, May 6, 1941 (D. J. and J. N. Knull).

16. *Exomalopsis* (*Anthophorula*) *torticornis* Cockerell.
Cockerell, 1927, Ann. Ent. Soc. Amer., XX, p. 399. Male.

This is a common species in the cismontane area of southern California and is found at the flowers of *Hugelia virgata, Eriogonum fasciculatum, Lotus strigosus* and *L. scoparius, Eschscholtzia californica, Opuntia vaseyi, Chroizanthe parryi, Centaurea melitensis, Gutierrezia californica, Encelia farinosa, Chaenactis glabriuscula, Hemizonia tenella, Marrubium vulgare, Cryptantha intermedia,* and *Mentzelia lindleyi* (the last-named sporadic temporarily from a wild flower garden). At mouth of Deep Creek, edge of Mojave Desert, it was taken at flowers of *Calochortus kennedyi.* At Pinon Flat, San Jacinto Mountains it has been collected by Linsley at flowers of *Sphaeralcea ambigua.* The favorite flower of the female, for collecting pollen, undoubtedly is *Hugelia virgata.* At Riverside this species has been taken from April 10 to June 27. The type locality is Los Angeles.

17. **Exomalopsis (Anthophorula) palmarum** new species.

Allied to *torticornis* but differs in having the puncturation of frons and mesoscutum less close, the apical depression of tergites much broader, more shining and less punctured, that on the first segment wider than space between it and the carina at summit of basal declivity, and flagellum clearer ferruginous, with extreme tip of the last joint piceous.

MALE.—Black, the venter of abdomen reddish brown. Mandibles, except reddish tips, labrum, clypeus, supraclypeal area to level of middle of antennal sockets, and small spot at base of front tibiæ, yellow. Apical tergite, flagellum, tarsi, and apex of front tibiæ, clear ferruginous. Tip of last joint of flagellum piceous beneath. Tegulæ testaceous. Wings dusky hyaline, the nervures dark brown. Similar to *torticornis* in structural characters and having the base of flagellum bulging and attached excentrically to pedicel. Frons and mesoscutum finely punctured, the punctures mainly about two puncture-widths apart. Punctures of mesopleura distinctly coarser than those of mesoscutum and less than a puncture-width apart. Abdomen considerably more finely and less closely punctured than in *torticornis*, the punctures on the base of tergites mostly about two puncture-widths apart. Apical depression of tergites very broad, with about the apical half of each shining, impunctate, and subhyaline, tinged with brown. Venation as in *torticornis*, except that the first recurrent nervure is interstitial with second intercubitus. Pubescence white, rather dense on head and thorax and short on mesonotum. Tergites 1 to 6, each with a broad band of white tomentum covering apical depression. Raised portion of disk of tergite 1 somewhat shorter in middle than the apical depression and covered with short erect hair. Basal declivity of tergite 1 with longer erect hair. Hair on inner side of tarsi ferruginous. Length, 5.5 mm.; anterior wing, 3.5 mm.

Known only from the holotype male collected at Andreas Canyon, near Palm Springs, California, at flowers of *Eriogonum inflatum*, April 24, 1932 (Timberlake).

18. **Exomalopsis (Anthophorula) cerei** new species.

Similar to *texana* Fr., *nitens* Ckll., *pygmæa* (Cress.), and *chlorina* Ckll., from all of which it differs in having the carina at summit of basal declivity well developed and the band of pale tomentum on disk of first tergite complete, although thinner at the middle. Actual relationship, however, is probably with the *compactula* group, and if this is true, *cerei* may prove to be the female of *palmarum*. The considerably sparser puncturation of the mesoscutum in *cerei* than in *palmarum* will not allow their association at the present time.*

* In *E. compactula* (Ckll.) and *E. torticornis* Ckll., both closely allied to *palmarum*, the male is slightly less closely punctured on the mesoscutum than is the female. The female of *palmarum*, therefore, by analogy should have the mesoscutum much more closely punctured than it is in *cerei*.

FEMALE.—Black, the mandibles reddish at base, piceous on apical half. Flagellum clear ferruginous beneath, dusky above. Venter and legs, especially hind tibiæ and tarsi, tinged with reddish. Tegulæ and spurs testaceous. Wings grayish hyaline, the stigma and nervures reddish brown. Stigma somewhat less than three times longer than wide. Second submarginal cell small, narrowed above, and receiving recurrent nervure close to apex. Clypeus and frons polished, with minute sparse punctures. Mesoscutum polished, finely and moderately closely punctured, the punctures mainly about two to four puncture-widths apart leaving a small impunctate space on the posterior middle. Mesopleura punctured about like the frons. Abdomen very finely, moderately closely punctured on basal part of disk of tergites 1 to 5, the apical depression of these segments broad, polished, and impunctate. Pubescence whitish, moderately dense on face, cheeks, and pleura. Hair of mesoscutum thin, not concealing surface. Hair of scutellum longer, tinged with brown, and restricted to apical margin. Middle of metanotum with a tuft of white hair. Base of tergite 1 with thin, erect white hair, becoming shorter on elevated part of disk. Apical depression of tergites 1 to 5 with a broad band of white tomentum, that on 1 receding from apical margin in middle and leaving a nude area. Bands on tergites 2 to 4 broadened in middle. Base of tergites 2 to 5 with fine short blackish hair. Hair of legs whitish, becoming ferruginous on inner side of tarsi. Scopa of hind tibia and basitarsus slightly tinged with brown on outer side above. Length, about 6 mm.; anterior wing, 4.1 mm.

Described from 6 females (holotype and paratypes) taken at flowers of *Cereus engelmannii,* Andreas Canyon, near Palm Springs, California, April 10, 1932 (Timberlake).

19. **Exomalopsis (Anthophorula) rufiventris** new species.

This and *euphorbiæ* are small, or very small, species with a red abdomen in both sexes. They are allied by the sculpture and other characteristics with the foregoing species of *Anthophorula,* rather than with *sidæ* Ckll., which is much larger, with the stigma relatively much larger, the frons and mesoscutum much more weakly punctured, and the abdomen thinly pubescent. *E. rufiventris* differs from *euphorbiæ* in its larger size and in having three submarginal cells and the mesoscutum more closely punctured.

FEMALE.—Head and thorax black, the abdomen red. Mandibles, except piceous tips, labrum, and narrow anterior margin of clypeus rufous. Flagellum dull ferruginous, darker above. Front and middle tarsi and small joints of hind tarsi dull ferruginous. Clypeus punctured on basal half. Punctures of frons mainly about two puncture-widths apart, those of the vertex in contrast extremely minute. Mesoscutum shining, finely but strongly and closely punctured, the punctures about a puncture-width apart except in a small area on the posterior middle. Punctures of mesopleura slightly coarser and less close than those of mesoscutum. Abdomen very finely and closely punctured. Wings grayish hyaline, nervures brownish. Stigma dull ferruginous, small, hardly twice as long as wide. Second submarginal cell small, a little narrowed above, and receiving recurrent nervure very close to apex. Pubescence white and dense on face, cheeks and pleura. Hair of mesoscutum short, erect, and fuscous on disk, but margin all around, except the middle third of anterior side, with short, plumose, white hair. Hair of scutellum and tuft on middle of metanotum much longer than that on scutum, that on the scutellum fuscous except on the extreme apical margin. Tergites 2 to 5 each with a moderately broad apical band of dense whitish tomentum, the bands on 2 and 3 a little narrowed sublaterally on each side. On tergite 1 a similar band, which recedes from the margin toward the middle and is broadly interrupted. Scopa of hind tibia and basitarsus whitish, tinged with pale brown on outer side at base of tibia and becoming fuscous or blackish on entire inner side of basitarsus. Length, about 5 mm.; anterior wing, 3 mm.

MALE.—Similar to female. Mandibles, except red tips, labrum, clypeus, and scape beneath, pale yellow. Scape otherwise, and pedicel, fuscous, the flagellum yellowish brown, a little darker above, and the last three joints entirely brown. Front tarsi and small joints of middle and hind tarsi dull ferruginous. Tegulæ reddish brown, more testaceous on outer margin. Antennæ reaching about middle of scutellum, the joints of flagellum somewhat longer than thick. Third antennal joint about equal to pedicel and much shorter than fourth. Clypeus polished, almost impunctate. Frons, mesoscutum and scutellum polished, strongly and closely punctured, the punctures mainly about one to two puncture-widths apart. Vertex and cheeks minutely punctured. Punctures of mesopleura slightly coarser and closer than those of mesoscutum. Propodeum closely punctured except on the middle of the truncation. Abdomen somewhat more finely punctured than mesoscutum, the punctures mainly about one puncture-width apart. Pubescence white, plumose, and rather dense on face, pleura and around margins of mesoscutum and scutellum. Hair of abdomen forming thin apical bands on tergites 2 to 6. Hair of legs whitish, becoming ferruginous on inner side of tarsi. Length, 4–4.5 mm.; anterior wing, 2.7–2.8 mm.

Described from one pair (holotype female and allotype) collected 10 miles south of Tucson, Arizona, the female at flowers of *Tidestromia lanuginosa*, and the male on *Boerhaavia*, August 7, 1940 (Timberlake). Also one male (paratype) taken 16 miles northeast of El Paso, Texas, on *Tidestromia lanuginosa*, August 18, 1929 (collector not known), in U. S. National Museum.

20. **Exomalopsis (Anthophorula) euphorbiæ** new species.

Easily distinguished from *rufiventris* by the very small size and by having only two submarginal cells.

FEMALE.—Head and thorax black, the abdomen red. Mandibles red, the tips piceous. Labrum and nearly apical half of clypeus ferruginous. Scape and pedicel brownish, or fuscous, the scape sometimes paler in front. Flagellum ferruginous, slightly darker behind. Front and middle tarsi and small joints of hind tarsi ferruginous. Coxæ, trochanters and the part of metapleura and propodeum surrounding insertion of middle and hind legs, tinged with red. Tegulæ brownish-testaceous. Wings grayish hyaline, the stigma ferruginous, nervures brownish. Clypeus finely punctured, the punctures becoming sparse anteriorly. Frons polished, with fine punctures about one to three puncture-widths apart. Mesoscutum polished, finely punctured, the punctures mainly about two to three puncture-widths apart. Scutellum similarly punctured. Punctures of mesopleura rather coarser and closer than those of mesoscutum. Propodeum minutely punctured. Abdomen closely and very minutely punctured. Carina at summit of basal declivity of tergite 1 distinct. Pubescence short, white and dense on face, pleura, around margins of mesoscutum, except anterior middle, and on base of propodeum. Hair of disk of mesoscutum short, erect, dusky or fuscous. Hair at base of scutellum white tomentose, at apex long, erect, fuscous or tipped with fuscous, except on the extreme margin. Tuft on middle of metanotum white. Hair of abdomen mostly very fine, short, and appressed, except on basal declivity of tergite 1, and forming moderately dense apical bands. Bands broad at sides of tergite 1 and broad in the middle on tergites 2 to 5. Apical margin of tergite 1 broadly smooth and nude except at sides. Scopa of hind tibia and basitarsus pale ochreous, the long plumose hair on posterior side of basitarsus tinged with brown, the simple hair on inner side of basitarsus ferruginous. Length, about 4 mm.; anterior wing, 2.9 mm.

MALE.—Similar to female. Mandibles, except red tips, labrum, clypeus and scape beneath bright yellow. Flagellum ferruginous, the last three joints tinged with brown. Tarsi ferruginous, with middle and hind basitarsi more or less infuscated. Sculpture about as in female, but propodeum, except the truncation, as coarsely punctured as mesoscutum, and abdomen with strong, fine, close punctures. Pubescence white, that on disk of mesoscutum and scutellum thin, short, and entirely light. Apical bands at sides of tergite 1 and on tergites 2 to 6 slightly tinged with ochreous and not broadened in middle. Length, about 3 mm.; anterior wing, 2.3 mm.

Described from a series of 27 females, 19 males (holotype female, allotype and paratypes) collected August 7, 1940, all at flowers of a low erect *Euphorbia,* except four of the females which were taken on *Boerhaavia,* Picacho Pass, Arizona (Timberlake).

One male out of the series of forty-six specimens has three submarginal cells on both wings. This is the smallest known member of the genus and the smallest non-parasitic anthophorid known to the author.

21. *Exomalopsis* (*Anthophorula*) *sidæ* Cockerell.

Cockerell, 1897, Trans. Amer. Ent. Soc., XXIV, p. 160. Female, male.

This species is allied to the *pygmæa* group, but differs in having the abdomen of the female red, and head of male broad, with inner orbits parallel and mandibles larger than usual. Known only from the Mesilla Valley, New Mexico, where it was taken by Cockerell in June and July at flowers of *Sida hederacea.*

22. *Exomalopsis* (*Anthophorula*) *chionura* Cockerell.
Cockerell, 1925, Proc. Calif. Acad. Sci., (4) XIV, p. 203. Female, male.

This little species occurs in the Great Valley of California. The type locality is Stockton. It has been taken also at Antioch in August and September (M. Cazier and E. G. Linsley) and I found it at Dos Palos, at flowers of *Grindelia camporum,* September 29, 1940.

23. *Exomalopsis* (*Anthophorula*) *texana* Friese.
Friese, 1899, Ann. Hofmus. Wien., XIV, p. 264. Female, male.

The type locality is Fedor, Lee County, Texas, where it was collected by Birkmann in September to November. I have examined material in the U. S. National Museum from Dallas, Texas, September 11 and 22, 1905 (F. C. Bishop and C. R. Jones), and from Runge, Texas, at flowers of *Helenium tenuifolium,* September 18, 1904 (J. C. Crawford).

24. *Exomalopsis* (*Anthophorula*) *nitens* Cockerell.
Cockerell, 1915, Jour. Ent. and Zool., VII, p. 231. Female.

This was described from Laguna Beach, California, and has been recorded by Cockerell from Westwood Hills, where it was taken in some numbers by E. G. Linsley, and from Catalina Island. The flower visits recorded by Cockerell are to *Opuntia littoralis, Bloomeria crocea, Calochortus,* and *Malvastrum catalinense.* I have the following additional locality and flower records: Whittier, on *Grindelia,* June 3, 1911 (Timberlake); Pomona, July 12, 1934 (B. J. Hall); San Diego, on *Malvastrum fasciculatum,* July 22, 1925 (Timberlake) and a male, May 31, 1932 (C. M. Dammers); the Gavilan, a female May 26, 1935 (Dammers), a male on *Calochortus splendens,* May 18, 1939, and both sexes on *Malvastrum,* May 29, 1946 (Timberlake); and Oceanside, females collecting pollen from *Hemizonia fasciculata* and *Grindelia rubricaulis,* var. *elata,* and visiting flowers of *Chlorogalum parviflorum,* August 17, 1946 (Timberlake).

The habitat of this species is, therefore, mainly coastal, but it ranges inland at least as far as Pomona and the Gavilan. It ranges northward to Monterey County, where it was taken by Michener, June 7–14, 1938, at Hastings Natural History Reservation, Santa Lucia Mts., at flowers of *Calochortus splendens* and *Brodiœa ixioides.*

25. *Exomalopsis* (*Anthophorula*) *pygmœa* (Cresson).

Melissodes pygmœa Cresson, 1872, Trans. Amer. Ent. Soc., IV, p. 279. Female.

Exomalopsis bruneri Crawford, 1902, Canad. Ent., XXXIV, p. 238. Female, male. (New synonymy.)

The type locality is Bosque County, Texas. It has been recorded also from Dallas, Texas; Lincoln, Nebraska (the type locality of *bruneri*) and from Sterling, Colorado. It visits *Helianthus* in August and September.

26. **Exomalopsis (Anthophorula) micheneri** new species.

Allied to *pygmœa* (Cresson) but considerably smaller, with more closely punctured mesoscutum and dusky wings. The male differs from all our other species of *Anthophorula* in having the clypeus black, with a median whitish mark.

FEMALE.—Black, the flagellum beneath and small joints of tarsi ferruginous. Mandibles more or less reddened. Tegulæ dark brown. Wings dusky hyaline. Nervures brown, tinged with fuscous, the stigma, except margins, more ferruginous. Venation normal, except that the stigma is large for an *Anthophorula,* and about four times longer than wide. Face shining, minutely and moderately sparsely punctate, the punctures becoming sparser and weaker on vertex. Mesoscutum finely and rather closely punctured, the punctures closer than in *pygmœa,* but not dense as in *compactula.* Abdomen minutely punctate, the punctures moderately close across the base of disk of first tergite. Apical depression of first tergite weakly impressed and carina at summit of basal declivity weakly developed. Pubescence moderately dense, rather short on head and thorax, ochreous, and becoming whitish on face and under parts. Hair of mesoscutum mostly very short and depressed, that of scutellum much longer. Tergites 2 to 4 each with a broad apical band of fine appressed grayish tomentum. Tergite 5 with a similar but narrower band, and similar pubescence on extreme sides of tergite 1. Base of tergites 3 to 5, when exposed, show a thin black pubescence. Band on tergite 2 obsolete in middle, the base of disk with blackish pubescence only on each side. Scopa of hind tibia and basitarsus brownish ochreous, more brownish above. Hair on inner side of hind basitarsus dark ferruginous. The little fan of hair at apex of hind basitarsus and hair on each side of pygidium of tergite 6 blackish. Length, 6–6.5 mm.; anterior wing, 4.4 mm.

MALE.—Similar to female. Labrum and a triangular mark on middle of clypeus (apex of triangle not quite reaching summit of clypeus) whitish. Head barely broader than long, the inner margin of eyes strongly convergent below. Antennæ short, as in female, the middle joints of flagellum not quite as long as thick. Sculpture nearly as in female, except mesoscutum more sparsely punctured, the punctures being from two to five, or more, puncture-widths apart. Pubescence similar but more whitish than in female. Hair of mesoscutum sparser and more erect. Hair of tergum of abdomen thin, the apical bands of light pubescence mostly worn off in the types, but presumably present on tergites 2 to 6 and at sides of 1. Base of apical tergites with blackish hair. Hair of venter moderately long and rather thin. Length, 5 mm.; anterior wing, 3.8 mm.

Holotype female and allotype, Hattiesburg, Mississippi, October 10, 1943 (C. D. Michener), in the Michener collection. Also the following paratypes: 1 male, 15 females, from type locality, October 10 and 24, 1943, and October 8 and 14, 1944 (Michener); and 2 females, Camp Shelby, near Hattiesburg, October 3, 1944 (Michener), all at flowers of *Gerardia purpurea.*

27. *Exomalopsis* (*Anthophorula*) *chlorina* Cockerell.

Cockerell, 1918, Ann. and Mag. Nat. Hist., (9) II, p. 477. Female.

Apparently known only from the type specimen taken at flowers of *Sphæralcea,* at Las Cruces, New Mexico, August 24, by Cockerell.

28. *Exomalopsis* (*Anthophorula*) *morgani* (Cockerell).

Anthophorula morgani Cockerell, 1914, Entomologist, XLVII, p. 114. Female.

Described from Falfurrias, Texas, on *Helianthus,* where it was taken by A. C. Morgan, May 18, 1907. It has been recorded by Cockerell (1935, Amer. Mus. Novitates, 766, p. 5) also from near San Antonio, Texas, where it was found by H. B. Parks, May 17, 1934. I have examined one male from the latter locality.

THE STORY OF SYRPHUS WEIDEMANNI, A FLY, MAGNIFIED IN PLASTIC

By Chris E. Olsen and Dorothy Olsen Davies

In preparation of museum exhibits the preparator, or technician if you prefer, occasionally runs into extremely interesting and exceedingly complicated subjects; subjects that to begin with seem well-nigh impossible. Not impossible of execution, but rather prohibitive in time and cost.

Years ago we, in our Department of Living Invertebrates, decided never to use the term "impossible" in speaking of the preparation of exhibits. There always seemed to be some way in which difficult problems could be overcome, but there was, of course, to be considered time limits and costs.

Personally I feel very fortunate to have been connected with a rather progressive department of a great institution, The American Museum of Natural History, and to have been associated with a curator whose ambition was ever to do the very best in exhibition work. No troubles were too great to make our exhibits scientifically the very best, and no expense was spared to make them technically unsurpassable; as true to nature as possible, and as substantial and permanent as feasible. Every year of these thirty years have been years of learning for me.

It was through my hobby, entomology, that I branched into museum activities from my old line of endeavor, modeling for ornamental decoration, and it was none other than our late curator of the Entomological Department, Dr. Frank E. Lutz, who recommended me to Dr. Roy W. Miner.

Naturally entomology is strongly attached to my career and deeply impressed in my interests in life. I started out by making insect models and would no doubt have continued had not Dr. Miner of the Marine Invertebrate Department grabbed me and pushed me under the sea for thirty years. However every now and then, when my head would pop out of water, there was entomology taking possession of my interests again.

It was early last year, January 1945, to be specific, when entomology again took possession of my interests. This time, however, I had a partner in crime. We ran into one of these extremely interesting and exceedingly complicated problems that I have already mentioned. My oldest daughter, Dorothy Olsen Davies, has for many years been my companion in interesting problems of museum exhibits. She has specialized in small models of marine invertebrates; her models and small marine groups are distributed in many museums and colleges, but she solemnly vowed that she had not the slightest interest in her father's love for bugs. Nevertheless, when this entomological problem of great interest presented itself, she was as enthusiastic as her father. Had she not been so interested I should never have been able to tell you our story, for upon her fell the heavy duty of the job, the actual work and time-consuming experiments, while I could only guide and help solve the problems as they appeared, since I had my time occupied at the Museum each day and could only offer my services part of evenings and weekends.

The problem that now confronted us was a request from the Sperry Gyroscope Company, Incorporated, with their large war plant at Great Neck, Long Island, N. Y. The Sperry Company had become interested in entomology because they had discovered that the fly had invented a gyroscope of its own and they wanted to see what kind of an inventor a fly could be; perchance they could learn something from this invertebrate creature. It is not often that the electrical engineers meddle with branches of natural sciences and of all, entomology, but the halteres of a fly, their movements and stabilization of the creature's flight fascinated them, not from a question of patent rights, for they were quite sure that the fly had no objection to the infringement of its gyroscopic mechanism, but they were curious to know how the fly could have gotten ahead of modern engineers by a few million years, and above all they wanted to know how it worked all this time. One way to find out was to construct an artificial fly as close to a natural fly as it was possible except that it should be magnified to a size where a motor could be placed within its body that would move the halteres at approximately natural motion and speed.

Here in New York City, The American Museum of Natural

History is, of course, the first place where questions on such problems of nature land. Here this question was turned over to the Museum's fly specialist, Dr. C. H. Curran; he in turn came to us and asked if we were interested. Of course we were interested; deeply interested. Even Dot could not resist against her former vows; she had to admit that it was an intensely fascinating problem.

Syrphus weidemanni magnified in plastic.

We doubted, however, that we were equipped for such an undertaking. We also thought a great deal of experimentation would be involved which would naturally make the job a costly one. However, Sperry Co. had made up its mind that it was to be done, and practically offered free reins so far as time and costs were concerned. This fly exhibit was the one remaining item undone that would complete their little Museum Hall at their Great Neck plant. The specific request was as follows: a typical fly, preferably of a showy variety and of fairly good size; magnification to fit a small motor which should be placed within its body for the purpose of moving the halteres; fly should be made in sections to take apart in order to repair in case of motor troubles;

fly to be incorporated in a natural setting of flowers, etc., of similar magnification; concealed wiring with rheostat to control speed movements of halteres; the whole to be assembled into a complete group to be placed on exhibition in the Sperry Company's Museum at Great Neck, L. I., with their numerous other exhibits of gyroscopic invention and allied mechanisms.

It cannot be denied that this was indeed an extremely interesting as well as an exceedingly complicated order. Dr. Curran was encouraging and optimistic, and Mr. Victor Anderson, Chief Engineer of the display exhibits at the Sperry Plant, was most anxious and we were willing to try our best.

The species of fly selected was *Syrphus weidemanni,* a common flower fly of fairly good size and striking color pattern, in which the pale cream-colored halteres were plainly visible against the almost black body. The size of magnification decided on was 32 diameters; in bulk this was equal to 32,768 natural-sized flies.

Now the difficult questions: what material should this model be made of; what material would be substantial enough to hold a motor, and allow for dismantling and assembling at will? Certainly none of the ordinary model materials, such as plaster, wax, papier-mache or wood could be used. The only material that sounded promising was some of the newer forms of plastic. But plastic had never as yet been used in this manner. It meant investigation and experimentation.

Plastic was not uncommon in strictly commercial work where ten thousand or a hundred thousand reproductions were required, but when but a single reproduction is all that is wanted, it is quite another story. In commercial work, thousands of dollars are invested in machinery and equipment to make as simple an item as a button or a buckle, what would it cost to have that machinery and equipment made for the 23 separate parts of a fly model 14 inches in length? The answer would be terrific.

Our problem was not the modeling or sculpturing of the fly from microscopic studies; that was more or less routine work, work that we had done so many times before; a fly, a worm or a sea anemone, all the same, you model and shape that which you see in the microscope; simple enough.

No, our problems were, first to secure the proper plastic material to work with. Next, to secure good expert advice on the manipulation of this material. Last, but not least, the problem of building our own equipment for plastic casting in plaster moulds. Our difficulties were increased in the first instance by the fact that it was wartime. Plastic materials were practically impossible to secure for an experimenter. We tried all the plastic concerns and although we told them we were working on a model for the Sperry Gyroscope Company, Inc., it was difficult for them to believe that it had anything to do with the war effort when we began to speak of the model of a fly. What could a fly have to do with the war efforts? It was not until Sperry sent several letters directly to the DuPont Co. that they finally agreed to help us out; in the meantime, several months had elapsed before we finally received a limited amount of material to work with.

Next, the expert advice. Here we really ran up against a snag. Knowing that modern dentures were all done in plastic casting, we investigated this while waiting for material. Fortunately a local dentist allowed us to consult his technician. From this technician we received the rudiments of plastic casting in plaster moulds. When finally we were promised material from DuPont, we were also permitted an interview with a technician at their Arlington, N. J., plant. On our visit here we were introduced to a burly fellow whom we felt was more of an energetic business man than a plastic technician. To this fellow we poured out our anxiety to learn about casting plastic in plaster moulds. I can still see him when he learned our job was only a single casting of a fly model, and when he saw the photographs of our sculptured model, lifting his bushy eyebrows slightly, with a sneaky smile on his lips, announce that material for casting in plaster moulds was of course methacrylate polymer monemer, but he added casting in plaster moulds is much too difficult for such an elaborate object. We should have experience in handling and we must have equipment for heat and pressure. Then he ventured a suggestion. Said he, "Why don't you get a block of lucite and sculpture the object directly?" I don't know whether he tried to be funny or if he wanted to throw us off the track, but I am sure he didn't mean it could be done. Our opinion of this technician was not very good, and we also think that his opinion of us was none better. I am sure he thought that this was another fellow with a crackpot idea about the use of plastic. However, he had given us the hint of the material used in casting, and that seemed to be all we could expect here.

A friend who happened to learn of our endeavor at hand offered us whatever assistance he was able to contribute to our cause. He was not a practicing technician like our dental technician, but a theoretical student in plastic who was engaged by a law firm as adviser in all actions that had to do with plastic work in any form. What this chap didn't know about plastics, formulas and methods was not worth knowing. To him we went with all our failures and it never failed but that he had a solution to our problem.

At this point we felt we had one and a half solutions to our three major problems solved. Our first problem was solved when we received 10 lb. of methacrylate polymer in grain and corresponding amount of monemer in solution. Problem two, half way cleared through the courtesies of our local dentist and our law firm adviser; the other half would be solved by experiments. The simplest part of the fly to make, the scutellum, was selected for first attempts. Top and bottom, each being about the size of an ordinary denture, was a fair beginning. Accordingly, and before these experiments could proceed, we had to secure the heating apparatus which consisted simply enough of a 3-gallon galvanized iron pail over a gas stove. Each separate piece of the fly had to be made in two parts: top piece and bottom piece which would then be cemented together into one unit with H94 cement. For each of these top pieces and bottom pieces a positive plaster mould and a negative plaster mould had to be made and these positive and negative forms enclosed in iron "flasks" furnished with bolts and nuts to supply the pressure required while cooking the plastic materials. Thus the twenty-three separate parts required forty-six positive and negative forms, many of which had to be made over two, three or more times before we had a fair casting. Fortunately I had worked in the foundry business and knew how the cope and navel or positives and negatives of a flask in casting metal were made. This I applied here. The gradual rise and fall of the temperature while cooking were important. The process must start in cold water and after cooking at boiling temperature for a set period must gradually cool off. This is very important. Pressure in cooking plastic is as important as temperature, if not more so. The length of cooking to the bulk of material is also important. Any housewife will tell you that when she cooks a Christmas turkey, a twenty-five pound bird will take considerably more time than a fifteen-pound one. This applies here too.

After three or four tries on the scutellum we made a usable set, so we felt that we had problem two licked and, incidentally, also problem three since that problem involved the cooking utensils and flasks for plaster moulds with their pressing devices. But these were only for the smallest and simplest part of the fly. As we began to make the larger sections our difficulties increased proportionately; a three-gallon pail was too small, and we had to bring in service a washboiler. Our nuts and bolts had to be increased in sizes to get the proper pressure. The wings, believe it or not, had to be done over eight times before a good set was made. The head and body also gave us plenty of trouble. Each time a new casting had to be made, it meant a new set of moulds in plaster.

All this accounts for the great amount of time consumed in the building of this fly model and the setting. It was started February 6 and delivered December 26. The handling of plastics is no secret; it is being done every day in great quantities, but there are definite methods that must be followed for the various plastic formulas. Methacrylate polymer is a lucite and non-inflammable, but the monemer that fuses the grain together is highly inflammable. We had only gas heat at our disposal; therefore, to avoid explosion, our product had to be cooked in a water bath, the cause of so many failures.

DRY-CLEANING FLUID AND THE KELP-FLY

In "Laboratory Procedures in Studies of the Chemical Control of Insects" (Pub. 20, Amer. Assoc. Adv. Sci., p. 174) Carroll M. Williams records the unusual behavior of the kelp-fly, *Cœlopa frigida* (F.) (*gravida* Hal.) in congregating around a dry-cleaning establishment, especially around an exhaust vent, on the roof of the building, which emitted trichlorethylene vapors. The fly breeds only on decaying kelp and according to the author its behavior is an example of the chemotropism of an insect to a chemical that apparently has no connection with its breeding habits or food.

Drosophila ampelophila is positively chemotropic to amyl alcohol, ethyl alcohol, acetic acid, etc., that occur in fermenting fruits. The Japanese beetle is attracted by geraniol, and this essential oil is found in such plants as rose, geranium, citronella, sassafras, lemon grass, etc. An analysis of decaying kelp might develop a definite explanation for the behavior of *C. frigida* to the dry-cleaning fluid.—H. B. W.

A CONSPECTUS OF THE TIPHIIDÆ, WITH PARTICULAR REFERENCE TO THE NEARCTIC FORMS (HYMENOPTERA, ACULEATA)

By V. S. L. Pate

The Tiphiidæ are a cosmopolitan family comprehending a large aggregation of very diversified forms. The tentative classification proposed here is, in many respects, different from that generally accepted for these wasps. At some future date, I hope to have an opportunity of discussing in detail the various reasons which have brought me to my present views on the subject. The following may be regarded as only a summary of my conclusions.

The tiphiid wasps have for the most part been treated as a collection of separate and distinct families: the Bradynobænidæ, Myrmosidæ, Anthoboscidæ, Tiphiidæ, Myzinidæ, Thynnidæ and Methocidæ. In the past, the Tiphiidæ and Myzinidæ have frequently been considered subfamilies of the Scoliidæ, whereas *Myrmosa* and *Brachycistis* have often been placed in the Mutillidæ. But all these forms lack the tripartite propodeum and striolate wing membrane of the Scoliidæ, as well as the "felt lines" on the abdomen and the absence of closed cells in the hind wing which are characteristic of most Mutillidæ. Moreover, the thorax of the apterous females is divided into two or three parts by functional sutures, whereas in most Mutillidæ the thorax of the females is always fused into a chitinous box without sutures. Recent investigation has shown that *Myrmosa* and *Methocha* are probably merely subfamilies of the Tiphiidæ. For some years I have harbored the conviction that *Brachycistis* and its allies were Tiphiids. In their recent paper on the females of this group, Mickel and Krombein have arrived at the same conclusion. And if forms such as these are to be included, along with the Tiphiinæ and Myzininæ, in one family, there is little justification for excluding such groups as the Anthoboscidæ, Thynnidæ and Bradynobænidæ from the same complex. Thus it is not difficult to show that a division which accords many, if not each, of these groups separate family status gives no adequate picture of the phylogeny of the group. Indeed, there is much to say in favor of including all these wasps in the single family Tiphiidæ, which may then be divided into a number of subfamilies corresponding to as many phylogenetic strains. The present case closely parallels that of the Diploptera and Sphecoid wasps: every indication points to the fact that each of these may be treated best as but one large family divisible into a number of subfamilies and tribes.

Obviously a classification such as proposed here may be subject to many modifications as the study and our knowledge of the group progresses. But I believe an attempt in this direction is not untimely now, particularly inasmuch as many of the groups are of considerable economic importance as parasites or means of control of such important pests as white grubs. Eight subfamilies are recognized as discrete here: the Bradynobæninæ, Myrmosinæ, Anthoboscinæ, Tiphiinæ, Myzininæ, Thynninæ, Methochinæ, and Brachycistidinæ. Nearly all of these are represented in the Nearctic fauna. The Thynninæ are extralimital and pannotial forms, attaining their greatest development in Australia and adjacent regions, while the Bradynobæninæ are confined to Chile.

Male Tiphiidæ are without exception winged, but the females of some groups show a marked tendency toward reduction of the wings or becoming wingless. Indeed, the females of the Bradynobæninæ, Myrmosinæ, Thynninæ, Methochinæ, and Brachycistidinæ are all totally apterous. The alitrunk of the females of the last three groups is divided into three parts by two functional sutures: one between the pronotum and the mesothorax, and another between the mesothorax (or metathorax) and the propodeum. In *Myrmosa* and *Bradynobænus*, the mesothorax, metathorax and propodeum are fused into a firmly chitinized box which is separated by a functional suture from the pronotum. The propodeum of all Tiphiidæ is simple, not trisected by two longitudinal sutures as in the Scoliidæ. The structure of the abdomen varies in the different groups, but the second segment is never furnished laterally with ''felt lines'' as in most Mutillidæ. The males of many groups (Tiphiinæ, Myzininæ, Methochinæ, Brachycistidinæ, and some Rhagigasterine Thynninæ) have the hypopygium armed apically with a recurved unciform aculeus.

In the Anthoboscinæ the hypopygium is simple; in *Bradynobœnus* trispinose; and in *Myrmosa* and many of the Thynninæ, it is variously shaped, but, except for some Rhagigasterini, never unciform. These wasps are fossorial, and the females of most groups are furnished with a well-developed pecten on the fore tarsi, while the apices of the middle and hind tarsal segments are provided with a verticellate whorl of setæ or strong spines. The middle coxæ are usually more or less separated and generally have their bases overlapped by small tubercles or more frequently by variously sized and shaped laminate plates of the mesosternum. The hind femora of the females are often provided apically with a laminate lobe on the lower posterior margin: this is the posterior genual plate and, when present, varies considerably in size in the different groups. The wings never have the membrane striolate as in the Scoliidæ, and the venation varies according to the groups: in the more generalized forms which are alate in both sexes the venation is more or less alike in the males and females, but in many of the more specialized genera the venation is dimorphic. The hind wings are always provided with closed cells and a distinct anal lobe; in the more generalized forms the costa is usually present and well-developed, but in the higher groups the costal cell is open anteriorly. The antennæ may arise from sockets with simple, reflexed rims or from beneath frontal lobes: the males and females always have thirteen and twelve segments respectively in the antennæ, but this number is not always apparent, for in some genera the pedicel is often hidden in the deeply concave distal end of the scape.

The Anthoboscinæ are without question the most generalized extant Tiphiidæ. From an ancestral stock similar to these have arisen not only the various phyletic lines within the Tiphiidæ but also in all probability many of the other Vespiform aculeate families like the Scoliidæ and Psammocharidæ. The Bradynobæninæ are aberrant, highly sidewise specialized forms; like *Myrmosa,* they have apterous females whose alitrunk is completely fused save for a functional suture between the pronotum and the mesothorax. The Tiphiinæ and Myzininæ* are closely

* Although considered a discrete subfamily here, the Myzinines may eventually prove to be merely a tribe of the subfamily Tiphiinæ.

related and may be considered the typical groups of this family. In the latter, there is a steady progression from forms with fully alate females to the completely apterous type exemplified by *Braunsomeria*. A form similar to this is presumably ancestral to the Thynninæ from which in turn *Methocha* probably has arisen, as Reid has recently demonstrated in his important contribution to our knowledge of the thorax of the wingless and short-winged Hymenoptera. The Brachycistidine line may also, in all probability, be traced back to some priscan Tiphioid or Myzinoid stock.

The Tiphiidæ are fossorial wasps which sting and paralyze the larvæ of beetles, particularly white grubs of the Scarabæidæ and Cicindelidæ, or the immature forms of other solitary bees and wasps. A brief statement of the biology, when known, of the various groups has been included under the discussion of each subfamily on the following pages. Clausen's recent book on entomophagous insects is an invaluable compendium of our knowledge on this subject.

A key to the subfamilies of the world, followed by one which will serve to differentiate the forms occurring in Nearctic America, is presented below. Under each subfamily, I have presented a brief diagnosis of the group and a key to the North American genera.

I am greatly indebted to Dr. C. Jacot-Guillarmod of Mamathes, Basutoland, for critical notes upon *Braunsomeria* and other South African Tiphiidæ; and to Dr. H. K. Townes of the Bureau of Entomology and Plant Quarantine, Washington, D. C., for interesting biological observations upon *Myrmosa*.

KEY TO SUBFAMILIES OF THE WORLD

1. Winged forms (males and females) 2
   Wingless forms (females only) 9

Alate forms (Males and Females)

2. Hind coxæ with an erect basal lamella on upper surface; tegulæ small, normal in size; (females apterous) 3
   Hind coxæ simple, without such erect basal lamella above, or if occasionally with a small tuberculoid lamella, then the tegulæ are large and cover the axillary sclerites; (females alate or apterous) 4

3. Hypopygium armed with a stout, recurved, unciform process (aculeus); fore wings with only two submarginal cells; hind wings with the cubitus arising before the transverse median vein, and the anal lobe large, two-thirds the length of the submedian cell; (widespread). METHOCHINÆ

Hypopygium not armed with a stout, recurved, unciform process; fore wings with three submarginal cells; hind wings with the cubital vein interstitial with the transverse median vein, and the anal lobe small, only about one-fifth the length of the submedian cell; (Holarctic forms) .... MYRMOSINÆ

4. Tarsal claws simple; middle tibiæ with a single apical calcar, antennæ arising from sockets with simple reflexed rims; castaneous to dark brown or rarely black, immaculate, usually concolorous, nocturnal, occasionally crepuscular, but very rarely diurnal forms, generally with abnormally large ocelli; (females apterous); (Nearctic forms). BRACHYCISTIDINÆ

Tarsal claws cleft or conspicuously dentate; middle tibiæ generally with two apical calcaria, or sometimes with only one; black or black and red forms, frequently maculated with yellow; generally diurnal species with normal sized ocelli, rarely nocturnal forms with enlarged ocelli 5

5. Thorax with scutellum very prominent (Fig. 15), its vertical posterior face forming a rounded angle with its horizontal anterior portion and superposed above the short, vertical postscutellum; propodeum vertical; males with hypopygium trispinose; Chilean forms with greatly reduced venation (Fig. 19); (females apterous). BRADYNOBÆNINÆ

Thorax with scutellum and postscutellum normal in size and both horizontal in position; propodeum with a distinct dorsal surface or obliquely declivous; venation more complete, although occasionally much reduced 6

6. Antennæ arising from beneath frontal ridges or tubercles; tegulæ short, not completely covering the axillary sclerites of fore wing 8

Antennæ arising from sockets with simple reflexed rims, not from beneath frontal ridges or tubercles; (females winged) 7

7. Tegulæ elongate, completely covering the axillary sclerites of the fore wing; hind wings with anal lobe longer than the submedian cell; mesopleura generally with omauli; males with the hypopygium unciform; females with the posterior genual plate of hind femora developed only at apex and distinctly less than one-third the length of femora; (widespread) .... TIPHIINÆ

Tegulæ short, not completely covering the axillary sclerites of fore wings; hind wings with anal lobe shorter than the submedian cell; mesopleura without omauli; males with hypopygium simple, not unciform; females with posterior genual plate of hind femora elongate, one-half or more the length of hind femora; (widespread, but mainly forms of the southern hemisphere) .... ANTHOBOSCINÆ

8. Fore wings with the first submarginal cell more or less divided by a spur from the first transverse cubital vein; males with the hypopygium variously modified but only rarely unciform; females always apterous; (Australian and Neotropical forms) .... THYNNINÆ
   Fore wings with the first submarginal cell not divided by such a spur from first transverse cubital vein; males with the hypopygium always unciform; females alate or apterous; (widespread). MYZININÆ

Apterous forms (Females only)

9. Tibial calcaria 1–1–1; ocelli present; legs slender, with the femora fusiform and the tibiæ cylindrical-obterete; thoracic dorsum divided into three parts (Fig. 2): the pronotum, mesonotum and metanotum and the propodeum .... METHOCHINÆ
   Tibial calcaria 1–1–2 or 1–2–2; ocelli generally absent; legs relatively short and stout 10
10. Alitrunk divided into only two parts by a suture between the pronotum and the remainder (Figs. 5, 12); mesosternum without a pair of flat lamellæ overlying the bases of the middle coxæ 11
   Alitrunk divided into three parts by a suture between the pronotum and mesonotum, and another between the mesonotum (or metanotum) and the propodeum (Fig. 3); mesosternum usually with a pair of flat laminate plates more or less overlapping the bases of the middle coxæ 12
11. Hind coxæ with an erect basal lamella above; antennæ arising from beneath distinct frontal ridges or tubercles; claws simple, edentate; ocelli present or absent; middle coxæ contiguous; (Holarctic forms). .... MYRMOSINÆ
   Hind coxæ without an erect basal lamella above; antennæ arising from sockets with simple reflexed rims; claws cleft to base; ocelli absent; middle coxæ widely separated; (Chilean forms) .... BRADYNOBÆNINÆ
12. Tegulæ present; antennæ arising from beneath frontal lobes or tubercles; (South African forms) .... MYZININÆ
   Tegulæ absent; antennæ arising from sockets with simple reflexed rims 13
13. Claws toothed or cleft; mesopleura not ankylosed with mesonotum; (Australian and Neotropical forms) .... THYNNINÆ
   Claws simple; mesopleura ankylosed with mesonotum; (Nearctic forms). BRACHYCISTIDINÆ

The North American fauna lacks representatives of the subfamily Bradynobæninæ and the large, complex, pannotial Thynninæ assemblage. The subjoined key will serve to distinguish the various groups which are known to occur in the Nearctic Region.

KEY TO THE NEARCTIC SUBFAMILIES

1. Winged forms; (males and females) 2
   Wingless forms; (females only) 7

Alate forms (Males and Females)

2. Hind coxæ armed with an erect basal lamella on upper surface; tegulæ small or normal in size; (females apterous) 3
   Hind coxæ simple, without such erect basal lamella above, or if occasionally with a small tuberculoid lamella above at base, then the tegulæ are large and cover the axillary sclerites; (females alate or apterous) 4
3. Fore wings with three submarginal cells (Fig. 18); hind wings with the cubitus interstitial with the transverse median vein, and the anal lobe small, only about one-fifth the length of the submedian cell; hypopygium not armed with a stout, recurved, unciform process; tibial calcaria 1–1–2 .... MYRMOSINÆ
   Fore wings with only two submarginal cells (Fig. 17); hind wings with the cubitus arising before the transverse median vein, and the anal lobe large, two-thirds the length of the submedian cell; hypopygium armed with a stout, recurved, unciform process (aculeus); tibial calcaria 1–1–1 .... METHOCHINÆ
4. Tarsal claws simple; middle tibiæ with a single apical calcar; mesopleura without omauli; antennæ arising from sockets with simple reflexed rims; hind wings with anal lobe separated from preanal area by a deep slit which is more than half the length of lobe; castaneous to dark brown or rarely black, immaculate, usually concolorous, nocturnal, occasionally crepuscular, but very rarely diurnal forms, generally with abnormally large ocelli; (females apterous). BRACHYCISTIDINÆ
   Tarsal claws cleft or conspicuously dentate; middle tibiæ generally with two apical calcaria (sometimes with only one); mesopleura with or without omauli; hind wings with anal lobe separated from preanal area by a short slit which is distinctly less than half the length of lobe; diurnal, black or red and black forms, frequently maculated with yellow, and with small or normal sized ocelli; (females winged) 5
5. Antennæ arising from beneath frontal ridges or tubercles. Tegulæ short, not completely covering the axillary sclerites of fore wing; hind wings with anal lobe generally shorter than the submedian cell (in North American forms only); mesopleura with omauli; males with an unciform hypopygium .... MYZININÆ
   Antennæ arising from sockets with simple, reflexed rims, not from beneath frontal ridges or tubercles 6
6. Tegulæ elongate, completely covering the axillary sclerites of fore wings; hind wings with the anal lobe longer than the submedian cell; meso-

pleura generally with omauli; males with hypopygium unciform; females with the posterior genual plate of hind femora developed only at apex and distinctly less than one-third the length of the hind femora .... TIPHIINÆ

Tegulæ short, not completely covering the axillary sclerites; hind wing with the anal lobe shorter than the submedian cell (at least in North American forms); mesopleura without omauli; males with hypopygium simple, not unciform; females with the posterior genual plate of hind femora elongate, one-half or more the length of hind femora .... ANTHOBOSCINÆ

Apterous forms (Females only)

7. Propodeum not separated from, but firmly ankylosed with, the thorax; hind coxæ with an erect basal lamella on upper surface; tibial calcaria 1–2–2; antennæ arising from beneath frontal ridges or tubercles .... MYRMOSINÆ

Propodeum separated from thorax by a distinct suture or constriction, or both; hind coxæ without an erect basal lamella above; antennæ arising from sockets with simple, reflexed rims, not from beneath frontal ridges or tubercles 8

8. Ocelli present; legs slender, with the femora fusiform and the tibiæ cylindrical-obterete; tibial calcaria 1–1–1; mesonotum narrower than the pronotum; mesosternum simple, without plates overlapping the middle coxæ .... METHOCHINÆ

Ocelli absent; legs stout, the middle and hind legs with the femora and tibiæ expanded; tibial calcaria 1–1–2; mesonotum broader than the pronotum; mesosternum with a pair of large laminate processes overlying the bases of the middle coxæ .... BRACHYCISTIDINÆ

SUBFAMILY BRADYNOBÆNINÆ

This is a small group of peculiar Chilean forms. The males are alate, with the venation of the fore wings considerably reduced (Fig. 19); the scutellum is greatly enlarged and superposed above the narrow, transverse, vertical postscutellum and vertical propodeum (Fig. 15); and the hypopygium is trispinose. Both sexes have the claws armed with a long, slender, acuminate basal tooth which is subequal in length to the claws and thus makes them appear superficially cleft; the apices of the tarsal segments are furnished with verticellate whorls of hairs; and the hind coxæ lack an erect basal lamella above. The females are completely apterous forms, lacking ocelli, and with the antennæ arising from sockets with simple reflexed rims. The thorax (Figs. 5, 16) has the pronotum separated from the mesonotum by a functional suture, but the remainder of the alitrunk is fused into a firm chitinized box without a suture or constriction between the propodeum and metathorax. The hind coxæ are contiguous but the middle pair are widely separated by the broad, flat mesosternum which, however, lacks plates or any other type of armature overlying the middle coxæ.

The few known species of this subfamily are referable to the genus *Bradynobænus* Spinola (of which *Chestus* Spinola and *Dyscolethes* Westwood are synonyms). E. P. Reed and Flaminio Ruiz P. have recently published diagnoses of the known forms.

SUBFAMILY MYRMOSINÆ

The Myrmosinæ are small forms readily differentiated from practically all other Nearctic Tiphiidæ by the simple, non-unciform hypopygium of the males. Male Myrmosines are alate, but the females are completely apterous. The antennæ are short, with their sockets overhung by small frontal lobes, and distinctly thirteen-segmented in the males and twelve-segmented in the females. The thorax of the males (Figs. 1, 11) has the metapleura ankylosed with the lateral faces of the propodeum; that of the females (Figs. 12, 13) has the pronotum separated from the remainder of the firmly chitinized, box-like alitrunk by a mobile suture. Both sexes have the legs slender; the coxæ contiguous; the hind coxæ armed with an erect basal lamella above; the femora and tibiæ slender, the latter without short, peg-like spines on the outer face in the females; the tibial calcaria 1–2–2; the tarsi without verticellate whorls of strong spines at the apices of the segments. The claws are simple in the females but toothed in the males. The fore wing of the males (Fig. 18) has three submarginal cells, the second and third of which each receive a recurrent vein. In the hind wings the costa is absent or very poorly developed; the cubitus is interstitial with the transverse median vein; and the anal lobe is small, only about one-fifth the length of the submarginal cell. The abdomen is fusiform to elongate-ovate; in the males it is generally distinctly constricted between the segments, the apices of which have narrow, flattened, polite margins. A pygidial area is lacking in both sexes. The males have a protean-shaped hypopygium which, however, is never unciform.

The group is Holarctic in distribution, with twelve species known at present from the Nearctic Region and eleven from the Palæarctic Region. These forms are distributed between two genera: *Myrmosa* Latreille and *Paramyrmosa* de Saussure (olim *Myrmosula* Bradley), each of which occurs in both hemispheres.

Ethology.—The Myrmosines are apparently parasites or commensals in the nests of other solitary bees and wasps, but there is very little definite information on the biology of the species. These wasps are generally diurnal forms, but Krombein has recently described a southwestern Nearctic species (*Myrmosa* (*Myrmosina*) *nocturna*) in which the ocelli are greatly enlarged; this form may, as the trivial name implies, be nocturnal. Dr. H. K. Townes informs me that during the summer of 1944 he captured a male *Myrmosa* flying about carrying a female during copulation, just as the Thynnines do.

KEY TO THE GENERA

1. Winged forms; males 2
   Wingless forms; females 3
2. Fore wing with second submarginal cell elongate-trapezoidal, broadly sessile on the radial vein; first abdominal sternite simple, unarmed; clypeus simple, not bisected by a keel; hypopygium simple, without lateral lobes or processes; last abdominal tergite convex, not abruptly declivous in lateral aspect .... *Paramyrmosa* de Saussure
   Fore wing with second submarginal cell trigonal, pointed or narrowly truncate on radial vein; first abdominal sternite (often the second also) armed with a median basal process; clypeus bisected at base by a carinule; hypopygium tripartite; last abdominal tergite abruptly declivous posteriorly .... *Myrmosa* Latreille

Subgenera of *Myrmosa*

a. Second abdominal sternite without a median basal process; squamæ of genitalia with a deep dorsoventral groove on inner faces; seventh sternite with apical margin emarginate; hypopygium with median lobe slender, hastate; (Nearctic forms) .... *Myrmosina* Krombein

aa. Second abdominal sternite with a median basal process; squamæ of genitalia not grooved on inner face; seventh abdominal sternite with apical margin entire, rounded out; hypopygium with median lobe slender, oblanceolate; (Holarctic forms) .... *Myrmosa sensu stricto*

3. Ocelli absent; clypeus without a median basal spine; mandibles with a basal laminate process on their lower margins; hypostomal carinule

tuberculate laterally on each side near posterior mandibular condyles; first abdominal sternite not bisected by a keel; finely punctate forms .... *Paramyrmosa* de Saussure

Ocelli present; clypeus with a median basal spine; mandibles simple, their lower margins without a basal laminate process; hypostomal carinule simple, not tuberculate laterally near posterior mandibular condyles; first abdominal sternite bisected by a keel; coarsely punctate and sculptured forms .... *Myrmosa* Latreille*

In 1940, Krombein presented a review of the Myrmosinæ. In the same year Mickel published a revised key for the separation of the females of *Paramyrmosa* under the name *Myrmosula.*

SUBFAMILY ANTHOBOSCINÆ

The Anthoboscines are small to medium or occasionally large-sized, black or red and black forms, sometimes maculated with yellow. Both sexes are winged and have the antennæ arising from sockets with simple, reflexed rims, the upper margins of which may be somewhat elevated. In the hind wing the cubitus arises distinctly before the end of the submedian cell; the costa may be absent or present, and in the latter case is often armed with a basal retinaculum in addition to the customary row of hamuli; the axillary excision is deep, one-third to one-half the length of the anal lobe which is generally distinctly shorter than the submedian cell. The mesonotum has the parapsidal furrows and the notauli developed, although the latter may be weak; the mesopleura lack omauli; the scutellum, postscutellum and propodeum are simple, and each is undifferentiated; the middle and hind coxæ are separated, with the bases of the middle pair overlapped by a pair of laminate mesosternal plates. In the females, the legs are short and stout, with the posterior genual plate of the hind femora very large and half or more the length of the femora; the outer faces of the middle and hind tibiæ are broad, more or less flattened, and armed with spines and short, more or less closely set peg-like tubercles; the fore tarsi are provided with a well-developed pecten, and the apices of the middle and hind tarsal segments are furnished with verticellate whorls of long spines. Both sexes have the tarsal claws dentate or cleft; the tibial calcaria 1–2–2; and the abdomen simple and relatively

* No females of *Myrmosina* Krombein are known.

undifferentiated. The hypopygium of the males is quite simple, never unciform.

About sixty-five extant species of Anthoboscinæ have been described: thirty-seven from the Australian Region; seventeen from the Ethiopian; and eleven from South America. These have been distributed among the following seven genera and subgenera: *Anthobosca* Guérin, 1838, *Cosila* Guérin, 1838, *Colobosila* Sichel, 1864, *Dimorphoptera* Smith, 1868, *Callosila* Saussure, 1892, *Odontothynnus* Cameron, 1904 and *Austrotiphia* Cockerell, 1906. However, in his interesting 1912 review of the group, Turner considers all of these, as well as the Colorado Miocene fossil *Geotiphia* Cockerell, 1906, synonyms of *Anthobosca.* It is very evident that the genera of this subfamily need further critical study.

The geographical distribution of these wasps is almost entirely southern: they reach their maximum development in Australia; in South America, they do not occur north of the Amazon; and in the Ethiopian Region they are confined chiefly to South Africa, although a few forms are known as far north as Abyssinia and the Aden district of Arabia. Undoubtedly the Anthoboscines were much more widely distributed in the past; this is attested by the four fossil species[1] described by Cockerell from the Miocene shales of Florissant, Colorado, and referred by Turner to this group. The subfamily is now known to be represented in the modern Nearctic fauna by the following remarkable new genus and species which in all probability is a Tertiary Great Basin relic.

Ethology.—Janvier reports that *Anthobosca chilensis* preys upon the larvæ of the Scarabæid beetle *Pseudadelphus ciliatus.*

Lalapa new genus

The strongly emarginate inner eye orbits of both sexes, the very simple, unspecialized scutellum, postscutellum, and propodeum, and, in the females, the peculiar armature of the middle and hind tarsi and the scaled apical margins of the abdominal tergites and sternites, readily differentiate *Lalapa* from all the other described genera of Anthoboscinæ.

Generic Features.—Small, hirsute, Scolioid forms. Head (Fig. 7) subcircular in anterior aspect, transversely oval in dorsal aspect; compound eyes

[1] † *Geotiphia foxiana* Cockerell, 1906; † *G. halictina* Cockerell, 1910; † *G. sternbergi* Cockerell, 1910; and † *G. pachysoma* Cockerell, 1927.

naked, reaching to bases of mandibles; larger in males than in females; inner orbits subparallel, deeply emarginate in both sexes. Front gently tumid throughout, broader than high; ocelli normal in size; occipital carina incomplete, absent below. Antennæ arising from sockets with simple, reflexed rims; widely separated from each other and also from nearest inner orbit; thirteen-segmented, straight and elongate in males, twelve-segmented, short and curled in repose in females. Clypeus short and transverse in females, longer in males. Mandibles falcate, with apices simple and acuminate in females (Fig. 6), but stouter and with a large preapical tooth in males (Fig. 7).

Thorax with pronotum rather elongate, simple, undifferentiated, gently and arcuately declivous from level of mesonotum to neck, without distinct dorsal and anterior faces. Mesonotum with parapsidal furrows present and well developed in both sexes; notauli well developed in males, obsolescent in females; scutellum and postscutellum flat, simple, undifferentiated, without lateral pits or foveæ. Mesopleura somewhat gibbous, without omauli or other suturiform furrows; metapleura tapering ventrally. Mesosternum with a pair of broad, trigonal laminate plates overlapping the bases of the separated middle coxæ, hind coxæ simple, contiguous. Propodeum simple, undifferentiated.

Both sexes fully alate. Fore wings (Figs. 23, 24) somewhat different in the sexes; stigma large and ovate; three submarginal cells present, the second and third each receiving a recurrent vein. Hind wings with costa absent; cubitus arising before transverse median vein; anal lobe very large and about two-thirds the length of submedian cell in males, but shorter, narrower, and only about one-half the length of submedian cell in females.

Females with legs short and stout. Fore legs relatively simple; tarsi with a distinct pecten of long, flattened bristles. Middle and hind femora compressed, the hind pair (Fig. 10) with a large posterior genual plate which is about half the length of femora. Middle and hind tibiæ flattened on outer face and with several rows of strong, peg-like tubercles, the hind margins multidentate. Middle and hind tarsi with verticellate whorls of spines at apices of segments; the metatarsi along lower anterior margin with a row, and the apices of second and third segments with one or two, elongate, flattened, translucent, spatulate processes. Both sexes with tibial calcaria 1–2–2; tarsal claws cleft; pulvilli small. Males with legs relatively simple, the femora slenderer than in females, hind femora with a very small posterior genual plate. All tibiæ slender, obterete, the hind tibiæ quinquedentate on posterior margins. Tarsal segments without either apical verticellate whorls of strong spines or elongate, flattened, translucent, spatulate bristles.

Abdomen sessile; relatively simple, fusiform, depressed; all tergites folded under roundly and imbricate with the flat sternites; no appreciable constriction between the first and second or any of the remaining segments. Males with pygidium and hypopygium (Fig. 9) simple, the latter with apex entire, roundly truncate. Females with apical margins of both tergites and sternites of first five segments with a transverse row of contiguous, translucent, flattened, elongate subrectangular scales; pygidium and hypopygium simple.

Genotype: *Lalapa lusa* new species.

This genus is represented in the Nearctic Region by the following distinctive new species.

Lalapa lusa new species

(Figs. 6, 7, 9, 10, 23, 24)

The distinguishing features given for the genus will likewise serve to differentiate *lusa* from all other Anthoboscine wasps.

Type.—♀; Hollister, Twin Falls County, Idaho. August 21, 1930. [United States National Museum.]

FEMALE. Length 7 mm. Black; the following badeous: mandibles except red apices; apex of clypeal lobe; apices of scapes; last abdominal segment.

Head perfulgid; clypeus laterally, occiput and temples posteriorly with long, erect, villous, white pubescence; remainder of head with a crinite white vestiture. Front gently tumid throughout, with sparse and scattered, rather coarse, setigerous punctures on lower half, almost impunctate above; ocelli in a curved line, the ocellocular line four-fifths the postocellar distance; vertex with a few scattered setigerous punctures. Antennæ situated low on face on dorsal margin of clypeus, the antennocular line five-sixths the interantennal distance; scape short, thick, seven-tenths the vertical eye length; pedicel obterete, four-fifths the length of first flagellar article; flagellum short, curled in repose, reaching about to pronotum, finely puberulent, first two segments subequal in length. Clypeus flat, median length one-third the vertical eye length; almost impunctate on upper half, the apical half produced into a broad, polite, impunctate lobe with apical margin truncate. Mandibles falcate; apices simple, acuminate.

Thorax perfulgid; pronotum, mesonotum laterally, scutellum and postscutellum laterally, mesopleura, venter, and lateral faces of propodeum, rather heavily clothed with long, erect, villous white pubescence; remainder of thorax and propodeum with shorter sparser vestiture. Pronotum, save for an impunctate apical band, with well-separated setigerous punctures throughout. Mesonotum almost impunctate anteriorly, with scattered setigerous punctures posteriorly; parapsidal furrows distinct on posterior two-thirds, notauli evident on median third, anterior third bisected by a fine impression; sutures between mesonotum and scutellum, and scutellum and postscutellum, simple, not strongly impressed; scutellum large, flat, laterally with setigerous punctures but without depressions of any kind, disc impunctate; postscutellum short, curved-linear. Mesopleura gibbous, with scattered, well-separated, setigerous punctures. Propodeum simple, with microscopically fine cancellate sculpture upon which is superposed a series of fine scattered setigerous punctures; dorsal and lateral faces evenly rounded into posterior face; dorsal face bisected by a fine suturiform furrow.

Legs heavily clothed with long erect, villous white hair; middle and hind tibiæ on outer faces with rather long, appressed, sericeous whitish pile.

Longer hind tibial calcar subequal in length to hind metatarsi. Otherwise as in generic diagnosis.

Abdomen fulgid; with microscopically fine cancellate sculpture; clothed with long, erect to declivent, white to light tawny, villous hair, which is heaviest on anterior face of first tergite, lateral portions of apical tergites, and caudal margins of apical tergites and sternites. Hind margins of first five segments armed with a row of contiguous, translucent, flat, elongate, subrectangular scales. Pygidium glabrous, semicircular, finely shagreened.

Allotype.—♂; Strawberry Valley, San Jacinto Mountains, Riverside County, California. July 17, 1912. (J. C. Bridwell.) [United States National Museum.]

MALE. Length 7 mm. The following features are those noteworthy of difference from those given in the foregoing diagnosis of the female (type).

Black; mandibles medially and last abdominal segment badeous.

Head fulgid; vestiture not as heavy or coarse as in female; front more coarsely and closely punctate throughout. Ocellocular line three-fifths the postocellar distance. Antennæ elongate, reaching as far back as postscutellum; situated higher on face; antennocular line two-thirds the interantennal distance; scapes three-eighths the vertical eye length; pedicel obterete, one-half the length of first flagellar article; flagllum straight, finely puberulent, first two and last two segments subequal in length. Clypeus one-half the vertical eye length; disc tumid, polite, impunctate, apex of lobe broadly retuse.

Thorax opaque throughout; with a thinner, shorter, and more uniform vestiture than in female. Mesonotum with both parapsidal furrows and notauli well developed; with well-separated, uniform puncturation throughout. Mesopleura with a fine cancellate-shagreened sculpture but no coarse puncturation. Metapleura and propodeum finely shagreened.

Legs slender; with only a moderate vestiture. Longer hind tibial calcar one-half the length of hind metatarsi. Otherwise as in generic diagnosis.

Abdomen subfulgid; with only a moderate vestiture throughout; apices of segments not scaled. Pygidium glabrous. Hypopygium simple, convex in ventral aspect, lateral margins tapering, apex entire, truncately rounded.

In addition to the types, I have seen a female paratype from Claremont, California, which agrees with the type in all essential respects save that it is slightly smaller (6 mm. long).

SUBFAMILY TIPHIINÆ

The members of this subfamily are moderate to large sized, diurnal, black or red and black forms, some of which are well maculated with white or yellow. The ocelli are small and normal in size; the antennæ, which arise from sockets with simple, reflexed rims, are clearly thirteen-segmented in the males and twelve-segmented in the females. Except in *Epomidiopteron*, the mesopleura are generally furnished with omauli. The tegulæ are elongate and completely cover the axillary sclerites (the antitegulæ of some authors). The mesosternum is equipped posteriorly with a pair of laminate plates which overlie the bases of the well-separated middle coxæ. The middle tibiæ have either one or two apical calcaria; the hind femora are very broad, with the posterior genual plate developed on the apical third only, while the outer faces of the middle and hind tibiæ of the females are more or less flattened and armed with closely set, short peg-like tubercles. The middle and hind tarsi have verticellate whorls of strong spines at the apices of the segments, and the tarsal claws are either dentate or cleft. Both sexes have well-developed wings, the venation of which may be dimorphic as in *Tiphia* (Figs. 25, 27), *Paratiphia* (Fig. 26), and *Neotiphia*, or not too dissimilar in the sexes as in *Epomidiopteron* (Fig. 22). In the hind wing the costa is absent, and the anal lobe is longer than the submedian cell and separated from the preanal area by a short slit which is distinctly less than one-half the length of lobe. The males have an unciform hypopygium but lack a distinct pygidial area, whereas the females may or may not have a clearly demarcated pygidial area.

The Tiphiinæ have representatives in all the major zoogeographic regions of the world with the exception of the Australian Realm. About three hundred species have been described: forty-five from the Neotropical; ninety from the Nearctic; sixty-five from the Palæarctic; thirty from the Ethiopian; and sixty from the Oriental Region. The following genera belong in this family: *Cyanotiphia* Cameron, *Epomidiopteron* Romand (of which *Scoliphia* Banks is a synonym[2]), *Neotiphia* Malloch, *Paratiphia* Sichel, *Tiphia* Fabricius (including *Pseudotiphia* Ashmead), and *Tiphiodes* Bréthes (including *Protophia* Bréthes). All of these genera are in urgent need of revisionary treatment. In 1936, Hedicke presented a catalogue of the world species.[3] The

[2] *teste* Bridwell, 1919, Proc. Hawaii. Ent. Soc., IV, p. 119.

[3] *v.* Krombein (1938, Ent. News, XLIX, pp. 184–189) for addenda and corrigenda.

four genera present in Nearctic America may be distinguished by means of the subjoined key.

Ethology.—The species of *Tiphia* and its related genera are parasitic upon white grubs, particularly upon such important pests as the Japanese beetle, various species of *Phyllophaga*, and divers other Scarabæid larvæ. As a consequence, these wasps are of considerable importance from an economic standpoint. In 1919, Davis presented an excellent account of the biology of certain Nearctic species, and Clausen has given a good résumé of the ethology of the group in his recent book on entomophagous insects.

KEY TO THE NEARCTIC GENERA

1. Tegulæ very large and elongate, extending back almost as far as the postscutellum and covering the bases of the hind wings; mesopleura without omauli; middle tibiæ always with two calcaria; large black forms with head, thorax, and abdomen spotted with yellow. *Epomidiopteron* Romand

   Tegulæ shorter, seldom, if ever, as long as above; mesopleura generally with distinct omauli; middle tibiæ with one or two calcaria; smaller, immaculate black forms, with the clypeus of some males white 2

2. Abdominal segments with conspicuous polite, impunctate, glabrous apical bands; sixth sternite of females bisected by a conspicuous longitudinal shagreened stripe, and that of males by a broad, shallow furrow margined laterally by carinules; first abdominal tergite with a transverse median carina ...... *Neotiphia* Malloch

   Abdominal segments without such conspicuous apical bands; sixth sternite of both sexes simple, without such features 3

3. First abdominal tergite with a transverse median carina and a well-defined, more or less marginate, oval depression laterally on each side; fore wings with three transverse cubital veins, the first obsolete posteriorly; males with clypeus often white ...... *Paratiphia* Sichel

   First abdominal tergite without either a transverse median carina or well-defined lateral depressions; fore wings with only two transverse cubital veins, the first absent or occasionally present anteriorly as a trace; males with clypeus always black ...... *Tiphia* Fabricius

Epomidiopteron is a small genus of large, black, highly ornamented forms, largely Neotropical in distribution. One species, *E. julii* Romand (of which *Scoliphia spilota* Banks is probably a synonym) reaches the southwestern United States.

Tiphia and *Paratiphia* are each represented in Nearctic America by a large number of small, concolorous black forms.

Malloch gave a key to a number of species in 1918, but both genera are in urgent need of revisionary treatment.

Neotiphia is an endemic Sonoran genus with seventeen described species. In 1938 Allen presented a key for the separation of fourteen of these. The genus is divisible into two clearly marked groups: the typical one, of which *Neotiphia acuta* Malloch, 1918 is type, has the pygidium of the females abruptly elevated on the basal three-fourths into a coarsely punctate, trigonal platform; in the males, the clypeus is produced medially into a small pointed or beaked process, and the sixth abdominal sternite is entire laterad of the median emarginate furrow. To this group belong the following species: *acuta* Malloch, *carinata* Krombein, *cockerelli* Allen, *conspicua* Allen, *crawfordi* Allen, *cristata* Allen, *luteipennis* Cresson, *novomexicana* Allen, *pima* Pate, *rostrata* Allen and *waltoni* Allen.

In the atypical group of *Neotiphia,* the pygidium of the female is flat throughout, not elevated at base into a trigonal platform; while in the males the clypeus is flat discally, with a broad apical margin, and the apical margin of the sixth sternite is more or less emarginate laterally on each side of the median marginate furrow. The following six species are referable to this group: *colorata* Allen, *chiricahua* Pate, *mexicana* Allen, *ocellata* Allen, *robusta* Allen, and *sulcata* Roberts. These groups, I believe, are worthy of subgeneric rank, and for the second or atypical one I propose the name *Krombeinia*[4] with *Neotiphia chiricahua* Pate, 1938 as type.

SUBFAMILY MYZININÆ

The subfamily Myzininæ is a large and varied cosmopolitan assemblage. The species vary considerably in size, and generally are diurnal, black or black and red forms, usually well maculated with white or yellow; a few, like the Transcaspian *Iswara,* are castaneous, nocturnal species with enlarged ocelli. The antennæ arise from beneath distinct frontal ridges in all members of this group, and the pedicel is often hidden in the end of the scape so that the males apparently have but twelve and the females only eleven antennal segments. Both sexes of the Nearctic genera are

[4] After K. V. Krombein, in recognition of his work on the members of this family.

fully winged and, moreover, generally have the anal lobe of the hind wing shorter than the submedian cell. This, however, is not true of all the exotic forms: for the females of some of the Old World genera are brachypterous or, as in the South African genus *Braunsomeria*, completely apterous; nevertheless, the males of such forms are always fully winged. Furthermore, in certain African genera like *Mesa,* the anal lobe of the hind wing is fully as long, if not longer than, the submedian cell. In alate forms the costa of the hind wing is present and well developed, and the cubitus arises before, beyond, or is interstitial with, the transverse median vein; while the venation of the fore wing may be similar in the sexes or dimorphic as in *Myzinum.* The mesosternum is furnished posteriorly with a pair of laminate plates which overlie the bases of the well-separated middle coxæ, and the middle tibiæ may have either one or two apical calcaria. In the females, the posterior genual plate of the hind femora may be well or poorly developed; the outer faces of the middle and hind tibiæ are more or less flattened and generally furnished with closely set, peg-like tubercles; and the middle and hind tarsi have verticellate whorls of spines at the apices of the segments. Both sexes of all forms have the tarsal claws cleft at apex or armed with a basal tooth. The males have the hypopygium armed with a recurved aculeus, and the apex of the pygidium retuse or emarginate at apex.

About two hundred and forty species of Myzinines are known from all parts of the world except the Australian Region: fifteen in the Nearctic; eighty-five in the Neotropical; eighty-six in the Palæarctic; twenty-five in the Oriental; and twenty-five in the Ethiopian. The following genera belong in this subfamily: *Braunsomeria* Turner, *Isotiphia* Ashmead, *Iswara* Westwood (including *Komarowia* Radoszkowski, *Magrettina* Ashmead, and *Milluta* André), *Meria* Illiger (including *Hemimeria* Saussure, *Macromeria* S. S. Saunders, *Poecilotiphia* Cameron, and *Tachus* Jurine), *Mesa* Saussure, *Myzinum* Latreille (including *Myzine* Latreille et Auctt., *Elis* Fabricius, and *Plesia* Jurine), *Parameria* Guérin, *Plesiomorpha* Bréthes, *Pseudomeria* S. S. Saunders, and *Pterombrus* F. Smith (including *Engycystis* Fox and *Hüberia* Ducke). In 1937 Krombein presented a tentative key to the genera of the world, but this is unsatisfactory in some respects, for he was unable to see material of a number of Old World genera and had to rely upon the literature which is far from trustworthy. The table given below will serve to characterize as well as to separate the two genera of this subfamily which occur in the Nearctic Region.

Ethology.—The wasps of this subfamily are, so far as known, parasitic upon the larvæ of Scarabæidæ and Cicindelidæ.

KEY TO THE NEARCTIC GENERA

Mesonotum with both the notauli and parapsidal furrows present; fore wings with the marginal cell confluent with the costal margin in males (Fig. 20) but distinctly separated from it in females (Fig. 21); antennæ with only eleven segments clearly visible in females and twelve in males, the pedicel hidden in the apex of the scape. Males with the inner eye orbits deeply emarginate; penis valves slender, slightly expanded at apex into a bulb, and without serrulations on ventral edge, the volsellæ with ctenidia broad and comprising more than ten teeth, at least in the middle rows. Thorax and abdomen black, spotted and banded with yellow, or apex of abdomen occasionally red .... *Myzinum* Latreille

Mesonotum with only the parapsidal furrows present; fore wings with the marginal cell confluent with the costal margin in both sexes (Fig. 28); antennæ with twelve segments in females and thirteen in males clearly visible. Males with the inner eye orbits entire; genitalia with penis valves broad and very finely serrulate on their ventral margins, the volsellæ with ctenidia reduced to a single tooth in each row. Black forms with abdomen entirely red .... *Pterombrus* F. Smith

Pterombrus is primarily a Neogæic genus but it has one species, *Pterombrus rufiventris* (Cresson), which reaches and is widespread throughout the southern United States. Nothing is known of the biology of this form, but in all probability it is parasitic upon the larvæ of tiger beetles (Cicindelidæ) as are its South American relatives, of which F. X. Williams in 1928 gave an excellent and well illustrated account.

Myzinum, which was formerly known as *Elis* Fabricius and prior to that went under the name *Myzine* Latreille,[5] is repre-

[5] Latreille described this genus in 1803 as *Myzinum* and, as was his custom, gave it a vernacular name—*myzine*. When referring to the genus in his later works, Latreille generally employed the vernacular name *myzine*, and most subsequent authors have followed and used this spelling of the name. However, this is contrary to the present rules of zoological nomenclature; the correct orthography for the genus is *Myzinum*. I have discussed the situation in detail elsewhere (1935, Ent. News, XLVI, pp. 265–267).

sented in the Nearctic Region by fifteen species and subspecies. In 1938 Krombein tendered a review of the Nearctic forms, and in 1942 a digest of the Antillean species. The wasps of this genus are of considerable economic importance inasmuch as their larvæ are parasitic upon white grubs or the larvæ of Scarabæid beetles. Davis in 1919 and Box in 1927 gave excellent accounts of the biology of various species of *Myzinum.*

The males of *Myzinum* have the curious habit of congregating in late afternoon on the stems of tall grasses, herbs, small twigs, or any suitable vertical object; there they spend the night together in a ''sleeping association'' and disperse in the early morning. Both Rau and Fernald have noted this interesting phenomenon. I have observed it on several occasions in New Mexico and New Jersey: in each case the plant was white sweetclover (*Melilotus alba*).

SUBFAMILY THYNNINÆ

The males of these wasps are fully winged forms with three submarginal cells in the fore wing, the first of which is usually more or less completely divided by a spur from the first transverse cubital vein. In the hind wing the costa is present and the cubital vein arises before the end of the submedian cell. The antennæ arise from beneath frontal ridges or lobes, or the upper margin of the antennal sockets is elevated. The hypopygium is very diverse in shape; in some forms it terminates in an unciform aculeus. The females are completely apterous and, except in *Diamma*, generally much smaller than the corresponding males. The antennæ are short, scarcely longer than the head; the scape is hollowed at apex and almost conceals the pedicel. The ocelli are absent, except in *Diamma.* The alitrunk is divided into three parts by a functional suture between the pronotum and mesonotum, and another between the metathorax and propodeum. Both sexes generally have the middle coxæ well separated, with their bases more or less overlapped by a bilobed projection of the mesosternum; the hind coxæ are contiguous; and the claws are either toothed or cleft.

The Thynnines are a large group of diversified forms which are predominantly Australian in distribution, although a considerable number of genera and species also occur in South America.

These wasps have hitherto been regarded as a distinct family divided into three subfamilies: the Diamminæ, Rhagigasterinæ, and Thynninæ. In the present classification, these may be accorded tribal rank. In 1910 Turner presented a review of the whole group, and in 1907–08 a synopsis of the Australian forms. Approximately four hundred and fifty species, distributed among sixty genera, have been described.

Ethology.—In nearly all the Thynnines, the large winged males carry the diminutive apterous females about in a nuptial flight for some length of time. In *Diamma* alone is the female much larger than the male; consequently he is unable to transport the female through the air. The females, when impregnated, drop to the ground and proceed to burrow in search of scarab beetle grubs which they parasitize. The species of *Diamma*, however, are parasitic upon mole crickets. There seems to be little foundation for the reports that these wasps are parasitic upon other aculeate Hymenoptera. The papers of Burrell, Janvier, Rayment and Turner, and the texts of Clausen and Tillyard may be consulted for details of the biology of the various species.

SUBFAMILY METHOCHINÆ

The subfamily Methochinæ is a small group:[6] all the species are referable to the genus *Methocha*[7] Latreille. The members of this genus display considerable sexual dimorphism: the males are generally concolorous black, winged forms, whereas the females are small, red or red and black, completely apterous, ant-like insects. The ocelli are present and normal in size in both sexes. The antennæ are clearly thirteen-segmented in the males, with their insertion somewhat overhung by small frontal lobes, whereas in the females the twelve-segmented antennæ arise from sockets with simple, reflexed rims. Both sexes have the legs slender, with the femora fusiform and the tibiæ cylindrical-obterete; tibial calcaria of the males 1–2–2, and of the females 1–1–1; hind coxæ

[6] *Andréus* Ashmead, 1903 *nec* Vosmaer, 1885, may be referable to this group. The genus is unknown to me.

[7] Latreille proposed this genus first as *Methocha* (March, 1804, Nouv. Dict. Hist. Nat., XXIV, 179) and later emended the spelling to *Methoca* (September, 1804, Hist. Nat. Crust. Insect., XIII, p. 268). Under the present rules of zoological nomenclature, it is necessary to use the original orthography *Methocha*.

of the males with an erect basal lamella above but simple in the females; claws toothed in the males but simple in the females; tarsi of both sexes without verticellate whorls of strong spines at the apices of the segments; both sexes with all coxæ contiguous, the middle pair with a pair of small mesosternal tubercles projecting over their bases. The thorax of the males (Fig. 4) has the mesonotum furnished with well-developed parapsidal furrows and notauli, and the mesopleura with omauli. The fore wings (Fig. 17) have only two submarginal cells, each of which receives a recurrent nervure, while in the hind wings, the costa is absent or at best very poorly developed, the cubitus arises distinctly before the transverse median vein, and the anal lobe is large, two-thirds the length of the submedian cell. In the females, both the pronotum and propodeum are separated by distinct sutures and constrictions from the remainder of the alitrunk (Figs. 2, 8). The hypopygium of the males is armed with a strong recurved, unciform aculeus, and the pygidium is emarginate at apex.

The subfamily Methochinæ is a small group, with representatives in all the major zoogeographic regions of the world except the Australian. Approximately forty-five species have been described: five from the Nearctic; five from the Neotropical; five from the Palæarctic; eleven from the Ethiopian; and twenty from the Oriental Region.

Ethology.—The species of *Methocha* are diurnal forms. The small, apterous, ant-like females may be found running about in sand and gravel pits or banks in search of the burrows of tiger beetle larvæ (Cicindelidæ) which they parasitize. The papers of Adlerz, Champion, Main, Iwata, Pagden, and Williams may be consulted for details of the life history of these interesting little wasps.

SUBFAMILY BRACHYCISTIDINÆ

The members of this subfamily are mainly nocturnal forms and may be recognized by their light tawny color; some forms, however, are dark brown or even black. The males are winged and generally have the ocelli and compound eyes greatly enlarged: the abdomen lacks "felt lines" on the second segment and the hypopygium is armed with a strongly recurved, unciform aculeus. The females are completely apterous and lack ocelli. Their alitrunk is divided into three parts by two functional sutures: one between the pronotum and mesothorax, and another between the firmly ankylosed metathorax and propodeum. Both sexes have the bases of the middle coxæ overlapped by laminate mesosternal projections; the tibial calcaria are 1–1–2; the claws simple and edentate; and the apices of the middle and hind tarsal segments, at least in the females, furnished with verticellate whorls of spines.

Hitherto this group has usually been regarded as a subfamily of the Mutillidæ, albeit a rather anomalous one. But the absence of "felt lines" on the second abdominal segment, the unciform hypopygium of the males, and the tripartite alitrunk of the females indicates that *Brachycistis* and its allies are properly placed in the Tiphiidæ.

The males of this group have been known for several generations, but the females have not been definitely associated with them until recently when Mickel and Krombein proved that Ashmead's *Glyptometopa,* formerly placed in the Thynnidæ, was the female sex of *Brachycistis* in the broad sense. Thirty years ago, however, Turner tentatively suggested this association of the sexes, but practically all authors ignored his proposal. At present a curious state of affairs exists within this subfamily. One set of generic names is now in use for the males and another entirely different one for the females. This anomalous condition will be rectified only when the sexes are correctly associated. When this is done a number of generic names, particularly those applied to the females, will probably fall into synonymy.

The Brachycistidines are restricted largely to the western United States, especially the southwestern states where they are particularly abundant in the more xeric and desert areas; a few forms reach as far eastward as Kansas. The group is a rather homogeneous one. At present about sixty species have been described from the male sex; these are apportioned among five genera, but this number will probably be considerably increased in the near future. In the female sex, fourteen species, distributed among eight genera, have been described. The following key will serve to separate the various generic groups now recognized.

Ethology.—Little is known about the biology of these wasps save that the majority are nocturnal and that the males come to light in appreciable numbers. A few are crepuscular, and the wholly black forms like *Brachycistellus* and *Colocistis* are believed to be diurnal.

KEY TO THE GENERA

1. Winged forms; (males) 2
   Wingless forms; (females) 6
2. Fore wings with only the first recurrent vein and one submarginal cell present; marginal cell minute; two discoidal cells present; hind wing with the cubitus arising distinctly beyond the transverse median vein; mandibles tridentate at apex 3
   Fore wings with both recurrent veins, two or three submarginal cells, and three discoidal cells present; marginal cell usually larger and more distinct; hind wing generally with the cubitus interstitial with the transverse median vein; mandibles bidentate or tridentate at apex 4
3. Ocelli small, normal in size; compound eyes not enlarged; mesonotum strongly arched; metapleura and lateral faces of propodeum not completely fused; propodeum coarsely sculptured, with a transverse carina separating the dorsal from posterior face; small, concolorous black, diurnal forms .... *Brachycistellus* Baker
   Ocelli and compound eyes enlarged; mesonotum not so strongly arched; metapleura and lateral faces of propodeum completely fused, no trace of a suture separating them; propodeum smooth, without sculpture, the dorsal and posterior faces not separated by a transverse carina; small, castaneous, nocturnal forms. [Type: *Brachycistis* (*Brachycistellus*) *paupercula* Bradley, 1917].
   Quemaya new genus
4. Mandibles more or less distinctly bidentate apically; hind wing with cubitus arising distinctly beyond the transverse median vein; castaneous, nocturnal forms with enlarged ocelli.
   Brachycistina Malloch
   Mandibles distinctly tridentate apically; hind wing with cubitus often more or less interstitial with a transverse median vein 5
5. Ocelli small, normal in size; compound eyes not enlarged, their inner orbits almost straight, not appreciably emarginate; scutellum strongly convex; concolorous black, diurnal forms.
   Colocistis Krombein
   Ocelli and compound eyes greatly enlarged, the inner orbits of the latter more or less emarginate; scutellum not strongly convex; tawny to dark brown, nocturnal forms .... *Brachycistis* Fox
6. Proepisterna ventrally with an elevated, sharp transverse carina extending from lateral margins to or almost to midventral line 10
   Proepisterna transversely elevated near ventral margin, but without a distinct transverse, elevated carina 7

7. Occipital carina a complete circle in extent, distinct above and below 8
Occipital carina incomplete, the ventral half entirely absent.
Stilbopogon Mickel & Krombein
8. Mandibles broadest subapically, with a small tooth within at widest point, and setose beneath adjacent to tooth ... *Glyptometopa* Ashmead
Mandibles broadest at base, gradually tapering toward apex 9
9. Genapontal distance between occipital and hypostomal carinules about one-third the length of the oral fossa; proepisterna punctate and only very faintly shagreened; mandibles with ventral carina distinct but not high and prominent .... *Glyptacros* Mickel & Krombein
Genapontal distance between occipital and hypostomal carinules about two-thirds the length of oral fossa; proepisterna very strongly shagreened and sparsely, transversely rugose; mandibles with ventral carina lamelliform, high and prominent.
Xeroglypta Mickel & Krombein
10. Vertex posteriolaterally with a curved, densely setose sulcus.
Aulacros Mickel & Krombein
Vertex posteriolaterally without such curved, setose sulcus, but with a curved row of contiguous or separated punctures 11
11. Mandibles broadest subapically; first abdominal segment sessile, not at all petiolate; ocellid impressions of vertex present and distinct 12
Mandibles broadest very near base at a strong tooth, then tapering gradually toward apices; first abdominal segment with a short, distinct petiole; ocellid impressions of vertex absent.
Astigmometopa Mickel & Krombein
12. Hind coxæ ecarinate on inner margins; proepisternal carina obsolescent toward midventral line; occipital carina with ventral half evenly arcuate throughout; maxillary palpi six-segmented.
Eurycros Mickel & Krombein
Hind coxæ with a strong, sharp carina on inner margins; proepisternal carina complete and prominent to midventral line; occipital carina with ventral half not evenly arcuate, but rectangular laterally and forming a transverse, straight line on ventral aspect of head; maxillary palpi five-segmented .... *Aglyptacros* Mickel & Krombein

Malloch in 1926 and Bradley in 1917 gave tables for the determination of the males of this subfamily; and in 1942 Mickel and Krombein presented a review of the females of this group.

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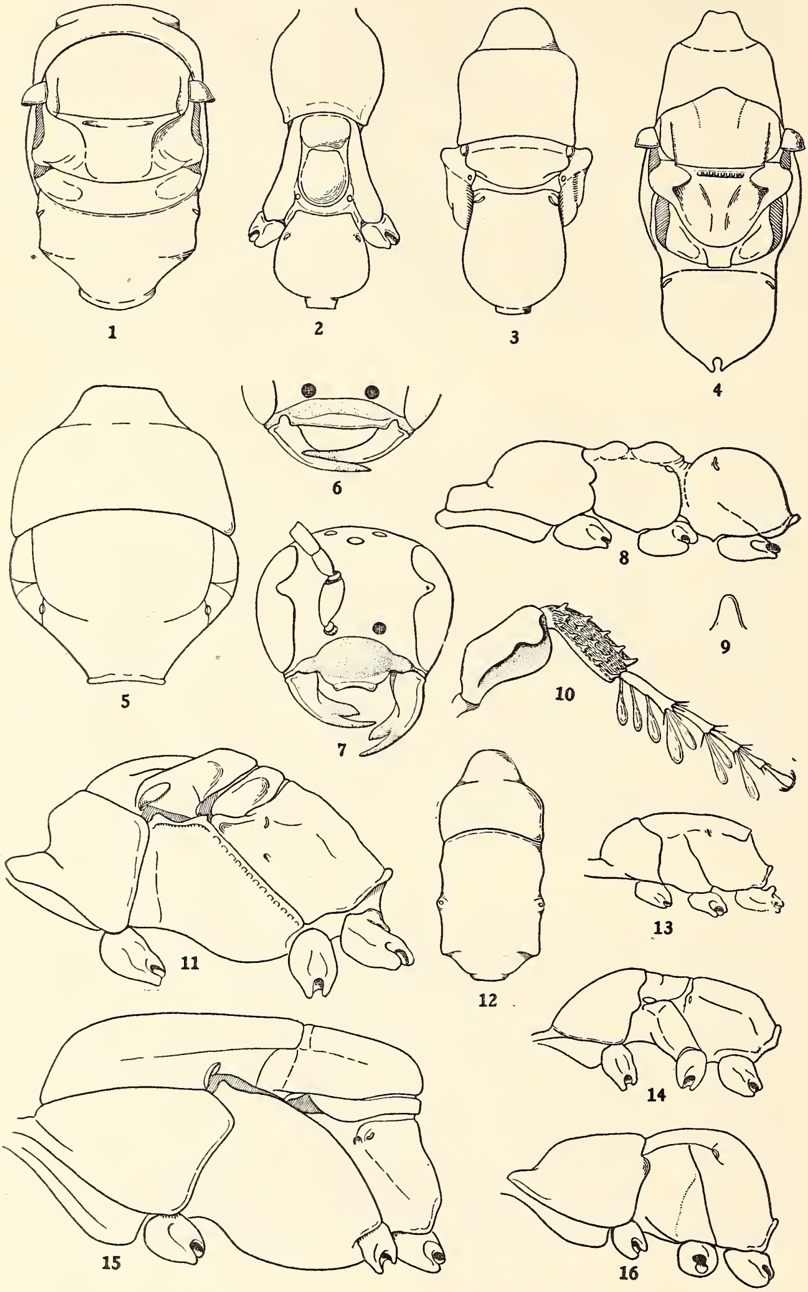
PLATE VI

Figure 1. Thorax, dorsal aspect, of *Myrmosa* (male).
Figure 2. Thorax, dorsal aspect, of *Methocha* (female).
Figure 3. Thorax, dorsal aspect, of *Braunsomeria* (female).
Figure 4. Thorax, dorsal aspect, of *Methocha* (male).
Figure 5. Thorax, dorsal aspect, of *Bradynobœnus gayi* (female).
Figure 6. Clypeal region of head of *Lalapa lusa* (female).
Figure 7. Head, anterior aspect, of *Lalapa lusa* (male).
Figure 8. Thorax, lateral aspect, of *Methocha* (female).
Figure 9. Hypopygium, ventral aspect in outline, of *Lalapa lusa* (male)
Figure 10. Hind leg, anterolateral aspect, of *Lalapa lusa* (female).
Figure 11. Thorax, lateral aspect, of *Myrmosa* (male).
Figure 12. Thorax, dorsal aspect, of *Myrmosa* (female).
Figure 13. Thorax, lateral aspect, of *Myrmosa* (female).
Figure 14. Thorax, lateral aspect, of *Braunsomeria* (female).
Figure 15. Thorax, lateral aspect, of *Bradynobœnus gayi* (male).
Figure 16. Thorax, lateral aspect, of *Bradynobœnus gayi* (female).

PLATE VII

Figure 17. Fore and hind wing of *Methocha stygia* (male).
Figure 18. Fore and hind wing of *Myrmosa unicolor* (male).
Figure 19. Fore wing of *Bradynobœnus gayi* (male).
Figure 20. Fore and hind wing of *Myzinum quinquecinctum* (male).
Figure 21. Fore and hind wing of *Myzinum quinquecinctum* (female).
Figure 22. Fore and hind wing of *Epomidiopteron julii* (female).
Figure 23. Fore wing of *Lalapa lusa* (female).
Figure 24. Fore wing of *Lalapa lusa* (male).
Figure 25. Fore wing of *Tiphia femorata* (male).
Figure 26. Fore and hind wing of *Paratiphia albilabris* (female).
Figure 27. Fore and hind wing of *Tiphia inornata* (female).
Figure 28. Fore and hind wing of *Pterombrus glabricollis* (female).



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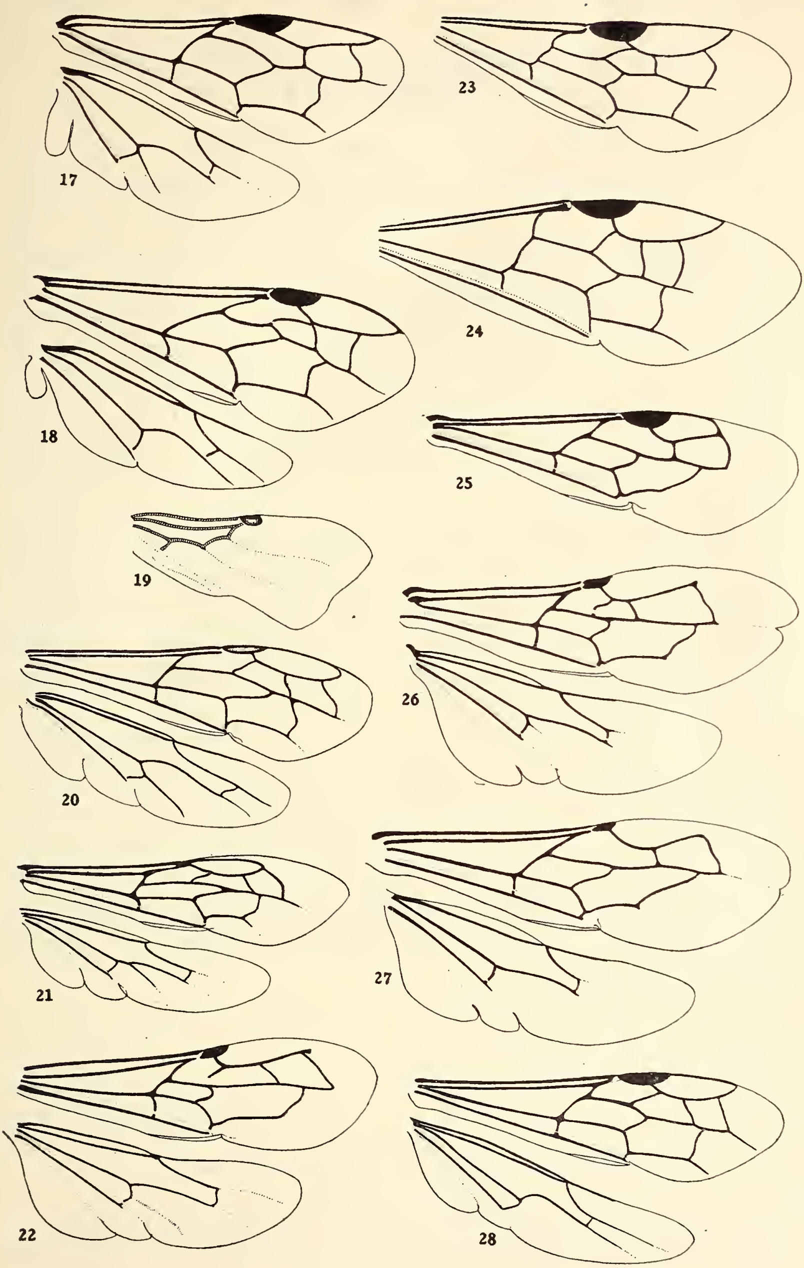

TIPHIIDÆ

SMOKE FLIES

In an interesting paper entitled "American Smoke Flies (Microsania: Clythiidæ)," published in The Wasmann Collector, Vol. 7, No. 1, p. 23–30, March, 1947, Edward L. Kessel describes the behavior of *Microsania occidentalis* Malloch to smoke and summarizes the observations of English and European entomologists on other species of smoke flies. Mr. Kessel's observations in California are apparently the first to be made in America relative to the response of an American species of Microsania to smoke. He describes the dancing of *M. occidentalis* in large numbers in the thick smoke above a chimney and reports other observations bearing on the positive response of this species to smoke.

Wood smoke consists mainly of carbonic acid and water mixed with finely divided carbon. When wood is burned the hydrocarbons are distilled off as gases and burn to CO_2 and steam if the air supply is ample and the temperature is high. If mixed with cool air and chilled below the ignition temperature they will pass off unburned.

One wonders if the flies are positively chemotropic to CO_2 and if so, why? Carbon dioxide, because it raises the rate of respiration in insects is sometimes mixed with fumigants and in humans the rate of the heart action is regulated by the CO_2 content of the blood. Perhaps the attraction is not CO_2, but other volatile products of the combustion of such things as gums, tannin, oils, etc. It would be of interest to know the correct answer.—H. B. W.

NEW FORMS OF APHÆNOGASTER AND NOVOMESSOR

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The ants of the tribe *Aphænogastrini* are easily recognized by the shape of their thorax, which in profile resembles the back of a "swayback" horse; the mesothorax is usually deeply sunken between the elevated prothorax and epinotum.

The various genera belonging to the tribe however differ greatly in their general structure; the genus *Novomessor* possesses more or less well developed gular hairs, a character which is generally assumed to be an adaptation to desert life. The subgenus *Deromyrma* of the genus *Aphænogaster* is distinguished by having its head drawn out behind in a long neck, usually ending in an upturned collar (this character is also found in some species of *Pheidole* as well as in certain South American species of the unrelated genus *Camponotus*). The species of the genus *Stenamma* are relatively small insects, closely resembling *Aphænogaster* except for the sculpture of the clypeus and other features.

The most common species of *Aphænogaster* subgenus *Attomyrma* along the eastern seaboard of the United States is *A. fulva* which occurs here in numerous varieties. This ant is easily kept in artificial nests; most of my work on the rebuilding of social organization in ants (published elsewhere) has been done on *A. fulva*.

The systematic position of the various varieties of *A. fulva* needs clarification. The original description of this species by Roger, 1863, is a collective one and includes practically all the later described forms. The subspecies *A. fulva aquia* Bly. should be reduced to a variety.

Aphænogaster fulva var. **rubida** var. nov.
(Plate VIII, bottom)

WORKER.—Length 3.5 mm. Color variable, most of the species being light reddish yellow; rare specimens are dark reddish brown; in all cases the body is uniformly colored though in the darkest individuals the trochanters may be lighter yellow.

Head longer than broad, with convex sides and posterior edge. Mandibles with three large apical and six to seven smaller and blunter basal teeth; with sinusoid outer border; strongly longitudinally rugose. Anterior edge of the clypeus triangularly excised in the middle; cheeks strongly longitudinally rugose punctate; front rugose; vertex and area behind the eyes reticulate punctate; antennal fossæ only punctate. Antennal scapes slender, surpassing the head by ⅓ their length; funiculus slender, 11-jointed, with an indistinctly 4-jointed club; all antennal joints longer than broad.

Thorax slender, deeply and broadly impressed between the meso- and epinotum, the mesonotum forming an elevated hump with sharp rectangular anterior corners which are connected by a strong transverse carina. The lateral margins of the mesonotal hump are outlined by several irregular longitudinal rugæ. Epinotal spines slender, divergent, semi-erect, and as long as the epinotal declivity. Prothorax, epinotal base and upper part of the epinotal declivity transversely rugulose punctate. Sides of the prothorax and epinotum with a few prominent longitudinal rugæ, the rest only punctate.

Both nodes very elevated; first node from above 1½ times as long as broad, second node as long as broad; both nodes punctate from above, on the sides with a few longitudinal rugæ; gaster finely punctate at the base, shiny, but less so than in the typical *A. fulva*. Rest of the body opaque.

The long hairs are numerous and of golden yellow color.

Described from a number of specimens taken in the Arnold Arboretum, Boston, Massachusetts.

The nest was under a flat stone in a shady open forest. Holotype No. 12 in my collection.

The new variety can be placed by means of the appended key.

Novomessor cockerelli var. **minor** var. nov.
(Plate VIII, top)

WORKER.—Length 6.7 mm. Color; head, thorax, pedicel, base of gaster and antennæ deep reddish brown to the unaided eye; gaster, femora and tibiæ blackish brown. Head longer than broad. Mandibles with 5 blunt teeth; coarsely longitudinally rugose. Clypeus sinuate in front, the middle portion with very coarse longitudinal rugæ. Frontal triangle sunken. Frontal carinæ elevated, partly hiding the antennal insertions. Antennal foveæ punctate. Rest of the head above coarsely longitudinally rugose, the interspaces punctate. The antennal scapes surpass the head by ⅓ their length. Funiculi filiform, 11-jointed, the joints becoming shorter toward the apex. Eyes in the middle of the sides of the head, very bulging. Psamnophore spread out, consisting of scattered long hairs with hooked ends.

Thorax long and slender, deeply impressed at the region of the mesonotum, without distinct sutures. The sunken mesothorax is faintly transversely punctate and striate. The rest of the thorax only punctate. Epinotal spines close together, very long, slender, sharp, diverging feebly. Pedicel slender; petiole with a rounded node above, peduncle not armed below. Postpetiole triangular, broadest behind. The entire pedicel is feebly punctate and shiny above. Gaster oval, microscopically punctate and highly polished; the base of the gaster on each side with a sharply outlined oval golden spot.

The pilosity consists of white erect hairs which are more abundant on the head and gaster, sparse on the thorax.

Described from a number of workers collected at Corpus Christi, Texas.

Holotype No. 11 in my collection.

The new form belongs to the subgenus *Novomessor* s. str. The other species of *Novomessor* are separated in the appended key. It is closest to the species *cockerelli* André from which it differs by the following characters; it is considerably smaller than the typical form, the color on the whole is lighter, the typical *cockerelli* has the base of the gaster reddish (with two golden spots in the new form). The pedicel of the typical form is more shiny and less sculptured than in the variety *minor*. Meso- and epinotum on the other hand are much stronger sculptured in the typical form. The eyes are surrounded in the type by a number of circular rugæ (absent in *minor*). The new form probably deserves species rank; there was not enough material on hand to ascertain this point by a study of its variability.

Aphænogaster (Deromyrma) araneoides var. **canalis** var. nov.
(Plate VIII, center)

WORKER.—Length 7 mm. Color uniformly bronze. Head elongate with the characteristic goose neck of the subgenus *Deromyrma*. Mandibles triangular with 8–9 teeth, decreasing in size toward the base, longitudinally striated punctate. Clypeus longitudinally striated and coarsely punctate. Frontal area deeply recessed, striate punctate. Rest of the head coarsely punctate and feebly rugulose, sharper on the cheeks. Eyes large and bulging. Antennal scapes very long, surpassing the upturned collar of the goose neck by nearly half their length. Funiculi filiform, 11-jointed, thin, the joints increasing in length toward the tips.

Thorax of the usual shape of a ''swayback'' horse. The sutures are feebly indicated by depressions. The mesonotum has an anterior hump as in *Aphœnogaster fulva*, and a second posterior hump in front of the mesepinotal impression. The prothorax and the anterior hump are coarsely punctate. The second hump and the epinotum are feebly striated, the hump obliquely, the epinotum transversely. The epinotum is unarmed.

The pedical is long and slender. The petiole has a rounded node above, the postpetiole is elongate and oval and a little broader behind than in front. The gaster is long and slender, pointed at the junction with the postpetiole. The pedicel is finely, regularly, and very densely punctate. The punctation on the legs is even finer.

The insect is covered with beautiful golden erect hairs, which are longer and more abundant on the vertex and gaster, shorter and sparser on the thorax and legs.

Described from a numbers of workers collected at Chiriqui, Panama, and sent to me for identification.

Holotype No. 13 in my collection.

The new ant is very close to *Deromyrma araneoides* Emery, 1890, and especially to the variety *inermis* Forel, 1899, both from Costa Rica. The typical *araneoides* differs from the new form by having small epinotal tubercles. The variety *inermis* lacks these tubercles as does the new form. The new variety differs from *inermis* by lighter color, more scanty pilosity, and especially by the sculpture of the epinotum which is irregularly rugulose in *inermis*, sharply and more regularly in *canalis*.

KEY TO THE WORKERS OF APHÆNOGASTER FULVA ROGER

1. Frontal carinæ broadened to lamellæ which partly hide the insertion of the antennal scapes; large forms, length about 5.5 mm.; often bicolored, light reddish brown with the gaster darker; intermediate to lamellidens, according to Emery. Northern United States. var. *rudis* Emery, 1895

   Frontal carinæ not broadened 2
2. Forms with short epinotal spines, shorter than the epinotal declivity... 3

   Forms with long epinotal spines 4
3. Small form, length 3.25–3.75 mm.; differs from *rudis* by having the head only punctate; the epinotal spines are short and nearly horizontal; color reddish brown with lighter appendages; (Emery suggests that this may be immature workers of another variety, but later authors have retained the name). Washington, D. C. var. *pusilla* Emery, 1895

   Larger and darker form; head behind feebly rugose and punctate; epinotal spines distinctly erect; color piceous. Atlantic seaboard, from Washington, D. C., to Canada .... var. *picea* Emery, 1895
4. Epinotal spines nearly horizontal; sculpture very rough and color very dark, nearly black with reddish appendages. Mexico. var. *azteca* Emery, 1895

Epinotal spines not horizontal but oblique or erect 5

5. Without rugæ on the pronotum; length 3–4.6 mm.; size variable; epinotal spines shorter than half the epinotal base; mesonotum with a small hump only; sculpture of the larger specimens as in the typical *fulva,* in the smaller ones the head behind densely punctate with a small shiny area. Eastern United States.
var. *aquia* Buckley, 1867

Rugæ present on the pronotum 6

6. Large form, length 7.5–8 mm.; (that is the length given by Emery; Rogers measurements include even the smallest forms, 3–8 mm.); Eastern United States .... *fulva,* typical, Roger, 1863

Smaller forms of light color and sharply outlined mesonotal hump. Massachusetts .... var. *rubida* var. nov.

KEY TO THE WORKERS OF NOVOMESSOR

(The asterisks behind the names indicate that type specimens have been compared.)

1. Workers monomorphic; antennal club not differentiated; psamnophore very small or vestigial .... *Novomessor* s. str. 2

Workers dimorphic; antennal club differentiated, mandibles thin and strongly curved, with a few or no teeth; soldiers with broad heads; psamnophore well developed .... *Veromessor* 5

2. Head and thorax coarsely reticulate;

A. *relictus** Wheeler and Mann, 1914—Length 4–5 mm.; head with distinct occipital margin; mandibles with 6–7 teeth; scapes surpassing the head by twice their diameter; mesepinotal constriction deep and narrow; epinotal spines long and sharp; petiole from above twice as long as broad; deep black, two spots on the gaster dark red. Diquini, Petionville, Port au Prince, Haiti.

B. *relictus* var. *epinotalis** Wheeler and Mann, 1914—Differs from *relictus* by a shorter epinotum which has a median transverse impression, very distinct in profile; epinotal spines shorter; the red on postpetiole and gaster duller. Manneville, Haiti.

Head and thorax striate and punctate 3

3. Thorax deeply and widely impressed, in profile shaped as in a sway-back horse 4

Thorax narrowly impressed .... *sonoræ* and *carbonaria*

4. Color light red; prothorax opaque; petiole punctate and opaque; gaster black; hairs white. New Mexico, Texas, Arizona.
albisetosus Mayr, 1886

Color darker; pronotum shiny; petiole shiny; head above striate and punctate; head not narrowed behind. Arizona.
cockerelli André, 1893

And var. *minor* var. nov.—Similar to *cockerelli* but smaller, more slender; gaster with golden spots at the base. Texas.

5. Epinotal spines very long, reaching the node or even surpassing it; very pilose form 6

Epinotal spines shorter, never reaching the node 7

6. Color lighter, reddish to yellow:

A. *andrei* subsp. *flava**—Color bright yellow. Jacumba, Califor-fornia.

B. *andrei* subsp. *castanea**—Color of uniform chestnut brown; larger than *flava*. Jacumba, California.

C. *andrei* subsp. *chamberlini* Wheeler, 1915—Length 4–4.3 mm.; color bright red, otherwise very similar to *castanea*. Santa Cruz Island, California, Nevada.

Color darker, reddish black:

A. *andrei*, typical, Mayr, 1886—Length 6–7.5 mm.; parts of thorax, petiole and gaster brownish black; appendages castaneous; hairs yellowish; mandibles not toothed; head much broader than the thorax and quadratic; thorax irregularly rugose and shiny; epinotum transversely rugose between the epinotal spines. California.

B. *julianus* Pergande, 1895—A large dark brown form with heavy sculpture; gaster shiny; pronotum with coarse transverse rugæ.

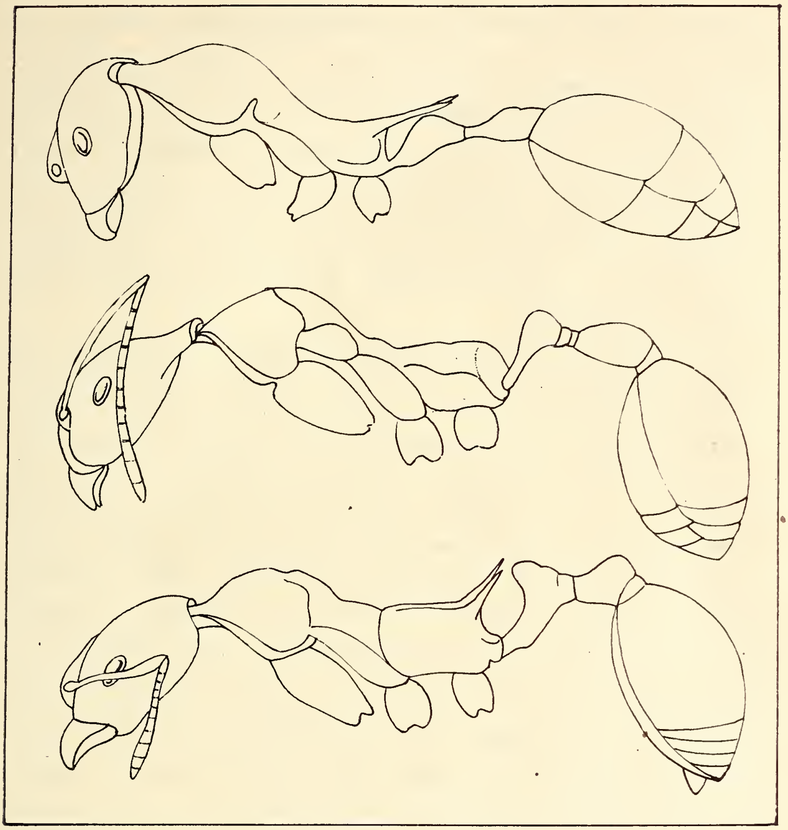
C. *julianus* var. *clarior*—Head to pedicel red, gaster black; thorax with the sculpture more irregular and stronger than in the type and in andrei.

7. Color black; length 6.3–7 mm.; sculpture feeble and body rather shiny; antennal joints $1\frac{1}{2}$ times as long as broad; California, Arizona.
pergandei Mayr, 1886

8. Gaster black; epinotal spines short; pronotum longitudinally striated; Color red 8

Jacumba, California .... *stoddardi* Emery, 1895

Gaster red; epinotal spines long; color of body nearly uniform. Colorado .... *subgen.* Lobognathus



Top. *Novomessor cockerelli* var. *minor*, in profile.
Center. *Aphœnogaster* (*Deromyrma*) *araneoides* var. *canalis*, in profile.
Bottom. *Aphœnogaster* (*Attomyrma*) *fulva* var. *rubida*, in profile.

ANIMAL DISEASES AND HUMAN WELFARE

The New York Academy of Sciences has just published the papers presented at a conference on "The Relation of Diseases in the Lower Animals to Human Welfare," held at the Academy on March 15 and 16, 1946. (Annals N. Y. Acad. Sci., Vol. XLVIII, Art. 6, p. 351–576, April, 1947.) Although most of these papers are concerned mainly with certain aspects of veterinary medicine, one in particular is of interest to medical entomologists. This is the paper entitled "The Prevention of Plague in the Light of Newer Knowledge" by K. F. Meyer of the University of California.

Doctor Meyer reviews the history of preventive measures and discusses the problem of sylvatic plague and its control. Numerous plague foci exist in the western part of the United States. It is believed that the plague bacillus was brought into the ports of San Francisco and Seattle by infected rats and eventually transferred to wild rodents. Some 38 species of wild rodents and rabbits have been found plague-infected in confined areas in California, Oregon, Washington, Montana, Idaho, Nevada, Utah, Arizona, New Mexico, Colorado and Wyoming. According to Doctor Meyer the potentialities of these reservoirs of sylvatic plague are as yet unknown. It is still a mystery why human cases fail to develop when conditions in many localities appear to be so favorable. Only more research into the ecology of sylvatic plague will provide the answer. Doctor Meyer's paper is of unusual interest throughout and will repay a careful reading by entomologists who have assumed that the Black Death disappeared entirely after its outbreaks in the fourteenth to seventeenth centuries.—H. B. W.

ENTOMOLOGICAL MEDICAMENTS OF THE PAST

By Harry B. Weiss

A reading of Dr. Loren C. MacKinney's article on "Animal Substances in Materia Medica, A Study in the Persistence of the Primitive," which appeared in "The Journal of the History of Medicine" (I(1): 149–170, 1946) has led me to compile the following records of the use of insects in medicine during past times. Dr. MacKinney mentions insects only incidentally and without details as this was outside the scope of his paper. The present paper is not concerned with insects in combination with magic nor with the extensive use of other animal substances, which far exceeded the use of insect substances. Insects, of course, played only a small part in the medicaments used in former times. They were greatly outnumbered by other animal substances and these, in turn, were exceeded by vegetable substances. Mineral substances were used less than the animal ones.

Insect substances were used in external and internal medicines. Some were used as fumigants, suppositories, etc. Most of the insect remedies were in use much earlier than the times in which their compilers lived. For example the materia medica of the Egyptians, as shown by the Papyrus Ebers, compiled in the sixteenth century B.C., includes the remedies of earlier centuries. And the books of Dioscorides who wrote in Nero's time show that the Greeks used animal remedies just like the Egyptians who preceded them. According to the writings of Celsus and Pliny the Elder who lived in the first century A.D., and later of Galen, the materia medica of the Roman Empire partook of the characteristics of many previous ages and regions. In fact Pliny compiled all ancient remedies including those of Rome during his time and many of these persisted in Western Europe right into modern times. Later writers continued to perpetuate these remedies and we find them mentioned in writings of the late eighteenth and early nineteenth centuries.

In the following preliminary list no attempt has been made to identify the species of insects involved in the various remedies and they have been arranged only by orders. The sources are indicated briefly in the text and more fully in the bibliography. It should be possible to extend this list by further search and no claim is made for completeness.

ORDER ORTHOPTERA

Records of Orthoptera used in medicine include the following. Robert James, quoting Dioscorides said "grasshoppers in a suffumigation relieve under a dysury [difficult micturition] especially such as is incident to the female sex," and that the *Locusta Africanus* is a very good remedy against the poison of the scorpion (James, Med. Dict.). A species of grasshopper *Tettigonia verrucivora* common in Sweden, was used by the natives to bite the warts on their hands, the black fluid which the insects emitted supposedly possessing the power of making warts disappear [Good, Study of Med., iv, 515]. In addition the eggs of the "Chargol" locust were used by Jewish women who placed them in their ears to prevent earache [Smith, Bib. Dict.].

Pliny stated, "the criquet called Gryllus doth mitigat catarrhs and all asperities offending the throat; also if a man doe but touch the amygdals or almonds of the throat, with the hand wherewith he has bruised or crushed the said criquet, it will appease the inflammation thereof." Also that it was good for the ears if dug up and applied together with the soil in which it was found. According to Dr. James the ashes of *Gryllus domesticus* were supposed to have diuretic properties. The body fluid dropped into the eyes was a remedy for weak sight and helped disorders of the tonsils if rubbed on them [Kunzé]. Kunzé wrote that Dr. J. M. Honigberger made a mother tincture of *Locustra migratoria* by triturating their bodies, minus the head, and appendages, into a paste and adding enough alcohol for a menstruum. He called it Locusteum and advised its use for bleeding piles and thirst.

ORDER BLATTARIA

Sloane wrote that the Indians of Jamaica drank the ashes of cockroaches as a physic. These insects, bruised and mixed with sugar were applied to ulcers as a suppurative. They were also given to children to kill worms [Hist. of Jamaica, II: 204]. In Russia *Periplaneta orientalis* was powdered and used for dropsy. It was also used as a remedy for pleurisy and pericarditis. In Russia the medicine was known as Tarakané and on the Continent it was sold under the name Pulvis Tarakanæ.

ORDER DEMAPTERA

Oil of earwigs was good "to strengthen the nerves under convulsive motions, by rubbing it on the temples, wrists and nostrils." The earwigs when dried, powdered and mixed with the urine of a hare were recommended for introduction into the ear as a cure for deafness [James, Med. Dict.].

ORDER ANOPLURA

Schroeder in his "History of Animals that are Useful in Physic" stated that lice were swallowed by country people for the cure of jaundice. Dioscorides said that they were used in suppression of the urine, by introducing them into the canal of the urethra. Elscherif wrote that a patient suffering from quartan fever would, in the experience of some, get relief, if a louse was put into the opening of a bean and swallowed. And Dr. Brickell stated that hog lice were good in all obstructions, jaundice, colic, king's evil, old sordid and rebellious ulcers, convulsions, stone, gravel, rickets in children, dimness of sight, etc.

ORDER HEMIPTERA

Pliny quoting Dioscorides mentions the various medical virtues of the bed-bug, *Cimex lectularius,* as follows. It neutralizes the venom of serpents; mixed with the blood of a tortoise it was applied externally to warts; used as a fumigant, it made leeches loosen their hold; a mixture of bugs crushed with salt and woman's milk, was used to annoint the eyes; in combination with honey and oil of roses, they were used as an injection for the ears; they were used in the treatment of lethargy and in strangury cases they were injected into the urinary canal. In addition Dr. James in his "Medical Dictionary" stated that the odor of the bugs relieved hysterical suffocation and that if seven bugs were swallowed with beans, as food, they would help in cases of quartan ague, if eaten previous to the accession of the fit. Some homeopathic physicians said that bed-bugs were suitable for children suffering from worms, epileptic attacks, etc.

SUBORDER HOMOPTERA

Cicadas were long used for diuretic and other purposes. Even as late as 1929 they were being utilized by the peasants of Provence [Myers]. They were mentioned by Dioscorides in the first century A.D., and later by Galen, both recommending roasted cicadas for bladder trouble. Galen advised that five to seven cicadas, with pepper, be eaten for colic and for years following, later physicians prescribed them for this purpose. A mixture of powdered cicadas and oil of scorpions was used as a counter irritant [Buckton]. Moufet (1634) cited eleven authorities for their use in medicine. According to Hearn (1900) they were used as earache cures in China and Japan. Boiled in water with certain plants they were given to children for fever and convulsions and also used for skin wounds. Their cast skins were preserved for medicinal uses and sold in Chinese and Japanese shops.

Among an aboriginal tribe of India, the Sańtâls, an ointment of cicadas and male crickets was used for screaming fits [Bodding]. Known to the Chinese as Ch' ant' ui, dried cicadas were used in various ways for many diseases, including sterility, rheumatic pains, evil eye, menstrual irregularities, etc. Their most effective use was against hydrophobia, for which they were taken in wine with cantharides. A Chinese species, *Elata limbata* secretes a kind of grease that adheres to the twigs of trees and hardens into a wax-like substance. When melted and purified it was employed by Chinese doctors as a preventive of palpitations and swoonings. Various workers have investigated the chemical and therapeutic properties of dried cicadas, with conflicting results.

Aphids were used, by homeopathists, in a tincture, and a trituration was also made of living aphids with sugar of milk, the species having been *Aphid chenopodii glauci* [Kunzé]. Several species of Coccidæ, in addition to furnishing dyes, were used in medicines. According to Geoffroy, *Coccus ilicis* and *Coccus cacti* were "esteemed to be greatly cordial and sudorific, being very full of volatile salts." They were administred to prevent abortion from strain or injury. Galen stated that the freshly collected insects, "kermes berries" possessed cooling and drying properties, being moderately astringent. Elscherif claimed that if a woman took a dram of *Coccus ilicis* in honey, every day for a week, the menstrual flow would be checked. When taken with vinegar it acted as a contraceptive and when the insects were worn as a necklace on a fever patient, the fever would disappear.

In the "United States Dispensatory," cochineal or *Coccus cacti* was recommended for whooping cough and neuralgia, being supposed to have anodyne properties. The Pela wax of China, deposited by *Coccus pela* on a species of ash tree, was used for medicinal and other purposes. Honigberger stated that the Hakims of India believed cochineal to be destructive of the generative faculty. Folsom states that in the Mediterranean coccids of the genus Kermes, living on oak, supply a medicinal syrup and that in Mexico, another coccid *Llavcia axinus* produces a substance known as axin which is used in external medicine and also as a varnish.

ORDER LEPIDOPTERA

A remedy against the bites of venomous animals and insects was, said Dioscorides, the larva of *Pieris brassicæ,* if rubbed in with oil. Ealand mentions the larvæ of *Euproctis chrysorrhœa* and of *Bombyx processionea* having been used as ingredients of certain homeopathic tinctures. Doctor Brickell, in his "Natural History of North Carolina," records oil of clothes moths as a cure for deafness, warts and leprosy. If mixed with tar they were thought to be good for "all sorts of rebellious ulcers, botches, scabs, whittles, etc." Doctor James mentions a caterpillar that feeds upon cabbage leaves, the *Eruca officinalis* of Schroeder, if bruised or in the powdered form as being capable of raising a blister like cantharides. Hippocrates stated that they were also good for quinsy.

As for *Bombyx mori,* the larvæ of this moth, dried and powdered, were applied to the crown of the head in cases of vertigo and convulsions [James, Med. Dict.]. The cocoons of *Bombyx mori* were used as one of the ingredients of "Goddard's Drops" and of "Confectio de Hayacintho" [Kunzé]. According to

Elscherif the larvæ of *Bombyx mori*, if dried and tied up in red linen and carried about, would cure a patient of fever.

ORDER COLEOPTERA

Coleopterous insects were used quite frequently in entomological materia media. Doctor Honigberger wrote of the cocoons of *Larinus maculatus* being imported into Lahore from Hindustan, and sold in the shops of drug-dealers in Constantinople. They were used frequently by Turkish and Arabian physicians in the form of a decoction believed to be helpful in diseases of the respiratory organs. A liter of boiling water was poured over about fifteen grams of the cocoons before the weevils emerged. After stirring for 15 minutes and then boiling, the decoction was drunk, unfiltered, by the patient. In Syria and Persia the natives used the cocoons of *Larinus nidificans* and *Larinus syriacus* [Zool. Med., Paris, 1859].

Professor Gerbi, during the latter part of the eighteenth century, published at Florence the history of a curculio that he named *Curculio anti-odontalgicus*. Fourteen or fifteen larvæ of this species were rubbed between the thumb and forefinger until the fluid was absorbed. If an aching tooth was touched with either the thumb or forefinger thus prepared, the pain would disappear. Unless touched to an aching tooth, the finger would retain its pain killing property for a year [Mon. Mag. ii, part II, 792, 1796].

Under the name "horns of scarabæi," the mandibles of the stag beetles *Lucanus cervus*, and *Scarabæus cornutus* were utilized as "an absorbent in cases of pains or convulsions supposed to be produced by acidity of the primae vitae" [Cuvier, An. King. Ins., i, 533]. An infusion of the beetles was recommended by Schroeder for pain in the ears. Pliny said that parents used to hang the beetles around the necks of young babies as a remedy for many illnesses, and that if tied about the necks of children, the beetles enabled them to retain their urine. Powdered *Scarabæus pilurarius*, "sprinkled upon a protuberating eye or a prolapsed anus is said to afford singular relief" according to Schroeder, also that a preparation made by boiling the beetles in oil, was useful in reducing the pains of blind hemorrhoids.

These remedies were repeated by Doctor James in his "Medical Dictionary." Galen said that oil in which Scarabæi had been roasted was good for earache, deafness, hemorrhoidal swellings, and the bites of scorpions. Elscherif recommended that the juice of Scarabæus, be applied to the eye, in minute quantities, for weakness and loss of sight. Such were the virtues of dung beetles.

Church-yard beetles, *Blaps* spp., prepared with oil were applied for ear troubles, and used externally for all sorts of dermoid affections. In Egypt and the Levant, *Blaps sulcata* was in addition used against scorpion bites. Women of the Nile country ate this species in order to become plump. According to Pliny other species of *Blaps* were good for leprosy, king's evil, wounds, bruises, scabs, etc. The bodies, minus heads, were bruised and applied to the affected parts of the patients' bodies. Sometimes they were mixed with resin or honey. The musk beetle *Aromia moschatus*, of the Cerambycidæ, when dried and powdered was used as a vesicatory and acted like cantharides [Drury, Ins., 1, 9].

Lady-bird beetles, Coccinellidæ, were once used for colic and measles. If one or two are mashed and put into the cavity of a tooth, the pain will be relieved [Jaeger, Life of Amer. Ins., p. 26]. Both Galen and Dioscorides refer to *Dermestes typographicus* as vesicators and the same species was used by Arabian physicians for opening abscesses. The powdered insects rotted the flesh when exposed to it sufficiently. In the Lampyridæ, Cardan said that some of the species had anodyne properties and Doctor James stated that the entire insect was used in medicine against the stone.

Relative to the blister beetles, Meloidæ, Pliny said that these were used externally with grape juice or sheep suet and were very good for the cure of leprosy and lichens and acted as an emmenagogue and diuretic for which reason Hippocrates used to prescribe them for dropsy. The dried bodies of the blister beetles possess strong vesicating properties. Used externally they produce blisters and when used internally, they are a powerful stimulant. Oil expressed from the beetles was used in Germany against hydrophobia and in Sweden in the cure of rheumatism, by annointing the affected parts. Doctor James said that taken in powder, the oil cured the vari or wandering gout. In liquor, it was useful in wounds and it was also used in plasters for "pestilential bubo" and carbuncles. An oil was prepared by the infusion of the living insects in common oil. According to Elgâfaki the powdered drug was mixed with vinegar and used against lice and the itch. Elscherif recommended a weak maceration of oil and cantharides for earache. Arabian physicians used blister beetles both externally and internally for their diuretic and aphrodisiac properties.

Of the Buprestidæ, Pliny said that *Buprestis* incorporated with goat suet took away the tettors called "lichenes" that occur in the face. Referring to beetles of this family Doctor James wrote, that all, in common were "inseptic, exulcerating" and possessed "a heating quality" for which reason "they were mixed with medicines adapted to the cure of Carcinoma, Lepra, and the malignant Lichen. Mixed in emollient pessaries, they provoke the catemenial discharge." However the Buprestis of the ancients may not be the same genus now and possible they were referring to Meloidæ or Cicindelidæ.

ORDER HYMENOPTERA

The Bedeguar or rose gall produced by *Cynips rosæ* was used against diarrhœa and dysentery, and also for scurvy, stone and worms [Cuvier, An. King., Ins., ii, 424]. Cuvier also mentions a gall on thistle, which was carried in the pocket as a remedy against hemorrhages. Many galls are full of tannin and were used medicinally and in the arts. Oak galls are astringent and the best were supposed to come from the Levant.

As for ants, Doctor James said that these insects "heat and dry and incite to venery." Their acid smell refreshed the vital spirits and they were said to cure the "Flora, Lepra, and Lentigo." Their pupæ were effective against deafness and corrected the facial hairiness of children when rubbed thereon. The oil of the house ant, by infusion was good for gout and palsy [Med. Dict.]. Formic acid from ants was long known as a rubefacient. The old "Spiritus Formicarum" of the Prussian Pharmacopœia was made by macerating two parts of bruised ants in three parts of alcohol and filtering. Schroeder prescribed an ant preparation for leprosy and for gout and palsy. In Thuringia, a spirit of ants was rubbed on parts of the body in cases of rheumatism and in Russia the same disease was treated by pouring boiling water on ants in a vapor bath [Ealand]. Sloane said that the Spaniards of the West Indies had a valued medicated earth which he thought consisted of ant nests [Hist. Jamaica, ii, 221]. And Owen wrote that if a person holds in his left hand, the grain of wheat that is carried by an ant and if this is wrapped in a "skin of Phoenician dye" and tied around the head of his wife, it will prove to be the "cause of abortion in a state of gestation" [Geoponica, ii, 148–9]. Elscherif of the Arabian School of Medicine thought that ants were a powerful aphrodisiac. His words on this subject were, "Take one hundred of large, black ants and macerate them for three weeks in half an ounce of not very heavy oil. Herewith annoint the urethral orifice to accelerate erections, tension of the yard and a free discharge of the fluids." Kunzé said that Maine lumbermen ate the large black ants, found in pine forests, as an anti-scorbutic.

In Hindustan and Lahore, according to Doctor Honigberger, *Mutilla antiguensis* was used by native physicians against snake bites and colic in horses, and was kept by the druggists. Wasps and hornets were formerly used in veterinary medicine. Doctor James said, "the combs of the hornet are recommended in a drench for that disorder in horses which Vigetius calls scrophula, meaning, I believe, what we call the strangles." For distemper and cold in the head, hornets' nests were smoked under the noses of horses. Honigberger stated that the nests of *Vespa crabro* had anti-spasmodic properties and that the "yellow wasp" had properties of some importance [Kunzé]. Dr. John Hamilton in 1893, writing of *Polistes,* said that although stinging might be a palliative in some chronic forms of rheumatism, it could not, from the nature of the disease, possibly effect a cure. He believed however that enough authentic examples existed to show that it might be used to advantage in certain neuralgic affections.

Doctor James in his "Medical Dictionary" said that the salts of bees, Apidæ, were volatile and "highly exalted" and that when dried, powdered and taken internally they were diuretic and diaphoretic. If this powder was mixed with unguents and applied to the head, it was supposed to "contribute to the growth of hair upon bald places." A tea made by pouring boiling water upon bees was prescribed for violent strangury. Dried powdered bees given to either man or beast "will often give immediate ease in the most excruciating pain, and remove a stoppage in the body when all other means have failed" [James].

Bees, venom, honey and wax, as remedies, were frequently mentioned by ancient writers including Hippocrates, Celsus, Pliny, Galen, etc. In Cuba the wax of stingless bees was used in removing corns and in southern Brazil the wax of *Trigona quadripunctata* var. *bipartita* was regarded highly by the natives for salves and plasters [Schwarz]. According to Ransome, in the Syriac Book of Medicine honey is mentioned in more than 300 prescriptions and wax in over fifty. Doctor James said, "all wax is heating, mollifying and moderately incurning. It is mixed in sorbile liquors as a remedy for dysentery, and ten bits of the size of a grain of millet, swallowed, prevents the curdling of milk in the breasts of nursing women." Elmansuri of the Arabian school recommended that honey be given to old men and those of a cold nature, and Dioscorides claimed detergent and diuretic properties for honey.

In 1935 there was published in New York, a book by Dr. Bodog F. Beck entitled "Bee Venom Therapy." In this work Doctor Beck reviews the use of bee venom therapy, with case records, relative to the use of injectable bee venom in cases of muscular rheumatism, neuritis, neuralgia, acute rheumatic fever, acute and chronic arthritis, etc., and also call attention to the research work still needed and to the variability of the injectable bee venom on the market when his book was written. Doctor Beck's work contains much historical matter such as the use of bees as medicine by the Celtic, Teutonic and Gallic races. Crushed bees, with honey was applied externally for ophthalmia, toothache, sore gums and carbuncles. Dried powdered bees constituted the principal ingredient in many remedies. To cure hydrophobia 12 or 15 freshly killed bees were put in water and the patient took one swallow of this two or three times a day. In Slavic countries today bees cooked with cereals such as barley and corn are used as a diuretic to cure "hydrops." In the "New London

Dispensatory," 1716, Salmon said, "The whole Bee in powder given inwardly provokes Urine, opens all stoppages of Reins, breaks the Stone, they are good against Cancers, Schirrus Tumors, the King's Evil, Dropsie, dimness of Sight, for being taken a good while they waste the Humor and restore Health; so their Ashes, both made into an Oyntment . . . cause Hair to grow speedily in bald places." Bee stings were supposed to cure podagra (gout of the foot).

Many homeopathic physicians used Apis internally in the form of tincture and infusum, and they were successful in the treatment of hydrocephalus of children [Beck]. In Philadelphia in 1876 at the World Congress of Homeopathy, H. Goullon read a paper on Apis and its medicinal qualities. Previously or in 1858, C. W. Wolf, homeopathic physician of Berlin, wrote about the poison of the honey bee as a therapeutic agent. Bees were found to be efficacious in ophthalmia, all inflammations of the mucus membrane, the tongue, mouth, throat, larynx; in the respiratory tract, for coughs, etc. And they were given extensively for gastritis, nausea, vomiting, distension, dysentery, etc., and used for arthritis, rheumatism and intermittent fevers. Carbuncles and furuncles were cured by covering them with a mixture of honey and crushed bees. Around 1925 an ointment containing bee venom and called Forapin was manufactured in Germany and was supposed to possess rubefacient and vesicant properties. Physicians reported this ointment to be useful in chronic arthritis, sciatic neuritis and muscular rheumatism [Beck].

ORDER DIPTERA

Pliny quoting Varro, said that the heads of flies, applied fresh to a bald spot constituted a "convenient medicine for the said infirmity." Some used the blood of flies and others mixed the ashes of flies and paper for application to bald places. Pliny also said that Mucianus carried about him a live fly wrapped in a piece of linen in order to preserve him from ophthalmia. Diodorus according to Pliny prescribed the taking of four flies internally with rosin and honey for the jaundice and for persons who "were so streight-winded that they could not draw their breath but sitting upright." The larvæ of bot-flies (Oestridæ) were used by the ancients as a cure for epilepsy [Kirby & Spence].

ORDER ARANEIDA

Pliny wrote that the cobweb of the common "fly-spider" applied to the forehead, across the temples, in a compress, was useful in defluxions of the eyes. However, the web had to be gathered by a boy who had not reached puberty. In addition the boy must not show himself to the patient for three days and during that period neither the boy nor the patient must touch the ground with their bare feet. Pliny also wrote that the thick pulp of a spider's body, mixed with oil of roses, was a remedy for the ears, and that albugo was cured by an ointment made of a spider and old oil. Furthermore, cobwebs were useful when applied with oil and vinegar to a fractured cranium. Cobwebs were also used in stopping bleeding from cuts made while shaving.

Moufet in his "Theatrum Insectorum," records the use of spiders in curing gout. The spider was caught when neither the sun nor moon were shining. The legs were pulled off and the body was put into a deer's skin and bound to patient's foot where it was left for some time. He also wrote that an ordinary spider's web, made into a little ball, placed on a wart, set on fire, and allowed to burn to ashes would roast the wart by the roots and it would never grow again. By swallowing a spider in drink, a woman who was troubled with a "timpany" was cured. In "Domestic Medicine" by Doctor Graham, pills made of spider webs were prescribed for the ague and intermittent fevers. Doctor Chapman in "Elements of Materia Medica and Therapy," Philadelphia, 1825, said that with doses of five grains of spiders' webs, repeated every fourth or fifth hour, he had cured "obstinate intermittents, suspended the paroxysms of hectic, overcome morbid vigilance from excessive nervous mobility, and quieted irritation of the system from various causes, and not less as connected with protracted coughs and other chronic pectoral affections."

The foregoing remedies are all found in the previous works of Galen and Dioscorides. Many homeopathic physicians used spiders in their medicines for reducing swelling of the spleen, hæmoptysis and hemorrhages from all organs, violent headaches, etc. Tinctures were made by using one part of the live spider to five parts alcohol, by weight, macerating for eight days and filtering.

In conclusion it may be said that cantharidin, extracted from the bodies of blister beetles, and used principally in certain diseases of the urinogenital system, has many rivals. Formic acid is now manufactured synthetically. And although dipterous maggots of the genus Wohlfahrtia have recently been utilized in cleaning up decayed tissue and bacteria, this method is being displaced by the use of synthetic substances derived from urea.

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SEPARATION OF ADULT PSYCHODA AND PERICOMA (DIPTERA, PSYCHODIDÆ)[1]

BY WILLIAM F. RAPP, JR.

Workers who have tried to separate adult specimens of *Psychoda* and *Pericoma* have found that they could do so only with a great deal of difficulty or by using reared specimens. The larvæ of the two genera may be easily recognized, since they differ greatly in form. A glance at plate XII in Dr. Johannsen's (1943) excellent work on aquatic diptera will verify this fact. Unfortunately, very few workers have reared material to work with.

The genus *Psychoda* was erected by Latreille (1796: 152) and was defined as follows:

> "Antennes de la longeur des deux tiers du corps, de douze articles pyriformes, plumeus. Antennules longues, droites ou inclinees, de quatre articles. Levres formant un becpointu."
>
> (Antennæ having a length of twice the body, with 12 pyriform plumose segments. Antennules long, straight, or curved, of 4 segments. Labrum forming a pointed beak.)

Tonnoir (1922: 50–54) has given an excellent discussion of the external morphology of the genus *Psychoda*.

The genus *Pericoma* was erected by Walker (1856: 256) and was defined as follows:

> "Proboscis brevior, non compressa. Labrum breve. Maxillae obsoletae. Antennae moniliformes. Alae maris et foeminae aequales.
>
> "Proboscis shorter than in *Psychoda*, not compressed. Labrum short. Maxillæ obsolete. Antennæ moniliform. Wings tense. Larva with rows of hairs; inhabits water, bent into a ring, the tufts of curved hairs detaining a covering of mud."

Unfortunately, we have never had a good morphological study of this genus.

The following table, in conjunction with the illustrations, will aid in separating the two genera.

[1] I am greatly indebted to Dr. H. F. Chu for making the drawings for Figure 1.

Psychoda

Antenna:

Intermediate segments with a bulbous base and a distinct neck; the terminal segments from the 13th on are diminutive and may be partly fused together. Fig. 1, C.

Pericoma

Antenna:

Segments pyriform, without distinct necks. Distinctly 16-segmented in both sexes. Fig. 1, D.

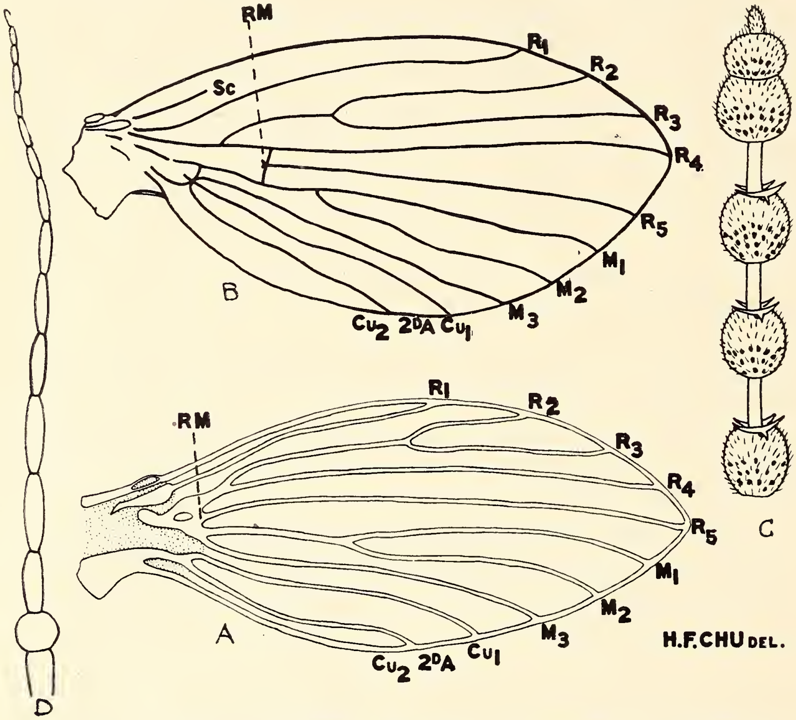

FIG. 1. A, Wing of *Psychoda;* B, Wing of *Pericoma;* C, Antennæ of *Psychoda;* D, Antennæ of *Pericoma.*

Psychoda

Wing:

The tip of R_5 exactly reaches the always pointed wing tip. Anterior fork always more pointed than the posterior.

Cross vein RM at base of wing. Fig. 1, A.

Pericoma

Wing:

The tip of R_4 ends either in the exact wing tip or a little behind it. When R_4 ends at the tip of the wing this tip is rounded.

Cross vein RM about $\frac{1}{3}$ of the length of the wing from the base. Fig. 1, B.

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RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDÆ, DIPTERA), XXII

By Charles P. Alexander
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At this time I am continuing the describing of various interesting Tipulidæ from South and Central America. Where not indicated to the contrary the types of the novelties are preserved in my personal collection of these flies.

Genus *Tipula* Linnaeus

Tipula (Bellardina) wetmoreana new species.

Female.—Wing 30 mm.

Related to *T.* (*B.*) *larga* Alexander (Mexico: Michoacan).

Frontal prolongation of head light brown, narrowly dark brown above, including the stout nasus; palpi broken. Antennæ with the scape and pedicel light brown; basal flagellar segments bicolored, the scarcely developed basal swellings brown, the remainder yellow; outer segments more uniformly infuscated. Head above brownish yellow, more darkened medially and on sides behind the eyes, forming three more or less distinct areas; vertical tubercle narrow, relatively inconspicuous.

Pronotal scutum narrowly produced medially, dark brown. Mesonotal præscutum with the ground fulvous, with four very slightly darker stripes, the intermediate pair with narrow darkened lateral margins, the median darkening less evident; lateral stripes merging with the broad brown lateral margins of the præscutum and scutum; scutal lobes chiefly grayish brown, restrictedly variegated with darker brown; posterior sclerites of notum brown, the mediotergite more pruinose, more or less patterned with brown. Pleura variegated light brownish gray and dark brown, the latter appearing as a broad dorsal stripe and a less conspicuous one over the ventral pleurites. Halteres with stem obscure yellow, knobs broken. Legs longer and more slender than in the female sex of *larga*, especially the femora; yellow ring of femur very narrow, followed by a dark annulus of nearly equal area, the very narrow tip again paler; tibæ and tarsi light brown, the tips of the former scarcely darkened. Wings slightly narrower than in *larga*, the pattern differently arranged, the dark ground color being much more extensive; pale area in outer end of cell R_5 greatly reduced; zigzag pale band before origin of *Rs* narrow, its cephalic end not expanded; cell 2nd A uniformly infuscated. Venation: *Rs* longer than in *larga*, cell R_1 more narrowed; R_{1+2} shorter; cell *1st* M_2 less pointed at its proximal end; cell M_4 broader, especially on the outer portion.

Basal abdominal segments reddish brown, the lateral portions of the tergites darker; intermediate segments destroyed; ovipositor and the preceding segment preserved. Ovipositor with the cerci relatively strong, projecting beyond the tips of the hypovalvae.

Habitat.—Guatemala.

Holotype, a badly damaged ♀, Sierra Santa Elena, Tecpan, altitude 9500 feet, November 25, 1936 (Wetmore); United States National Museum.

I take pleasure in naming this species for the collector, Dr. Alexander Wetmore, distinguished ornithologist and Secretary of the Smithsonian Institution. The nearest relative is *Tipula* (*Bellardina*) *larga* Alexander, of Michoacan, Mexico, which differs in several characteristics, as noted throughout the description.

Genus *Nephrotoma* Meigen

Nephrotoma boliviana new species.

Allied to *cacuminis;* general coloration black and yellow, the præscutum with three polished black stripes, the lateral pair curved outward to the margin; occipital brand broad and conspicuous; antennæ black throughout; male hypopygium with the outer dististyle strongly narrowed outwardly, the tip subacute; inner dististyle near its posterior end with a single stout blackened flange or point; gonapophysis a little dilated, the tip narrowed to a spinous point; eighth sternite with the setæ of normal length.

MALE.—Length about 8.5 mm.; wing 9.5 mm.

Frontal prolongation of head above weakly infuscated, especially near distal end, clear light yellow on sides and beneath; nasus elongate, with black setæ; palpi brownish black. Antennæ short, brownish black throughout; flagellar segments only moderately incised; verticils of outer face subequal to or slightly exceeding the segments, those of the inner face short and spinous; first flagellar segment subcylindrical, with more numerous spinous setæ. Head orange yellow with a small brown spot on orbits at about the narrowest point of the vertex; occipital brand large and conspicuous, black, broad, narrowed into a point in front; anterior vertex wide, exceeding four times the diameter of the scape.

Pronotum above clear light yellow, infuscated on sides. Mesonotal præscutum with the ground light yellow, with three polished black stripes, the central part of the median stripe a trifle more reddened; anterior ends of outer præscutal stripes bent laterad to the margin; scutum extensively yellow medially, the lobes patterned with black, the vicinity of the suture extensively blackened; scutellum brownish black, parascutella extensively yellow; mediotergite light yellow, with a blackened central stripe, expanded but paler on the posterior portion; pleurotergite chiefly dark brown, partly encircling a large yellow mark on the katapleurotergite. Pleura yellow, extensively variegated with dark brown, especially on the propleura, anepisternum, ventral sternopleurite and pteropleurite. Halteres obscure yellow, bases of knobs weakly infuscated, the tips obscure yellow. Legs with coxæ more or less darkened on outer faces, the tips more yellowed; trochanters yellow; femora obscure yellow, the tips narrowly brownish black; tibiæ brown, the tips and the tarsi blackened; claws large, toothed, conspicuously hairy. Wings with a weak brownish tinge, cells *C* and *Sc*, together with the prearcular field, more yellowed; stigma oval, brown; axilla and extreme tip of wing vaguely darkened; veins brown, paler in the brightened costal field. Stigma with about 6 or 7 trichia. Venation: Cell M_1 narrowly sessile; *m–cu* immediately before the fork of *M*.

Abdominal segments reddish yellow, the posterior borders, especially the tergites, marked with brownish black; subterminal segments more uniformly blackened to form a ring; hypopygium, excepting the eighth sternite and ninth tergite, more yellowed. Male hypopygium with the lateral tergal lobes broadly rounded, especially the outer shoulders, the median notch relatively narrow. Outer dististyle strongly narrowed on outer half, the apex subacute. Inner dististyle with both the beak and lower beak obtusely rounded, the latter blackened, the former pale; dorsal crest low; posterior crest elevated into a single blackened point or narrow flange. Gonapophysis pale, on distal half a little dilated and narrowed to a spinous point. Eighth sternite with the setæ abundant but not unusually lengthened.

Habitat.—Bolivia.

Holotype, ♂, Cochabamba, Chapare, November 1930 (Francisco Steinbach).

Among the described regional species of the genus, the present fly is closest to *Nephrotoma cacuminis* Alexander, of southern Ecuador, differing in details of coloration of the body, antennæ and wings, and in the structure of the male hypopygium, especially the tergite, inner dististyle, gonapophysis and eighth sternite.

Genus *Gnophomyia* Osten Sacken

Gnophomyia (Gnophomyia) propatula new species.

General coloration of mesonotum reddish brown, restrictedly patterned with darker; wings with a weak brownish tinge; cell M_2 open by the atrophy of the basal section of M_3; male hypopygium with the inner dististyle having the stem relatively short, outer portion strongly dilated into a long-oval head; phallosome subtended on either side by incurved blackened arms that are weakly bifid at tips, the outer or lateral lobe microscopically denticulate.

MALE.—Length about 5 mm.; wing 5.3 mm.

Rostrum obscure brownish yellow. Palpi and antennæ broken. Head dark gray; eyes large.

Pronotum yellow; pretergites light yellow. Mesonotum light reddish brown, the præscutum and scutal lobes weakly darker; base of scutellum and central portion of mediotergite somewhat paler. Halteres infuscated, base of stem restrictedly yellow. Legs with the coxæ and trochanters pale yellow; remainder of legs pale brown (terminal tarsal segments broken). Wings with a weak brownish tinge, the extreme base more yellowed; stigma barely indicated as a narrow seam along R_{1+2}; veins brown. Venation: Sc_1 ending a short distance before the level of R_2; *Rs* oblique, straight, in direct alignment with R_5; *r–m* a short distance before the fork of *Rs*; R_2 immediately beyond the fork of R_{2+3+4}; veins R_3 and R_4 long, extending generally parallel to one another; cell M_2 open by the atrophy of the basal section of M_3, cell *2nd* M_2 a little longer than its petiole; *m–cu* about one-third its length beyond the fork of *M*.

Abdominal tergites brown, sternites yellow; hypopygium dark brown. Male hypopygium with the tergite produced into a median lobe that is longer than broad. Basistyle unarmed. Outer dististyle a slightly curved blackened rod, relatively narrow, its tip subacute. Inner dististyle with the base expanded, the stem relatively short, strongly dilated outwardly into a long-oval head that is provided with several weak setæ. Phallosome with the central organ subtended on either side by incurved blackened arms that are weakly bifid at tips, the outer or lateral lobe microscopically denticulate.

Habitat.—Costa Rica.

Holotype, ♂, Pedregoso, altitude 2500 feet, January 1939 (Dean Rounds).

Gnophomyia (*Gnophomyia*) *propatula* is readily distinguished from all other regional species by the open cell *1st* M_2 of the wings.

Genus *Teucholabis* Osten Sacken

Teucholabis (Teucholabis) wilhelminæ new species.

General coloration polished black, the ventral pleurites with a whitish longitudinal stripe; pronotum yellow; knobs of halteres obscure yellow; all coxæ and trochanters yellow; fore femora brown, the distal third or fourth blackened, middle and hind femora yellow, the tips narrowly blackened; posterior basitarsi dilated on proximal third; wings whitish subhyaline, this color less extensive than three broad diffuse brown bands; Sc_1 ending about opposite three-fifths the length of *Rs*; abdominal sternites bicolored, black, the incisures broadly yellow; male hypopygium with the outer dististyle a powerful blackened rod, bifurcate near apex, the lateral spine much stronger than the axial one; inner dististyle with a slender elongate tubercle that is tipped with three elongate setæ.

MALE.—Length about 6 mm.; wing 5.5 mm.

Rostrum black; palpi brownish black. Antennæ black throughout; flagellar segments oval, with conspicuous verticils. Head black.

Pronotum yellow. Mesonotum polished black. Dorsal pleurites similarly blackened, including the dorsopleural membrane, anepisternum, dorsal pteropleurite and pleurotergite; ventral pleurites yellow, including the propleura, sternopleurite, ventral pteropleurite and the meral region, the more dorsal portion of this latter with a silvery pruinose stripe. Halteres with stem brownish black, knob obscure yellow. Legs with all coxæ and trochanters yellow; fore femora brown, more yellowish basally, the distal third or fourth blackened; middle and posterior femora yellow, the tips blackened, narrower on the posterior legs where about the outer tenth is included; fore tibiæ light brown, the other tibiæ brownish yellow, the tips narrowly darkened; tarsi black; posterior basitarsi dilated on about the proximal third. Wings with the relatively restricted ground whitish subhyaline, with three broad diffuse brown bands that are more extensive than the ground; the pale color includes the prearcular and costal fields, as well as complete bands before and beyond the cord; basal dark band or cloud occupying about one-fourth the length of wing, its limits very ill-defined; band at cord narrower, darker over the anterior cord and confluent with the oval dark brown stigma; third dark band at wing tip, extending basad to the outer end of cell *1st* M_2; veins brown, a trifle darker in the patterned areas. Venation: Sc_1 ending about opposite three-fifths the length of Rs, Sc_2 some distance from its tip; branches of Rs nearly parallel to one another for almost the entire length of the anterior branch, the posterior one (R_5) thence bending strongly caudad so cell R_3 at margin is very wide, only a little less than cell R_2; cell *1st* M_2 long and narrow, subequal to the distal section of M_3; *m–cu* about one-fourth its length beyond the fork of M, in transverse alignment with *r–m*.

Abdominal tergites black, sternites bicolored, the incisures broadly yellow, the intermediate portions brownish black; eighth segment and ninth tergite chiefly yellow, the remainder of hypopygium darkened. Sternal pocket on segment five large but comprised of relatively few setæ. Male hypopygium with the spinous lobe of the basistyle long and very slender, originating low down on mesal face near the lower end of the mesal flange; spine strongly curved to the acute terminal point, the distal half with long setæ; flange of basistyle heavily blackened, its outer margin irregularly serrate, the outermost tooth more conspicuous. Outer dististyle a very powerful blackened rod, bifurcate near apex, the axial spine much smaller and weaker than the lateral branch, the latter arising almost perpendicularly, very stout at base, narrowed and curved into the long terminal spine, the base on lower margin with a few blackened teeth and scattered elongate setæ; outer margin of main stem with conspicuous setæ and a few appressed denticles that are continued onto the axial spine. Inner dististyle elongate, the usual two teeth separated by a broad U-shaped notch; lateral lobe long, terminating in about three unusually long strong setæ. Ædeagus with its apex broken before the tip with about three long setæ.

Habitat.—Surinam.

Holotype, ♂, Wilhelmina Mountains, Km 10, along stream, August 23, 1943 (Geyskes).

The most similar species is *Teucholabis* (*Teucholabis*) *strumosa* Alexander, which has a somewhat similar general appearance, including the wing-pattern. The male hypopygium of the unique type of *strumosa* was defective in the loss of the outer dististyle, but the other hypopygial structures, including the spine of the basistyle and the inner dististyle, are quite distinct from those of the present fly.

Teucholabis (Teucholabis) cuneiformis new species.

General coloration of thorax polished reddish yellow, variegated only by a cuneiform polished black median stripe on cephalic half of præscutum; head and abdomen darkened; legs with femora black, tibiæ and tarsi pale yellow, the bases of the former narrowly blackened; wings with a strong blackish tinge, the prearcular, costal and stigmal fields still darker; *Sc* long, Sc_1 ending about opposite five-sixths the length of *Rs*; R_{2+3+4} relatively long, about two-fifths *Rs*; cell *1st* M_2 unusually long and narrow, subequal to or longer than any of the veins beyond it, *m–cu* at near one-third its length.

FEMALE.—Length about 6 mm.; wing 5.5 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, with elongate verticils. Head uniformly dark brown; anterior vertex relatively narrow, about one-half wider than the diameter of the scape.

Pronotal scutum brownish black, scutellum yellow. Mesothorax uniformly polished reddish yellow, variegated only by a cuneiform polished black median stripe on cephalic half of præscutum. Halteres with stem obscure whitish, knob blackened. Legs with all coxæ and trochanters abruptly blackened, contrasting with the conspicuously brightened mesopleura and sternum; femora black; tibiæ pale yellow, the bases narrowly blackened; tarsi pale yellow, the apex of the terminal segment weakly darkened. Wings with a strong blackish tinge, the prearcular and costal fields even more darkened; stigma long-oval, darker than the ground; veins brown. Venation: *Sc* long, Sc_1 ending about opposite five-sixths *Rs*, Sc_2 some distance from its tip, Sc_1 alone subequal to *m–cm*; R_{2+3+4} relatively long, about two-fifths *Rs* and about two and one-half times R_2; cell *1st* M_2 unusually long and narrow, subequal to or longer than any of the veins beyond it; *m* virtually lacking, the basal section of M_3 correspondingly lengthened to include virtually the entire outer end of the cell; *m–cu* more than its own length beyond the fork of *M* or at near one-third the length of the cell; cell *2nd A* broad, the vein gently sinuous.

Abdomen brownish black, the cerci horn-yellow, long, upcurved to the acute tips.

Habitat.—British Guiana.

Holotype, ♀, Bartica, February 10, 1913 (H. S. Parish).

The most similar described species are *Teucholabis* (*Teucholabis*) *flavithorax* (Wiedemann), of southeastern Brazil, which differs in the much larger size, coloration of thorax, venation and coloration of the legs, and *T.* (*T.*) *schineri* Enderlein, differing in details of color, especially the legs.

Teucholabis (Teucholabis) dileuca new species.

Allied to *schineri;* mesothorax almost uniformly orange or reddish orange, the præscutum without darkening; halteres with stem yellow, knob blackened; legs with all coxæ blackened; femora and tibiæ black, with dense erect black setæ; tarsal segments one and two whitened, their tips narrowly infuscated; wings with a strong brownish suffusion throughout; R_{2+3+4} about one-half longer than R_2; abdomen black, the valves of the ovipositor light horn-yellow.

Female.—Length about 7 mm.; wing 6 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, with elongate verticils. Head above blackened.

Pronotum and propleura blackened. Mesonotum almost uniformly polished orange, præscutum without darkening. Pleura orange yellow. Halteres with stem yellow, knob blackened. Legs with coxæ blackened, the middle pair a trifle paler; trochanters brownish black; femora and tibiæ black, with dense erect black setæ; tarsal segments one and two whitened, the tips narrowly infuscated, a little more extensively so on the second; remaining tarsal segments black; no paler femoral rings as in *schineri.* Wings proportionately a little narrower than in *schineri,* with a strong brown suffusion throughout; stigma scarcely differentiated; veins darker brown. Venation: Sc_1 ending just beyond midlength of *Rs*; R_{2+3+4} about one-half longer than R_2, less elevated than in *schineri;* cell *1st* M_2 narrow, *m* very short, less than one-third the basal section of M_3; *m–cu* about its own length beyond the fork of *M.*

Abdomen black, including the genital shield; both cerci and hypovalvæ light horn-yellow, the former strongly upcurved to the acute tips.

Habitat.—Guatemala.

Holotype, ♀, Quirigua, March 1915 (William Schaus); United States National Museum.

The nearest ally of the present fly is *Teucholabis* (*Teucholabis*) *schineri* Enderlein, which differs in the details of coloration of the thorax, halteres and legs, and in slight details of venation. A re-description of the holotype specimen of *schineri* has been given by the present writer (Encycl. Ent., Diptera, 4: 26–27; 1927).

Genus *Erioptera* Meigen

Erioptera (Mesocyphona) surinamensis new species.

Allied to *immaculata;* size very small (wing, male, 2.5 mm.); general coloration of thoracic dorsum dark brown, the præscutum faintly patterned; thoracic pleura conspicuously striped with brown and silvery white; knobs of halteres weakly infuscated; legs yellow, the femora with a pale brown subterminal ring; wings with a moderately strong brown tinge, unpatterned; abdomen, including hypopygium, black; male hypopygium with the dististyle two-branched, the stronger outer arm expanded at apex into a subtriangular head, the outer angle of which bears two powerful appressed spines; apex of head with a regular comb of smaller teeth and with long erect setæ; inner branch a very elongate paddle; gonapophyses single on either side, appearing as flattened dark-colored blades, the distal fourth or more with setæ and appressed pale spinulæ.

MALE.—Length about 2.5 mm.; wing 2.5 mm.

Rostrum and palpi brownish black. Antennæ with scape and pedicel dark, flagellar segments somewhat paler. Head dark.

Pronotum brown, the posterior portions of the scutellum obscure yellow. Mesonotum brownish gray, the præscutum faintly patterned with darker brown on the interspaces. Pleura conspicuously striped with brown and silvery white, the latter appearing as a broad longitudinal stripe that is narrowly bordered by darker brown, the ventral sclerites and the dorsopleural membrane paler brown. Halteres with stem yellow, knob weakly infuscated. Legs with the coxæ and trochanters testaceous yellow; remainder of legs yellow, the femora with a relatively broad, pale brown subterminal ring. Wings with a moderately strong brownish tinge, the prearcular and costal fields a trifle more yellowed; veins very pale brown, macrotrichia darker. Venation: Cell M_2 open by the atrophy of the basal section of M_3; vein *2nd A* only moderately sinuous, relatively short.

Abdomen, including hypopygium, black. Male hypopygium distinctive; dististyle 2-branched, dark colored throughout; outer branch stouter and more conspicuous, at apex expanded into a subtriangular head, the somewhat produced apex with several long erect black setæ; apex of outer angle of dilated portion with at least two very powerful appressed black spines, their tips directed toward the apex, the intervening apical margin with a comb of smaller teeth; inner branch arising at extreme base, nearly equal in length to the outer arm, very gently expanded outwardly, the apex obliquely obtuse. Gonapophysis single on either side, appearing as a flattened dark-colored blade, the distal third slightly more narrowed and gently incurved, the apex obliquely truncated; surface of distal fourth microscopically scabrous, the outer margin of distal third with rather abundant setæ and a few pale spinulæ.

Habitat.—Surinam.

Holotype, ♂, Paramaribo, March 27, 1939, at light (Geyskes).

Erioptera (*Mesocyphona*) *surinamensis* is one of the smallest known members of the subgenus. It is readily told from the now relatively numerous allied forms by the structure of the male hypopygium, especially the dististyle and gonapophysis. I am very much indebted to Dr. Geyskes for many fine Tipulidæ from Surinam.

Erioptera (Mesocyphona) intercepta new species.

Allied to *immaculata;* legs yellow, all femora with two narrow brown rings; wings with a brownish tinge, unpatterned; male hypopygium blackened, including the dististyle and gonapophysis; dististyle a single curved rod that bears a small flange and an additional acute spine at and before midlength; gonapophysis single on either side, the subacute tip pale.

MALE.—Length about 2.5 mm.; wing 2.5 mm.

Rostrum and palpi black. Antennæ with the basal segments dark, flagellum pale yellow, the outer segments not or scarcely darker; flagellar segments with long verticils. Head dark brown, the anterior vertex and orbits gray pruinose.

Pronotum dark; pretergites narrowly silvery. Mesonotal præscutum medium brown, vaguely patterned with darker; posterior sclerites of notum darker brown. Pleura dark brown, with a silvery gray longitudinal stripe; dorsopleural region pale yellow. Halteres with stem yellow, knob infuscated. Legs with the coxæ dark brown; trochanters obscure yellow; remainder of legs yellow, the femora with two narrow brown rings, one at or just beyond midlength, the second subterminal, about as wide as the intervening pale annulus. Wings with a brownish tinge, the prearcular and costal fields slightly more yellowed; veins pale brown, macrotrichia darker. Venation: R_{2+3+4} relatively short and elevated, subequal to R_{2+3}; cell M_2 open by the atrophy of basal section of M_3.

Abdomen brownish black; hypopygium black, including the styli and apophyses. Male hypopygium with the dististyle single, unbranched or virtually so, appearing as a long curved rod that is only a little shorter than the basistyle; on face of style, at or shortly before midlength, with two small projections that are scarcely branches, the outer one a small subtriangular darkened blade, the slightly more basal second a more slender acute spine. Gonapophysis single on either side, broad at base, narrowed to the subacute pale apex.

Habitat.—Surinam.

Holotype, ♂, Paramaribo, July 13, 1938 (Geyskes).

The nearest relative of the present fly is *Erioptera* (*Mesocyphona*) *bicinctipes* Alexander, which is very similar in its general appearance, differing in the details of structure of the male hypopygium, particularly the dististyle. In this species, the dististyle is much paler horn-yellow, with the armature different, there being a low blunt triangular flange at near midlength but with no other points or lobes.

Genus *Molophilus* Curtis

Molophilus (Molophilus) shannoninus new species.

Belongs to the *gracilis* group and subgroup; general coloration of thorax varying from reddish brown to dark brown; antennæ short, the longest verticils unilaterally arranged; male hypopygium with the ventral lobe of basistyle obtuse at apex; three dististyles, the outermost very slender and needlelike; intermediate style a more flattened curved sickle.

MALE.—Length about 4–4.2 mm.; wing 4.6–5 mm.; antenna about 1.1–1.2 mm.

Rostrum and palpi black. Antennæ brownish black throughout, relatively short; flagellar segments long-oval, with truncated ends; longest verticils unilaterally arranged, approximately twice as long as the segments. Head dark brownish gray.

Thorax varying in color from reddish brown to dark brown; pretergites yellow; posterior sclerites of notum and the pleura, in cases darker than the præscutum; scutellum darkened. Halteres infuscated, base of stem narrowly yellow. Legs with the coxæ and trochanters yellow; remainder of legs brown, the femoral bases more yellowed, the outer tarsal segments darker. Wings with a weak brownish tinge; veins and macrotrichia darker brown. Venation: R_2 about in transverse alignment with *r–m*; petiole of cell M_3 relatively short, about one and one-half to two times *m–cu*; vein *2nd A* long, sinuous, ending about opposite the posterior end of *m–cu*.

Abdomen, including hypopygium, dark brown to brownish black. Male hypopygium with the ventral lobe of basistyle obtuse at apex; mesal lobe much shorter and more broadly obtuse. Three dististyles or profoundly divided branches, the outermost a slender needle-like rod, very gradually narrowed to the acute tip; intermediate style or branch of the latter subequal in length, appearing as a more flattened curved sickle, the tip acute; outer margin of distal half with numerous subappressed spines; mesal face of basal half with about 8–10 scattered tubercles, each bearing a small setula; inner style shortest, appearing as a pale more flattened blade, the apex darkened and pointed; surface of blade with a very few scattered spicules. Phallosome relatively narrow, densely setuliferous. Ædeagus flattened, the tip narrowed and directed laterad.

Habitat.—Argentina.

Holotype, ♂, Tucumán, March 1926 (Shannon). Paratopotypes, 3 ♂♂.

I take great pleasure in naming this unusually distinct fly in memory of my long time friend and co-worker, Mr. Raymond

C. Shannon. There is no close described relative among the comparatively few known Neotropical species of the *gracilis* subgroup. In some regards it comes closest to *Molophilus* (*Molophilus*) *quadristylus* Alexander, from an unknown locality in Brazil. This latter differs conspicuously in the structure of the male hypopygium, particularly of the armature of the basistyle and the presence of only two dististyles or branches of the same.

Molophilus (Molophilus) pacifer new species.

Belongs to the *gracilis* group and subgroup; size medium (wing, male, about 4 mm.); antennæ short; mesonotal præscutum almost uniformly black, the humeral region restrictedly reddened; legs brown; wings with a weak brownish tinge; petiole of cell M_3 about one-third longer than *m–cu*; male hypopygium with the dorsal lobe of basistyle conspicuous, its margin produced into three spinous points, ventral lobe relatively short and slender; outer dististyle at apex expanded into a blade that terminates in an apiculate point; inner dististyle a very slender sinuous rod, gradually narrowed to the acute tip.

MALE.—Length about 3.5 mm.; wing 4.1 mm.; antenna about 1.1 mm.

Rostrum and palpi brownish black. Antennæ short, pale brown, outer segments darker; flagellar segments oval, longest verticils about one-half longer than the segments. Head dark brown, still darker medially.

Pronotum brown, the lateral portions of the scutellum, and the pretergites, paler. Mesonotum almost uniformly black, the humeral region more reddened; posterior sclerites of notum chiefly blackened, more or less pruinose; median region of scutum obscure yellow; scutellum destroyed by pinning. Pleura black, more or less pruinose. Halteres with stem weakly infuscated, knob obscure yellow. Legs with the coxæ black, sparsely pruinose; trochanters brown; remainder of legs brown or light brown. Wings with a weak brownish tinge; veins and macrotrichia darker brown. Venation: R_2 lying a short distance beyond level of *r–m*; petiole of cell M_3 about one-third longer than *m–cu*; vein *2nd A* ending shortly before level of *m–cu*, gently sinuous.

Abdomen, including hypopygium, black. Male hypopygium with the ventral lobe of basistyle relatively short and slender; dorsal lobe very conspicuous, appearing as a flattened dark-colored blade, its inner edge produced into three acute spinous points, the outermost longest; surface of lobe with numerous short setæ from conspicuous basal punctures. Outer dististyle of distinctive conformation; basal half straight, the outer portion constricted into a more slender sinuous neck, the apical fifth again expanded into a flattened blade that ends in a short apiculate point; the entire concave margin with microscopic serrulations; outer portion of the apical blade with a few microscopic tubercles and one more developed spine. Inner dististyle slightly longer, appearing as a very slender sinuous rod that gradually narrows to the acute tip; just before apex on outer margin with a small blunt spine, with one or two more acute ones at about three-fourths the length. Phallosomic plate narrowly oval, the apex obtuse; surface apparently with microscopic delicate setulæ.

Habitat.—Costa Rica.

Holotype, ♂, Higuito, San Mateo (Pablo Schild); United States National Museum.

The present fly is very different from the relatively few species of the *gracilis* subgroup so far discovered in Tropical America, differing especially in the structure of the male hypopygium. Among such regional forms it is closest to *Molophilus* (*Molophilus*) *procax* Alexander, of Mexico, yet abundantly distinct.

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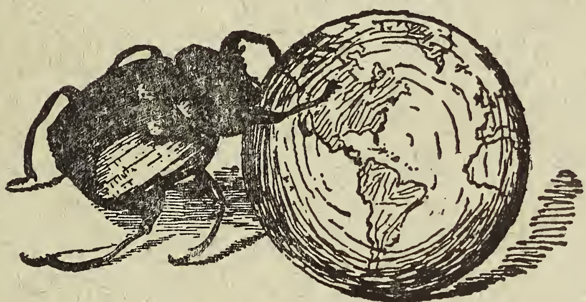

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NOTES ON THE DISTRIBUTION, HABITS, AND HABITATS OF SOME PANAMA MOSQUITOES (DIPTERA, CULICIDÆ)

By Ross H. Arnett, Jr.
Cornell University, Ithaca, N. Y.

These notes are the results of the author's observations during 1944–1945, made throughout the Canal Zone and parts of the Republic of Panama. Though they are far from complete, it is hoped that they will fill in some of the gaps in our knowledge of the habits and habitats of the Panama mosquitoes and add somewhat to our knowledge of their distribution.

Acknowledgment: Special mention is made of the information and guidance given me in the preparation of this paper by Prof. Robert Matheson. Mr. W. H. W. Komp provided the impetus for this work and readily lent much of his time to answering many questions, to instruction of various techniques and to checking the identification of much of the material collected as well as reading the manuscript in semifinal form. For the assistance of my many associates while in Panama I am very grateful. They readily contributed data, specimens, and suggestions. With the sincere hope that I have included everyone, I wish to thank the following: Drs. W. W. Middlekauff, S. L. Meyer; Messrs. Kenneth Frick, Paul K. Adams, Robert VanDoran, George Wood, Wellman Turney, George Ryan, Phillip Marucci, Joseph Griffing, Esberaldo D. Martinez and Robert Olsen. For aid in certain curatorial work, I wish to thank Srs. Osvaldo Cardona and Ruben Lopez.

In undertaking the work of studying the mosquito fauna of Panama, the author was impressed with the comparative lack of exact data on the habits and habitats of these organisms. Even with the great amount of collecting which has been done, little information has found its way into print, and that scattered in a fair number of publications.

These records of field observations do not include all the Culicinæ found in that area. They are, however, notes on at least most of the common species and in a number of cases on those generally considered to be rare.

There is no complete list of the mosquito fauna of Panama. While the author has compiled a list thought to be complete as far as published records are concerned, it became evident, after checking with Mr. Komp, that there were many notable omissions. Therefore it was thought best to withhold any such attempts at a list for the present. When more data have been gathered, then a full, up-to-date account can be made which includes a taxonomic study. Following the reference to the original description of the species discussed here will be found those names which have been used in recording the Panama fauna and have since been placed in synonymy. But the list is not complete for the species throughout its range. In addition a reference is given as to who first treated each name as a synonym.

The mosquitoes of Panama were first systematically investigated by Mr. August Busck who visited the Canal Zone and nearby portions of Panama in 1907. His first collections and those of Allan H. Jennings formed the starting point for the extensive studies of Dyar and Knab. Many new species were described from this material. With the additional material supplied throughout the ensuing years by Jennings, Zetek and most of all by J. B. Shropshire, Dyar (1923) published an extensive list of the mosquitoes of Panama, followed in 1925 by a systematic treatment of all the species of Culicidæ. Since then there have appeared only descriptions of new species and occasional notes. Over two decades have now passed since Dyar's publications, and these years have brought not only many new records but a great change in the nomenclature and a fair number of new species.

We now have records from all the inhabited areas of the Canal Zone. But there is a considerable area of the Canal Zone unsurveyed. The towns such as Ancon, Balboa, Gamboa, Gatun, Cristobal, Mount Hope, Pedro Miguel and Margarita, and the area immediately surrounding them have been thoroughly sampled. Many sites along the Panama Railroad and of course the military posts, such as Corozal, Fort Clayton, Fort Sherman, Fort Randolph, France Field, Coco Solo, Albrook Field, and many others are carefully surveyed. In the Republic of Panama it is a different matter. The principal cities, Panama and Colon, are under the guidance and supervision of Canal Zone officials and are sampled. To the west of the Canal Zone collection records have been published principally from the towns of David, Boquete, and Almirante. In this account will be found additional records for La Chorrera, Pina, Lagarto, Nuevo Chagres, Salud and El Valle de Anton. To the east of the Canal, Chepo supplied only a few records. There are scanty records from the area close to Panama City, Old Panama, Juan Diez and farther from Panama City at La Joya. From this then it is apparent that there are extensive areas from which there are still no published records.

Part I

DISTRIBUTION, HABITS, AND HABITATS OF THE SPECIES

ANOPHELINI

Chagasia Cruz

Chagasia bathanus Dyar

Anopheles bathanus Dyar, Carnegie Ins. Wash., Pub. 387, 433, 1928. (Type Loc.: Gatun, C. Z.)

Distribution:—Gatun (Bath); Barro Colorado Is., (Komp); Cocoli, Empire, Pedro Miguel, Chiva Chiva, National Forest, Gamboa (Author).

Habits and Habitats:—The larvæ are collected throughout the year. They are most abundant during the rainy season. Adults were collected once after dark on the screens of a barracks at La Chorrera (March). Experiments have been conducted[1] to deter-

[1] This work was directed by W. W. Middlekauff.

mine if this species could be a vector of malaria. An outdoor insectary using the natural habitat was constructed. However, conditions were never favorable for egg laying. To date rearing has been unsuccessful. Several attempts have been made to infect wild females with malaria, but they all refused to feed on malarial patients.

This species is generally considered to be rare, but the larvæ have been found to be abundant in certain situations. All collections of the larvæ are made in shady streams having clear, swift flowing water, an absence of vegetation and with a rocky or sandy bottom. The larvæ rest against the banks in grass or rootlets out of reach of the current.

A field character for recognizing the larvæ of this species is the pointed-appearing head. The adults grossly resemble *Mansonia titillans,* but of course both sexes have long palpi. In the laboratory rearing pans the larvæ rest parallel to the edge instead of the customary "head-on" position, a habit which is also readily seen in the field.

Anopheles Meigen

Subgenus *Stethomyia* Theobald

Anopheles kompi Edwards

Anopheles nimbus var. *kompi* Edwards, Bull. Ent. Res., 21: 287, 1930. (Type Loc.: Almirante, R. de P.)

Anopheles kompi Edwards, Genera Insectorum, fasc. 194, 35, 1930. (raised to specific rank).

Distribution:—Barro Colorado Is., Fort Davis, Fort Sherman (Bath); Almirante (Komp); Gamboa, La Chorrera, Nuevo Chagres, Pina (Author).

Habits and Habitats:—The larvæ are most abundant during the dry season, January, February, and March. (Also collected in May and June.) The adults have not been taken in the field.

The larvæ breed in very slow moving, drying streams or in pools left by drying streams deep in shady jungles. Apparently they are associated with an alga. They were never collected in similar stream beds lacking this alga, with the one exception of a few larvæ collected at Pina and Nuevo Chagres at the beginning of the rainy season. These were in a flowing stream. A possible explanation is the washing down stream of the larvæ by sudden heavy rains at the beginning of the rainy season which flood isolated pools left in drying streams.

This is a rare species. It was first discovered at Almirante by Komp. It has a restricted habitat and a short breeding season.

Subgenus *Anopheles* s. str.

Anopheles eiseni Coquillett

Anopheles eiseni Coquillett, Jour. N. Y. Ent. Soc., 10: 192, 1902.
Myzomyia tibiamaculatus Neiva, Bras. Med., 20: 288, 1906. (Syn. *eiseni* Coq., *vide* Howard, Dyar & Knab, Carnegie Ins. Wash., Pub. 159, 1002, 1917.)
Anopheles niveopalpus Ludlow, Psyche, 26: 166, 1920. (Type Loc.: Empire, C. Z.) (Syn. *eiseni* Coq., vide Root, Am. Jour. Hyg., 3: 274, 1923.)

Distribution:—Tabernilla (Busck); Paraiso (Jennings); Gatun (Zetek); Monte Lirio, Toro Point, Margarita, Arenal River, Empire, Coco Solo (Shropshire); France Field (Dyar and Shannon); Fort Sherman (Zetek); Fort Randolph (Morgan); Chagres River (Busck); Porto Bello, Caldera Island, Upper Pequini River (Jennings); Fort Clayton, Chiva Chiva, Gamboa, National Forest, Chilibre, Empire, Nuevo Chagres, Lagarto, La Chorrera, El Valle de Anton (Author).

Habits and Habitats:—The larvæ are found throughout the year. Adults were not taken in the field.

The larvæ of this species breed in a variety of places. They have been collected in an old metal pot, axils of the leaves of aerial bromeliads, and in tree holes. However, the usual habitat is in shallow rock pools in the shade of trees at the edges of streams. One collection was made in *Najas* mats in the Rio Mandinga, but this is undoubtedly a rare occurrence. It may be encountered in pools full of grass, or in leafy pools. Sometimes it is collected in streams with grass and algæ. (Bamboo joints, Palm leaf—Busck.)

This is a very common species in Panama. It can be expected in many situations. The adults apparently are not attracted to human or animal bait. It is most abundant at the beginning of the rainy season; common throughout the dry season.

Anopheles pseudopunctipennis Theobald

Anopheles pseudopunctipennis Theobald, Mon. Cul., 2: 305, 1901.
Anopheles franciscanus McCraken, Ent. News, 15: 12, 1904. (Syn. *pseudopunctipennis* Theobald, vide, Howard, Dyar and Knab, Carnegie Ins. Wash., Pub. 159, 1014, 1917. [Panama material])*

Distribution:—Culebra, La Boca, Tabernilla, Chilibre, Empire, Gatun, Las Cascades (Busck); Cartagenita, Pedro Miguel, Ancon, Paraiso, Bas Obispo, Cocoli River, Miradlores, East La Boca (Jennings); Fort Sherman (Zetek); Corozal, Paja, Cardenas River, Majagual, Mandinga, Gold Hill, Monte Lirio (Shropshire); Fort Randolph (Baker); Chagres River, Panama, Colon (Busck); Caldera Is., Cucaracha (Jennings); La Palma (Komp); Chiva Chiva, Fort Clayton, Cocoli, Gatun, La Chorrera, Pina, Salud, Nuevo Chagres, Lagarto (Author).

Habits and Habitats:—The larvæ are collected during the dry season and most of the rainy season throughout the Canal Zone and in the Republic of Panama. The adults have been taken in the evening on screens and at horse traps. It is not a vector of malaria in Panama, but it is commonly encountered as an adult and will bite.

The larvæ breed most abundantly in drying stream beds in open sunlit areas. They have also been taken in road ditches and in open grassy pools as well as in rock pools.

This is a very common species. Sunlight habitats seem to be required. It is most easily collected in algæ, both in filamentous green algæ and in a type called "ball" algæ (*Cladophora?*). These balls float on the surface of the water, are quite large, and resemble sponges. They have entrapped air inside the irregular sphere and the larvæ of *pseudopunctipennis* are often found inside of these balls. It breeds well into the dry season but is washed out by the heavy rains during the rainy season. (Surface pools, particularly temporary ones. Abundant in rainy season—Dyar.)

* Note: The author is not here considering the various subspecies or species that recent workers have separated from *A. pseudopunctipennis* Theobald. If more forms occur in Panama, they are included under this name.

Anopheles apicimacula Dyar & Knab

Anopheles apicimacula Dyar & Knab, Proc. Biol. Soc. Wash., 19: 136, 1906.

Anopheles maculipes Dyar (nec Theobald), Ins. Ins. Mens., 13: 192, 1925. (Misdetermination.)

Distribution:—Tabernilla (Busck); Mindi (Zetek); Corozal, Majagual, Gatun, Las Cascades, Paitilla, Miraflores, Mount Hope, La Pita, Paja, Arenal River, Comacho (Shropshire); Barro Colorado Is., (Shannon); Fort Sherman, Fort Randolph (Baker); Juan Diez (Bath); Colon (A. L. Kendal); Chiva Chiva, Fort Clayton, Cocoli, Empire, Pedro Miguel, National Forest, Lake Gatun, La Chorrera, Pina, Salud, Nuevo Chagres, Lagarto (Author).

Habits and Habitats:—The larvæ breed in pools, swamps, pastures, rivers, ditches, jungle streams, springs, grassy ponds, rock pools, and water holes. In general they seem to prefer shade. However, numerous records were made of their occurrence in sunny places. The flow is of minor importance as long as it is not near swift flowing water. The water may contain grass, leaves and debris and may be muddy but there are no records of it with algæ or other floating aquatics. The water surface may be broken by vegetation or debris, or it may be devoid of surface breaking material if it is a small body of water and still breed abundantly this species.

Larvæ are abundant throughout the dry season and well into the rainy season. They are never absent but may be greatly reduced in number by the heavy rains at the end of the rainy season. They are generally distributed throughout the area at all times.

The larvæ may be spotted in the field by the large size and dark color but can be easily confused with *punctimacula,* although they are somewhat smaller than *punctimacula.*

The pupæ are large and can be recognized after some practice as being either *punctimacula* or *apicimacula.*

The adults may be taken at horse traps and at screens at night. They are nocturnal in habit and are not as abundant as *punctimacula.* They are identified as being in the *Arribalzaga* group by the large black spots on the wings but cannot be distinguished from *punctimacula* or *neomaculipalpus* in the field. They do not have any obvious habits to distinguish them from the others. They are more abundant at the end of the dry season but may be encountered at any season.

Anopheles neomaculipalpus Curry

Anopheles neomaculipalpus Curry, Am. Jour. Hyg., 13: 645, 1933. (Type Loc.: Old Panama, R. de P.)

Distribution:—Old Panama (Curry); Chiva Chiva, Fort Clayton, Rio Abajo, Old Panama, Nuevo Chagres (Author).

Habits and Habitats:—The larvæ breed in sunny hoofprints, pasture marshes, grassy pools, small ground pools, wheel ruts, and small potholes. They are never collected in flowing water or in shady places. They may be collected in pools having aquatic vegetation, but aquatics are not necessary. The water surface may be broken by vegetation, but may not be littered with debris. However, they are easily found in foul or turbid pools.

The larvæ first appear late in the dry season and extend through the rainy season, disappearing towards the end when the heavy rains start.

Larvæ and pupæ may be readily identified in the field by the longitudinal white stripe running the length of the body. However, all specimens are not so marked. The markings are most obvious on those collected in the type locality. Those collected elsewhere are not so uniformly marked.

Adults are often taken at screens at night, nearly as abundant as *apicimacula* adults at certain times during the year. They have also been captured in horse traps. The adults cannot be distinguished in the field other than being a member of the *Arribalzagia* group. They will not bite.

Anopheles punctimacula Dyar & Knab

Anopheles punctimacula Dyar & Knab, Proc. Biol. Soc. Wash., 19: 136, 1906.

Anopheles malefactor Dyar & Knab, Jour. N. Y. Ent. Soc., 15: 198, 1907. (Syn. *punctimacula* Dyar & Knab, *vide*, Dyar, Ins. Ins. Mens., 6: 147, 1918.) (Type Loc.: Chagres River, C. Z.).

Distribution:—Tabernilla (Busck); Gatun, La Boca, (Jennings); Monte Lirio, Frijoles, Fort Sherman, France Field (Zetek); Empire, Gold Hill, Las Cascades, Majagual, Cativa, Margarita, Coco Solo, (Shropshire); Mindi, Fort Davis, Cardenas River (Baker); Colon (Black); Chagres River, Trinidad River (Busck); New Porto Bello (Jennings); Empire, Chiva Chiva, Santa Rosa, Chilibre, Nuevo Chagres, Lagarto, Salud, Pina (Author).

Habits and Habitats:—The larvæ may be found in many situations, such as jungle streams, pools, rock holes, swift streams, large ponds, seepage areas, drying streams, wash holes, ditches, and rivers. The amount of light is of little importance. They may be collected in deep shade or direct sunlight, from pools deep in the jungle to open rivers in floating vegetation. They are often found in foul water, in water with floating debris, or in both muddy and clear water. In general it may be said that this species will breed in almost any type of surface water offering protection from wave action and flow.

The larvæ are abundant throughout the year. They may be recognized in the field by the large size and dark color, but may be easily confused with *apicimacula.*

The adults will bite man, even during the day. They are abundant at screens at night and may be found in native houses during the day. Hundreds are attracted to horse traps. They have been found under natural conditions infected with *Plasmodium* (see Simmons, *et al.*). Although not generally conceded, there is strong evidence that this species is a vector of malaria in Panama. They are present in great numbers in highly malarious areas (*i.e.,* Pina area) even at times when *Albimanus* is absent or very rare. However, it has not been definitely demonstrated in the field to be a vector. Several hundred dissections were made by the author, both of stomachs and of salivary glands, of material from houses and horse traps in the Pina area at a time when the blood positives of the population ran as high as 90 per cent. Yet no infected specimens were discovered.

The adults are recognized in the field after some practice by the large size and black spots on the wings. Both *apicimacula* and *neomaculipalpus* tend to be smaller. (Breeds in surface water in jungles, in stream beds and similar temporary water—Dyar.)

Subgenus *Nyssorhynchus* Blanchard
Anopheles albimanus Wiedemann

Anopheles albimanus Wiedemann, Dipt. Exot., 1: 10, 1821.
Anopheles tarsimacula Goeldi (nec Root), Os Mos. No Para, 133, 1905. (syn. *albimanus* Wied., *vide* Komp, Ann. Ent. Soc. Am., 34: 801, 1941.)
Anopheles gorgasi Dyar & Knab, Jour. N. Y. Ent. Soc., 13: 198, 1907. (Syn. *albimanus* Wied., *vide,* Komp, Ann. Ent. Soc. Am., 34: 802, 1941.) (Type Loc.: La Boca, C. Z.)

Distribution:—La Boca, Tabernilla, Pedro Miguel, Gatun (Busck); La Boca (Jennings); Gatun, Ancon, France Field (Zetek); Majagual, Mindi, Monte Lirio, Dabalo, Corozal, Gold Hill, Hundred Foot Hill, Cative, La Pita, Comacho (Shropshire); Cardenas River (Baker); Colon (?); Trinidad River, Panama (Busck); Tabago (Jennings); Gamboa, Miraflores, Chiva Chiva, Gatun Lake, Rio Gatun, La Chorrera, Puerto de la Chorrera, Rio Abajo, Old Panama, New Providence, Port Limon, Chilibra, Pina, Nuevo Chagres, Lagarto, Salud (Author).

Habits and Habitats:—This species breeds in *Najas* beds, pools, rivers, sand flats, pastures, ponds, swamps, seepage areas, brackish pools, stagnant streams, potholes, ditches, road ruts, and lakes. *General necessities:* SUN, VEGETATION, LITTLE OR NO FLOW.

The larvæ breed in many different situations, but always in sunny places with very little or no water movement, and with some kind of vegetation, either floating aquatics, grass, or a green alga. No records were made of its breeding in shady places or clear pools. (Old boat—Jennings)?

This species is abundant throughout the year. However, during the dry season it is restricted to permanent bodies of water. Great numbers are present in Gatun Lake so long as the floating mass of vegetation is there. When the heavy rains come, the mats break up and the number of *albimanus* greatly decreases.

At Puerto de la Chorrera, R. de P., on the beach is a hole dug into the sand which is filled with sea water that has seeped into it. The salt concentration is about half that of sea water. There is no shade from even grass throughout the entire day and the only vegetation present is a green filamentous algæ. This pool breeds *albimanus* the year around in sufficient numbers to keep the native village continuously infected with malaria. No other breeding place in the vicinity has *albimanus* except at times dur-

TABLE I

Anopheles albimanus—Nocturnal Flights

Station number	TIME					
	7:00	7:30	8:00	8:30	9:00	9:30
1	0	0	17	14	12	5
2	0	3	5	2	1	0
3	18	98	71	60	10	5
4	37	68	62	37	23	9
5	17	50	81	64	56	15
6	12	52	43	17	5	5
7	21	17	15	7	1	1
TOTAL:	105	288	294	201	108	40

DATE: May 27; LOCATION: Rio Chagres.

These human bait traps were spaced about equidistant for a distance of three miles along the shore of the river at a section full of *Najas* and with high larval counts of *Anopheles albimanus.*

WEATHER: Rained from 2:00 to 3:15 that afternoon. Low hanging clouds, temperature 86° F. at 6:25. High humidity. THIS IS A TYPICAL FLIGHT RECORD. SIMILAR RECORDS WERE MADE FOR THE PERIOD OF MAY 20 TO JUNE 12.

ing the rainy season. The nearest station breeding this species is two miles from the town. Breeding in this same pool were equal numbers of *Aedes tæniorhynchus.* This should serve as a good example of the necessity of a very thorough survey if perfect control by larviciding is expected. If this pool happened to be in the nearby jungle and overlooked, larviciding of all the remaining pools would be in vain.

The adults readily bite man. They can be found in large numbers in light traps, animal traps and in dwellings. They do not all rest inside of houses during the day. After the first light of dawn, many leave the house for other shelter. At night they seem to have certain definite flights (see Table I). These flights vary according to the weather conditions, but are very definite and collections made at this time are sufficient to give an idea as to the population of the area. A person inside a human bait trap can tell when the flight has begun by the increased hum of their wings. These flights last for about thirty to forty-five minutes. After that the adults settle down and remain quiet unless disturbed by a flashlight. Inside a building or a tent they will follow the beam of a light from place to place. Sometimes there may be a second smaller flight about an hour after the first one.

Anopheles albitarsis Arribalzaga

Anopheles albitarsis Arribalzaga, El. Nat. Arg., 1: 151, 1878.

Distribution:—Gatun Lake on west side (Komp); Nuevo Chagres, Pina, Lagarto, Salud (Author).

Habits and Habitats:—The larvæ are most abundant in the floating vegetation in the western arm of Gatun Lake but have been taken in flooded areas, pools and small streams in stagnant water in full sun; usually but not always vegetation is present.

This species was collected only during the last half of the dry season.

The adults have been collected in small numbers in horse traps. There are no records of its biting man.

Anopheles argyritarsis Robineau-Desvoidy

Anopheles argyritarsis Robineau-Desvoidy, Mem. Soc. Hist. Nat., Paris, 3: 411, 1827.

Distribution:—Culebra, Pedro Miguel, Empire (Busck); Corozal, East La Boca, Rio Grande, Comacho, San Pablo, Ancon, Las Cascadas (Jennings); Gold Hill, Summit, Empire, Diablo, Miraflores, Monte Hope, Mindi, La Pita, Majagual, Paja, Mandingo, Paraiso, Cativa (Shropshire); Culebra, Otro Lado (Zetek); Chiva Chiva, Fort Clayton, La Chorrera, Chilibre, Pina, Nuevo Chagres, Lagarto, Salud, El Valle de Anton (Author).

Habits and Habitats:—This species breeds in pools, hoofprints, wash holes, seepage areas, swamps, marshy pastures, streams, potholes, rock holes and rivers. Usually it breeds in stagnant water but is not uncommon in flowing water. Possibly it is more abundant in sunny habitats but is often found in shade. Habitat may have debris and grass breaking the water surface, or it may be open, but seldom is it foul or turbid water.

The larvæ are abundant throughout the year but are found in greatest numbers during the dry season.

In the field the larvæ may be recognized by the light yellow color resembling the larvæ of *eiseni*. With practice the two may be separated in the field but are easily confused.

The adults have been collected in horse traps during the dry season. There are no records of its biting man.

The adults may be easily recognized in the field by the white hind tarsi. They may be distinguished from the other *Nyssorhynchus* by the absence of the black ring on the fifth hind tarsal segment. But it may be confused with *albitarsis* which also has an all white hind tarsus, but which is not commonly seen. (Various ground pools, preferring smaller ones and frequently in artificial containers—Dyar.)

Anopheles oswaldoi Peryassu

Cellis oswaldoi Peryassu, A. Fl. Med., 3: 179, 1922.

Anopheles aquacelestis Curry, Am. Jour. Hyg., 15: 566, 1932. (Not proven a syn. *oswaldoi* Pery., vide Komp, An. Ent. Soc. Amer., 34: 792, 1941.)

Distribution:—Atlantic side (Komp); Pina, Lagarto, Salud, Fort Sherman (Author).

Habits and Habitats:—The larvæ were not collected. However, the author examined some that were collected in a ditch near Fort Sherman.

Adults were collected on screens and in horse traps.

This is a rare Anopheline, easily confused with *aquasalis* and unless male genitalia are examnied, identifications are never positive except in typically marked females, *i.e.,* females with the second hind tarsal segment 1/6 black.

Anopheles strodei Root

Anopheles strodei Root, Am. Jour. Hyg., 6: 711, 1926.
Anopheles evansi Dyar (*nec* Brethes), Carnegie Ins. Wash., Pub. 387, 438, 1928. (Syn. *strodei* Root, *vide,* Komp, An. Ent. Soc. Amer., 34: 802, 1941.)
Distribution:—David (Komp); La Chorrera (Author).

Habits and Habitats:—This species was collected only at La Chorrera, R. de P., yet throughout the area of a three mile radius surrounding this city, this species was by far the most abundant Anopheline. It breeds throughout the year in many different habitats such as potholes, ponds, streams, pools, seepage areas, hoofprints, rock holes, ruts, pasture marshes, swamps, and ditches. It is not usually found in flowing streams. It is found breeding in the shade or in the sun, with or without vegetation, apparently without preference.

The adults were never taken in horse traps but were collected on screens at night on several occasions. There are no records of its biting man.

Anopheles aquasalis Curry

Anopheles aquasalis Curry, Am. Jour. Hyg., 15: 566, 1932. (Type Loc.: Panama).
Distribution:—Tabernilla (Busck); Cristobal, Pina, Nuevo Chagres, Lagarto, Salud (Author).

Habits and Habitats:—This species is referred to as a salt water breeder. However, it is now known that it breeds in both salty and fresh water. It is found in salt marshes, stream mouths, streams, ditches, sandy pools, and swamps.

It is collected throughout the year in salt marshes except during the heavy rains.

The adults are occasionally taken in horse traps.

Anopheles triannulatus Neiva & Pinto

Cellia triannulatus Neiva & Pinto, Bras. Med., 36: 356, 1922.
Anopheles bachmani Petrocchi, Rev. Ins. Bact. B. A., 4: 69, 1925. (Syn. *triannulatus* N. & P., *vide,* Pinto, Mem. Inst. Osw. Cruz., 34, 1939.)

Distribution:—"In Panama" (Komp); Santa Rosa (Simmons); Gamboa, Empire, Gatun Lake, La Chorrera, Lagarto, Nuevo Chagres, Pina, Salud (Author).

Habits and Habitats:—The larvæ breed in river vegetation, ponds, swamps, streams, potholes and rock holes.

This species resembles *albimanus* in its habits but is less abundant and has more diversified breeding habits. The larvæ are collected with *albimanus* and also in other habitats such as shady ponds, rock pools and potholes where *albimanus* is not found. Sun and vegetation are not as necessary as is the case with *albimanus*. This species has been collected in streams with some flow. It is common from April to September, from the end of the dry season well into the rainy season. The lavræ breeding in river vegetation inhabit the rosette crowns of *Pistia stratioles* L., water lettuce, and are seldom found elsewhere in rivers except rarely in the marginal grass.

The adults are found in small numbers in horse traps, becoming more abundant in August and September, gradually increasing as the number of *albimanus* decreases. They may be distinguished in the field from *albimanus* by the smaller size and darker appearing wings.

Subgenus *Kerteszia* Theobald

Anopheles neivei Howard, Dyar & Knab

Anopheles neivei Howard, Dyar & Knab, Carnegie Ins. Wash., Pub. 159, 4: 986, 1917. (Type Loc.: Panama.)

Anopheles hylephilus Dyar & Knab, Ins. Ins. Mens., 5: 38, 1917. (Syn. pro parte *neivai* H., D. & K., *vide* Komp, An. Ent. Soc. Am., 30: 521, 1937.)

Anopheles cruzii of authors. (Syn. *neivai* H., D. & K., vide, Komp, An. Ent. Soc. Am., 30: 502, 1937.)

Distribution:—Cano (Zetek); Gatun (Dunn); Majagual, Margarita (Shropshire); Fort Randolph (Bath); Caldera Island, Porto Bello (Jennings); Fort Sherman (Author).

Habits and Habitats:—This is apparently a rare species. The larvæ inhabit bromeliads. The females will bite humans (Curry in Komp).

This discussion has included all the Panama species of Anophelines except five* two of which are very questionable records. The two questionable records are Malaret's records of *A. crucians* and *grabhami* in Panama. The other three species are very rare and unknown to the author. They are: *A. parapunctipennis* Martini, *A. vestitipennis* Dyar and Knab, and *A. anomalophyllus* Komp.

* Since this was written, the following has appeared: Galindo, P., *Anopheles xelajuensis* DeLeon, a new addition to the known anopheline fauna of Panama, Pan-Pacific Ent., 23: 44, 1947.

(*To be continued*)

A NEW SPECIES OF THE GENUS THERION (HYMENOPTERA, ICHNEUMONIDÆ) WITH A KEY TO THE SPECIES OF THE NORTHEASTERN STATES

By R. R. Dreisbach

The new species herewith described is apparently well distributed over the northeastern states since the specimens in this series are from Michigan, New York, New Jersey and Pennsylvania.

Therion nigripes, new species.

Female.—Length 20–21 mm., wing 12–13 mm. Black, except as follows: face, mentum, clypeus (except apical edge), broad inner orbits to above antennal sockets, longitudinal ridge in center of face, a narrow stripe on outer orbits extending from base of mandibles to top of head, bright yellow; antennæ entirely light yellow except the first four joints, posterior side of these joints entirely black except apex of fourth which is yellowish; first joint whitish in front, second and third black, fourth black on basal third and yellowish on apical two thirds; a small reddish spot on anterior one-third of third tergite of abdomen; antennæ with 55–59 joints. Thorax shining and covered with short black hair; wings entirely black except tegulæ and a small spot at base of fore wing which are testaceous; propodeum roughly sculptured, the posterior surface with strong transverse ridges, and the sides projecting outwards forming knobs about the center; entire propodeum roughly sculptured with heavy ridges as is typical in the genus. Legs black except as follows: anterior pair slightly yellowish all over, a reddish ring on base of middle and posterior femur; metatarsal joints of middle and posterior legs with basal three-fourths yellowish; posterior femur with a yellow basal stripe on anterior side for three-fourths of length; middle and posterior tarsal joints covered with light-colored hair.

Male.—Length 21–23 mm., wing 10–11 mm. Similar to the female except as follows: first two segments of antennæ white in front; front legs more yellowish and anterior sides of middle legs also slightly yellowish; posterior tarsal joints entirely yellow except apical joints; face with surface between middle ridge and inner orbits black except for a broad yellow spot just below antennal sockets.

This species may be separated from all the other species in this region except *T. tenuipes* by the dark-colored posterior tibiæ. As noted in the key it may be distinguished from this species by the difference in comparative lengths of the posterior tarsal joints.

Holotype female.—Allegan Co., Mich., 3–25–42 (RRD).[1]

Allotype male.—Midland Co., Mich., 7–23–38 (RRD).

Paratypes.—Female, Ithaca, N. Y., V–21–33 (Tow.)[2]; female Moorestown, N. J., VIII–2–39 (Tow.); female, Valley Forge, Pa., VIII–9–39 (Tow.); female, Elmira, N. Y., VII–4–37 (Tow.); female, Lockport, N. Y., VIII–25–36 (Tow.); female, Canandaga, N. Y., VII–11–35 (Tow.); 6 males, Midland Co., Mich., VII–21–38, VII–23–38, VII–21–39 (Tow.); 2 females, Midland Co., Mich., VIII–13–38, VII–21–38 (Tow.); female, Isabella Co., Mich., VII–21–38 (Tow.); female, Wayne Co., Mich., VIII–21–18 (U.M.)[3]; female, Midland Co., Mich., VII–23–38 (RRD); 7 males, Midland Co., Mich., VII–23–38, VII–15–44 (RRD).

For the present, the types will be retained by the author but ultimately will be deposited at the Museum of Comparative Zoology, Harvard College, Cambridge, Mass.

I wish to thank Dr. H. K. Townes for the loan of the species in this genus which are not in my collection and also for his help in making up the keys.

KEY TO THE NORTHEASTERN SPECIES

1. Posterior tibiæ entirely dark, or at least with their basal two thirds dark fulvous with only a stripe of yellowish on one edge; wings black 2
1. Posterior tibiæ with their basal two thirds yellow 3
2. Posterior tibiæ longer than the posterior femur and trochanter joints combined, approximately one and one seventh times as long; posterior basitarsi longer than the remainder of posterior tarsal joints; a narrow yellow stripe in center of face and one on each inner orbit, remainder of face black .... *tenuipes* Nort.
2. Posterior tibiæ about the length of posterior femur and trochanter joints combined; posterior basitarsi shorter than remainder of posterior tarsal joints; face yellowish all over with a blackish cast .... *nigripes* n. sp.
3. Posterior coxæ and trochanters entirely black; wings dark; thorax head and abdomen entirely black .... *morio* Fab.
3. Posterior coxæ and trochanters not entirely black 4

[1] RRD—Collection R. R. Dreisbach.

[2] Tow.—Collection Henry K. Townes.

[3] U.M.—Collection University of Michigan.

4. Fore wings more than 15 mm. long; coxæ all black 5
5. Wings dark brown in reflected light; posterior tibiæ about one-tenth longer than posterior femur and trochanters combined; face yellow with a dark longitudinal stripe a short distance within inner orbits; the second and third antennal joints and a basal ring on fourth entirely dark; outer surface of mandibles almost entirely dark. Whole costal cell light yellow, as well as stigma ...... *confusum* Ash.
5. Wings yellowish brown in reflected light; posterior tibiæ just about length of posterior femur and trochanters; face entirely yellow; second, third and fourth antennal joints yellowish on under side; outer surface of mandibles almost entirely yellow; costal cell and stigma with only a very narrow stripe on fore edge yellow. *fuscipenne* Nort.
6. Wings dark brown; hind femur mostly dark 7
6. Wings light brown; if hind femur is almost entirely dark, then fore and middle coxæ are yellowish white 9
7. Costal vein entirely black except a very short length at base, stigma entirely black or very dark brown; posterior tibiæ shorter than posterior femur and trochanters combined; length about 20 mm. in one case, and a little over 13 mm. in the other case 8
7. Costal vein yellowish as is also the stigma; posterior tibiæ longer than combined length of posterior femur and trochanters; length about 22.5 mm. .... *nigrovarium* Br.
8. Size large, 20 mm.; length of posterior tibiæ 5.25 mm., of posterior femur and trochanters 4.65 mm. .... *texanum* Ash.
8. Smaller, slightly over 13 mm.; length of posterior tibiæ about 4 mm., of posterior femur and trochanters about 3.65 mm. smaller in every way than the preceding .... *petiolatum* D.
9. A large species, over 20 mm. in length; thorax almost entirely black, some red spots on mesopleura in some cases; first three segments of abdomen conspicuously red; coxæ black; face of female with a yellow central stripe, and a narrow yellow line on inner orbits, rest of face black; face of male entirely yellow .... *circumflexum* (L.)
9. Smaller species, length 13 mm. to 15 mm.; thorax red and black; only first two segments of abdomen conspicuously red, the third much more black than red; coxæ black and red in females and black and yellowish white in males; face of females entirely yellow 10
10. Stigma very light yellow; wings yellowish; a much stouter species than the following; fore wings of male 8 mm.; face concave in center. *sassacus* Vier.
10. Stigma very dark yellow; wings much more nearly hyaline; species more slender than preceding; fore wings of male 6.25 mm.; face with a longitudinal ridge in center extending length of face. *varicolor* Vier.

EIGHTH INTERNATIONAL CONGRESS

The eighth International Congress of Entomology will be held in Stockholm, Sweden, August 8–15, 1948. The fact that all steamship sailings are currently booked to capacity for months in advance makes it seem necessary for those expecting to attend the congress in 1948 to arrange for passage as early as possible. Steamship companies have not issued sailing lists for 1948, but expect to do so in the early fall. A number of lines have listed sailings for the present season, among them, the Cunard, French, Belgian, Swedish, Norwegian, Gdynia (Polish), Holland-American, etc., the first mentioned expecting soon to have two new steamers in service. It is understood that the Thirteenth International Congress of Zoology will be held in Paris some time in July, 1948, and it is hoped that all entomologists going to Stockholm will plan to attend the Zoological Congress also in order that the interests of the entomologists may be fully represented before the more comprehensive body. Should a sufficient number of individuals indicate that they expect to sail about mid June, it may be feasible to engage passage on the same steamer. Early information as to the probable number of participants is especially desired in order that the housing committee in Stockholm may make the necessary arrangements. The undersigned, as member of the executive committee, would appreciate it if he be kept informed as early as possible as to plans of those expecting to attend the sessions.

O. A. JOHANNSEN,
Comstock Hall, C. U.
Ithaca, N. Y., June, 1947.

POPULAR NAMES OF GYRINIDÆ

In 1926 (Entomological News, 37: 269), the writer listed five vernacular names for these water beetles. More than thrice that number can now be cited and it seems desirable to assemble them in print as a possible stimulus to some historically inclined entomologist to undertake the collection of folk names of insects. As one who has collected bird names for a generation, the writer can recommend this as an interesting and rewarding field.

Per Kalm, whose broad sympathies led him to record the first observations along varied lines of American natural history, in his journal entry for April 13, 1749, noted "vattenbaggen (*Dytiscus natator*)." The translators have made free with this term, which means only "water-beetle." Thus a French interpreter rendered it "tourniquet" (a turning thing), a Dutch one as "zweemer" (swimmer), and an Englishman as "whirl beetle."

John D. Godman, author of "Rambles of a Naturalist," whose wanderings were in the neighborhood of Philadelphia, said in 1830 (Waldie's Library, 2: 85) that they are "called by the boys the water-witches and apple smellers," and that they have "a delightful smell exactly similar to that of the richest, mellowest apple." Confirmation of the existence of this pleasant aroma occurs in the oft-quoted "Swallow Barn" (John P. Kennedy, 1832, 1: 129), where we read, "The apple-bugs (as schoolboys call that glossy black insect which frequents the summer pools, and is distinguished for the perfume of the apple) danced in myriads over the surface of the still water." Mellow-bugs and sugar-bugs are names of the same origin.

The dancing alluded to, familiar to all entomologists as well as to many of the general public, a swift darting in intersecting curves, each leaving a momentary wake upon the water, accounts for two of the Kalm-associated names, for the water-witch of Godman, and also for such terms as scuttle bugs, whirligigs, and whirligig beetles. Of quite different origin must be the names penny bugs, dollar bugs, and lucky bugs; the first two of these may have been suggested by the ovate shape, or all of these terms may have an allied and obscure significance. In the writer's experience, a lucky bug in the United States is one that brings luck in love. Professor H. E. Jaques informs me that at McGregor, Iowa, "The kids around the river were told that if they would catch one (some trick to that of course) and put it under their pillow when they went to bed, the next morning there would be a *scent* there."

Names of Gyrinidæ recorded for England, some of which evidently were imported to the United States, are: steelcoat, water-flea, whirligig, whirligig beetle, and whirlwig.

Following is a check-list of the names with indications of the states where they are known to have been used*:

Apple bug, N. J., Md., Va., Ind.
Apple smeller, N. J., Pa., Minn.
Dollar bug, Mass.
Eel bug, N. C.
Lackey bug (may be a variant of lucky bug), Mass.
Lucky bug, Mass.
Mellow bug, Ala.
Penny bug, Iowa.
Scuttle bug, N. J.
Sugar bug, Md.
Tourniquet (French).
Water-flea, N. Y.
Water-witch, N. J., Pa.
Whirl beetle.
Whirligig, N. Y.
Whirligig beetle, N. Y.
Zweemer (Dutch).

W. L. MCATEE, CHICAGO, ILLINOIS.

* I am indebted to Hugh B. Leech of Vernon, B. C., Canada, for useful suggestions.

THE LAST FEW YEARS

By STANLEY W. BROMLEY, PH.D
BARTLETT TREE RESEARCH LABORATORIES, STAMFORD, CONN.

The last few years have seen some striking advances in the field of insect control. This has been particularly true in regard to the new insecticides which have burst into view during the past few years. Of these insecticides two general bug-killers, DDT and benzene hexachloride have been outstanding. Both of these insecticides kill a wide range of insects and possess a residual action which continues their period of effectiveness over a considerable period of time.

DDT was first found to be an effective insecticide when it was used in 1939 to control the Colorado potato beetle in Switzerland. Since then it has been tested extensively by the Army and Navy Medical and Sanitary Corps and found to be the most effective control for a number of insect pests intimately concerned in the dissemination of human diseases.

Benzene hexachloride is more effective than DDT on a wider range of insects but does not possess residual effects over so long a period of time.

It should be pointed out that both these insecticides kill beneficial as well as injurious insects and blanket applications of each over large areas should be discouraged except in the case of an outbreak of a particularly destructive pest.

Few people realize that of the million and a half kinds of insects described scientifically during the past two hundred years, it is only a very small proportion of these that are inimical to the interests of mankind. There are as many or more beneficial species as there are destructive insects and interfering with the natural biological balance of the beneficial species may produce disastrous results.

Coming to the effects of the new insecticides on shade and ornamental trees, the particular field in which I am most interested, I would predict that both DDT and benzene hexachloride will find an important niche. DDT is the quickest and cheapest control when applied by mist blower for the gypsy moth. It holds out, furthermore, great promise in controlling the elm bark beetle and consequently the Dutch elm disease. There are many insects, however, which it does not control and it even fosters outbreaks of certain others, particularly of red spiders and plant mites.

In the shade tree and ornamental field, the most promising insecticidal spray we have found at our laboratories and subsequently tested in several years of field practice is a relatively new development, namely, a resin emulsion of pyrethrum and rotenone, with the trade name of STYX. STYX has the advantage of being a relatively safe spray both to operator and to plants, controls a great variety of tender insects such as aphids, thrips, leafhoppers, lacebugs and other harmful insects. STYX is superior to DDT in that it controls red spiders and plant mites, leaves no objectionable residue on the foliage and may be applied with safety to tender blossoms.

Coming to the strictly insect phase of the situation, I would like to present an article I had prepared under the title "Insect Armies on Evergreen Trees."

Some of our most dangerous and insidious enemies of ornamental pine trees are the small insignificant aphids, or plant lice.

It is difficult to realize that these little insects are injuring trees until brown and dying needles begin to show up. The injury may not be restricted to the foliage alone but may spread to the twigs or branches and sometimes entire small trees may be killed.

Ornamental coniferous trees frequently show browning foliage and dying twigs, the cause of which may not be immediately apparent. In many instances, however, this type of injury can be definitely traced to the work of plant lice.

A very common type of injury is the combination of aphid feeding and winter killing. Certain aphids may become abundant in late summer or autumn and their feeding late in the season may so greatly weaken twigs, branches or even the entire tree that it succumbs to freezing or drying out during the winter or early the following spring. At the latter time there may be little or no indication of the plant lice although in many cases their previous presence may be betrayed by the blackened condition of bark and needles as a result of sooty mold fungus developing in the honeydew produced by the aphids or by the presence of small black glistening aphid eggs on the needles or twigs.

It is noteworthy that of a considerable number of plant lice or aphids attacking a certain type of tree, only a few species may cause damage. Among the more injurious are the pine twig aphid and the pine leaf aphid.

The pine twig aphid is a European importation which attacks the bark of the twigs and branches of the Japanese table pine, the black or Austrian pine and the Mugho pine resulting in serious weakening or winter killing. This same aphid has also been recorded from the Scotch pine. It is a large aphid and dark colored but the colonies are inconspicuous on the bark due to the protective coloration or natural camouflage of the aphids themselves.

This aphid seems to be most destructive to the Japanese table pine, an ornamental evergreen cherished because of its unique spreading table-like shape. Frequently in the spring, branches and twigs here and there will show fading needles which eventually turn brown and drop. The blackish aspect of the bark in the interior of the tree, a condition resulting from sooty mold, may indicate the basic cause as being due to an infestation of these aphids which occurred the preceding autumn. The twigs and branches devitalized by the aphid feeding frequently fail to survive the winter. Sometimes the entire tree is killed.

This same aphid or a closely related species has been observed in the fall on the bark of twigs and branches of Japanese black pine. The damage on this pine, however, seems to be lighter than in the case of the Japanese table pine although even here many needles were noted as turning brown and falling off with the end result that twigs and branches died back to some extent. The pine twig aphid is amenable to control by spraying thoroughly with a good contact insecticide during September before the aphid colonies have caused serious damage.

The pine leaf aphid is an elongate, mouse-gray, long-legged plant louse which attacks the needles of Mugho, Japanese, red, Austrian, Scotch, and pitch pines. This is an unusually active plant louse and when disturbed runs around the needles like a spider. It normally rests lengthwise on the leaf where it is quite inconspicuous. The needles so affected turn a mottled yellow in color and drop readily so that the final result of infestation is a very sparsely needled tree. In cases of prolonged and serious infestations, the entire tree may succumb. The pine-leaf aphid is also a European introduction. The younger stages show a greenish coloration of the body which in the adult is obscured by the grayish powdery appearance. The legs of the aphid are yellowish-green in color, closely matching the color of the needle.

It is interesting to note that a very close relative of this leaf aphid and one which is much more conspicuous on the needles of such pines as the native red pine is apparently not injurious. We have never been able to tie up definite injury from the presence of this whitish powdery aphid although in some cases large colonies may be found on the needles of the red and related pine trees.

The pine leaf aphid may be found at its nefarious work from early spring to late fall. It may be readily controlled by spraying thoroughly with a good contact insecticide.

Among the other aphids destructive to pines may be mentioned the white pine aphid. This is a large black aphid rather sluggish in its movements which attacks the thin bark of the smaller twigs and branches of the white pines. The presence of this aphid may be betrayed by the blackish appearance of the bark and needles resulting from the sooty mold which develops in the honeydew produced by this plant louse. While this aphid feeds entirely on the twigs and not on the needles, the eggs are laid on the needles usually in long chains lengthwise with the leaf. The eggs are yellowish at first but become a shiny black. They are usually laid in the fall and hatch in the spring.

Another aphid which may be mentioned is the willow aphid which feeds on the bark of twigs and branches of many types of willows. The willow aphid becomes numerous in September and may last through until early November. Heavily infested branches of willow may be so weakened by this aphid that they may die or may succumb during the winter or early spring from winter-killing.

The aphids or plant lice are proof of the old statement about the meek inheriting the earth. Aphids are nearly helpless, practically defenseless, small delicate insects, yet there are over 300 different kinds occurring in North America and many kinds become extremely abundant so that in spite of their helplessness they are able to survive through sheer force of numbers.

So frail are they, some with and some without wings, and so tender that it is extremely difficult to pick one up in the fingers without inflicting serious injury to it. Their potential of increase is so great that it has been a source of inspiration to naturalists, particularly naturalists with a mathematical turn of mind, for centuries. For instance, the apple aphid may produce 100 young; The plant louse of the hop vine may produce 12 generations, each female bringing forth 100 young. Several centuries ago the great French Scientist, Réaumur, (the one who devised the thermometer bearing his name), starting with 90 young of the female aphid and 5 generations estimated the progeny from one aphid at 5,904,900,000 individuals. With 6 generations there would be, provided they all lived, 531,441,000,000 individual aphids. If these were arranged in colums of 4, allowing each plant louse 1/10″ in length, this would mean an army of plant lice 209,691 miles in length. This alone would be sufficient to form 8 belts around the earth at the equator with three 3,000 mile strips and 700 miles additional.

The possible living progeny from one hop plant louse in the 12th generation would amount to one sextillion or 3,945,707,070,-707,070 miles of plant lice arranged in a column of 4. This vast horde is sufficiently numerous if each plant louse occupied a space of 1/10″ long and 1/20″ wide to cover 12,454,875 square miles or sufficient to cover the entire area of the United States with a layer of plant lice over 14 feet deep. The total progeny of 12 generations of these aphids would, if nothing happened to them, equal 10,101,010,101,010,101,010,100 individuals.

Unfortunately for the dreams of the mathematicians but fortunately for us this terrific population is never reached because something always happens to the aphids to prevent them from breeding so recklessly. Weather conditions may intervene which may almost wipe them out. There are other natural checks such as ladybird beetles, flower flies and other beneficial insects which feed on the aphids and keep their numbers down within bounds. In many cases, the aphids may be their own worst enemies. They may commit race suicide—but a kind of race suicide quite the reverse of Teddy Roosevelt's famous theory. It would be due not to lack of progeny but just the opposite, the aphids in most cases would breed so fast that they would outstrip their food supply and all starve to death long before the above mentioned astronomical figures could be reached.

Scale insects are in many ways similar to aphids. They feed by means of sucking mouthparts but are sedentary for the greater part of their existence. Those attacking evergreens are of particular interest.

The two outstanding scale insects which attack evergreen trees are the pine needle scale and the juniper scale. Both are whitish in appearance but the pine needle scale is relatively long and slender and rests lengthwise on the needle, while the juniper scale is circular. Both scales are capable of doing considerable damage to their respective hosts if they are sufficiently abundant.

The pine needle scale over-winters in the egg stage underneath the old scale coverings. The minute eggs are purplish in color contrasting with the white of the scale itself. The eggs hatch and the young crawlers begin to appear on the leaves about the middle of May. A second generation may appear on the leaves in July but there is a great variation in development from year to year.

The weak point in the life cycle is the young, unprotected, crawling scale. Best control may be obtained by spraying with a contact spray when the young are crawling.

If the infestation is allowed to increase and build up, serious damage to the needles may be in evidence by early fall. At this time of year, spraying is ineffective. In other words controlling this insect is a matter of prevention rather than cure. In fact, with all scale insects the story is the same. They are so small that they usually pass unnoticed until damage to the tree begins to show up at which time it may be too late to apply control measures for the purpose of saving that particular tree or at least, the badly affected branch.

The juniper scale has a somewhat different appearance as well as somewhat different life cycle. The juniper scale is usually most destructive to ornamental junipers although it has been recorded also from red cedar, arborvitæ, and a species of pine. The full grown scale is circular and snowy white and about 1/20″ in diameter. They are occasionally so numerous on junipers as to give the appearance of whitewash having dropped on the foliage. The winter is passed in the nearly full grown condition, the young appearing early in June and also in August. Excellent control with the use of a good contact spray in August may be frequently obtained.

In dealing with scale insects, we are dealing with pests which have a tremendous potential for increase. In figuring the rate of population growth one may deal in numbers which are astronomical. In fact, knowledge of the factors governing populations is best obtained from a study of such insects as scales and aphids. However, great population increases are influenced by many external factors which usually counteract any undue increase in population. Weather conditions, natural enemies and even factors incidental to great population increases may act in themselves as counterbalances. For instance, in many cases, insects may breed so rapidly as to exhaust their food supply. Then they starve to death. This sequence of events is not confined to the insect world but is true of all living things with the possible exception of mankind. Mankind through science has been able to regulate his environment, control his diseases and govern food production to such an extent that the population of the globe is continually increasing. Even wars fail to exert much of a check on population growth of the human species. Considered in this light, the specter of over-population looms as appalling as the threat of the atomic bomb. In fact, the basic reasons for most wars is the factor of population pressure. With all checks removed, it seems possible that mankind may increase to the point of "standing room only" on this planet. It seems very doubtful that the atomic bomb can destroy the entire human race. It may, however, destroy the brains of civilization—knowledge and science—so that people will revert to barbarism, with the accompanying resurrection of the great plagues, diseases and with tribal and inter-tribal warfare and thus restore all the old controls, so thwarting the ultimate possibility of great over-crowding.

While browning needles may be a symptom of scale infestation on evergreens, this is by no means true in every case. Browning tips of two needle pines may be due to shoot-moth infestations or to infections of the brown-tip disease caused by the fungus, *Sphæropsis,* or it may be due to an entirely different and to many persons a most surprising cause.

Every September and October we are deluged by calls about pine needles turning brown. The owners are apprehensive about the possibility of a new disease making its appearance. In many cases, this turns out to be simply the maturing of the older needles which have lived their allotted three years of life and are dying normally and dropping off. There is no need for alarm where this occurs on three-year-old wood. Where the browning needles appear on the current year's growth or on last year's growth, there is cause for alarm because this is an abnormal type of dying and indicates the presence of an insect pest or disease, or mechanical or storm injury—some condition which demands attention and treatment.

THE "SPECIAL SURVEY IN THE VICINITY OF PORTS OF ENTRY" AS A CONTRIBUTION TO "A LIST OF THE INSECTS OF NEW YORK"

By Mortimer D. Leonard
Washington, D. C.

A special survey in the vicinity of ports of entry was conducted by the Division of Foreign Plant Quarantines of the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, in all the Seaboard, Gulf Coast and Mexican Border States from June 1943 through June 1945. Its purpose was to determine whether, with the increased wartime traffic and its accompanying unavoidable relaxation of plant quarantine vigilance, new foreign agricultural insect pests had been permitted entry and establishment in the port areas.

Determinations of the insects collected in this survey were made by the specialists in the Division of Insect Identification of the U. S. Bureau of Entomology and Plant Quarantine and the data in connection with these determinations were written up on the standard record sheets used in the files of the Bureau's Insect Pest Survey. Copies of these record sheets were then sorted out by states and a set of the records for his state were sent to the proper authority in each state covered by the survey.

In connection with the work on a Supplement to "A List of the Insects of New York" (Cornell Univ. Memoir 101, 1928) the writer has been able to examine the "Special Survey" records for New York. This was done through the courtesy of Dr. A. B. Buchholz, Director of the Plant Industry Bureau, New York State Department of Farms and Markets, and Mr. P. M. Eastman, the Assistant Director. An analysis of these records shows that the work done in New York State, resulting from nearly 2000 inspection hours, constitutes a significant contribution to an increased knowledge of the insects which occur in the state. In New York the collections were naturally confined almost entirely to Long Island, Staten Island and the Bronx.

Staten Island and Long Island have for many years been intensively collected by the large and enthusiastic group of entomologists in the New York City area. In view of this the addition by the "Special Survey" of 106 species new to Long Island and of 35 species new to Staten Island shows the need for much more collecting and the value of survey work.

The collections for the "Special Survey" in New York were made by the following members of the Foreign Plant Quarantines Division's inspection staff, listed approximately in the order of the number of records they contributed; C. S. Tuthill (made more collections than any other) A. S. Mills, C. G. Anderson, A. T. Gaul, A. O. Plummer, J. A. Herrick, G. J. Rau, H. L. Smith.

A total of around 1375 collections were made in the vicinity of the Port of New York. As is usual many of the insects collected were determinable only to family or to genus since often only immature forms were obtained. No attempt has been made to count the number of species which could be definitely or tentatively determined specifically. Naturally many of these were already well-known in New York but the previous distribution of some of them within the state was significantly extended by the survey. Valuable food-plant data were also added in many instances.

The number of definitely as well as tentatively determined species new to the New York List or which significantly extend the distribution within the State of species already listed is 253.

Order	Species recorded	Genera new to N. Y.	Spp., new to N. Y.	Spp., new to S. I.	Spp., new to L. I.
Coleoptera	75	2	26	6	32
Diptera	13	......	4	......	9
Hemiptera	16	1	5	2	7
Homoptera	79	4	24	17	17
Hymenoptera	12	3	11	1	7
Lepidoptera	54	7	18	8	33
Thysanoptera	4	......	1	1	1
Totals	253	17	89	35	106

Of these, 89 species, 17 genera and 1 family are not in the New York List of 1928 although several of these had subsequently been recorded as occurring in New York.

The foregoing table gives the number of genera and species in each order which are not recorded in the 1928 New York List as well as those not therein recorded for Long Island and Staten Island.

BOOK NOTICE

Catalogue of North American Beetles of the Family Cleridæ. By Albert B. Wolcott. Fieldiana: Zoology, Volume 32, Number 2. Chicago Natural History Museum, June 12, 1947. p. 61–105.

This catalogue by Albert B. Wolcott, long an authority on, and student of the Cleridæ, will be welcome to many coleopterists because it is the result of his mature consideration of various problems in the taxonomy and synonymy of that family. Dr. Wolcott's catalogue is a revision of previous catalogues and includes such subfamily and generic revisions as have appeared. An adequate index and bibliography form part of the catalogue. Among the changes, the long-familiar *Hydnocera* Newman is discarded and becomes a synonym of *Phyllobaenus* Dejean.—H.B.W.

ANTS ASSOCIATED WITH APIARIES IN THE NEW ENGLAND STATES

By Jane Enzmann
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Many ants are inordinately fond of sweets and seek out places where such dainties may be found, such as the floral and extra-floral nectaries of plants, the sugary excretions of aphids, or even preserves on the kitchen shelves. One may therefore expect that apiaries, where sweets are accumulated in great abundance, will not escape the attention of foraging ants.

During the past two years the writer has made a study of the species of ants which are found in or near beehives in the New England States, with the object of assessing the possible damage done to apiculture by ants. The observations were made at my own apiary, located in a two-acre garden in Dedham, Massachusetts.

Root and Root in their well-known popular book, ''ABC and XYZ of Bee Culture,'' have recorded some interesting observations which agree, for the most part, with my own. In many instances, however, the interpretations put forward by these authors are anthropomorphic, and not in accordance with the behavior pattern of either bees or ants.

The ants which are found in or near beehives fall into three groups; those which use the hives as temporary or permanent shelters, those which prey on living bees, and finally those which rob the bees of stored honey. The first group is of little or no economic importance. In our climate at least, ants rarely attempt to nest in hives occupied by bees; only empty hives are occasionally used as nesting sites by ants. The following freshly dealated queen ants, hunting for nesting sites, have been taken from empty hives: *Camponotus herculeanus* subsp. *pennsylvanicus* and var. *novoboracensis* (the subsp. *pennsylvanicus* is known as the ''black carpenter ant'' and the variety *novoboracensis* may be called the ''redbreasted carpenter ant''). *Crematogaster lineo-*

lata subsp. *cerasi* (*cf.* Jane Enzmann, 1946, JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, 54: 89–97) was found on several occasions in empty hives. In one case (observed in New Jersey) a flourishing colony of *C. lineolata* had established its nest between the storm cover and the inner cover of a hive. Workers of this ant colony were also found on the combs of this rather weak bee colony, pilfering stored honey. In another case a very small nest of *Solenopsis molesta,* (the "thief ant") was found in a hive, but the nest had disappeared a few days later. This association with bees was, in the writer's opinion, more or less accidental, for although this ant will not refuse sweets, it seems to prefer fatty substances for food.

Several species of ants were often found nesting near beehives, including *Lasius* ssp. (the "lawn ant"), and *Aphænogaster.* Both of these forms are rather fond of sweets. *Lasius* will quickly overrun a partly filled or damaged honey comb left outside the hive on the ground, but neither *Lasius* nor *Aphænogaster* have been observed entering hives in order to rob the bees. *Formica fusca* (the "gray ant") and *F. sanguinea* (the "blood-red slavemaker") likewise make their appearance when honey combs are exposed, but have not so far been seen inside inhabited hives. It is obvious that none of these species cause any serious damage. *Camponotus* might conceivably do damage to the wood of the hives, but then, this ant is so large that it cannot easily escape detection by the bees, who make short work of the intruders.

The second group of ants *i.e.,* those that prey on living bees, is of no importance in our climate. However, in the southern states and especially in the tropics this group is noxious and great precautions have to be taken to exclude ant pests from the hives. Root and Root (*loc. cit.*), quoting O. O. Poppleton (in "Gleanings"), state that in late fall (September to December) many colonies of bees in Florida are lost to the depredations of "red ants," nearly half an inch in length, of nocturnal habits, that nest ordinarily in decaying wood. According to these writers the ants may battle the bees for hours or days and the ground surrounding the hives may be covered with dead ants and crippled bees. The battle is said to end always in favor of the ants, which finally kill all the bees and occupy the hive. Unfortunately, Poppleton's account does not give enough descriptive data for identification of the ant in question; it might be a form of *Camponotus.*

In the tropics several ants species attack bees. The army ants (*Eciton* spp.) are perhaps the worst killers and may clean out a beehive in a matter of minutes. Root and Root cite the following account by Poppleton relating to ants' forages in beehives: "the worst feature is their readiness to travel, so that, when one destroys their nest, there is no assurance that the apiary is safe from their attack. Another bad feature is their habit of travelling by night; in fact, nearly all their depredations are made in the dark." This account suggests *Eciton* or "army ants." Beekeepers in tropical countries protect their hives by placing them on platforms supported by posts which are ringed with cups filled with coal tar, creosote, or crude petroleum.

The last group of ants includes the species which invade hives occupied by living bees in order to rob them of honey. The only species of any importance in the northern states is *Prenolepis imparis.* This ant is a bold honey thief and marches right into the entrance of the hives, emerging later with the gaster greatly distended with stolen honey. In some cases, especially when a colony is weak, *Prenolepis* forages in files, boldly marching past the guardian bees which rarely pay any attention to them, so that they may steal appreciable amounts of honey during a season. One such hive which had been set aside during 1944 for the purpose of determining the amount of damage, at the end of the honey gathering season, contained less than two pounds of honey, while an equally weak colony, which had been protected with spray on the ground, had collected nearly 80 pounds. Sometimes the guardian bees at the hive entrance will notice larger ants, for instance *Camponotus,* seize them and fly high in the air, carrying them a few feet from the hive and dropping them on the ground unharmed.

The repletes have their abdomens swollen with honey and often carry so much that they are barely able to waddle along. The repletes of *Prenolepis* are obliged to regurgitate their honey within a short time. Isolated ants kept overnight in a closed container, usually disgorge their honey and empty their crops. A few of them, which for some reason do not regurgitate, actually burst. *Prenolepis* is therefore not a true "honey ant," a fact indicated by Wheeler, and is not as highly specialized as *Melophorus, Leptomyrmex, Plagiolepis, Camponotus inflatus, Crematogaster inflata* and *Myrmecocystus.* The last named, the "true honey ant," is capable of storing very large amounts of sweets for a considerable length of time in its gaster. The repletes of this ant are unable to move and remain hanging from the ceiling of the nest, forming living honey pots. The crop filling is retained by the repletes of *Myrmecocystus* (the honey ants of Texas) for long periods of time and can be distributed to the other nest mates during the lean season, when the outside world is sunparched and no food is available.

NEW SPECIES OF SERICA (SCARABÆIDÆ). VIII

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The species of *Serica* are numerous and the external characters few and often variable. Consequently the usual descriptions do not suffice for the identification of the species. The characters of the male genital armature should be considered first and the descriptions of external characters used as a supplement.

The relative sizes of head, eyes, clypeus and antennæ vary somewhat between the various species of *Serica*, and are therefore in general of value in differentiating the species. Since subjective impressions of measurements are not very reliable, actual measurements in tenths of a millimeter have been calculated from micrometer measurements and are given in the following descriptions. While the student may not so measure his specimens he will at least have definite statements of size and proportion to aid him in making judgments.

Serica arkansana, new species.

♂. Length 8 mm.; width 4.5 mm. Color chestnut brown, glabrous and shining.

Clypeus nearly flat, slightly depressed before the moderately reflexed lateral edges. Anterior margin rather strongly reflexed and arcuately bent, separated from the sides by a narrow V-shaped notch. Surface closely punctured, the punctures separated by not more than their diameter, and tending to crowd together into irregular lines. Clypeal suture fine but distinct. Front less closely punctured, especially above. Measurements of head in tenths of a mm.: diameter through eyes, 22.1; distance between inner eye margins, 13.6; extreme width of anterior reflexed margin of clypeus, 10.3; antennal club, 8; dorso-ventral diameter of eye, 8.6.

Pronotum with the disc rather evenly, but less closely punctured than the head. Punctures separated by one to three diameters, except in a narrow area near the sides where the punctures are crowded to about half their diameter. Width through posterior angles, 35; width through anterior angles, 22.2; median length, 19.3.

Elytra bare except for a single row of sparse, short, yellow hairs on the lateral margins; definitely striated, the grooves densely punctured, and the intervals anteriorly and laterally nearly impunctate. Punctures crowding over the first two (sutural) intervals anteriorly and covering them rather evenly as they flatten over the posterior curvature.

Genital armature of male 2.2 mm. in length; figured on Plate IX.

♀. Very similar to the male, antennal club only very slightly smaller, and clypeal notch narrower; more readily recognized by the evenly convex under surface of the abdomen and the less emarginate last ventral plate.

Type: ♂, Washington Co., Arkansas, April 6, 1938. (Ill. Nat. Hist. Survey Col.)

Paratypes: 11 ♂, 14 ♀, all from Arkansas: Fayetteville, 1 ♂; Franklin Co., 1 ♂, 4 ♀; Miller Co., 1 ♀; Washington Co., 9 ♂, 9 ♀. Most of the specimens were collected by Milton W. Sanderson and generously loaned to the writer for description.

Arkansana is most closely related to the *texana-atratula* complex of species, reviewed in this paper.

Serica atratula Le Conte.

1856. *Serica atratula* Le Conte, Jour. Acad. Nat. Sci. Phil., (2) III, p. 274.

The following description, based on type #2 in the Le Conte collection, is given in full as it was written some years ago.

♂. Length 6 mm.; width 3.3 mm. Color piceous black, surface polished and shining.

Clypeus very slightly depressed below the suture and vaguely tumid beyond the middle; anterior margin moderately reflexed, viewed perpendicularly, feebly and evenly arcuate, viewed at an angle from above, strongly and evenly curved; lateral margins only moderately elevated, separated from the anterior margin by rather strong, deep and subacute lateral incisures; puncturation strong and deep, but not coarse, the punctures separated by about half their own diameter and frequently partially coalescing. Clypeal suture nearly arcuate, fine and inconspicuous. Front less regularly and densely punctured, the punctures coalescent to separated by two to three diameters. Antennæ with the club pale testaceous and about the same length as the exposed portion of the stalk, which is darker colored, especially toward the base. Eyes rather small. Measurements of head: diameter through eyes, 18; distance between inner eye margins, 12; extreme width of anterior reflexed margin of clypeus, 8; antennal club, 7; dorso-ventral diameter of eye, 6.

Pronotum rather strongly convex, with the lateral margins viewed from the side only feebly arcuate, and viewed from above but little convergent until the anterior third. Just in front of the scutellum the pronotum rather more convex, prominent and posteriorly produced than usual. Posterior angles distinct and rectangular. Puncturation rather strong, distinct and moderately coarse, and quite regularly distributed, the punctures separated on the average by about their own diameter. Measurements of pronotum: width through posterior angles, 27; width through anterior angles, 18; length on median line, 17.

Elytra rather strongly and deeply furrowed, the sulci with three confused rows of strong, closely crowded or coalescent punctures, the impunctate interspaces very narrow and somewhat irregular from the encroachment of the adjacent, coarse punctures; length, 40; width, 33.

Metasternum and posterior coxal plates strongly but irregularly punctured. Abdominal sternites finely punctured, the punctures separated by one to four times their own diameter; the transverse rows of ambulatorial setæ inconspicuous because of the dark brown color against the blackish integument; sternites unmodified.

Genital armature of male (Plate X) only moderately asymmetrical, length 1.8 mm.

♀. Differs from the male in having the clypeal margin less elevated, the apical margin scarcely higher than the lateral margins, and the clypeal notch feeble and acute; antennal club but slightly smaller than that of the male (6.2 instead of 7).

Specimens examined:

Texas: ''Texas'' 2 ♂ (Le Conte types); Dallas, 1 ♀.

Oklahoma: Harrah, 1 ♂, 2 ♀; Oklahoma City, 1 ♀; Payne Co. (near Ripley) W. J. Brown, April and May, on Oak, 239 ♂, 230 ♀.

In the Oklahoma series from Payne Co. there are intergrades in color from piceous black to amber brown, some four or five per cent of the specimens being as light as typical *texana*. The intergradation of color and the frequent occurrence of light and dark individuals taken together in copula establishes the specific identity of the amber-brown and black color phases.

The radical color difference and the fact that the black phase seems not to occur in the eastern part of the range of the species justified the use of a subspecific name to designate the pallid form.

Serica atratula monita, new subspecies.

Name applied to the pallid eastern race of *atratula*.

Type ♂, Longview, Texas (about 40 miles east of Dallas) April 26, 1937 (R. W. Dawson). (California Academy of Sciences.)

Specimens examined:

Texas: "Texas," 4 ♂, 3 ♀; Longview, 46 ♂, 64 ♀; Dallas, 1 ♂; Harris Co., 1 ♀; San Antonio, 1 ♀.

Oklahoma: "Ind. T.," 2 ♂; Payne Co. (Intergrades with typical *atratula.*)

Louisiana: "La.," 1 ♀; Vowell's Mill, 1 ♂, 4 ♀; Winnfield, 1 ♀.

Serica texana Le Conte.

1856. *Serica texana* Le Conte, Jour. Acad. Nat. Sci. Phil., (2) III, p. 274.

There are five specimens in the Le Conte series of "*texana*"; numbers 1 and 2 are females, 3, 4, and 5 are males. Presumably the first four served as cotypes, and #5 was added later. Since Le Conte did not designate holotypes, it was necessary in handling his collection to number serially all specimens of each species in the order in which he left them, and to declare number one *the* type in order to settle questions of identity in composite series. It is not clear that the *texana* series is homogeneous, and since only the males can be positively identified, the first male (#3) is here declared to be the holotype. It is the specimen used in drafting the figures on Plate XI, and in taking the measurements which follow.

Texana is almost a perfect counterpart of *æmula*. A comparison of the measurements shows that *texana* has relatively somewhat smaller eyes and shorter antennal clubs.

Measurements of head: diameter through eyes, 20.5; distance between inner eye margins, 12; extreme width of anterior reflexed margin of clypeus, 8; dorso-ventral diameter of eye, 9.

Definite determination is to be made only on the examination of the male genital armature. The stalk of the armature is less inflated, less curved and less attenuated at the apex than in *æmula*. The right side of the stalk is definitely longer than the left, and the right clasper broad at the base and deeply emarginate near the middle. The dorsal membrane extends further down the back of the stalk.

Le Conte records: "Found at Ft. Gates, Texas, by H. Haldeman."

A single specimen in the writer's collection exactly matches the Le Conte type (#3). It bears the data: Lee Co., Texas, March, 1912 (Rev. G. Birkmann). Otherwise the species is unknown to the writer.

Serica contorta, new species.

♂. Length 7 mm.; width 4 mm. Color light brown (amber brown to argus brown), polished and shining. Striæ and margins of elytra with short, inconspicuous hair in sparse single rows.

Clypeus exactly continuous with the slight convexity of the front; suture fine and arcuate (rather than angled), sides moderately reflexed, front margin strongly, vertically reflexed; when viewed from above (dorsally) strongly bowed to subangulate at the middle; a few erect hairs at the base of the reflexed margin. Clypeal notch broad and deep, completely dividing the apical from the lateral reflexed margins. Surface strongly punctured, with the punctures separated by about their own diameter. Front sparsely and less strongly punctured than the clypeus.

Measurements of head: diameter through eyes, 21.4; distance between inner eye margins, 10.1; extreme width of anterior reflexed margin, 8; antennal club, 9.3; dorso-ventral diameter of eye, 9.3 (which is relatively large).

Pronotum moderately punctured. Punctures of the disc separated by one to three diameters, of the margins by about one diameter. Measurements of pronotum: width through posterior angles, 31.4; through anterior angles, 23; median length, 18. Elytra strongly striated, the grooves with about three confused rows of closely placed punctures, the intervals almost impunctate.

Genital armature of male (Plate XII) strikingly asymmetrical, the right clasper strangely scrolled ("contorted") with the basal, comma-shaped portion minutely, densely punctured or shagreened. No attempt was made to indicate this surface modification in the figure of the armature. Length of armature, 2 mm.

♀. Differs from the male by the shorter antennal club (6.4 instead of 9.3), the wider anterior, reflexed margin of the clypeus (9.3 instead of 8) which is less deeply and widely separated from the lateral margins, and which is also less strongly elevated and less sub-angulate medially. A character of some value (if examined with a binocular microscope) is to be seen in the anterior declivity of the submentum. This sloping area is somewhat more shining, bare and sharply defined than in the other similar species, and somewhat more evident than in the male.

Type: ♂. Wills Point, Texas, April 29, 1937 (feeding on oak at night) R. W. Dawson. (California Academy of Sciences.)

Paratypes: Same data as the type, 101 ♂; 47 ♀; Longview, Texas, April 26, 1937, 6 ♂, 14 ♀; "Tex.," 3 ♂.

Arkansas: Miller Co., May 8, 1939, 1 ♂.

Oklahoma: Cloudy, May 4, 1940, 1 ♂.

Serica æmula, new species.

♂. Length 8 mm.; width 4 mm. Color as in *contorta*, which species it so closely resembles that the description may best be given by comparisons.

Clypeus with a vague, transverse depression below the suture, which appear slightly calloused, and is more evident than in *contorta*. Another and more distinct depression extends between the broad, deep clypeal notches, thus a vague transverse ridge is defined just below the middle of the clypeus. Puncturation coarser and denser than in *contorta*; and anterior reflexed margin evenly arcuate (when viewed dorsally and from the rear) instead of subangulate medially as in *contorta*. Declivity of the submentum not quite so clearly defined.

Measurements of head: diameter through eyes, 22.1; distance between inner eye margins, 10; extreme width of anterior reflexed margin, 9; antennal club, 9.3; dorso-ventral diameter of eye, 9.5; thus the measurements support the impression of slightly larger eyes.

Pronotum with slightly deeper and coarser puncturation, measurements the same as in *contorta*. Elytra likewise with stronger puncturation, more evidently covering the two sutural intervals especially posteriorly.

The differences noted are such as one appreciates best after carefully comparing series of specimens, and which one would doubtless discount as ordinary variation were it not for the radical differences in the genital armatures of the two species.

Genital armature of male (Plate XIII) characterized by the inflated stalk with its attenuated, asymmetrical apex, and by the delicate, arcuate claspers. Length of armature, 2 mm.

♀. Differs from the male by having the clypeal margins less elevated and the clypeal notch sharp and narrow, scarcely or not dividing the reflexed margin; width of anterior reflexed margin greater than in the male, 9.5 instead of 9; antennal club, 7; dorso-ventral diameter of eye, 7.2.

Type: ♂. Conroe, Texas, March 26, 1933 (H. A. Budde). (U. S. Nat. Mus. Col.)

Paratypes: 17 ♂, 4 ♀ with the same data as the type; 1 ♂ College Station, Texas; 1 ♂ "Fla."

Serica anthracina Le Conte.

1856. *Serica anthracina* Le Conte, Jour. Acad. Nat. Sci. Phil., (2) III, p. 276.

1856. *Serica frontalis* Le Conte, l.c., p. 276.
1856. *Serica robusta* Le Conte, l.c., p. 276 (not *robusta* Blanchard, 1850).
1869. *Serica valida* Harold, L'Abeille, VI, p. 123 (new name for *robusta* Le Conte).
1866. *Serica crassata* Walker, Naturalist in Brit. Col., II, p. 323.

Anthracina is one of the most widely distributed of our western species of *Serica*. It is common from southern California to British Columbia, occurring in diminishing numbers to central New Mexico, central Colorado, extreme western Nebraska, the Black Hills region of South Dakota, and central Montana. Over this wide range some geographical (perhaps better "ecological") variation occurs, but it is not apparent to the writer after examining approximately 1,000 specimens that races or forms can be defined with clarity or profit.

The color varies from uniform testaceous to black. In general the lighter phases are eastern in distribution, and the darker, western. In California occasional specimens occur showing a striking color variation. The whole body is black except the elytra which are contrastingly bright reddish testaceous. Various intergrades in color between this form and the brownish black to pure black forms also are frequent. All may be collected together at the same time in the same local population, as was done by F. T. Scott, May 25, 1937, at Kaweah P. O., California. One of the red-winged specimens from the series just mentioned was used for drafting the accompanying figures of the male genital armature (Plate XIV).

Size as well as color also shows marked variation. Specimens from the dryer plains regions are smaller (Ardmore, S. D., length 5 mm.) and from the more humid mountain regions are larger (Forest Grove, Oregon, 8.5 mm.).

There is some variation in the form of the genital armature, especially in the outline of the apex of the claspers, but no other species closely resembles *anthracina* and the figures given should serve for definite determination.

Serica fimbriata Le Conte.

1856. *Serica fimbriata* Le Conte, Jour. Acad. Nat. Sci. Phil., (2) III, p. 275.

♂. Length 10.5 mm.; width 6.5 mm. Color bright chestnut brown to fulvous with a strong velvety opacity. Under surface and legs, especially the front and middle ones, with an ample covering of long, erect, fulvous hair. Pronotal and elytral margins fimbriate with long, stiff, fulvous hair.

Clypeus shining, finely, densely and evenly punctured; punctures separated by about one-half their diameter. Clypeal margins strongly reflexed, especially the anterior margin which is subtended by a shallow, shining and almost impunctate groove. When viewed vertically the anterior margin shows a crenate outline of rounded corners and strongly bent middle, when viewed at a strong angle from above the corners and middle are slightly prominent, giving an evenly rippled outline. Clypeal notch obsolete, but a faint calloused line marks the position for the notch. Front and pronotum opaque and velvety in luster with rather numerous, very minute, shallow, shining or silvery punctures. (In old or greasy specimens the punctures appear larger and dark colored, and the velvety luster is obscured.)

Measurements of head: diameter through eyes, 25.7; distance between inner eye margins, 17.2; dorso-ventral diameter of eye, 7.9; antennal club, 8.2.

Measurements of pronotum; width through posterior angles, 4.7 mm.; width through anterior angles, 2.7 mm.

Elytra with fine, line-like striæ, which are only feebly impressed. Striæ with a somewhat confused, single row of very minute, shallow, shining punctures, more numerous and spreading upon the intervals basally. Discal striæ with a few inconspicuous, short, fulvous hairs, last, lateral stria with an evident, "fimbriate" row of hair.

The most distinctive feature of the genital armature of the male (Plate XV) is the broad, falcate base of the right clasper.

Fimbriata is the largest and most robust of the American species. Its opaque, reddish brown color and ample coat of fulvous hair on the ventral side mark it easily from all but the following species.

♀. Distinguished from the male by more robust form, slightly smaller antennal club and less emarginate last sternite.

Habitat: Southern California, San Diego Co. and vicinity.

Serica satrapa, new species.

Closely resembles *fimbriata* with which it has been confused. It may well be defined by comparison with that species.

♂. Length 10 mm.; width 6 mm. Thus it is seen to be slightly smaller and definitely narrower. The color averages a little lighter, more fulvous than chestnut, and the opacity is not quite so dense. It is similarly fimbriate and hairy beneath, but the hair is slightly finer and slightly lighter in color. The striæ and punctures are even less evident, and the row of hairs on the last lateral stria much less developed.

Since these characters are in degree only, they are insufficient for certain identification without an examination of the male genital armature (Plate XVI). Here the most outstanding character is in the right clasper, in its narrow, inwardly flexed base, and sharp basal thorn. The left clasper is broader apically and the stalk more flaring and asymmetrical apically.

Type: ♂. El Monte, California (near Riverside) May 28, 1937 (R. W. Dawson). (California Academy of Sciences.)

Paratypes: 200 ♂, 226 ♀ with the same data. Fully two quarts of additional specimens were discarded. All were taken in the top three inches of cultivated soil under small plum trees which were being defoliated by the nocturnal feeding of the beetles. Additional specimens are from: Alhambra, Claremont, Haynes, Laguna Beach, Los Angeles Co., Morongo, Mt. Wilson, Ontario, Pasadena, and Cajon Pass.

Serica porcula Casey.

1884. *Serica porcula* Casey, Contr. to Desc. and Syst. Coleopterology of N. A. II, p. 177.

1902. *Serica porcula* Casey, Berl. Ent. Zeitschrift, 47, p. 38. (Copied by Brenske.)

Except for the radical differences in the genital structures one would not be inclined to differentiate *porcula* and *concinna* as distinct species. Mixed series of the two, however, may be separated with reasonable accuracy on the basis of the following characters: In *porcula* the clypeal margins are distinctly narrower and less elevated; the puncturation of the clypeus and front somewhat denser, and the clypeal suture a little more nearly arcuate.

The pronotum of *porcula* is relatively a little broader, less convex, the sides a little straighter and the anterior angles definitely more bluntly rounded. The margins of the pronotum and elytra are less conspicuously fimbriate—the hairs shorter and less numerous.

On the basis of the male genital armature (Plate XVII) one easily recognizes *porcula*.

Specimens examined:

Arizona, 158: Benson, Chiricahua Mts., Globe, Grand Canyon, Huachuca Mts., Nogales, Palmerlee, Pinal Mts., Prescott, Santa Rita Mts., Verde Valley, White Mts., Williams.

New Mexico, 5: Dripping Spring, Organ Mts.

Texas, 1: Alpine.

Colorado, 1: Colorado Springs.

The specimen used in drafting the plate of the male genital armature (Plate XVII) bears the label "Benson, Ar. Ricks."

Serica concinna, new species.

♂. Length 8 mm.; width 4 mm. Color auburn brown (varying in series, from light to dark) polished and shining, but with an extremely minute alutaceous surface texture which slightly deadens the luster. Margins of pronotum and elytra fimbriate with light, coarse hairs.

Clypeus relatively broad, densely punctured, the punctures confluent to separated by half their diameter. Clypeal margins moderately reflexed with the clypeal notch almost obsolete, its position recognizable on some specimens and not on others. Anterior reflexed margin finely and densely punctured, moderately bowed or bent at the middle, and when viewed at an angle from above nearly straight with rounded corners. Clypeal suture fine and inconspicuous.

Lower part of front densely punctured like the clypeus, but occipital region broadly impunctate. Measurements of head: diameter through eyes, 18.6; distance between inner eye margins, 13.2; anterior reflexed margin between the sub-obsolete clypeal notches, 15.6; antennal club, 5.7; dorsoventral diameter of eye, 6.7.

Pronotum convex with arcuate sides, strongly punctured, the punctures separated by one to three diameters, except for a small posterio-lateral area where they are crowded to scarcely half a diameter apart. Measurements of pronotum: width through posterior angles, 30.4; width through anterior angles, 19.7; median length, 19.

Elytra with narrow, closely and strongly punctured striæ, and nearly uniform, feebly convex intervals, with many scattered, coarse punctures. Elytra with short, very sparse, deciduous, pale hairs.

Metasternum and posterior coxal plates with strong, coarse punctures. Posterior third of hind femora with a dense band of coarse, variable punctures extending from base to apex.

Genital armature of male (Plate XVIII) symmetrical, with a relatively coarse stalk and small claspers.

♀. Differs from the male only by the usual sexual characters,—a very slightly smaller antennal club, more convex underline of the abdomen and less emarginate last sternite.

Type ♂. South Rim of Grand Canyon, Arizona, May 23, 1937 (R. W. Dawson). (California Academy of Sciences.)

Paratypes, 27 ♂, 34 ♀, Grand Canyon, May 23 and 24, 1937, feeding on Cliff Rose (*Cowania stansburiana*) about an hour before sunset, and 1 ♂, 1 ♀, Astec, N. M., July 15, 1899 (G. W. Bock).

Serica laguna Saylor.

1935. *Serica laguna* Saylor, Pomona Jour. Ent. and Zool., 27, p. 1.

In the form of the male genital armature *Serica laguna* shows relationship to *porcula*, as well as to *searli* and *alleni* as noted by Saylor. Externally *laguna* also resembles *concinna* here described.

A figure of the armature of *laguna* (Plate XIX) is presented for comparison with *porcula*.

Additional records of specimens: Laguna Mts., San Diego Co., June 3, 1937 (R. W. Dawson) 13 ♂, 11 ♀ on *Ceanothus palmerii*. San Jacinto Mts., June 30, 1933 (R. H. Beamer) 1 ♂, 1 ♀; Warner's San Diego Co., July, 1919 (Geo. H. Field) 1 ♂; Idyllwild, Riverside Co., July 4, 1929, 2 ♂ (recorded by Saylor).

Serica subnisa, new species.

♂. Length 8 mm.; width 5 mm. Color brown (chestnut to bay) with a distinct rainbow iridescence on the elytra. Striæ of elytra with a few minute, pale hairs, and margins of elytra and pronotum moderately fimbriate.

Clypeus broad, strongly punctured; the punctures confluent in irregular lines, to separated by their own diameter. Margins broadly but moderately elevated; the lateral margins nearly as strong as the apical margin. Clypeal notch indicated only by a suture or an obscure line; corners very broadly rounded and middle of apical margin arcuately bent. Viewed at a strong angle from above nearly straight across, with the corners and middle slightly more prominent. Clypeal suture obscure, arcuate and vaguely but broadly impressed. Front with smaller, scattered punctures.

Measurements of head; diameter through eyes, 20; distance between inner eye margins, 14.3; dorso-ventral diameter of eye, 6.8; antennal club, 5.3.

Pronotum moderately, rather uniformly punctured; punctures separated by one to three diameters. Surface shining, slightly pruinose and iridescent. Width through posterior angles, 34.3; width through anterior angles, 20.7; median length, 18.6.

Elytral striæ line-like with a single, somewhat confused row of closely placed punctures. Intervals with scattered punctures.

Metasternum and posterior coxal plates, especially the latter, with strong punctures, separated by one to four diameters.

Genital armature of male (Plate XX) resembling somewhat that of *repanda*, and less closely that of *falcata*. Some variation occurs in the shape of the claspers as is indicated by the additional outline figures.

Type: ♂. Kaweah P.O., California, June 10, 1937 (R. W. Dawson). (California Academy of Sciences.)

Paratypes: 3 ♂, 5 ♀, collected at the same time and place on redbud trees at night.

Serica catalina, new species.

♂. Length 8 mm.; width 4.5 mm. Color brown (light to dark auburn) bare and shining with a trace of metallic or brassy iridescence.

Clypeus finely and densely punctured; the punctures separated by about half their diameter. Lateral margins feebly elevated, and anterior margin only moderately so. Clypeal notch obsolete. Clypeal suture arcuate, very fine and obscured by the puncturation. Front more coarsely and irregularly punctured, becoming impunctate toward the occipital region.

Measurements of head: diameter through eyes, 19.6; distance between inner eye margins, 12.1; dorso-ventral diameter of eye, 7.1; antennal club, 7.1.

Pronotum closely and rather evenly punctured, a little more densely so near the posterior angles, punctures separated by one to two diameters. Measurements of pronotum: width through the posterior angles, 32.1; width through the anterior angles, 20; median length, 18.6.

Elytra with striæ rather sharply lined, with three dense, confused rows of punctures crowding upon the intervals. Beneath nearly bare; metasternum and posterior coxal plates, especially the latter, coarsely and closely punctured.

Genital armature of the male (Plate XXI) symmetrical. The nearly parallel sided claspers constitute a distinctive character.

Type: ♂. Avalon, Santa Catalina Island, California, May 24, 1932 (Don. Meadows). (Snow Collection, University of Kansas.)

Paratypes: 11 ♂, 10 ♀, all from Santa Catalina Island: 1 ♂, May (A. Fenyes) and the remainder from Avalon, May 2–28, 1932 (Don. Meadows).

Additional data on three little known species of *Serica*:

Serica tantula Dawson.

1922. *Serica tantula* Dawson, Jour. N. Y. Ent. Soc., XXX, p. 162.

Tantula was described from a single male taken at Lake Worth, Florida. Since the original description three additional Florida specimens have come to hand:

Melbourne, March 10, 1938 (R. Kempfer) 1 ♂.

Boca Raton, March 21, 1944 (E. R. Tinkham) 1 ♂, 1 ♀.

Serica mixta Le Conte.

1856. *Serica mixta* Le Conte, Jour. Acad. Nat. Sci. Phil., (2) III, p. 276.

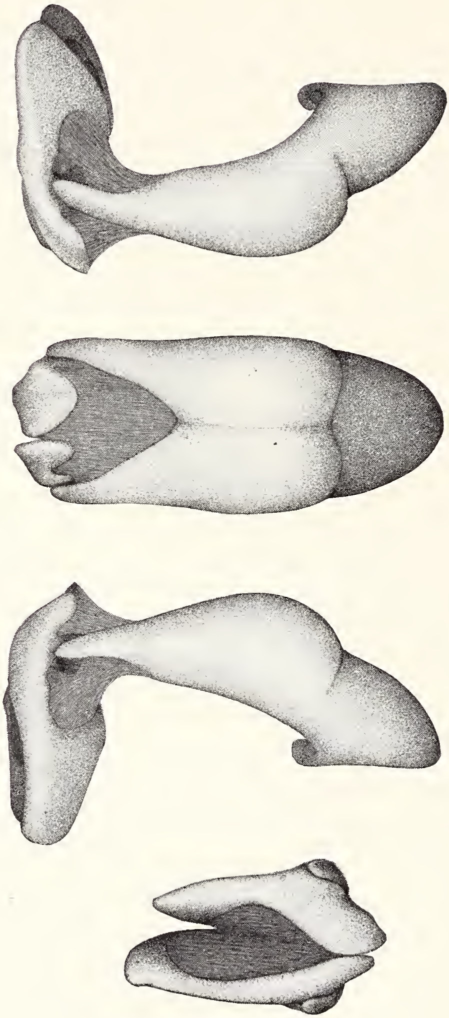
1922. *Serica mixta* Dawson, Jour. N. Y. Ent. Soc., XXX, p. 166.

In addition to the three male specimens in the Le Conte collection from San Diego, California, the only specimens that have ever come to the writer's attention are the following: 1 ♂ in the Berlin Museum without definite locality label; 4 ♂ in the Blaisdell collection from Coronado, California; 1 ♂, 1 ♀ in the Van Dyke collection, also from Coronado. The Coronado specimens were taken May 6 and 23, 1890.

Serica abdita Dawson.

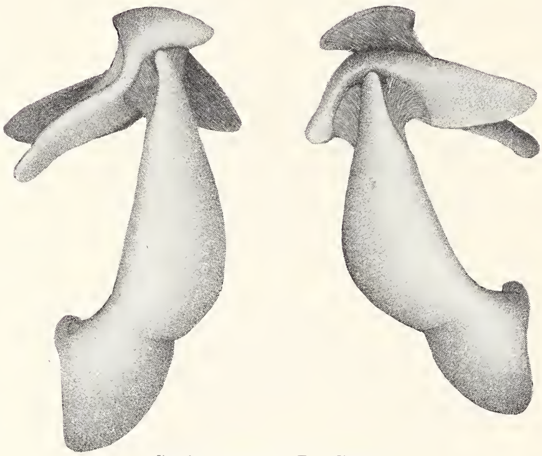
1921. *Serica abdita* Dawson, Jour. N. Y. Ent. Soc., XXIX, p. 166.

In addition to the type in the Le Conte collection, the writer has seen only the following specimens, all from California: Bakersfield, 1 ♂, 1 ♀; Kern Co., 3 ♂; Tejon Canyon, Kern Co., 1 ♂; Tulare Co., 1 ♂.

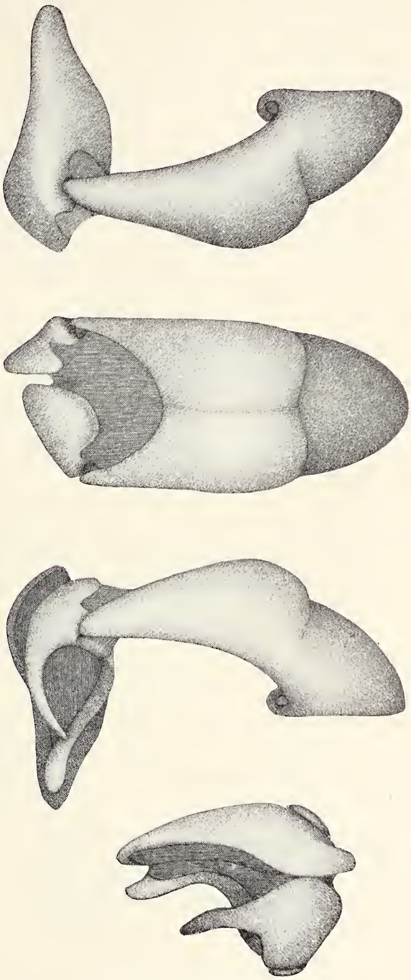


Serica arkansana n. sp.

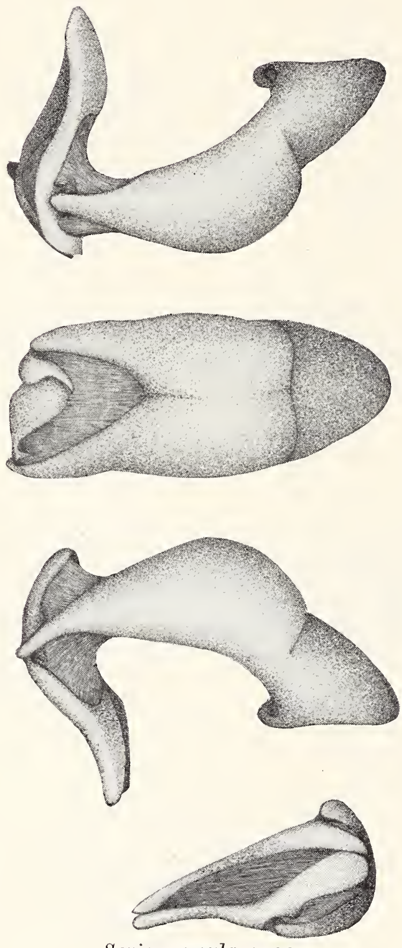
Serica atratula Le Conte



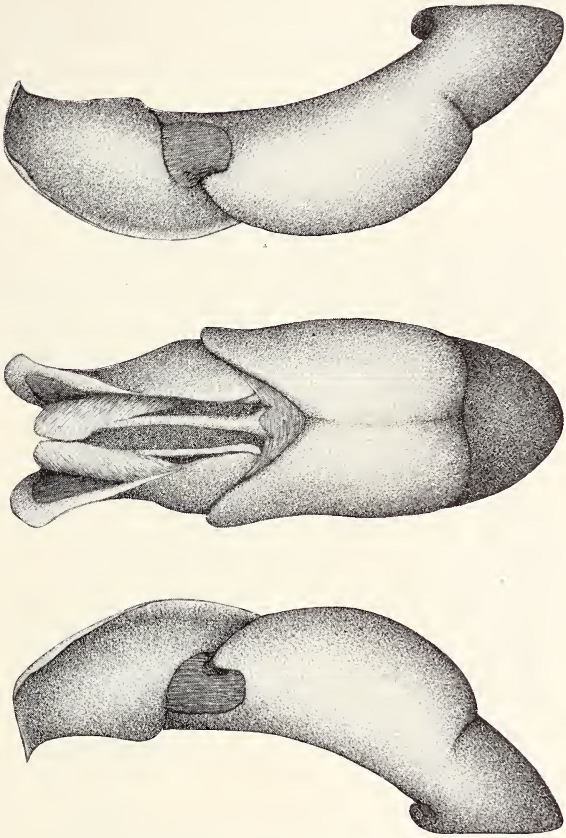
Serica texana Le Conte



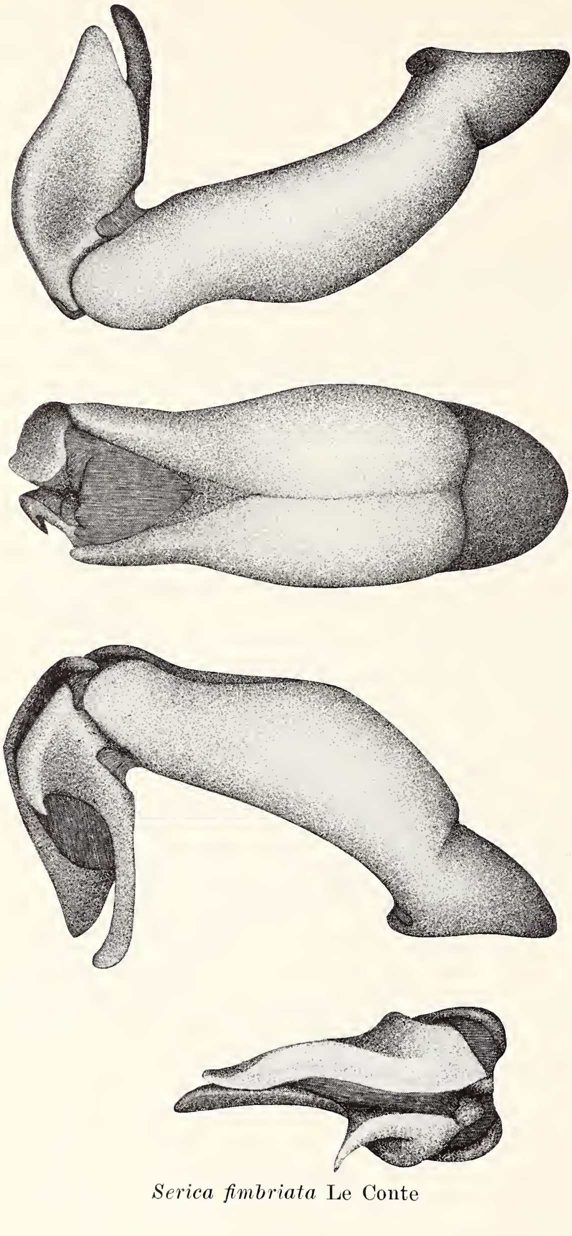
Serica contorta n. sp.



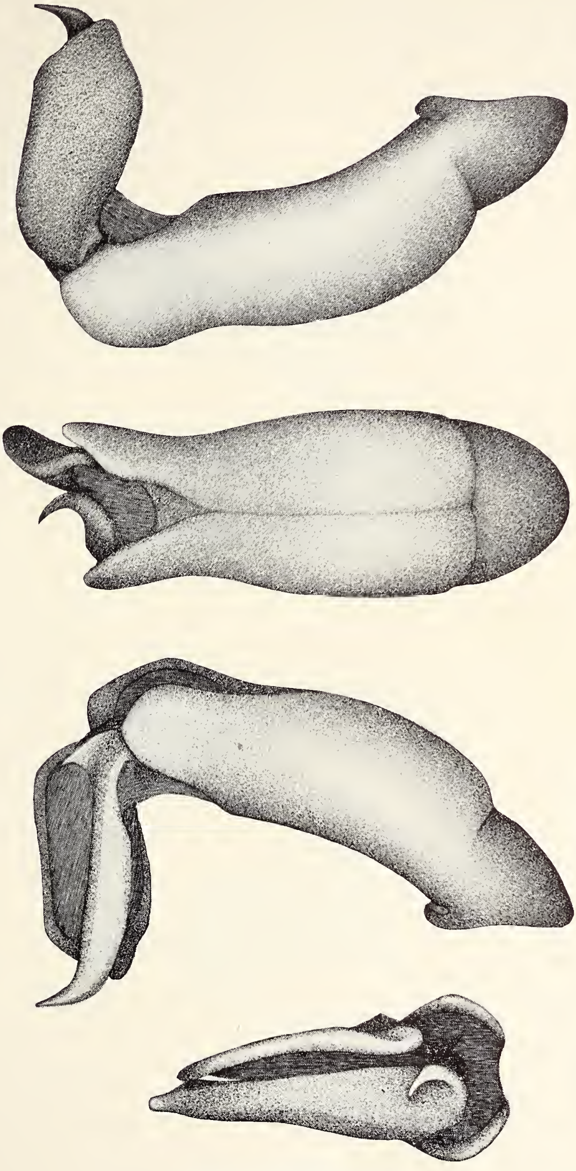
Serica æmula n. sp.



Serica anthracina Le Conte



Serica fimbriata Le Conte



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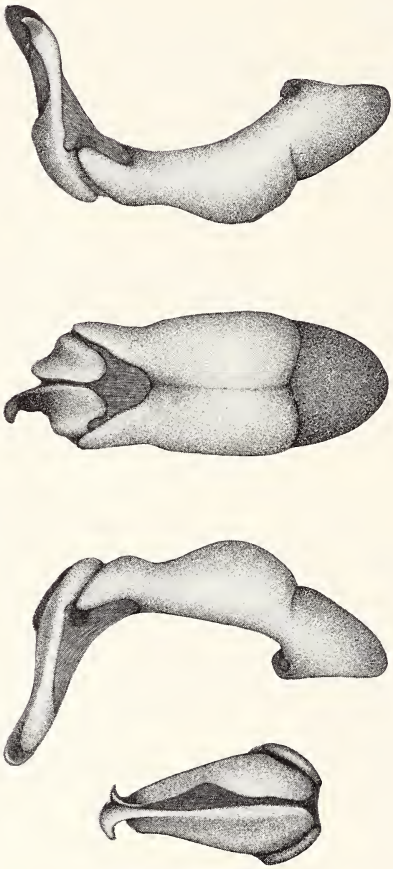
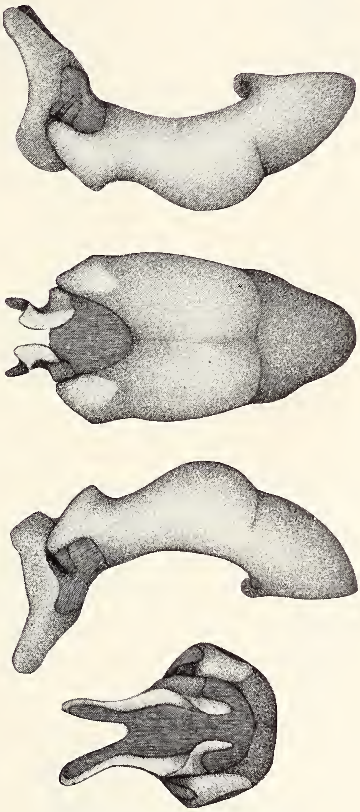


Serica porcula Casey



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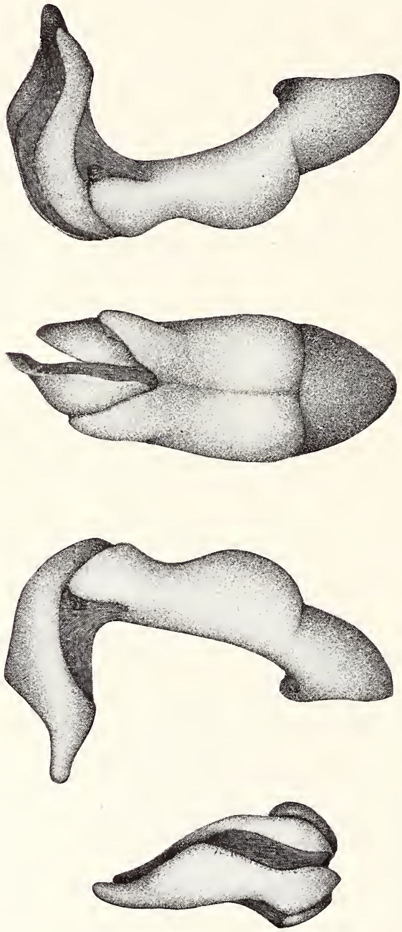
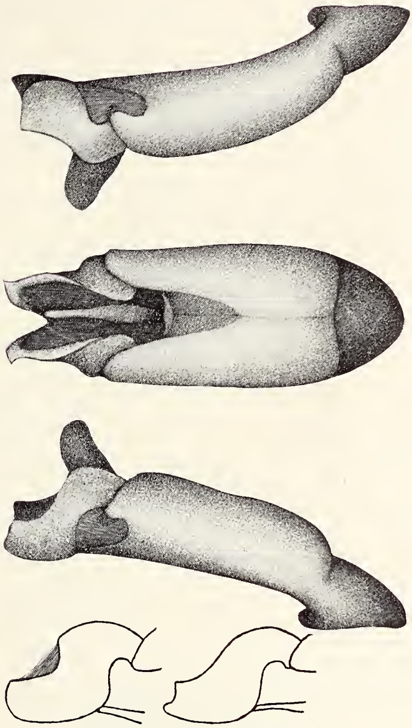
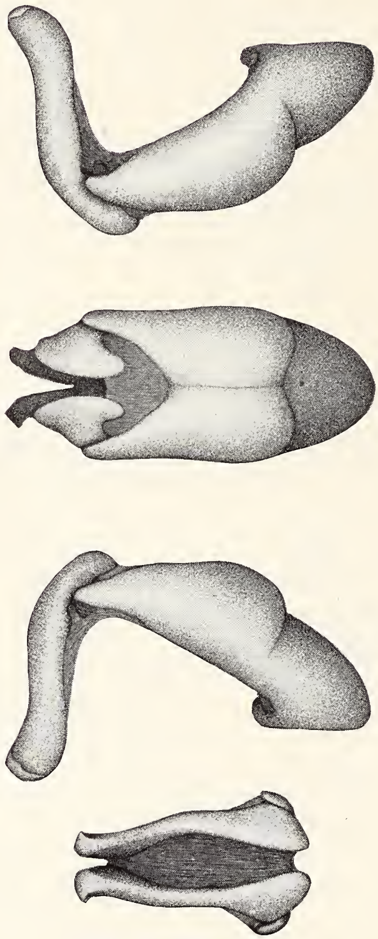


Serica laguna Saylor



Serica subnisa n. sp.



Serica catalina n. sp.

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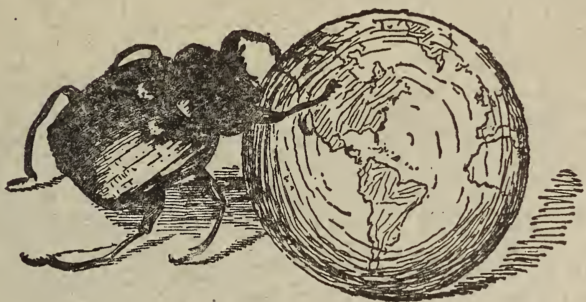

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SYNOPSIS OF THE HEMERODROMIINÆ (DIPTERA, EMPIDIDÆ)

By Axel Leonard Melander

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The Hemerodromiinæ comprise a compact subfamily of the Empididæ, characterized by having unduly long tubular front coxæ and strongly raptorial front legs with strong femora armed beneath with biseriate setæ and denticles. The front legs are far separated from the slender posterior pairs by an unusually long mesosternum. Their favorite habitat is on damp foliage along banks of streams. Several species are nocturnal and are attracted to lights and thus find their way into dwellings, in the daytime then to appear on windows.

The males are easy to name by means of their characteristic genitalia, as indicated on the plates of figures. Surmounting the ventral part, or hypandrium, in the Hemerodromiini are three paired lamellæ or "valves," which are termed basal, dorsal or upper, and lateral or middle. The penis is sometimes visible as a short thick projection from the rear of the hypandrium flanked by the lateral valves. The shape of the several parts and their proportions are distinctive. Thus the figures afford a quicker index to the species than the descriptions of the other body parts.

In the following pages are presented a key to the North and South American genera and a further tabulation of the species occurring in North and Central America, together with descriptions of the new forms and notes on the others. The illustrations are from free-hand pencil sketches made by myself, most of which were inked in by my former Investigational Assistant, Selina Tetzlaff Johnson, the remainder by Mabel Hutchinson. Unless otherwise stated the specimens were collected by myself and the types are in my collection.

KEY TO THE AMERICAN GENERA OF HEMERODROMIINÆ

1. Style shorter than third antennal joint; thorax without discal macrochætæ, metapleura bare; pygidium erect or terminal, the valves extending backward (Figs. 1–42); ovipositor long or short, the slender cerci terminal and contiguous; third vein normally forked, anal cell when present broader toward apex, the anal crossvein usually straight .... *Hemerodromiini*, 2
   Arista more than twice as long as third antennal joint; thorax with some discal macrochætæ, metapleura with some fine setulæ; pygidium more or less reflexed over abdomen, the valves extending forward (Figs. 43–52); ovipositor very short, the quadrate cerci lateral; third vein simple, anal cell with parallel sides and more or less rounding crossvein, subequal to the small second basal cell. *Chelipodini*, 9
2. Humeral crossvein wanting, auxiliary vein fused with costa close to base of wing, first vein short, ending before middle of wing; eyes nearly or quite contiguous on face 3
   Humeral crossvein present, auxiliary vein separate from costa, first vein ending at or beyond middle of wing, anal cell complete or at least anal vein weak; eyes separated on face 4
3. The combined discal-basal cell small, emitting two veins, second posterior cell long-petiolate, no anal cell; lower facets large; ovipositor usually short and conical. (*Microdromia* Bigot) *Hemerodromia* Meigen, 10
   The combined discal-basal cell large, surpassing middle of wing, emitting three veins, second posterior cell sessile, anal crossvein present; facets small; thorax mostly red; front coxæ of male swollen; ovipositor ensiform .... *Colabris* Melander, 29
4. Discal cell complete; front legs strongly raptorial (if front femora are slender cf. some South American species of *Neoplasta*) 5
   Discal cell incomplete, fused with either second basal or third posterior cell; thorax not narrowed in front 7
5. Style very short; anal cell much shorter than second basal cell 6
   Style about one-third as long as the lanceolate third antennal joint; anal cell equal to second basal, the anal crossvein rounding into the anal vein. (South America) .... *Chelipodozus* Collin
6. Second posterior cell petiolate; thorax more or less narrowed in front. (*Mantipeza* Rondani) .... *Chelifera* Macquart, 30

Second posterior cell sessile or short-petiolate; thorax broad in front; ovipositor rather long and thick. (South America) *Cladodromia* Bezzi

7. Second posterior cell petiolate; front femora more or less spinose; first vein ending beyond middle of wing, second vein not shortened 8

Second posterior cell sessile; front femora weak and not strongly spinose, front tibiæ pubescent; ovipositor ensiform; face narrow; thorax shining black or brown; style microscopic; humeral crossvein vestigial, first vein ending at middle of wing, second vein usually short .... *Neoplasta* Coquillett, 44

8. Discal cell fused with third posterior cell, *i.e.*, anterior crossvein beyond end of second basal cell; style microscopic; abdomen of female blunt .... *Thanategia* Melander, 41

Discal cell fused with second basal cell, *i.e.*, anterior crossvein much before end of cell; style one-third as long as third antennal joint; ovipositor ensiform .... *Metachela* Coquillett, 43

9. Discal cell complete, emitting three veins apically, anal crossvein rounding the anal cell. (*Chiromantis* Rondani, *Litanomyia* Melander). *Chelipoda* Macquart, 51

Discal cell open, the posterior crossvein absent and the fourth vein acutely forked, anal cell truncate, slightly shorter than second basal. (*Lepidomyia* Bigot, *Thamnodromia* Mik) *Phyllodromia* Zetterstedt, 58

KEY TO THE NORTH AMERICAN SPECIES OF *Hemerodromia*

10. Branch of third vein ending in costa; wings more or less hyaline; front femora not both black and with strong basal tubercle 11

Branch of third vein retrorse, ending in second vein; wings heavily infumated; front femora very robust, black, and equipped with a large, bisetose, black tubercle near base, front tibiæ drawn out into a strong apical spur. (Costa Rica) .... *reflexa* n. sp.

11. Mesonotum subshining or polished; no femoral tubercle 12

Head and thorax opaque or silky pollinose, ranging from black to yellowish 18

12. Thorax testaceous, head opaque; face linear, with a row of at least six fine hairs; upper valves of pygidium forming narrow encircling arms 13

Thorax black or piceous; head subshining; eyes more or less contiguous on face 14

13. Upper pygidial valves of uniform width (Fig. 10); front 1.5 times as long as broad. (Fla.) .... *haruspex* n. sp.

Upper valves much wider on basal half (Fig. 4); front twice as long as wide. (Costa Rica) .... *divinator* n. sp.

14. Front femora black, contrasting with remainder of legs; basal part of pygidium large and globose, lateral valve curved and strap-shaped (Fig. 1). (Costa Rica) .... *brachialis Melander*

Legs pale yellow 15

15. Second vein ending nearly opposite end of fifth vein and much before fork of third vein 16
Second vein ending much beyond fifth vein and nearly opposite fork of third vein; eyes broadly contiguous on face; crossvein beyond middle of discal-basal cell. (St. Vincent, W. I.) ...... *defessa* Williston
16. Anterior crossvein before middle of discal-basal cell; scutellum opaque velvety black; eyes briefly contiguous on face; pleura typically pale; venter pubescent; pygidium erect, hairy, basal keel small, lower valve large, rather triangular and flat (Fig. 11); front femora rather slender. (Mass. to Wisc.) .... *jugulator* Melander
Anterior crossvein at or beyond middle of discal-basal cell; eyes broadly contiguous or subcontiguous on face; thorax wholly black; venter nearly bare; front femora rather robust 17
17. Pygidium globular, basal ventral part large and bulbous, lower valve small, rounded and very convex (Fig. 9); thorax subshining when viewed from front, scutellum concolorous. (Costa Rica) *extispex* n. sp.
Pygidium small, basal part small and more or less keel-like, lower valve strap-shaped (Fig. 12); notum polished, the humeri opaque, scutellum velvety. (Conn., N. Y., Ont.) .... *melanosoma* n. sp.
18. Front femora without distinct basal tubercle beneath, though with basal spine 19
Front femora with prominent spine-tipped tubercle at base beneath (not pronounced in female of *rogatoris*) 27
19. Furcation of fourth vein occurring before ends of second and fifth veins, the pedicel equal to the fork or nearly so 20
Furcation of fourth vein in a line between ends of second and fifth veins, the pedicel longer than the fork; thorax including pleura reddish brown. (Ga.) .... *brunnea* Melander
20. Dorsal valve of pygidium large and deeply cleft (Fig. 2); thorax including pleura black. (Me.–Va.–Ind.; Ont.) .... *captus* Coquillett
Dorsal valve of pygidium small and not two-pronged; thorax reddish, yellow, or medially vittate with a dark cinereous stripe which sometimes is broad, pleura yellowish or reddish 21
21. Pygidium shining black, lateral valve ending in a corkscrew-like prong (Fig. 16). (Conn.) .... *vates* n. sp.
Pygidium shining black, lateral valve large and capitate or hastate in outline, upper valve convex (Figs. 5–8). (*empiformis* group) 22
Pygidium dull testaceous or blackish, the lateral valve not capitate, its under edge not emarginate but somewhat convex, upper valve seen from above horizontally broad on basal half and then abruptly thin and rather acute (Figs. 17, 18). (Conn. to D. C.). .... *vittata* Loew
22. Dorsal valve nearly as long as the slender middle valve, which is three times as long as its preapical width, basal valve very small (Fig. 14); veins usually brown. (Tex.) .... *stellaris* n. sp.

Dorsal valve much shorter than the broad lateral valve, which is about twice as long as its greatest width; veins usually pale 23

23. Exposed part of dorsal valve of pygidium larger than basal valve, long-hairy and ending in a claw-like projection, penis-sheath distinct (Fig. 3); front less than twice as long as wide. (Wyo., Wash., B. C.) .... *coleophora* Melander

Exposed part of dorsal valve usually smaller than basal valve, short-hairy and never ending in a claw (Figs. 5–8). (*empiformis* Say) 24

24. Upper edge of lateral valve acutely notched near middle (Fig. 5); front more than twice as wide as long. (Ont.–Va.; Minn.) *empiformis* sens. str.

Upper edge of lateral valve evenly concave but not notched 25

25. Front more than twice as long as wide; face distinct; pygidium robust, nearly half the length of the hind tibia, valves large and strong, the basal valve nearly as large as the widened end of lateral valve, dorsal valve round at end (Fig. 7). (Ga.) .... *exhibitor* n. var.

Front not over twice as long as wide; basal valve much smaller than the widened end of lateral valve, dorsal valve more or less triangular 26

26. Lateral valve coarsely hairy, posterior edge of dorsal valve abruptly deflexed, the pair ending in a common straight transverse alignment (Fig. 8); face narrow. (Ida., Wash.) .... *sufflexa* n. var.

Valves not coarsely hairy, dorsal valve with acute ending (Fig. 6); middle of face almost obliterated. (Cal.) .... *brevifrons* n. var.

27. The strong front femora notched distal to tubercle for reception of apical spine of tibia; thorax vittate or not; pygidium globular, dorsal valves ending in encircling arms (Fig. 15); eyes distinctly separated on face. (Conn.–Fla.–Tex.–Wisc.) .... *superstitiosa* Say

Front femora not conspicuously notched distal to tubercle; face very narrow 28

28. Front femora greatly thickened; thorax vittate, the vitta expanding over humeri. (Panama) .... *femorata* Melander

Front femora moderately thickened; thorax almost always testaceous, if vittate, the humeri are light colored; pygidium barrel-shaped (Fig. 13). (U. S., Can.) .... *rogatoris* Coquillett

KEY TO THE SPECIES OF *Colabris*

29. Legs pale yellow, only apical tarsal joint dusky. (Costa Rica, Panama) *rufescens* Melander

Front coxæ blackish and with black hairs. (Panama) .... *coxalis* Melander

KEY TO THE NORTH AMERICAN SPECIES OF *Chelifera*

30. Wings with black or brownish stigma, the second vein bending out of its course to surround the stigma 31

Wings with faint or no stigma, the marginal cell not widened at tip; anal crossvein oblique, pedicel shorter than second posterior cell or subequal to it 33

31. Thorax wholly cinereous or blackish; second posterior cell much longer than the pedicel 32
Body mostly yellowish, thorax with median blackish vitta; second posterior cell subequal to pedicel, anal crossvein at about 75 degrees. (Me.–Ill.) .... *notata* Loew
32. Stout, thorax cinereous marked with two narrow darker vittæ; stigma weak, not filling end of marginal cell, about three times as long as deep, discal cell oblong. (NE. Can., Alaska, N. Y.) ...... *valida* Loew
Slender, thorax wholly blackish; stigma strong, rounded, filling end of marginal cell, discal cell pointed on fourth vein. (Eur.; NE. Can.?) *precatoria* Fallen
33. Dorsal valve very large and broad, deeply excised above, heel of pygidium tumid, the lateral valves drawn in so that the pygidium appears constricted in profile 34
Dorsal valve never deeply cleft, if emarginate on upper edge the apical portion is distinctly longer than the proximal thumb-like projection 35
34. Emargination of dorsal valve wide, with a large clavate process growing from its bottom, the apical part of dorsal valve wide, spoon-shaped and notched posteriorly (Fig. 30); front widened above; body robust, brown or piceous. (Alaska) .... *scrotifera* n. sp.
Emargination of dorsal valve narrow, without any process, much smaller than basal portion (Fig. 21); sides of front parallel; body yellow. (Conn., N. Car.) .... *Banksi* n. sp.
35. Pygidium large, erect, ventral part with lobose sides which overlap the lateral valve; petiole shorter than second posterior cell; female with shining ensiform ovipositor 36
Pygidium with ventral part rather globose, not lobate at sides, overlapped by the lateral valves which never bear bunched hairs, dorsal valve with spoon-shaped or spatulate termination; abdomen of female blunt, with no ovipositor 37
36. Dorsal valve with zig-zag pointed termination, lateral valve bearing a bunch of yellow hairs at ventro-posterior angle (Fig. 22); body opaque brownish. (Wyom.) .... *cirrata* n. sp.
Dorsal valve with separated disk-like termination, lateral valve without bunched hairs (Fig. 23); body subshining testaceous. (Wash.) *ensifera* n. sp.
37. Dorsal valve bearing a strong thumb-like projection near middle of upper edge, the apical portion slender and spatulate, pygidium globose, longer than deep, lateral valve large and trapezoidal (Fig. 25). (Ida., Wash., Oreg.) .... *Lovetti* n. sp.
No strong thumb-like projection near middle of dorsal pygidial valve, the end portion of the valve more or less spoon-like, lateral valve rounded triangular, pygidium sub-erect 38
38. Front femora of male greatly swollen and bearing a tumescence above knee, pictured with two brown concentric marks on inner face and

irregular black marks toward knee, flexor denticles strong; front tibiæ swollen toward geniculation and marked with central flexor black spot. (Ida., Wyom.) .... *varix* n. sp.
Front legs of usual raptorial construction and not pictured 39

39. Thorax darker at margins, with scutellum, metanotum, tergites and pygidium blackish; valves projecting behind the main ventral portion of pygidium (Fig. 26). (Conn.–Md.–Ill.) .... *obsoleta* Loew
Pale yellowish except the occiput; ventral part of pygidium projecting behind lateral valves 40

40. Upper valves with crenulate inner margin closely denticulate toward base and scarcely broadened apically, ventral part of pygidium extending much beyond valves (Fig. 31); body dull colored. (N. Car.) .... *rastrifera* n. sp.
Upper valves broadly spoon-shaped, without black denticles, ventral part of pygidium not extending beyond dorsal valves, base of hypandrium with erect prong (Fig. 27); mesonotum shining. (Me.–N. Car.; Wash.) .... *palloris* Coquillett

KEY TO THE SPECIES OF *Thanategia*

41. Body pale yellowish, apex of pygidium and last two tarsal joints brown. (Mass.–D. C.) .... *defecta* Loew
Body including pygidium piceous, legs wholly yellow; Western species 42

42. Dorsal valve of pygidium horizontal and bearing a strong triangular projection near middle of upper side (Fig. 33). (Wash.) *stuprator* n. sp.
Dorsal valve of pygidium curving straight up at apex and without projection near middle (Fig. 34). (B. C., Wash.) .... *recurvata* n. sp.

KEY TO THE SPECIES OF *Metachela*

43. Pygidium obliquely erect, upper edge of lateral valve shallowly emarginate, eighth tergite small (Fig. 36). (Mont., Colo.–Wash., Oreg.) *collusor* Melander
Pygidium horizontal, upper edge of lateral valve deeply emarginate, eighth tergite large, shield-shaped, overlapping base of pygidium (Fig. 35). (Labr.–N. H.) .... *albipes* Walker

KEY TO THE NORTH AMERICAN SPECIES OF *Neoplasta*

44. A pair of semicircular filaments visible at base of pygidium above (Fig. 38); lower orbits thickly coated with white pile. (Mex.) *mexicana* Melander
No exposed filaments on pygidium; infraocular white pile not unusually heavy 45

45. Pygidium minute, less than diameter of abdomen (Fig. 39); second vein ending close to first vein; humeri black; middle femora without setigerous basal swelling. (Costa Rica) .... *puerilis* n. sp.

Pygidium strong; second vein ending nearly midway between first vein and branch of third vein; middle femora of male with more or less distinct setigerous swelling near base beneath 46

46. Dorsal valve of pygidium large and more or less hemispherical, ventral part of pygidium globular, not compressed or carinate, the dehiscence closed over at base (Figs. 40, 41) 47

Dorsal valve of pygidium inverted triangular, ventral part of pygidium usually compressed and carinate, its dehiscence open at base (Fig. 37); humeri black, abdomen of male piceous, of female dull yellowish. (Wash.–Cal.) .... *hebes* n. sp.

47. Scutellum with two erect apical hairs; thorax mostly castaneous. (Costa Rica) .... *spadix* n. sp.

Scutellum bare; thorax black. (*scapularis* Loew) 48

48. Second vein ending much closer to branch of third vein than to end of first vein; humeri black. (Vt.) .... *radialis* n. var.

Second vein ending about midway between first vein and branch of third, or closer to first vein 49

49. Humeri black, like rest of thorax. (Pa., Va., Tenn.) .... *alleghani* n. var.

Humeri and usually most of propleura yellowish 50

50. Dorsal valve larger than lateral valve, sometimes very large (Fig. 41); tumescence of middle femora of male pronounced, confined to basal fifth, its setæ usually close-set. (U.S.) .... *megorchis* n. var.

Dorsal valve of pygidium scarcely larger than lateral valve (Fig. 40); tumescence of middle femora of male extending along basal fourth or third, not pronounced, its setæ evenly spaced. (U.S., Can.) *scapularis* sens. str.

KEY TO THE NORTH AMERICAN SPECIES OF *Chelipoda*

51. Abdomen including pygidium yellowish, at most the tergites brownish; wings uniformly clear hyaline or flavescent 52

Abdomen including pygidium concolorous piceous black; wings with a blackish band between end of discal cell and the narrow clear apex. (Costa Rica) .... *rhabdoptera* Melander

52. Apex of pygidial valves rather square, penis free and filamentous, arising from caudal end of pygidium, with a thin wishbone-shaped appendage extending forward toward base (Fig. 47); bristles of head and thorax strong and black; face linear at middle. (Central Am.) .... *mexicana* Wheeler and Melander

Valves of pygidium usually much longer than wide, penis with no wishbone-like appendage; bristles of thorax yellowish to brown; face narrow but not coarctate to a line 53

53. Pygidium without terminal valves or prongs (Fig. 49); front femora with biseriate strong black setæ beneath; front coxæ with basal seta; arista black, bristles of head, mesonotum and metapleura black. (Va., Tenn.) .... *sicaria* n. sp.

Pygidium ending in valves or prongs; arista and bristles paler 54

54. Pygidial parts extending forward to or beyond middle of abdomen; front coxæ with basal seta; front femora with only the inner row of black denticles beneath 55

Pygidium not attaining middle of abdomen; front coxæ usually without basal seta; front femora with double row of minute black denticles beneath 57

55. Valves flattened, as long as the depressed body of the pygidium which has a pronounced heel (Fig. 48); arista brown. (Eastern U.S.) *præstans* n. sp.

Valves small, twisted at middle, much shorter than the massive body of the pygidium; arista apically yellowish or whitish 56

56. Pygidium reaching forward beyond middle of abdomen (Fig. 51); discal dorsocentrals distinct; female abdomen with short indistinct terminal styles; arista yellowish. (Eur., U.S.?) ...... *vocatoria* Fallen

Pygidium reaching forward about to middle of abdomen (Fig. 44); discal dorsocentrals typically small; female abdomen with two distinct terminal styles; arista white. (Eur., U.S.?) *albiseta* Zetterstedt

57. Pygidium open, *i.e.*, its valves, penis and paired penis-sheath ringent (Figs. 45, 46); arista pale; bristles dark. (Eastern U.S.) *elongata* Melander

Pygidium very small and closed, its appendages not freely visible (Fig. 43); arista dark; thoracic bristles pale. (Northern U.S.) *contracta* n. sp.

THE AMERICAN SPECIES OF *Phyllodromia*

58. Anal crossvein perpendicular and nearly straight; pygidium small, compact, penis thick (Fig. 52); terminal styles of female abdomen broadly oval. (Eastern U.S.) .... *americana* n. sp.

GENUS *HEMERODROMIA* MEIGEN

Auxiliary vein slightly curved, fusing with costa along middle and separating at tip, pedicel of second and third vein atrophied, costa abruptly thinner beyond fourth vein, hind margin of wing thickened only at base, anal vein entering hind margin at its root; humeri not constricted; antennal style at least half as long as third joint.

Almost cosmopolitan, not recorded from Australia.

Hemerodromia brachialis Melander (Figure 1)

Length 3 mm. Infraocular band of white pollen narrower than width of the brown third antennal joint; abdomen dull black, upper valves ham-shaped, thin on apical half; front femora robust, without spine, front tibiæ two-thirds as long as femur; wing-veins brownish, whitish at root.

Costa Rica.

Hemerodromia brunnea Melander

Length 3 mm. Head black, cinereous dusted, front one-half longer than wide, face almost linear in middle, infraocular band of glistening white pollen wide, expanding below to reach behind proboscis; abdomen piceous, paler below; front coxæ darker than remainder of legs; wing-veins pale.

Georgia.

Hemerodromia captus Coquillett (Figure 2)

Length 2.5 mm. Eyes briefly contiguous on face; abdomen piceous, yellow before genitalia, pygidium horizontal, ventral keel elongate and not deep; front femora with a small dent to accommodate apical spur of tibia.

I have eighty-four specimens from Massachusetts, Ontario, New York, Maryland and Virginia.

Hemerodromia coleophora Melander (Figure 3)

Length 3 mm. Pygidium large, about two-thirds the tibial length, the valves showing more than the main body, penis arising anterior to a conspicuous leaf-like sheath, upper basal valve hairy, almost circular, dorsal valve thickly convex, ending above in a strong claw-like projection and bearing hairs which reach nearly or quite to tip of lateral valve, upper edge of lateral valves gently rounded, not angulate; center of mesonotum broadly blackish, merging with paler sides; front one-half longer than wide, face distinct; ovipositor longer than depth at base.

Yellowstone Park, British Columbia and Washington.

Hemerodromia defessa Williston

Abdomen opaque black, venter yellow. Length 2 to 3 mm.

St. Vincent, West Indies.

Hemerodromia divinator sp. nov. (Figure 4)

Length 3 mm. Agreeing with the description of *H. haruspex* except the following characters. Face linear, cheeks with conspicuous silvery white pruinosity; thorax subshining, bare; upper pygidial valves sharply narrowed at middle on inside; lateral valves widest at middle and not at all clavate; setæ of front femora as long as tibial width or longer; anterior crossvein at middle of cell.

Three males and three females. Pedregoso, Costa Rica, D. L. Rounds, collector.

Hemerodromia empiformis Say

The species thought by Coquillett and others to be Say's *empiformis* is represented by a group of closely related yet distinct forms. All agree to a large extent in color, venation, raptorial structure of the front legs and general plan of pygidium, but the males without great difficulty can be separated into groups by the details of the pygidial parts. Color, such as the degree of striping of the thorax, is not of importance and so it is impossible to segregate the females other than by association with the males.

While there is some individual variation in proportions of parts of the pygidium, to be seen among specimens taken in a given locality, such variation is slight as compared with the group variation. Accordingly the groups deserve names, and in the table of species have been designated as varieties of *empiformis*. Which one of the forms, if any, is typical of Say's species will probably never be determined. Loew's species *vittata* has been regarded as synonymous with *empiformis*, as has also Williston's described but unnamed female from St. Vincent, but Loew's species has the pygidium of quite different structure. Williston in the St. Vincent paper stated that Coquillett misidentified Say's *empiformis*, but there is no need for not accepting the present group as Say's species. In view of the segregation into varieties, the old records of distribution given for *empiformis* can pertain only to the species in its broader sense.

empiformis Say, *sens. str.* Length 3.5 mm. Pygidium two-fifths length of hind tibia (Figure 5), its body appearing smaller than the valves, end of penis-sheath not exposed, hairs of dorsal valve rather abundant and long, dorso-basal valve unusually large, exceeding the exposed part of the dorsal valve and approximating the expanded end of the lateral valve, nearly bare of hairs, dorsal valve robust, convex, somewhat truncated at apex and bearing a short inward-directed triangular projection near the middle of the truncation, lateral valve expanded both above and below at end, above with a pronounced V-shaped sharp incision. Thorax rufo-testaceous, sometimes medially vittate; front twice as long as wide, or narrower, the sides slightly curving in, front ocellus largest; face distinct; sections of fourth vein proportioned 4: 3: 10: 12.

I have specimens of the restricted *empiformis* from Ontario, Connecticut, New York, Pennsylvania, Maryland, Virginia and Minnesota.

brevifrons var. nov. MALE. Length 2 mm. Pygidium small (Figure 6). about one-third the length of the hind tibia, its body heavy, exposing more area than the valves, a short broad sheath about base of penis, hairs of valves scattering and short, dorso-basal circular valve nearly bare, upper valve about half as long as lateral valve, thick to the end and shaped like a boomerang, lateral valve but little expanded below at apex, the upper edge not angulate nor protruding. Median vitta of thorax broad and obscurely limited; the white glistening triangular area under posterior orbits attaining the hindmost part of eye when viewed from above; front one-half longer than wide; face linear; sections of fourth vein proportioned 4: 3: 9: 8.

FEMALE. Last abdominal segment shining; front scarcely longer than wide.

Holotype: San Diego County, California, 15 April 1915, received from M. C. Van Duzee. Allotype: Fortuna, California, 20 April 1935. The female can be distinguished from those of *coleophora* and *sufflexa*, the other Western forms, in that the face is almost linear and the front is much shorter.

exhibitor var. nov.. Length 3 mm. Face at middle half as wide as third antennal joint, cheeks with the glistening white pollen of lower orbits reaching behind proboscis; thorax dull testaceous, with a darker median vitta including scutellum and metanotum; abdomen blackish above, last segment yellow, Figure 6, pygidium; front femora beneath with double row of black denticles and a depression for the strong apical tibial spine; wing-veins pale, petiole of fourth vein slightly shorter than fork, anterior crossvein slightly beyond middle of cell.

Burton, Georgia, received from Professor J. C. Bradley.

sufflexa var. nov. MALE. Length 2.75 mm. Pygidium equal to three-fifths tibial length (Figure 8), in profile the main body showing as much or more area than the valves, dorso-basal circular valve sparsely hairy and about equal to the exposed part of the dorsal valve, the last thick and shortened by being abruptly bent down at apex so as to reach less than halfway along the lateral valve and devoid of long hairs, lateral valve widened above and below toward apex, the upper edge obtusely projecting on basal half and then broadly angulate at beginning of expanded portion, apical hairs short and bushy above. Center stripe of mesonotum linear, expanding in a quadrate spot before scutellum; front twice as long as wide, face one-third the width of third antennal joint.

FEMALE. Mesonotal vitta occupying about one-fourth of notum; pedicel of fourth vein usually shorter than fork; ovipositor not longer than depth at base.

Type and allotype: Chatcolet Lake, Idaho, August 1915. Twenty-three paratypes from same locality, Priest Lake, Idaho, and Spokane, Washington.

Hemerodromia extispex sp. nov. (Figure 9)

Length 2 mm. Front parallel-sided, 1.75 times as long as wide, face broadly obliterated, postorbital pollinose stripe narrow, gray; antennæ pale yellow. Thorax with slight brownish tinge, pleura concolorous with dorsum, scutellum with two hairs; abdomen all dull black, upper valve of pygidium circularly excised at tip. Front femora with fifteen black denticles in each flexor row, front tibiæ short, two-thirds as long as femur, the apical spine small. Wing-veins brown, pale at base, anterior crossvein slightly before middle of cell.

Three males, La Suiza de Turrialba, Costa Rica, May, 1924–1926 (Pablo Schild). *Extispex,* Latin, one who phophesies by an examination of the viscera of sacrificial victims.

Hemerodromia femorata Melander

Length 3.5 mm. Head and metanotum black, mesothorax testaceous, the median vitta including base of scutellum and tapering anteriorly to the sudden humeral expansion; flexor denticles of front femora strong.

Panama.

Hemerodromia haruspex sp. nov. (Figure 10)

Length 2 mm. Head black, cheeks and lower anterior occiput white-pruinose, face nearly obliterated by the approximation of the eyes, antennæ testaceous, outer joint elongate ovate, twice as long as deep, a little longer than the style; mouthparts testaceous. Notum with some scattered delicate hairs visible, scutellum and most of pleura dull; abdominal tergites blackish, sternites yellow, pygidium projecting backward, widely open, piceous, upper valves long and strap-like, acutely pointed at the inflexed tip, fringed with long hairs, lateral valves long and slender, somewhat clavate, ventral piece very small. Legs entirely pale yellow, front tibiæ about three-fourths as long as their femora, with slender black terminal spine, front femora moderately robust, no basal tubercle but basal seta pronounced, about four additional small flexor setæ which are shorter than the tibial diameter. Wings hyaline, veins pale yellow, anterior crossvein visibly beyond middle of cell, second vein ending midway between forks of third and fourth veins and beyond end of fifth vein, petiole of fourth vein longer than fork; halteres pale yellow.

FEMALE. More robust, 2.5 mm. in length; tergites piceous, veins brown, no chitinized ovipositor.

One male and five females, Orlando, Florida, 26 April 1930. *Haruspex,* Latin, an interpreter of sacrifices through inspection of victim's entrails.

Hemerodromia jugulator Melander (Figure 11)

Length 3 mm. Front 1.6 times as long as wide, middle of face obliterated, infraocular white band wide below. Humeri, pleura and venter yellow. First posterior cell scarcely tapering.

I have collected the species in Massachusetts, Connecticut, Ontario, New York, Maryland and Wisconsin. *Jugulator,* Latin, a cut-throat.

Hemerodromia melanosoma sp. nov. (Figure 12)

Length 2 mm. Head and body black, basal sternites brownish, mouthparts, antennæ, legs and halteres pale yellow. Front one-half longer than wide, middle of face obliterated by contiguity of eyes, the white orbital spot of lower occiput scarcely wider below. Pleura lightly dusted; pygidium long but not deep, open, dorsal and lateral valves long and narrow, the dorsal pair bowed and provided with scattering long hairs. Front femora with about six small setæ in the posterior flexor row, front tibiæ two-thirds as long as their femora and trochanters combined. Wings nearly hyaline, veins pale brown, petiole of fourth vein slightly longer than fork, anterior crossvein at middle of cell.

Types: Petawawa, Ontario, Canada, 4 July 1938. Eleven paratypes, topotypic and from Redding, Connecticut, 2 August 1936; Waubamick, Ontario, June 1915 (H. S. Parish); Milford Center, New York, July 1935 (H. K. Townes).

Hemerodromia reflexa sp. nov.

FEMALE. Length 4.7 mm. Body black, subshining. Front three times as long as wide, sides coarctate, width at front ocellus almost no more than at antennæ, face glistening white, linear at middle, occiput nearly bare, the hairs of upper portion brown, the orbital white pollinose stripe heavy; lower facets coarse; basal antennal joints brown (third joint missing); proboscis and palpi pale yellow. Thorax with about eight microscopic hairs in each of the acrostichal and dorsocentral rows, dorsum very finely rugulose, not pollinose, pleura not pollinose. Ovipositor shorter than seventh segment, compressed and shining, the terminal styles microscopic. Legs pale yellow, the robust front femora nearly black, with nine pale setæ below and about twenty-four black denticles to each row, front tibiæ strongly mucronate at apex, extending nearly half the length of the metatarsus beyond insertion of tarsus, hind tibiæ slightly expanded at apex and fimbriate. Wing-veins firm, marginal cell truncate at insertion of the recurved branch of third vein, first posterior cell narrowed apically, its end one-third the length of last section of third vein, sections of fourth vein proportioned 1: 1: 2: 2, sections of fifth vein equal; halteres black, base of stalk yellowish.

Holotype: La Suiza de Turrialba, Costa Rica, September 1924 (Pablo Schild). When the male is known this species may warrant the erection of a separate genus.

Hemerodromia rogatoris Coquillett (Figure 13)

Length 2.5 mm. Head black, all of thorax yellow, middle tergites brown, genitalia shining black, rest of abdomen yellowish. Front one-half longer than wide, face linear. Dorsal valves of pygidium very wide, quadrate, with crenulate apex and included within the convex squarish lateral valves, penis erect with bulbous apex.

I have seventy-six specimens from Connecticut, New York, Virginia, North Carolina, Georgia, Tennessee, Montana, Idaho, Washington, Oregon, California, Quebec, Ontario and British Columbia. The species is strikingly like *H. oratoria* Fallen, but European specimens received from K. Kertesz and G. Strobl lack the tubercle at base of front femora.

Hemerodromia stellaris sp. nov. (Figure 14)

Length 2.75 mm. Head black, indefinite middle of mesonotum, the scutellum, metanotum and dorsum of abdomen piceous, last abdominal segment, venter, legs, mouthparts and antennæ yellow, pleura testaceous. Front parallel-sided, twice as long as wide, face linear at middle, infraocular white stripe reaching from ocelli to back of proboscis but merging into the cinereous occiput; front femora stout, with a small black basal thorn, twenty-two denticles to the row, front tibiæ three-fourths as long as the femur, ending in a strong spur; branch of third vein ending midway between second and third veins, anterior crossvein just beyond middle of cell.

Thirteen specimens, Comal River at New Braunfels, Texas, 24 March 1942. *Stellaris,* Latin, belonging to a star, *i.e.,* the "Lone Star State."

Hemerodromia superstitiosa Say (Figure 15)

Length 4 mm. Front twice as long as wide, middle of face nearly half the width of third antennal joint; base of dorsal pygidial valves wide, suddenly narrowed on inside to form encircling arms, lateral valves convex, with incurved round apex, basal plate prominent; first posterior cell half as wide at apex as at middle, anterior crossvein beyond middle of cell.

I have taken this species in Connecticut, New York, Ontario, Maryland, Virginia and Ohio, and also have specimens from Wisconsin and Texas.

Hemerodromia vates sp. nov. (Figure 16)

Length 2.5 mm. Front 1.75 times as long as wide, middle of face linear, the infraocular white mark concave posteriorly and reaching back of proboscis below; thorax testaceous, lightly pollinose, scutellum and metanotum piceous; abdomen piceous, venter and last segment yellow, upper valves sharply excised beyond middle, the narrowed apical portion incurved, basal plate minute; legs wholly pale yellow, front femora rather stout, slightly indented opposite end of tibia, with seventeen black denticles in each of the two flexor rows, front tibiæ five-sevenths the length of the femur and tipped with a black spine; wings nearly hyaline, third, fourth and fifth veins firm and brown, pale at base, branch of third vein ending nearer second vein than wing-tip, anterior crossvein just beyond middle of cell.

Two male specimens, Kent, Connecticut, 16 July 1938. *Vates,* Latin, a soothsayer.

Hemerodromia vittata Loew (Figures 17, 18)

Length 2.5 mm. Front broad, one-half longer than wide, face distinct, at middle two-thirds as wide as third antennal joint; color of thorax ranging from wholly testaceous to black on median vitta, scutellum and metanotum; abdomen blackish above.

Originally described from District of Columbia. I have specimens of the pale form from Redding, Connecticut. C. W. Johnson supplied the museum name *pallida* to the evittate variation. This species has been placed as a synonym of *empiformis,* but its totally different genitalia show that it is distinct.

GENUS *COLABRIS* MELANDER

Auxiliary vein straight, completely fusing with costa beyond base, pedicel of third and fourth veins strong except proximal end, ambient vein complete, anal vein separate from hind margin of wing; humeri delimited; no antennal style.

Restricted to Central America, unless *Hemerodromia radialis* Collin from New Zealand belongs here.

Colabris rufescens Melander (Figure 19)

Reddish yellow, head, metanotum and genitalia black, prescutellar triangular spot brown, scutellum, lower mesopleura and halteres pale brown. Middle femora bowed, swollen on basal two-thirds and with about five outstanding setæ near middle; middle tibiæ with subapical swelling which is mucronate with minute black denticles beneath. Third section of costa longer than fourth. Length 2.2 mm.

Canal Zone, Central America.

Colabris is related to *Neoplasta,* as indicated by its shortened second vein and hairy front tibiæ.

Colabris coxalis Melander (Figure 20)

Similar to *C. rufescens* but with blackish front coxæ. Third section of costa shorter than fourth.

Canal Zone, Central America.

GENUS *CHELIFERA* MACQUART

Pedicel of third and fourth vein distinct though short, anal cell complete, the anal vein separated from the thickened hind margin; thorax with distinct depressed prescutellar area and with evident humeri; ovipositor usually undeveloped, rarely ensiform.

Palæarctic, North America, South America and New Zealand.

Chelifera banksi sp. nov. (Figure 21)

Length 3.5 mm. Face, cheeks, front, thorax, abdomen, antennæ, legs and halteres pale testaceous, vertex and occiput cinereous. Pygidium very large, globular, the dorsal valves much longer than in the other species, expanding triangularly and convexly overlapping, their distal portion deeply excised almost through to the side margin to form a spatulate terminal appendage on the valves, middle valves with inflexed triangular end, ventral body of pygidium globose, reaching half the length of the dorsal valves. Front femora not greatly incrassated. Wings hyaline, no stigma, veins nearly colorless, second vein straight almost to tip, petiole of fourth vein equal to posterior branch of fork and also equal to second discal section, last two sections of fifth vein equal, anal crossvein nearly straight, forming an angle of sixty degrees with fifth vein.

Male and female, Watertown, Connecticut, 5 June 1931, and one male from North Fork, Swannanoa River, Black Mountain, North Carolina, May, the last received from Dr. N. Banks. The species bears resemblance to *Ch. rastrifera* in company with which it was collected by Dr. Banks, but differs in the remarkable expansion of the dorsal valves of the pygidium.

Chelifera cirrata sp. nov. (Figure 22)

MALE. Length 3 mm. Piceous, with satiny coating, face, palpi, halteres, legs, last segment of abdomen and pygidium pale yellowish, antennæ and proboscis reddish. Third antennal joint short and deep, scarcely longer than broad, style less than one-fourth the third joint; front relatively broad, slightly tapering, at the front ocellus twice as wide and three times as long as the distance between the posterior ocelli. Pygidium very strong, erect, the ventral part produced upward on each side as an overlapping thumb-like piece, middle valve large, more or less quadrate, bearing a pronounced brush of yellow hairs at outer lower angle, dorsal valve in outline curiously resembling the profile of a rodent, as indicated in the figure. Legs without special characteristics, the front femora bearing seven yellow setæ in posterior flexor row, black denticles of front tibiæ rather pronounced, twenty-five to a row, the apical one strong, last tarsal joint a little dusky. Wings hyaline, veins yellow, no stigma, first submarginal cell shorter along the costa than the marginal or second submarginal cells, petiole of fourth vein shorter than posterior fork, anal crossvein oblique.

Holotype: Lava Creek, Yellowstone National Park, Wyoming, 5 July 1923. A female taken ten days later at Spring Creek, Yellowstone Park, has rufous body coloring and the ovipositor long and chitinized. It probably is the same species, showing the same broad front as the male.

Chelifera ensifera sp. nov. (Figure 23)

MALE. Length 3 mm. Head black, thorax and abdomen testaceous, antennæ, mouthparts, halteres and legs pale yellow. Front rufous, short and wide, slightly tapering, its average width equal to distance between posterior ocelli and its length less than twice this distance, face narrow, nearly linear; third antennal joint twice as long as wide, the style equal to width of this joint. Pygidium obliquely ascending, the ventral piece extending lobosely upward on each side so as to overlap the quadrate middle valve which does not arise near base of pygidium but under the lobose projection of the keel, its distal border produced and acute, its posterior edge loosely fringed with inflexed hairs but with no long bunched hairs, dorsal valve deeply constricted, the distal part convex and circular with excised apex. Wings hyaline, veins yellow, no stigma, submarginal cells equal along costa, pedicel of fourth vein slightly shorter than posterior fork, anal vein oblique forming an angle of fifty degrees.

FEMALE. Ovipositor as long as four abdominal segments, compressed glistening castaneous.

Type: male, Piedmont, Lake Crescent, Washington, 26 July 1917. Three females: Vancouver, Washington, July 7; Longmire, Mount Rainier, Washington, July 30; Tahoma Fork, also on Mount Rainier, July 25.

Chelifera lovetti sp. nov. (Figure 25)

MALE. Length 3.25 mm. Testaceous, sometimes two dorsocentral brownish vittæ, dorsal valve of pygidium apically brown, knob of penis jet-black, legs, halteres, antennæ, mouthparts, front and face pale yellow. Sides of front nearly parallel, width of the front less than twice the distance between posterior ocelli; body of third antennal joint scarcely longer than deep, the apical slender portion long, terminal seta minute. Pollinose coating of thorax rather sparse. Pygidium globular, dorsal valve narrow with strong thumb-like projection near middle of upper side, the margin of the thumb black-crenulate, middle valve large, convex, the upper distal corner angulate, ventral part of pygidium globular. Wings hyaline, veins narrow and brownish, no stigma, pedicel of fourth vein equal to upper fork, first submarginal cell somewhat shorter than marginal or second submarginal along costa, anal crossvein reflexed.

FEMALE. Abdomen with blunt termination.

Type and allotype: Mount Hood, Oregon, on Hood River at 3000 feet elevation, 29 July 1921. Twenty-four paratypes: Moscow Mountain, Idaho; and the following localities in Northwest Washington, Adna, Everett, Lake Crescent, Lake Cushman, Mount Baker, Mount Rainier, and Tokeland.

The species is named in memory of Professor A. L. Lovett of Oregon State College, whose career was regrettably terminated on April 25th, 1924, but whose helpful influence over western entomology will long be appreciated.

Chelifera notata Loew (Figure 24)

Length 3 mm. Front parallel-sided, three times as long as wide; middle of dorsum including scutellum and metanotum dark; body of pygidium spherical, lateral valves large, hemispherical, concealing all but the end of the narrow upper valves; ovipositor compressed, shining, not much longer than an abdominal segment; stigma rounded, black, almost filling the enlarged end of marginal cell, second posterior cell longer than its pedicel, posterior branch of fourth vein subequal to petiole, three sections of fifth vein equal, anal crossvein about 75 degrees.

Originally described from Illinois, the species has been recorded from New Hampshire, Maine and New York. I have taken a closely related species in the Yellowstone National Park. The thorax is yellowish with two brown vittæ, but not having the male I defer giving a description.

Chelifera obsoleta Loew (Figure 26)

Length 3.5 mm. Front slightly coarctate, three times as long as width at middle; margin of notum and metathorax blackish, disc reddish brown, a darkened spot in middle of mesopleura; pygidium black, bulbous, ventral portion small, upper valves chitinized, with opposing hoof-like ends; ovipositor blunt; discal cell oblong, second posterior cell a little shorter than its pedicel, pedicel of fourth vein one-third longer than the posterior branch, last two sections of fifth vein equal, anal crossvein forming angle of 60 degrees.

Originally described from Illinois. I have taken the species in Massachusetts, Connecticut and New York. It is also recorded from Maryland.

Chelifera palloris Coquillett (Figure 27)

Length 4 to 5 mm. Almost wholly yellow, the head except face and lower front blackened; mesonotum with two brown vittæ, laterally pale, scutellum yellow but metanotum brown. Front parallel-sided, three times as long as wide; no style; dorsum of thorax sparsely dusted; upper pygidial valves broad apically, their upper margin closely and finely pubescent toward base; front tibiæ two-thirds the length of the femur; second posterior cell about equal to pedicel, anal crossvein forming angle of 50 degrees.

Originally described from the White Mountains, New Hampshire. I have collected twenty-seven specimens in the following states, Maine, Connecticut, Vermont, New Hampshire, Massachusetts, New York, Pennsylvania; and have a male specimen from Keyport, Washington, given me by Dr. Aldrich, which is indistinguishable from the Eastern material.

Chelifera precatoria Fallen (Figure 28)

Length 4 to 5 mm. Upper pygidial valves large and black.

The inclusion of this European species in the American fauna rests on the identification of F. Walker, who in 1849 recorded its occurrence at St. Martin's Falls of the Albany River in Northeastern Canada. In the same publication Walker mentioned English specimens of *precatoria,* which he thus had for comparison. The species is included in the table and figured, but I suspect that Walker's specimens are the subsequently described *valida* Loew.

Chelifera rastrifera sp. nov. (Figure 31)

Length 3.5 mm. Body pale yellow, head black, heavily coated with white dust, ground color of face and of the narrow front yellowish, thorax completely coated with white dust except the usual posthumeral spots; legs pale yellow as usual; wings hyaline, no stigma. Front twice as long as width at front ocellus; antennal style a microscopic hair. Body of pygidium bullate, extending posteriorly beyond the valves, upper valve narrow, its upper margin wavy and toward the base with inturned black denticles. Front tibiæ two-thirds their femora. Sections of fourth vein proportioned 1: 2: 3: 3, of fifth vein 1: 0.8: 1, anal crossvein forming angle of sixty degrees.

North Fork of Swannanoa River, Black Mountains, North Carolina, May, received from Dr. Nathan Banks.

Very similar to *palloris* and *Banksi,* but at once distinct in pygidial structure.

Chelifera scrotifera sp. nov. (Figure 30)

Length 4.75 mm. Robust, dull gray-brown to piceous, heavily pollinose, with antennæ, mouthparts, legs and halteres pale yellow. Front tapering, slightly longer than width at front ocellus, upper part of face as wide as second antennal joint. Thorax seen from in front showing two brown vittæ under the pollen and the large circular flat prescutellar area dark, the small shining spot immediately behind the humeri appearing black. Apical segments of male abdomen funnel-like to accommodate the large genitalia, eighth sternite small, the usual heel of the pygidium enormously bulbose but placed far forward before the large valves, visible part of lateral valve triangular but the apex bent inward and continued as a hairy tip, upper valve deeply excised at middle of upper side and bearing a strong capitate process which arises from the bottom of the excision, the apical part of the upper valve circular but angulate below, penis short, visible within the excision of the valves as a black knob. Front coxæ strong, front tibiæ about two-thirds their femora. Wings hyaline, veins light brown, no stigma, pedicel of fourth vein slightly shorter than second basal cell, sections of fifth vein equal, anal crossvein at an angle of about sixty degrees.

Five specimens from Savonoski, Naknek Lake, Alaska, June, 1919, received from Professor J. S. Hine.

This species is very close to *Ch. Frigelii* Zetterstedt which occurs in northern Europe and Siberia, but which has a truncate anal cell and the capitate process of the upper valve distinctly shorter and thicker.

Chelifera valida Loew

Length 4 mm. Face three times as long as width at middle; mesonotum with two narrow vittæ a little darker, two minute scutellar hairs; front femora with five long setæ and twenty-five denticles below; stigma very faintly brown, discal cell oblong, sections of fourth vein 1 : 2, the four sections of fifth vein equal, anal crossvein oblique.

Originally described from Hudson Bay Territory; recorded from Alaska by Coquillett; and included in the New York List as from New York. The female type at the Harvard Museum of Comparative Zoology is mildewed and lacks the antennæ and the tip of the abdomen. There is a contradiction in the original description. The preliminary diagnosis states that the second posterior cell is much shorter than the pedicel, the main description correctly states that the cell is much longer than the pedicel. It is quite probable that Walker's identification of *precatoria* from Northeast Canada will prove to be this species.

Chelifera varix sp. nov. (Figure 29)

MALE. Length 3 mm. Pale testaceous yellow, occiput piceous. Front short, slightly tapering, at the middle about twice as wide as distance between posterior ocelli, face coated with white; antennæ yellow, the apical seta about one-third the depth of the third joint. Pygidium small, obliquely ascending, dorsal valve petaloid, its base swollen, its upper inner margin furnished with a row of black denticles, lateral valve convex and quadrate, heel rather small. Front femora very robust, pictured with two brown concentric curves parallel with lower edge, with a brown flexor stripe and with small black markings on inner side near knee, just above the black markings swollen and bearing a brush of brown hairs, flexor denticles strong; front tibiæ geniculate, swollen on basal half and bearing a fine flexor fringe along the swelling, marked with a black spot midway their length, with preapical flexor spine and fimbriate apex. Halteres light yellow, wings hyaline, veins thin and light brown, no stigma, first submarginal much shorter along the costa than the marginal or second submarginal cells, petiole of fourth vein shorter than posterior fork, anal crossvein oblique at an angle of 60 degrees.

FEMALE. Abdomen blunt, no ovipositor; front legs raptorial in the usual manner; anal crossvein at about 45 degrees.

Types: St. Regis Pass of the Coeur d'Alene Mountains at the Idaho-Montana State line, 27 July 1918. Another pair from Dunraven Pass, Yellowstone National Park, 28 July 1934.

GENUS *THANATEGIA* MELANDER

Auxiliary vein straight, thin, lying close to first vein, evanescent near middle of costal cell, crossvein limiting second basal cell located opposite origin of second vein, fourth vein with long petiole; front tibiæ geniculate at base and with apical spine.

Restricted to the United States. There is a tendency for the anterior branch of the third vein to be imperfect or even completely wanting.

Thanategia defecta Loew (Figure 32)

Length 3 mm. Lower front yellowish, face pale yellow, occiput black, more or less pruinose; proboscis pale yellow. Body pale yellow, distal two-thirds of pygidial valves infumated, dorsal pair with deep apical excision and with a group of four inflexed short black spines toward base above, penis thick, contrasting black. Legs pale yellow, fourth and fifth tarsal joints only slightly dusky. Wing-veins pale yellowish, stigma evanescent, second vein bent midway and apically parallel with costa, petiole of fourth vein nearly three times the fork, sections of fifth vein 1 : 1 : 2.5; halteres pale yellowish.

Type from District of Columbia. Recorded from Massachusetts, Connecticut and New Jersey.

Thanategia stuprator sp. nov. (Figure 33)

MALE. Length 3 mm. Occiput and vertex piceous, front rufous, face pale yellow, sides of front nearly parallel, width of front nearly four times the distance between hind ocelli, face half as wide as front; antennæ yellow, third joint pyriform, the thin apical part of style one-fourth the length of the third joint; mouthparts yellow. Thorax and abdomen piceous, hairs pale, a white glaucous coating on thorax; dorsal pygidial valves ending in narrow encircling arms, triangularly expanded above toward base, lateral valves shorter and convex, the black penis erect, with reflexed fimbriate tip. Legs, halteres and root of wing yellow, wings cinereous hyaline, veins brown, submarginal fork vestigial in type, discal cell open, petiole of fourth vein one-fifth longer than second posterior cell, anal crossvein not much reflexed, rounding into anal vein.

Holotype: Mount Rainier, Washington, at Eagle Peak, 19 July 1922. *Stuprator*, Latin, a ravisher.

Thanategia recurvata sp. nov. (Figure 34)

MALE. Length 4 mm. Cinereous, with glaucous coating over the light piceous body color; front brown, yellow at antennæ, slightly tapering, at middle only slightly wider than distance between hind ocelli, face half as wide as front; antennæ yellow, apical seta of style minute; mouthparts yellow. Abdomen with caudal incisures yellowish, genitalia very large, dorsal valves nearly uniformly narrowed and curving up and forward at tip, lateral valves narrowed, ventral part forming a pronounced heel, penis with stout reflexed head. Legs, halteres and base of veins yellow, wings hyaline, veins thin, branch of third vein interrupted, pedicel of fourth vein as long as fork, discal cell open outwardly, anal crossvein much reflexed and nearly straight.

FEMALE. Tip of abdomen blunt, no ovipositor. The third vein is normal.

Holotype and allotype: Nelson, British Columbia, 17 July 1910. A female from Mount Baker, Washington, 10 August 1925, with unbranched third vein, may belong here, but the body is yellowish, as in *defecta*.

GENUS *METACHELA* COQUILLETT

Auxiliary vein straight, thin, ending near middle of costal cell, base of radial sector weak, posterior crossvein oblique, located far beyond anterior crossvein, petiole of fourth vein not longer than second posterior cell; front tibiæ geniculate at base and with apical spur.

Distribution: two species from North America, seven from South America and one from Europe.

Metachela albipes Walker (Figure 35)

Length 4 mm. Eighth sternite split into two parts, body of the opaque pygidium consisting of two large rotund side pieces; setæ of front femora longer than diameter of femur; crossvein at end of second basal cell strongly oblique.

St. Martin's Falls of Albany River, NE. Canada. The species is recorded in the New England List as from the White Mountains, New Hampshire. L. M. Turner has collected it at Fort Chino, Labrador, for the United States National Museum.

Metachela collusor Melander (Figure 36)

Length 4 mm. Pygidium shining, compressed, apex acute; crossvein at end of second basal cell nearly perpendicular.

Types from Dubois, Wyoming, 7200 feet, collected by W. M. Wheeler. The species is widely distributed through the Western United States. I have mounted about two hundred specimens from Colorado, Wyoming, Montana, Idaho, Washington, Oregon and California.

GENUS *NEOPLASTA* COQUILLETT

Auxiliary vein straight, thin, extending midway between costa and first vein; humeri strongly separated from mesonotum; front tibiæ not geniculate and without apical spur, strongly pubescent both within and without.

The genotype, *scapularis,* and one other species occur in North America. Beside the three Central American species enumerated here, at least fifteen species are known from South America. Some of the South American species have a crossvein dividing the second basal cell from the discal cell, instead of the two cells being confluent as in the species from North America.

Neoplasta hebes sp. nov. (Figure 37)

Length 3 mm. Body wholly black; legs, antennæ, mouthparts and halteres pale yellow; postocular stripe, face and cheeks white pruinose. Very much like *scapularis* in color, unchitinized abdomen, venation and pilosity of front legs, but differing in the structure of the genitalia and in the arrangement of the setæ of the middle femora. Ventral part of pygidium compressed, about equal to the convex lateral valves, the upper valves obtriangular, not at all hemispherical as in *scapularis,* and smaller than the lateral valves which are straight below and acutely angled behind. Tumescence of middle femora weak, extending along basal third, with a fringe of six or seven evenly spaced flexor setæ reaching nearly to middle of femora.

Type: Berkeley, California, August 1915. Thirty-eight paratypes from the following Western localities. California: Stanford, July 1915; Muir Woods, 17 August 1915; Crestline, 4 June 1942; Scotland, 19 September 1943; Valyermo, 13 May 1944; Live Oak Park, 24 May 1944 and 7 June 1945; Mountain Home

Canyon, San Bernardino Mountains, 7 July 1945; Rincon, 6 June 1945; Oak Glen, 2 July 1945. Oregon: Oneonta Gorge, 9 September 1934. Washington: Vashon, 28 May 1917; Wawawai, 20 May 1911; Mount Rainier, 11 August 1940. Idaho: Moscow Mountain, 12 May 1910; Junction of Divide Creek and Snake River, 10 May 1925.

Neoplasta mexicana Melander (Figure 38)

Very similar to *scapularis* in color and structure, differing in the conformation of the pygidium. The upper valves are large and squarish, the ventral part of the pygidium projects backwards, and two semicircular filaments are visible above the upper valves. Length 2.5 mm.

Habitat: Orizaba, Mexico. Holotype in the American Museum of Natural History.

Neoplasta puerilis sp. nov. (Figure 39)

Length 2.4 mm. Black, head, thorax, pygidium and ovipositor shining, abdomen opaque. Front twice as long as wide, face obliterated at middle, below silvery pruinose as also the palpi and narrow infraocular border; third antennal joint circular, with small radiating hairs, style nearly as long as third joint. Prothorax wholly black, minute hairs on dorsocentral and acrostichal rows, scutellum bare; legs testaceous. Costal ratio between first and third veins 1:5:3.

One male and two females, Pedregoso, Costa Rica, D. L. Rounds, collector.

Neoplasta scapularis Loew (Figure 40)

Black, head shining, face and lower orbits pruinose; thorax lightly dusted, humeri, propleura and pectus yellowish; abdomen not well chitinized, piceous, sometimes pale; genitalia forming a globular mass, shining black. Antennæ, mouthparts, halteres and legs yellow, last tarsal joint blackened. Wings hyaline, veins firm and brown. Length 3 mm.

The species is variable in the size of the pygidium, individuals with the largest genitalia forming the variety *megorchis*. Usually the swelling under the middle femora is weak and extends along the basal third, with its setæ not bunched as in *megorchis*. This is the most generally encountered species of the subfamily. I have mounted nearly three hundred specimens from the following States: Maine, Massachusetts, Connecticut, New Hampshire, Vermont, Ontario, New York, Pennsylvania, District of Columbia, Virginia, Georgia, Wisconsin, Montana, Wyoming, Colorado, Idaho, Washington, Oregon, California and British Columbia.

This is the species described by Bigot in 1887 as *Clinocera maculipes.* The synonymy was first made possible through the kindness of J. E. Collin, who brought me Bigot's type for inspection on his visit to America in 1928.

Megorchis, var. nov. Very much like *scapularis,* differing in the swelling at base of middle femora, which is short and pronounced, not extending beyond basal fifth and is furnished with five close-set yellow setæ, just posterior and distal to which arises an isolated seta. Regularly correlated with the femoral structure is an excessive development of the genitalia (Figure 41), the upper valves of the pygidium hairy, globose and much larger than the middle valves, ventral part of pygidium not pronounced.

Eleven males from the Western United States show this correlation of femoral tumor with the extreme form of genitalic development. Type from Ilwaco, Washington, 25 May 1917; paratypes from Orcas Island, Washington; Humbug State Park, Oregon; Forest Grove, Oregon (F. R. Cole); Yosemite Park, California; Blue Lake, Humboldt County, and Santa Cruz Mountains, California (J. C. Bradley); Jefferson Island, Montana, and Yellowstone Park. Three specimens from Estes Park, Colorado, are similar, but the humeri are piceous.

Alleghani var. nov. Whereas the yellow-shouldered *scapularis* is widely distributed through the United States there is an area between New York and Georgia where the specimens before me have the prothorax and humeri black, concolorous with the rest of the thorax. As they consistently conform to this variation they may be considered a local variety. Otherwise they agree with normal *scapularis.*

I have taken eighteen specimens of this form from the following localities: Tuxedo, New York, 29 May 1926; Lewiston, Pennsylvania, 7 June 1940; Luray, 24 June 1933 and Shenandoah Park, Virginia, various places, July 1939 and June 1941; Great Smokies National Park, Tennessee and North Carolina, various places, June 1941. Dr. Banks has also collected a specimen at Falls Church, Virginia, and another at Black Mountain, North Carolina; and Professor Bradley has taken a specimen at Black Rock Mountain, Georgia.

Radialis var. nov. A male which I collected at Lyndon, Vermont, 13 June 1914, differs from all the others in that the second vein is not shortened, but terminates much beyond the end of the discal cell. The section of the costa before the end of the second vein is therefore longer than the following, the ratio of the three sections between the first and third veins being 2:1:3. In normal *scapularis* the costal section between the second vein and the branch of the third is never distinctly the shortest. The humeri are black.

At first this specimen was regarded as an aberrant individual of *scapularis.* But Collin's discovery of several species of *Neoplasta* in Patagonia which have the second vein lengthened makes it probable that a distinct variety is indicated.

Neoplasta spadix sp. nov. (Figure 42)

MALE. Length 2.75 mm. Head, thorax and pygidium shining. Front twice as long as wide, not tapering, face linear, silvery white, as are also the narrow infraocular border and the palpi. Mesonotum castaneous, sides slightly gray pollinose, scutellum and metanotum darker, prothorax somewhat lighter, dorsocentral and acrostichal hairs fine, uniserial; abdomen opaque piceous. Hind femora with brownish preapical ring, last joint of anterior tarsi and last three joints of hind tarsi brownish.

Holotype: Pedregoso, Costa Rica, D. L. Rounds, collector. *Spadix,* Latin, nut brown.

GENUS *CHELIPODA* MACQUART

Although the males can be identified without difficulty because of their distinctive genitalia, the females of the species occurring in the United States present less tangible distinctions. There is enough variability in the diagnostic characters to make it difficult to interpret any species formula. The length and color of the arista, the shape and color of the third joint of the antennæ, the dimensions of the front and face, the breadth of the thorax especially anteriorly, the degree of pollinosity of the mesonotum and pleuræ, the size of the discal dorsocentral bristle, the shape of the terminal styles, the length of the front tibiæ as referred to their femora, and the degree of fimbriation at the apex of the hind tibiæ afford the best characters for separating the females. While this array should seemingly remove doubt as to specific identity, determination is sometimes rendered uncertain, either because of the intergrading variability, or because the characters cannot always be properly evaluated. Greasiness of the specimen will destroy pollinosity, the degree of exsertion of the styles affects the interpretation of their shape, and relative proportions cannot be judged when only a single specimen is available. Even association with the males is not infallible inasmuch as the species consort together.

It might be concluded that we are dealing with a single polymorphic species, but this I believe is not so. Phylogenetically this group, with its high genitalic specializations, may be recent and hence variable, but the species have been established sufficiently long for true speciation to take effect. Certainly *elongata* with its narrow thorax is distinct from the relatively broad-shouldered *præstans* and *contracta* which species show the extremes of pygidial structure.

Chelipoda occur in Europe, Asia, North and South America, Oceania and New Zealand.

Chelipoda albiseta Zetterstedt (Figure 44)

Length 2 to 2.5 mm. Testaceous with dark medial thoracic stripe and abdominal tergites brown. Front gray pollinose, lower occipital hairs white; arista thickly white pubescent. Front coxæ with one to four short strong yellow bristles near base on anterior face and a diminishing series beyond.

Recorded in the New York List on the basis of a female from Ithaca which I had named as possibly this species because of its strikingly white arista. It is recorded also in Johnson's New England List as from Southbridge, Massachusetts. It is doubtful if these references pertain to the European species. None of the two hundred American specimens of *Chelipoda* before me agrees exactly with *albiseta* as sent by G. Strobl and E. O. Engel. When the male of the form with heavy white arista is discovered it will probably require a new name.

Chelipoda contracta sp. nov. (Figure 43)

Length 2 mm. Yellowish, head blackish. Front trapezoidal, usually slightly wider at front ocellus than long; third antennal joint one-half longer than deep, brown except the black tip or all yellow, arista equal in length to antenna or slightly longer, blackish or pale. Thorax shorter than in *elongata*, dorsum thinly white-dusted, pleura all white-pruinose, sometimes a little thinner under notopleural suture, discal dorsocentral rather small.

Pygidium small, compacted, attaining fifth segment; styles of female short and broadly oval, the visible part scarcely longer than wide. Front tibiæ five-sixths the length of their femora.

Type male, Petersham, Massachusetts, 9 June 1932; allotype, same locality, July, 1926. Over ninety specimens from the following localities:—Connecticut: Redding, May, June; Massachusetts: Boston, June; Maine: Seal Harbor, July; New Hampshire: Mt. Washington, July, Mt. Monadnock, July; New York: Millwood, June (H. K. Townes), Tuxedo, 29 May, Ithaca, June; Ontario: Waubamic, June (H. S. Parish); Montana: Flathead Lake, August; Washington: Nooksack, May, Bellingham, July, Lake Cushman, July, Mount Vernon, July, Mt. Constitution, July, Mt. Baker, August, Index, August, Sultan, August; British Columbia: Selkirk Mts., August (J. C. Bradley), Abbotsford, August.

The distribution of this species is noteworthy. There are two widely separated centers, in Northwestern Washington and in New England, both with mountain localities much in evidence. A female from Divide County, Wisconsin, may belong here, but with greater probability may prove to be associated with some other species when its male is discovered. Some of the Western specimens have the front slightly longer than wide at the front ocellus.

Chelipoda elongata Melander (Figures 45, 46)

Length 2 mm. Yellowish, with black head. Front oblong, longer than width at front ocellus, face almost parallel-sided, in width about one-third the second antennal joint; third antennal joint black, triangular, twice as long as deep, arista dirty whitish, one and three-fourths the length of the antennæ or shorter. Thorax relatively long and narrow, dorsum very lightly dusted, subshining, pleura with lower portion white pruinose when viewed from above, the upper part shining, a well-marked horizontal line of demarcation between the two, discal dorsocentral small. Pygidium compressed, attaining the fifth segment, penis groove distinct and forming a keel to the pygidium, penis sheath rather erect and straddling the penis where it emerges from the groove, about as long as the thin valves; styles of female slender, distinctly over twice as long as wide. Front tibiæ about two-thirds their femora. Wings more bluntly rounded at apex than in *mexicana.*

Cotypes from Massachusetts, Wisconsin, and South Dakota, the last here designated as a neotype. I have the species from Ontario, New York, Rhode Island, Maryland and Florida. The species has been recorded also from Connecticut, Maine, New Hampshire and New Jersey, but it is not certain if these records pertain to *elongata* or to some of the related new species here described.

Chelipoda mexicana Wheeler and Melander (Figure 47)

Length 2 mm. Testaceous, with black head. Front trapezoidal, as long as width before front ocellus, upper half of face almost linear; third antennal joint oval, its lower edge rounding, one-fourth longer than deep, black, arista black, one and one-third the length of third joint. Thorax typically with two abbreviated dark vittæ in front. Pygidium reaching to fourth abdominal segment, visible part of valves small, almost hemispherical, fringed with microscopic black denticles, penis filamentous, free beyond lower angle of pygidium, the wishbone-like attachment very thin and easily overlooked, penis sheath expanded into two thin slipper-shaped contiguous plates which lie in a horizontal plane over the apical part of the penis; female abdomen blunt, styles not projecting. Wings less bluntly rounded at apex than in the Northern species.

Type, female, Guerrero, Mexico, in the British Museum. Fifty specimens from La Suiza de Turrialba, Costa Rica, taken throughout the year by Pablo Schild, lack the two short darkened stripes of the thorax noted in the type. One of these, designated as the neallotype, furnished the information on the male genitalia.

Chelipoda præstans sp. nov. (Figure 48)

Length 2 mm. Front trapezoidal, slightly wider than long; antennæ brown, third joint oval, one-fourth longer than deep, arista one-fourth longer than third joint, blackish. Thorax shorter and wider than in *elongata,* dorsum white-dusted, not shining, lower half of pleura white-pruinose, upper half faintly so but the line of demarcation not pronounced as in *elongata,* discal dorsocentral moderate. Pygidium attaining third segment of abdomen, sometimes reaching second segment; styles of female triangular with rounded tip, about twice as long as wide at base. Front tibiæ about five-sixths the length of femora.

Type and allotype: Redding, Connecticut, 10 June 1929. Thirty-five specimens from: Maine: Seal Harbor, July; Massachusetts: Petersham, July; Connecticut: Redding, May and June; New Hampshire: Pinkham Notch, July, Mt. Washington, Franconia; Ontario: Waubamic, July (H. S. Parish); New York: Bear Mountain, July; Pennsylvania, Chester County (J. C. Bradley); Virginia: Shenandoah Park, June.

Chelipoda rhabdoptera Melander (Figure 50)

Length 2 mm. Front nearly square, face almost linear, widening at bottom; third antennal joint short oval, blackish, arista one and one-third times the antennal length, dark. Dorsum of thorax typically black, white pruinose in posthumeral region, pleura lightly pruinose, the lowermost part of pleura lighter in color, discal dorsocentral as long as lateral bristles, the two or three metapleurals rather long and dark. Pygidium almost reaching fourth segment of abdomen, the fifth segment shortened above, penis free, filamentous.

Holotype from La Suiza de Turrialba, Costa Rica, April. Another male from same locality, September 1924, has the mesonotum brown. The dark body and pictured wings make this species easily recognized.

Chelipoda sicaria sp. nov. (Figure 49)

Length 2.25 mm. Head black, cinereous-coated, cheeks pale-pubescent, thorax testaceous, antennæ, mouthparts, legs, halteres, venter and apex of pygidium yellow, tergites and heel of pygidium fuscous. Metapleura with a group of six or seven setulæ; pygidium reaching the fifth tergite, the hypandrium short and stout, penis thin and tubular, projecting forward, tip of penis-sheath thin and curving back. Front femora stout, with dusky hairs above and with two rows of seven strong black setæ beneath, only a single close row of coarse black denticles along the inner flexor face. Wings flavescent, first basal cell longer than the second by length of anterior crossvein.

Holotype and allotype: Great Smokies National Park, Newfound Ridge on the Tennessee–North Carolina line, 11 July 1941. Paratypes: a male and female, taken with the types and a female on the trail to Andrews Bald, North Carolina, 9 July 1941.

The arista and bristles may not be as dark as in the type. *Sicarius,* Latin, a stabber, an assassin.

Chelipoda vocatoria Fallen (Figure 51)

Length 2 to 2.5 mm. Testaceous, middle of dorsal side of thorax and abdomen more or less brownish. Front trapezoidal, as long as width at front ocellus, the anterior part white pollinose, face coarctate at middle, lower occipital hairs gray; arista densely pubescent with yellowish to brown hairs. Dorsum of thorax moderately dusted, the medial stripe brownish, pleura evenly but thinly white pruinose. Pygidium massive; terminal styles of female elongate ovoid, about twice as long as width at base. Basal bristles of front coxæ sometimes hairlike, spinous bristles of femora especially strong and dark, about as long as diameter of femur, three or four toward base of femur in inside row.

Recorded in the New York List from Ithaca and Speculator, the last from a determination in the New York State Museum. *C. vocatoria* of the New Jersey List is *elongata.* It is not certain that this European species occurs in America.

GENUS *PHYLLODROMIA* ZETTERSTEDT

The only real difference between *Chelipoda* and *Phyllodromia* is the presence or absence of the posterior crossvein. *Phyllodromia* has therefore been generally regarded as a subgenus of the earlier described *Chelipoda,* though Engel in the "Fliegen der palaearktischen Region" gives it generic standing. There has been much confusion in the application of the names, the catalogues interchanging them because of the misunderstanding of the genotypes.

But one species, *melanocephala* Fabricius, is found in Europe; two species occur in India and one in Formosa. The following species adds America to the distributional list.

Phyllodromia americana sp. nov. (Figure 52)

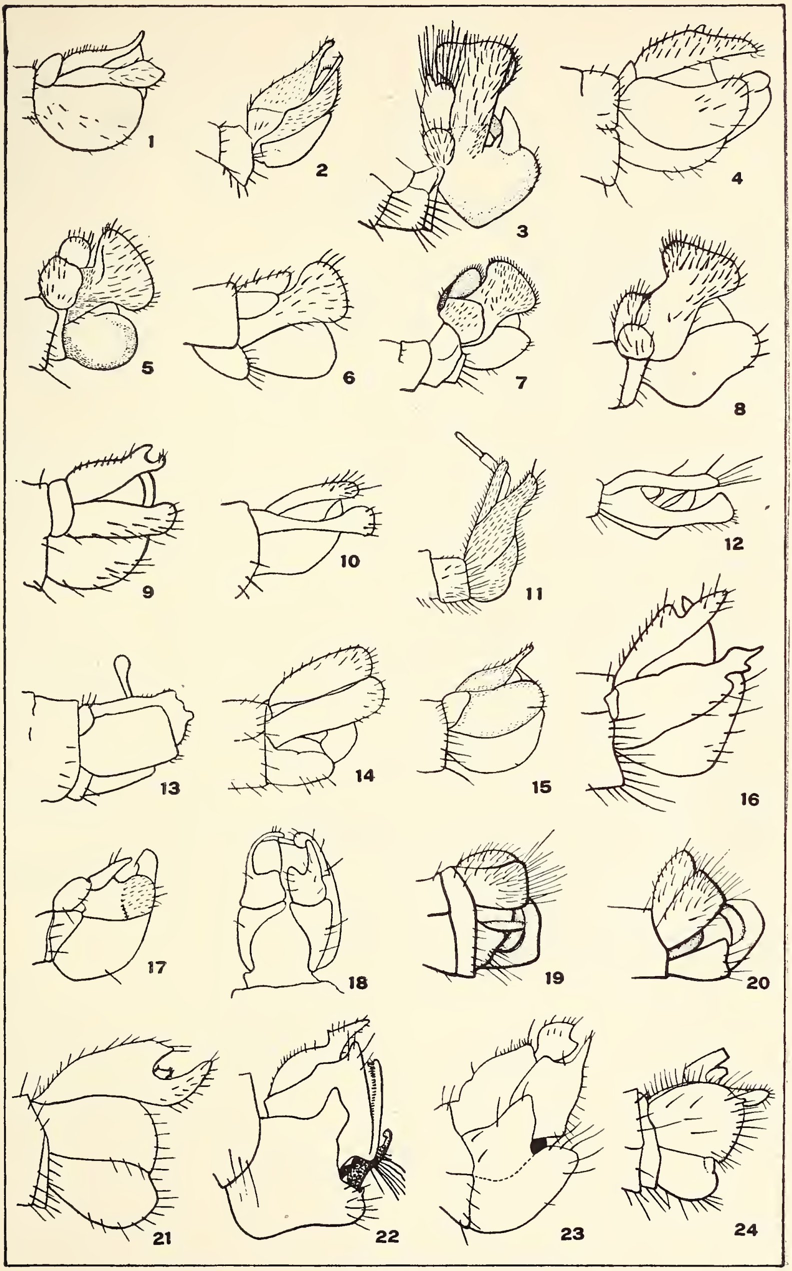
Length 1.75 mm. Body and legs testaceous, head and last tarsal joint blackish. Front trapezoidal, slightly longer than width at front ocellus; face about half the width of first antennal joint, gradually widening below; third antennal joint short oval, brownish, arista one-third longer than antenna, brownish. Thorax lightly dusted, bristles pale, discal dorsocentrals moderate, three pale metapleural hairs. Pygidium small, globular, attaining fifth segment, valves spindle-shaped, inner valves (homologs of penis sheath) curved and with thin black margin, penis short and thick; eighth tergite of female deeply sunken in middle, the terminal styles short and broadly oval. Front tibiæ five-sixths the length of femora. Wings hyaline, veins testaceous, anal cell shorter than second basal by about the length of anal vein.

Type: Mount Monadnock, New Hampshire, 26 July 1926. Nine paratypes: Great Falls, Virginia, 21 June, 1931; Burton and Spring Creek, Georgia (J. C. Bradley); Hasecock and Millwood, New York (H. K. Townes); Westerly, Rhode Island (M. Chapman).

Ph. melanocephala Fabr. has the styles of female abdomen narrowly triangular, the male with large and strongly compressed pygidium, the penis sheath acicular, extending forward and clasping the penis.

PLATE XXII

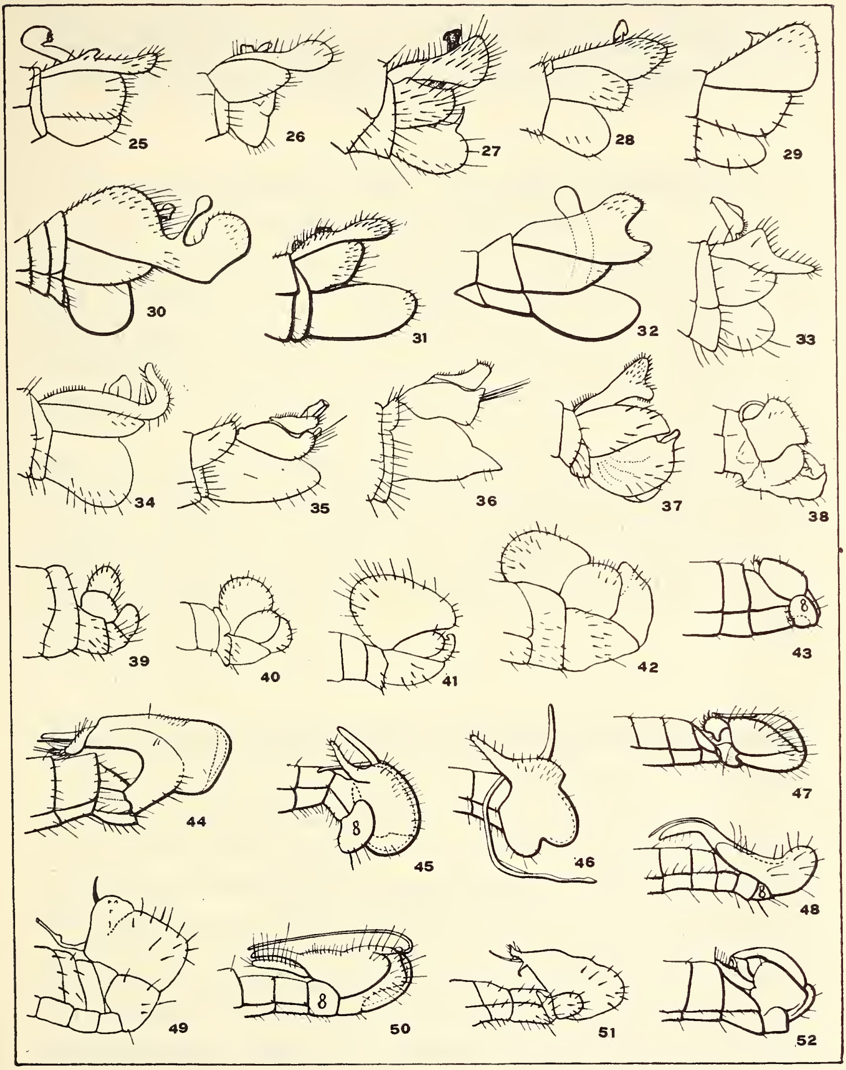
Figure 1. Pygidium of *Hemerodromia brachialis* Melander.
Figure 2. *Hemerodromia captus* Coquillett.
Figure 3. *Hemerodromia coleophora* Melander.
Figure 4. *Hemerodromia divinator* n. sp.
Figure 5. *Hemerodromia empiformis* Say.
Figure 6. *Hemerodromia empiformis* var. *brevifrons* n. var.
Figure 7. *Hemerodromia empiformis* var. *exhibitor* n. var.
Figure 8. *Hemerodromia empiformis* var. *sufflexa* n. var.
Figure 9. *Hemerodromia extispex* n. sp.
Figure 10. *Hemerodromia haruspex* n. sp.
Figure 11. *Hemerodromia jugulator* Coquillett.
Figure 12. *Hemerodromia melanosoma* n. sp.
Figure 13. *Hemerodromia rogatoris* Coquillett.
Figure 14. *Hemerodromia stellaris* n. sp.
Figure 15. *Hemerodromia superstitiosa* Say.
Figure 16. *Hemerodromia vates* n. sp.
Figure 17. *Hemerodromia vittata* Loew.
Figure 18. *Hemerodromia vittata* Loew, dorsal aspect.
Figure 19. *Colabris coxalis* Melander.
Figure 20. *Colabris rufescens* Melander.
Figure 21. *Chelifera Banksi* n. sp.
Figure 22. *Chelifera cirrata* n. sp.
Figure 23. *Chelifera ensifera* n. sp.
Figure 24. *Chelifera notata* Loew.



HEMERODROMIINÆ

PLATE XXIII

Figure 25. *Chelifera Lovetti* n. sp.
Figure 26. *Chelifera obsoleta* Loew.
Figure 27. *Chelifera palloris* Coquillett.
Figure 28. *Chelifera precatoria* Fallen (Europe).
Figure 29. *Chelifera varix* n. sp.
Figure 30. *Chelifera scrotifera* n. sp.
Figure 31. *Chelifera rastrifera* n. sp.
Figure 32. *Thanategia defecta* Loew.
Figure 33. *Thanategia stuprator* n. sp.
Figure 34. *Thanategia recurvata* n. sp.
Figure 35. *Metachela albipes* Walker.
Figure 36. *Metachela collusor* Melander.
Figure 37. *Neoplasta hebes* n. sp.
Figure 38. *Neoplasta mexicana* Melander.
Figure 39. *Neoplasta puerilis* n. sp.
Figure 40. *Neoplasta scapularis* Loew.
Figure 41. *Neoplasta scapularis* var. *megorchis* n. var.
Figure 42. *Neoplasta spadix* n. sp.
Figure 43. *Chelipoda contracta* n. sp.
Figure 44. *Chelipoda albiseta* Zetterstedt (Europe).
Figure 45. *Chelipoda elongata* Melander.
Figure 46. *Chelipoda elongata* Melander, ringent.
Figure 47. *Chelipoda mexicana* Wheeler and Melander.
Figure 48. *Chelipola præstans* n. sp.
Figure 49. *Chelipoda sicaria* n. sp.
Figure 50. *Chelipoda rhabdoptera* Melander.
Figure 51. *Chelipoda vocatoria* Fallen (Europe).
Figure 52. *Phyllodromia americana* n. sp.



HEMERODROMIINÆ

DECEASED

Frank Edward Watson, May 11, 1877—November 6, 1947. Life member and honorary member of the NEW YORK ENTOMOLOGICAL SOCIETY. An obituary will appear in a later issue.

A JAPANESE WEEVIL, PSEUDOCNEORRHINUS SETOSUS (RŒLOFS)

During September 1947, specimens of this weevil were taken at South Orange, New Jersey (identified by J. C. Pallister). Previous records (Connecticut State Entomologist Report, 1923) report that the weevil was first collected in the United States in Connecticut in 1920 by M. P. Zappe. He took adults, feeding on *Bidens* sp.

In South Orange, New Jersey, heavy adult feeding occurred on privet, rhododendron, mimosa, and Japanese barberry. Preliminary scouting indicates that this insect is established over a considerable area in northern New Jersey. So far as is known the life history of this weevil has not yet been studied.—F. A. Soraci.

MORE ENTOMOLOGISTS RECOMMENDED IN 1858

Francis Gregory Sanborn a collector and one time clerk to C. L. Flint, the secretary of the Massachusetts State Board of Agriculture, later employed by the Boston Society of Natural History, the Bussey Institution, the Worcester Society of Natural History, etc., wrote in 1858 of the increased interest of scientific men, students, and farmers, in insects, and recommended the employment of one or more entomologists by every town or village "who should be prepared to describe the destroyers of agricultural products, to classify and name each specimen brought to them for examination, and direct the best means of treating it."—H. B. W.

THE DEATH–FEINTS OF IDIOBATES CASTANEUS KOCH AND BOLETOTHERUS BIFURCUS FAB. (COLEOPTERA, TENEBRIONIDÆ)

BY HARRY B. WEISS

During 1945 there was an opportunity to determine the duration of successive death-feints of two species of tenebrionid beetles, namely *Idiobates castaneus* Koch and *Boletotherus bifurcus* Fab., and the following notes are the results of the timing tests that were made.

Idiobates castaneus Koch

In this species the death-feint was initiated by dropping the beetles through a distance of several inches or by pressing or tapping the ventral surface of the thorax. The number of successive feints that could be induced in this manner varied from 5 to 19 for the 10 beetles that were tested. After an individual would no longer feign death it was discarded for a new individual that had not been tested previously. As soon as an individual recovered from a death-feint, it was immediately stimulated, so that it went into another one, and this was kept up until it no longer responded. The total length of time it was possible to produce death-feints in this way varied from 50 seconds to 1,180 seconds, or from less than 1 minute to almost 20 minutes.

In the following table the records for each beetle are listed, together with a figure showing the average duration of the successive death-feints. These averages varied from 17 to 127 seconds, but they do not show the large variation that occurred in the duration of single death-feints, which ranged from 1 to 900 seconds. It was impossible to initiate each death-feint with the same amount of stimulation, and the variations in duration may be due, in some part, to variations in the degree of stimulation. Their behavior at 76° F., was substantially the same as their behavior at 70° F., and it made no difference whether they were placed on their dorsal or ventral surfaces during the death-feints.

DURATION OF SUCCESSIVE DEATH-FEINTS OF *Idiobates castaneus* KOCH AT TEMPERATURES OF 70° F. AND 76° F.

Beetle A 70° F. Seconds	Beetle B 70° F. Seconds	Beetle C 70° F. Seconds	Beetle D 70° F. Seconds	Beetle E 76° F. Seconds	Beetle F 76° F. Seconds	Beetle G 76° F. Seconds	Beetle H 76° F. Seconds	Beetle I 76° F. Seconds	Beetle J 76° F. Seconds
4	7	5	460	4	5	6	3	17	47
3	103	22	13	125	9	3	27	4	70
7	28	150	35	10	310	2	14	3	8
480	70	190	45	165	505	900	4	2	240
7	15	55	80	6	2	3	1	18	2
15	6	422	633	10	4	5	1	14	1
		Av.	Av.		2	1	50	85	1
9	6	84	127	4			Av.		
5	9			7	837	14	8	3	3
8	5			3	Av.				
7	17			1	120	240		5	1
6	7			50		3		151	6
3	8			7				Av.	
2	5			8		2		17	2
4	10			6		1			1
1	5			4		1,180			4
561	7			7		Av.			
Av.						98			1
37	4			3					387
	6			2					Av.
	1			422					28
	319			Av.					
	Av.			23					
	17								

DURATION OF SUCCESSIVE DEATH-FEINTS OF *Boletotherus bifurcus* FAB. AT TEMPERATURES OF 77° F. AND 92° F.

Beetle A Resting on dorsum Mech. stim. 77° F. Seconds	Beetle B Resting on dorsum Air stim. 77° F. Seconds	Beetle C Resting on ventral surface Mech. stim. 77° F. Seconds	Beetle D Resting on ventral surface Air stim. 77° F. Seconds	Beetle E Resting on ventral surface Mech. stim. 92° F. Seconds	Beetle F Resting on dorsal surface Mech. stim. 92° F. Seconds
120	5	105	20	900	280
145	30	220	253	165	130
80	20	75	23	7	80
405	28	323	92	24	60
83	3	265	6	6	6
195	15	83	15	115	16
115	3	200	17	85	11
180	9	327	11	100	69
420	22	95	9	3	235
260	15	76	16	5	27
30	8	20	8	7	8
92	8	200	6	3	3
8	85	50	3	3	4
360	43	85	12	5	11
22	12	190	3	4	2
30	24	180	19	3	2
55	45	100	8	3	1
180	14	25	9	2	1
152	27	75	5	2	1
100	8	20	9	4	2
12	5	16	8	2	1
24	9	30	12	7	8

DEATH-FEINTS OF *Boletotherus bifurcus* FAB. (CONTINUED)

Beetle A Resting on dorsum Mech. stim. 77° F. Seconds	Beetle B Resting on dorsum Air stim. 77° F. Seconds	Beetle C Resting on ventral surface Mech. stim. 77° F. Seconds	Beetle D Resting on ventral surface Air stim. 77° F. Seconds	Beetle E Resting on ventral surface Mech. stim. 92° F. Seconds	Beetle F Resting on dorsal surface Mech. stim. 92° F. Seconds
6	50	4	10	1	2
3,074	19	6	6	2	1
Av. 134	11	8	8	4	3
	23	2,778	6	2	1
	5	Av. 111	4	3	73
	8		24	2	68
	6		5	1	32
	7		5	1	33
	5		6	1	5
	3		2	1,472	3
	7		6	Av. 47	2
	6		5		1
	12		5		1,182
	11		7		Av. 35
	8		8		
	32		671		
	20		Av. 18		
	5				
	676				
	Av. 17				

Boletotherus bifurcus Fab.

This species feigns death at the slightest touch, and the death-feints for the six individuals tested were initiated by first picking them up and then inducing the successive death-feints by gently tapping, with a pencil, their ventral and dorsal surfaces. The durations of the death-feints were apparently not affected by the positions of the beetles. Two methods of stimulation were used—a mechanical stimulation or tapping and air stimulation. In the latter case, two or three puffs of air from a small hand-bellows, such as is used to distribute "bed-bug" powder, were directed against the insects.

At a temperature of 77° F., the average duration of a death-feint induced by mechanical means varied from 111 seconds to 134 seconds as compared with averages of 17 and 18 seconds, for air stimulation. As the degree of air stimulation was more constant and lighter than the mechanical pressure, this indicates that some correlation exists between the force of the stimulus and the duration of the death-feint. Although large variations occurred in the durations of the death-feints, the figures in the following table show that air-stimulated death-feints were, on the whole, relatively short. An increase of 15 degrees in the Fahrenheit temperature also decreased the durations of the death-feints and hastened recovery.

The number of successive death-feints that could be induced among the 6 beetles varied from 23 to 40 and the total durations of the combined death-feints for each beetle varied from 671 seconds to 3,074 seconds or from about 10 minutes to 51 minutes.

EARLY FEMININE ENTOMOLOGISTS IN AMERICA

Dorothy Lynde Dix best known as a philanthropist and for her work in prison reform published some notes on *Aranea aculeata, Phalaena antiqua* and several species of Papilio in 1831 in the American Journal of Science and Arts. These were probably written while she was teaching school in Boston.

Margaretta Hare Morris, of Germantown, Pa., was the first woman elected to membership in the Pennsylvania Academy of Natural Sciences. She often made communications to scientific societies on economic insects and her writings involved the Hessian fly (1841), the periodical cicada (1848), and *Cecidomyia culmicola* (1849) a species which she thought had previously been confused with the Hessian fly. In 1859 she wrote upon insects injurious to fruits for the ''Horticulturist.'' Her entomological conclusions were not always correct.

Charlotte de Bernier Taylor, of Savannah, Georgia, became quite skilled in making entomological observations and in writing entomological articles for the popular journals. Quite a few of her papers appeared in Harper's Magazine after 1857. In 1858–59 she wrote ''Microscopic Views of the Insect World'' for Orange Judd's ''American Agriculturist.'' She illustrated her own articles and was sometimes assisted by her daughters.—H. B. W.

A NEW GENUS AND SPECIES OF ANT FROM GUATEMALA (HYMENOPTERA, FORMICIDÆ)

By Marion R. Smith

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The species described below possesses such unusual characters that I have assigned it to a new genus, *Perissomyrmex,* the name meaning "strange ant." Though definitely belonging to the subfamily Myrmicinæ, its exact tribal placement is questionable. This is especially true since no winged forms are available for study. Even though these forms are lacking, I am provisionally placing the species in the tribe Myrmecinini.

The most outstanding characters of the new genus are: The 9-segmented antenna with a more or less distinct 3-segmented club; median region of the clypeus with denticulate anterior border; lateral border of the clypeus forming a trenchant ridge in front of the antennal fossa; frontal carina poorly developed, not lobed, thus exposing base of scape and fossa; mandible elongate, with 3-toothed masticatory border and another tooth on the superior border; promesonotal suture obsolescent or absent, mesoepinotal impression well developed; epinotum with a pair of spines; anterior tibia with well developed, pectinate spur, each middle and posterior tibia without spurs; petiole and postpetiole nodiform, the former also pedunculate.

Ants of this new genus resemble those of *Pristomyrmex,* but the resemblance is more superficial than real. There is a difference in the number of antennal segments, presence or absence of tibial spurs, development of frontal carinæ and other characters; furthermore, no *Pristomyrmex* is known to occur in the Americas, the genus being native to Indo-China, Japan, Malaysia, New Guinea and Australia. *Perissomyrmex* may be an ancient genus whose taxonomic position and affinities cannot be determined until more specimens are available for study.

Worker.—Small, apparently monomorphic. Head large; posterior border not emarginate; sides convex, strongly divergent anteriorly. No ocelli. Eye located anterior to the middle of the side of the head, protuberant but small. Frontal area distinct, subtriangular. Frontal carina very poorly developed, not lobed, thus exposing the base of the scape and the antennal fossa. Median region of the clypeus flattened, its anterior border with 4 more or less irregular teeth, the 2 central teeth largest; lateral border of clypeus extended in front of antennal fossa as a trenchant ridge. Antenna 9-segmented; apex of scape surpassing the posterior border of the head when the scape is fully extended posteriorly; last 3 funicular segments enlarged, forming a more or less distinct club. Mandible elongate; masticatory border with 3 teeth, superior border with a prominent tooth slightly anterior to its middle.

Promesonotal suture obsolescent or absent. Mesoepinotal impression well developed. Epinotum bearing a pair of sharp spines which are not as long as the space between their apices, the spines divergent but also directed posteriorly and upward. In profile, the promesonotum evenly arched, meeting the almost horizontal base of the epinotum at the mesoepinotal impression. Legs slender but with slightly incrassated femora and tibiæ. Anterior tibia with a well developed, pectinate spur, middle and posterior tibiæ without spurs. Petiole and postpetiole from above, slender, with a compressed appearance; in profile, the petiole pedunculate and bearing a convex node; the postpetiolar node higher than that of the petiole and its dorso-ventral axis with an oblique slope.

Gaster from above, oval, broadest at the base and without humeri, the basal segment occupying most of the gaster.

Genotype.—Perissomyrmex snyderi, new species.

Perissomyrmex snyderi, new species

(Figs. 1, 1a, 2)

WORKER.—Length 3.5 mm.

Frontal area, dorsal surface of petiole and postpetiole, and gaster, smooth and shining. Head and thorax with a rugulose sculpturing which has a general longitudinal trend, that on the pronotum however somewhat arcuate and that on the epinotum transverse. Mandible coarsely striated.

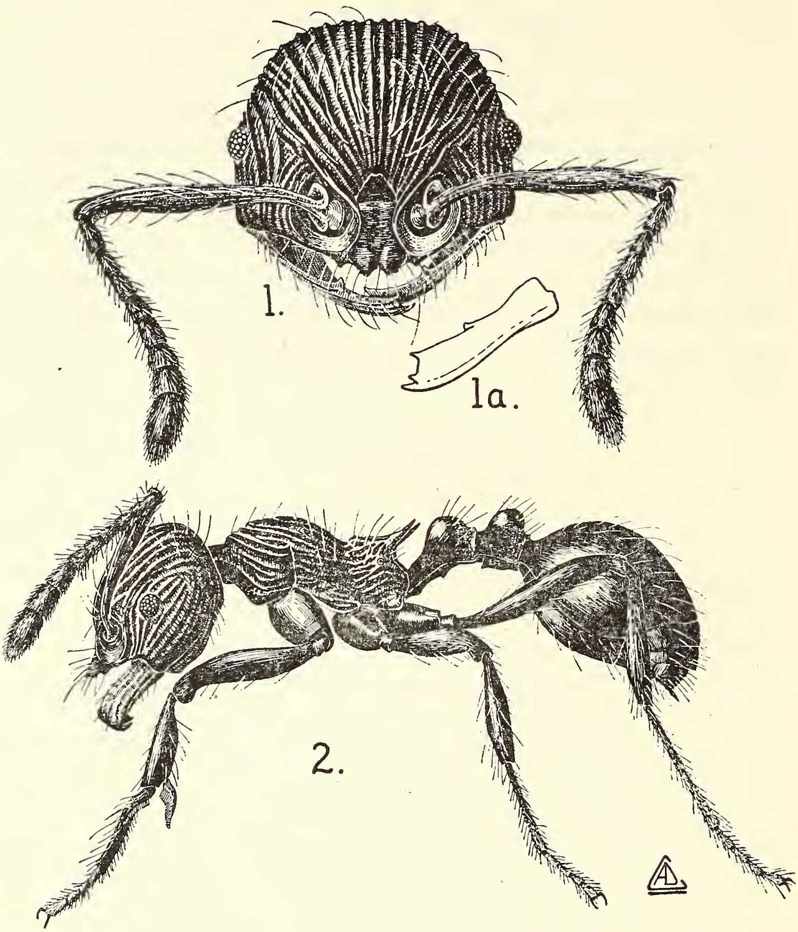
Body and appendages covered with moderately abundant, long, simple, yellowish hairs. Clypeus with a row of anteriorly directed hairs which are of variable length.

Body black; mandible lighter, tarsi light brown.

Type locality.—Guatemala (specific locality unknown).

Described from a holotype and a paratype worker collected at Hoboken, N. J., January 13, 1947, by Miss Ruth F. Olsen of the inspection force of the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture. The ants were found in the tuberous root of a begonia plant, the shipment of which originated in Guatemala. Both specimens have been placed in the United States National Museum; they bear U. S. N. M. No. 58310. The species is named for Dr. Thomas E. Snyder, the eminent termite specialist.

The paratype does not differ materially from the holotype except that one of its lateral clypeal teeth is of approximately the same size as either one of the central clypeal teeth. The paratype is also slightly shorter, 3.4 mm.



Worker of *Perissomyrmex snyderi* new species. Fig. 1, head. Fig. 1a, mandible. Fig. 2, body in profile. (Illustrations by Arthur D. Cushman.)

THE ROLE OF THE ANTENNÆ IN THE ORIENTATION OF CARRION BEETLES TO ODORS

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INTRODUCTION

It is now clear beyond reasonable doubt that the principal site of olfactory receptors in the majority of insects is on the antennæ (Marshall, 1935). There is also an increasing number of indications pointing to the existence of auxiliary olfactory receptors on the palpi (Wigglesworth, 1939). Furthermore, it appears that the ability to perceive odors emanating from a distance resides in the antennæ while the palpal end-organs are relegated to the perception of odors from sources near at hand. There is convincing evidence that this is certainly the case in dung and carrion beetles. Warnke (1931) has demonstrated that species of *Geotrupes* require the presence of the apical lamellæ of the antennæ to orient successfully to dung from distances as great as 2 or 3 meters. In the absence of the antennæ these beetles are able to locate dung from a distance of a few centimeters only, and then, provided the palpi have not been removed.

Warnke's experiments were conducted for the most part indoors and involved relatively short distances. The experiments reported below were designed (1) to supply data relative to the mechanism of orientation to carrion in the field under conditions involving maximum distances and (2) to compare the receptors, involved in long range olfactory orientation, of several species of carrion beetles of the family Silphidæ with those of *Geotrupes,* a member of the Scarabæidæ. Since preliminary experiments designed to test the function of the palpi confirm Warnke's work in every respect; this phase is not reported at great length.

MATERIALS AND METHODS

Four stations were established in a northern New England conifer forest. Stations 1, 2, and 3 were equidistant ($\frac{1}{4}$ mile) from each other. Station 4 was located 300 feet from station 3. At each station the fresh carcass of a red squirrel (*Tamiasciurus hudsonicus loquax*) was hung five feet from the ground in a tree. This procedure was adopted because by forcing beetles to fly to the carcass it reduced the chances of accidental discovery so frequently a feature of orientation to buried carrion. Moreover, the carcass retained its attractiveness over a longer period of time, and each beetle could be captured with a minimum of disturbance to its fellows. Beetles usually began arriving the second day and continued to arrive for a period of 15 days. At this point the carcass was more or less completely cleaned and no longer attracted insects.

Each morning all new arrivals were collected, operated upon, marked with a spot of paint on the pronotum, and liberated at a minimum distance of 15 feet from the base of the tree in which the carcass hung. Operations involved amputation of one or both antennæ at the scape or removal of various numbers of apical segments as outlined in Table II. No anesthetic was used. Captures of returned beetles were made at irregular intervals during the day. All those recaptured were retained for microscopic examination.

In this manner the orientation to carrion of 314 *Necrophorus*, 75 *Silpha noveboracensis* Forst., and 30 *Silpha americana* L. was studied.

THE ROLE OF THE ANTENNÆ

From the results tabulated in Table I it is strikingly apparent that the antennæ are in some manner involved in orientation to odors from a distance. Not a single beetle of the 142 from which each antenna had been severed at the scape returned whereas 60.6 per cent of those lacking one entire antenna were recaptured.

Observations of the reactions of beetles lacking both antennæ did not reveal any immediately apparent abnormality of behavior. It is especially significant that specimens with bilateral amputation were capable of normal flight a few minutes subsequent to the operation. None of the erratic behavior usually associated with antennectomy was observed. In caged specimens neither longevity nor ability to reproduce was impaired. A further indication that bilateral injury of the antennal nerve is not a major

TABLE I

EFFECTS OF PARTIAL AND COMPLETE ANTENNECTOMY ON THE ABILITY OF CARRION BEETLES TO ORIENT TO ODORS FROM A MINIMUM DISTANCE OF FIFTEEN FEET

Species	Lacking 1 antenna		Lacking both antennæ		Lacking tips of antennæ		Controls	
	No. liberated	Per cent returned	No. liberated	Per cent returned	No. liberated	Per cent returned	No. liberated	Per cent returned
Necrophorus								
tomentosus Weber	78	59.0	110	0	56	27.0	70	87.5
vespilloides Hbst.								
Silpha noveboracensis Forst.	13	61.5	21	0	21	50.0	20	85.0
Silpha americana L.	8	75.0	11	0	6	33.3	5	80.0
Total	99	60.6	142	0	83	32.5	95	85.2

factor preventing normal activity and orientation is seen in the results of experiments in which one or more apical segments of both antennæ of 83 beetles were amputated. Thirty-two and one-half per cent of this group were recaptured. As will be shown below, the relatively low percentage of returns in this category resulted from the fact that tips were cut at different segmental levels without regard to the minimum number of segments required for orientation.

From these observations it appears that the inability of beetles lacking both antennæ to orient to odors is due neither to impairment of normal activity nor to interference with flight functions but rather to the loss of receptors essential to the perception of odors emanating from a distant source.

On the other hand, beetles lacking both antennæ are still able to locate buried carrion from distances of a few (in this case 30) inches. It was on the basis of this type of experiment that Abbott (1927, 1927a, 1936, 1937) concluded that the antennæ of *Necrophorus americanus* (Oliv.), *N. orbicollis* (Say), *N. tomentosus* (Weber), *Silpha inæqualis* Fabr., and *Trirhabda canadensis* (Kby.) are of little importance in orientation to odors and that the olfactory sense is widely scattered over the body. From similar experiments employing animals from which the palpi alone had been removed he concluded that the palpi did not bear olfactory receptors. Unfortunately beetles lacking both antennæ and palpi were not tested. When this is done beetles are no longer able to locate buried carrion. In these respects the Silphidæ are like the Scarabæidæ. Warnke (1931) has shown this to be the case with *Geotrupes* which possess on the antennæ olfactory receptors suited to long range perception and on the palpi auxiliary receptors suited to short range perception. The experiments reported here confirm Warnke's results and indicate that comparable situations exist in Scarabæidæ and Silphidæ.

It is probable that the chief difference between long range and short range perception involves either the thresholds of individual sensilla or a total intensity of stimulation associated with the population density of receptors.

LOCALIZATION OF OLFACTORY RECEPTORS

Because operations involving the removal of individual segments of the flagellum were conducted under field conditions it was necessary to check microscopically the extent of injury on each beetle after it was recaptured. The results of this post-experimental examination (Table II) show that the presence of

TABLE II

Analysis of the Extent of Antennal Amputation on Recaptured Beetles

Number of beetles	Number of segments of flagellum removed	
	Right antenna	Left antenna
3	1	1
3	1	3
3	1	4
2	2	2
3	2	3
13	2	10

a minimum of one lamella (the apical three segments forming the club of each antenna) is essential to distance orientation. No insect returned which lacked the apical three segments of each antenna although 13 specimens lacking one entire antenna as well as two lamella from the remaining antenna were recovered.

These findings are in complete agreement with the conclusions of Warnke. It is thus apparent that members of the Silphidæ as well as of the Scarabæidæ possess in the apical three segments of the flagellum receptors which are essential to orientation to odors from a distance.

ANTENNAL SENSE ORGANS

Examination of the lamellæ of the four species studied reveals a picture comparable in most respects to that existing in *Geotrupes*. Reference to Fig. 1 shows that the lamellæ in contrast to the other antennal segments possess several hundred sensilla.

Four forms are found here:

(1) thick walled hairs (sensilla trichodea)
(2) thin walled hairs of various lengths (the sensilla chætica of Warnke)
(3) short curved sensilla trichodea (the *gebogene Haare* of Warnke)
(4) thin walled tapering cones (sensilla basiconica).

By contrast the remaining segments of the antenna are remarkably free of sensilla. The same three basic types are found here

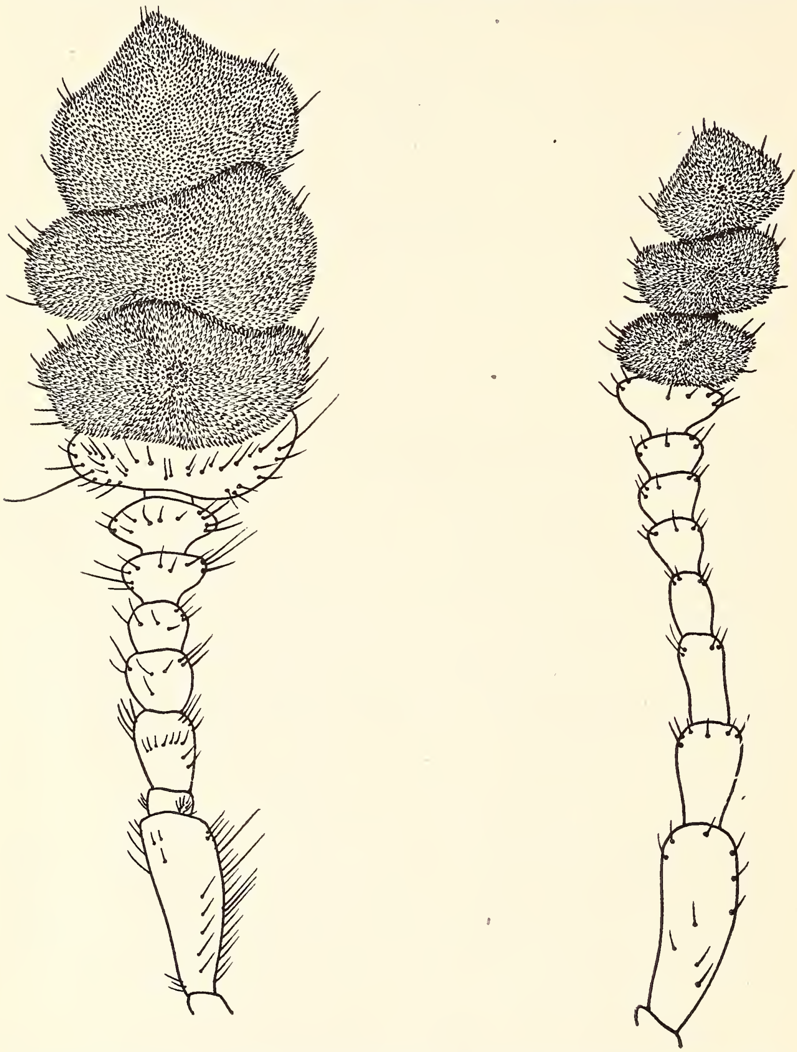

FIG. 1. Dorsal view of an antenna of *Necrophorus tomentosus* Weber (left) and of *Silpha noveboracensis* Forst., (right) showing the distribution of sensilla.

as in *Geotrupes:* thick walled sensilla trichodea, thin-walled hairs of various lengths, and a few sensilla cœloconica. The outstanding difference in the sensory complement of the lamellæ as contrasted with the rest of the antenna is the presence in the former of thousands of short curved sensilla trichodea and delicate sensilla basiconica (Sinneskegel). It would seem, therefore, that one or both of these types subserve an olfactory function. Structurally the latter appear more suited to the task.

MECHANISM OF ORIENTATION

Since there is obviously a limit to the distance over which an odor is effective, it is apparent that dung and carrion beetles cruise more or less at random through the forest until they encounter the periphery of a center of odor diffusion or currents of odor-bearing air. The distance over which the odor is operative depends naturally upon many variables of which the most important is air movement. Under favorable conditions orientation is speedily accomplished. Marked beetles liberated in the foregoing experiments frequently relocated the carrion from a distance of 30 feet in a matter of 15 minutes. A major portion of this time was taken with aimless wandering prior to flight. It is of particular interest that marked beetles liberated 15 feet to the windward of station 3 were frequently recaptured at station 4 some 300 feet distant.

Observations of returning beetles revealed that several flew in from distances of the order of 50 feet in a more or less wavering path and landed either on the trunk of the tree bearing the carcass or on that of a neighboring tree five to six feet away. From this point, after waving the antennæ and extending the lamellæ, the beetle usually flew directly to the carcass.

The speed with which the insect is able to return to the source of an odor from distances in excess of 15 feet and the high percentage of returns from those liberated at this distance points to the existence of a klino-kinetic mechanism rather than truly random movement. As Fraenkel and Gunn (1940) point out, in the confines of a laboratory the chance of locating bait by purely random movement is great. Under the conditions of these experiments the chances are greatly reduced.

The behavior of beetles with only one antenna was remarkably similar. No pronounced tendency toward circus movements was observed. Animals which landed on the trunks of adjoining trees behaved in every respect like the controls, *i.e.*, the antenna was moved about and the lamellæ extended after which the animal flew directly to the carcass.

It would thus appear that as the gradient becomes steeper the insect is able to orient by means of a klino-tactic mechanism. Circus movements as reported for *Geotrupes* following unilateral extirpation were not observed here although it is not improbable that they may have been less pronounced in flight and consequently overlooked.

SUMMARY

The orientation of the following species of Silphidæ to odors in the field under conditions involving maximum distances was studied: *Necrophorus tomentosus* Weber, *N. vespilloides* Hbst., *Silpha noveboracensis* Forst., and *S. americana* L.

Experiments involving various combinations of complete and partial antennectomy and palpectomy indicated that the principal site of olfactory receptors is on the antennæ and that auxiliary olfactory receptors are located on the palpi. The former are suited to long range perception; the latter, to short range perception.

Antennal olfactory receptors are confined to the apical three segments or lamellæ. These segments possess special sensilla trichodea and sensilla basiconica not found elsewhere on the antenna. The sensilla basiconica are probably olfactory end-organs.

At extreme distances orientation to odors is probably by means of a klino-kinetic mechanism. As the gradient becomes steeper the insect is able to orient by means of klino-taxis. Circus movements following unilateral antennal extirpation were not observed.

With respect to the rôle of the antennæ in orientation to odors from a distance the Silphidæ studied are similar to *Geotrupes* (Scarabæidæ).

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RAFINESQUE'S PULMEL

Constantine Samuel Rafinesque, the distinguished naturalist, brought out in 1829, at Philadelphia, a work entitled "The Pulmist; or, Introduction to the Art of Curing and Preventing the Consumption or Chronic Phthisis." In this medical essay he introduced his new medicine, Pulmel. This nostrum was available as a syrup for internal use, as a balsam either for internal use or inhalation, as a lotion for use as a wash, as a cake, mixed with chocolate for internal use, as sugar of Pulmel for use in tea or coffee, as a spread for bread when mixed with honey, as a powder, and as lozenges of Pulmel for dry coughs and painful consumptions. There was even Pulmelin, a salt of Pulmel for internal use.

Rafinesque believed in his medicine because he had cured his own "fatal phthisis." For a first personal visit he charged $5.00 and for succeeding visits, $1.00 each. Several doctors wrote testimonials about Rafinesque's cures. He wrote—"I introduced also a new branch of medical knowledge and art. I became a Pulmist, who attended only to diseases of the lungs, as a Dentist attends only to the teeth. Being thus the first Pulmist, and perhaps the only one here or elsewhere. The new Profession changed my business for awhile; yet enabling me to travel again in search of plants or to spread my practice, and to put my collections in better order, publishing many pamphlets, &c."—H. B. W.

INSECT HEMOLYMPH: A REVIEW

By Janet L. C. Rapp

The purpose of this paper is to give a generalized account of what is known concerning the hemolymph of insects with a bibliography of the more important works on the subject. It makes no attempt to include circulation nor any papers on arthropods other than insects. There are three published reviews available; one by Maluf (1939), which includes all arthropods; another by Wigglesworth in his textbook, the Principles of Insect Physiology (1939), and a third by Shulz, covering the tracheates in Hans Winterstein's Handbook (1925).

The circulating fluid of insects is termed hemolymph, because it is not enclosed within vessels except where it is moved through the dorsal vessel. For this reason it corresponds both to blood and lymph. However, since it is never so complex nor highly differentiated as the blood of higher animals, it is more like lymph in actual composition. The formed elements or cells are termed hemocytes. According to the latest classification there are 10 classes subdivided into 32 types (Yeager, 1945).

The first worker on insect hemolymph seems to have been H. Landois in 1864 who studied the crystallization of the fluid from 14 different insects. He described the different types of crystals, making many sketches. In addition, he made several other observations, namely that the blood consists of serum and corpuscles; it is usually water white, but often colored greenish, brownish, reddish, or yellowish; that the color very seldom harmonizes with the color of the adult insect; further that it contains protein, globulin, and iron. He also found that the larvæ are richer in hemolymph than adults and that poor fliers and long-lived mature adults have more than good fliers and short-lived adults. He stated that the proportion of body weight to blood weight, in the case of the larvæ, is four to one. In the light of subsequent investigation, Landois appears to have done a creditable piece of work.

Perhaps more time has been spent on the cytology of the hemolymph than on any other one phase. In 1937 Maria Rooseboom published a thesis listing some 173 species in which the hemocytes had been described or included in a more generalized description. Some of the workers included Barrat and Arnold (1911), Blaustein (1935), Bruntz (1908), Cuénot (1891), Haber (1926), Hollande (1909, 1911), Hufnagel (1918), Kollman (1908), Landois (1864), Metalnikov (1908), Muttkowski (1923), and Paillot (1919).

Since Rooseboom's summary two of the papers to appear were by R. Ermin on *Periplaneta americana* and H. W. Jackson on *Tenebrio molitor,* both in 1939. Perhaps the newest approach in recent times has been the actual counting of blood cells by Tauber and Yeager (1934, '35, '36). Some estimation had occurred in previous literature, but not on so large a scale. They counted the total hemocytes from 502 individuals of 33 different species of Orthoptera, Odonata, Hemiptera, and Homoptera and 237 individuals of 29 species representing Neuroptera, Coleoptera, Lepidoptera, and Hymenoptera. From 220 counts of the field cricket, *Gryllus assimilas,* the average was 70,118 cells per cubic millimeter. The average for *Blatta orientalis* was 32,698 cells per cubic millimeter. In these studies they often obtained a wide range of counts but were able to duplicate averages. It was found that, as far as the orders with incomplete metamorphosis were concerned, the average count for the females was higher than that for the males. High hemocyte counts tended to be associated with some physiological or pathological condition such as ecdysis, oviposition or parasitism. In the Orthoptera the counts seemed to be higher for the adults than for the nymphs. However, the larval counts seemed higher than the adults for the orders with complete metamorphosis.

Many of the workers mentioned above established classifications of the hemolymph cells, of which probably the best known were those of Hollande (1911) and Paillot (1919). However, there were almost as many classifications as there were workers. Recently J. Franklin Yeager in 1945 published "The Blood Picture of the Southern Armyworm (*Prodenia eridania*)," which seems an excellent classification, at least for this particular order. As mentioned before he described 10 classes of hemocytes which were then subdivided into 32 types. The changes of these different kinds of cells, which were studied during all stages of the life cycle, may serve to divide the cycle into early larval, late larval, metamorphic, and adult phases.

Some small attempts have been made to see if there is any affect made by poisons on the hemocytes. Tareev and Nenjukov in 1931 stated that "arsenite of sodium, when penetrating into the blood through the integument of the intestine, causes a change in the cellular elements, destroying their nuclei and dissolving the protoplasm." Shull *et al.,* in 1932, listed 34 inorganic and organic gaseous compounds of widely differing physical and chemical properties to which they subjected *Periplaneta americana,* in what they considered a probably lethal concentration, without producing a noticeable effect on coagulation or on the appearance of the cells. Pilat in 1935 added that intestinal poisoning by sodium arsenite and silico fluoride produced no change in the normal blood picture. As criteria he included the relative size and form of the nucleus, color reactions, and the ability for phagocytosis, because, as he pointed out, it is difficult to determine whether or not the hemocytes have been changed when a good classification of them is lacking. To my knowledge the latest paper on the changes effected by poisons was by Yeager and Munson in 1942, on the southern armyworm [*Prodenia eridania* (Cram.)]. They studied the affect on the blood cells and the hemocyte glycogen by such poisons as nicotine bentonite, rotenone, pyrethrum, phenothiazine, barium fluosilicate, sodium fluoride, calcium arsenate, paris green, etc. There were no significant changes noted due to nicotine bentonite, nicotine peat, rotenone, pyrethrum, and phenothiazine, although there were marked hemocyte changes involving cellular swelling, decrease in glycogen, formation of pseudopodia, appearance of numerous vacuoles and raggedness following the administration of arsenicals, fluorides and mercuric chloride.

To date little is known concerning the physiological functions of the hemocytes. However, it is known that immunity to diseases is due to the faculty of phagocytosis possessed by them. Workers on this phase include Chorine (1931), Hollande (1930), Metalnikov (1926), and Paillot (1933). The hemocytes also participate in coagulation which will be discussed later. Several workers have noted that they store glycogen (Babers, 1938, and Yeager and Munson, 1941) and fat (Munson and Yeager, 1944).

As for physical properties of the hemolymph as a whole, the color has already been previously mentioned. It is usually straw colored, but often yellow, green, orange, or reddish. Muttkowski in 1923 listed a number of insects together with the life stage, color of blood, and type of food. He concluded that there was no correlation between the type of food and the hemolymph color, but that the color of the hemolymph of the immature was generally brighter than that of the adults. Often a difference in the color of the blood exists between the two sexes. Muttkowski (1923) mentions the fact that the female of *Dytiscus* has bright orange hemolymph while that of the male is clear yellow. Steche in 1912 listed 16 Lepidoptera in which the color of the hemolymph of the sexes differed. Geyer in 1913 attempted spectroscopic examination of the green color in the hemolymph of females and the yellow color of the males of certain caterpillars. He concluded that in the case of the females the green was a chlorophyll derivative; while, the males possessed only xanthophyll. He said that the difference in the color of the hemolymph of the two sexes occurred only in phytophagous species. This of course does not correlate with Muttkowski's work.

The volume of blood per body weight varies somewhat. Bishop (1923) gives 25–30 per cent of the body weight for the honey bee larva; Babers (1938), 0.17 to 0.2 ml. per army worm (*Prodenia eridania*) depending on age and type of food; Richardson, Burdette and Eagleson (1931), 31.2 cc. per 100 g. of body weight for *Bombyx mori* by the absorption method and 28.6 per 100 g. of body weight by the dry weight method and 41.0 cc. per 100 g. of body weight for *Galleria mellonella* by the dry weight method. Both these insects were in the larval state. Yeager and Tauber (1932) give 0.069 and 0.047 per g. of body weight, depending on the method, for *Periplaneta fulginosa*. Several other workers had made more or less approximations by bleeding. The difficulty lies in the complete removal of all the hemolymph.

Although the volumes in relation to the total body weight are fairly large as compared with vertebrate blood, the amount that can be obtained for analyses seems amazingly small. Bishop, Briggs, and Ronzoni (1925) state that 30 drone honeybee larvæ or 50 to 60 worker larvæ yield only 1 cc. of hemolymph; Busnel and Drilhon (1937) that 100 individuals of *Leptinotarsa decimlineata* give only 0.15 cm.[3], Pepper, Donaldson, and Hastings (1941), however, obtained 0.05 to 0.10 ml. per 1 mormon cricket (*Anabrus simplex* Hald.).

Various reports have been made on the specific gravity. Among these are: Bishop (1923) for the honeybee larva, 1.045 g.; Barrat and Arnold (1911) for *Dytiscus marginalis,* 1.025 g. to 1.027 g. and for *Hydrophilus piceus,* 1.012 g.; Babers (1938) for the armyworm (*Prodenia eridania*), 1.032 g.; and Yeager and Fay (1935) for *Periplaneta americana,* 1.0163. These last investigators described a micromethod for determining the specific gravity of the hemolymph. They found no significant difference between nymphs and adults nor males and females.

Several workers have attempted to determine the hydrogen ion concentration of the hemolymph. Landois as early as 1864 reported that the blood of 14 species was alkaline. Muttkowski in 1923 found the blood to be alkaline to neutral to moist litmus paper; while, Haber in 1926 was still using litmus to test the hemolymph of 42 different species. Bodine in 1926 used a microhydrogen electrode so that individual studies could be conducted on a single individual from the day of hatching of a grasshopper until its death. He tables a whole series of pH values ranging from 6.23 to 7.11 and concludes that although considerable variation exists between the same and different species, one individual is at least constant for one day. There was no marked difference detected between different sexes, ages, or species. Kocian and Spacek (1934), on the other hand, found that the pH of the hemolymph of Coleoptera does vary with age and species from 6.2 to 7.2 and that carnivorous species have a higher pH than phytophagous ones. Demjanowski (1932), too, who ran up to 2,000 determinations on *Bombyx mori,* felt that the pH between the males and females differed from 0.02 to 0.05 points, the female through three developmental periods always being higher than the male. Other figures include 6.8 for the larva of the honeybee (Bishop, 1923); 6.8 to 7.2 by Hastings and Pepper (1943) for grasshoppers; 6.6 for the caterpillar and pupa of *Pieris brassicæ* by Brecher (1929), and 6.53 by Babers (1938) for the armyworm (*Prodenia eridania*). It would seem then that, in spite of the earlier workers, the pH inclines toward the acid side of neutrality.

Concerning the subject of bleeding, all workers agree that the hemolymph darkens on exposure to air, either to dark brown or black, and add that this is probably due to tryosinase contained in it. However, the literature concerning coagulation has been somewhat sparse, most workers saying incidentally that the blood does or does not coagulate. Muttkowski (1923), Yeager *et al.* (1932) and Yeager and Knight (1933) have offered the main contributions. The last pair named, following a study on 47 species set up three categories of insects: 1, those in which no coagulation takes place, namely Hymenoptera, Coleoptera and Lepidoptera; 2, those in which a clot is produced by leucocyte agglutination, namely Orthoptera, Homoptera, Coleoptera, Hymenoptera, Diptera, and Lepidoptera; and 3, those in which mainly a blood protein coagulation occurs although accompanied by some cell agglutination, namely Heteroptera, Orthoptera, Coleoptera, and Lepidoptera. Before this second study, Yeager had maintained that protein coagulation did not occur. During the coagulation process Yeager states that the blood cells may "lose their original . . . shapes, round up . . . form thread pseudopodia, agglutinate into clumps and disintegrate." According to Muttkowski (1923) the addition of potassium oxalate, while producing a calcium oxalate percipitate does not prevent the blood from clotting. Therefore, calcium is not necessary. Neither does the blood produce clotting when added to solutions of fibrinogin or thrombin from normal horse serum (Babers, 1938). The whole mechanism of clotting then is very different from what we know concerning the clotting of human blood. Clotting of the hemolymph can be prevented by immersion of the insect in water at 60° C. from 1 to 10 minutes or by an acetic acid vapor treatment (Shull and Rice, 1933) or a fatty acid vapor treatment (Shull, 1936).

Chemically, relatively little accurate work has been done, probably because of the small volume available for study from each insect. Many investigators found it necessary to collect hemolymph from many individuals for a sample. Most workers devote little or no space to a discussion of the methods used, so that it is difficult to draw comparisons between species or orders. Earlier workers often ran analyses on the ash or on the ash of the total insect rather than on the hemolymph alone.

Considering first the inorganic constituents, it has been pointed out many times that sodium and chloride are low in percentage; while potassium, phosphorus, calcium and magnesium are present in relatively high concentrations. Recently Boné (1946) has contested this view as regards the Na/K ratio. According to Boné "the supposed biochemical hiatus between the insects and the rest of the animal kingdom clearly does not exist; the problem, open to experimental analysis, emerges of the variation of ionic regulation among members of a single zoological group." Vegetarian insects have more potassium ions than sodium ions; while carnivorous insects have more sodium than potassium ions.

As an example of analysis, Brecher in 1929 for the pupa of *Pieris brassicæ* lists for the following minerals expressed in milligrams per 100 cc.: Na, trace; K, 137.8; Ca, 33.0; Mg, 56; Cl, 59.5; and P, 66. Other investigators include Heller and Moklowska (1930), Babers (1938), Busnel and Drilhon (1937), and Bishop, Briggs and Ronzoni (1925). As contrasted with Brecher, Babers (1938) found 51.2 mg. per 100 cc. of Na in the larva of *Prodenia eridania;* while, Drilhon found 14.7 mg. per 100 for the various pupæ. No other investigators reported as high a figure for P, the next highest being 31 mg. per 100 cc. by Bishop *et al.* in 1925 for the honeybee larvæ, and the lowest 12 for the larva of *Deilephila euphorbiæ* by Heller and Moklowska in 1930. Clearly a variation must exist in different species of insects, so that analyses of a greater number of species seems indicated before drawing any sweeping conclusions. As for differences in the same species, Brecher (1929) found a slight difference between the male and female hemolymph content of potassium, calcium, magnesium, and chloride, but not phosphorus.

Muttkowski in 1923 reported Cu and Fe in insect hemolymph, but only qualitatively.

Of the organic constituents the amino acids are present in extremely high percentages as compared with human blood, although total proteins in themselves are lower. For instance, Florkin in 1937 figured about 3.5 per cent total proteins for *Dixippus*. However, Bishop *et al.* (1925) figured 6.6 per cent for the larva of the honeybee. Duval, Portier, and Courtois (1928) reported the content of amino acids as follows: for the adult of *Dytiscus marginalis,* 1.34 g. per liter, and of *Hydrophilus piceus,* 1.46; for the pupa of *Attacus cynthia,* 3.27, of *Sphinx ligustri,* 3.22, of *Saturnia pyri,* 2.85, of *S. carpini,* 3.58; and of the larva of *Cossus cossus,* 2.34, all g. per liter. Amino acids are said to furnish the most effective fraction osmotically.

Several investigators have reported on the relative proportions of the nitrogenous products of protein degradation. For instance, Babers (1938) for the larva of *Prodenia eridania* gives 6.2 mg. per 100 cc. of urea, 14.8 mg. per 100 cc. of uric acid and 8.0 mg. per 100 cc. of creatin; Florkin (1937) for *Hydrophilus piceus,* 7.4 mg. per 100 cc. of urea and 8 to 15 mg. per 100 cc. of uric acid; and Bishop *et al.* (1925) for the honeybee larva, 5.3 mg. of uric acid, 1.1 mg. of creatin and 41.6 mg. of other nonidentified nonprotein nitrogen per 100 cc.

A great deal of time has been expended on whether or not insects contain a respiratory pigment such as the hemocyanin of molluscs, certain Crustacea, and some spiders and scorpions. Muttkowski, 1921, suggested that they might because of the large amount of copper he detected qualitatively. Among authors to refute this statement are Redfield (1934) in studies on the Florida grasshopper, Bishop (1925), who pointed out that the oxygen capacity of the honeybee larvæ is 0.2 to 0.8 per cent per volume and within the errors of experimental error, and Babers (1938). The latter points out first of all that some insects accumulate copper. Although the definite physiological function is unknown, it does not necessarily follow that copper is combined with a respiratory protein. Indeed, there is no method to distinguish qualitatively between dissolved oxygen and oxygen bound by a respiratory protein. Further, although copper in *Prodenia* is about 5 per cent, it occurs only to the extent of 1.99 per cent in the protein precipitate.

Hæmocyanin and hæmoglobin where they occur in invertebrate blood are said to be suspended in the plasma and not incorporated in the corpuscles where they occur in vertebrate blood. This seems true of the larva of *Chironomous*. The larva of *Gastrophilus equi* has been proven to contain hemoglobin in the fat body and "Tracheal body." However, Hungerford (1922) and Bare (1928) say that oxyhæmoglobin in the genus *Buenoa* occurs in "definite bright red clusters of cells, enmeshed and closely associated with the tracheal system of the abdomen." These cells do not circulate, however, but "may fix and store oxygen."

Leitch (1916) and Harnisch (1927) have pointed out, however, that the hæmoglobin seems to dissociate oxygen only at low oxygen pressure, so that the respiratory proteins would seem of value not so much as storers, but as an aid in an environment with low oxygen content.

The fat content of blood may occur in lipomicrons, minute fat particles according to Haber (1926). Bishop, Briggs, and Ronzoni (1925) report 453 mg. per 100 cc. of total fat for the honeybee larva and that at the time of pupation the fat content rises a great deal. Compared with human values, this is high. However, the cholesterol value, being 35 mg. per 100 cc. in the feeding honeybee larva, is lower than humans.

Carbohydrates in insect hemolymph has been studied somewhat more than the fat content. A peculiarity here is that the hemolymph has a high percentage of reducing substances that are not glucose. Earlier workers presumed all reducing substances to be sugar, and hence gave results comparable to human blood sugar levels. According to Kuwana (1937) on the silkworm, Babers (1938) on *Prodenia eridania* and Florkin (1937) on *Hydrophilus*, about one half of the total reducing substances are something other than glucose. Figures for total reducing substances, sometimes calculated as glucose, include: 30.6 to 49.4 for various species of grasshoppers according to Blumenthal (1927); 127 for *Deilephila euphorbiæ* according to Heller and Moklowska (1930); 65.9 for *Prodenia eridania* according to Babers (1938) with 11.1 and 3.29 of glucose and glycogen, respectively; 24.43 for the larva of *Bombyx mori* with 0.4 to 4 of glucose according to Kuwana (1937) and 203 mg. for the feeding larva according to Bishop, Briggs and Ronzoni (1925). All these figures are calculated as mg. per 100 cc. Ronzoni and Bishop (1928) have shown that blood sugar is utilized as a source of energy during spinning and pupation and the percentage naturally falls from 685, feeding, to 154, prepupa, to 20–80, pupa, mg. per 100 cc. Kuwana (1937) supports them in this statement as the blood sugar of the silkworm larva descends to zero when pupation begins and stays at zero through the pupal stage. At the same time, however, a great deal of glycogen is liberated into the hemolymph, the glycogen content rising from less than 10 mg. per 100 cc. to 2,800 (Ronzoni and Bishop, 1928). This glycogen must, of course, be hydrolyzed to glucose before being utilized by the tissues for energy. Studies in 1941 by Yeager and Munson show that glycogen is stored in the hemocytes for such a purpose, since blood cell glycogen increases during the different instars to the prepupa and then falls very rapidly.

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PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of March 19, 1946

A regular meeting of the New York Entomological Society was held March 19, 1946, in the American Museum of Natural History. Vice-President Harold R. Hagan was in the chair. Twenty-three members and visitors were present.

Mr. Comstock showed three specimens of *Zaretes isidora* Cramer, a common South American species, one male, one female, and a gynandromorph, the latter with one side male, the other side female. This was a striking specimen because of the marked difference in the sexes.

Doctor Roger B. Friend, the speaker of the evening, presented an interesting talk on "Mist Blowers for Dispersing Insecticides," illustrated by lantern slides.

Lina Sordillo, *Secretary*

Meeting of April 2, 1946

A regular meeting of the New York Entomological Society was held April 2, 1946, in the American Museum of Natural History. Vice-President Harold R. Hagan was in the chair. Fifty members and visitors were present.

Mr. Comstock read a letter from Dr. Bromley whose operation was successful. His improvement was satisfactory and he was going to try to get to one of the meetings in May.

Mr. Lou H. Gibson, the speaker of the evening, presented a very interesting talk on "Methods and Styles of Insect Photography," illustrated by projections in color.

When photographing insects in natural surroundings it is necessary to introduce contrasts between subject and background: contrasts of tone, sharpness, texture, and color. At least one of these contrasts, strongly rendered, is needed for visualization.

Early attempts at providing color contrasting backgrounds for pinned specimens were shown.

The use of high-speed motion pictures for studying insect movements was taken up by showing a film "How Does a Fly Land on the Ceiling." An abstract of this talk follows.

METHODS AND STYLES OF PHOTOGRAPHING INSECTS

By H. Lou Gibson, A.P.S.A.
Medical Division, Eastman Kodak Company

The photography of insects is a versatile tool for the entomologist and an exacting but fascinating diversion for the nature photographer. Full-color records give a better indication of the appearance of many living specimens than do the dried insects. Care should be taken to arrange a subject for an entomological photograph in such a way that the keys to its identity are clearly apparent from the camera viewpoint. Insect pictures for public presentations need a story-telling style.

In a visual examination of an insect it is possible to observe it in several positions and under various lighting angles. The camera though "sees" the specimen from a single viewpoint and under a single lighting. This is an advantage because once a good position and lighting have been provided for photography, the record captures and holds the results of the photographer's efforts and gives the viewer a favorable presentation of the insect's beauty, color, and structure. It is important, however, to make sure that the image on the ground glass of the camera corresponds accurately with the mental picture the photographer has formed of the insect—it is the groundglass image not the mental one that photographs!

This point was demonstrated with pictures of the beetle *Plusiotis gloriosa.* Here the mirror characteristic of the silver-like bands on the elytra make lifelike photography difficult because the mirrors reflect the dark room area around them. The problem was solved by building a lead-foil "cage" around the specimen so that the reflection of the foil in the bands photographed silver and gave the true appearance of the insect. The use of double exposure was shown in making lifelike records of fireflies and their light organs.

When photographing insects in natural surroundings it is necessary to introduce contrasts between subject and background: contrasts of tone, sharpness, texture, and color. At least one of these contrasts, strongly rendered, is needed for visualization. All four in considerable degree enable the subject to stand out most clearly and when contrasts are weak the four are imperative for even seeing the specimen at all.

Early attempts at providing color contrasting backgrounds for pinned specimens were shown. Transilluminated colored paper had been used but there was a tendency for shadows to appear around the insects. Much better in this respect were results obtained by using a light-box developed at the Rochester General Hospital for photographing gross specimens. This system uses transilluminated colored background glasses. When photographing butterflies over such a background it is necessary to place a black-paper counterpart of the wings on the pin underneath the insect to prevent the colored background light from passing through the wings and diluting their colors.

Living aquatic insects may be photographed in a tank by hanging a glass retaining wall behind the front glass of the tank at such a distance as to confine the specimen to the depth of field of the camera. Colored backgrounds may be introduced by hanging another, painted, sheet of glass behind the retaining glass.

A sequence of color transparencies was presented which showed the remarkable color changes the goldbug (*Metriona bicolor*) undergoes upon being disturbed. It had been necessary to photograph the specimens living and active. At 3 ×, this needs a special setup, which was illustrated.

Kodatron Speedlamp studies were shown of a spider (*Aranea sericata*) tearing down and building its web. Its actions when hanging on the drag line were also pictured.

The use of high-speed motion pictures for studying insect movements was taken up by showing a film "How Does a Fly Land on the Ceiling." This was obtained from Kodak Limited in England where it had been made by Dr. E. Eyles.

There was evidence that the fly makes a "barrel roll" and some suggestion of an occasional "inside loop." Yet whether the fly first makes an attachment with its feet to aid in these maneuvers could not be observed.

LINA SORDILLO, *Secretary*

Meeting of April 16, 1946

A regular meeting of the New York Entomological Society was held April 16, 1946, in the American Museum of Natural History. The Vice-President of the Society was in the chair. Eleven members and twelve guests were present.

In the absence of Miss Sordillo, Howard Schiff volunteered to act as Secretary.

Mr. Olsen invited the Society to set aside Decoration Day for a field trip to his home at West Nyack. The Society accepted this invitation.

Mr. Teale then made a motion that later in the summer, at no set date, the Society go on a field trip to his place at Baldwin, Long Island. This invitation was also accepted.

Mr. Comstock brought up the matter of the Index to the first fifty volumes of the Journal and offered a resolution authorizing Mr. Weiss to proceed with the printing of the Index. After some discussion of the matter Mr. Comstock withdrew his resolution pending the acquisition of all data bearing on the subject. A motion to postpone the business of publishing the Index until the next meeting was approved.

Mr. Sherman read a letter offering a complete collection of Long Horned Beetles and a fine set of books about them. The price of 175,000 dollars for the beetles and books provided a laugh for all.

Mr. Teale reported on a visit to Dr. L. O. Howard telling us that he was quite well and sent the Society his regards.

There being no further business, Mr. Olsen read his paper on "The Making of a Plastic Fly and Notes on South Sea Collecting." Slides showed the fine and exact work on the fly. Three boxes of insects which were collected in the South Sea Islands were passed around for examination.

Howard M. Schiff, *Acting Secretary*

Meeting of May 7, 1946

A regular meeting of the New York Entomological Society was held May 7, 1946, in the American Museum of Natural History. Vice-President Harold R. Hagan, was in the chair. Seventeen members and eleven guests were present.

Mr. Raoul Nadeau spoke about his stay in Paris, eighteen months, and the wonderful reception given him by Dr. Jeannel and the entire staff of the Entomological Laboratory of the Paris Museum.

Mr. Nadeau became a member of the oldest entomological society in the world, the Entomological Society of France, and Dr. Jeannel put a laboratory at his disposal, where he did much research on the Histeridæ. They have the finest collection of insects he had ever seen, so far as numbers and arrangement. They were only slightly molested by the Germans and the laboratory functioned as in normal times. Dr. Jeannel, and many of his staff, published several books; one by Dr. Jeannel, the "Carabidæ of France," being an extremely important work systemmatically and morphologically. The Director, Dr. Jeannel, asked Mr. Nadeau several times to request all the societies in the United States to exchange insects with the Paris Museum as they were very poor in North American specimens. He also desired to find American subscribers to the Revue entomologique francaise.

A field trip of the Society was scheduled for Decoration Day, Thursday, May 30, at the Olsen's place in West Nyack. Later in the season, the Society will go on a field trip to Mr. Teale's Insect Ranch, Baldwin, Long Island. Members will be notified as to the details of these trips.

There being no further business, Doctor Herman T. Spieth, the speaker of the evening, presented an interesting talk on "Observations on Some Social Wasps." A box of insects was passed around for examination. Abstract follows.

OBSERVATIONS ON SOME SOCIAL WASPS

A colony of *Polistes fuscatus hunteri* Beq., was observed at Port St. Joe, Florida, from the last of July until the colony disbanded on 28.IX.45. Throughout this period, the queen was responsible for the initiation of new cell construction and all oviposition. Cleaning, feeding and trophallaxis conformed to that reported for other subspecies and species. Just before the colony dispersed the developing larvæ were removed from the cells, probably they were consumed by the adults. Once they were gone the colony immediately broke up and the event occurred in the evening after darkness had fallen and during a rain shower. The chief enemy of Polistes colonies in the warmer regions of the world appears to be various species of Formicidæ for once a nest is unguarded it is immediately invaded by these creatures.—DR. HERMAN T. SPIETH.

LINA SORDILLO, *Secretary*

MEETING OF MAY 21, 1946

A regular meeting of the New York Entomological Society was held May 21, 1946, in the American Museum of Natural History. Vice-President Harold R. Hagan was in the chair. Eighteen members and thirty-seven guests were present.

The following motion made by Mr. Comstock and seconded by Dr. Ruckes was passed unanimously without discussion;—That the New York Entomological Society authorizes Mr. Weiss to proceed with the publication of the Index to the first fifty volumes of the Journal of the Society, based upon the recent estimate furnished by the Science Press Printing Company, which was transmitted to Dr. S. W. Bromley, President, in Mr. Weiss's letter of May 16; to proceed with the publication of an edition of 400 copies of which 200 are to be bound and 200 to be held in sheets, at a cost of $661.00. A further motion was made by the same sponsors and passed unanimously that the price of the Index be fixed at $5.00.

It was decided that the Field Trip Committee should fix a date for a field trip to be held at the Insect Ranch of Mr. Teale, Baldwin, Long Island, some Sunday in August. Members would be notified about details.

Doctor Herbert Ruckes, the speaker of the evening, presented an interesting talk on the topic, "New Mexico and Arizona, A Naturalist's Paradise."

''New Mexico and Arizona combined are equivalent in area to about one-fourth of the eastern United States and offer unlimited opportunities for the study of various floral and faunal zones.

''In relatively short time one may pass from the Lower Sonoran mesas where animals and plants are similar to those found in Northern Mexico, through the Upper Sonoran mesas and valleys, with their endemic desert organisms, to the transitional zone represented by the foot hills of the highest mountain ranges, thence into the Canadian zone. Going still higher one eventually reaches the Alpine meadows on the highest peaks.

''One of the most astonishing features of the south western countries, is the abundance of species of organisms to be found in relatively limited areas. While individuals of a species may not be abundant, one is constantly amazed at the great varieties of different organisms that one finds.

''Both states are provided with main highways in excellent condition and if one is willing to travel over rougher roads, hardly any remote area in the states is inaccessible. For the most part, the best collecting grounds are to be found in such remote places, probably for the reason that such areas have not been frequently visited as the more readily accessible places.''

LINA SORDILLO, *Secretary*

MEETING OF OCTOBER 1, 1946

A regular meeting of the New York Entomological Society was held October 1, 1946 in the American Museum of Natural History. President Stanley W. Bromley was in the chair. Eighteen members and eight guests were present.

Thomas C. Desmond, 94 Broadway, Newburgh, New York, Senator from 32d District, and Mr. John I. Gedney, Jr., 30 Red Oak Lane, White Plains, N. Y., were proposed for membership.

An obituary note on John Watson Angell is to be prepared for the Journal of the Society.

Mr. Lacey presented the following resolution which was adopted:

WHEREAS, in the death of John Watson Angell on July 29, 1946, the New York Entomological Society has lost a distinguished member of approximately 30 years standing and son of Mr. G. W. J. Angell, one of the founders and the first President of this Society.

Be It Resolved, that the Secretary be instructed to prepare a letter of sympathy and condolence to be sent to his surviving daughter, Mrs. Yvonne Kenward, c/o Mrs. Gladys A. Fry, 262 North Mountain Avenue, Upper Montclair, N. J., to be forwarded to Mrs. Kenward, in England, together with a similar letter to be sent to Mrs. Fry, his surviving sister.

A letter from the Zoological Society of London asking whether it would be possible for us to send them a donation again this year for the support of the ''Zoological Record'' was read. The procedure followed in getting the funds was to secure donations, from individual members, which were made to the Society for this purpose. Donations to the Society for this worthy purpose may be mailed, or given personally, to Dr. Michener.

The program of the evening was a general discussion on summer activities and observations of the members; large local flights of aphids were noted and discussed.

Mr. Schwarz spoke of his experiences on a recent trip to Mexico.

Dr. Schneirla spent several months on Barro Colorado Island, where he studied habits of certain army ants.

LINA SORDILLO, *Secretary*

MEETING OF OCTOBER 15, 1946

A regular meeting of the New York Entomological Society was held October 15, 1946, in the American Museum of Natural History. President Stanley W. Bromley was in the chair. Twelve members and eighteen guests were present.

Thomas C. Desmond and John I. Gedney, Jr., were elected to membership.

A letter from Mr. E. P. Wiltshire was read, saying he was leaving New York for Egypt and would resign from the Society at the end of this year. His resignation was accepted with deep regret.

Dr. H. E. Elishewitz, the speaker of the evening, presented an interesting talk on the topic, "The Distribution of Malaria and Anopheline Mosquitoes in the Petroleum Producing Areas of Northern South America" (illustrated by Kodachrome slides).

"Under the authority of the Medical Department of the Standard Oil Company (N. J.) and with the cooperation of their subsidiary and affiliated operating companies in northern South America a 9-months' survey was instituted to attempt to apply DDT control programs, and more recent entomological and insecticide discoveries, developed during the war by the armed forces, to commercial organizations.

"Therefore the DDT and control surveys, mainly directed against malaria but having as their accessory functions all insect-borne diseases, were made in the 35 odd producing fields, camps, wildcat camps, exploratory areas and oil pipeline pump stations in Venezuela, Colombia, Ecuador and Peru. Most, but not all, of the main petroleum producing areas of these countries were visited."

LINA SORDILLO, *Secretary*

MEETING OF NOVEMBER 19, 1946

A regular meeting of the New York Entomological Society was held November 19, 1946, in the American Museum of Natural History. President Stanley W. Bromley was in the chair. Twenty-three members and twenty-one guests were present.

Mr. Weiss had corrected and returned the page proof of the 50-year Index to the printer. The completed Index will be out shortly.

Dr. Michener, reported that he had collected $60.00 from members of the Society, to be sent to the Zoological Record Fund of London, as a gift.

The President appointed a Nominating Committee, to nominate a full slate of Officers, Trustees and Elective Committees at the Annual Meeting, consisting of George G. Becker, Edwin W. Teale, and Lina Sordillo.

Dr. Charles D. Michener, the speaker of the evening, presented an interesting talk entitled ''Chiggers.'' This was primarily an account of his experiences with chiggers or redbugs (Trombiculinæ) during fourteen months spent in Panama during the war. The work on these mites was carried out in order to develop rearing techniques necessary for studying the transmission of scrub typhus, an oriental chigger-borne disease. The remarkable life history, consisting of seven stages, two of which are pupa-like, was explained with the aid of lantern slides. Chiggers attack vertebrate animals only in the larval stage, being free-living, soil-inhabiting organisms during the nymphal and adult stages. Their chief food during these latter stages appears to be insect eggs.

LINA SORDILLO, *Secretary*

MEETING OF DECEMBER 3, 1946

A regular meeting of the New York Entomological Society was held December 3, 1946, in the American Museum of Natural History. President Stanley W. Bromley was in the chair. Fifteen members and nine guests were present.

Dr. Herman T. Spieth, the speaker of the evening, presented an interesting talk entitled ''The Mating Behavior of the Species of the *Drosophilia willistoni Complex.*''

''Utilizing a small observation cell the mating behavior of *Drosophilia willistoni, equinoxalis, nebulosa, fumipennis, succinea* and *capricornis* was observed. The mating patterns of all species show qualitative differences and these roughly parallel the morphological differences that exist between the species. The exception to this statement occurs in the case of *willistoni* and *equinoxialis* since these two species are morphologically indistinguishable but do show small but definite differences between the mating patterns. Interspecific pairing adds further evidence to Dobzhansky's findings that these two species although inseparable on structural evidences are completely isolated sexually.''

LINA SORDILLO, *Secretary*

MEETING OF DECEMBER 17, 1946

A regular meeting of the New York Entomological Society was held December 17, 1946, in the American Museum of Natural History. President Stanley W. Bromley was in the chair. Fourteen members and nine guests were present.

The Society accepted with thanks a gift of $25.00 from Mr. Bernard Heineman, to be used for the general purposes of the Society. The Secretary was instructed to acknowledge the gift with thanks.

Mr. William P. Comstock, the speaker of the evening, unfortunately could not be present. Mr. Samuel Harriot took over. His topic was ''Block Island, R. I.'' (illustrated by Kodachrome slides).

"The island is politically a part of the state of Rhode Island, lying some 12 miles off the coast, Block Island Sound intervening. A small steamer serves as a year-round ferry from Wakefield running out past Point Judith; while during the summer, another boat runs from New London, a trip of about 30 miles, out the Thames River and past Fishers Island.

"The surface of the island is typical of a glacial terminal moraine condition. The surface is formed in rounded hills and valleys. Because of the underlying preglacial clay beds the drainage of the valleys is poor and the island is studded with fresh water ponds said to number over 200. It is surprising to climb to a hilltop and find a small pond inhabited by painted turtles.

"The impoverished biota of Block Island may be accounted for by its early isolation from the coastal strip, following the retreat of the ice, which made it difficult to populate by other than a waif biota, and also by its deforestation by man."

LINA SORDILLO, *Secretary*

INDEX TO NAMES OF INSECTS AND PLANTS IN VOLUME LV

Generic names begin with capital letters. New genera, subgenera, species, varieties and new names are printed in italics.

The New York Entomological Society

Organized June 29, 1892—Incorporated February 25, 1893

Reincorporated February 17, 1943

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 79th St., & Central Park W., New York 24, N. Y.

Annual dues for Active Members, $3.00; including subscription to the Journal, $4.50.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

A set of the Journal, volumes I to L inclusive, unbound, $90.00.

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