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PROCEEDINGS OF THE

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VOL. 35 JANUARY, 1933 No. 1

PRELIMINARY RESULTS OF A MOSQUITO SURVEY IN THE CHESAPEAKE BAY SECTION.

By F. C. BISHOPP, E. N. CORY, AND ALAN STONE.

It is now generally recognized that mosquito control operations to be economical and effective must be preceded by a rather intensive survey of conditions existing in the area under consideration. The desirability of reducing the mosquito population in the Chesapeake Bay section has been recognized for years by many residents, and the splendid accomplishments in mosquito control in New Jersey have impressed citizens of Delaware, Maryland, and Virginia with the practicability of such work. The interest of the citizens of the Chesapeake Bay region and particularly of the Del-Mar-Va Association resulted in the initiation of a mosquito survey in Delaware and parts of Maryland and Virginia. The work in Delaware, we are informed, has progressed very satisfactorily under the direction of Dr. L. A. Stearns of the Delaware Experiment Station. The work in Maryland was carried on cooperatively during the summer of 1932 by the Bureau of Entomology and the University of Maryland. The Bureau conducted surveys at two points in the eastern shore counties of Virginia. These surveys in Maryland and Virginia were of a preliminary nature but some new records on the distribution of important economic species of mosquitoes were obtained. These and some of the information on seasonal occurrence and abundance seem worthy of record.

These data were secured mainly by the operation of 20 light traps, of the New Jersey type, which were operated by volunteer cooperators in as many localities. The traps were set up during the latter part of June and in early July, and were operated more or less continuously until about October 1st. Some of the early spring species may have been missed by not starting the traps earlier. For the most part, the traps were emptied daily.

In the installation and operation of the traps the authors were assisted by Messrs. S. L. Crosthwait, D. H. Brannon, and R. D. Wagner, graduate students at the University of Maryland, and in the sorting of the great numbers of insects captured, by

Carroll N. Smith, scientific aid of the Bureau of Entomology. The authors gratefully acknowledge the work of these men and the assistance rendered by the cooperators who emptied the traps, gave attention to their operation, and in several instances contributed the electricity consumed.

Four traps were operated on the western shore of Chesapeake Bay, the locations being Solomon's Island, Chesapeake Beach, Annapolis, and Gibson Island. Two were operated on the eastern shore of the Potomac, one near Mt. Victoria, and one at Indian Head. In addition to these, one trap was operated near College Park, considerably removed from the Chesapeake area. On the eastern shore of Maryland traps were located at Crisfield, Cambridge, Easton, and Chestertown, and at the four somewhat inland points of Pocomoke, Snow Hill, Princess Ann, and Salisbury. On the Atlantic side three traps were located at Ocean City and one somewhat inland at Berlin. Traps were also located at Onley and Exmore, Virginia, well down the peninsula, where both the Atlantic and Chesapeake influences are felt. No specimens were received from Exmore as the trap was run only one week and the material was lost in the mails. The distribution of these traps should give a fair cross-section of the mosquito fauna of the Chesapeake Bay section.

In addition to the trap records some larval collections were made during late September by G. H. Bradley and the senior author and a small amount of hand collecting of adults was also done. Twenty-eight species of mosquitoes were obtained during the season. The localities in which each of these 28 species was collected are presented in the accompanying table. The relative abundance of each of these species throughout the season is indicated by the numerals 1 to 5, 1 being used for very few, 2 for few, 3 for a moderate number, 4 for many, and 5 for very many. It should be borne in mind that the length of time the traps were operated varied in the different localities and also that hand and larval collections were not made in several of the localities, notably Mt. Victoria, Chesapeake Beach, Solomon's Island, Berlin, and Ocean City.

ANOPHELES.

Anopheles atropos D. & K., a species capable of carrying malaria, was taken in two localities in Maryland. This is far out of its previously known range, as it has hitherto been reported only from the extreme southern states. This species was taken in large numbers at Crisfield, Maryland, every day the trap was operated from June 29th to October 4th. A single female was also taken at Chesapeake Beach on August 21st. Adults of this species were taken by Bradley and Bishopp on September 29th in a rather dark stable on the marsh at Crisfield, and larvae were taken there in the grass-grown margins of pools on the edge of salt marshes. Larvae were also collected on the same day in a similar habitat near Onley, Virginia. Among the other anopheline mosquitoes, *A. crucians* Wied., also a possible vector of malaria, was most widely distributed. It was taken in the traps in 15 out of the 18 localities. The sixteenth locality was added by the collection of larvae of this species at Hyattsville, near College Park. *A. quadrimaculatus* Say, the principal vector of malaria in this country, was taken in the traps in 14 localities. One other locality, Gibson Island, was added as a result of larval collections. This species was present throughout the trapping period with a slight peak of abundance during the first week of July and another the first week of August. *A. crucians* was also present throughout the trapping period, but appeared slightly more abundant during July. This species was most abundant at Crisfield, much less so at Cambridge, while still fewer were taken at other points. *A. quadrimaculatus* was most abundant at Cambridge with relatively few specimens being taken elsewhere. *A. punctipennis* Say was caught in traps in 8 localities and 3 others (Gibson Island, Pocomoke, and Annapolis) were added as a result of larval collections by Bradley and Bishopp. Although this species was present during the entire trapping period, in no case were many specimens taken. The latest date of collection was at College Park on November 6th. Our knowledge of the abundance of *A. quadrimaculatus* and *A. punctipennis* in certain of the localities where the traps were operated indicates that these species do not enter the traps in proportion to their relative abundance. *A. walkeri* Theo., a relatively rare species, was taken in small numbers at College Park, Princess Ann, and Chestertown. Larvae of this species were taken by Bradley and Bishopp in the edges of cat-tail marshes at Delaware City, Delaware, under conditions similar to those found in many places in Maryland.

AEDES.

Among the 10 species of Aedes mosquitoes captured, the rain-pool breeder, *Aedes vexans* Meig., was most widely distributed, it being taken in every trap and throughout the entire season, but in no case in great numbers. The trap at Annapolis took the greatest number of *A. vexans*. The northern salt-marsh mosquito, *A. sollicitans* Walk., was taken in every one of the traps, and the southern salt-marsh mosquito, *A. taeniorhynchus* Wied., was captured in all but one. Only two specimens of the former and one of the latter were taken at College Park, and relatively few were taken at Chestertown and Easton, while great numbers were trapped at points farther south on the eastern shore. While College Park is about 25 miles from a possible breeding place, this occurrence is not surprising, as both of these species are known to migrate considerable distances from their breeding grounds. These are clearly the most important pest mosquitoes of that region. While some of the traps caught fair numbers of these two species throughout the season, there were distinct peaks of abundance about the middle of July and the latter part of September. The last was during a very severe outbreak which began about September 21st and was severe for a week or more. During this outbreak farm and other operations were severely handicapped. On September 21st the trap at Crisfield yielded 470 *A. sollicitans* and 1,778 *A. taeniorhynchus*, and on September 24th the trap at Pocomoke, Maryland, made a catch of 666 *A. sollicitans* and 2,248 *A. taeniorhynchus*. The abundance curves of these two salt-marsh breeders, as would be expected, coincide closely. The figures just given indicate their relative numbers in nearly all traps. *A. taeniorhynchus* outnumbered the more northern species, *A. sollicitans*, about three or four to one. *Aedes mitchellae* Dyar has been reported from the Gulf states only, heretofore, but the National Museum collection contains one specimen taken at Lumberton, North Carolina, May 13, 1920, by H. P. Barrett. In the present survey only a few specimens were taken in Maryland, at Cambridge (July 23–27), Ocean City (July 5), Gibson Island (July 19), and Solomon's Island (July 2). The other six species of *Aedes* were taken in very small numbers, *A. cantator* Coq., another salt-marsh breeder, being the most abundant of these.

CULEX.

Six species of Culex were taken. The northern rain-barrel mosquito, *Culex pipiens* L., and the unbanded salt-marsh mosquito, *C. salinarius* Coq., were caught in each of the 18 localities. They are both of distinct economic importance in this region. In some localities, notably Salisbury, Maryland, *C. pipiens* greatly predominated and in this case it far outnumbered all others. In other localities, as at Cambridge, where *salinarius* far outnumbered *pipiens*, both species were present throughout the entire trapping period. There were no very marked peaks of abundance throughout the trapped area. *C. territans* Walk. ranked next in abundance, but seldom were more than 2 or 3 specimens taken during a night. It was found in all but five localities and was present during the entire season. It is noteworthy that only a single southern rain-barrel mosquito, *Culex quinquefasciatus*, was taken (College Park, Oct. 21), although this species is usually considered to be as abundant in Maryland as is the northern rain-barrel mosquito, *Culex pipiens*.

PSOROPHORA.

Two species of Psorophera were taken. The giant mosquito, *Psorophera ciliata* Fab., the larvae of which are predacious on other mosquito larvae, was taken in small numbers in seven localities and *P. columbiae* D. & K., which is often a severe pest of livestock, was taken in 13 localities. It was present in moderate numbers at Easton and Cambridge, Maryland, during July and early August.

MANSONIA.

Mansonia perturbans, which is a very annoying pest, was taken in rather limited numbers in eight localities. The larvae and pupae, as is well known, remain attached to the stems of aquatic plants, from the tissues of which they derive their oxygen. Larvae of this species were taken on the roots of cat-tails in a swamp near Hyattsville, Maryland, by G. H. Bradley and Carroll N. Smith. Larvae were also found in great numbers in swamps and at the edges of lakes in Delaware and New Jersey by G. H. Bradley and the senior author. Similar conditions were observed on the eastern shore of Maryland and no doubt breeding occurs there, although no larvae were collected. Relatively little time was devoted to a search for the larvae of this species.

URANOTAENIA.

The beautiful little mosquito *Uranotaenia sapphirina* was captured in 12 localities in the traps and another locality (Pocomoke, Maryland), was added through hand collecting. This species is considered rather rare, and only an occasional specimen was taken in the traps except in the case of the trap at Cambridge, Maryland, in which 57 specimens were taken on September 5th and 30 the following night. In most cases it appeared in the late summer and fall.

THEOBALDIA.

Theobaldia melanura Coq. is also considered rather rare and locally restricted, yet we took it in 9 localities. Very few specimens were taken in all localities except Salisbury, where 56 were caught and at Pocomoke, where it was rather common, 32 being taken on July 22d. It occurred throughout the trapping period. *T. inornata* Will. was taken at Snow Hill, Maryland, on October 2d.

TABLE I. DISTRIBUTION AND RELATIVE ABUNDANCE OF MOSQUITOES TAKEN IN SURVEY.

Localities (Maryland except as shown)	Aedes										Anopheles					Culex						Mansonia perturbans	Orthopodomyia signifera	Psorophora ciliata	Psorophora columbiae	Theobaldia inornata	Theobaldia melanura	Uranotaenia sapphirina	Number of species taken
	atlanticus	canadensis	cantator	cinereus	mitchellae	punctor	sollicitans	taeniorhynchus	triseriatus	vexans	atropos	crucians	punctipennis	quadrimaculatus	walkeri	apicalis	inhibitator	pipiens	quinquefasciatus	salinarius	territans								
College Park							1	1	1	2		*1	2	1	1	1		2	1	2	2	2	1		1			1	17
Indian Head							1			2		1	1	2		1	2	2		2	2	1						1	12
Mt. Victoria							1	1		1								1		2				1	1				7
Gibson Island			2		1		1	2		3		1	*1	*1				1		4	1								11
Annapolis	1		1				2	2	2	3		1	*1	1		2		2		2	2	1	1		1			1	17
Chesapeake Beach			1				2	4	1	2	1	2		1		1		2		2	1	1			1		1	1	16
Solomon's Island					1		1	2		2			2					2		2		2		1	1				10
Chestertown							1	2		2		1	2	2	1	1		2		2	2	1		1	2		1	1	16
Easton							1	1		2		1	1	2		1	*1	2		2	1			1	2		1	1	15
Salisbury			1				2	2		2		2	1	2		2		5		2	2	2					2	1	14
Cambridge		1			1	1	2	4		2		2		3			1	2		5				2	3		1	2	15
Crisfield			2				5	5		2	5	5					1	2		3	1		1		1				12
Princess Ann		1	1				3	4	1	2		2		1	1	1		1		3					2			1	14
Pocomoke		1	2				5	5		2		2	*1	1		1		3		2	1				1		3	*1	15
Snow Hill	1		2	1			5	5		2		2	1	1		1		4		3	2	1	1	1	1	1	1	1	20
Onley, Va.							2	5		2	*1	1	1	1		1		3		2	1						1		12
Berlin			1			1	4	5		2		2		1				5		2	1				1			1	12
Ocean City			2		1		5	3		2		2		1				3		5				1			1	1	12
Number of localities where respective species occurred	2	3	10	1	4	2	18	17	4	18	3	16	11	15	3	11	4	18	1	18	13	8	4	7	13	1	9	13	....

*Larvae collected or adults taken by hand. Not represented in trappings.

NOTES ON THE OVIPOSITION HABIT OF CHELONUS SERICEUS (SAY) (HYMENOPTERA).

By R. A. Cushman, *Bureau of Entomology*.

On September 19, 1931, Mr. J. C. Bridwell handed me four females of *Chelonus sericeus* (Say), which he had taken the previous day on the flowers of a golden aster, *Chrysopsis mariana*, at Barcroft, Va. This species differs from all other North American species of *Chelonus* in having its maxillae greatly elongated, indicating an anthophilous habit, which Mr. Bridwell's observations and my own, made later, confirmed. It also differs from most of the other species in having its ovipositor distinctly exserted, which indicates the probability that in order to reach its host for oviposition it must penetrate some plant tissue.

These two characters, together with the recent discovery by W. V. Balduf[1] that certain species of *Feltia* deposit their eggs in the flower tubes of Compositae, suggested the possibility that *C. sericeus* might be visiting the flowers of *Chrysopsis* for oviposition as well as for feeding. In order to make observations to confirm or to refute this suspicion Mr. Bridwell and I visited the site of the capture of the specimens. *C. sericeus* was not at all abundant, only four specimens being seen during several hours of search, but the first one found justified the suspicion as to its habits of oviposition, for it was observed to thrust its ovipositor into flowerheads of *Chrysopsis* several times. The other three specimens were merely feeding.

The only moths that were at all abundant on the *Chrysopsis* flowers were *Heliothis obsoleta* and a species of *Feltia*, probably *ducens* Walk. No oviposition by either species was observed. The well known habits of *Heliothis* probably exclude it as a possible host of the *Chelonus*, while Balduf's studies of the habits of *Feltia* indicate that this was the host.

Two flower heads that the ovipositing *Chelonus* was observed to visit were picked and the *Chelonus* captured.

When I returned to my desk on the 21st, I first dissected the female *Chelonus* to determine the type of egg to be found in the ovaries. These eggs were very minute, about 0.4 mm. long. Most of them were club-shaped with a spherical or ovoid swelling on one end (figs *a* and *b*) while a few were irregularly fusiform (fig. *g*).

Having determined the type of egg I began the investigation of the flower heads. These had dried considerably during the two days and the corolla tubes had shrivelled. Here and there through the heads, however, were florets that were distended, and these disclosed eggs of a lepidopteran, occurring usually

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[1]Proc. Ent. Soc. Wash., vol. 33, 1931, pp. 81–88.

three to a corolla tube placed one on top of another. Rarely there were two and in one instance only one. A few eggs occurred between the florets, usually also arranged in rows of three.

The first moth egg examined for possible parasitism by *Chelonus* revealed five eggs similar to those found in the ovary but with the stem much thicker (fig. *d*). The parasitized egg was the top one of three. Examination of 100 or more eggs showed that the second egg in a row was rarely parasitized; and in only one instance was the bottom egg parasitized. None of the eggs outside of the flower tubes was parasitized.

After oviposition the egg of *Chelonus* increases very greatly in size and becomes of entirely different shape as shown in figure *e*. The egg from which this drawing was made was about 0.55 mm. in length by more than a third as thick. Several parasites considerably larger than this (fig. *f*) were found, in which mandibles could be seen very clearly, but in which no trace of segmentation could be observed. Whether these were larvae or full-grown eggs could not be determined with certainty because of the extreme delicacy of the chorion.

In none of the moth eggs examined had the embryological development progressed beyond the mere beginning.

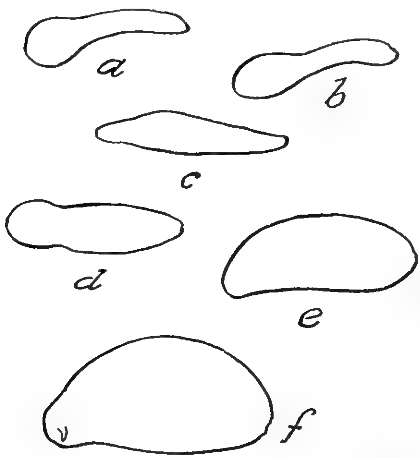

Fig. 1.—Eggs of *Chelonus sericeus* (Say). *a–c*, ovarian eggs; *d–e*, eggs removed from host; *f*, newly hatched larva (?)

NOTES ON THE TACHINID GENUS CERACIA RONDANI (DIPTERA), WITH A NEW SPECIES FROM THE PHILIPPINES.

By J. M. Aldrich, *Division of Insects, U. S. National Museum.*

This is a widespread genus of grasshopper parasites, species having been described from Europe, North and South America, Australia and the Oriental region.

Genus **CERACIA** Rondani.

Ceracia Rondani, Atti Soc. ital. Sci. nat., vol. 8, p. 221, 1865. Type designated, *mucronifera*, new, from Italy.—Bezzi, Zeitsch. Hym. und Dipt., vol. 6, p. 51, 1906.—Townsend, Revista Ent., vol. 1, p. 89, 1931, syn.

Ceratia (emendation) Brauer and Bergenstamm, Zweif. Kais. Mus., pt. 4, p. 112, 1889; pt. 6, p. 160, 1893.

Myothyria Van der Wulp, Biologia, Dipt., vol. 2, p. 338, 1890. Type *majorina*, new, by designation of Coquillett, Proc. U. S. Nat. Mus., vol. 37, p. 573, 1910.—Brauer and Bergenstamm, Zweif. Kais. Mus., pt. 5, p. 358, 1891; pt. 6, p. 160, 1893.—Malloch, Proc. Linn. Soc. N. S. Wales, vol. 55, p. 338, 1930.

Acemyiopsis Townsend, Proc. U. S. Nat. Mus., vol. 49, p. 433, 1915. Type *punensis*, new, from Peru.

Clythopsis Townsend, Revista Mus. Paul., vol. 15, p. 276, 1926. Type *confundens*, new, from Brazil (syn. of *Myobia brachyptera* Thomson, 1869, from Brazil.

The genus is closely allied to the familiar *Acemyia*, which has the third antennal joint ending in a distinct upturned point at apex. The principal differences are that the prosternum is bare in *Acemyia*, and has hairs along the sides in *Ceracia;* and that the male in *Acemyia* has a rather narrow front, without orbitals, while in *Ceracia* the male has a wider front, with a row of orbitals. Of our two rather common species in the United States (Coquillett, Revision, 1897, p. 115), *tibialis* Coquillett is a true *Acemyia*, and *dentata* Coquillett is a *Ceracia*.

Townsend has asserted the synonymy of *Clythopsis*. I have added *Myothyria* from a cotype in the U. S. National Museum, and *Acemyiopsis* from the type, which is also in the National Museum.

Ceracia aurifrons, new species.

Black, densely gray pollinose; head silvery except parafrontals, which are light golden.

♂ ♀. Length, 5–7 mm.

♂. Frons at vertex .27 of head width, continuing at the same width almost to antennae; frontal stripe velvet black; parafrontals golden pollinose, wider than the stripe all the way; parafacial, clypeus, cheek and orbit silvery; antennae black, second joint red on apical half or more, third red at extreme base, the up-turned point of the third joint varying considerably in the prominence;

arista thickened on basal fourth, basal joints short; palpi reddish yellow; cheek one-fourth eye height, a row of about six orbital bristles.

Thorax densely pollinose with a yellowish cast, the usual two pairs of black stripes, very narrow and interrupted at the suture, the outer one showing merely a spot anterior to it; scutellum black, uniformly pollinose. Chaetotaxy: dorsocentral 2, 3; acrostichal, 2, 2; humeral 2; posthumeral 1; presutural 1; supraalar 3 (first and third minute); intraalar 3; postalar 2; sternopleural 1, 1; scutellum with 2 lateral pairs and a long apical; no discals.

Abdomen rather elongate, densely gray pollinose especially when viewed from behind, when viewed from the sides some darker reflecting spots appear; first segment without median marginals; second with one pair; third with a row of 10; fourth with a row of 12; no discals on any of the segments. The abdomen is especially shining black around the bases of all the bristles.

Legs black; claws and pulvilli moderately elongate, the latter yellowish; middle tibia with two bristles on outer front side; hind tibia with irregular row on outer hind side.

Wings hyaline; third vein with one hair at base; first posterior cell closed in margin of the wing rather far before apex; bend of fourth vein rounded, without appendage; hind crossvein joining fourth at three-fifths of the distance from anterior crossvein to bend; calypters white.

♀. Frons at vertex .32 of head width; only two pairs of orbital bristles; second antennal joint wholly yellow; arista yellow at base.

Described from 6 males and 2 females, reared from grasshoppers at La Carlota Central, occ. Negros, Philippine Islands, by E. P. Goseco, to whom two paratypes are being returned.

Type.—Male, Cat. No. 44773, U. S. Nat. Mus.

NOTES ON SPHECOPHAGA BURRA (CRESSON), AN ICHNEUMONID PARASITE OF VESPULA MACULATA (L.) (HYMENOPTERA).

By R. A. Cushman,
Bureau of Entomology, U. S. Department of Agriculture.

A large nest of the bald-faced hornet, *Vespula maculata* (L.), brought to the Museum by C. E. Mickel on August 31, 1929, showed fifteen cells containing the parasite *Sphecophaga burra* (Cresson). Dr. Mickel had killed everything in the nest by fumigation with carbon disulphide, but several items of interest in regard to the parasite were obtained, as well as some valuable material.

All the parasites had progressed at least to the point of cocoon construction, most of them to the pupal stage, while in two cells adults were found. There had been no emergence. From one to eight parasites were found in a cell. In every case the host was a fresh pupa, and in no case was the entire body content exhausted by the parasites.

Most of the cocoons were in cells around the periphery of the combs, but a few were far removed from the edge so that they would be vulnerable only from the bottom or the cap. All of the cocoons were white and thin walled, entirely different in texture from a cocoon in the National Museum Collection taken by J. L. Zabriskie many years ago. This cocoon is light brown in color and very firm in structure, especially the top. The adult emerged from this cocoon in April, 1894.

Also in the Museum Collection are two series of specimens reared at West Manayunk, Pa., by R. G. Schmieder, one series of five that emerged from white cocoons on September 15, 1922, and one series of seven that emerged from brown cocoons on May 20, 1923.

Apparently there are two generations of the parasite, the first emerging in late summer or early autumn from delicate white cocoons and the second hibernating in the cocoons, which are made firmer and heavier than those of the first generation.

MINUTES OF THE 442D REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, DECEMBER 1, 1932.

The 442d regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, December 1, 1932, in Room 43 of the new building of the National Museum. Dr. F. C. Bishopp, president, presided. There were present thirty members and thirteen visitors. The minutes of the previous meeting were read and approved.

Mr. Francis Munger of the Bureau of Entomology was unanimously elected to membership on recommendation of the executive committee.

The President stated that Doctor L. O. Howard, our honorary president, is improving rapidly after the operation on his eye, and is now able to read part of the day. He expressed the hope that Dr. Howard may soon meet with us again.

The following officers were elected by the society for the year 1933: President, C. T. Greene; First Vice-President, J. S. Wade; Second Vice-President, B. A. Porter; Recording Secretary, F. M. Wadley; Editor, W. R. Walton; Corresponding Secretary-Treasurer, S. A. Rohwer; Executive Committee, the above officers and W. H. Larrimer, S. B. Fracker, and H. E. Ewing. Harold Morrison was renominated to represent the Society as vice-president of the Washington Academy of Science.

Under the heading "Notes and Exhibition of Specimens," Mr. R. A. Cushman showed specimens and photographs of *Sphecophaga burra*, a parasite of hornets. His notes will be included in a paper to be published in the Proceedings shortly.

Mr. J. C. Bridwell exhibited the characteristic work, nymphs and adults of the cockroach, *Cysticercus punctulatus* Scudder, obtained by him on July 24, 1932, at the only known local station of the species on Cupid's Bower I. in the Potomac River near Great Falls, where it was discovered by Mr. H. S. Barber in 1915, and has not since been taken. At Mr. Barber's suggestion he went to this station and undertook to determine if the mother insect shows material solicitude for the young. This seems to be the case since several young white nymphs were found closely associated with the mother insect around red-rotten pine wood finely comminuted, it is believed, by the mother insect. Beside these young nymphs, others half grown, occurring singly, were found, seeming to indicate that this insect requires more than one year for its development. These insects were found in characteristic tunnels and chambers excavated by them in red-rotten pine logs which had lain on the ground for several years.

Dr. F. C. Bishopp spoke of the work of Mr. R. W. Wells, of the Bureau's Division of Insects Injurious to Man and Animals, on the burrowing of first instar larvae of the common horse bot in the mucous membranes of horses' mouths, and the bearing of this habit on dermal myiasis in man.

The first communication of the regular program, following "Notes and Exhibition of Specimens," was by Dr. P. N. Annand, and was entitled "Relations of breeding areas of the beet leafhopper to the prediction of outbreaks."

The size, location with reference to the beet areas, and the host plant sequence, of beet leafhopper breeding areas in Idaho, Utah, Colorado, New Mexico, and California were discussed; and the importance of these facts to prediction of outbreaks was emphasized. The Idaho breeding area has a two-host sequence—mustard in winter and spring, and Russian thistle in summer and fall, is adjacent to the Twin Falls beet area, and is ideally situated for making accurate predictions of leafhopper abundance.

The Utah breeding area is far removed from the beet-growing sections, and has a host sequence consisting of a mixed annual flora in the winter and spring, and perennials during the summer and fall. The difficulty of judging movement, as determined by wind, of obtaining accurate population estimates over the very large broken area, and of obtaining summaries of the rather diverse factors affecting population in this area would make prediction difficult and somewhat hazardous. The same situation holds for Western Colorado, although it was possible to issue a prediction there last year because of the extreme conditions existing.

The New Mexico breeding area has a single host, a perennial mustard, and no host sequence is involved. The climatic and host plant relations to abundance of leafhoppers are relatively simple, and predictions could possibly be made with accuracy.

The California summer breeding areas consist of weed and cultivated hosts in the low lands, and the winter breeding areas consist of filaree in the foothills. As years of drought rather closely determine the movement of the insects northward in the San Joaquin Valley, prediction could probably be made with accuracy when observations have been carried over a few more years to check the exact relation between climate and insect movement.

The variations in conditions in the different areas emphasize the impossibility of transferring information obtained in one area to another without very carefully checking its applicability.

This paper was discussed by Bishopp, Fracker, McIndoo, Gahan, Bridwell, and Poos.

Meeting adjourned at 10.17 P. M.

F. M. WADLEY,
Recording Secretary.

Actual date of publication, February 6, 1933

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OF WASHINGTON

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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 35 FEBRUARY, 1933 No. 2

THE DESCRIPTION AND LIFE HISTORY OF A NEW SAWFLY, STERICTIPHORA APIOS (ARGIDAE : HYMEN.).

By HERBERT H. ROSS,
Illinois State Natural History Survey, Urbana, Illinois.

The species described in this paper was first collected in 1930 as larvae feeding on the ground bean (*Apios tuberosa*), at Sherman, twelve miles north of Springfield, Illinois. The ground bean was growing along a railroad embankment and formed a patch probably fifty yards long and five or six wide. Rearings of adults were made from this area in 1930 and 1931, but in the summer of 1931 the area was burned over and the species was apparently exterminated in that locality.

Sterictiphora apios, new species.

Female.—Length 6 to 7 mm. Head and antennae black; thorax with the following parts black: cervicum and prosternum, meso- and meta-pectus, a triangle occupying most of the praescutum, and the exposed part of the postnotum; abdomen yellow with the sutures of the basal plates, the sheath and its basal sclerites, black. Legs (including coxae) dark blackish brown, with the front tibiae and tarsi paler. Wings infuscate with brown at base, the infuscation gradually shading into grayish at the apical margins; veins and stigma dark brown or blackish. The coxae, clypeus and supraclypeal area may have areas of yellowish red on them, but this condition is not general.

Body short and very robust; head moderately robust, slightly wider than distance between tegulae.

Head seen from above three-eighths as long as wide; clothed with fine, silky pubescence; polished, sometimes clypeus and supraclypeal area sufficiently striate to be dull. Mandibles scythe-like, as in Fig. 5. Labrum short but wide, broadly rounded in front. Clypeus wide, slightly emarginate over its entire width; moderately convex, sometimes distinctly carinate down the meson; entire surface covered with moderate, distinct punctures. Supraclypeal area tapering from a broad base to an elevated crest in the side of which the bases of the antennae are inserted; punctured similarly to clypeus; both of them sometimes faintly striate. Region between this crest and the eyes hollowed out, forming a declivous basin terminated at one end by the pretentorina and at the other by the supratentorina. Moderately deep furrows extend from this point to the posterior margin of the head. Ocellar region raised, its lateral margins rounded, the median ocellus surrounded by a very narrow depressed area which extends anteriorly as a narrow line and becomes confluent with the small ovate median fovea. Head behind eyes robust but not produced laterally beyond eyes. Antennae variable in length, third segment from one-fifth shorter to one-fifth longer than width of head across eyes; clothed with short, close, stiff pubescence; widest near base, of almost equal thickness to near apex, then either tapering to a point or terminating with a blunt end.

Thorax polished, with only sparse pubescence. Venation of wings as in genotype and allied species in the genus. Legs short, tarsal claws simple.

Abdomen with a noticeable sheen. Sheath (Figs. 12, 13) very broad, the apex with lateral processes raised above the sheath surface and not confluent with it, the base and sides of the sheath with fine hairs, the processes with conspicuous and abundant hairs.

Male.—Length 5.5 to 6.5 mm. Head and antennae entirely black; pronotum yellow, tegulae yellowish, remainder of thorax black; abdomen reddish yellow with parts of the sutures of the basal plates and portions of the caudal segment and genitalia, black. Legs and wings as in female.

Similar in structure to female, with the following antigenetic differences: third antennal segment of antennae bifurcate to base, lyriform; male genitalia with claspers broad and rounded at apex, and with the lateral aspect of the penis valve as in Fig. 11.

Holotype.— ♀; Sherman, Illinois, May 22, 1930 (H. H. Ross). Reared from *Apios tuberosa.* In the collection of the Illinois State Natural History Survey, Urbana, Ill.

Allotype.— ♂; same data.

Paratypes.—14 ♂♂, 28 ♀♀, from Sherman, Ill., collected as adults or larvae May 22, 1930 (H. H. Ross), or May 17, 1931 (Ross and Mohr), those collected as larvae reared at Urbana, Ill., on *Apios tuberosa;* 1 ♀, same locality, May 23, 1930 (T. H. Frison); 1 ♀, Urbana, Ill., May 9, 1916 (C. S. Spooner). Deposited with the holotype.

This species is most closely related to *S. nigriceps* (Konow), but differs from it in the sharper carina of the supraclypeal area, in having the median fovea connected by a narrow, depressed line to the ocellar basin, and in the female by the differently shaped and detached lateral process of the sheath (Figs. 12, 13 and 14). The female may be distinguished from all other species by the shape of the sheath, but good characters for the separation of the males in this group have not yet been worked out.

Sterictiphora apios form **atrescens,** new form.

Male and female structurally identical with the typical form. Differ in color in having the abdomen entirely black except for the ventro-lateral plates of the terga and membranous areas on the basal plates which are sometimes yellowish. In addition, the males sometimes have small, diamond-shaped, yellowish areas on the venter.

Holotype.— ♀; Sherman, Illinois, collected as larva May 17, 1931 (Ross and Mohr), reared from *Apios tuberosa*.

Allotype.— ♂; same data.

Paratypes.—2 ♂ ♂, 4 ♀ ♀, same data; 1 ♂, same locality, collected May 22, 1930 (H. H. Ross); 1 ♂, same locality, May 23, 1930 (T. H. Frison). Types deposited with those of the typical form.

This dark form is apparently only a melanic genetic combination, having been reared from the same batches of larvae as the typical form. No intergradations between the two forms have yet been observed. The female can be distinguished on the basis of the sheath, but the males have not yet been satisfactorily keyed out.

DESCRIPTIONS OF IMMATURE STAGES.

Egg.—Length 1.1 mm., width 0.7 mm. Shape ovoid, round-elliptic in cross-section. Membrane white and thin.

First instars of larvae.—Structure and setation similar to full grown larva; differ in appearance in that the body tubercles are more prominent.

Larva, full grown.—Length 17 mm.; head 2 mm. wide. Color of head gray yellow orange with gray orange mottling; body yellowish green to bright green with dark brown tubercles, brownish areas on the thoracic legs and at their base, and with the epiproct brown.

Head (Figs. 1, 2) with sparse setae. Epicranial suture curved slightly to left. Front pentagonal, bearing about ten prominent setae arranged symmetrically around the margin. Occipital areas with a group of about twelve similar setae forming a semicircle from one antenna to the other, arching over the front. Eyes prominent, black. Antennae (Fig. 6) plate-like, with five large pores and one small one, and three small, circular opaque ares. Labrum mostly membranous. Clypeus dark brown, with two pairs of prominent setae. Epipharynx (Fig. 3) with four central pairs of pointed setae, marginal area with about fourteen pairs, the eleven apical setae apparently modified into sense organs.

Mandibles (Fig. 4) robust, right one with four teeth, the left with five. A portion of the mesal area of the left mandible is modified into a membranous area covered with a brushy setation. This undoubtedly is a prostheca. The right mandible has a corresponding brushy area but not situated on membrane. The left mandible also has a well defined ventral side, which is not angulate in the right mandible. Maxillae as in Fig. 10; palpi five segmented, the second and third narrowed on opposite sides; galea horn-shaped; lacinia blunt, with apical teeth similar to distal teeth of epipharynx; stipes and cardo present as chitinized plates. Labium (Fig. 9) with three-segmented palpi, the third segment extremely small; totaglossa large and spadiciform.

Alitrunk (Fig. 1) with smooth epidermis conspicuously studded with nipple-like tubercles, each tipped with a spine. General appearance cylindrical, of about equal diameter throughout, except the prothorax and anal segments which are smaller. Segments 2 to 7 of abdomen slightly greater in diameter than remainder of body.

Prothorax with two annulets; the first consisting of only the pleural region with a large spiracle, three tubercles above it and three below; the second consisting of the tergum only, bearing 6 pairs of tubercles. Meso- and metathorax similar, four annulets present on dorsum, with 2, 1, 4 and 4 pairs of tergal tubercles respectively; pleuron with a reduced spiracle and 6 tubercles; the mesopleuron with a small, pore-like structure caudad of the tubercles. Legs distinct on all three segments, articulating with distinct hypopleurites. Prothoracic leg distinctly four segmented, coxa large, femur and tibia smaller and sub-equal, tarsus still smaller, pad-like, with an anterior claw. Meso- and metathoracic legs similar to each other, but larger than the prothoracic legs, and with femur and tibia very closely united, approaching a fused condition.

Abdomen with ten visible segments, the first eight with a pair of spiracles, segments 2 to 7 with pair of distinct larvapods, segment 8 with a minute pair, and segment 10 with a large pair. Typical annulation, etc., of a segment as follows (Fig. 1, "3"); three annulets, the anterior one complete, the last two evident only on the tergum and sternum. Annulets with 2, 4 and 4 pairs of tergal tubercles respectively, 2 and (representing two annulets) 9 pairs of lateral tubercles and 0, 4 and 3 pairs of sternal tubercles. The ventro-tergal tubercle on the third annulet is very small. The first annulet of the first segment is reduced to the tergal region; the ninth segment has only indistinct annulation, a reduced number of pleural tubercles, and has a tubercle in place of a larvapod. The tenth, or last, segment is greatly modified, having no apparent annulation; the posterior half is a prominent epiproctal region (Fig. 8) with 2 pairs of large apical setae; the anterior half bearing 7 prominent pairs of tubercles. The region below the anus bears a lunate, semi-sclerotized area with four pairs of long setae, two pairs slender and inconspicuous, the other two much more prominent. The legs of this segment are, as usual, thick and stubby. They bear a ring of small tubercles around the base, below the hypoproctal region.

Prepupa.—Similar to previous larva in size, structure and color, differing slightly in having the tubercles slightly wider at the base but not so tall.

Descriptions drawn up from about 60 larvae of all stages reared on *Apios tuberosa* at Sherman, Ill., May, 1930 and 1931; preserved in alcohol.

This larva resembles in color the larvae of *S. cellularis* (Say) and *S. prunivora* (Dyar), but differs from them in the well-developed epiproct and the arrangement of spines on it. The head, also, is darker than other reared species in the genus.

LIFE HISTORY NOTES.

In order to make these observations, larvae and pupae were brought to Urbana and placed upon potted plants of the ground bean. These plants were kept in an open west window which afforded good ventilation and plenty of sunlight. The time given for the duration of the various stages is therefore typical of the May and June temperature in this vicinity.

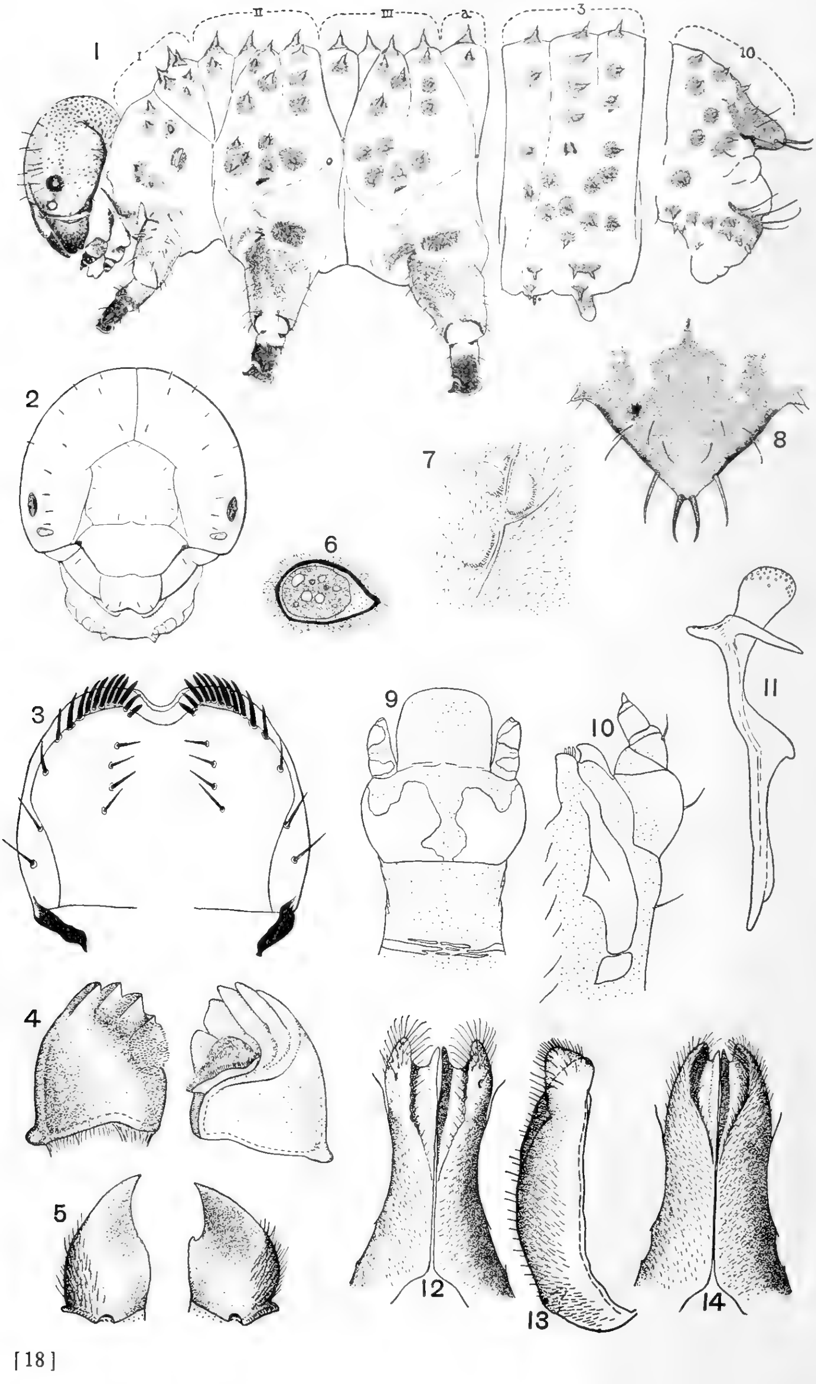
The eggs (Fig. 7) are laid within the tissues of the leaf, deposited in an incision made along a lateral vein on the under side of the leaf. They appear like nodules under the epidermis, and when abundant present a very curious appearance. They hatch in about four days. Immediately the larvae begin feeding upon the leaves of the plant. Their legs, both thoracic and abdominal, are well developed, and with them the insect clings most tenaciously along the edge of the leaf. The entire thickness of the leaf is eaten, and a heavy infestation will strip the plants of all their foliage except the heavier veins and stems. The black markings of the larvae are present on the earliest instars and a group of larvae feeding together make a conspicuous picture.

The number of instars is not known, but the entire larval period is passed in about ten days. This is very rapid development compared to that of most sawflies which have been studied. There is very little variation in the size of members of each brood. After becoming full grown the larvae do not wander to any extent, but construct their cocoons upon either the same plant upon which they feed or a nearby one. In this latter case it is often upon some other plant species, such as grasses or sweet clover. The cocoons are made from a rather coarse silk which becomes brittle and hard soon after exposure to the air; the color is at first white but finally turns rich brown. They are attached to leaves or stems at varying distances from the ground but usually on a part of the plant exposed to sunlight. Most frequently they are made in a terminal bunch of small leaves which are pulled together around the cocoon.

Within the cocoon the larva changes in two or three days to the pupa, which in another four to six days emerges as the adult. The total period within the cocoon is from six to nine days, averaging seven or eight. This gives a total period of development, from egg-deposition to the emergence of the adult, of twenty-two days, or slightly more than three weeks.

The adults, judging from the few studied in cages, are not very long-lived, dying in less than a week. Copulation and egg-laying took place in the rearing cages three days after emergence, all the eggs being laid on the third day.

The feeding habits of the adults are very interesting. They eat the luxuriant pubescence on the leaves of the host plant just as a cow crops grass. The scythe-shaped mandibles (Fig. 5) are used in the cutting operation. The sawfly, when feeding, stands at one point, crops the pubescence in front of it in a semicircular swathe, then steps forward and repeats the process until the leaf is denuded. In vials in the laboratory the pubescence was eaten from either side of the leaf. This is the first time such a feeding habit has been recorded for a sawfly. I have, however, previously observed the same habit with the


1
I
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adults of *Pteronidea mendica* (Walsh), in which the mandibles are also sickle-shaped. In all likelihood this will prove to be a common habit in certain sawfly groups.

LIST OF ILLUSTRATIONS AND ABBREVIATIONS.

Figures 1—13, *Sterictiphora apios*, n. sp.:

Fig. 1—Lateral aspect of head, thorax, and third and tenth abdominal segments of larva.
Fig. 2—Front view of head of larva.
Fig. 3—Epipharynx of larva.
Fig. 4—Meso-ventral view of mandibles of larva.
Fig. 5—Dorsal view of mandibles of adult female.
Fig. 6—Antenna of larva.
Fig. 7—Portion of leaf of *Apios tuberosa* with sawfly eggs beneath the epidermis.
Fig. 8—Dorsal aspect of epiproctal region of larva.
Fig. 9—Ventral aspect of labium of larva.
Fig. 10—Ventral aspect of maxilla of larva.
Fig. 11—Lateral aspect of penis valve.
Fig. 12—Ventral aspect of sheath.
Fig. 13—Lateral aspect of sheath.
Fig. 14—*Sterictiphora nigriceps* (Konow), ventral aspect of sheath.
I, II, III = first, second and third thoracic segments respectively.
a = first annulet of first abdominal segment.
3, 10 = third and tenth abdominal segments respectively.

Figures 1, 2, 7 and 8 were drawn by Mr. C. O. Mohr, of the Illinois State Natural History Survey.

NOTES ON THE TACHINID GENUS ELODIA R. D., WITH THREE NEW SPECIES OF ELODIA AND PHOROCERA (DIPTERA) FROM JAPAN.

By J. M. ALDRICH, *National Museum.*

The new species here described were received by the Bureau of Entomology from G. J. Haeussler and turned over to me for identification. All the specimens were reared in Japan and Korea (Chosen) from larvae of the Oriental Fruit Moth (*Grapholitha molesta* Busck).

ELODIA ROBINEAU-DESVOIDY.

Elodia Robineau-Desvoidy, Dipt. Environs Paris, vol. 1, p. 936, 1863.—Stein, Arch. Naturgesch, 90, 144, 1924.—Villeneuve, Ann. et Bull. Soc. Ent. Belgique, vol. 69, p. 182, 1929.

Robineau included three new species, all of which are considered a single species by Bezzi in vol. 3 of the Palaearctic

Catalogue, p. 396. The type species was designated by Robineau as the first one, *Elodia gagatea* n. sp., which is a synonym of *Tachina tragica* Meigen. Stein, 1924, indicates the synonymy of *gagatea*, and Villeneuve, 1929, considers the genus valid for *tragica*, the only species heretofore known belonging to it.

The National Museum has a series of 14 specimens of both sexes of *tragica*, labeled as bred from Codling Moth (*Carpocapsa pomonella*) in Saxony by "Miss Rühl"; they were received in 1907 through the Bureau of Entomology with Quaintance numbers. I have identified them from Stein's 1924 work on the European Tachinidae, in which they run very satisfactorily to this species; the jet black color and small size make the identification comparatively easy.

The principal characters of the genus, as derived from these specimens are as follows:

Eyes bare; head rather broad; front broad in both sexes; the frontal profile equal to the facial; length at vibrissae considerably less than at base of antennae; two pairs vertical bristles, frontals reaching to base of third antennal joint, two or three uppermost pairs reclinate but not strikingly large; two pairs of orbitals in both sexes; parafacial bare, narrower than third antennal joint; clypeus depressed, including epistoma, which is wide; vibrissae at oral margin; facial ridges rather high, with bristles about to the middle in the female, a little farther in the male; antennae reaching almost to vibrissae; third antennal joint twice the second, moderately broad; arista with penultimate joint about twice as long as thick, last joint thickened on basal two-fifths; proboscis small; palpi of the same size. Thoracic chaetotaxy: dorsocentral 2, 3; acrostichal 3, 3; humeral 2; posthumeral 2; presutural 2; notopleural 2; postalar 2; supraalar 3 (middle large); intraalar 3; sternopleural 2, 1; pteropleural small; propleura bare; prosternum with two or three bristly hairs on each lateral margin; scutellum with three lateral pairs, the last close together at apex but having between them a pair of small hairlike upturned apicals, disk of scutellum with a pair of small bristles and some erect hairs.

Abdomen with one pair discals on the second and third segments and many discals on the apical three-fourths of the fourth segment; second segment has a marginal pair, the third a marginal row of eight; hind tibia on outer side with a fairly regular row of about 14 bristles, two or three being longer than the others; the third vein of the wing has two large setules at base; the fourth vein has an oblique rounded bend, thence a little concave and joins the costa very slightly before the apex, first posterior cell being narrowly open; last section of fifth vein short; hind crossvein joining fourth just beyond middle between anterior crossvein and bend.

Key to Species of Elodia.

(All are small, jet-black species.)

1. Palpi yellow, intermediate abdominal segments without discals................ *flavipalpis*, new species.
   Palpi black, at least the third abdominal segment with discals.................. 2.

2. Length under 3.5 mm.; male with faint cinereous basal crossbands on third and fourth abdominal segments.................*subfasciata*, new species.
   Length over 4.5 mm.; abdomen wholly shining black in both sexes............ *tragica* Meigen.

Micrometer measurements of the width of front at vertex, expressed as a decimal fraction of the width of the head, were made of both sexes of all three species. The variations are wide enough to leave little significance in this relation:—*tragica*, male .37, female .39; *flavipalpis*, male .33 and .35, female .33 and 39; *subfasciata*, male .36 and .39, female .50.

Elodia tragica Meigen.

Tachina tragica Meigen, Syst. Beschr. Zw. Ins., vol. 4, p. 408, 1824.
Degeeria tragica Meigen, ibid, vol. 7, p. 249, 1838.—Macquart, Ann. Soc. ent. Fr., ser. 2, vol. 8, p. 453, pl. 13, fig. 14, 1850.—Rondani, Dipt. Ital. Prod., vol. 4, p. 45, 1861.—Schiner, Fauna Austr. vol. 1, p. 535, 1862.—
Arrhinomyia tragica Bezzi, Kat. Pal. Dipt., vol. 3, p. 396, 1907.—Villeneuve, Wien. Ent. Ztg., vol. 26, p. 249, 1907.—Baer, Die Tachinen, p. 153, 1921.—Stein, Arch. Naturgesch., 90, p. 144, 1924.—Lundbeck, Dipt. Dan., pt. 7, p. 366, 1927.—Wainwright, Trans. Ent. Soc. Lond., p. 211, 1928.
Pentamyia parva Brauer and Bergenstamm, Zweif. Kais. Mus., pt. 4, p. 164, pl. 2, fig. 25, 1889.
Roeselia atricula Pandelle, Rev. Entom., vol. 15, p. 44, 1896.
Elodia tragica Villeneuve, Bull. et Ann. Soc. Ent. Belg., vol. 69, p. 182, 1929.

The synonomy of *Pentamyia* is by Villeneuve, 1907 supra; that of *Roeselia* is by Villeneuve, Ann. Soc. ent. Fr., vol. 76, p. 338, 1907.

Jet black all over except the parafacials, which have thin cinereous pollen; calypters yellow; wings yellowish at base and with yellow veins; the front is almost as wide in the male as in the female and in both the dark brown median stripe is hardly as wide as one parafrontal; in the male the claws and pulvilli are slightly elongated, the latter brownish.

Male and female, length 4.8–5.8 mm.

Elodia flavipalpis, new species.

Jet black all over as in *tragica*, but the palpi and tip of proboscis are yellow; bristles of the facial ridges are stronger than in *tragica* or *subfasciata;* there are no discal bristles on the intermediate abdominal segments; the wings are not distinctly yellow and the calypters are white; the size is distinctly smaller than in *tragica*, but in other details the characters appear to be the same.

Length, 2.8–3.8 mm.

Described from 13 males and 15 females: The type and allotype are from Obukuro, Saitama Province, Japan; the rest of the material is from the provinces of Nagano, Miyagi, Niigata, Saitama, Kanagawa, Fukuoka, Fukushima and

Shizuoka, from Tokyo and Osaka; also one male from Kaijo, Keikido, Chosen.

Type.—Male, U. S. N. M. Cat. No. 44802.

Elodia subfasciata, new species.

The characters differentiating this species from *tragica* are mentioned in the key; it is much smaller and somewhat more slender, agreeing in these respects with *flavipalpis;* the males show a faint basal pollinose band on the third and fourth abdominal segments. The head, when viewed from in front, is not so broad in proportion to the height as in *tragica*. The wings are not at all yellowish at base and the calypters are white. Discal bristles of the abdomen are as in *tragica*.

Length, 3.7–4 mm.

Described from 2 males and one female from Sakata-Mura, Yamagata Province, Japan, in 1932.

Type.—Male, U. S. N. M. Cat. No. 44803.

Phorocera pumilio, new species.

A minute species; black, including palpi, with cinereous pollen.

Male.—Head at vertex .30 of head width, widening very slightly for some distance; eyes pilose; two pairs of verticals; ocellars proclinate and divergent; frontals about 8, extending to level of arista, the upper two pairs reclinate but not strikingly large; frontal stripe brown, narrower than one parafrontal, the latter shining above, gradually becoming pollinose anteriorly; parafacial bare with silvery pollen, narrow, less than one-half the width of third antennal joint; antennae black, third joint about five times the second, moderately broad, upper and under edges parallel; arista with short basal joints, thickened on basal two-fifths, its total length hardly exceeding that of third antennal joint; cheek one-eighth of eye height; clypeus rather broad with gray pollen; facial ridges moderately prominent, with bristles almost up to arista; vibrissae far apart at oral margin; palpi rather large; proboscis small.

Mesonotum subshining black with thin gray pollen anteriorly, on which the usual four dark stripes are visible; humeri with gray pollen which extends back to root of wing; dorsocentral 3, 4; acrostichal 3, 3; humeral 3; posthumeral 2; presutural 2; notopleural 2; supraalar 3; intraalar 3; postalar 2; sternopleural 2, 1; pteropleural present but not very large; prosternum with numerous small hairs mostly along the sides; propleura bare; scutellum with three laterals, the intermediate rather small; a pair of erect decussate bristles at apex and a pair of distinct discals.

Abdomen black, with indistinct basal bands of gray pollen at bases of segments; first segment with a median marginal pair, second with a discal pair and a few erect bristly hairs, also one pair median marginals; third segment with one pair of discals, a marginal row of six; fourth segment with irregular discal row of four or six and a marginal row of about the same number; genital segments black; venter almost shining, the pollen being very thin.

Legs entirely black; claws and pulvilli not much enlarged; middle tibia with one bristle at middle on outer front side; hind tibia with a sparse row of bristles on the outer hind side interspersed with two larger.

Wings hyaline; third vein with two setules at base; fourth vein with rounded oblique bend, ending distinctly before the extreme apex of the wing, the distance being equal to two-thirds of the length of the hind crossvein, the latter a little oblique, joining fourth at about four-sevenths of the distance from anterior cross-vein to bend; last section of fifth vein short; costal segment before the tip of first vein longer than hind cross-vein; calypters white.

Female.—Front at vertex .33 of head width; two pairs of orbitals; third antennal joint four times the second, otherwise as in the male.

Described from 3 males and 2 females. The type male is from Taikyu, Keisho Hakudo, Chosen; the allotype female is from Nishino, Yamanashi Province, Japan; the other three are from Yamagata, Saitama and Nagano Provinces, Japan.

Type.—Male, U. S. N. M. Cat. No. 44804.

A NOTE ON THE OCCURRENCE OF THE AUSTRALIAN CATTLE TICK IN TEXAS.

By H. O. Schroeder, Jr.,
Entomologist, Division of Insects Affecting Man and Animals, U. S. Bureau of Entomology.

The American cattle tick, *Boophilus annulatus* Say, has two recognized varieties. One of these, *Boophilus annulatus* var. *australis* Fuller, has a wide distribution, but only recently has it made its appearance in the United States. The habits of this tick, commonly known as the Australian cattle tick, are essentially the same as those of *B. annulatus* proper. The most outstanding structural character which distinguishes it from *B. annulatus* is a prominent protuberance or "tail" on the posterior margin of the male. The distribution of the Australian cattle tick in the Western Hemisphere as given by Hooker, Bishopp and Wood, 1912, U. S. Bureau of Entomology Bulletin No. 106, is as follows: "* * * It undoubtedly occurs in all of the countries of South America, having been reported from British Guiana, Brazil, Paraguay, Uruguay, Argentina, and Chile. It is known to occur as far north as Tampico, Mexico, where it was found to be a bad pest. In Central America it has been reported from Guatemala, Costa Rica, and Panama. It appears to be widely distributed in the West Indies, having been reported from Cuba, Jamaica, Porto Rico, Antigua, Guadeloupe, Dominica, and Trinidad." These authors stated that it occurred as far north in Mexico as Tampico, where it was a severe pest.

In 1913 (Entomological News, Vol. 24, pp. 366–368) Bishopp reported the collection of this variety on cattle in Key West, Florida, on February 8, 1912. He also referred to the Mexican situation and stated, "There is always danger of this form being brought into southern Texas from Mexico but the likelihood is equally great of its establishment on the mainland of Florida from the infestation now existing in Key West."

Both of these probabilities have become a reality, as the variety is now well established in many Florida counties and in 1931 the Australian variety was found to be very abundant in Matamoros, Mexico. With the assistance of Dr. N. E. Dutro of the Bureau of Animal Industry, collections of cattle ticks were made on the Texas side of the international boundary from Brownsville to Laredo in order to determine its distribution in Texas. Systematic eradication of cattle ticks is nearing completion in some of the counties bordering on the Rio Grande in this area and the ticks are, therefore, not at all numerous. However, it appears from these collections that *Boophilus annulatus* var. *australis* is confined to the lower Rio Grande valley counties of Hidalgo and Cameron.

Collections were also made on the Mexican side of the border from Matamoros to San Pedro, a point approximately 120 miles up the river. Although cattle ticks were found to occur in great abundance throughout this region, the Australian variety seemed to be restricted to an area corresponding to its occurrence on the Texas side of the river. Fully 90 per cent of the cattle ticks collected at Matamoros, Mexico, were of the Australian variety. This ratio dropped to about 30 per cent at Rio Rico, 30 miles farther up the river, and all those collected beyond that point were of *annulatus* proper.

At times during the last 20 years when markets were favorable large numbers of Mexican cattle were imported into the United States at various ports of entry on the Rio Grande. These importations caused a more or less general movement of cattle north of Tampico, which no doubt hastened the natural spread of the Australian cattle tick.

THE REACTION OF EARTHWORMS TO ALTERNATING CURRENT OF ELECTRICITY IN THE SOIL.

By W. R. Walton,
Bureau of Entomology, U. S. Department of Agriculture.

In recent years dealers in fishing tackle have been advertising what is called an "electrical worm digger." This apparatus has some scientific interest but so far as I am aware it has escaped notice in this respect. The apparatus is designed for the use of the ordinary household 110–120 volt A. C. electric current in bringing earthworms to the soil surface, and the writer has given this scheme preliminary investigation. The results of these inquiries are reported herewith.

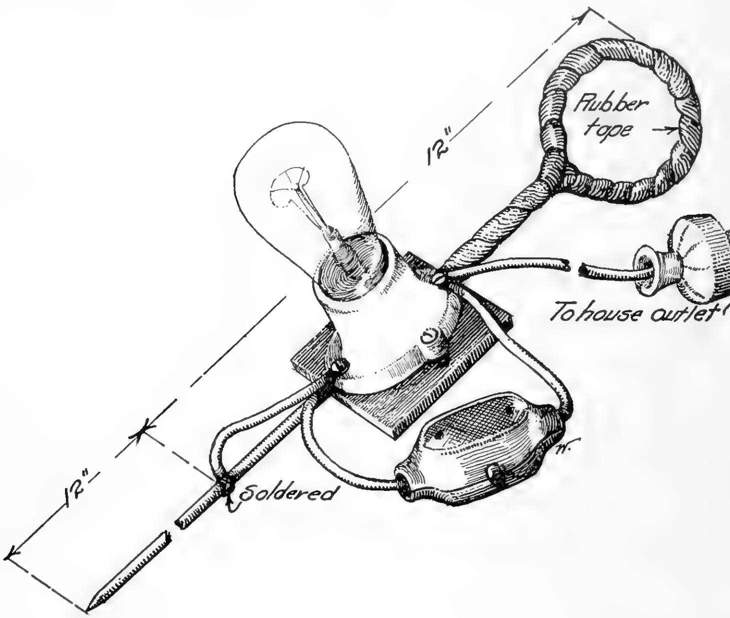
The commercial apparatus offered for sale consists essentially of two spindle-shaped metallic electrodes 18 to 24 inches long, each sharply pointed on its lower end and bearing an insulated handle on its upper end. To each of these is connected, a few inches below the handle, one of the two ends of a double conductor extension cord some 30 or more feet long. This cord is attached to a separable plug which is intended to be plugged into any household outlet supplied with the current as previously mentioned.

In use, the spindles are thrust into the soil from 3 to 4 feet distant from each other to a depth of from 8 to 12 inches. A spot should, of course, be selected which contains earthworms. When this is done and the current is turned on, the worms begin to come to the surface, if at all, in from 60 to 90 seconds after connection is made and with quite evident haste. They were found to be thus affected even in broad daylight, but this result was most evident when the place chosen was in the shade, as only dire necessity will induce an earthworm to emerge from the soil in full sunlight.

It was soon noticed that not all the worms inhabiting the immediate vicinity of the electrodes came to the surface. In fact only a comparatively few were thus affected. Another noticeable incident was the fact that practically all of the worms emerged near a single one of the electrodes, which was invariably the same one. The reason for this seemed to be that since one side of the house current is intentionally "grounded" or short circuited to the domestic water system, the principal flow of electric current was not between the electrodes but between the open or "hot" side of the circuit and the relatively enormous surface of the domestic water system. This assumption was confirmed by the withdrawal of the apparently inactive electrode with the result that the remaining one continued to affect the worms quite as much as when two were used.

This discovery suggested the simplification of the apparatus as follows: A single conductor with its electrode was substituted for the double one and in order to determine when the plug was in contact with the open or hot side of the circuit an electric light bulb, with its socket, was connected in series with the electrode. This was accomplished by bolting an ordinary porcelain lamp socket (5 and 10 cent store) to the upper part of the electrode. A 20-watt bulb was screwed into the socket and the current turned on. The electrode was thrust into the soil and when the lamp did not light it indicated that the grounded side of the circuit had been tapped; it then became necessary merely to withdraw the plug from the outlet and reverse its prongs. This lit the lamp, but since a low-powered lamp passes only a small flow of current, it became desirable to supply some means of cutting it out when necessary. This was accomplished by connecting an ordinary cord, "through" push button switch, such as is commonly used on electrical sadirons, across the terminals of the light socket.

A lamp of not more than 20 watts power should be used on the electrode because when this apparatus is used at night a stronger light usually frightens the worms and may thus defeat the object of the apparatus. The light provided by the low-power bulb serves conveniently not only to locate the burrows of the earthworms at night, but also the worms themselves when they emerge at the surface. The use of the single conductor reduces to a minimum the liability of low-voltage shock to the operator and the very real danger of blowing out a house fuse presented by the accidental contact of the two electrodes furnished with the commercial apparatus. With the light cut out, current consumption is about 65 Watts.



In case other insulating material is not available for use as handles for electrodes, electricians' rubber tape (not ordinary friction or "tar-tape") may be wound about the upper third of the electrode and is both safe and easy to apply. Number 4 B & S galvanized iron or steel wire is suitable for use as electrodes.

The operator should always wear a sound pair of high rubber overshoes as a sensible precaution against low-voltage shock which might prove dangerous under wet conditions.

It was found that this apparatus, when used in a heavy clay-loam soil that was thickly populated by large earthworms, was only moderately successful even under what appeared to be the most favorable conditions for operation. Only two or three worms were ejected from a given location, and in some places well sprinkled with worm holes no result whatever was observed. This inconsistency in result is due to undetermined factors such, perhaps, as uneven moisture content of the soil, depth of location of the worms at the time of application of the current, or the descent instead of ascent of the worms to zones unaffected by the oscillating current.

That only a small proportion of the worms apparently lying in the electrical field produced by this apparatus are affected by it was proven by the following experiment. In a glazed stoneware crock 11 inches in diameter was placed 9 inches of clay-loam garden soil in moist but not muddy condition. In this were placed 16 large specimens of *Lumbricus terrestris* Linn. Two electrodes were thrust into opposite sides of the jar completely to its bottom and the current was connected. It was allowed to remain on for 3 minutes and then the position of the electrodes was shifted to various sectors of the circle in turn, until the entire area had been electrified. The results were, that not in any case were more than 3 earthworms of the entire 16 brought to the surface at any one time. The efficiency of this apparatus in its present form, therefore, is low at best.

Dr. C. L. Marlatt has suggested the possible utility of this principle in entomological green house work, for the purpose of ridding potted plants of earthworms. It seems that a modification of the previously described apparatus might prove useful in that way.

MINUTES OF THE 443D REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, JANUARY 5, 1933.

The 443d regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, January 5, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, president, presided. There were present 41 members and 16 visitors. The minutes of the previous meeting were read and approved.

The following individuals were unanimously elected to membership on recommendation of the executive committee: Mr. George Marvin, Mrs. Doris Blake, Mrs. M. F. Benson, Mr. Heber Donohoe; all of the Bureau of Entomology.

Under the heading "Notes and Exhibition of Specimens," Mr. R. W. Harned spoke of visiting Doctor Howard in company with Mr. Loftin and of receiving a message of greeting from him to the society. Doctor Howard hopes to attend our meetings again in the spring.

A motion was passed that the president convey to Doctor Howard our greeting and thanks.

Doctor Ewing exhibited two new books on Medical Entomology, one by Matheson, and one by Riley and Johannsen. He also spoke of the question of credit for borrowed llustrations.

Mr. Cushman spoke urging presentation of more notes.

Dr. R. H. Painter of Kansas State College, upon invitation, greeted the Society. He spoke of the work of the Kansas Entomological Society.

Mr. Curry remarked on usage in giving credit for copied figures. The note was discussed by Ewing and McIndoo.

Mr. Rohwer spoke briefly of the Agricultural Appropriation Bill and its probable influence on entomological work.

The first communication on the regular program was by Dr. J. R. Parker, and was entitled "Highlights on the grasshopper situation in 1932."

The damage done in 1931 was widespread, and in the worst area in Nebraska and South Dakota about 6,000,000 acres of crops were totally destroyed. In 1932 damage was less general, but was locally severe.

The species involved were *Melanoplus differentialis* and *M. bivittatus* in South Dakota and Nebraska, and the latter species alone in North Dakota and Minnesota. These species had not previously been regarded as very dangerous, and were believed to be non-migratory. These ideas were reversed in 1931 and '32. The connection of the migratory tendency with Faure's phase theory was discussed. Migration was usually aimless rather than definite, but in some cases considerable spread of *M. differentialis* in one year was found. Most migrants were under 600 feet, but some were found as high as 1600 feet. Another grasshopper species of solitary habit suddenly developed a positive light reaction, and swarmed to lights in towns.

In Nebraska and South Dakota in 1932, rain and cold at hatching time reduced numbers; in North Dakota and Minnesota this did not occur, and a hard fight was necessary. Organization for proper use of poison bran mash was the key to success. Minnesota did an especially fine piece of work. Futile attempts to spread disease were made in some places.

With present knowledge of changes in grasshopper populations, annual survey work should enable us to head off grasshopper outbreaks at a considerable saving over present conditions of injury and control expense.

This paper was discussed by Bulger, McIndoo, Cory, Rohwer, Bishopp, Gahan and Barber.

The second communication was by J. C. Bridwell, and was entitled "Some aspects of the biology of Bruchidae." This paper will be published in the proceedings. The paper was discussed by Mr. Wadley.

Meeting adjourned at 10 P. M.

F. M. WADLEY,
Recording Secretary.

Actual date of publication, February 23, 1933.

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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

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TWO NEW GENERA AND SPECIES OF APHIIDAE (HOMOPTERA).[1]

By A. A. GRANOVSKY, *Division of Entomology, University of Minnesota.*

The genus *Chaitophorus* was originally described by Koch (8), in 1854, and characterized mainly by the short, thick and truncate cornicles, hairiness of the body, legs and antennae as well as of the wart-like cauda. He listed twelve species as belonging to this newly erected genus, without designating any of them as the type of the genus. The type of *Chaitophorus* was fixed by Gerstaecker (6), in 1856, using *Aphis populi* Linnaeus for the purpose.

Since that time several new species were described and placed in the genus *Chaitophorus*, while some of the species, originally listed by Koch, have been removed from it and are placed in different genera of the tribe *Callipterini*. Among the American species usually considered under *Chaitophorus* we also find a species known as *Chaitophorus quercicola* Monell. Describing both apterous and alate forms of his species in 1879, Monell (9, p. 32), placed it in this genus with considerable doubt, for he states: "Though the antennae of this species are not sufficiently pilose to justify its being placed in *Chaitophorus*, its general appearance seems to point to this as its rightful position."

In 1880, Thomas (14) described a species *quercifolii*, placing it in the genus *Callipterus* of early workers' conception of the genus. Thomas's species is doubtless that of *quercicola* Monell, as has been shown by Davis (3 and 4), who examined and tabulated Thomas's collection in 1913 and gave an annotated list of Illinois aphid material in 1910. The original Thomas' slide of the species is in the custody of the Illinois Natural History Survey Laboratory. Through courtesy of Dr. Theo. Frison the writer had the opportunity of examining the cotypic slide of *quercifolii* Thomas. Both alate and apterous viviparous females mounted on this slide, agree in all respect with the original description of *quercicola* Monell.

In 1886, Oestlund (10) described his *Chaitophorus spinosus*

[1]Paper No. 1170 of the Journal Series of the Minnesota Agricultural Experiment Station.

from the apterous oviparous female, and in 1887 he (11) gave a description of apterous viviparous form. Davis (3), in 1910, and Baker (1), in 1917, considered *spinosus* Oestlund as a synonym of *quercicola* Monell. In his later publication, 1922, Oestlund (12) accepted this synonymy of his species. Just recently Dr. Oestlund was very kind to show to the writer the cotypic material from which a description of *spinosus* was made. This material agrees with the description of *quercicola* Monell, and leaves no doubt as to the identity of this species.

Hottes and Frison (7) in their remarkable volume on "The Plant Lice, or Aphiidae of Illinois" have rightly placed both *quercifolii* Thomas and *spinosus* Oestlund as synonyms of *quercicola*. They also consider *Callipterus? quercicola* Monell, which was described by Monell from two alate specimens mounted on a slide, sent to him from St. Louis, Missouri, to be synonymous with *Chaitophorus quercicola* Monell. The original description of Monell's former species (9, p. 31) is at some variance with the description of alate form of the latter species (9, p. 32). What species Monell described under *Callipterus? quercicola* is difficult to tell, but it is certain, however, that it is different from his *Chaitophorus quercicola*. The relative length of antennal segments, the nature and the length of unguis, reduced cornicles to mere pores, as well as other characters, together with the host on which it was taken, suggest strongly that he was probably dealing with *Stegophylla* sp. In spite of these discrepancies, his former species may be provisionally considered synonymous with the species now well recognized by many aphidologists as *Chaitophorus quercicola*, until further light as to its identity may be thrown on Monell's *Callipterus? quercicola*.

At the time Monell described his *quercicola*, the number of generic characters were limited. The types of caudae and anal plates were hardly discernible with the equipment used by the workers of former years, and naturally, were not considered then as most stable and useful generic categories, as they are employed to-day together with other morphological and biological characters in aphis taxonomy. Baker (2), Theobald (13) and others redefined aphid genera and characterized *Chaitophorus* by the distinctly knobbed cauda; entire, rounded or flat anal plate, rarely somewhat indefinitely indented; rather prominent hairy covering of the body, legs and antennae; short truncate cornicles with reticulations and imbrications; the absence of frontal tubercles; and the unguis twice or more times the length of the base of the sixth antennal segment.

After a careful examination of a long series of available specimens of *Chaitophorus quercicola* Monell, it becomes apparent that this species radically departs in a number of generic characters from the genus *Chaitohporus*, especially in the type of cornicles, anal plate, cauda, spiny armature and relative length of the unguis. The cornicles of *quercicola* are neither imbricated nor reticulated, but are entirely smooth with a rather prominent constriction in the middle, while the imbrication and reticulation of the cornicles are strikingly typical characters of all of the species properly belonging to *Chaitophorus* (compare figs. 8 and 11). The anal plate is deeply bilobed and the lobes are somewhat separated in both alate and apterous forms of *quercicola* (figs. 6 and 7), resembling in this respect *Myzocollis* species, while the genus *Chaitophorus* is characterized by the entire, rounded or flat anal plate, only rarely, usually due to shrinkage, it may look somewhat indented (figs. 9 and 10). The cauda is large and is broadly knobbed, with a short, thick neck, somewhat departing from a typical *Chaitophorus* cauda, which is also knobbed, but is small and is set, as a rule, on a narrow, thin neck. The relative length of the unguis is a more specific character than generic, yet each genus in the tribes *Callipterini* and *Chaitophorini* can readily be defined, in addition to other characters, also by the type rather than the length of the unguis. The unguis of *quercicola* is short and thick, about the length of the base of the sixth antennal segment (fig. 1), while the typical *Chaitophorus* species have strikingly characteristic unguis, being much longer than the base and narrowly tapering distally (fig. 2). Perhaps the most conspicuous character of *quercicola*, of greater value than specific, is that of the heavy armature with very prominent long, thick, black or concolorous spines, situated on conspicuous tubercles, which are grouped in clusters, forming longitudinal rows over the entire dorsum of the body of apterous viviparous, apterous oviparous females and nymphs. The alate forms are likewise armed, but with much shorter and less prominent spines. This spiny armature led Dr. Oestlund to name his species *spinosus*. A number of *Chaitophorus* species are provided with long curved hairs and bristles over the antennae and the entire body; these hairs or bristles, however, are not the type of heavy spines as in the case of *quercicola*. Two other differences can be noted: first, that the antennae are only sparingly armed with short bristles instead of numerous long hairs and curved bristles so characteristic of *Chaitophorus*, and second, that there are broad fuscous bands bordering the wing veins.

In consideration of the above listed, obviously generic, differences between *quercicola* and the typical *Chaitophorus* species, a more suitable generic position for this species was searched for among the known genera of *Chaitophorini* and *Callipterini*, but without avail. The nearest approach is the genus *Eichochaitophorus* erected by Essig (5) in 1912 for his new species *Eichochaitophorus populifolii*. His species, however, is typical *Chaitophorus* as shown by Baker (2) in 1920, at which time *Eichochaitophorus* was sunk as a synonym of *Chaitophorus*.

The writer had the opportunity of examining several cotype slides of Essig's species of both alate and apterous viviparous females. In addition to this material he also has in his possession a few slides of apparently the same species taken by Prof. H. F. Wilson in Oregon. A careful examination of *E. populifolii* Essig and his excellent original description and illustrations of the species proves that it agrees in all respects with typical species of *Chaitophorus* as to generic characters discussed above, and it must be considered under the latter genus. This leaves *quercicola* without a generic designation, therefore a new genus, *Hoplochaitophorus*, hereby is proposed for the species.

HOPLOCHAITOPHORUS, new genus.

Body stout, somewhat elongated. Antennae of six segments, shorter than the body, sparingly armed with a few short bristles and with circular secondary sensoria in alate and none in apterous viviparous or in oviparous females. Primary sensorium at the base of the unguis small, subcircular; the unguis relatively short, thick, about the length of the base. Frons without prominent antennal tubercles. Cornicles truncate, broader at the base, somewhat constricted in the middle just below the flange, and without reticulations or imbrications. Cauda broadly knobbed, with a short thick neck. Anal plate distinctly and broadly bilobed. Both cauda and anal plate provided with stout, long bristle-like hairs. Head, thorax and abdomen of apterous viviparous and oviparous forms armed with prominent, long, thick spines over tuberculate dorsum. Alate forms likewise armed with much shorter and less conspicuous spine-like hairs. Wing venation normal, with broad fuscous bands bordering veins. Fore wings with media twice branched; radial sector short, moderately curved; hind wings with media and cubitus present, somewhat bordered with fuscous bands. Oviparous females with drawn out ovipositor. Eggs deposited in crevices of the bark of the tree. Males wingless. Forms are robust, living in thick colonies along the veins on upper surface of foliage. Alatae not common.

Genotype, **Chaitophorus quercicola** (Monell).

This genus can be readily separated from other genera of *Chaitophorini* and *Callipterini* by the prominent armature of apterous forms, the type of cauda and anal plate, as well as the type of antennae and cornicles of both alate and apterous forms.

The genus *Hoplochaitophorus* phylogenetically is probably more closely related to the genus *Neosymydobius* than to *Chaitophorus*, where the genotype was customarily included. The relationship between *Neosymydobius* and *Hoplochaitophorus* is not only seen in food habits and the host on which they feed (oak), but in a number of morphological characters, such as general resemblance of antennae, with their sparse armature, drawn out ovipositors in oviparous forms, cornicles without reticulations and even in anal plate, which in *Neosymydobius* is only slightly indented and in *Hoplochaitophorus* it is broadly bilobed. It differs from *Neosymydobius* in the type of cauda, which in the later genus is more rounded or indistinctly constricted, while in *Hoplochaitophorus* it is distinctly knobbed.

In anal plate and cauda as well as the type of wing venation it approaches *Myzocallis*, but it is clear that it is distinct on account of profound differences in structure and general type of the insect.

There is hardly any relationship between *Hoplochaitophorus* and *Chaitophorus* as it is pointed out above, with the exception of knobbed cauda, hairiness of antennae and pilose or bristly covering of the body, which in *Hoplochaitophorus* is prominently spiny. It differs from *Chaitophorus* in having the anal plate distinctly and broadly bilobed; cornicles without sculpturings; and in the type of unguis.

From *Patchia* it differs by deeply divided anal plate, the clavate cauda, and almost glabrous antennae as compared with profuse hairiness of antennae found in *Patchia*. Both genera agree in having wing veins bordered with smoky bands. This character, however, may or may not be of generic value. In *Patchia* the radial sector is absent—in *Hoplochaitophorus* it is present.

The genus *Hoplochaitophorus* doubtless represents a phylogenetic link between the genera belonging to the tribes *Chaitophorini* and *Callipterini*. To the former it is related by the general type of the insect, the armature of the body and antennae, but it also approaches the latter by the structure of antennae, wing venation, cornicles, cauda and anal plate.

Since 1923 a species of aphid, inhabiting young twigs and petioles of *Quercus borealis* and *Quercus velutina*, has periodically been collected at different times of the growing season in northern Wisconsin. In many respects it approaches to *Neosymydobius* and *Patchia*, and yet it possesses a series of individual characters that separates it from the above named genera. It is Lachnus-like in general appearance, especially of apterous forms with their long hind tibiae, and upon close examination it shows some structures that are typical of *Lachnus*, *Chaitophorus* and *Callipterus* groups of aphids. It can not be safely placed in any of the known genera, and phylogenetically, to all appearances, it constitutes a link between *Patchia* and *Neosymydobius*, doubtless deserving a new generic designation. For this reason a new genus, *Lachnochaitophorus*, is here proposed.

LACHNOCHAITOPHORUS, new genus.

Body globular, short and robust, liberally covered with stiff hairs. Antennae of six segments, shorter than the body, Lachnus-like in appearance, well armed with rather long, thick, bristle-like hairs, and large circular secondary sensoria in alate and none in apterous viviparous or in oviparous females. Primary sensorium at the base of the unguis large and circular with a few small circular auxiliary sensoria; the unguis very short and thick, Lachnus-like in appearance. Frons without antennal tubercles. Cornicles truncate, very short, not as long as wide, without flange. Cauda broadly rounded, semicircular, not knobbed. Anal plate conspicuously, but not deeply indented. Anal plate and cauda profusely armed with long bristle-like hairs. Wing venation normal, with broad fuscous bands bordering rather heavy veins of both pairs of wings. Fore wing with media twice branched; radial sector present or well indicated, sharply curved upward, and broadly margined with smoky bands. Hind wings with media and cubitus present. Oviparous females with long drawn out ovipositors. Males wingless. Forms are living in small compactly crowded colonies on young bark, petioles of leaves, and occasionally along the basal part of mid-rib on lower side of the foliage. Well attended by ants.

Genotype, **Lachnochaitophorus querceus,** new species.

This genus is closely related to *Patchia* by the structure of cauda and anal plate, cornicles, as well as the bordering of the wing veins with broad smoky bands. It differs from *Patchia* by having a well developed radial sector, more rounded, semicircular cauda, the less pilose antennae, the type of the unguis and the absence of secondary sensoria in apterous forms, while *Patchia* is in part characterized by having such sensoria. (Figs. 3, 4, 5, 12, 13, 14, and 15.)

Lachnochaitophorus approaches to *Neosymydobius* by the indented anal plate, cornicles and drawn out ovipositor in oviparous females. It differs from that genus by the type of antennae and unguis, greater pilosity of the body and antennae, by rounded cauda, without any evidence of constriction or tendency to a knobbed shape of cauda as is the case with *Neosymydobius* species.

To *Hoplochaitophorus* it is related by fuscous banding of the veins, indented anal plate and hairy armature of body and antennae. It differs from it by the cornicles, semicircular cauda, armature and the type of antennae. (Figs. 1, 4, 5, 6, 7, 8, 14, and 15.)

To *Chaitophorus* it is related by the general appearance of the insect, hirsute covering of the body and antennae with curved bristle-like hairs. It differs by the indented anal plate, rounded cauda and the type of cornicles. (Figs. 2, 4, 5, 9, 10, 11, 14, and 15.)

The genus *Lachnochaitophorus* strikingly merges the *Chaitophorea* type of the body of the insect and cauda with the *Lachnea* type of antennae and hind tibiae, as well as the *Callipterea* type of wings, cornicles and anal plate.

Lachnochaitophorus querceus, new species.

Alate viviparous female. (Plate 2, figures 4, 14, and 15.)

Average length of body from vertex to the tip of anal plate, 1.751 mm. General color of living specimens to naked eye is black with very dark brown undertone. Freshly mounted in balsam they appear dark brown with olive green background. Head convex, dark brown, distinctly infuscated, with prominent median ocellus and long, curved hairs. Ocelli bordered with black. Eyes carmine, with distinct ocular tubercles. Antennae of six segments without antennal tubercles or placed on very shallow, hardly discernible elevations. Length of antennae 0.955 mm. Comparative average lengths of antennal segments as follows: I–4; II–4; III–15.3; IV–11.7; V–10.6; VI–6.25 plus unguis 2.8. The unguis, Lachnus-like, less than half the length of its base. Antennae dusky brown, with darker annulations distally and provided with hairy vestiture. Antennal hairs often curved and about twice as long as the width of antennae. Antennal segments I and II very dark brown with blackish tinge; segments III and IV greenish light brown with black annulations; segments V and VI including unguis, from brown to dark brown or almost black. Antennae, beginning with distal half of segment III to the tip of the unguis, rather roughly imbricated. The entire length of segment III carries in a row from 4 to 8 rather large circular secondary sensoria, often irregular in size, extreme numbers are rare, and only 5 to 6 sensoria more common. In about fifty per cent of alate specimens antennal segment IV also carries from 1 to 2 somewhat smaller circular sensoria. The end of segment V with primary circular sensorium without the fringe of sensilia, and the usual primary circular sensorium at the base of the unguis with a few small auxiliary circular sensoria and a small fringe of crown-like sensilia. Rostrum dusky, about reaching to the hind coxae.

Prothorax dark brown, infuscated, narrow anteriorly and much wider caudad. Posterior margins of prothorax with lateral small, finger-like, black tubercles, often obscured by meso-thorax. Thoracic lobes black; meso- and meta-thorax very dark brown to black; intersegmental thoracic areas light brown. The entire thorax liberally armed with small curved hairs. Fore femora dusky brown with yellowish tinge, meso- and meta-femora almost black. Fore and meso-tibiae very fuscous to black with distal halves greenish yellow, slightly fumose; meta-tibiae conspicuously long, entirely black and somewhat inwardly curved. Tarsi and claws dusky brown; empodium present. Legs beset with prominent dark hairs. Wings narrow and slender; veins rather heavy and broadly margined with fuscous bands; interveinal areas of wings thickly sculptured with scale-like infumations. Fore wings with media bifurcated; the base of media not reaching the subcostal vein; stigma short, very dark smoky brown without clear cell; radial sector present, sharply curved upward, either complete or slightly fading toward stigma. Hind wings with media and cubitus present, distinctly bordered with dusky brown bands; hooklets from three to five.

Abdomen dark brown with olive green tinge, often almost black due to eight rather wide abdominal dusky or black dorsal bands, which extend to the sides of the abdomen. These bands are somewhat constricted along the median line of the dorsum and again interrupted laterally, forming lateral black patches on the sides of the abdomen which may appear independent of the dorsal bands.

Abdomen rather short and globular, without lateral tubercles, but with numerous curved hairs. Cornicles truncate, very short, not as long as wide, without flange or ornamentation, the average length of cornicles about 0.021 mm., dusky brown with olive green undertone. Cauda broadly rounded, semicircular, not knobbed and without evidence of constriction. Anal plate conspicously, but not deeply, indented. Anal plate and cauda dark dusky brown and profusely armed with long bristle-like curved hairs.

Described from 33 specimens collected at Egg Harbor, Wisconsin.

Apterous viviparous female. (Plate 2, fig. 5.)

Average length of body from vertex to the tip of anal plate, 1.869 mm. General color of living specimens black, almost shiny black. Freshly mounted in balsam appear very dark brown with dusky-black shadings. Head and thoracic segments dark brown with smoky-black cast and olive green inter-segmental areas. Prothoracic lateral tubercles present. Eyes carmine with distinct ocular tubercles. Antennae of six segments, dusky dark brown, each segment somewhat lighter at the base and considerably darker distally, segments V and VI together with unguis black. Length of antenna 0.907 mm. Comparative average lengths of antennal segments as follows: I–4; II–4; III–14.5; IV–10.45; V–10.1; VI–6.35 plus unguis 2.4. Antennae without secondary sensoria, but with usual circular primary sensoria on segments V and IV. Antennal vestiture and imbrications as in alate viviparous females. Vertex convex; head, thoracic segments and abdomen thickly set with curved hairs.

Rostrum dusky brown reaching beyond the second coxae. Legs very dark brown to black, with distal ends of pro- and meso-tibiae lighter brown; hind tibiae long, rather conspicuous, somewhat inwardly curved, and almost jet black. Tarsi dusky brown. Dorsum of abdomen highly elevated, globular, dark brown with smoky-black cast over the entire dorsum, resulting from the fusion of dorsal bands. There is a separate broad dusky-black band over the penultimate abdominal segment. The entire abdomen often appears black. Cornicles truncate, dusky brown without flange, much shorter than the width at the base. Structure of cauda and anal plate as in alate viviparous females, dusky brown in color.

Described from 42 specimens collected at Egg Harbor, Wisconsin.

Apterous oviparous female.

Length of body from vertex to the tip of anal plate, including drawn out ovipositor, about 2.587 mm., some are over 3.0 mm. long. Dorsum of abdomen hirsute, highly arched, globular as in apterous viviparous females. General color very dark brown to black, almost shiny black. Freshly mounted in balsam show broad black transverse abdominal bands with somewhat irregular, narrow, brownish in color intersegmental areas. Head dusky dark brown. Eyes dark red. Prothorax and meso-thorax reddish brown. Meta-thorax dusky dark brown. Ovipositor long, reddish brown with greenish tinge. Color and structure of antennae as in apterous viviparous females. Length of antenna 0.835 mm. Comparative average length of antennal segments as follows: I–4; II–3.2; III–13.25; IV–9.6; V–9.1; VI–6.0, plus unguis 2.55; without secondary sensoria. Hind legs are long and black, except tarsi, which are pale brown. Hind tibia about 1.05 mm. long, slightly swollen, inwardly curved, armed with bristly hairs and carries on the inner margin a few scattered groups of elevated, circular sensoria. Fore femora light brown; fore tibiae dusky brown with distal ends paler in color. Second pair of legs similar to fore pair with the exception of femora, which are almost black. Tarsi pale brown with black claws. Rostrum reaching beyond the third pair of coxae. Cornicles truncate, dusky to black. Cauda rounded, anal plate slightly indented, sometimes appears to be rounded. Both cauda and anal plate dusky and hairy.

Eggs freshly laid are olive green in color, later turning black. Described from 29 specimens taken in Wisconsin.

Apterous male.

Males are small. Length of body from vertex to the tip of anal plate about 1.126 mm. General color dark brown to reddish black or black with greenish undertone. Eyes red. Entire body, legs and antennae hirsute. Legs black with the exception of pro- and meso-tibial distal ends, which are light brown. Rostrum reaching far beyond the third pair of coxae. Antennae with bristle-like hairs, dusky brown, distally black. Length of antennae 0.8803 mm. Comparative average lengths of antennal segments as follows: I–4; II–3.8; III–13.0; IV–10.0; V–9.6; VI–6.9, plus unguis 3.0. Secondary sensoria present on all antennal segments and distributed as follows: III–from 6 to 10, usually 6 to 7, circular, irregular in size in a somewhat uneven row over the entire segment, scattered basally; IV–from 4 to 7, usually 4 to 5, circular, very irregular in size, from very small to quite large, often coalescent, placed as a rule more toward the distal end of the segment in irregular row; V–from 4 to 5, placed as in IV; VI–with 1 to 3 usually 2, circular sensoria varied in size. The primary sensorium at the base of the unguis with 4 to 6 auxiliary circular sensoria usually placed toward the unguis. The very tip of the unguis always with rod-like sensilia and often with one or two sensoria-like structures. Abdomen reddish brown to black due to dusky transverse dorsal coalescent bands. Cornicles small, truncate, not as long as wide, dusky to black. Cauda rounded, dusky and hairy; anal plate very slightly immarginate, dusky brown, with long hairs. Claspers dark brown to black, thickly beset with fine hairs. Genital organ greenish yellow, about 0.315 mm. long, and 0.070 mm. in diameter.

Described from 7 specimens collected in Egg Harbor, Wisconsin.

Nymphs and pupae.

Variable in color. Body hairy. Head and thorax reddish brown with dusky shading. Eyes red. Abdomen of various shades of brown or reddish brown to almost black with greenish tinge and always with several clear, slit-like areas of green on each lateral side. Transverse dusky, dorsal bands present. Cornicles dusky. Legs as in apterous viviparous females. Wing pads dusky brown.

Host Plant and Feeding Habits.

This interesting species was repeatedly collected on two different oak trees, black oak, *Quercus velutina* Lam.; and red oak, *Q. borealis* Mischx. It feeds in small colonies primarily on petioles of the leaves and young bark of succulent, one year old shoots. Sometimes small colonies may be found feeding on the basal part of the midrib on the lower and more rarely on the upper side of the foliage. This species is very tenaciously attended by small black ants, *Crematogaster lineolata* var. near *cerasi* Fitch, which was kindly determined by Prof. M. R. Smith. Each colony of aphids is attended by several of these ants, often as many as aphids, and upon the least disturbance, both the aphids and ants raise their abdomens upward, which appear identical due to the structure and black color of aphids. Upon further disturbance the ants carry the aphids away. In many cases the ants constructed conical roofs, consisting of bits of oak epidermis and mud, over the upper part of leaf petioles, just at the base of the leaf blades. In rainy weather drops of rain water run off of these roof structures, keeping the aphids entirely dry.

Type locality.—Egg Harbor, Wisconsin.

Cotypes and paratypes in the U. S. National Museum and in the collections of the Division of Entomology of the University of Minnesota, Dr. C. P. Gillette and the writer. The following material was used for description of species, all collected at Egg Harbor, Wisconsin, by the writer:

July 24, 1923. Three slides, apterous and alate viviparous females.

September 18, 1923. Three slides, apterous viviparous females and nymphs.

July 24, 1925. Six slides, apterous and alate viviparous females.

September 15, 1926. Three slides, apterous and alate viviparous females, oviparous females and one male.

July 31, 1927. Eleven slides, apterous and alate viviparous females.

August 28, 1927. Two slides, apterous and alate viviparous females.

September 16, 1927. Nine slides, apterous oviparous females, males and nymphs.

A number of specimens of a closely related species were received in alcohol vials from Mr. Theo. L. Bissell, collected by him on various dates in Thomasville, Georgia. This material, in so far as coloration is concerned, is almost identical to the above described *Lachnochaitophorus querceus*. Both alate and apterous viviparous females exhibit, however, a considerable departure from the above species in the relative lengths of antennal segments, and the number of secondary sensoria on the antennae of alate forms. The antennal segment III is much longer and carries more sensoria than in the preceding species. Size of the body is somewhat smaller with slight differences in coloration. In view of the fact that these differences, especially the number of sensoria and the relative lengths of antennal segments, are constant in a long series of specimens, it seems it should be justifiable to consider it as a distinct species. It is hoped that biological studies will point out still further differences. In accordance with the above mentioned facts it is named in the honor of Mr. Theo. L. Bissell, who kindly supplied this material.

Lachnochaitophorus bisselli, new species.

Alate viviparous female.

Average length of body from vertex to the tip of anal plate 1.672 mm. General color burnt sienna with heavier chitinized parts dark, giving the whole body the appearance of dark brown. Abdomen with a greenish cast. Head burnt sienna, sides above the eyes and around the bases of the antennae dark brown. Eyes carmine. Antennae of six segments, much as in the preceding species as to color and structure, but usually much darker and with longer, considerably curved hairs. Length of antennae 0.990 mm. Comparative average lengths of antennal segments as follows: I–4; II–4; III–17.7; IV–11.25; V–10.85; VI–6.1 plus unguis 2.65. The entire length of segment III armed with a row of secondary circular, quite regular in size, sensoria from 6 to 11 in number, usually 8 and 9. The secondary sensoria is almost twice the number per segment as compared with the preceding species. Segment IV with 1 to 3 secondary sensoria in above fifty per cent of the specimens. Rostrum not quite reaching the middle pair of coxae.

Thoracic segments, structure and coloration of legs and wings as in preceding species.

Abdomen burnt sienna with greenish to orange tinge. Abdominal dusky transverse bands either absent or very indistinct; the lateral dusky patches are present and are conspicuous. Cornicles truncate, dusky to black. Cauda broadly rounded; anal plate distinctly, but not deeply immarginated. Both cauda and anal plate dusky brown, and conspicuously armed with long bristle-like hairs.

Described from 56 specimens collected by Theo. L. Bissell at Thomasville, Georgia.

Apterous viviparous female.

Average length of body from vertex to the tip of anal plate 1.643 mm. General color is very dark brown to black. Head and thoracic segments as in the alate viviparous females. Eyes red. Antennae of six segments, imbricated, hairy, almost uniformly dusky brown, distally black. Length of antenna 0.886 mm. Comparative average lengths of antennal segments as follows: I–4; II–4; III–15.687; IV–9.25; V–9.187; VI–5.875 plus unguis 2.625. Antennae without secondary sensoria. Rostrum about reaching the second coxae.

Thoracic segments as in preceding species. Legs almost black with brownish tinge, pro- and meso-tibiae slightly lighter distally.

Dorsum of the abdomen markedly elevated, without transverse bands, but almost uniformly coated with dusky cast. Cornicles truncate, dusky brown, shorter than wide. Structure and coloration of cauda and anal plate as in alate viviparous females.

Described from 15 specimens collected by Theo. L. Bissell at Thomasville, Georgia.

Host plants and feeding habits.—It inhabits the small twigs and leaf petioles of water oak, *Quercus nigra,* and is always found in association with ants, *Crematogaster lineolata* (Say).

Type locality.—Thomasville, Georgia.

Cotypes and paratypes in the U. S. National Museum, and in the collections of Mr. Theo. L. Bissell, the Division of Entomology of the University of Minnesota, and that of the writer. The following material was used for description of species, all of which was collected at Thomasville, Georgia by Mr. Bissell:

Summer of 1926, one alate viviparous female, one slide.

February 15, 1927, only alate viviparous females, six slides.

March 4, 1927, one alate viviparous female, one slide.

April 18, 1927, apterous and alate viviparous females, six slides.

May 2, 1927, apterous and alate viviparous females, nine slides.

This species can be separated from *Lachnochaitophorus querceus* primarily by the number of secondary sensoria, which are, as a rule, more or less uniform in size and run from 6 to 11, usually 8 to 9 to the segment. They are placed on somewhat longer segments than is the case with *L. querceus*, which usually has only from 4 to 6 sensoria, placed on much shorter and thicker segments. Rostrum of *L. bisselli* is much shorter, abdominal dorsal bands inconspicuous or absent, lateral dusky patches are more prominent, body smaller and general coloration is somewhat darker. The antennae are provided with somewhat longer and more curved hairs.

The difference in number of sensoria may be best illustrated by the following table:

Name of species	Antenna having following number of sensoria									Total number of antennae
	4	5	6	7	8	9	10	11	12	
Lachnochaitophorus querceus	7	30	26	14	2	0	0	0	0	79
Lachnochaitophorus bisselli	0	0	5	12	39	26	9	2	0	93

Acknowledgments are due to Dr. C. P. Gillette and Professor M. A. Palmer for their opinion as to generic value of *Lachnochaitophorus querceus*. To Professor M. R. Smith for determination of ants and to Mr. Theo. L. Bissell for the supply of undescribed aphid material and the permission for the free use of it. To Dr. Theo. Frison for the loan of the type slide of Thomas' *Callipterus quercifolii* and to Dr. O. W. Oestlund for the loan of his *Ch. spinosus*.

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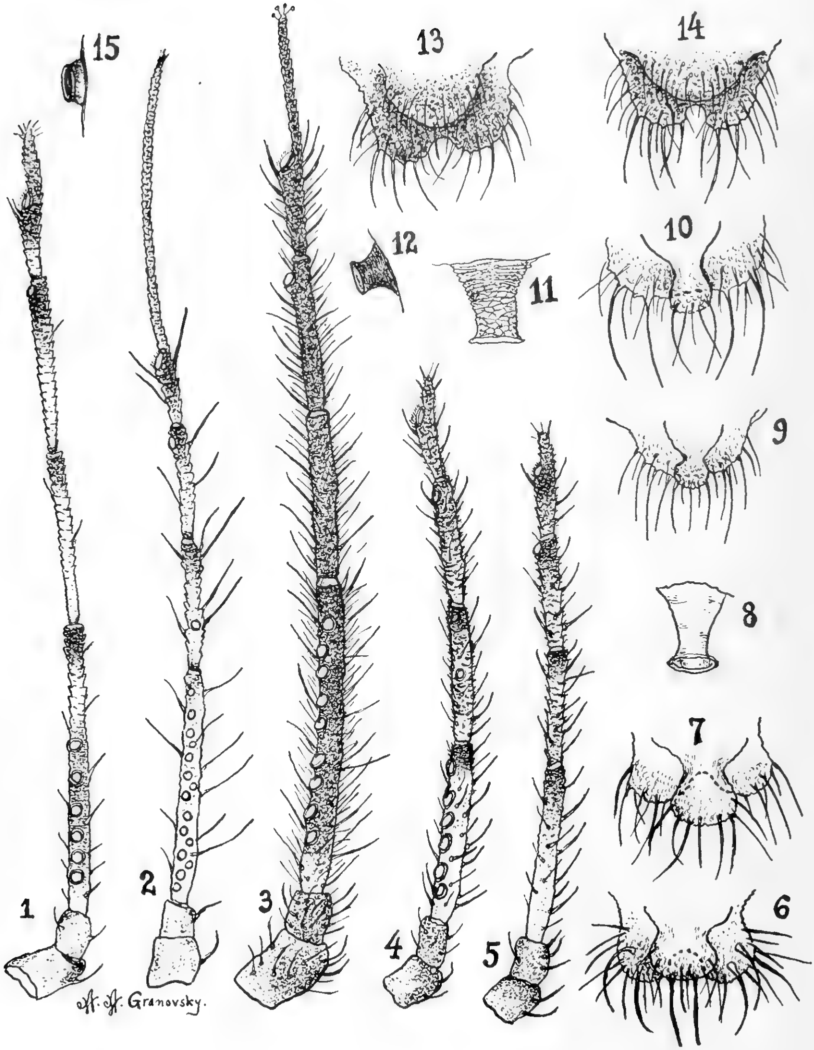
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Explanation of Plate.

Hoplochaitophorus quercicola (Monell).
Alate viviparous female:
1, antenna; 6, cauda and anal plate; 8, cornicle.
Apterous viviparous female:
7, cauda and anal plate.
Chaitophorus populifoliae Oestlund.
Alate viviparous female:
2, antenna; 9, cauda and anal plate; 11, cornicle.
Apterous viviparous female:
10, cauda and anal plate.
Patchia virginiana Baker.
Alate viviparous female:
3, antenna; 12, cornicle; 13, cauda and anal plate.
Lachnochaitophorus querceus, n. sp.
Alate viviparous female:
4, antennae; 14, cauda and anal plate; 15, cornicle.
Apterous viviparous female:
5, antenna.

All drawings are made to the same scale and therefore are comparable.

CORRECTION.

In the January number of the Proceedings, in the last paragraph on page 11, the generic name "Cysticercus" should read "Cryptocercus." the name having been inadvertently changed in copying.

J. C. Bridwell.

MINUTES OF THE 444TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, FEBRUARY 2, 1933.

The 444th regular meeting of the Entomological Society of Washington was held at 8 p. m., Thursday, February 2, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, president, presided. There were present 47 members and 30 visitors. The minutes of the previous meeting were read and approved.

The president reported visiting Doctor Howard, as instructed at last meeting, and of receiving a greeting from him to the Society.

The president mentioned the coming centennial of the London Entomological

Society, and appointed Doctor Howard, Mr. Walton and Mr. Cushman as a committee to prepare a suitable message of congratulation.

Major G. C. H. Franklin of the army medical school, and his assstant, Mr. Saunders, upon invitation, greeted the Society.

Under the heading "Notes and exhibition of specimens" Mr. A. B. Gahan presented a note regarding the genus *Pseudomicromelus* Gahan and Fagan, in which he stated that the type of the genus was *Micromelus silanus* Walker, and that *Dibrachys australis* Girault and *Pteromalus deplanatus* Vess also belonged in the genus. The last named species, hitherto known only from Europe, has recently been reared in California from *Anarsia lineatella* Zeller. Mr. Gahan has drawn up a short paper on the subject which will be found elsewhere in the Proceedings. (Author's abstract.)

In discussing Mr. Gahan's remarks, Mr. Rohwer called attention to recent importations into California of an important European parasite, *Copidosoma pyralidis* Ashm., of the peach twig borer. This parasite of *Anarsia lineatella* had been collected in southern France during 1930 and 1931 and sent to the Bureau's laboratory at Moorestown, New Jersey, where the shipments were examined and sent forward to State officials in California by air mail, the State officials undertaking liberation and colonization. (Author's abstract.)

F. M. Wadley remarked on misplaced use of statistical terms.

Dr. H. L. Parker, of the Bureau's European Parasite Laboratory at Hyeres, France, upon invitation, greeted the society, and presented notes on his work. He discussed the method of making and caring for collections of cornborer material for parasite work, in southern France and Italy, and spoke of the labor problems involved.

The first communication on the regular program was by Miss Mabel Colcord, and was entitled "Aids in making entolomological literature available."

Miss Colcord told of the card catalogs of the Bureau of Entomology Library, and of the "Check list of publications on entomology . . . issued by the United States Department of Agriculture through 1927, wth subject index," and the "List of publications on apiculture," May, 1930 (United States Department of Agriculture Library Bibliographical Contributions 20 and 21). The current Index to the Literature of American economic entomology was described, as were special indexes of articles by the members of the Bureau staff appearing in departmental and in non-departmental publications. Mention was also made of a manuscript list of biographies, and of the picture collection gotten together by Dr. Howard. The various uses to which these indexes can be put was explained. (Author's abstract.)

This paper was discussed by Gahan and McIndoo.

The second communication was the retiring president's address, by Dr. F. C. Bishopp, and was entitled "Medical Entomology; its field and function." This paper is intended for early publication, hence no abstract is reported here.

This paper was discussed by Fracker, Sasscer, McIndoo, Bridwell, and Major Franklin.

Meeting adjourned at 10 P. M.

F. M. WADLEY,
Recording Secretary.

Actual date of publication, March 21, 1933

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OF WASHINGTON

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THE

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RHABDOTHRIPS ALBUS, A NEW GENUS AND SPECIES OF THYSANOPTERA FROM PANAMA.

By J. DOUGLAS HOOD, *University of Rochester.*

The curious insect described below was sent for determination by Mr. John R. Johnston of the United Fruit Company. The types are in my collection.

RHABDOTHRIPS gen. nov.

(ῥάβδος, a rod or stick; θρίψ, a wood worm.)

Body and all appendages very slender. Major setæ very large and heavy, pinnatifid apically. Head moderately long, with one pair of enormous setæ between the ocelli; vertex not produced beyond frontal costa. Antennæ nine-segmented, with a dorsal U-shaped trichome on segment 3 and a similar ventral one on segment 4. Maxillary palpi two-segmented; second segment narrowed in distal half or more. Prothorax with one very large bristle at each anterior angle and two at each posterior angle. Wings very narrow; anterior vein almost completely fused with ambient vein along fore margin; posterior vein represented briefly at middle of wing but partly fused with anterior vein and ambient at or near either end, these fusions perhaps representing cross veins; two rows of large, heavy bristles similar in structure to interocellars and pronotals borne by the fused veins, one row inclined cephalad and the other caudad; fringing hairs sparse and weak. Abdomen with four pairs of similar enormous bristles on segment 9 and two pairs on segment 10.

Genotype.—*Rhabdothrips albus* sp. nov.

This genus undoubtedly finds its closest relative in *Coremothrips* Hood, with which it agrees in the possession of the exceedingly stout and apically divided bristles which have suggested the generic name. Both genera are related to *Scolothrips* Hinds, and all three are probably predacious. From *Coremothrips* this new genus differs in that (a) the vertex is not prolonged forward to cover the frontal costa when observed from above, (b) there is but one pair of enlarged cephalic setæ, interocellar in position, and (c) the anterior angles of the pronotum bear one pair of large bristles instead of two, the inner pair being wanting. *Rhabdothrips* is clearly the more primitive of the two genera. It is interesting to note that in it the midlateral and anterior marginal setæ of the pronotum are moderately well developed, and that one of these two pairs—probably the anterior marginal—is quite likely the source of the additional pair of monstrous setæ found on the pronotum of *Coremothrips*.

Rhabdothrips albus, sp. nov.

(Pl. 3, figs. 1–5.)

Female (macropterous).—Length about 1.1 mm. Color nearly white; ocellar pigmentation and eyes bright red and black, respectively, by transmitted light, orange and orange-red by reflected light; antennæ nearly white, with segment 3 palest, 4 and 5 shading to light gray apically, 6–9 light gray; legs and wings white.

Head (Pl. 3, fig. 1) long, broadest across eyes, its median dorsal length just equal to its least width behind eyes; vertex elevated between eyes but not produced to overhang frontal costa, the elevated portion bearing the three ocelli and a pair of low tubercles from which arise a pair of monstrous, colorless, stick-like bristles (74μ) which are fringed in their distal halves with microtrichia (Pl. 3, fig. 2); all other cephalic setæ minute, pale, and inconspicuous; occipital line and sculpture caudad to it very indistinct. Eyes large and prominent, decidedly bulging, slightly pilose, composed dorsally of rounded, separated facets of which two at the posterior margin are particularly large and several at the middle of the inner margin noticeably smaller than any of the others; ventral facets polygonal, not separated. Ocelli situated close together, the posterior pair farther from each other than from the anterior ocellus and directed laterally as well as dorsally. Mouth-cone of moderate length, extending backward to a point below a line connecting the bases of the large bristles at the posterior angles of the pronotum; maxillary palpi two-segmented, proximal segment short, about as long as wide and less than one-fourth the length of the second segment, which measures 32μ. Antennæ (Pl. 3, fig. 5) slender, 9-segmented, the distal stylus composed of three segments; segments 3 and 4 each with a U-shaped trichome.[1]

Prothorax slightly longer than head and about 1.3 times as wide as long; one pair of bristles at anterior angles and two pairs at posterior angles exceedingly stout and heavy and fringed with microtrichia in distal portion, these three pairs of setæ (as well as midlaterals) arising from tubercles; the pair at posterior angles (74μ) equal to interocellars, twice as long as the inner pair near posterior angles (35μ), and about 1.6 times the length of those at anterior angles (46μ); anterior marginal and midlateral bristles small and scarcely pointed. Legs particularly long and slender, especially the femora of all pairs. Wings (Pl. 3, fig. 3) of fore pair sabre-shaped, with two series of long, heavy setæ similar to the anterior angular ones of pronotum.

Abdomen long and slender, with a few diagonal, asperate lines of sculpture on sides of middle tergites; with a few small, pale setæ on segments 1–8; with two pairs of monstrous curved setæ on segment 9, and with one similar pair on segment 10 (Pl. 3, fig. 4).

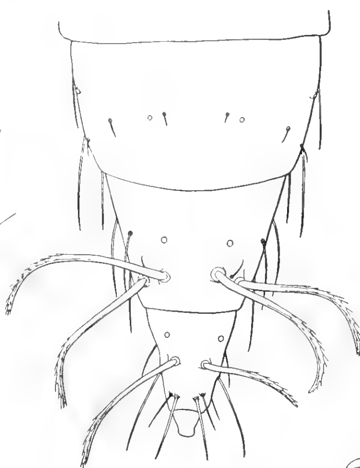
Measurements of holotype (♀): Length 1.13 mm. Head, median dorsal length 0.106 mm., width across eyes 0.121 mm., width just behind eyes 0.106 mm., width at base 0.107 mm.; eyes, length 0.061 mm., width 0.039 mm., interval 0.046 mm.; interocellar bristles, length 74μ; pronotum, length 0.112 mm.,

[1]One antenna only is available for study, and unfortunately it does not present a strict dorsal view. In studying the figure it should be kept in mind that the revolution of the antenna exposes a portion of its inner surface.

1

2

3



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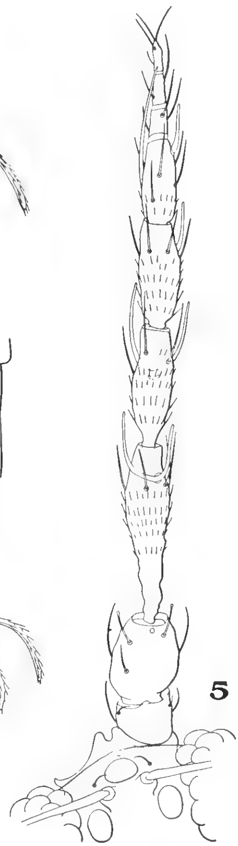

5

greatest width 0.147 mm., length of setæ at anterior angles 46μ, of outer setæ at posterior angles 74μ, of inner setæ at posterior angles 35μ; pterothorax, width 0.187 mm.; fore wings, length 0.720 mm., width at middle 0.033 mm., width near base 0.044 mm.

Antennal segments	1	2	3	4	5	6	7	8	9
Length (μ)	18	36	70	47	42	33	11	13	11
Width (μ)	21	25	18	17	17	14	8	5	4

Total length of antenna 0.281 mm.

Described from 18 females taken "on the leaves of young banana plants near Almirante, Panama," May, 1932, by Mr. John R. Johnston, who has supplied the following note: "You may be quite correct in considering that this species is probably a predacious form, as I was unable to discovery any injury whatever on the banana plant that I could attribute to it. This species is not uncommon on the young leaves of banana, but was never abundant."

EXPLANATION OF PLATE.

(The drawings were made with the aid of a camera lucida by Miss Helen Rearwin.)

Rhabdothrips albus, gen. et sp. nov.

Fig. 1. Head and prothorax, ♀, paratype; bristles omitted from all appendages.
Fig. 2. Distal portion of seta of tergite 9, ♀, paratype.
Fig. 3. Right fore wing, ♀ paratype; microtrichia omitted.
Fig. 4. Segments 8–10 of abdomen, ♀, paratype.
Fig. 5. Right antenna and portion of head; ♀, holotype.

FIVE NEW HYMENOPTEROUS PARASITES OF THE ORIENTAL FRUIT MOTH.

By C. F. W. MUESEBECK, *Bureau of Entomology*.

This paper contains descriptions of four new Braconidae from Japan and one new species of Bethylidae from Australia, all recorded by investigators of the Bureau of Entomology as parasites of *Grapholitha molesta* Busck.

SUPERFAMILY ICHNEUMONOIDEA.

FAMILY BRACONIDAE.

Bassus diversus, new species.

Differs from all other species of the genus known to me in combining an unusually thin head, sharply impressed and punctate notauli, strongly rugulose exareolate propodeum, foveolate mesopleural furrow, closely striate three basal abdominal tergites, and black body.

Female.—Length 4 mm. Head strongly transverse, not rostriform; face very broad, broader than distance from antennae to apex of clypeus, covered with minute setiferous punctures; clypeus broad, only very weakly convex; distance between clypeal foveae much greater than length of foveo-ocular line; malar space strongly inclined inward, not half as long as the eye; frons short, polished; frontal impression immargined; vertex polished; ocell-ocular line twice diameter of an ocellus, a little longer than postocellar line; median ocellus barely in front of a line drawn tangent to anterior margins of lateral ocelli; antennae about as long as the body, 31-segmented, inserted only a little below level of upper eye margins; temples strongly receding.

Thorax rather stout, about as broad as head; mesoscutum minutely punctate, shining, with sharply impressed punctate notauli; scutellum convex, smooth, not margined at apex; propodeum convex, completely closely rugose, not areolated; sides of pronotum mostly smooth; prepectus sharply carinately margined; mesopleurum minutely punctate, shining, with a straight foveolate longitudinal groove below the middle; metapleurum rugulose; posterior coxae minutely punctate, shining; inner calcarium of posterior tibia not quite half as long as metatarsus; second cubital cell of anterior wing triangular, short-petiolate; radial cell very narrow, on wing margin a little more than half as long as stigma and just about as long as that part of metacarpus beyond the radial cell; nervulus slightly postfurcal, first brachial cell open at apex, submediellan cell of posterior wing much less than half as long as mediellan; nervellus weak.

Abdomen as long as the thorax but slightly narrower; first tergite longer than broad at apex, with two prominent, nearly parallel, longitudinal dorsal keels extending beyond the middle, the area between them smooth basally; remainder of tergite rather coarsely striate; second and third tergites virtually parallel-sided, closely longitudinally striate except the apex of the third tergite, which is smooth, each of them with a shallow transverse impressed line; remaining tergites smooth and shining; ovipositor sheaths considerably longer than abdomen.

Black; tegulae brownish; wings smoky; coxae black or blackish, the anterior pair brownish beneath; remainder of anterior and middle legs brownish yellow; posterior trochanters and the femora except toward apices blackish; the extreme apices of posterior tibiae and the posterior tarsi, except basally, slightly infuscated.

Type locality.—Mitsuoka, Nagano, Japan.
Type.—U. S. N. M. No. 44850.
Host.—*Grapholitha molesta* Busck.

Three female specimens reared by G. J. Haeussler of the Bureau of Entomology June 28, 1932 (type and one paratype) and August 24, 1932 (one paratype).

Phanerotoma grapholithae, new species.

Very similar to *tibialis* Haldeman, but distinguished especially by having the first abscissa of the radius shorter than the second, by the anterior wings being only very indistinctly banded or maculated, by the more delicate sculpturing of the head, and by the weaker and shorter basal keels of the first tergite and the relatively longer third tergite.

Female.—Length about 3 mm. Head large, quadrate, excavated behind; eyes prominent, nearly circular in outline, bare; face about twice as broad as long from antennae to base of clypeus, finely rugulose, subopaque; clypeus large, smooth and shining, its apical margin broadly rounded and provided with three minute teeth medially; malar space distinctly shorter than basal width of mandible; frons and vertex mostly finely shagreened, with some irregular rugae; temples convex, not receding, scarcely as wide as length of ocell-ocular line, finely lineolated; longest diameter of a lateral ocellus longer than postocellar line but less than half ocell-ocular line; antennae 23-segmented; scape fully twice as long as thick; basal segments of flagellum much lengthened; segments 7 to 11 faintly broadened, the following gradually narrowed; the basal seven segments of flagellum as long as all the following united.

Thorax narrower than head; mesoscutum granular and opaque; scutellum very weakly granular, smooth at apex; propodeum finely rugulose; mesosternum and meso- and metapleurum evenly finely granular, opaque; inner calcarium of posterior tibia very nearly half as long as metatarsus, the latter about as long as the next three tarsal segments combined; parastigma large; radius emerging from beyond middle of stigma; first abscissa of radius a little shorter than second; first intercubitus straight, interstitial with recurrent vein.

Abdomen strongly depressed, about as broad as thorax; first tergite only very slightly longer than second, with two prominent strongly convergent keels arising at the basal lateral margins and not extending beyond the middle of the tergite; second tergite nearly twice as broad as long; the third nearly half again as long as the second; first, second, and base of third tergites longitudinally wrinkled, remainder of third tergite finely rugulose; ovipositor not exserted.

Yellow; mandibles ferruginous, tips black; apices of antennae weakly fuscous; stemmaticum black; the broad polished curved line bounding the scutellum behind piceous; legs entirely yellow, with only the posterior tibia slightly infuscated on the sides near apex; wings hyaline; stigma brownish, pale at base and very narrowly so at apex; a faint indefinite cloud just below stigma and covering first abscissa of radius.

Male.—Essentially as in the female; ocell-ocular line not more than twice the greatest diameter of a lateral ocellus, and the antennal flagellum not broadened beyond the middle.

Type-locality.—Takatsu, Kanagawa, Japan.
Allotype-locality.—Hara, Shizuoka, Japan.
Type.—U. S. N. M. No. 44851.
Host.—*Grapholitha molesta* Busck.
Described from 14 females and 10 males reared from the

above host by G. J. Haeussler, of the Bureau of Entomology. The paratypes are from various localities in Japan and Chosen.

Apanteles molestae, new species.

Related to *agilis* Ashmead but differing from that species in the closely sculptured and opaque first and second abdominal tergites, the longer first abscissa of radius, and the slightly longer ovipositor.

Female.—Length 2.7 mm. Head thin, the temples strongly receding; the face only very weakly convex, narrowing a little below, very shallowly punctate, subopaque; malar space not distinctly as long as basal width of mandible; eyes elliptical; frons and vertex with very faint punctures, sub-opaque; ocell-ocular line longer than postocellar line, about twice the diameter of an ocellus; antennae scarcely as long as the body; the four apical segments but little longer than broad.

Thorax stout, much broader than head; mesoscutum with closely placed but definitely separate punctures, rather opaque; disk of scutellum large, flat, polished, with only a few very faint punctures laterally; polished area on lateral face of scutellum not extending half way to the base; propodeum broad, evenly convex, with a large oval well-defined areola; costulae distinct; surface of propodeum mostly smooth, with only indefinite sculpture in the areola, along the costulae and sometimes in the apical areas; mesopleurum smooth except anteriorly where it is closely punctate; metapleurum smooth; posterior coxa smooth, with only a few weak punctures at base above; inner calcarium of posterior tibia about half as long as metatarsus; radius emerging from slightly beyond middle of stigma, the first abscissa weakly curved, a little longer than recurrent vein, intercubitus, or width of stigma, and only weakly angled with the intercubitus.

Abdomen narrower than propodeum; first tergite large, broadening very slightly behind, closely finely rugulose, longitudinally so posteriorly, and with an irregular elongate median impression on posterior half, which is mostly smooth; second tergite strongly transverse, much longer medially than at the sides, its posterior margin strongly arcuate; surface of second tergite very delicately wrinkled and opaque; remainder of dorsum of abdomen smooth but subopaque; ovipositor sheath at least as long as posterior tarsus, unusually slender, slightly broadened on apical fourth, and with a distinct apical spine.

Black; antennae entirely black; tegulae black; wings hyaline, stigma brown, indefinitely lighter toward apex and with a small indistinct paler spot at base; legs black, the anterior femora except at extreme base, and their tibiae and tarsi, yellowish; middle tibiae on basal half, their tarsi, and posterior tibiae at extreme base brown.

Male.—Differs from the female principally in the longer antennae, which are definitely longer than the body, in the practically smooth second tergite, the darker anterior femora, and the paler stigma.

Type locality.—Kariha-Mura, Niigata, Japan.
Allotype locality.—Dogo, Ehime, Japan.
Host.—*Grapholitha molesta* Busck.
Type.—U. S. N. M. No. 44852.

Described from three females and two males reared by G. J. Haeussler of the Bureau of Entomology. One female paratype is from Saiden, Okayama, the other from Oanshimura, Kagawa, Japan, and the male paratype is from Suigen, Keikido, Chosen.

Orgilus longiceps, new species.

This species is very similar to *obscurator* (Nees) but is readily separated from that species by its even longer and more strongly compressed head, by its punctate rather than rugulose face, by having the propodeum broadly polished across the base, and by its paler clypeus, mandibles, antennae, and legs.

Female.—Length 3.5 mm. Head long, compressed, not wider than thorax; face prominent, apparently a little longer than broad, punctate and shining; clypeus strongly transversely convex; cheeks and lower temples flaring slightly beyond the eyes, smooth and shining, sharply margined; malar space fully as long as basal width of mandible; eyes twice as long as broad, narrowing below; frons abrupt, rather short; vertex narrow, smooth; ocell-ocular line indistinctly longer than the greatest diameter of a lateral ocellus, a little shorter than post-ocellar line; head descending abruptly behind lateral ocelli; occipital carina broadly effaced medially; antennae nearly as long as the body, 31-segmented, the apical 10 or 12 segments not longer than broad.

Thorax slender, narrower than high; notauli sharply impressed, finely foveolate or punctate; mesoscutum and scutellum smooth, finely hairy; impression at base of scutellum broad and deep; propodeum convex, smooth and polished across the base, the remainder of its surface finely rugulose; lateral face of pronotum finely wrinkled and subopaque except in the upper posterior angle where it is mostly smooth; mesopleurum polished, with a longitudinal finely foveolate furrow below; metapleurum smooth and shining except at extreme apex; posterior coxa finely roughened and subopaque above; inner calcarium of posterior tibia slightly more than half as long as metatarsus; stigma narrow, less than one-third as broad as long, emitting radius from slightly beyond its middle; first abscissa of radius strongly oblique, a little longer than width of stigma, much shorter than first intercubitus; second abscissa of radius straight, on a line with first intercubitus and nearly parallel with outer side of stigma; radial cell on wing margin scarcely longer than stigma, its apex far from apex of wing; recurrent entering first cubital cell, removed by about half its length from intercubitus; stub of cubitus beyond intercubitus longer than second abscissa of cubitus; nervulus very slightly postfurcal or interstitial; first brachial cell closed at apex; subdiscoideus arising far below the middle of outer side of first brachial cell; submediellan cell complete and more than half as long as mediellan.

Abdomen at least as long as thorax, slightly narrower, depressed; first tergite broadening gradually to apex, where it is slightly more than half as broad as long, its spiracles well before the middle and farther from each other than from base of tergite, its surface finely longitudinaly wrinkled; second tergite one and one-half times as broad as long, nearly parallel sided, closely finely longitudinally rugulose except for a small basal median area, which is smooth and polished; third tergite shorter than the second, mostly smooth and polished but with a finely rugulose or punctate band across the middle; remaining tergites polished; ovipositor sheaths very slender, distinctly longer than the abdomen, fully as long as posterior tibia and tarsus combined.

Black; palpi blackish; clypeus, except at base, and mandibles ferruginous; basal half of flagellum and under side of scape brownish yellow; anterior and middle legs including coxae ferruginous; posterior legs ferruginous except for basal two-thirds of coxae, apices of posterior femora, especially above, and the apices of posterior tibiae, which parts are more or less blackish; wings weakly infumated; basal two-thirds of venter of abdomen brownish yellow.

Male.—Like female except that apical antennal segments are more elongate. Antennae of allotype 30-segmented.

Type locality.—Togo, Shizuoka, Japan.
Allotype locality.—Mito, Ibaragi, Japan.
Type.—U. S. N. M. No. 44853.
Host.—*Grapholitha molesta* Busck.

Described from two females and three males, the female paratype and one male paratype from the type locality, the second male paratype from the allotype locality, all reared by G. J. Haeussler, June and July, 1932.

SUPERFAMILY MUTILLOIDEA.

FAMILY BETHYLIDAE.

Perisierola angulata, new species.

Distinguished especially by having the apex of the radius bent forward at a right angle, by the unusually small stigma, the somewhat infumated wings, the distinct and complete parapsidal grooves, and the long eyes, which are fully three times as long as the distance from the upper edge of eyes to the vertex.

Female.—Length 2.5 mm. Head only slightly longer than broad; eyes at least twice as long as broad, at least as long as width of face; malar space practically wanting; clypeus compressed, keeled, the keel extending only slightly above level of lower eye margins; surface of the head minutely coriaceous with scattered shallow setiferous punctures; vertex acute; temples receding sharply from directly behind the eyes, delicately reticulate; posterior ocelli touching the acute ridge of the vertex; ocell-ocular line only slightly longer than postocellar line; antennae 13-segmented, but little longer than head; scape stout, about twice as long as wide; pedicel slightly longer than first segment of flagellum, subequal with second and third flagellar segments; the following segments successively faintly shorter, except the apical segment, which is nearly as long as the pedicel; none of the segments beyond the scape twice as long as broad.

Thorax hardly as broad as head, depressed; pronotum large, more than one and one-half times as long as mesoscutum, delicately reticulated, shining;

mesoscutum strongly transverse, more than twice as broad as long, with distinct parapsidal grooves, sculptured like pronotum; disk of scutellum flat, a little broader than long, with a small elongate puncture on each side at base, its surface weakly reticulate like mesoscutum; propodeum narrowing gradually posteriorly, carinately margined at sides, dorsal face much longer than posterior face and not separated from it by a carina; down the middle and on posterior face the propodeum is nearly smooth, laterad on the dorsal face it is delicately wrinkled; all femora considerably swollen, the anterior pair the largest, the middle pair the smallest; stigma small, subquadrate, not longer than parastigma; radius long, bent sharply forward at apex, the short apical section forming virtually a right angle with the long basal abscissa and usually nearly attaining anterior margin of wing; first discoidal cell complete, short-petiolate; posterior wings without distinct venation. Abdomen as long as thorax and slightly broader although strongly narrowed toward base and apex, entirely smooth and shining.

Black; the antennae yellowish brown toward base, brownish black apically; legs black or brownish black; anterior tibiae and all tarsi brownish yellow; wings rather strongly infumated, the stigma and parastigma dark brown, the veins paler.

Male.—Like the female in all important respects, but the abdomen is rather broadly rounded at apex, and the antennae and legs are paler, the anterior coxae entirely, the anterior femora except along the dorsal edge, and the middle coxae below, usually brownish yellow.

Type locality.—Eastwood, New South Wales, Australia.
Type.—U. S. N. M. No. 44854.
Host.—*Grapholitha molesta* Busck.

Described from 16 females and 8 males reared by R. W. Burrell, of the Bureau of Entomology, in 1931. The National Collection contains, in addition, a considerable number of insectary-bred specimens from Sydney, New South Wales, *G. molesta* likewise being the host of this material.

This species was first identified as an undescribed species of *Perisierola* by Mr. A. B. Gahan. He has suggested that I describe it in this paper along with the other new foreign parasites of the Oriental fruit moth for which names are desired.

NEW SPECIES OF HELMIDAE (COLEOPTERA).

By Paul N. Musgrave, *Fairmont, West Virginia.*

Helmis dietrichi, n. sp.

Male.—(Figure 2, A)—*General*—Body elongate, convex, piceous black with four oblique luteus bands on elytra located as in figure, moderately shining; ventral side, base of antennae, palpi, front margin of pronotum and legs, rufous. Length 2.5 mm. Greatest width, across elytra, slightly less than 1 mm. *Head* globose, inserted in the prothorax to the eyes, surface granular, sparsely covered with recumbent pubescence. Eyes not prominent, whitish. Antennae filiform, 11-jointed, 1 and 2 enlarged, 3–8 approximately equal, 9 and 10 larger than 7 and 8, 11 slightly thicker than 1 and 2, about as long as 9 and 10 together, pointed and hairy at apex, reaching to about 3/4 length of pronotum. *Pronotum* approximately as wide as long (.6 mm), convex, sides almost parallel in basal third and then gradually convergent, widest about 1/3 from base, basal margin sinuate, apical margin moderately extended forming a hood over head, disc uniformly punctulate, punctures separated by about or more than their own diameter, clothed with sparse gray pubescence; no elevated lines as in *Limnius*. *Legs* long and strong; front coxa transverse, femora piceous at apex, tarsi curved, with large claws. *Elytra* at base slightly wider than thorax, sides gradually divergent for first fourth, then almost parallel to apical third, then convergent, tips truncate, convex, impressed stria of punctures about same size of those of thorax, intervals with grayish pubescence arising from minute punctures. Under side of abdomen covered with the usual short, silky, decumbent pubescence, heavier on sides. Longer, stronger hairs scattered over entire under surface. *Genitalia.* (Aa–Ab)—Median lobe slender, strongly decurved.

Female.—Slightly larger (length 2.6 mm., width 1.1 mm.), otherwise externally similar to male.

Variations.—Marked variation in size of bands of elytra. One paratype shows apices of basal bands joining apical bands. Wings vary through series of paratypes from vestigial to normal Helmid form.

Type locality.—Dog River near Lucedale, Mississippi.

Types.—Holotype (male), allotype (female) and four paratypes in the U. S. National Museum. Several additional paratypes in collection of author and that of Henry Dietrich, for whom the species is named. Paratypes were collected by author (and Mr. Dietrich) from several localities in southern Mississippi; near DeFuniak Springs, Florida, and Wrens, Georgia, from June 22 to July 7, 1931. Specimens were almost always found clinging to submerged roots. May be separated from other Eastern species of *Helmis* having no raised lines on pronotum (*H. 4-notata* Say, *H. vittata* Melsh., etc.), by the oblique bands. Outline drawings for figure made by author.

Variations in *Helmis pusilla* Lec.

It is not the intention to add to the available literature by describing a great number of subspecies, but in collecting through the Southern States during June and July of 1931 such a good geographical series of *Helmis pusilla* Lec. was taken that it is felt advisable to make note of it. The typical form of *pusilla* taken in the Northern States and through the Alleghenies has four yellowish spots, two on each elytron, one on the humerus and the other near the apex (B). East of the Alleghenies a form is found in which the spots practically coalesce into a continuous band, but as one goes toward the Gulf the spots disappear, the apical ones first, until a form is taken in Alabama and Mississippi in which no maculation at all is seen. By removing an elytron one can see, even in a few of the solid black forms, a faint maculation, although no trace is shown externally. Genitalia and external appearance show that they are forms of the same species. In a few localities two subspecies have been taken in the same stream. Suggested names for three subspecies follow:

Helmis pusilla apta, n. subsp.

Size and general appearance as in typical *pusilla* with the exception of the maculation of elytra. The two spots normally found on each elytron, in this subspecies, are joined by a narrow band giving the appearance of a constricted stripe (C). Some paratypes have no constriction, thus showing an indefinitely outlined band from umbone almost to apex.

Types.—Holotype (female) collected in Dunlap Creek west of Clifton Forge, Virginia, July 13, 1931, in U. S. National Museum, as are also two paratypes. Other paratypes in collection of University of Florida, Gainsville, Florida, and in that of the author, taken in Flat Creek, south of Lynchburg, Virginia, Shenandoah River, east of Berryville, Virginia, Holmes Creek at Bonifay, Florida, and Hog Town Creek at Gainsville, Florida.

Helmis pusilla perdita, n. subsp.

Size and general appearance as in typical *pusilla* with the exception of the maculation of the elytra. One of the two spots normally found on each elytron has been lost leaving only that on the umbone (D). Holotype (female) taken July 1, 1931 at Leesburg, Florida. Holotype and several paratypes were collected from submerged roots of the water hyacinth. The plants completely filled the mouth of a small stream entering Lake Harris. Other paratypes were taken in Hog Town Creek, Gainsville, Florida, in company with *H. pusilla apta.*

Types.—Holotype and two paratypes in U. S. National Museum, two paratypes in collection of University of Florida and other paratypes in collection of author.

Helmis pusilla lödingi, n. subsp.

Size and general appearance as in typical *pusilla* except that there are no yellowish spots, thus leaving the elytra solid black. Holotype taken in Monger Creek near Lucedale, Mississippi, June 24, 1931. Paratypes collected by the author from several small streams in southern Mississippi (a few by the kindness of Henry Dietrich) and from creek just outside Mobile, Alabama. It is a great pleasure and privilege to name the subspecies for Dr. H. P. Löding, of Mobile, who has pioneered in the coleopterology of Alabama.

Types.—Holotype and two paratypes in U. S. National Museum, other paratypes in collections of Dr. Löding, Mr. Dietrich and the author.

Stenelmis blatchleyi, nom. n.

Stenelmis sulcata Blatchley 1910, "The Coleoptera of Indiana," page 681. Grouvelle having described *Stenelmis sulcata* from Sumatra in 1892 (Not. Leyd. Mus. XIV, 1892, p. 188) the name becomes a homonym and *blatchleyi* is offered for the species described from Lake Maxinkuckee, Marshall County, Indiana.

EXPLANATION OF FIGURE 2.

A—outline drawing of *Helmis dietrichi* Musgrave. *Aa*—dorsal view of aedeagus of *H. dietrichi*. *Ab*—lateral view showing decurved form of median lobe in aedeagus of *H. dietrichi*. *B*—normal maculation of *H. pusilla* Lec. *C*—maculation of *H. pusilla apta* Musgrave. *D*—maculation of *H. pusilla perdita* Musgrave.

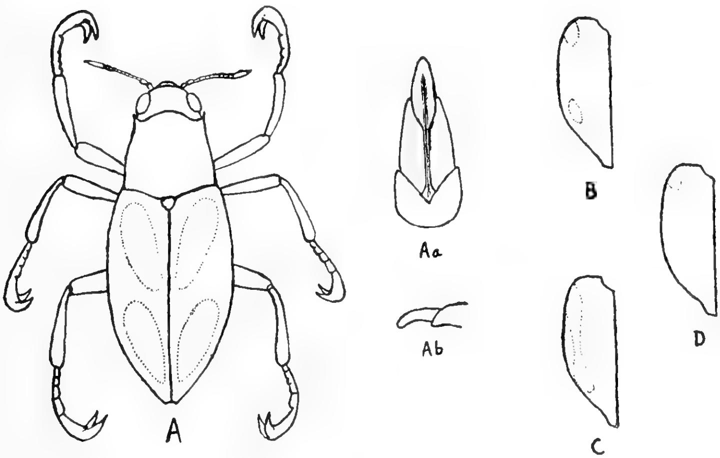

Figure 2.

CORRECTION.

In view of forthcoming articles it is advisable to point out that the name *Anopheles* (*Stethomyia*) *lewisi* Shannon, used in describing a species of mosquito from Brazil (Proceedings Entomological Society of Washington, 1931, 33, 154) is preoccupied by *Anopheles maculipennis* Meigen, 1818.

The name *Anopheles* (*Stethomyia*) *thomasi* is herewith proposed to replace the earlier name. This name is given in commemoration of Dr. H. Wolferstan Thomas, noted for his medical work in the Amazon region.

RAYMOND C. SHANNON.

REVIEW OF HOWARD'S "FIGHTING THE INSECTS, THE STORY OF AN ENTOMOLOGIST."

Fighting the insects, the story of an entomologist. 8 vo., cloth, 333 pp. New York. MacMillan and Company. 1933. $2.50.

It is with an acknowledgment of gratitude to the publishers that at their request this review of an unusual book is undertaken. It reveals the personality of a very brilliant and unusual individual and comprises a modest, simple narrative of the background, the development, and the outstanding events of a career of first rank in the field of science. The work is of especial and outstanding significance in the history of economic entomology in America because the career of L. O. Howard, for the greater part of a long lifetime, has been inseparably blended with its development. And this is true not only in our own country but to a degree in other widely separated parts of the civilized world. The entomological fraternity everywhere will applaud the distinguished author for having placed on permanent record such a wealth of information from his experience. The skill of a veteran is disclosed in the marshaling of material and in the highly informal anecdotal manner of presentation. The result is not only a most entertaining book but one which will appeal to every lover of his fellowmen. The analysis is keen and illuminating and occasionally there is a comment that is radiantly penetrating. Dr. Howard has not only studied the insects but he has had a deep interest in, a wide experience with, and a keen sympathy and affection for his fellow-beings as well, hence the book overflows with a spirit essentially human, sincere and illuminating. The narration of any life is of dramatic interest when properly and adequately presented. This is particularly true when, as in this instance, it has been crowded to overflowing with events and contacts of perennial interest: His ancestry, his birth and early childhood, his boyhood and college days at Ithaca, N. Y., his early entomological work under Professor Comstock, his later work in Washington, D. C., under Prof. C. V. Riley, and the events of his further career are traced step by step. There are many pages that deal with significant themes, as the growth of entomological work in the United States; the control of imported insect pests; the development of various phases of medical entomology; narrations of his various travels to remote parts of the earth and his contacts with famous people of many countries. The author's work as official in various scientific organizations; his recreations; and his associations with the habitués of the famous Cosmos Club in Washington afford many interesting and amusing incidents. He has known many noteworthy men, such as Alexander Graham Bell, Lord Calvin, Lord Lister, Harvey W. Wiley, Jules Jusserand, ex-president Theodore Roosevelt, and others. Indeed such a large portion of the volume is devoted to the memories of friends and acquaintances that one thinks a bit whimsically of substituting some such title as "Recollections of a Globe-trotter," or "The Reminiscences of Abou Ben Adhem." It is a matter of some difficulty for this reviewer to take an impersonal and dispassionate attitude in dealing with this book, for he has spent long years under Dr. Howard's sympathetic leadership and these have engendered an accompanying growth in affection and veneration for a superior who has been always helpful, always considerate, and always kindly.

J. S. Wade.

MINUTES OF THE 445TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, MARCH 2, 1933.

The 445th regular meeting of the Entomological Society was held at 8 P. M., Thursday, March 2, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, president, presided. There were present 31 members and 11 visitors. The minutes of the previous meeting were read and approved.

The president read a letter from Mr. Howe, the corresponding secretary of the Washington Academy of Science, to Mr. Rohwer, which called attention to a change in the editorial policy of the Journal of the Academy, making possible publication of brief summaries of current research.

Mr. D. L. Van Dine, chief of the fruit insect investigations of the Bureau of Entomology, upon invitation, greeted the society.

Under the heading "Notes and Exhibition of Specimens," Mr. J. C. Bridwell showed a collection of leafhoppers taken at light at Vienna, Va., in the late summer of 1932, and remarked on seasonal color changes. He also remarked on the policy of the Hawaiian Sugar Planters' Association toward entomologists, in encouraging diverting local studies and their publication; and on the desirability of studies thus encouraged.

Mr. C. N. Smith exhibited puparia of *Sarcophaga securifera*, from which adults had attempted unsuccessfully to emerge backward.

This note was discussed by Bishopp, Greene and Bridwell.

Mr. C. T. Greene stated that this abnormal emergence occasionally occurred in species of several dipterous families, and discussed possible reasons for the condition.

Dr. F. C. Bishopp commented on the unusually numerous reports of flea infestations in homes during the winter.

This note was discussed by Wadley and Snodgrass.

Dr. B. A. Porter mentioned a recent report of flea infestation in a New York office building, which was traced to cats occupying the basement, but which was spread to the top floor by the elevator.

Dr. H. E. Ewing spoke of introduction of the giant toad into Hawaii and elsewhere.

This note was discussed by Bridwell, Van Dine and Cushman.

The first communication on the regular program was by W. S. Abbott, and was entitled "The work of the insecticide testing laboratory of the food and drug administration."

Mr. Abbott briefly outlined the essential points covered by the Insecticide Act of 1910, and described the work of the Insecticide Testing Laboratory in connection with the enforcement of the provisions of this Act. (Author's abstract.)

This paper was discussed by McIndoo, Wood and Wadley.

The second communication was by R. E. Snodgrass and was entitled "Ovipositors and Stings."

The fundamental form of the insect, with respect to paired abdominal appendages, was shown. The ovipositor and other abdominal structures, in simple and complex insects, were then discussed. The probable origin of the ovipositor from the appendages of the 8th and 9th abdominal segments, and modifications in a number of species, were traced. The sting of the bee, and its structure as a modified ovipositor, was discussed. The paper was illustrated by a number of lantern slides.

Meeting adjourned at 10.15 P. M

F. M. WADLEY,
Recording Secretary.

Actual date of publication, April 21, 1933

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CONTENTS

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PROCEEDINGS OF THE

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VOL. 35 MAY, 1933 No. 5

THE HYPOPYGIA OF CERTAIN ANOPHELINES (DIPTERA: CULICIDAE).

By E. MARTINI,

Institut für Schiffs und Tropenkrankheiten, Hamburg, Germany.

The collection of the materials underlying this communication was effected during work done in collaboration with Dr. Hackett and Prof. Missiroli. The funds were appropriated by the public health division of the Rockefeller Foundation.

In 1921, I gave a description of the hypopygia of the three German anophelines then known. To the "normal" condition I added another variety from the south of Europe. But later on, when I obtained other specimens of *Anopheles elutus* exhibiting the same features as the said variety, I believed that hypopygium to characterize *A. elatus*, as at that time I was relying on scanty material (1924).

In 1924, La Face, having studied a larger number of hypopygia, pointed out the variability of these parts and demonstrated that I was mistaken in drawing a clear line between the structures of the two "species." In 1930, I supported her statement by giving some drawings of varieties and assymetries of the terminalia, but remarked the prevalence of different varieties in different regions. Later in the same year, Swellengrebel, de Buck and Schoute, attempting to clearly define their variety *atroparvus*, stated that "in wild short-winged males (*var. atroparvus*) round tipped ventral (really dorsal) claspette spines were present in but 0.3% out of 557 cases (in 279 males). In 12%, there was only one ventral spine, in wild long-winged males, 40% had round-tipped ventral claspette spines. In 50%, there existed only one spine on the ventral lobe. In the laboratory broods reared under identical conditions, the incidence of round-tipped spines in the short-winged male was 0.6% (1210 cases in 605 males) against 37% (722 cases in 361 males) in the long-winged. A solitary ventral spine occurred in 18% of the short-winged, and 559 of the long-winged cases."

In 1931, Hackett, Missiroli and the writer showed that by means of the characters of the eggs emphasized by Falleroni, a reliable distinction of at least two races was possible, and the courtesy of the Dutch authors Schüffner and van Thiel enabled us to demonstrate that the short-winged mosquitoes of Medemblik (*atroparvus*) were identical with Falleronis variety *labran-*

chiae of northern Italy, and almost pure, and that the long-winged race of Leiden was a mixture of Falleronis *messeae* with some *labranchiae*. Therefore probably neither the wild collected individuals nor the reared mosquitoes of either pupulation will represent an absolutely genetically pure stock.

La Face, raising males from selected eggs, proved in the same year that the one (or two) most dorsal spines are always acutely tipped, in the race with the gray eggs, whereas in the males bred from the dark barred eggs (*messeae*), at least the most "ventral" (really dorsal) spine is mostly blunt. From the striped eggs (*maculipennis* typ.), she raised males with almost identical hypopygia as in *messeae*. For the American *A. maculipennis*, Frost (1932) briefly says: "Claspettes bilobed the dorsal lobe small with two pointed spines, the ventral lobe larger with two or three spines, usually the latter." "Dorsal" and "ventral" have here the same meaning as in this paper. [Compare Christophers 1915 and Edwards 1920.]

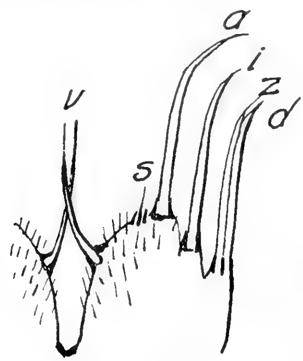

Fig. 1.

By our investigations of 1931 we obtained knowledge of some places where one or the other subspecies occurred purely or almost purely. The mounts of hypopygia of such places are well in accordance with the results of La Face. In the rough sketch (Fig. 1) the spine at the tip of the claspette, the apical spine, is marked "a," the most ventral one "v," the most dorsal one "d." In addition there is always a small sensory hair "s" at the inner side of the apical spine. It is very rarely replaced by a spine.

This poor set is often all that a male of *Anopheles maculipennis* possesses. It is also present in *A. elutus*, *quadrimaculatus*,[1] in *punctipennis*, *atropos*, *walkeri*, *punctimacula*, and others, modified only by the configuration of the spines and by additional appendages. Thus "Fig. B" of Frost shows on the ventral

[1]In Booth's Figure of this species "v" is merely a hair. But in a specimen caught by Dampf in northern Mexico it is developed as a spine.

lobe the spine "v," the sensory hair "s," and the spine "a"; on the dorsal lobe, the "d" and an accessory spine. In the description quoted above, she calls the hair "s" a spine, whereas in *punctipennis* it is called a hair. The shape of the spines of the dorsal lobe is not mentioned but the figure shows them to be blunt.

Also in European *maculipennis* additional spines are common. Very often spine "d" is accompanied by another spine, the twin-spine "z." Rarely there is a third one attached to the most dorsal lobe. But sometimes midway between the apical spine and the dorsal ones on a separate lobe there is an intermediate one, "i" (as I figured it for *elutus* (1930) and La Face for the *messeae*). The spines v, a, d are always present and as well the small sensory hair "s." The "z" and "i" are not always easily distinguished, as "i" by its base may be almost attached to the dorsal lobe, and because "z" is not always placed on the same level as "d," but sometimes is inserted posteriorly and more ventrally than "d." Therefore it may be arbitrary if we claim a spine, to be an "i" or a "z," whereas in *A. bifurcatus* the three groups of spines, that of the dorsal, the intermediate and the apical lobe are always easily told and counted.

It should be kept in mind also, that the shape of the claspettes is subject to variation, the bases of the spines often being lobe-like, but not always, and that different position on the slide results in different outlines.

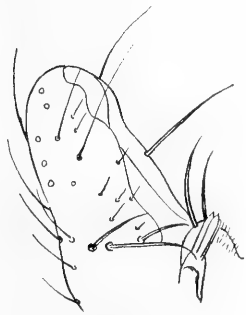

Fig. 2.

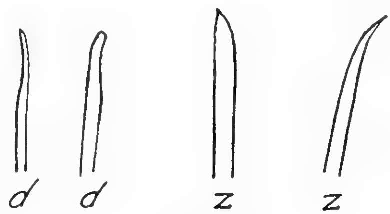

Fig. 3.

As to the shape, "v" and "a" and mostly "i" are slowly tapering sharply pointed spines. The spines "d" may be blunt and rodlike, or acute. But the same spine sometimes looks different in different positions, thus Figure 2 is taken from the same detached dorsal spine rolled beneath the cover slip, and Figure 3 from the same "z" spine. Both are taken from a male of *messeae*. In this subspecies some "d" spines therefore may be placed with the acute spines, which in another position might have been recognized as blunt. The acute spines of *atroparvus* hardly ever give any difficulty.

Rarely "v" is duplicated, the one spine being placed a bit dorsad of the other one, and both exhibiting the peculiar shape of that spine. This variation occurred, among the *atroparvus* material, in two symmetrical hypopygia (4 times) and symmetrically in one *messeae*. Or the sensory hair "s" may be enlarged to form a bristle or a weak spine or a strong spine. It was in *atroparvus*, replaced by bristles on both sides of one hypopygium by spines in both sides of 3 hypopygia and in two single claspettes among the typical *maculipennis*. However, the apical spine "a" may be duplicated, a normal sensory hair being present as well (twice unilaterally among the *atroparvus*).

In one object, the dorsal spine "d" was lacking, only "a," "s," and "v" being present.

Most hypopygia are symmetrical but asymmetries are not at all rare. This remark refers not only to the number but also to the shape of the appendages. Therefore in statistical work we take every claspette as one object, as did Swellengrebel and his co-workers.

In one hypopygium from Ardea (Italy), one side piece exhibited (asymmetrically) the duplication of the interior basal spine. Similar varieties I noted two times in *A. pseudopunctipennis*,[2] In that of Fig. 4, an accessory spine is developed most laterally. Such observations disprove the reliability of this kind of characters that Kingareff and the present author have used to define certain species of *Anopheles* s. str.

The statistical results are:

A. atroparvus		*blunt*	*tipped*	*acute*
Luurhusen	near Emden			20
Loppersum	near Emden		2 x 2	83
Aland	near Emden			22
Greetsiel	near Emden			69
Larrelt	near Emden			48
Twixlum	near Emden			8
Tetkum	near Emden			9
Neuwerk	near Hamburg	1	1	44
Groden	near Hamburg			8
Totals		1	5	311

[2]About *A. pseudopunctipennis*, Frost says: "No specimen of our species of *pseudopunctipennis* yet examined has had the four delicate serrate leaflets noted by Root (1924) on specimens from Mexico." I got a specimen from Mexico, where these leaflets are not easily detected. Otherwise all our Mexican *A. pseudopunctipennis* exhibit this character clearly and among them is one specimen, where they are as strongly developed as in *A. punctipennis*. I suggested (1932), that this male might belong to a new species, *A. cricillium* described from a single female. One more species of this group is met with in southern Mexico. For the typical *A. pseudopunctipennis*, Matheson also figures the serrate leaflets, and so does Dyar. If they are really absent in the Californian specimens, these might prove to be a new species or subspecies.

In all these localities, *messeae* is met with only exceptionally.

In 26 cases the dorsal spine was single, double 22 times and triple 3 times among the Emden males. An intermediate spine is registered 21 times.

For the var. *messeae* the pure population of Kaninchenwerder had at least one blunt rod 39 times, at least one shortly tipped rod 17 times, all spines acute 32 times. But I do not doubt that according to previous remarks, by tearing every hypopygium and rolling the rods we would come to a more homogeneous impression. A "z" was present 35 times, an "i" in 3 samples, among which two belonging to the same hypopygium were associated with two dorsal spines.

At Kappel, I found 16 times, the blunt rod, and only once symmetrically the acute spine. Among Grünberg *messeae* the "d" was 24 times blunt, 3 times tipped and 2 times a spine. 28 times a "z" was present and 12 times an "i" in this material.

In the almost pure population of *A. maculipennis maculipennis* collected in the Orti di Schito (striped eggs), I found no acute dorsals. Five times the "d" appeared like a very shortly tipped rod, 59 times the "d" was blunt, 11 males of the same race from the Lago di Fucino had blunt rods on all of the 22 halves.

From these 85 objects but 25 had the "d" rod single, 13 times an "i" was present only twice associated with a "z," once three spines were present on the dorsal lobe.

In all places where the light gray eggs occurred, the population is so mixed that this line of research relying on the purity of the population was excluded.

Discussion.

The results confirm those of de Buck, Schoute and Swellengrebel as well as those of La Face concerning the *atroparvus* (*labranchiae*) and *messeae*. For the typical *maculipennis* the Dutch author gives no information. La Face says that the hypopygium comes near to that of *messeae*. Yet I find the blunt rod so regularly in that race, that I would maintain a hypopygium with "d" tapering into a long spine be never a *maculipennis maculipennis*.

I would not wonder if a closer examination, by detaching the spines, would reveal an even higher degree of regularity. But for the moment I have no time for this rather tedious work.

As to the American representatives of this group, the hypopygia of *A. maculipennis* as drawn by Root and Frost agree with the European *atroparvus,—labranchiae*, probably the more thermophilous subspecies of our *A. maculipennis*. We therefore urgently need information on the hypopygia of the northern most *maculipennis* of America.

What I wrote in Lindner's Handbook 1930 still holds good, viz: The variability of the hypopygium of *A. maculipennis* is too great to allow a clear separation from the most closely related species.

In conclusion, I may draw attention to a genetic question. In *messeae* a spine "i" is more like spine "a," if it is inserted midway between the dorsal and the apical lobe. The closer it stays to the dorsal lobe, the more it resembles a spine "z," and this latter spine comes closest to the shape of the dorsal most one "d," where it is inserted absolutely at the same level as this. That would mean that the shape of a spine is a function of its position on the claspette. If that be true, and if we were able to stimulate or suppress the formation of spines, it nevertheless would only be possible to get a blunt rod in *messeae* at the most dorsal part of the claspette. If there the formation of a spine would be suppressed, we never would get a blunt rod, no matter how many spines we might produce elsewhere. It is a pity that we are not able to do experimental work with these delicate parts, but it might be that similar conditions prevail in other parts of larger insects and might furnish a possibility for experimental work.

Given this idea genetically the variability of the shape of the dorsal spines would be a complex one, being produced by the variable tendency of the organism to form blunt appendages, a tendency which on the edge of the claspette always decreases from dorsal ventrad, and by the variable arrangement of the spines on this posterior edge of the claspette. The reason why a blunt spine is lacking may be that there is little tendency to form a blunt appendage at all, or that the most dorsal spine is placed a bit off the most dorsal part of the claspette.

Resumé.

The author gives a scheme of the appendages of the claspette in the *A. maculipennis* group. He describes some anomalities; he corroborates the statements of de Buck, Schoute & Swellengrebel and La Face, that the most dorsal spine in the subspecies *atroparvus-labranchiae* is practically always acute, whereas in *messeae* it is prevailingly blunt or short-tipped. He finds in *A. maculipennis maculipennis* the dorsal-most spine practically always blunt. The American *maculipennis* studied by Root and Frost would go with *atroparvus-labranchiae*.

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CALCARITERMES IN THE UNITED STATES.

By Thomas E. Snyder,
Senior Entomologist, Bureau of Entomology, United States Department of Agriculture.

The genus *Kalotermes* Hagen is divided into a number of subgenera, some of which undoubtedly deserve generic rank. They are all designated as subgenera, however, until more complete biological series of associations of soldiers and winged sexual adults from world collections have been studied.

The subgenera *Calcaritermes* Snyder, *Glyptotermes* Froggatt, and *Lobitermes* Holmgren are very closely related in that in the winged adults the median vein runs close to and parallel with the subcostal vein. There are, nevertheless, marked differences in the soldier caste.

Ten species of *Calcaritermes* are known, all from the Neotropical zoo-geographical region, one being from Colima in western Mexico. Species of *Glyptotermes* have been recorded from the Australian, Oriental, Ethiopian, and Neotropical regions. They are equally well represented in all of these regions except the Ethiopian, where but few species have been recorded. *Lobitermes* is represented by three species, one from Sarawak and two from South America. No species in any of these subgenera have been recorded from the United States.

Among the insects captured in traps in Florida in connection with a survey of the Mediterranean fruit fly infestation, there were found three winged adults of a new species of *Calcaritermes*, one insect each from Clay, Levy, and Orange Counties, respectively.

Kalotermes (Calcaritermes) nearcticus, n. sp.

Winged adult.—Head castaneous brown, with scattered long hairs; labrum yellow. Eyes large, separated from lateral margin of head by a distance less than their long diameter. Ocelli fairly large, nearly touching the eyes.

Antennae with 13 segments; second, third, and fourth segments of about the same size.

Pronotum slightly lighter colored than head, with scattered long hairs. Anterior margin of pronotum shallowly concave; posterior margin shallowly and roundedly emarginate, with longitudinal corrugations at base.

Wings irridescently bronze colored, membrane coarsely stippled, margins ciliate. In fore wing median vein running parallel and close to subcosta. In hind wing median branching from subcosta near the base (at 1.5 mm. from base, wing 5.5 mm. in length and 1.60 mm. in width). (Fig. 1.)

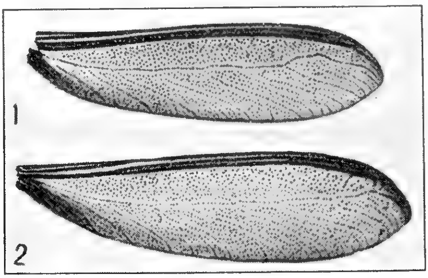

FIGURE 1.—Microphotograph of fore (1) and hind (2) wings of *Kalotermes* (*Calcaritermes*) *nearcticus* Snyder. Enlarged 10 times.

Abdominal tergites with a row of long hairs near base.

Legs with femora swollen and with pulvillus between claws.

The dimensions and details of the wing venation distinguish *nearcticus* from the known species.

Measurements. —

Length of entire winged adult	7.00 mm.
Length of dealated adult	3.50 mm.
Length of head (to tip of labrum)	1.1 mm.
Diameter of eye (long diameter)	0.30 mm.
Length of pronotum	0.60 mm.
Length of fore wing	4.70 mm.
Length of hind tibia	0.8 mm.
Width of head (at eyes)	0.95 mm.
Width of pronotum	1.00 mm.
Width of fore wing	1.40 mm.

Type locality.—Clay County, Fla.

Described from three winged adults, one from the type locality, collected on April 18, 1930, by A. M. Towles; one from Levy County, Fla., collected on April 21, 1930, by O. L. Milan; and one from Orange County, Fla., collected on January 22, 1930, by P. A. Anslay, Jr.

Holotype.—Winged male adult, Cat. No. 44835, U. S. National Museum; two winged adults as autotypes in U. S. National Museum.

A NEW SPECIES OF MOSQUITO FROM COLORADO (DIPTERA, CULICIDAE).

By Robert Matheson.

Aedes klotsi, n. sp.

Female.—Length 6 to 6.5 mm.; length of wing, 4.5 to 5 mm. Proboscis long, slender, brownish-black; palpi short, one-fifth the length of the proboscis, brownish-black, clothed with small brownish scales and a few short brownish hairs. Antennae about as long as the proboscis, with short brownish hairs forming small whorls; the segments clothed with numerous short, narrow, whitish scales; tori black with numerous white scales. Occiput with a broad median area clothed with narrow, curved white scales bordered with narrow, curved brownish-yellow scales; sides with flat, white scales; erect, forked scales numerous, yellowish-white in the middle and brownish at the sides of the occiput. Mesonotum almost black, clothed with numerous curved scales, yellowish-brown predominating on the median area and whitish to yellowish-white on the sides and anterior margin. Pleura and coxae heavily clothed with broad, flat, white scales. Abdomen brownish-black with broad basal segmental white bands, widening on the sides; venter brownish, densely white scaled. Legs brownish-yellow, the tarsal segments being nearly black; femora heavily white scaled especially on the ventral surface; tibiae with a few white scales intermixed with numerous blackish-brown scales; all tarsal segments black. Claw formula, 1.1 – 1.1 – 1.1. Wing scales all narrow, brownish-black to black.

Male.—The general color is practically similar to that of the female. The antennae possess dense whorls of long brownish-yellow hairs. The palpi are slightly longer than the proboscis; the apices of the long segment and the last two segments are blackish-brown; the basal portion of the long segment is yellowish-brown with a more or less distinct ring of whitish scales preceding the black apical part. Length 6.5 mm.; wing, 5 mm. Claw formula, 2.1 – 2.1 – 2.1.

Hypopygium.—The structure of the male hypopygium (Fig. 1) readily separates this species from any known North American species. Side-piece more than three times as long as wide; apical lobe long, rounded, with numerous short outward projecting setae on the dorsal face; a few longer hairs arise from the ventral surface. Basal lobe prominent, triangular, the apex projecting upward; the posterior margin of the triangle forms a narrow ridge which bears a single row of long, densely crowded hairs, the outer two of which are rather stout spines; the first spine is short and the second is extremely long and curving at the tip. Clasper long, narrow, not expanded in the middle and with a very few very fine setae along its inner margin. Claspette with a stout stem bearing a few short hairs; filament as long as the stem, sharply expanded just before the middle so that the terminal half appears sickle-shaped. Tenth sternites prominent with recurved tips. Phallosome (mesosome) short,

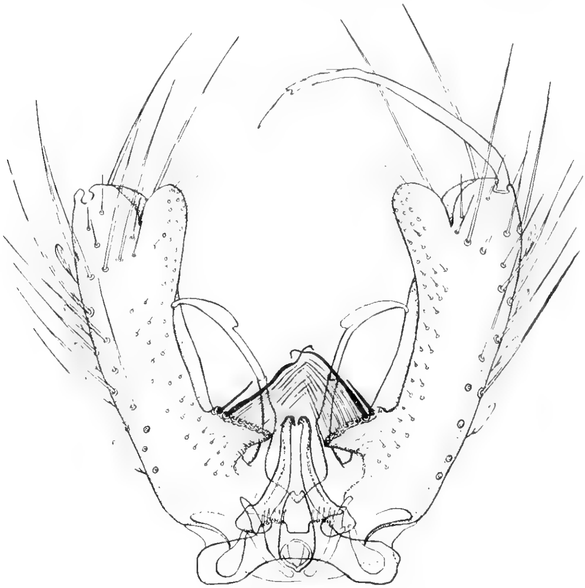

Figure 1

cylindrical, narrowing towards the apex. Lobes of the ninth tergite distinct and each bears 4 to 6 short, stout spines.

Holotype.—1 male, No. 49241, U. S. National Museum. *Allotype.* 1 female, U. S. Nat. Museum. *Paratypes.* 2 males and 1 female in the U. S. Nat. Museum; 6 males and 2 females in the collection of Cornell University. The genitalia of the holotype and the paratypes (males) are mounted on slides. This species was collected by Dr. A. B. Klots and Dr. Elsie B. Klots at Mountain Home Lake, Fort Garland, Colorado, July 20 to 25, 1932. Altitude 8300 feet.

This species falls in my key to the adults (Handbook of the Mosquitoes of North America, 1929) with *cataphylla*, from which it may be separated by its larger size and the color pattern of the mesonotum. In the key to the males it falls with *dorsalis*, from which it may be easily separated by the possession of a short and an extremely long spine on the basal lobe (Fig. 1).

I thought at first that this might prove to be *Aedes cacothius* Dyar which was described from six females taken at Shoshone

Point, Yellowstone National Park, Wyoming (elevation 8200 ft.). However, Dyar describes *cacothius* as a small species and his original description (Ins. Ins. Mens., 11, p. 44, 1923) and that given by him in his Mosquitoes of the Americas (p. 197, 1928) do not agree in several particulars. Through the kindness of Dr. J. M. Aldrich of the U. S. National Museum I have been able to compare my species with one of the type females (only females are known) of *Aedes cacothius*. *A. cacothius* is small, not over 4 mm. in length and the color pattern is distinct from *A. klotsi*. Dr. Klots informs me that this species was collected along the edge of a small, cold, clear, mountain stream. The adults were abundant in the tall grass in the meadow just before the stream emptied into Mountain Home Lake.

A FURTHER NOTE ON THE COLEOPTEROUS GENUS ASERICA (MELOLONTHINAE).

By Gilbert J. Arrow,
Deputy Keeper, British Museum (Natural History).

In a note published in the Proceedings of the Entomological Society of Washington in 1927 (p. 69), I gave the facts which seemed to me to make Brenske's name *Autoserica* a synonym of the previously published name *Aserica*, Lewis, for the great genus of Melolonthine Scarabaeidae which has recently become so well known and important both in the Eastern and Western hemispheres. Mr. E. A. Chapin, in the volume of the same journal for 1932, has published a note contesting that conclusion upon grounds which appear to indicate a misconception of the facts and, in view of the importance of the very large genus in question, a re-statement of the circumstances in clearer terms appears desirable.

The name *Aserica* was introduced by Lewis in 1895 (Ann. Mag. Nat. Hist. (6) 16, p. 394) "for a considerable number of species hitherto included in *Serica*. It differs essentially from *Serica* in having smaller eyes, the scutellum wide at the base, the hind femora considerably widened and truncate at the apices, posterior tibiae also dilated, tarsi more robust and the intermediate coxae widely separated." Two Japanese species in Lewis's own collection were referred to the genus by the names *japonica* Motsch. and *orientalis* Motsch. (which had been assigned to them by Waterhouse in an earlier paper), the limits of size of his specimens of each stated, the first-mentioned species cited as the genotype and a detail drawing from it given to show the essential characters.

Two years later Brenske (Berl. Ent. Zeitschr., 1897, p. 377) formulated the genus *Autoserica*, assigning to it the same essential characters, although in less detail than Lewis had given, and following the latter in including in it the species named by him. Having evidently discovered the earlier name too late to suppress his own without great inconvenience, he admitted the synonymy but proposed to overcome the difficulty by treating the older name as subgeneric and applying it to a part only of the genus called *Autoserica*. As I pointed out in my note, a new name can not take precedence of an older one in this way and the name *Aserica* should have been used, instead of the redundant *Autoserica*, for the genus whose species, unmistakably defined by the characters set forth by both authors, have since become only too familiar.

Mr. Chapin, however, anxious, like Brenske, to retain the name *Autoserica*, makes the rather surprising proposal to treat *Aserica* as a synonym of *Serica* in its restricted form, first defined by Lewis in excluding the "considerable number of species" for which he devised the name *Aserica*. Mr. Chapin's reason for this proposal is the fact announced by myself that the name *japonica* Motsch., applied by Lewis to his type-species, does not belong to it but to another species of the old complex to which the name *Serica* was applied. I was able to establish this by actual comparison of the specimens described (and figured) by Lewis with the type of Motschulsky, the specimens of Lewis's type-species being now in the British Museum collection.

In order that his proposal may not seem out of harmony with "opinion 65" of the International Commission on Zoological Nomenclature, Mr. Chapin makes the following remarkable statement:

"It is here maintained that Lewis did not base his genus on 'certain definite specimens,' for had he done so he would have indicated the fact and would have given detailed information concerning his specimens."

This contention is demolished by Mr. Chapin himself a few lines later, in referring to Lewis's actual statements and detail drawing from his type-species. The statements are: "My measurements are 9–11 millim." and "Some of my specimens are in color light brown." The sketch is of the metasternum of a beetle; certainly not of a "*Serica*." (The important parts of the drawing, however, are of the mesosternum and hind legs.)

The details supplied by Lewis were therefore sufficient to satisfy Mr. Chapin that *Aserica* is not the same as *Serica* and to satisfy Brenske that it is the same as *Autoserica*. The specimens from which the genus was diagnosed being permanently placed in the British Museum collection, remain available to satisfy any who may in future be interested of the correctness of these inferences.

The true *Serica japonica*, Motsch., although it has not all the characters of *Aserica*, as defined, and must therefore retain its old name pending a satisfactory delimitation, is as certainly not a true *Serica*. Lewis possessed examples of it which were undistinguished from *Aserica orientalis*, Mots. It is undoubtedly less closely related to the type-species of *Serica* (*S. brunnea* L.) than to those of *Aserica* (*A. secreta* Brsk.) and *Autoserica* (*A. piceorufa* Fairm.) and a study of the multitudinous species of the group may show that it is not possible to separate it ultimately from *Aserica*.

THE IDENTITY AND SYNONYMY OF THREE ORIENTAL SPECIES OF CREMASTUS (HYM., ICHNEUMONIDAE).

By R. A. Cushman,

Bureau of Entomology, United States Department of Agriculture.

The importation into the United States of *Cremastus flavoorbitalis* (Cameron) from Japan as a parasite of the European corn borer, *Pyrausta nubilalis* Hübner, has led to a study of its identity. In the course of this study it has become evident that there has been much confusion on the part of Japanese authors between this species and two other species, *japonicus* (Ashmead) and *chinensis* (Viereck).

This paper is the result of the study of types and published discussions.

Cremastus flavoorbitalis (Cameron) (new combination).

Tarytia flavoorbitalis Cameron, Journ. Bombay Nat. Hist. Soc., 1907, p. 589.

Ophionellus biguttulus (Matsumura) Munakata, Extra Rept. Agr. Sta. Aomori No. 2, 1910, p. 67, Pl. 2, fig. 1 (in Japanese) (new synonymy).

Cremastus hymeniae Viereck, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 189 (new synonymy).

Tarytia flavoorbitalis Morley, Fauna Brit. India; Hym., vol. 3, Ichn. pt. 1, 1913, p. 506.

Cremastus hymeniae Swezey, Proc. Hawaiian Ent. Soc., vol. 3, 1915, p. 106.

Ophionellus biguttulus Nawa, Ins. World, Gifu, Japan, vol. 19, 1915, p. 456; Kondo, Extra Rept. Agr. Sta. Nagasaki, No. 15, 1917, p. 101.

Cremastus hymeniae Swezey, Proc. Hawaiian Ent. Soc., vol. 4, 1918, p. 13.

Diaparsis japonica (Ashmead) Uchida, Journ. Faculty Agr. Hokkaido Imp. Univ., vol. 21, 1928, p. 285, Pl. 6, fig. 28 (not *Temelucha japonica* Ashmead).

Cremastus hymeniae Rust, Proc. Hawaiian Ent. Soc., vol. 7, 1929, p. 223.

Cremastus japonica Uchida, Journ. Faculty Agr. Hokkaido Imp. Univ., vol. 25, 1930, p. 356 (not *Temelucha japonica* Ashmead).

Cremastus (*Tarytia*) *biguttulus* Sonan, Trans. Nat. Hist. Soc. Formosa, vol. 20, 1930, p. 141 (part).

In the last reference cited above Sonan synonymized *Cremastidea chinensis* Viereck and *Cremastus japonica* Uchida (not Ashmead) with *biguttulus* Munakata, a species originally described in Japanese. In the case of *japonica* Uchida he appears to be correct, but *chinensis* is a distinct species, as is also the true *Cremastus japonicus* (Ashmead).

The types of *chinensis*, *japonicus*, and *hymeniae* are all before me. They are separable by structural characters as follows:

1. Lower margins of first tergite not nearly meeting ventrally but widely separated and parallel; stigma broad with radius distinctly beyond middle.................................(*hymeniae Viereck*) = *flavoorbitalis* (Cameron).
   Lower margins of first tergite nearly or quite meeting ventrally; stigma narrow with radius at or very near middle...2.
2. Abdomen narrow, second tergite fully five times as long as broad at base; areola barely one and a half times as long as broad; in female, diameter of an ocellus shorter than ocell-ocular line and malar space nearly as long as basal width of mandible (male unknown)...................
   japonicus (Ashmead).
   Abdomen broad, second tergite less than four times as long as broad at base; areola two or more times as long as broad; in female, diameter of an ocellus much longer than ocell-ocular line and malar space barely half as long as basal width of mandible; in male, eyes and ocelli very large, malar space and ocell-ocular line nearly obliterated ....*chinensis* Viereck.

Cremastus flavoorbitalis (Cameron) is very widely distributed through the Oriental and Australian Regions and spreads into the Palearctic Region in eastern Asia as far north as the Island of Honshu, Japan, east to the Hawaiian Islands and west to Ceylon and India.

The National Collection includes specimens from Japan reared from *Pyrausta nubilalis* Hübner and *Grapholitha molesta* Busck; from Hawaii reared from *Hymenia fascialis* Cramer and *H. recurvalis* Fabricius (types of *hymeniae*); from the Philippine Islands, including two reared from *Crocidolomia binotalis* Zeller at Los Baños by V. J. Madrid under College of Agriculture No. Ec-388; and a series from Singapore in the Baker Collection.

The species exhibits very marked variation in color, especially of the thorax, which is sometimes largely black above and sometimes entirely without black.

Cremastus japonicus (Ashmead).

Temelucha japonica Ashmead, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 185.

Since the publication of Ashmead's description there have been four references to the name, all by Japanese authors. In 1915 Nawa (Insect World, vol. 19, p. 489, Pl. 23) recorded it as a parasite of a rice insect, *Bradina admixtalis* Walker; in 1928 Uchida (Journ. Faculty Agr. Hokkaido Imp. Univ., vol. 21, p. 285) transferred the name to *Diaparsis* and recorded it as a parasite of another rice insect, *Chilo simplex* Butler; in 1930 Uchida (1. c. vol. 25, 1930, p. 356) transferred it to *Cremastus;* and in 1930 Sonan (Trans. Nat. Hist. Soc. Formosa, vol. 20, p. 141) synonymized *Cremastus japonica* Uchida (not Ashmead) with *Cremastus* (*Tarytia*) *biguttulus* (Munakata).

In the National Collection under the name *Temelucha japonica* Ashmead stand two female specimens, one labelled "Type No. 7260" and the other "Paratype No. 7260." The former is from Swatow, China, the first locality mentioned in the description. The other is from Hong Kong. There is no specimen from Japan. The Swatow specimen agrees perfectly with the original description, while the Hong Kong specimen is not the same species but is *Cremastus flavoorbitalis* (Cameron). Since there is no specimen from Japan, since the Swatow specimen is labelled "Type" and since this specimen is the only one that agrees with the original description, it is obvious that it must be recognized as the holotype and Swatow, China, as the type-locality.

Apparently all of the references subsequent to the original description should be considered as applying to *Cremastus flavoorbitalis* (Cameron).

Cremastus chinensis (Viereck).

Cremastus (*Cremastidea*) *chinensis* Viereck, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 587.

Cremastidea chinensis Rust, Proc. Haw. Ent. Soc., vol. 7, 1929, p. 223.

Cremastus chinensis Cushman, Proc. U. S. Nat. Mus., vol. 75, art. 25, 1930, p. 14.

Cremastus (*Tarytia*) *biguttulus* Sonan, Trans. Nat. Hist. Soc. Formosa, vol. 20, 1930, p. 141 (part).

This species is mentioned here only to call attention to the fact that it is not synonymous with *biguttulus* (Munakata) as has been indicated by Sonan.

It is parasitic on the rice borer, *Chilo simplex* Butler, as indicated by a series of specimens reared from that host by D. T. Fullaway at Kobe, Japan, and by others reared from rice straw from Japan intercepted at quarantine in New York and New Orleans.

TWO NEW SPECIES OF TABANUS FROM NORTH AMERICA (DIPTERA).

By ALAN STONE, *Bureau of Entomology.*

During the course of a study of the nearctic species of *Tabanus* two unusually distinct new species have been discovered. It was not originally intended to describe these before the completion of the study, but since a name was requested for the one from Oklahoma and since the other was so distinct, it was thought advisable to describe them immediately.

Tabanus oklahomensis, n. sp.

Female.—Length 13–15 mm. Eyes transverse and short dorso-ventrally, the angle formed by the lower margin of the eyes wider than usual; clothed with short, dense, white pile; in life dark purple with four green-blue diagonal stripes, not touching the eye margin laterally, and the three lower ones curved upward at the outer end. Front very broad, sometimes less than twice as high as its width, and never more than 2½ times its width, the sides parallel or nearly so; clothed with yellowish brown pollen, paler between the median spot and the frontal callus and with downward pointing hair, black except just above the frontal callus, where it is creamy white. Vertex somewhat concave with a shiny black triangle, in the middle of which lies a sharply defined, raised, dark reddish, ocelligerous tubercle. A slender black line runs from the ocelligerous tubercle to the frontal callus; on each side of this line, on the middle of the front, lies a large black spot, either separated from the line, or broadly joined to it. Frontal callus black, wrinkled, transverse, somewhat protuberant, tapering somewhat to each side but touching the eyes; the line between the frontal callus and the subcallus distinctly curved downward medianly. Subcallus swollen and shining black with a median depressed line. Semicircles above antennal bases with pale yellow pollen. First antennal joint stout and somewhat enlarged apically, with gray pollen, pale yellowish and black hair, and a distinct tuft of reddish hair at the apex above; second joint small with black hair and a distinct dorsal point; third joint rather stout with a strong dorsal angle and quite concave anterior to it; basal third to half of the basal portion dark reddish brown to nearly black; the rest black; annulate portion stout, about equal in length to the width of the basal portion at the dorsal angle. Face, cheeks, and back of head pale yellowish gray pollinose with abundant, long, nearly white hair; posterior orbital fringe of hair, to either side of vertex for a short distance, distinctly yellowish orange. Palpi short, stout, swollen at base and coming to a sharp point; clothed with pale yellowish pollen and long, nearly white hair. Proboscis very short, the labellae black.

Dorsum of thorax black with abundant, long, silky, pale yellowish or brownish hair. Antealar callus with shorter black hair. Pleurae, sternum, and coxae gray pollinose, densely clothed with long, nearly white hair. Wings hyaline with black veins; costal cell often somewhat infuscated; no stump at base of vein R_4; cell R_5 not at all coarctate. Legs with femora black, the under surface, particularly of the fore pair, with abundant, long yellowish hair. Tibiae dark reddish, the fore pair with the apex black; all tibiae clothed with a mixture of pale and black hairs; hind tibial fringe not prominent. Tarsi black, the ventral surface with short, bright orange hair.

Abdomen broad, black, clothed with pale yellowish and black hair, the pale hair forming rather indefinite posterior margins to the tergites; these bands expanding at the lateral margin of each tergite and sometimes forming faint median triangles. Venter gray pollinose, the posterior margin of the sternites somewhat paler.

Holotype, Catalogue No. 49377, U. S. N. M., Atoka, Oklahoma, March 31, 1933, collected by Harold Schnorrenberg. *Paratypes*, 14 others taken at Atoka, Atoka Co., and Tishomingo, Oklahoma.

This species is similar to *Tabanus carolinensis* Macquart of the eastern part of the United States, but differs in its wider front, entirely black subcallus, entirely black ground color to the abdomen, and its darker legs.

Tabanus bishoppi, n. sp.

Female.—Length 12 mm. Eyes clothed with short, but distinct, white pile; color (revived) green-blue with a single yellow-green diagonal stripe. Front of moderate width, its height about 3½ times its width at the frontal callus, scarcely narrowed below; clothed uniformly with yellow pollen and with brown hair above the median spot, yellow hair below. A small, slightly raised spot at the vertex, entirely covered with pollen and hair. Frontal callus black, shining, convex, about square and separated from the eye by a narrow strip of pollen. Median spot of the holotype black, very slender and lanceolate, and very narrowly joined to the frontal callus; in the paratype much shorter and completely isolated. Subcallus flat, pale yellowish. Face and cheeks with white pollen and hair. First and second antennal joints small, yellowish brown, clothed with black hair above; third joint orange-brown, the annulate portion black; basal portion of the third joint stout, its greatest width nearly as great as its length, only slightly concave anterior to the obtuse dorsal angle; annulate portion equal in length to width of basal portion. Palpi pale yellow, the second joint of moderate width at base but the apical half very slender; clothed with short white and scattered black hair. Proboscis black, nearly 2 mm. long.

Thoracic dorsum black in ground color with a very fine coating of yellow pollen and an indication of grayish stripes on the mesonotum; clothed with black and yellow hair, the latter predominating. Pleurae, sternum, and coxae dark gray, the fore coxae paler than the rest; upper part of pleurae with yellowish hair, the rest white. Wings hyaline with reddish brown veins, darker apically; costal cell and first cell R very dilute yellow. No stump vein at base of vein R_4, and cell R_5 wide open. Femora gray pollinose with mostly pale hair. Tibiae yellow, the apical third of the fore pair dark brown to black; hind tibial fringe mostly yellow, but with scattered black hairs apically. Fore tarsi black; middle and hind tarsi dark reddish brown.

Abdomen with a continuous pale yellow stripe from scutellum to apex, slightly widening at the posterior margin of each tergite. On first tergite a black spot to either side of the stripe; an indication of black bordering the stripe on the other tergites, the apex of the abdomen largely black; rest of the dorsal surface of the abdomen rather dark orange-brown except for a lateral row of nearly square spots of yellow pollen and hair on tergites 1–5, the spots beyond the first tergite not touching the hind margin. Venter pale orange, somewhat darker apically.

Holotype, Catalogue No. 49378, U. S. N. M., Silver Springs, Florida, March 26, 1929, Bishopp No. 13073, collected by F. C. Bishopp. *Paratype*, Ft. Pierce, Florida, April 14, 1918, Bishopp No. 7889.

In habitus this species resembles *fulvulus* Wied. or *longiusculus* Hine, but the distinctly pilose eyes and the slender palpi separate it from these and other related species.

NOTES ON SOME NORTH AMERICAN SPECIES OF HALICTUS WITH THE DESCRIPTION OF AN APPARENTLY NEW SPECIES (HYMENOPTERA: APOIDEA).

By Grace Adelbert Sandhouse,

Bureau of Entomology, United States Department of Agriculture.

This paper gives synonymical notes on two species of *Halictus* previously considered to be limited to the Palearctic fauna; the description of an apparently new species, in order that the name may be available for use in economic entomological literature; and a key for separating these from other closely related species occurring in the eastern part of the United States and Canada.

Halictus leucozonius (Schrank).

Apis leucozonia Schrank, Enum. Ins. Austr., 1781, p. 406, n. 819.
Halictus similis F. Smith, Cat. Hym. Brit. Mus., pt. 1, 1853, p. 69, n. 105.
Halictus similis Cockerell, Can. Ent., vol. 41, 1909, pp. 334–335.

When Frederick Smith described *Halictus similis* from Hudson's Bay, North America, he compared it with *H. leucozonius* but considered it to be distinct. In 1909, however, Cockerell saw the type of *similis* in the British Museum and considered it synonymous with *leucozonius*. A careful study by the writer of a series of specimens from both Europe and North America has confirmed the synonymy. Recently further confirmation has been received from Mr. P. Bluthgen, who writes that at his request Mr. R. B. Benson of the British Museum compared the type of *similis* with specimens of *leucozonius* and could find no difference between them. Since the species has apparently been previously known in America only from the type material seen by Smith, it was of especial interest to receive for identification a large series of specimens from Nova Scotia, where it is reported to be very abundant.

Halictus zonulus, Smith

Halictus zonulus Smith, Zoologist, vol. 6, 1848, p. 2171, n. 22.
Halictus similis Lovell, Can. Ent., vol. 37, 1905, p. 299 (new synonymy).
Halictus craterus Lovell, Psyche, vol. 15, 1908, p. 35 (new synonymy).

A specimen of *Halictus zonulus* from Europe was recently received from Mr. Bluthgen, with the notation that it occurs in Canada. It was recognized to be the same as the species known in North America as *craterus* Lovell. It occurs in eastern Canada and in the northeastern part of the United States as far west as Michigan.

Halictus athabascensis, new species.

Male, holotype.—Length 8 to 9 mm. Black, with the apical half of the clypeus pale yellow; tegula brown; tarsi and under side of flagellum brown testaceous.

Pubescence white, except for some fuscous hair on the abdominal tergites and yellowish hair on the tarsi.

Head without particular modification; distance between the anterior ocellus and the apical margin of the clypeus to that between the eyes just before the anterior ocellus as 6.25 to 4.75. Space between the inner margins of the eyes at the base of the clypeus and just before the anterior ocellus about the same width. Vertex and sides of face densely clothed with pubescence; clypeus and postclypeus nearly bare. Front uniformly covered with fine contiguous punctures. Vertex shining between finer but more widely separated punctures. Clypeus flat, nearly impunctate, apical margin truncate; postclypeus shining between small, widely separated punctures. Labrum nearly impunctate, basally depressed in the middle; apical margin subtruncate, fringed with long straight hairs. Temples broadest just below the middle of the eye, then narrowing abruptly to the base of the mandible, lower three-fourths punctate-striate; postgenae along the hypostomal carinae microscopically longitudinally striate, basally produced slightly below the level of the hypostomal carinae; genae reduced to a mere line. Mandibles reddish in the middle, when closed the tip of one reaching to the anterior-lateral angle of the clypeus on the opposite side. Joints of flagellum weakly moniliform beneath, of uniform length; third antennal joint nearly twice as long as second and about two-thirds as long as fourth.

Thorax with moderately dense erect pubescence. Prothorax without particular modification. Mesoscutum shining; the punctures of moderate size, on the anterior portion and laterad of the parapsidal furrows separated by a little more than the diameter of a puncture, between the furrows by about twice; mesopleura shining, finely and irregularly foveolate, indistinctly punctured; mesoscutellum polished, with a median longitudinal impressed line, the punctures smaller and more widely separated than on the mesoscutum, two lateral spots nearly impunctate. Metatergum and metapleura irregularly foveolate, indistinctly punctured. Propodeum shining, dorsal surface with a subcrescentic disk which is bordered posteriorly by a polished strip, very irregularly carinate; lateral and posterior surfaces finely and irregularly carinate-punctate; carinae on posterior-lateral angles weakly developed on lower fourth only. Wings yellowish hyaline, faintly iridescent. Stigma and wing-veins brown testaceous. Tegula brown, anteriorly testaceous, largely impunctate. Legs normal, tibial spurs testaceous.

Abdominal tergites purplish black, the apical margins brownish, finely and uniformly punctured; basal hair bands well developed; shining pygidial area of seventh tergite flat, lower margin rounded. Sternites unmodified; second with erect pubescence; third, fourth, and base of fifth with pubescence in the middle erect, at the sides longer and bending laterally; apices of fifth and sixth with ordinary pubescence; sixth with a median longitudinal streak and apical margin impunctate; seventh at the base wider than the eighth, its median process broader than that of the eighth.

Female, allotype.—Very similar to the male in color, sculpturing, and pubescence, but differing in the usual sexual characters. Length 9 to 10 mm. Black, without pale markings; legs brownish, tibiae and tarsi brown-testaceous; tibial spurs testaceous, lower edge of the hind spur serrate with broadly rounded teeth. Head ordinary; distance between anterior ocellus and apical margin of clypeus to that between the eyes before the anterior ocellus as 7 to 5.5; face more sparsely pubescent, the sides more sparsely punctured; clypeus and postclypeus microscopically tessellate, with large shallow well separated punctures; postgenae very finely longitudinally striate along the hypostomal carinae. Thorax more robust; mesoscutum duller, more closely punctured. Abdomen more robust, tergites duller, more strongly purplish; hair apicad of basal hair bands largely black.

Type.—Cat. No. 44882, U. S. National Museum.

Locality of type, 70 miles up Athabasca River, Alberta, Canada; of allotype, Toronto, Ontario.

Described from the following: Type and 18 males, 70 miles up Athabasca River, Alberta, August 5, 1903 (Merritt Cary); 1 male, Carlisle, Pennsylvania, July 26, 1918 (Robert Fouts); 1 male, St. John, New Brunswick, Oct. 3 (A. G. Leavitt); 1 female, allotype, Toronto, Ontario, April 15, 1892 (Wm. Brodie); 3 females, Lehigh Gap, Pennsylvania, June 26, 1901; 1 female, North Cumberland, Pennsylvania, May 23, 1908, No. 192a (P. R. Myers); 2 females, Pequaming, Michigan, July 2 and 13, 1903 (Morgan Hebard); 1 female, Detroit, Michigan; 1 female and 1 male, Durham, New Hampshire (Weed and Fiske); 1 female, Canada, No. 2416 (C. F. Baker); 1 male, Hazelton, British Columbia, Sept. 6, 1919 (H. G. Dyar); from Kaslo British Columbia, all collected in 1903—1 female, June 26, and 1 without date (R. P. Currie), 1 female, May 30 (H. G. Dyar), and 1 female, July 7 (J. W. Cockle). All the specimens listed above are in the collection of the U. S. National Museum. Those below are in the Canadian National Collection: 1 male, Truro, Nova Scotia, Aug. 14, 1917; 1 female, Kings County, Nova Scotia, May 20, 1931, on *Pyrus malus* (C. E. Atwood); 1 female, Hunts County, Nova Scotia, June 16, 1931, on *Cornus stolonifera* (C. E. Atwood).

The following key will help to separate this species from related species known to occur in the eastern part of the United States and Canada:

1. Abdominal tergites dull, purplish black, very finely and uniformly punctured, the apical margins not at all depressed; basal hair bands creamy white, the hairs more closely appressed and seldom rubbed off to any extent. Dorsal surface of propodeum rather dull, its median length equal to that of mesoscutellum, finely and irregularrly carinate, the carinae weaker apically, without a well-defined enclosed area. Male—posterior-lateral angles of seventh tergite ordinary; sixth sternite not modified, with usual pubesence; seventh with a well-developed median process; eighth with the process somewhat pointed and more triangular. Claspers of genitalia with a ventral lobe-like process. Lower half of clypeus usually largely yellow, in the middle extending to the apical margin. (These species would go into the subgenus *Curtisapis* of Robertson.) .... 2.

– Abdominal tergites shining black, more coarsely and irregularly punctured, apical margins depressed, more conspicuously so laterally; basal hair bands white, the hairs looser and more frequently partly rubbed off. Dorsal surface of propodeum shining, its median length about equal to that of metatergum, with a well-defined enclosed area which has more regular longitudinal carinae uniformly developed to the apex. Male—posterior-lateral angles of seventh tergite produced and reflexed; sixth sternite modified, with unusual pubescence; seventh with a very small median projection; that of the eighth broad and nearly quadrate. Claspers of genitalia without a ventral process. Lower half of clypeus with a yellow spot which nowhere reaches entirely to the apical margin........5.

2. Anterior-lateral angles of pronotum strongly developed and sharply right-angled; mesoscutum with punctures clearly defined and uniform in size, anteriorly slightly bigibbous in the middle. Posterior-lateral angles of propodeum carinate up to the truncate posterior margin of the dorsal surface; the disk bordered posteriorly by a very low carina. Wings yellowish infumate, more conspicuously so in the female. Pubescence of head and thorax white. Male—temples gradually narrowed below and receding posteriorly; mandibles ordinary; posterior margin of fifth sternite broadly emarginate in the middle; sternites 2 to 4 without polished apical margins, densely clothed with posteriorly recumbent hairs; clypeus convex, dull, microscopically tessellate, strongly punctured; labrum not impressed in the middle; third joint of antenna twice as long as second........*fuscipennis* Smith.

– Anterior-lateral angles of pronotum not strongly developed, obtusely angled; mesoscutum anteriorly not bigibbous, the punctures less distinctly defined and varying in size. Posterior-lateral angles of propodeum carinate on lower half only; apical margin of dorsal surface rounded; the disk not bordered posteriorly by a carina. Wings yellowish hyaline. Pubescence of head and thorax yellowish. Male—temples broader below and not receding posteriorly; mandibles unusually long; posterior margin of fifth sternite truncate; sternites 2 to 4 with polished apical margins, the pubescence sparser and nearly erect; clypeus shining, flat, sparsely and finely punctured; labrum basally impressed in the middle; third joint of antenna one and one-half times as long as second........3.

3. Mesoscutum anteriorly not at all declivous, elevated only very slightly above the pronotum. Disk of propodeum carinate on the basal third only, apically polished in the male, dull with microscopic tessellations in the female. Male—mandibles very long, the tip of one reaching over beyond the base of the other; polished pygidial area of seventh tergite transversely concave, the apical margin subtruncate; head subquadrate, inner margins of eyes not converging below; hypostomal carinae narrow basally, but becoming wider apically and bending laterally with a strongly rounded curve; vertex posteriorly elevated; labrum weakly impressed in the middle........*coriaceus* Smith.

– Mesoscutum anteriorly abruptly declivous in the middle and elevated distinctly above the pronotum. Disk of propodeum carinate on at least the basal three-fourths, although the carinae are stronger basally. Male—mandibles varying in length, but never with the tip of one reaching the base of the other; polished pygidial area of seventh abdominal tergite not concave, the apical margin strongly rounded and sometimes weakly pointed in the middle; head somewhat narrowed below; hypostomal carinae of uniform width, bending laterally with a slightly rounded angle; vertex posteriorly not elevated; labrum distinctly impressed in the middle .... 4.

4. Hair on abdominal tergites apicad of basal bands largely pale. Female—postgenae along the hypostomal carinae polished; posterior margin of dorsal surface of propodeum slightly elevated, the disk more dull and microscopically tessellate between carinae; clypeus and postclypeus polished between punctures. Male—tip of mandible reaching about half way between anterior-lateral angles of clypeus and base of other mandible; tarsi yellow; third joint of antenna as dark as second; flagellum scarcely paler beneath; hair on third and fourth abdominal sternites longest in the middle; ventral surface of postgenae basally produced down below the hypostomal carinae .... *forbesii* Robertson.

– Hair on abdominal tergites apicad of basal bands largely fuscous. Female—postgenae along the hypostomal carinae longitudinally striate; posterior margin of dorsal surface of propodeum not elevated, the disk more shining; clypeus and postclypeus microscopically tessellate between punctures. Male—tip of mandible reaching to anterior-lateral angle of clypeus; tarsi dark brown; third joint of antenna much paler than second, color of those distad; flagellum much paler beneath; hairs on third and fourth sternites longest at the sides and bending over laterally; ventral surface of postgenae basally about level with the hypostomal carinae .....*athabascensis* Sandhouse.

5. Anterior-lateral angle of pronotum forming a right angle. First abdominal tergite very sparsely punctured in the middle. Posterior-lateral angles of propodeum with carinae extending up to dorsal surface and for a short distance along its posterior margin; disk posteriorly rounded in the middle. Vertex behind postocellar line punctate, not striate. Wings strongly yellowish; stigma and nervures testaceous. Male—legs dark brown; posterior-lateral angles of seventh tergite produced beyond the middle so that the posterior margin is emarginate in the middle; sixth sternite laterally impunctate, medially with a basal tuft of erect hairs, and just beyond this a longitudinal row of hairs which is expanded laterally at the apex; apical margin of fifth sternite broadly emarginate in the middle........ *zonulus* Smith.

– Anterior-lateral angle of pronotum obtuse. First abdominal tergite quite uniformly punctured. Carina on posterior-lateral angle of propodeum becoming obsolescent at the posterior margin of the dorsal surface; disk posteriorly somewhat pointed in the middle. Vertex behind the postocellar line finely transversely striate. Wings clear hyaline; stigma and nervures brown, paler basally. Male—legs with small spots at bases of front and middle tibiae, a larger spot at base of hind tibia, the middle and hind metatarsi (except the extreme apices) pale yellow; posterior-lateral angles of seventh tergite not produced beyond the middle of the posterior margin, so that the margin is truncate; sixth sternite with a broad triangular slightly depressed area at the apex, the lateral margins of which are fringed with several rows of rather long plumose hairs; apical margin of fifth sternite truncate............................*leucozonius* (Schrank).

MINUTES OF THE 446TH REGULAR MEETING OF THE WASHINGTON ENTOMOLOGICAL SOCIETY, APRIL 6, 1933.

The 446th regular meeting of the Washington Entomological Society was held at 8 P. M., Thursday, April 6, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, president, presided. There were present 45 members and 20 visitors. The minutes of the previous meeting were read and approved.

In reporting on the recent meeting of the executive committee, Mr. Rohwer stated that the Society's current funds were tied up in a closed bank, and that greetings for the centenary of the London Entomological Society were being prepared.

Major G. C. H. Franklin, of the Army Medical School, was unanimously elected to membership on recommendation of the executive committee.

Dr. W. F. Jepson of the Imperial Bureau of Entomology, upon invitation, greeted the society.

Under the heading "Notes and Exhibition of Specimens," Doctor Fracker showed specimens of fleas sold in curio stores in Mexico, dressed in imitations of human costumes. This note was discussed by Bishopp.

Dr. Aldrich read notices of the coming meetings of the Centenary of the Entomological Society of London, which gave an idea of the program.

The first communication on the regular program was by Major G. C. H. Franklin, and was entitled "The London school of hygiene and tropical medicine, with special reference to the department of entomology."

The paper presented a brief history of the school from the time of its foundation in 1899 to the present; a description of the present buildings opened in 1929; the purpose of the school and the reasons for its location in London. Mention was made of the excellent entomological and helminthological exhibits in the museum, and of the wealth of material for study and experimental work. The work of Doctors Buxton and Wigglesworth of the Division of Entomology in insect physiology was discussed. A recent address by the former, title, "The Effect of Climatic Conditions upon Populations of Insects," formed the basis for a discussion on the value of the study of insect physiology from the view point of medicine and agriculture. Dr. Buxton believes that the field worker should collect more critical data in the places where insects actually live. The laboratory could then check this data and from it develop by experiment, methods which would lead to a better control of insect pests. A partial list of the work already accomplished by these insect physiologists is given. A brief account of the Division of Helminthology at the school, and some of the work they are doing under the direction of Prof. Leiper, was given. The paper concluded with the hope that the vast collection of entomological and parasitological material available in Washington would some day be put to use in the teaching of post-graduate students. (Author's abstract.)

This paper was discussed by Howard, Bishopp, and Snodgrass.

The second communication was by Mr. D. L. Van Dine and was entitled "The relation of sugar-cane varieties to the problem of insect transmission of sugar-cane mosaic in Cuba."

This paper reviewed the work in Cuba on the transmission and spread of the mosaic disease of sugar cane, under Cuban conditions. The work extended over the period from 1924 to 1932, and included a study of the alternate grass host plants of the virus of the disease and of the corn aphid, *Aphis maidis* Fitch, the agent of transmission. At the beginning of the investigations, the sugar crop of the Island was dependent almost entirely upon one variety of cane, highly susceptible to the disease. A large number of varieties were tested, both by control cage methods and by plantings under natural field conditions, for their comparative susceptibility to the disease. From these, certain varieties with promising commercial possibilities, which proved highly resistant to infection, were selected for field tests. The selections were made after several years of study regarding the field growth and sugar making qualities of the canes. A soil survey was made of the cane areas of Cuba and the soil types were determined and classified. The desirable resistant canes were tested on a field basis on all of the more important types of soil. These varieties proved desirable for planting and commercially resistant to the disease. The canes by an intensive method of propagation were produced for seed purposes and distributed to the plantations. Surveys over a period of years indicated that the Island could be zoned in respect to the spread or activity of the disease, zones in which the natural spread of the disease was low, medium, or high. This information gave greater latitude in the utilization of varieties. The studies on the insect carrier of the disease were continued to determine the natural conditions which promote the secondary spread of the disease. Such information is capable of great practical application. In a zone where the aphid population is not sufficient to insure the spread of the disease, and only healthy seed is planted, the disease factor can be discounted. Varieties of cane which are commercially more desirable, or more suitable, for growth on certain soil types, can replace the highly resistant varieties. Also a change in varieties for disease control purposes can be made in a more deliberate and economical manner.

Details of the work of the Tropical Plant Research Foundation in Cuba, organized and directed by the late Dr. W. A. Orton, are a matter of record and references were given to the publications dealing with the work under discussion on sugar cane mosaic. (Author's abstract.)

This paper was discussed by Howard, Bishopp, Wood and Kisliuk.

Dr. L. O. Howard, honorary president, attending after long absence, greeted the society upon invitation.

Dr. Howard said that he was not prepared to talk about his experiences while away from Washington, but he admitted that he had a very good time, and a most interesting one. Nevertheless, he said he was very glad to be back among his old friends, and hoped to see much of them, now that his eyes were again functioning.

Meeting adjourned at 9.35 P. M.

F. M. WADLEY,
Recording Secretary

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PROCEEDINGS OF THE

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MISCELLANEOUS NOTES AND DESCRIPTIONS OF CHALCIDOID PARASITES (HYMENOPTERA).

BY HERBERT L. DOZIER.

This paper contains the descriptions of ten new species of Chalcidoidea and records of twenty other species, all reared by the writer, and for the most part from Coccidae and Aleyrodidae. *Marietta maculatipennis*, *Thysanus insularis*, *T. magniclavus*, and *T. louisianae* are most probably secondary and the others primary parasites. Unless otherwise designated the types are retained in the writer's collection.

EULOPHIDAE

SUBFAMILY ENTEDONINAE.

Euderomphale quercicola, new species.

Differentiated immediately from *E. flavimedia* (Howard) and *E. aleurothrixi* Dozier by different coloration and by having the forewings with a narrow infumation beneath the marginal vein at about the middle. The corneous sensoria project beyond the distal ends of the joints, reminding one very much of the antennae of members of the trichogrammatid genus *Ufens*.

Female.—Length 0.969 mm.; expanse 1.88 mm.; greatest width of forewing 0.358 mm. General color black with metallic reflections; antennae fuscous; legs black, except cephalic tarsi, the proximal three joints of the middle and hind tarsi, and the knees, pale; the cephalic tibiae mostly pale but dusky on lateral margins. Forewings hyaline, a comparatively narrow infumation or clouding beneath the marginal vein at about the middle; this clouding does not cross the entire wing but reaches only to the row of setae that runs along close to the lower border of the wing; venation brown; caudal wing hyaline, the vein pale brown.

Antennae setose, the scape long; pedicel elongate, narrow at base and gradually enlarging, supplied with a number of conspicuous sensoria arranged in a revolving manner; two small but distinct ring-joints present, the proximal one being the smallest; the single funicle joint two-thirds as long as the pedicel but distinctly wider; club three-jointed, widest near distal end of the basal joint, then narrowing to acutely pointed tip; pedicel and club joints supplied with a number of longitudinal corneous sensoria that project more or less beyond the distal ends of the joints. Eyes naked, the margin of the vertex with a number of prominent setae. Marginal vein of the forewing very long, over three times as long as the submarginal; just beneath the marginal vein are from 3 to 5 long setae that are directed downwards. Abdomen sessile, conic-ovate, the ovipositor barely visible from above. Tarsi four-jointed, the distal joint the longest.

Male.—Length, exclusive of the exserted genitalia, 0.645 mm.; expanse 1.61 mm.; greatest width of forewing, 0.301 mm. Smaller in size than the female and distinguished immediately by the difference in antennae. Antennae of the male have the pedicel and club joints distinctly stouter than in the female and the corneous sensoria appear more numerous and projected more beyond the distal ends of the joints, giving a peculiar appearance to the apical joint of the club. The infumation of the forewing in the male is decidedly less deep and the venation is a paler brown. Abdomen not sessile as in the female but with petiole extremely short, distinctly narrower at base than the thorax, narrowing to tip where the genitalia is distinctly exserted.

Described from a female and two males reared by the writer from a large, undescribed whitefly, *Tetraleurodes* sp., on the Live Oak, *Quercus virginiana*, at City Park, New Orleans, La., January 12, 1932, and a female caught on the foliage of same tree on same date. Paratype female on slide is deposited in the U. S. National Museum collection. Type No. 44823.

Euderomphale vittata, new species.

Distinguished from all described species at once by its distinct abdominal coloration. A large, robust West Indian species.

Female.—Length 0.833 mm.; expanse 1.79 mm.; greatest width of forewing 0.402 mm. Head and thorax black, the abdomen pallid with a very distinctive broad, brown-black cross band just before the pale tip; antennae and legs entirely pale; ovipositor grayish-black. The forewings hyaline, without any trace of infumation, the venation pale yellowish.

Antennae short, sparsely covered with rather short, pale setae; pedicel stout and about twice as long as wide; one small and narrow ring-joint; second and third funicle joints of about same length but the third distinctly wider and same width as the pedicel; club three-jointed, stout and thick, the second joint slightly the widest, the distal joint narrowing to distinctly tapered point. Eyes abundantly but minutely setose. The pronotum, prescutum, and scutellum scaly-reticulate, with numerous short black setae. Forewings very broad, almost twice as long as wide; the distal half thickly and uniformly ciliated, the remainder appearing clear, but this is due to the almost transparent cilia covering that area; marginal cilia very short. Abdomen pedicillate, somewhat spherical in outline, the ovipositor only very slighly exserted.

Male.—Length, exclusive of exserted oedeagus, 0.817 mm. Only slightly smaller than the female; the abdomen less spherical and somewhat truncated; the tip of the abdomen not as distinctly pale as is the case with the female. The male can be distinguished at once from the female by the pale oedeagus in contrast to the gray-black ovipositor and by having the third funicle joint much longer, about twice as long as the second funicle and distinctly wider.

Described from a series of seven females and three males, reared by the writer from a large whitefly, *Aleurodicus* sp., on "Maria," *Calophyllum antillarum*, at San Juan (Santurce), Porto Rico, March 2 and June 8, 1925. Holotype female and allotype male, mounted in balsam, are deposited in the U. S. National Museum collection. Type No. 44824.

SUBFAMILY APHELININAE.

Marietta busckii (Howard).

Howard, U. S. D. A. Tech. Bul., Ser. 12, pt. 4, p. 87, 1907, *Perissopterus*.

This species was described from a single male, reared from *Asterolecanium aureum* at San Juan, Porto Rico, in 1899 by A. Busck. To this the following records, obtained by the writer in 1925 at Rio Piedras, Porto Rico, may be added:—one male from soft scale on *Citrus*, May 26; two females from *Asterolecanium pustulans* on *Cassia fistula*, June 13–14; two females from *Ceroplastes cirripediformis* on passion vine, July 3. In addition, the species is abundant in Haiti where it was reared as follows:—one male from *Terminalia catappa* infested with *Saisettia oleae* and *Aspidiotus destructor* at Port-au-Prince, Dec. 14, 1929; one male from green *Lecanium* on guava at Damien, Feb. 11, 1930; four males and five females from *Tachardiella cydoniae* (Hempel) on *Annona* at Source Puantes, May 13, 1930; two males and one female from *Coccus mangiferae* on mango foliage at Petionville, Nov. 22–24, 1930, and four males and three females from same source Dec. 1–2, 1930; one female from *Cerococcus* n. sp. on wild fig, *Ficus mitrophora*, at Damien, March 13, 1931; and one male from *Asterolecanium pustulans* on oleander at Damien, June 18, 1931.

Marietta pulchella (Howard).

Howard, Report of the Entomologist, Ann. Rept. Com. Agr., p. 356, 1880, *Aphelinus*.

Two females, reared by Thos. F. Catchings from *Lecaniodiaspis* n. sp. on willow at City Park, New Orleans, La., Nov. 19, 1928.

Marietta carnesi (Howard).

Ent. News, vol. 21—p. 162, 1910.

On May 31, 1927, the writer reared a single female of a *Marietta* from the San Jose scale, *Aspidiotus perniciosus*, on Japanese quince at Newark, Delaware, in association with *Prospaltella perniciosi* Tower and *Azotus americanus* Dozier, that according to Mr. Gahan appeared to resemble remarkably *M. carnesi* (Howard). More recently, a slide with numerous specimens of *M. carnesi* reared from *Chrysomphalus aurantii* in Japan, Dec. 12, 1922, by C. P. Clausen, has been received through the kindness of Harold Compere and has been studied. The Delaware specimen, although distinctly smaller, measuring only 0.516 mm. in length, appears to be undoubtedly the same and adds the Asiatic species *M. carnesi* to the North American fauna.

Marietta maculatipennis, new species.

This species is probably best placed in *Marietta* Motschulsky, although the male wings are hyaline and not spotted as in that genus, and is very similar, especially in the wings, to *Marietta puntaticorpus* (Girault). It appears to be congeneric with the species described as *Perissopterus capillatus* Howard and *P. noumeaensis* Howard, which have the spotted appearance of the female wings due to groupings of heavy black setae and not to a dark granulated integument between the setae as is the case with the *pulchella* group. The new species appears also to be very close to *Paraphytis* Compere but the male antennae are six-jointed instead of five-jointed.

Female.—Length, including ovipositor, 0.588 mm.; expanse 1.31 mm.; greatest width of forewing 0.20 mm. General color orange-yellow, the abdominal segments marked with fuscous at lateral margins; antennae yellowish, the proximal two-thirds of the club slightly browned; eyes bluish-white in life, black in balsam mounts, distinctly setose; ocelli reddish; legs pale yellowish, the middle and hind femora marked with fuscous near distal end and the tibiae with two fuscous bands; the short, stout front tibiae with a single band across middle. The forewings hyaline, with groupings of heavier, black setae giving an appearance of being six-spotted, quite different from *M. pulchella* (Howard) which has the pattern of markings on the forewing due to dark granulated integument between the setae; a hairless oblique streak present across forewing.

Apex of the vertex incised or notched at the middle. Prescutum with a single small seta in the outer angles, a row of four setae on each side near the median line, the anterior one being the smallest and the posterior one very long and stout; in addition near the anterior margin is a smaller and less conspicuous seta that lies about midway between the other setae; scapula with three setae and the axilla with a single one; scutellum with a pair of extra strong, long setae on each side. Dark portions of body appear reticulated under high magnification. Endophragma rather short but very distinct and prominent in balsam mounts. Abdomen as long as the thorax and about as wide, the ovipositor short but distinctly exserted. All tarsi five-jointed.

Male.—Length 0.459 mm.; expanse 1.12 mm.; greatest width of forewing 0.186 mm., decidedly smaller than the female and less orange in color, being more sordid; the abdomen with a transverse band of fuscous covering the first tergite, and nearly the apical half, infuscated. Antennae six-jointed, the scape decidedly wider than that of the female and the entire antenna is soiled yellowish. Forewings hyaline, lacking the groupings of stout black setae of the female, a very small area at the stigma inconspicuously infumed. The legs are pale, without the definite markings of the female, the hind tibiae with a single median band of fuscous.

Described from a series of both sexes, reared by the writer in extremely abundant numbers from a diaspine scale, *Aspidiotus* (Diaspidiotus) sp., incrusting the trunk and branches of young mahogany, *Swietenia mahogani*, in nursery at Cote Plage, Haiti, June 27, 1930. From the same material a few specimens of an undescribed *Prospaltella* and an abundance of *Ablerus* n. sp. issued June 25–27th. As all members of the genus *Marietta* to date whose habits are known are secondary parasites, this species is most probably secondary on the *Prospaltella*. A single male of the new *Marietta* was reared from the scale, *Vinsonia stellifera*, on undetermined shrub near Las Cahobas, Haiti, Dec. 19, 1930. Holotype female and allotype male are deposited in the U. S. National Museum collection. Type No. 44822.

Aspidiotiphagus citrinus (Craw).

Craw, Destructive Insects, Sacramento, Cal., 1891, *Coccophagus*.

Reared by the writer in abundant numbers from Florida Red Scale, *Chrysomphalus aonidum*, heavily encrusting rose stems at Port-au-Prince, Haiti, Oct. 28, 1929. This appears to be the most common scale parasite in Porto Rico and Haiti.

Aspidiotiphagus lounsburyi, Berl. & Paoli.

Berlese & Paoli, Redia, XI, Firenzi, fasicle 1, p. 305, 1916.

Reared in very abundant numbers from *Parlatoria zizyphus* on the West Indian lime foliage at Port-au-Prince, Haiti, June 1–20, 1931.

Aphytis fuscipennis (Howard).

Howard, Ann. Rept. Com. Agr., p. 356, 1880, *Aphelinus*.

Reared in abundance from *Lepidosaphes alba* Ckll. on *Manihot cassava* at Damien, Haiti, Jan. 29, 1930.

Aphytis limonus (Rust).

Rust, Ent. News, vol. 26, p. 77, 1915

This lemon-yellow primary parasite was reared in abundance from *Lepidosaphes alba* Ckll. on *Manihot cassava* at Damien, Haiti, Jan. 27–29, 1930, in association with *A. fuscipennis* (How.), *Thysanus maculatus* (Girault) and *Thysanus insularis* Dozier. The distinctly lemon-yellow venation distinguishes this heretofore rare species at once. This material has been kindly compared by Mr. Gahan with the type from Peru in the U. S. National Museum and found to be identical.

Aphytis chrysomphali (Mercet).

Mercet, Bol. Soc. Esp. Hist. Nat., vol. 12, p. 135, 1912, *Aphelinus*.

Very abundant on *Aspidiotus destructor* on the West Indian almond, *Terminalia catappa* on the Champs de Mars at Port-au-Prince, Haiti, Dec. 13, 1929.

Aphytis maculicornis (Masi).

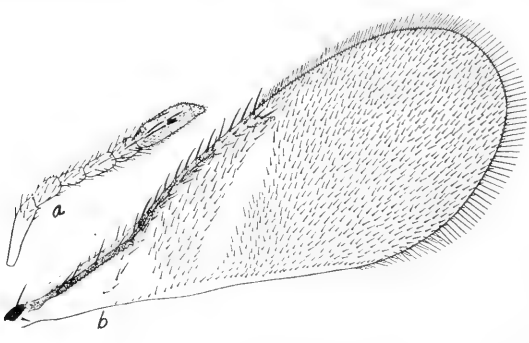
Masi, Boll. Lab. Zool. Gen. Agr., Portici, vol. 5, p. 140, 1911, *Aphelinus*.

Reared by the writer in abundant numbers from *Parlatoria crotonis* Douglas on cultivated Croton foliage at Port-au-Prince, Haiti, April 30–May 8, 1931, in association with *Hispaniella* sp.

Mesidia gillettei Howard.

Howard, Proc. Ent. Soc. Wash., vol. 16. p. 80, 1914.

The original description of this rare species was based on a single female reared by C. P. Gillette from *Brachycolus tritici*, Oct. 13, 1908, presumably at Fort Collins, Colorado. Its general color was given as dull honey-yellow and does not mention the darkening of the posterior margins of the abdomen, which makes it appear as if striped transversely across (even more apparent in freshly balsam-mounted specimens). Mr. Gahan has kindly compared the Illinois material with the type in the U. S. National Museum and finds them to be identical. The drawings were made by Mr. Carl Mohr by courtesy of Dr. T. H. Frison of the Illinois State Natural History Survey.



Female.—Length 0.789–0.903 mm.; expanse 1.91–1.94 mm.; greatest width of forewing 0.287 mm. General color a dirty or soiled yellowish-orange, the pronotum and anterior margin of the prescutum dusky, the abdominal segments dusky along their posterior margins giving the abdomen an appearance of being transversely banded; the head slightly ferruginous; eyes black; ocelli red; antennae nearly concolorous with the body; the legs uniformly soiled yellowish-testaceous, the tarsi pale except for the dark distal joint, venation pale yellow.

Eyes distinctly setose. Vertex supplied with rather prominent setae. Antennae six-jointed (Fig. a), all the joints furnished with setae; the scape long, enlarging towards distal end; pedicel about twice as long as wide, slightly longer than the first funicle joint and subequal the second in length; funicle one distinctly narrower than the pedicel, subequal the third funicle in length; the funicle joints each successively slightly wider; the club composed of a single joint, about a third wider than the widest funicle joint, nearly equalling in length the three funicle joints combined, and provided with a number of longitudinal sensoria. Prescutum with a number of sparsely arranged setae, a pair of larger ones near the posterior margin; scapulae with two setae, the axillae with one and the scutellum with a very strong, prominent seta on each side near its anterior margin; metanotum with a pair of prominent setae. A very distinct endophragma extends back into the abdomen. Forewings long and slender (Fig. b), hyaline, densely ciliated over the disk, with a distinct oblique hairless streak across the wing; marginal vein slightly longer than the submarginal. Abdomen rather rounded, the ovipositor slightly exserted. Tarsi five-jointed.

Male.—Unknown.

The above description is based on three females taken by the writer sweeping low vegetation at edge of pond near Cache, Ill., May 6–7, 1932.

TRICHAPORUS Förster.

1856 Förster, Hym. Stud., vol. 2, p. 84, *Trichaporus*.
1895 Howard, U. S. Dept. Agr., Div. Ent. Tech. Ser. Bul I, p. 28, *Encarsia*.
1912 Mercet, Trab. Mus. Cien, Nat. Ser. Zool., no. 10, p. 149, *Encarsia*.
1930 Nowicki, Neue Beitr. z. Syst. Insektenkunde, vol. 4, nos. 13–14, p. 157, *Trichaporus*.
1930 Mercet, Rev. de Biol. Forestal y Limnologia, vol. 2, Ser. B, no 2, p. 82, *Trichaporus*.

Förster described the genus *Trichaporus* in 1856 without assigning any species to it, placing the genus in the Tetrastichinae. Kurdjumov, in examining the Förster collection, preserved in the Vienna Museum, found six different species placed under the generic name *Trichaporus:*—the first species *T. solutus* Frst. (not described) did not belong to the Tetrastichinae but to the Omphalini of the subfamily Entedoninae and is identical with the genus *Astichus* Frst. The second species was *Euderus arithmeticus* Frst. described in 1851 and chosen by him in 1856 as the genotype of his new genus *Astichus*. In addition to these two species the other four all belonged to the Aphelininae, namely:—*T. aleyrodis* Frst., *conferarum* Frst., *infuscatus* Frst. and *nigrinus* Frst. S. Nowicki in 1930 in his paper "Bemerkungen zu den europaischen Apheliniden-Gattungen" (Observations on European Aphelinid genera), has shown that *Trichaporus* Frst. is distinct from *Trichoporus* Ashmead and that *Trichoporus melleus* Ashm. (selected by Girault in 1912 as genotype) differs from the original generic description of Förster in at least two very important characteristics—in the larger number of antennal joints and in the presence of grooves on the scutellum, which shows clearly that *T. melleus* Ashm. can not serve as genotype for *Trichaporus* Förster, which genus according to Förster has both sexes with 8-jointed antennae. According to Nowicki and Mercet, the genotype of *Encarsia* Förster (*Encarsia tricolor* Frst.) is the same insect as *Doloresia conjugata* (Masi) and *Encarsia* Frst. is characterized by 8-jointed antennae in the female sex and only 7-jointed in the male. Therefore we must either erect a new genus to contain all the species that fall into *Encarsia* as used by Howard and other authors since, or else accept that proposed by Nowicki and place these under the genus *Trichaporus* Förster with the type of that genus *T. aleyrodis* Frst.

Trichaporus variegata (Howard).

Howard, Proc. Ent. Soc. Wash., vol. X, p. 64, March–June, 1908, *Encarsia*.

This species was described from two females reared from *Paraleyrodes perseae* (Quaint.) on lemon foliage in Florida. It was recorded for the second time by the writer as attacking *Paraleyrodes naranjae* Dozier on *Citrus* in Porto Rico. The species is abundant in Haiti where it was reared by the writer in numbers at Port-au-Prince and Source Cazeau from a species of *Paraleyrodes* that is common on *Annona squamosa*, *Bauhinia divaricata*, and *Citrus*. *Trichaporus variegata* can be immediately distinguished from the other members of the genus by the silvery-white scutellum which reflects iridescent in balsam mounts. Apparently it confines its activities to members of the whitefly genus *Paraleyrodes*.

Trichaporus cubensis (Gahan).

Gahan, Proc. Ent. Soc. Wash., vol. 33, no. 5, pp. 121–122, May, 1931, *Encarsia*.

This parasite was reared by the writer in very abundant numbers at Damien, Haiti, Dec. 6–15, 1930, from the Woolly Whitefly, *Aleurothrixus floccosus* (Maskell), on *Spondias mombin* together with *Trichaporus haitiensis* (Dozier), *Prospaltella brasiliensis* (Hempel) and *Euderomphale aleurothrixi* Dozier; from an undescribed *Aleurothrixus* on Haitian oak, *Catalpa longissima*, at same locality March 6, 1931; and from *Aleurothrixus floccosus* on Lignum-vitae, *Guajacum officinale*, at Sarthe, Haiti, Jan. 26, 1931. It was originally described from the Woolly Whitefly in Cuba and is undoubtedly one of the most important parasites of this aleyrodid.

Trichaporus catherineae, new species.

One of the most beautiful and distinctly marked species of the genus. Belongs to the group of *Trichaporus* (*Encarsia* sensu Howard et auctores), having all tarsi five-jointed.

Female.—Length, including ovipositor, 0.731 mm.; expanse 1.378 mm.; greatest width of forewing 0.215 mm. General color orange-yellow, the two apical joints of the antennae and the abdomen except the extreme tip, dark brown; legs entirely pale; the forewings lightly clouded below the marginal vein across the middle; eyes black; ocelli red.

Under high magnification, the vertex, prescutum, scapulae, and scutellum appear very faintly, polygonally reticulated. Prescutum and scutellum without setae. Antennae eight-jointed, without a distinctive club differentiation; the scape long and slender, equal in length to first two funicle joints combined; pedicel short, about two-thirds as long as the first funicle but distinctly wider; the first funicle slightly narrower and shorter than the other funicles which are subequal; the last two antennal joints are slightly wider than the others and together with their dark color have the appearance of a two-jointed club. Forewings slightly over twice as long as wide, rather uniformly covered with cilia but bare on the basal third; the cilia in the clouded area appear distinctly darker than those of the apical third; marginal vein grayish. Abdomen robust, slightly longer than the thorax, the ovipositor distinctly exserted. All tarsi five-jointed, the proximal joint nearly as long as the others combined.

Male.—Unknown.

Described from two females reared by the writer from an undescribed whitefly, *Aleuroplatus* sp., on Haitian oak, *Catalpa longissima*, at Damien, Haiti, Nov. 1, 1929, and four females from the same host and locality, March 16–19, 1931. The type female on slide is deposited in the collection of the U. S. National Museum. Type No. 44820.

Coccophagus ochraceus Howard.

Howard, U. S. Dept. Agr., Div. Ent. Tech. Bul. No. 1, p. 38, 1895.

A male and a female reared by the writer at New Orleans, La., Jan. 14, 1932, from oleander infested with *Saissetia oleae* and *Aspidiotus* sp., are undoubtedly this species which has heretofore been known only from California and South Africa, as a primary parasite of the Black Scale.

Prospaltella diaspidicola Silvestri.

Silvestri, Reale Accad. dei Lincei, vol. 18, p. 564, 1909.

The writer reared this parasite from *Aulacaspis pentagona* on papaya fruit at Port-au-Prince, Haiti, July 14, 1930, in small numbers. It was first described from Italy and Gahan (Proc. U. S. Nat. Museum, vol. 65, p. 14, 1924) states that it is now known from South Africa, Japan and Brazil from the same host. The writer reared the same species from *Aulacaspis pentagona* at Rio Piedras, Porto Rico, in 1925. Repeated rearing attempts in both Porto Rico and Haiti failed to show the presence of *Prospaltella berlesei* Howard and this useful parasite should be introduced against *Aulacaspis pentagona* which incrusts the trunks of papaya, oleander, mulberry and many other shrubs and vines in those islands.

Physcus uvae, new species.

A very distinctly colored West Indian species.

Female.—Length, including ovipositor, 0.746 mm.; expanse 1.16 mm. greatest width of forewing 0.215 mm. General color dark brown to black, the abdomen yellowish with the lateral margins outlined with fuscous; antennae pale yellowish-white, the basal half of the scape fuscous; legs entirely pale yellowish. In balsam-mounted specimens a narrow median line on the prescutum and scutellum and the inner portion of the scapulae appear lighter colored.

Under high magnification, the vertex appears scaly-reticulate, the prescutum without reticulation, and the scutellum longitudinally reticulate. Eyes minutely setose. Anterior margin of vertex with a number of rather coarse black hairs; prescutum with coarse sparsely placed setae; scutellum with a prominent pore and a pair of slightly longer and stouter setae on each side. Antennae seven-jointed, composed of long, slightly compressed scape, pedicel, three funicle joints, each twice as long as wide, the third being slightly longer and wider than the first two, and a two-jointed club which tapers to a point. Forewings hyaline, with short marginal fringe and the disk covered rather uniformly with cilia. Abdomen as long as the thorax and about equal in width, the ovipositor rather short but distinctly exserted. All tarsi five-jointed.

Male.—Length 0.516 mm.; expanse 1.06 mm.; greatest width of forewing 0.186 mm. Distinguished at once from the female by its eight-jointed antennae, distinctly smaller size, and the head and entire body are dark brown-black. The legs are soiled testaceous, the front and hind femora lightly shaded with brown. In the male the club is not differentiated from the funicle; the joints are all subequal in length and width, with numerous longitudinal sensoria; the apical joint tapering to point.

Described from a series of 37 females and 3 males, mounted in balsam on ten slides, reared from *Aspidiotus lataniae* on grape vine at St. Marc, Haiti, August 20, 1931. U. S. Nat. Museum No. 44821. The host scale was very abundant on the stems and foliage of grape vine on porch of hotel and apparently killing it. A few specimens of *Marietta busckii* (Howard) issued at the same time and are probably secondary on the *Physcus*.

ENCYRTIDAE

Paracalocerinus marilandia Girault.

Girault, Chalcidoidea Nova Marilandensis, p. 1, May 21, 1917 (Privately published).

This species fits perfectly in Mercet's genus *Masia*, which Timberlake states is a synonym of *Paracalocerinus* Girault. It is very closely allied to the European *Paracalocerinus pulchripennis* (Mercet).

Female.—Length, exclusive of ovipositor, 1.29 mm.; expanse 2.09 mm.; greatest width of forewing 0.25 mm. General color of balsam-mounted female is brownish, possibly with metallic reflections in life; the antennae entirely grayish-brown; legs concolorous with the antennae except for the more yellowish front and middle femora, the distal fifth of the middle tibiae, and pale first four joints of the tarsi; distal joint of all tarsi, black. Venation grayish. Forewings hyaline, with a wide band across the middle covering the area in which the oblique hairless streak lies and nearly the entire distal third, brown; this gives to the forewings the appearance of being twice-banded. Ovipositor brown.

Head convex and rounded in front. Eyes large, oval, and hairless. Mandibles apparently bidentate, the maxillary palpi four-jointed, and the labial palpi three-jointed. Under high magnification, all dark portions appear scaly-reticulate. Antennae inserted near the mouth, very broad and flattened, composed of nine joints, the club solid and very conspicuous; scape long and slightly compressed, equalling the combined length of the first five funicle joints, reticulated; pedicel subtriangular, short; the six funicle joints much flattened, distinctly wider than long, enlarging to the apex; the first funicle decidedly narrower than the others: the second funicle joint is slightly longer than the other joints, which are all subequal in length; the club is elongate-ovoid in shape, solid and very distinctive, widest at base and rounded at tip; with a longitudinal raised conspicuous ridge running along the lower portion of the club and this portion to the posterior margin, under high magnification, appears pebbled like pig skin; funicle and club furnished sparsely with very short, irregularly placed sensoria; antennae setose, those of the club being distinctly shorter and more numerous. Forewings long and narrow, the marginal cilia short, those along the outer lower margin being the longest; an oblique hairless streak present beneath the marginal vein; the discal setae are very dark and prominent on the banded portions but are almost transparent across the middle and basal portions, giving to these the appearance of being hyaline and hairless. Distal end of front tibia furnished with curved strigil and an oblique pectinate row of spines; first joint of front tarsi with an oblique row of pectinate spines running diagonally across; middle tibiae furnished with a number of much larger and thicker distal spines and the first tarsal joint has a number of stout but transparent spines along its inner margin; the hind tibiae somewhat flattened, with conspicuous heavy spines along the inner margin. Ovipositor strongly exserted.

Male.—Unknown.

Above description made from a single female collected by the writer sweeping and beating near Waukegan, Illinois, July 4, 1932. Mr. Gahan has kindly compared this specimen with the unique type in the U. S. National Museum and states that it differs from the type by having somewhat broader wings but the same coloration, and that the wings of the type are obviously not fully developed.

Euaphycus portoricensis Dozier.

Dozier, Proc. Ent. Soc. Washington, vol. 28, no. 5, May 1926, p. 101.

A male and female of this species were reared by the writer from *Asterolecanium pustulans* on fig at Port-au-Prince, Haiti, Nov. 21, 1929, and a female from the same host on "Flamboyante" at Damien, Haiti, April 16, 1930. The species was originally described from the same host scale in Porto Rico. Although a special attempt was made, no specimens of the more important primary, *Mercetiella reticulata* Dozier, of Porto Rico, were obtained by the writer in Haiti.

MYMARIDAE

Polynema longipes Ashmead.

Ashmead, Canadian Entomologist, vol. XIX, p. 192, 1887, *Ooctonus*.

A female collected by the writer on window of the Experiment Station at Newark, Delaware, August 9, 1927, agrees well with material in the U. S. National Museum and also with a slide in the Illinois Natural History Survey collection, labeled Centralia, Ill., Aug. 25, 1909. The scape is distinctly flattened and broad, and is pale in color. A series of two females on window at Newark, Delaware, July 30 and Aug. 6, 1927, one female from Wilmington, Del., June 30, 1927, and a female taken sweeping shrubbery at Magnolia, Del., Aug. 24, 1927, were at first thought to be different due to their smaller size and narrower scape and pedicel but are undoubtedly the same species.

Polynema mymaripennis, new species.

Differing from all other described species of the genus in the peculiar shape of the forewings, resembling somewhat superficially those of the genus *Mymar*.

Female.—Length, including ovipositor, 0.459 mm.; expanse 1.15 mm.; greatest width of forewing .086 mm. Head, thorax and abdomen light brown in color, the latter palest at base; petiole and legs pale testaceous; antennae light brown, the scape and pedicel pale.

Scape twice as long as greatest width, rather broad and distinctly compressed; pedicel short, only half as long as the scape, and about the same width; first funicle joint very short, the shortest about a third as long as the pedicel; the second funicle distinctly the longest, slightly narrower than and three and a half times as long as the first; third funicle nearly as long as the second and same width; fourth funicle only a half as long as the second; the fifth and sixth subequal in length and about twice as long as the very short first funicle, successively wider; the club very large and conspicuously stout, equal in length to that of the last three funicle joints combined, twice as wide as the greatest width of the scape, solid, with three very short sensoria present at apex. Forewings barely perceptibly smoky, becoming completely hyaline around the outer posterior border; reminding one of the forewings of members of the genus *Mymar* and *Neomymar* in outline; rather long and slender, the posterior border irregular in outline; marginal fringe unusually long and conspicuous, the cilia along the outer posterior margin being distinctly the longest, about twice as long as the greatest width of the forewing; with a clear path at the base of the fringe; discal cilia covering the entire disk except for very narrow, clear space along the outer posterior border. Petiole only one-third as long as the abdomen. The ovipositor rather short but distinctly exserted. All tarsi four-jointed.

Male.—Unknown.

Described from a single female collected by the writer on Experiment Station window at Newark, Delaware, Aug. 6, 1927.

Camptoptera brunnea, new species.

Next to *C. minutissima* Dozier from Haiti in size but readily distinguished from all described species by the extremely long, brown scape and the short, brown first funicle joint. Very close to *C. foersteri* Girault described from Germany.

Female.—Length 0.287 mm. General color brown, the antennae concolorous with the body except the pale pedicel; legs pale brownish.

Antennae elbowed, long and slender, nine-jointed with the additional ring-joint; scape extremely long and slender in comparison with the other described species, about four times as long as the pedicel; pedicel short; serrate, over twice as wide as the scape; first funicle short for the genus, subequal in length to the pedicel; ring-joint distinct; second true funicle joint twice as long as the first, distinctly the longest joint of the funicle; the third, fourth, fifth and sixth subequal in length, each increasing slightly in width; club solid, distinctly wider than the funicle, about three times as long as the last funicle joint, subcylindrical ovate. High magnification does not show the lineate appearance of the prescutum and scutellum that is found in *C. minutissima* Dozier. Forewings typical for the genus, being slender, distinctly dilated along the caudal margin at basal third, then narrowed, followed by a gradual widening outwards, distinctly bowed or curved on the apical third; furnished with a complete fringe of long marginal cilia, interrupted by the usual clear path near their base around the margin; a double longitudinal row of minute setae follow around the margins of the wing with a third median row on the disk. Petiole short, not barbed as in *C. pulla* Girault. The abdomen in the single specimen is twisted and therefore it is impossible to state its form accurately. Legs normal, with five tarsal joints, the first and last of which are slightly longer than the other joints.

Male.—Unknown.

Described from a single female taken by the writer on the Experiment Station window at Newark, Delaware, August 12, 1929. Type retained in author's collection.

TRICHOGRAMMATIDAE

SUBFAMILY CALESINAE MERCET.

Cales noacki Howard.

1907 Howard, U. S. Bur. Ent., Tech. Ser. Bul. 12, pt. 4, p. 82.
1915 Brethes, Nunquam otiosus, p. 15, *Diaspidophilus pallidus*.
1928 Stuardo, Rev. Chilena Hist. Nat., vol. 32, pp. 154–156.
1929 Mercet, E. O. S., Rev. Esp. de Entomologia, vol. 5, pp. 114–117, *C. pallidus*.

The writer reared four females from *Aleurothrixus* n. sp. on "Amandier à petites feuilles," *Prunus myrtifolia*, in association with *Eretmocerus paulistus* Hempel and *Prospaltella brasiliensis* (Hempel) at Kenskoff, Haiti, Nov. 5, 1929; four females from *Aleurothrixus floccosus* (Maskell) on foliage of young mahogany seedlings at Cote Plage, Haiti, June 21, 1930, in association with *Eretmocerus paulistus;* three females and two males from *Aleurothrixus* n. sp. on *Catalpa longissima* at Damien, Haiti, March 21–23, 1931; 15 females and 22 males from *Aleurothrixus floccosus* on young mahogany foliage at Port-au-Prince, Haiti, June 18–19, 1931; and 9 females and 5 males reared from lime foliage infested with *Aleurocanthus woglumi* Ashby and *Parlatoria zizyphus* at Port-au-Prince, Haiti, June 18–19, 1931.

This material agrees with the description of *C. pallidus* (Brethes) but specimens compared by Mr. Gahan with the unique female type of *Cales noacki* Howard from Brazil show no specific differences. The species is not very abundant and is most probably a secondary parasite.

SIGNIPHORIDAE

Thysanus unifasciatus (Ashm.).

Ashmead, Proc. U. S. Nat. Mus., vol. 22, p. 410, 1900, *Signiphora*.

Three females were reared by the writer from nymphs of the pit-forming psyllid, *Ceropsylla sideroxyli* Riley, on "Bois comat," *Sideroxylon foetedissimum*, at Tapion Hill, Haiti, Feb. 19, 1930. This material was compared with the unique female type in the U. S. National Museum, reared from the same host at Georgiana, Florida. The distinct narrow yellow band across the base of the scutellum at once distinguishes this species from *T. noacki* (Ashm.), the only other known psyllid-infesting *Thysanus*.

Thysanus insularis, new species.

Belongs to the *flavopalliata* group. Very close to *Thysanus fax* (Girault) but the type of that species is shorter and more compact, with the abdomen not over one and a half times as long as broad, broadly rounded at the apex, the legs distinctly darker, and the head a somewhat darker yellow than is the case with *insularis*.

Female.—Length 0.516 mm.; expanse 0.72 mm.; greatest width of forewing 0.158 mm. Small for the genus. General color dark brown, the head lighter, the lower half of the prescutum and scutellum being distinctly lemon yellow; antennae light brown except the pale scape; legs entirely pallid yellowish-white; eyes dark red. The forewings hyaline at base wth smoky cross band out to the end of the venation.

Antennae six-jointed, the club rather elongate, measuring .086 mm. in length, four times as long as its greatest width, twice as long as the pedicel. Marginal fringes of the forewing moderate in length, longest along the apical margin, there being about as long as the greatest width of forewing. Oblique crease of forewing only very faintly indicated; pale discal bristle present. The endophragma prominent, deep and broad, extending back into the abdomen for half the length of the latter. General form rather elongate, the ovipositor only shortly exserted.

Male.—Unknown.

Described from six females, reared by the writer from *Lepidosaphes alba* (Ckll.), Jan. 27–29, 1930, at Damien, Haiti, in association with *Aphytis fuscipennis* (Howard), *Thysanus maculatus* (Girault), and *Aphytis limonus* (Rust), and most probably secondary on the last named parasite.

The type female on slide in balsam is deposited in the U. S. National Museum collection. Type No. 44818.

Thysanus maculatus (Girault).

Girault, Proc. U. S. Nat. Mus., vol. 45, p. 221, 1913, *Signiphora*.

Large numbers reared from the Manioc Scale, *Lepidosaphes alba* (Ckll.), Jan. 27–29, 1930, on *Manihot cassava* at Damien, Haiti, in association with the primary parasites *Aphytis fuscipennis* (Howard), *Aphytis limonus* (Rust), and *Thysanus insularis*. *T. maculatus* (Gir.) is most probably secondary on *Aphytis fuscipennis*. Of the 24 specimens mounted on slides, all proved to be females. The species was originally described from 18 females reared from the same host in Cuba.

The *Aphytis* spp., upon issuing, were very active but both of the species of *Thysanus* refused to leave the heavily incrusted manioc branches although these were roughly handled on purpose. Nothing but a sudden jarring would dislodge them and interrupt their work of ovipositing.

Thysanus magniclavus, new species.

A very robust species that is distinguished at once from all described members of the genus by its large conspicuous club. Apparently belongs to the *flavopalliata* group but closely related to *T. bifasciatus* (Ashm.).

Female.—Length, including ovipositor, 0.60 mm.; expanse 1.06 mm.; greatest width of forewing 0.143 mm. General color of balsam-mounted specimen dark black brown with a narrow pale yellow band between the wings; antennae entirely brown; forelegs light brown, the three middle tarsal joints pale; middle legs pale yellowish, the first four tarsal joints pale; hind femora yellowish, the tibiae brown, lighter at distal tip, the first four tarsal joints pale. Forewings smoky out to the end of the stigmal vein; oblique crease and discal bristle present; broad, the marginal fringe comparatively short, the longest cilia being about one half as long as the greatest width of the forewing. Antennae short and stout, the club slightly less than three times as long as the greatest width, measuring 0.10 mm. in length and greatest width 0.036 mm.; width of club about equal the length of the pedicel; scape five times as long as wide, compressed. Abdomen robust, the ovipositor distinctly exserted.

Male.—Unknown.

Described from a single female taken by the writer sweeping grass, weeds and shrubbery at Port-au-Prince, Haiti, May 3, 1931, mounted in balsam on slide.

Thysanus louisianae, new species.

Closest allied to *T. townsendi* (Ashm.) but differs distinctly in the less curved wing venation and the abdominal coloration.

Male.—Length, exclusive of oedeagus, 0.473–.545 mm.; expanse 0.717–.803 mm.; greatest width of forewing 0.086 mm. Belongs to the *flavopalliata* group as defined by Girault. A medium sized species. General color sooty brown, with a wide lemon yellow band across the thorax, including the lower fourth of the prescutum, the scutellum, the entire metanotum and propodeum; a band across the distal third of the abdomen and the tip of abdomen, yellow; antennae and legs pale brown except the pale proximal four tarsal joints. Forewings hyaline with a very distinct broad smoky cross band, the infumation extending slightly beyond the stigmal vein and faintly maculated on outer lower portion; a deep median hyaline emargination or clear area on the inner margin of the cross band; oblique crease distinct; discal bristle absent; marginal fringe long and slender, the longest cilia being slightly longer than the greatest width of the forewing. Antennal club of medium length, measuring 0.086 mm. in length and slightly less than twice as long as the pedicel.

Female.—Unknown

Described from four males, reared by the writer from *Aspidiotus lataniae* (det. by Dr. H. Morrison as *not typical*) incrusting oleander twigs at New Orleans, La., Jan. 14, 1932, in association with a few *Prospaltella* sp.; and seven males reared from similar material at same place Sept. 24–25, 1932. The species varies considerably in degree of yellow coloration and with some specimens the legs are pale yellowish brown.

The type male and a paratype male on single slide is deposited in the U. S. National Museum collection. Type No. 44819.

SOME OBSERVATIONS ON THE LIFE HISTORY AND PARASITES OF HYPERA RUMICIS (L) (COLEOPTERA : CURCULIONIDAE).[1]

By T. R. Chamberlin,
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This interesting weevil first came to the attention of the staff of the Forest Grove, Oreg., laboratory in June, 1924, when L. P. Rockwood swept it from dock (*Rumex crispus*) in an alfalfa field near Redmond, Oreg., while scouting for the alfalfa weevil (*Hypera postica* Gyll.). Since that time it has been taken from dock near Gaston and Lebanon, Oreg., and a few specimens taken as early as 1914 at Forest Grove have been found in the laboratory collection. The rearing of parasites from various collections of larvae since 1930 has brought out several new facts which are of economic importance because of the close relationship of the weevil to several more distinctly economic species.

The weevils swept by Rockwood at Redmond, as well as those taken earlier at Forest Grove, were determined by F. H. Chittenden as *Hypera rumicis* (L.), and other specimens reared more recently were determined by L. L. Buchanan as the same species.

LITERATURE.

There are few references to (*Phytonomus*) *Hypera rumicis* in the literature of economic entomology in the United States for the last 50 years, or in Europe for the last 18 years. In 1879 Osborne (*7*) described cocoons formed by *Hypera rumicis* and by two ichneumoid parasites of the larva. His description of one of the latter corresponds to that of the *Bathyplectes* parasite reared by the writer from Oregon material. In 1882 Riley (*8, p. 171*) wrote that "Ph.[ytonomus] *rumicis* Fabr. [feeds] upon various species of Rumex and also *Polygonum aviculare*." In 1909 Webster (*14*) mentioned *H. rumicis* as occurring along the coast of Massachusetts, but according to Titus (*12, p. 432–433*), who apparently examined the specimens seen by Webster, the species concerned was *P. maritimus* Titus. Shøyen (*10*) in 1916 wrote that *Phytonomus rumicis* attacked the leaves of barley in Finland without causing any serious injury. In 1923 Buchanan (*2*) stated that *Phytonomus rumicis* feeds upon *Rumex* and *Polygonum amphibium* in Europe, that it was found

[1]Acknowledgment is made to L. P. Rockwood, under whose general supervision the work was done, for criticism of the manuscript and assistance in the field work and in many other ways; to L. L. Buchanan for determination of the weevil; to A. B. Gahan, R. A. Cushman, and C. F. W. Muesebeck for determinations of the parasites; and to Helen Gilkey, of the Oregon State Agricultural College, for assistance in the determination of the host plants.

in considerable numbers on a patch of *Polygonum* near Iowa City, Iowa, in May, 1917, and at Edmonton, Alberta, in 1919. He also mentioned that one specimen was found in the stomach of an upland plover (*Bartramia longicauda*) collected at Gronna, N. Dak., May 25, 1912. In 1925 Hukkinen (*5, p. 49*) reported *H. rumicis* feeding on rhubarb in northern Finland. Jenkins (*6*) in 1926 recorded the weevil as being found on red clover in Wales, where it probably occurred accidentally. In 1932 the insect was found attacking sorrel grown for seed in Connecticut (*15*).

OCCURRENCE IN OREGON.

In Oregon the species has not been found feeding upon any of the cultivated crops or upon *Polygonum*. It was common on *Rumex crispus* L. at Redmond in June, 1930, 1931, and 1932, and less common on *R. crispus* near Lebanon in 1932, and on *R. crispus* and *R. mexicanus* Meisn. at Gaston in 1931 and 1932. When *R. crispus* and *R. mexicanus* occurred together, it was more plentiful on *R. crispus*.

The weevil is most common on dock in wet meadows or in wet places along roadsides. One meadow in which it is known to occur is frequently under water in winter and early spring, and recently it was covered with water for several weeks. At Redmond the weevil is often found in alfalfa fields that are subject to heavy irrigations and especially in old fields where the alfalfa is thin and the dock abundant. Infestation throughout the districts in which it occurs has been spotted and at Redmond many fields that seem to offer a favorable environment contain few or no weevils.

LIFE HISTORY.

Most of the observations on the life history of *Hypera rumicis* have been made on specimens reared or bred in the laboratory at Forest Grove.

The freshly laid egg is pale yellow, short elliptical in outline, and slightly more than 0.5 mm. in length. Eggs are usually placed beneath the epidermis of the leaf in masses of from 1 to 32 eggs each. This produces upon the surface of the leaf characteristic blister-like swellings more or less circular in outline and varying in color from yellowish green to brown, blackish green, or black. Most of the masses contain from 2 to 6 eggs each, the mass of 4 eggs occurring with greatest frequency although the total number of eggs in masses of 5 slightly exceeds that in masses of 4. In the larger masses there is often a variation in the color of the eggs, an indication that they are of different ages and represent different ovipositions. Eggs are occasionally laid in pits in the stems, petioles, or midribs of the leaves or upon the outside of various parts of the plant.

If fertile, the eggs change in color from lemon yellow to black within 1 to 3 days. Under laboratory conditions in August eggs hatched in 4 to 7 days. In an incubator, where the temperature was 65 F. and the humidity ranged from 70 per cent at night to 80 per cent in the day, the incubation period was between 7 and 11 days, most frequently 9 days.

The larva is similar in form and structure to other species of *Hypera* known to the writer. When newly hatched, it is dirty yellow and has a black head. The full-grown larva is about 8 mm. long. The head is black; there is a dull green stripe down the middle of the back and one down each side beneath the spiracles; the rest of the dorsum is dull blackish green. Under the binocular microscope the black color is seen to be located in minute skin-granules which are closely and evenly distributed over the surface except in the dull green stripes. In the later stages a distinct reddish-brown color often predominates over the usual green, but as the black in the pits is unchanged the larva presents a dull reddish-brown appearance. In the first stage this species may be confused with larvae of *H. postica*, *H. punctata*, or *H. nigrirostris*. In the later stages it can easily be distinguished from those species by the suffused fuscous color on the integument, which gives to both greenish and reddish larvae a smudged or dirty appearance.

Most of the larvae in the field feed beneath the epidermis of the leaves in groups which probably represent the hatch from individual clusters. If larvae are numerous in a leaf, they completely mine it, leaving nothing but the epidermis, which soon turns brown and dries up. Some larvae, especially after they have attained fair size, may leave the leaves and feed elsewhere. In such cases they are usually found in the flower heads. Occasionally a large larva may tunnel into a stem and feed in the center of it.

In an incubator (temperature 65° F., humidity 70 to 80 per cent), where the larvae were kept in shell vials or glass-topped salve boxes and fed clippings from dock plants every day or two, they attained medium size in from 5 to 9 days and large size in from 8 to 14 days. The variation in time required for development appears to be due in large part to feeding conditions. It is probable that if growing plants could have been provided the beetles for oviposition and the larvae for development, there would have been less variation.

Cocoons of *H. rumicis* are frequently made inside the leaves, but they are also found in the trash about the crown of the plants or among the green seeds of the heads. These cocoons are reticulate in structure and loosely woven, especially if they are spun inside the leaves. They are short ellipsoidal or globular in form. The typical ellipsoidal cocoon is approximately 5 mm. in length and 3.5 mm. in width, the globular cocoon approximately 5 mm. in diameter. The color is usually reddish-brown, but it may show any variation between this and dull white. Apparently the reddish-brown larvae spin more highly colored cocoons than do the dull-colored larvae. Under laboratory conditions in August cocoons were spun in from 8 to 13 days after hatching from the egg and at 65° F. in from 11 to 16 days. Prepupae remained as such in cocoons for from 1 to 6 days.

Pupation took place in from 10 to 15 days after the hatching of the egg under laboratory conditions in August and in 12 to 18 days in the incubator at 65° F. Pupae also remained in cocoons from 1 to 6 days. The pupae, like the mature larvae, vary in color from dull blackish-green to reddish-brown.

In the laboratory in August adults issued from cocoons in from 18 to 23 days after hatching from the egg and in an incubator at 65° F. in from 20 to 25 days. Since the eggs are known to hatch in as short a time as 4 days and in as long a time as 11 days, the minimum time between the oviposition and emergence of the adult is 22 days and the maximum 36 days. Were ideal conditions for hatching of the eggs and rearing of the larvae known, and could they be provided, very likely the minimum period would be shorter.

The adult *H. rumicis* is not likely to be confused with other species of *Hypera* that are commonly swept in clover or alfalfa fields in Oregon, with the exception of *H. postica*. *H. punctata* is much larger, 6 to 8 mm. in length. *H. nigrirostris* is smaller, 3 to 3.5 mm. in length,[2] and in thoroughly hardened but unrubbed specimens the dorsum is more or less colored by iridescent bluish-green scales which are cleft to the base. It is more difficult, in field examination, to distinguish *H. rumicis* from *H. postica*.

Hypera rumicis is, on the average, smaller than *H. postica*. In a collection of the former at the Forest Grove laboratory the length ranges from 3.2 to 4.5 mm. and averages 3.86 mm. In a group of *H. postica* of average or slightly below average size, the length ranges from 3.8 to 4.7 mm. and the average is 4.34 mm.; in another group, consisting of specimens obviously larger than normal, the length ranges from 4.5 to 5 mm. and the average is 4.85 mm. As a rule *H. rumicis* presents a more mottled appearance in black and gray or grayish-brown than does *H. postica*, and in hardened but unrubbed specimens the color of the body tends to be definitely black, instead of brownish as

[2]Titus (*12, p. 445*) gives the length of *Hypera nigrirostris* as 3.5–4.5 mm. and these figures have been repeated by others (*1, p. 151, and 13, p. 5*). Oregon specimens have not averaged so large as this.

is the case with *H. postica.* Other differences can be seen on closer examination. In *H. rumicis* the scales are truncate, broadly rounded, or very slightly emarginate at the tip; the bristles on the elytral intervals are sparse, short, and inconspicuous; there are no erect setae in the strial punctures;[3] the eye is short, elliptical, less than twice as long as broad; the front is square, almost as broad as the base of the beak, and seen from above is broader than the eye; the beak, which is as long as the thorax, broadens gradually from the base to the tip, as seen from above; the scape does not attain the eye. In *H. postica* the scales are hairlike, cleft two-thirds of their length; the bristles on the intervals on the dorsum are long and conspicuous; short setae are present in the strial punctures; the eye is long, elliptical, twice as long as broad; the front is oblong, distinctly narrower than the base of the beak, about one-half the width of the beak at its broadest part, scarcely as broad as the eye; the beak as viewed from above is parallel-sided except at the base, and is shorter than the thorax; the scape attains the eye.

On issuing from cocoons in the laboratory in July and August, adult *H. rumicis* feed rather heavily on the dock for several days and some of them even as long as several weeks. There has always been a heavy mortality during this period. After feeding, most of the weevils become inactive and lie concealed in the foliage or trash in the cages. Some of them become active again in the fall and feed a little, but they do not lay eggs at this time and most of them die before winter.

Among the weevils reared from material collected at Redmond there were, each summer from 1930 to 1932, inclusive, some females that did not cease feeding or aestivate, but began laying eggs as early as 19 days after removal from the cage. It is probable that some of these individuals issued from their cocoons several days before they were removed, but it is known that 30 days before eggs were laid there were no adults in the cage and only a little over one-half had spun up. Adults of this second generation have been obtained as early as August 28 from eggs laid by females issuing the first week in July. As far as is known to the writer, this is the first record among the species of the genus *Hypera* of a complete second generation in one season.

No eggs have been obtained in the fall from second-generation weevils, but when weevils were brought to the laboratory from a hibernacle late in February, egg laying began on March 7. From three females of this generation 1,197 eggs were obtained, one individual laying 666 eggs.

[3]According to Titus (*12*, *p. 395* and *417*) and Blatchley and Leng (*1*, *p. 148–149*) *Hypera compta*, a closely related species, has no setae (bristles) on the dorsum and according to Titus none in the strial sutures.

SEASONAL HISTORY.

Very few eggs of *Hypera rumicis* have been collected in the field, largely because heavily infested fields have not been examined at the proper time. At Redmond egg laying is probably at its height about May 1, since small larvae are abundant by the middle of the month. Egg laying must be more or less prolonged, for some newly hatched larvae were found late in June when most of the larvae had become large or had spun up. In July and August it is difficult to find adults by sweeping or by examining plants or surface material, presumably most of them are aestivating. In August, 1930, a careful search was made for evidence of a second generation in the field, but none was found.

PARASITES.

Bathyplectes exigua (Grav.).[4]—This species appears rarely as a parasite of *Hypera rumicis*. From a large number of larvae reared from 1930 to 1932, inclusive, only two cocoons of *B. exigua* were obtained. A female issued from one of these. These cocoons came from larvae collected at Redmond in 1930, practically all of which were taken from the flower heads of the dock, where they were feeding in a rather exposed position. In 1931 and 1932 most of the larvae came from the inside of the leaves. The usual host of *B. exigua* is *Hypera nigrirostris* (*9*), which feeds in a concealed position in the heads of clover but not completely within the tissue of the plant. It is possible that *B. exigua* will not oviposit in larvae concealed within plant tissue and that it only attacks *H. rumicis* when this weevil is feeding upon the outside of the leaf or stem or among the green seeds of the head. Since *H. nigrirostris* occurs at Redmond and is parasitized there by *B. exigua*, it is assumed that it is the main source of the parasites infesting *H. rumicis*.

Habrocytus n. sp.[5]—Two specimens of a species of *Habrocytus* have been reared from cocoons of *H. rumicis*. Examination of the weevil cocoons from which they issued showed that they were primary parasites which had fed externally upon the spun-up host.

Dibrachoides dynastes (Foerst.).—A few cocoons from a small lot collected on June 13, 1932, near Gaston, Oreg., were parasitized by this parasite of *H. postica* in Europe (*4*, *11*) and of *H. nigrirostris* in the Pacific Northwest (*9*). Its larva feeds externally upon the spun-up host.

Spilochalcis delumbis (Cress.).[5]—In the same lot of cocoons from which the *Dibrachoides* came was found this species of

[4]Determined by R. A. Cushman, of the U. S. Bureau of Entomology.

[5]Determined by C. F. W. Muesebeck, of the U. S. Bureau of Entomology.

Spilochalcis. It is a solitary internal parasite of the pupa and it parasitized one-third of the lot. From small lots of cocoons collected in the same locality on June 5 and 8, 1931, no parasites were reared.

Necremnus n. sp.[6]—Up to the present, the most important parasite of this weevil has been this small eulophid. It is an external parasite of the prepupa and pupa and has been abundant at Redmond from 1930 to 1932, inclusive. It also occurs at Lebanon and at Gaston. It has been found infesting cocoons collected from surface trash, the base of plants, the flower heads, and the inside of the leaves. The number of parasites per host in field-collected material has ranged from 1 to 16. Prepupae seem to be parasitized more commonly than pupae.

It is difficult to determine the extent of parasitization in the field, since many cocoons are inside the leaves and some of them are invariably broken up during the search for the parasites. It has also been necessary to carry the material to the laboratory in the leaves before it could be examined, and many of the cocoons in the final counts have been spun after the material was removed from the field and these had no chance of becoming parasitized. In a lot of 172 cocoons obtained from dock leaves collected at Redmond in June, 1932, and examined five days later, 41, or 23.8 per cent, were parasitized. Probably one-half of these cocoons were spun after the material had been removed from the field. If so, the original parasitization of cocoons spun in the field was almost 50 per cent.

In habits the species seems to be similar to *Necremnus leucarthros* (Nees), a parasite of *H. postica* in Europe. However, although the writer was able to breed *N. leucarthros* back upon its host in the laboratory (*3*), he has not been successful in so doing with the species under consideration. It is a hardy and long-lived parasite and it seems probable that some individuals issuing in July could live through the summer and fall and enter hibernation before reproducing. Of a large lot of adults reared late in June and early in July, 1932, a few were still alive on November 5, 1932.

SUMMARY.

Hypera rumicis (L.), a weevil closely related to the alfalfa weevil (*H. postica* Gyll.), has frequently been taken in alfalfa fields containing dock near Redmond, Oreg., and has been taken from dock near Lebanon and Gaston, Oreg. In the literature there are scattered references to its occurrence in this country, in Europe, and in Canada.

This insect lays eggs in masses of from 1 to 32, placing them usually beneath the epidermis of the leaf, but occasionally upon

[6]Determined by A. B. Gahan and C. F. W. Muesebeck, of the U. S. Bureau of Entomology

other parts of the plant. Under laboratory conditions in August the eggs hatch in from 4 to 7 days, in from 8 to 13 days later the larvae have become full grown and spun cocoons, pupation takes place in from 10 to 15 days after hatching, and the adults issue in from 18 to 23 days. In an incubator at 65° F. and 70–80 per cent humidity the eggs hatch in from 7 to 11 days, the larvae become large in from 8 to 14 days later, and spin cocoons in from 11 to 16 days after hatching, pupation takes place in from 12 to 18 days, and the adults emerge in from 20 to 25 days. The minimum time between oviposition and emergence of the adult is 22 days and the maximum 36 days.

The eggs are yellow when first laid, but in from 1 to 3 days they turn black. The newly hatched larvae are dirty yellow with black heads, but when full grown they have a dull green, or occasionally a dull reddish-brown, appearance. They then spin loosely woven ellipsoidal or globular cocoons, usually reddish-brown. The pupae also vary in color from dull green to reddish-brown. The adult averages 3.86 mm. in length, and is black and gray or grayish-brown with a mottled appearance.

Adults issuing in August feed rather heavily for a while and then become inactive. There is a heavy mortality during this period. Some of the survivors may become active again in the fall, but they do not lay eggs before winter. A few of the female weevils issuing the first week in July, however, were found to lay fertile eggs in about 19 days after issuance. Adults of the second generation were obtained as early as August 28, but no eggs were obtained from these weevils in the fall. Apparently this is the first record in the genus *Hypera* of two complete generations in one season.

At Redmond, Oreg., egg laying is probably at its height about May 1, as small larvae are abundant about the middle of the month. In July and August few weevils are found in the fields, presumably because most of them are aestivating.

Five species of parasites have been reared, namely, *Spilochalcis delumbis* (Cress.), *Habrocytus* n. sp., *Necremus* n. sp., *Bathyplectes exigua* (Grav.), and *Dibrachoides dynastes* (Foerst.). The last two species have been reared previously from *Hypera nigrirostris* in the Pacific Northwest and the last from the alfalfa weevil in Europe as well. *Necremus* n. sp. is similar in habit to *N. leucarthros* (Nees.), a parasite of the alfalfa weevil in Europe.

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A NEW SPECIES OF SARCOPHAGA INHABITING NESTS OF PAPER WASPS.

By David G. Hall Jr., *U. S. Bureau of Entomology*, *Savannah*, *Ga.*

Sarcophagid larvae inhabit the nests of several species of Polistes or paper wasps, and during the past few years they have been collected rather frequently. Of the species reared from larvae collected in such nests and forwarded for determination, the following is described as new, and a figure of the male genitalia is given.

Sarcophaga polistensis, n. sp.

Male.—Head; front, 0.200 of head width, average of 4 specimens (0.203, 0.190, 0.200, 0.207); parafrontals and parafacials yellowish and golden pollinose, the latter with a row of several small bristles below near eye; frontal bristles about 9 in number, diverging below to about the middle of the second antennal joint; orbital bristles absent; outer vertical bristles absent; antennae yellowish, third joint 2½ times the length of second, reaching almost to the vibrissae which are slightly above the oral margin; arista with medium length plumosity for 3/5 its length; palpi yellow, proboscis black, both ordinary; bucca 1/3 the eyeheight, with both black and pale hairs before the metacephalic suture; back of head with 2 rows of post-ocular ciliae, around the middle and below with pale hairs.

Thorax; yellowish-gray pollinose, with the normal 3 to 5 black stripes; anterior achrostical bristles absent; posterior dorsocentral bristles 4; sterno-

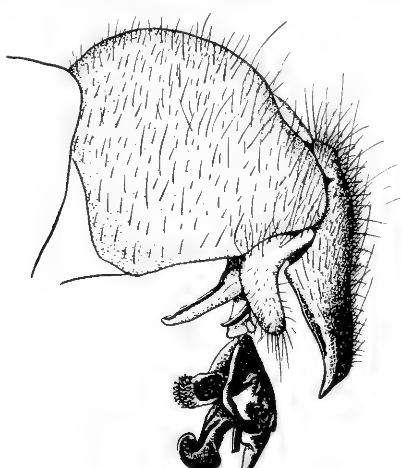

Fig. 1. *Sarcophaga polistensis* n. sp. Left lateral view of genital composite.

pleural bristles 3; prescutellar bristles 1 large pair. Scutellum with 2 marginal bristles, 1 preapical bristle and with 1 apical bristle.

Abdomen tessellated with 3 shifting black stripes; median marginal bristles on the third segment; fourth segment reddish with a marginal row of about 14 bristles.

Hypopygium small; first segment red, with short hairs and a marginal row of about 6 small bristles; second segment red and with long hairs. Genital features as illustrated in figure 1.

Wings hyaline; costal spine absent; third costal segment as long as fifth and sixth together; first vein bare; third vein with several setulae.

Legs black; middle femur with comb; middle tibia with 2 anterodorsal bristles and without villosity; hind tibia with distinct villosity.

Female.—More golden than male; scutellum without apical bristles; median marginals on third segment depressed. Otherwise as described above, except in the usual female differences.

This species belongs to the group of Sarcophaga possessing 4 posterior dorsocentral bristles, the male having red terminalia and the hind tibia with villosity. It is distinctly related to *S. bullata* Parker, *cooleyi* Parker, etc. The male terminalia in each of these is distinctive. Most of these species in which the biologies are known are scavengers on decaying meats of various types.

Holotype and allotype, No. 49786 in the U. S. Nat. Museum.

Reared April 4, 1932, by H. B. Parks in Bexar Co., Texas, from nests of *Polistes texanus* Cress.

The type series shows the following distribution in addition to the above: Stillwater, Okla., July 28, 1932, and Payne Co., Okla., Sept. 30, 1932 (C. C. Deonier).

MINUTES OF THE 447TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, MAY 4 1933.

The 447th regular meeting of the Entomological Society of Washington was held at 8 p. m., Thursday, May 4, 1933, in Room 43 of the new building of the U. S. National Museum. Mr. C. T. Greene, President, presided. There were present 49 members and 17 visitors. The minutes of the past meeting were read and approved.

The Corresponding Secretary-Treasurer exhibited to the Society a copy of formal greetings from the Entomological Society of Washington to the Entomological Society of London, in connection with the latter's forthcoming Centenary celebration.

On recommendation of the Executive Committee, Mr. R. H. Nelson, of the Bureau of Entomology, was duly elected to membership in the Society.

The Corresponding Secretary-Treasurer read a letter from Dr. E. N. Cory of the University of Maryland, extending invitation to the Society, on behalf of the Extension Service of the University of Maryland in cooperation with the Department of Entomology, to meet at College Park, Md., on June 15, next, for a picnic supper and formal program. It was voted by the Society that a letter of thanks be sent to Dr. Cory, and that the invitation be referred to the Program Committee for appropriate attention.

The regular program of the evening comprised a symposium on "Classification of Insects," in which the following individuals participated: R. A. Cushman, H. G. Barber, Carl Heinrich, E. A. Chapin, and S. A. Rohwer.

Mr. Cushman prefaced the symposium with a few general remarks on classification. He pointed out that the association of insects into groups is based primarily on general appearance or habitus. But habitus can not be described in words sufficiently exact in their implication to render its use on written classification advisable, if it were possible. Habitus, however, is accompanied by certain details of structure or morphological characters that are characteristic of all members of a given group and distinguish them from the members of all other groups. It is these characters that we use as the basis of our classification. Mr. Cushman stated that the idea of the symposium was to point out the major characters used in each order and to review briefly the history of the classification. (Author's abstract.)

Mr. H. G. Barber, in reading a paper on the Classification of the Hemiptera-Heteroptera, first traced the origin and development in this suborder, pointing out some of the characters employed by such early workers as Latreille and Fieber. The latter originating the terms Cryptocerata and Gymnocerata, pertaining to the location and character of the antennae. Reference was made to the later important contribution of Schiodte, especially the stressing of the importance of the attachment and consequent movement of the coxae by means of which he separated the Hemiptera into the Trochalopoda and Pagiopoda. Among more recent developments of the system of classification to show phylogenetic relationships, reference was made to the contributions of Herbert Osborn, Handlirsch, Kirkaldy and Reuter. Special emphasis was placed on two articles of Reuter: "Neue Beitrage zur Phylogenie und Systematik der Miriden" 1910 and "Bemerkungen uber mein neues Heteropteren system" 1912. With some modifications, this system was followed by Brues and Melander in their very recent classification. In connection with the most recent schemes of classification, Mr. Barber explained the salient characters employed with their particular significance in certain family and superfamily groups. In conclusion, he mentioned a few of the difficulties encountered in arranging the families in true phylogenetic sequence. (Author's abstract.)

Mr. Heinrich stated that the Lepidoptera form an excellent group for classification as the various families and lesser groups contain a number of important structural characters, most of which are well marked. He then gave numerous examples of such throughout the order, and illustrated these with blackboard drawings of characters and variations, both of mature and immature forms. Special attention was given by him to the value of larval chaetotaxy, and a brief résumé was included of the use of venational and genitalic characters. (Author's abstract.)

Dr. E. A. Chapin discussed the classification of Coleoptera. As a basis for discussion, the classification of the Coleoptera according to Leconte and Horn 1883, was adopted. Here the structure of the thorax and abdomen, the tarsal formula and the structure of the antenna were used in creating the fundamental divisions of the order. Contrasted with this system was the system of Leng

1920, in which several radical changes were made. The tarsal formula is here given a much more subordinate position and greater stress is laid upon the thoracic and abdominal modifications. It is believed that a great advance can be seen in the more recent of these systems. In closing, the very recent system of Peyerimhoff, 1933, was discussed. The use of the wing venation, the male genitalia, and the internal anatomy in classification were briefly mentioned. (Author's abstract.)

Mr. Rohwer discussed the classification of Hymenoptera, and stated that the order was included among those first recognized by Linnaeus, and contains more forms beneficial to man and his crops than any of the other orders of insects. Vast numbers of the species are parasitic, others are predaceous, one species—the honeybee—has been domesticated, while others make useful agricultural products such as the Turkish or Allepo gall of commerce. Not all are beneficial, however, as sawflies and woodwasps feed on vegetation and sometimes occur in destructive numbers. Certain species of ants are pestiferous and other relatives—e. g. the leafcutting and harvest ants—often are responsible for actual losses to crops.

Linnaeus in 1758 included and defined 8 genera as belonging to the order. Many hundreds of genera are now known. The most recent system of classification, namely that published in Comstock's recent book on insects, divides the order into three sub-orders, seven superfamilies and 48 families. This arrangement does not include various groups confined to the tropics and southern hemisphere.

Practically every specialist who has undertaken to classify the order has proposed some new arrangement, and no one system has been accepted for any long period. The greatest progress in classifying the order in some logical sequence has been made since 1904. Many students have placed considerable emphasis on single characters or a small group of characters, some of which have proven to be either unusable or unsatisfactory for other reasons. In 1837 Hartig divided the order into two major groups on the number of joints in the trochanters. This grouping was followed in general for a number of years, and is reflected in the classification compiled from the works of others by Cresson in 1887.

The separation of the order into two major groups, based on the manner the second and third divisions of the body are joined, was recognized as a fundamental character long before it was definitely proven that the first abdominal segment fuses with the metathorax and becomes a part of the second part of the body or thorax. It was Packard's work with bumblebees that fully established the fact that the so-called medium segment or propodeum was really the first segment of the abdomen. In classifying the Hymenoptera into major groups, emphasis has usually been placed on characters found in the wings, mouth parts, antennae, legs, abdomen and the egg-laying apparatus. Recently the value of characters found in the thorax has been recognized. Some of the major groups have been separated from each other by single characters which would seem to be of minor importance. For example, Saunders in 1833 distinguished the bees from the related fossorial wasps by the plumosity of the hairs on the thorax. In the wasps the hairs are simple.

These general remarks were followed by exhibits of some 30 lantern slides illustrating typical members of the major groups. These slides were used to show the characters used to recognize the major super-generic groups. (Author's abstract.)

Due to lateness of the hour there was no discussion of these papers. Meeting adjourned at 10:10 p. m.

J. S. WADE,
Recording Secretary, *pro tem.*

MINUTES OF THE 448TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, JUNE 1, 1933.

The 448th regular meeting of the Entomological Society of Washington was held at 8 p. m. Thursday, June 1, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, President, presided. There were present 29 members and 11 visitors. The minutes of the previous meeting were read and approved.

There was no preliminary business.

First on the regular program was a continuation from the previous meeting of the symposium on insect classification, by A. N. Caudell, J. M. Aldrich, and A. G. Böving.

In Mr. Caudell's absence, his paper on classification of Orthoptera was read by Mr. J. S. Wade. The Linnaean conception of classification and distinguishing characters was reviewed, and later developments in classification were touched upon. Six families usually accepted at present were characterized: Blattidae, Mantidae, Phasmidae, Acrididae, Tettigoniidae and Gryllidae.

Dr. Aldrich discussed classification of Diptera, mentioning first the distinctive adult and larval characters of the order, especially the extremely complete metamorphosis. About 40,000 species are known; many more will probably be known when the order is as thoroughly collected as Lepidoptera and Coleoptera have been. The term Diptera was first used by Aristotle. Development of classification from Linnaeus to the present was briefly outlined. The sub-orders and principal families, the important distinguishing characters, and the habits of a number of forms, were discussed.

Dr. Böving spoke on classification of coleopterous larvae, stating that three groups of sub-ordinal rank must be recognized for larvae: Adephaga, Polyphaga, and Cupesid-like forms.

Under each group was discussed typical forms and distinguishing characters, including legs, head and mouth parts, and cerci. Charts illustrating these characters were shown. The principal families of each group were mentioned, showing advances from primitive to derived forms. The phylogeny of the order, as indicated by larval studies, was shown by a chart. Recently published work by P. de Peyerimhoff was discussed.

The second part of the regular program was a demonstration of an airplane insect trap, by P. A. Glick, of the Cotton Insect Investigations of the Bureau of Entomology.

Mr. Glick spoke briefly on collecting insects by airplane. He exhibited traps, and described this work with the aid of lantern slides. Results from 1,358 flights, including 1,538 hours of flying time, in which 29,922 specimens were taken were discussed. Of this number 3,954 were collected in 150 hours of flying at night. The specimens represented 19 orders of insects, the Diptera predominating, and the spiders. Flights were made to the height of 16,000 feet, and the specimen taken at the highest altitude was a spiderling at 15,000 feet. Insects were taken from near the surface to the altitude of 14,000 feet. Meteorological data were recorded at the time the flights were made. (Author's abstract.)

Because of the lateness of the hour there was no discussion of these communications. The meeting adjourned at 10 p. m.

F. M. Wadley,
Recording Secretary.

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PROCEEDINGS OF THE

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ANOPHELINES OF THE AMAZON VALLEY.[1]

By Raymond C. Shannon.

I.

INTRODUCTION.

The following is an account of the anophelines collected during a general mosquito survey made in the Amazon Basin between the latter part of March to the end of June, 1931. Collections were made chiefly at Iquitos, Peru; Porto Velho, Rio Madeira; Manáos, Rio Negro; and Boa Vista (Fordlandia), Rio Tapajos. The period of the survey corresponds roughly to the latter part of the rainy season, presumably one of the most favorable periods for mosquito life in the valley. The more interesting results of the survey are:

1. Fourteen species were found, one-half of the known anopheline fauna of Brazil.
2. No new species were discovered, although important material was obtained of seven species that are little known.
3. All of the species found belong to the "lowland" and "open country" groups. The "upland" breeders apparently do not exist here or else have a very localized distribution.
4. The absence of *An. argyritarsis*[2] is the most surprising omission in the fauna, especially as this species is, in general, one of the commonest and most widely spread of the South American anophelines. Also, the typical form of the equally common and widely distributed *An. albitarsis* was found only along the periphery of the basin, although its variety, *brasiliensis*, was found in a restricted locality at Manáos.

[1] The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation. The writer is indebted to officials of the U. S. National Museum and U. S. Bureau of Entomology for permission to examine the collection of *Culicidae* in their custody; and to Dr. Harvey Bassler, formerly of Iquitos, for his friendly advice and assistance at Iquitos. He is likewise indebted to Mr. Clarence Rogge and Dr. Claude Smith, of Fordlandia, and to Sr. R. de Mello, of Manáos, for similar courtesies.

[2] The species heretofore recorded as *An. argyritarsis* from the Amazon region is, in all probability, *An. darlingi*.

5. Five species were fairly common locally. Nowhere, however, were anophelines found in such great densities as is commonly attained by *quadrimaculatus*, *maculipennis*, and *elutus* in certain regions of the north temperate zone.

6. Only one species, *An. darlingi*, was found in houses in appreciable numbers; others (*mattogrossensis*, *bachmanni*, *tarsimaculatus*, and *albitarsis*) were seen only occasionally.

7. *An. darlingi* doubtlessly is the most important vector of malaria in Amazonia. The evidence obtained during the trip indicates that it is primarily a flood-water breeding species.

8. The survey, in addition, shows that the malaria vector, *Anopheles pseudopunctipennis*, does not exist in the Amazon Basin (as anticipated by Shannon, Davis, and Delponti, 1927) although it is known to occur, in company with *argyritarsis*, in the eastern Peruvian Andes at altitudes between 1,500 and 3,500 feet (Shannon, 1930).

II.

SPECIES OF ANOPHELINES FOUND IN THE AMAZON REGION.

Previous Records of Anophelines from the Amazon Region.

(Only publications in which specific names are given are listed.)

YR.	AUTHOR	SPECIES	PRESENT DESIGNATION	LOCALITY
1902	Durham	*Anopheles lutzii*	*A.* (*Stethomyia*) *nimbus* Th.	Manáos and Pará
1902	Durham	*Anopheles argyrotarsus*	?*A.* (*Nys.*) *darlingi* Root	Manáos
1904	Lutz	*Pyretophorus lutzi* Cruz	?*A.* (*Nys.*) *lutzii* Cr.[3]	Manáos
1904	Lutz	*Myzomyia lutzii* Theo.	?*A.* (*Nys.*) *cruzii* D. & K.[3]	Pará
1904	Lutz •	*Cyclolepidopteron mediopunctatum*	*A.* (*Arr.*) *mediopunctatus* Th.	Manáos
1905	Goeldi	*Anopheles argyrotarsis*	?*A.* (*Nys.*) *darlingi*	Pará
1905	Goeldi	*Anopheles argyrotarsis* var. *tarsimaculatus*	*A.* (*Nys.*) *tarsimaculatus* G.	Pará
1910	Newstead and Thomas	*Cellia argyrotarsis*	?*A.* (*Nys.*) *darlingi*	Amazon
1910	Newstead and Thomas	*Cellia albimana*	*A.* (*Nys.*) *tarsimaculata*	Manáos, etc.
1910	Newstead and Thomas	*Stethomyia nimba*	*A.* (*Steth.*) *nimbus*	Manáos
1921	Peryassu	*Stethomyia nimba*	*A.* (*Steth.*) *nimbus*	All from Amazonas and Pará
1921	Peryassu	*Anopheles lutzii*	?*A.* (*Nys.*) *cruzii*[4]	
1921	Peryassu	*Myzorhynchella lutzii*	?*A. lutzii*[4]	
		Cycloleppteron mediopunctatum	*A.* (*Arr.*) *mediopunctatus*	
		Cycloleppteron intermedium	*A.* (*Arr.*) *intermedius* Ch.	
		Cycloleppteron maculipes	?[5]	
		Cycloleppteron pseudomaculipes	?[5]	
		Cellia argyrotarsis	?*A.* (*Nys.*) *darlingi*	
		Cellia albimanna	?*A.* (*Nys.*) *bachmanni* Pet.	
		Cellia tarsimaculatus	*A.* (*Nys.*) *tarsimaculatus*	
1923	Christophers	*Anopheles amazonicus* Chr.	*A.* (*A.*) *mattogrossensis*	Amazon River
1926	Bequaert	*Anopheles amazonicus* Chr.	*A.* (*A.*) *mattogrossensis*	Rio Branco
1926	Bequaert	*Anopheles tarsimaculatus*	*A.* (*Nys.*) *tarsimaculatus*	Amazon Basin
1926	Bequaert	*Anopheles celidopus* D. & S.	*A.* (*A.*) *peryassui* D. and K.	Rio Branco
1931	Davis	*Anopheles tarsimaculatus*	Designation as given by author	All from Belém, Pará
		Anopheles darlingi		
		Anopheles intermedius		
		Anopheles shannoni		
		Anopheles mediopunctatus		
		Anopheles nimbus		

[3] These species, *lutzii* and *cruzii*, probably have not been found in the region since these 1904 records. They probably have a very localized distribution in the valley.

[4] Apparently based on Lutz' 1904 records.

[5] Of doubtful occurrence in the Amazon region.

Species Collected During the Survey.

SPECIES	LOCALITY
An nimbus Theobald	Iquitos, Manáos, Sanatarem, Belém
An. thomasi Shannon[6]	Iquitos
An. kompi Edwards	Manáos
An. mattogrossensis Lutz and Nieva	Iquitos, Porto Velho, Abuna, Manáos, Boa Vista
An. peryassui Dyar and Knab	Iquitos, Porto Velho, Abuna, Manáos
An. intermedius Chagas	Iquitos (Belém, Davis)
An. fluminensis Root	Iquitos
An. shannoni Davis	Iquitos, Manáos, Belém
An. mediopunctatus	Iquitos, Guajara-Mirim, Manáos
An. albitarsis L. Arribalzaga	Abuna, Guajara-Mirim, Boa Vista
An. darlingi Root	Nazareth, Juhaty, Porto Velho, San Antonio, Abuna, Murtinho, Guajara-Mirim, Guayara-Mirim, Manáos, Boa Vista, Belém
An. tarsimaculatus Goeldi	Iquitos, Tonantins, Trapiche, Porto Velho, Guajara-Mirim, Manáos, Boa Vista, Belém
An. strodei Root	Abuna
An. bachmanni Petrocchi	Iquitos, Porto Velho, Guayara-Mirim, Manáos, Boa Vista

III.

GENERAL ACCOUNT OF THE DISTRIBUTION OF THE BRAZILIAN ANOPHELINES IN RELATION TO THE AMAZON VALLEY.

1. Characteristics of the Amazon Valley.

It is evident that the great uniformity of climate and topography of the Amazon Basin makes it favorable only for certain species of anophelines. The species found here are therefore of unusual interest from the standpoint of distribution and ecology.

The following brief account dealing with the characteristics of the region is abstracted from Councilman and Lambert (1918):

> The Amazon Valley is the largest area on earth which can be treated as a single unit in which practically the same conditions persist throughout. It includes approximately 2,000,000 square miles and is almost as flat as the sea. At Iquitos, Peru (2,300 miles from the mouth of the river), the altitude is but 315 feet. The basin is roughly delineated by the fall-lines on the north and south and by the Andes of the west.
>
> The entire low region, which is subject to flooding, is known as the flood plain, and this is divided into the igapó and varzea. The igapó, really a swamp forest, is the lowest and is subject to tidal overflows in the eastern portion and to slight rises in the river in the upper part. The varzea is flooded only during high water. A third type of land, the terra firma, is still higher and is not subject to overflow.

[6] Originally described under the name *lewisi* Shannon (1931) from Bahia.

There are seasonal variations in the rainfall, producing a long wet and a long dry season, and between these there is a short wet and a short dry season. There is a general rise in the rivers from March to June. The rise in some places is enormous: 100 feet has been recorded at Manáos, although from 40 to 50 feet is the usual rise. The valley at times becomes a sea and travel through the forest by canoe is possible.

The largest forested area in the world exists here; the towns and cities are but mere specks. The rivers and tributary streams are so numerous that a vast area is readily accessible by boat. Extending from the rivers there are everywhere igarapes or canoe paths which pass long distances into the land.

From the standpoint of anopheline breeding, the igarapes, which are usually densely vegetated, and the flooding of the varzea are the most important features of the valley. It may be further observed that rock outcrops and subsequently rocky stream beds occur only very sporadically. Possibly in their vicinity anophelines other than the ones here recorded may occur.

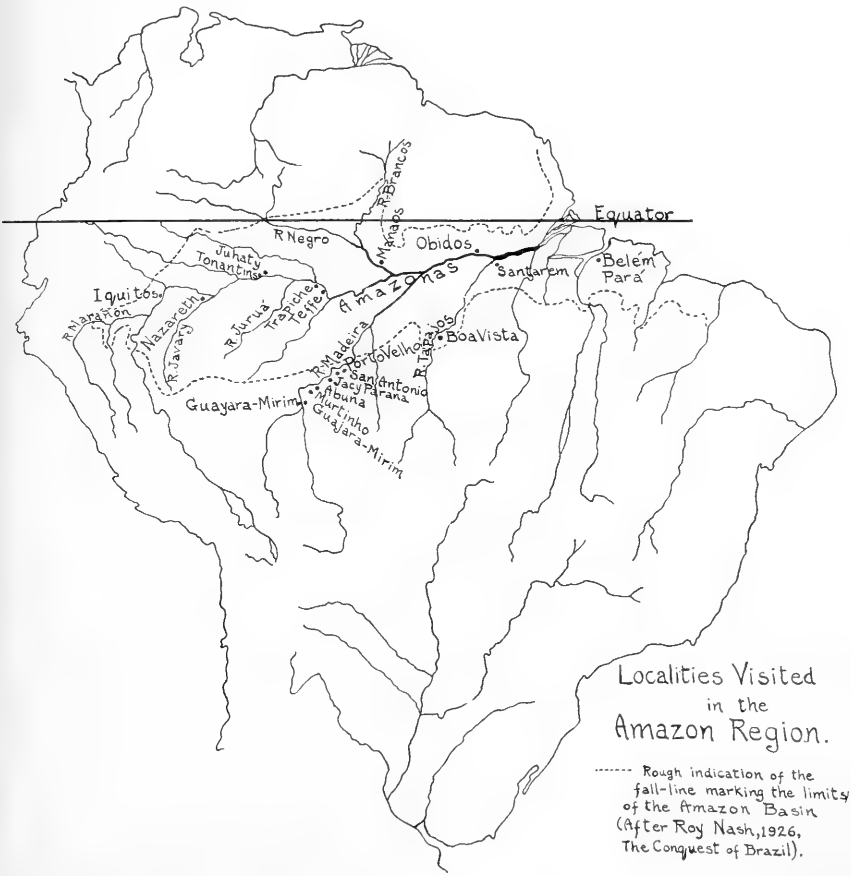

Fig. 1.

2. A Group System of the Brazilian Anophelines as Based on the Type of Country They Inhabit.

The anophelines of Brazil can be considered under four groups according to the type of breeding place or type of country in which they occur: (1) The upland-region group, which as far as is known breed in streams and rock pools; (2) the lowland forest, marsh, and swamp breeders; (3) the open country species (either upland or lowland); (4) the species inhabiting bromeliads.

These groups in turn conform remarkably well to the systematic grouping of the species as given in the latest classification (Edwards, 1932). The tabulation on page 122 indicates the general type of country inhabited by the different groups and subgroups, and the number of species of each group which were found in the Amazon region.

The Grouping of Brazilian Anophelines According to the Type of Country They Inhabit.

GROUP	USUAL TYPE OF BREEDING PLACES	NO. OF BRAZILIAN SPECIES	NO. FOUND IN AMAZON REGION
Genus *Chagasis*	Upland regions, in fairly swift-flowing streams	1	0
Genus *Anopheles*			
Subgenus *Stethomyia*			
Subgenus *Anopheles*	Lowland forests	3	1
Group *Anopheles*			
a. Series *Anopheles*	Upland regions	2	0
b. Series *Cycloleppteron*	Lowland marshes and swamps	2	2
Group *Arribalzagia*	Jungle pools	5	4
Group *Arribalzagia*	Rocky stream breeder	1	0
	(*An. minor*)	1	0
Subgenus *Nyssorhynchus*			
Group *Nyssorhynchus*	Open country, as a rule	9	5
Group *Myzorhynchella*	Upland regions, in small streams (? all)	3	0
Group *Kerteszia*	In forested regions with luxuriant growths of bromeliads	1	0
Subgenus *Myzomyia*	Open country (an African species, to date known only from the state of Rio Grande do Norte)	1	0

It will be noted that all of the species found during the survey are either typical of densely forested and lowland marsh and swamp regions (*Stethomyia*, *Cyclopeppteron*, *Arribalzagia*) or belong to the "open country" group of species (group *Nyssorhynchus*). Probably all of the former are generally distributed throughout the basin. Two of the latter group, *albitarsis* (typical form) and *strodei*, were found only at the periphery (fall-line) of the basin, where there is a perceptible change in the character of the country. However, a variety of *albitarsis*, *braziliensis*, was found in a small restricted locality near Manáos. The absence of the rather ubiquitous *An. argyritarsis* (another member of the *Nyssorhynchus* group) probably indicates, more than anything else, the strong relation existing between the nature of the region and its anopheline fauna.

The absence of certain species probably shows that factors other than the ones here indicated are also involved. Thus, larvae of *An. maculipes* of the group *Arribalzagia* have been found by Root on several occasions associated with larvae of *intermedius* in heavily shaded pools in or at the edge of low second growth jungle in the state of Rio de Janeiro. Davis (1933) states that *maculipes* and *intermedius* range together through the lowlands of the state of Rio de Janeiro; but whereas *intermedius* is found northward to the Amazon, *maculipes* has not been found even as far north as the state of Bahia.

It is very curious that no specimens of *Kerteszia*, a group addicted to breeding in the water contained in bromeliads, were found; in fact none appear to have been found since Lutz recorded *An. cruzii* from Pará (1904). Adults are easily attracted to animal bait and such bait was used wherever extensive collecting was done. But, although large terrestrial bromeliads were seen in some abundance at Iquitos, Porto Velho, and Manáos,[7] the arboreal types appeared to be rather sparse and of small size as compared with the luxuriant growth of these plants in other parts of the tropics.[8] It may be added that whereas in Panama the sabethines breeding in bromeliads form a large and characteristic portion of this country's mosquito fauna, they are rather poorly represented on the Amazon.

It is probable that some of the "upland" species (e. g. *Myzorhynchella*) occur within the limits of the basin where there chance to be hilly sections with rock bottom streams. In fact Lutz (1904) has recorded one of these, *An.* (*Myzorhynchella*) *lutzii* Cruz, from Manáos. In connection with this, it may be noted that water falls (Taruman Falls) exist not far from Manáos; likewise a small, rock-bottom stream is located on the outskirts of the city at the British club, the "Bosque." Search was made in this stream but no anopheline larvae were found.

---

[7] Many of these were examined.

[8] Dr. Lyman B. Smith, an authority on *Bromeliaceae*, in addition to informing me, by letter, that according to present knowledge the number of genera and species of the bromeliads is comparatively small in the Amazon Basin, adds, that in this region a high percentage of the plants are inhabited by ants, owing to the periodic flooding, and that such would be unfavorable for mosquito life.

IV.

ANOPHELES AND MALARIA IN AMAZONIA.

1. An. darlingi AND tarsimaculatus.

Published accounts (see pages 141 to 143) state that although malaria is generally prevalent throughout Amazonia, certain portions are much more afflicted than others. Particularly is it considered that the more dangerous portions occur along the tributary rivers, especially in the vicinity of their lowermost rapids.

General observations made during the survey suggest that this condition results from the fact that *An. darlingi*, in all probability the most dangerous vector in the region, apparently finds optimum breeding conditions in these tributary streams following the flooding of their valleys. The fact, too, that a number of the largest and more healthy cities and towns (Iquitos, Manáos, in part, Teffe, Itacoatiara, etc.) are located on high ground, the terra firma, and more or less well removed from the varzea and igapó levels, lends support to this observation. On the other hand, many of the smaller towns along the tributary rivers present a very decadent appearance, due in large part to malaria (see accounts of Iquitos, Nazareth, and Porto Velho given below).

Early authors, on circumstantial evidence, incriminated both *An. argyritarsis* and *An. tarsimaculatus* as the vectors. Doubtlessly the *argyritarsis* of these writers was *darlingi*, and to this extent they were correct in their views. Certain observations made upon *tarsimaculatus*, however, indicate that the species plays but a minor rôle in this region.

Davis (1931), on the basis of a series of dissections made at Belém, Pará, established the definite fact that *darlingi* is a malaria vector. He found a stomach infection rate of 22.3 per cent (197 specimens) and a gland rate of 9.5 per cent (181 specimens). Later, Davis and Kumm (1932) and Kumm (1932) demonstrated that this species is a vector in other parts of Brazil (Franca and Itapira, state of Bahia), and Benarroch (1931) has likewise found this species infected in nature in Venezuela. Furthermore the writer found at Porto Velho, Amazonas, a stomach infection rate of 9 per cent and a gland rate of 1.8 per cent in a series of 56 specimens. There can, therefore, be no doubt as to the importance of this species in connection with malaria.

Although *An. tarsimaculatus* seems to be much more common and ubiquitous in Amazonia than *An. darlingi*, and in fact, to be the commonest anopheline in this region, it would appear from circumstantial evidence to be of relatively little importance (see account under Iquitos). Moreover dissections of more than 400 specimens of this species made by different workers in various parts of Brazil give an infection rate of only 0.8 per cent (including one gland infection, Boyd, 1926).

The following records show that *An. darlingi* is decidedly a house-haunting species while *An. tarsimaculatus* is rarely found indoors:

Houses Versus Animal Bait Captures of **An. darlingi** and **An. tarsimaculatus.**

AUTHORS AND LOCALITY	SPECIES	HOUSE	ANIMAL BAIT
Davis (1931)	*darlingi*	252	1
Belém, Pará	*tarsimaculatus*	24	138
Davis and Kumm	*darlingi*	250[9]	80
(1932) Franca, Bahia	*tarsimaculatus*	0	172
Shannon, Amazonia	*darlingi*	800[9]	74
	tarsimaculatus	1	1000[9]

2. Anopheles albitarsis.

Although *albitarsis* does not as a rule appear to be as domestic as *darlingi*, it will at times invade houses in fairly large numbers. Kumm (1932) records 423 specimens found in houses during less than a month's time at Salvador, Bahia, and from 240 of these a stomach infection rate of 5.8 per cent was obtained.

The fact that *albitarsis* occurs along the periphery of the Amazon Basin (Rio Madeira and Rio Tapajos) may to some extent complicate the malaria problem there.[10]

V.

LOCALITIES VISITED AND ANOPHELINES FOUND.

1. The Upper Amazon Region.

(*1*) *Iquitos and Vicinity.*—Iquitos, Peru, the third largest city (population about 18,000) in Amazonia, is situated mainly on the fairly high bank (50–75 feet above the river level) of the Rio Itaya near its junction with the Amazon. In the rear of the town, the ground slopes gradually to swamp land, which

[9] Approximate number observed.

[10] Dr. William Mann (Washington, D. C.) has supplied me with the following unpublished observations on *albitarsis* which are of interest owing to the proximity of the locality to the Amazon region. "At Lake Rocagua, northern lowlands of Bolivia, we found these mosquitoes so abundant that we would be driven out into the hot sunshine to get free of them. I ran a little fever while there. The region is thinly populated pampas country." Many specimens were collected and are now in the U. S. N. Museum collection. Neiva and Penna (1918) and other Brazilian observers have likewise observed swarms of this species attacking in sunlight.

begins about two miles distant. On the west is a fairly large lake, the Morona Cocha, which during the rainy season is partly surrounded with boggy ground. The vicinity of the town is rarely if ever flooded by river overflows, a fact which appears to be of great importance and which may account for the absence of *An. darlingi* in the captures made here. Local doctors and residents claim that although numerous persons with malaria arrive in Iquitos from highly malarious places in the general region, comparatively few secondary cases develop.[11] The section called Pijuayo Loma is considered to have some endemic malaria. No larvae however were found in the few bodies of water there, and in an evening capture only a few *An. tarsimaculatus* adults were taken.

List of Anopheline Species Found at Iquitos.

SECTION	CONDITIONS	SPECIES	NUMBER OF ADULTS CAPT'D	REMARKS
(1) Versailles and beyond to swamp	Open and forested country with field and forest streams, pools, marsh, swamp waters	*nimbus*	Moderate	Larvae in pooled woodland stream
		mattogrossensis	Rare	One larva, open swamp
		peryassui	Few	Few larvae, open swamp
		mediopunctatus	Moderate	Larvae associated with *nimbus*
		shannoni	Few	
		bachmanni	Moderate	Larvae along edges of pond
		tarsimaculatus	Moderate	Larvae in marsh
(2) Morona Cocha	A fairly large open lake, partly surrounded by boggy ground	*mediopunctatus*	Few	
		shannoni	Rare	
		bachmanni	Few	
		tarsimaculatus	Few	
(3) San Juan	13 kilometers from Iquitos, densely forested, a few scattered clearings, large portions swampy, a few small streams, pools, but no open marshes.	*nimbus*	Many	Larvae in swamp water; a few males net-captured
		thomasi	Few	Four males collected
		mediopunctatus	Many	
		intermedius	Few	
		fluminensis	Few	
		shannoni	Few	One pupa in jungle swamp
		bachmanni	Moderate	
		tarsimaculatus	Moderate	

[11] Councilman and Lambert (1918) state: "Malaria is said to be not common in Iquitos although there is much in the surrounding region. The official report for 1916 lists only eleven deaths from malaria. Why it is not common here is one of the many puzzling features of the disease." Thomas (1906) likewise states that Iquitos itself is comparatively free of malaria, although numerous cases come from neighboring river basins. Freyd (1930), however, lists Iquitos among the places highly afflicted with the disease.

Certain forested areas near San Juan were extremely dense, with only a twilight degree of illumination. In these areas *An. nimbus* and *An. mediopunctatus* were abundant; the other species were very scarce, although a pupa of *shannoni* was found in a swamp well within the heart of the forest.

It was also noted that although *nimbus* was collected throughout the day, its main flight occurred during the half hour preceding that of the other species. After the first specimens of *mediopunctatus* began to appear, the flight of *nimbus* was practically at an end. This observation has previously been made by Neiva and Penna (1918).

(*2*) *Nazareth, Peru.*—Nazareth is a small town situated on the notoriously malarious river Javary, which is part of the boundary between Peru and Brazil. Portions of the town site are subject to flooding.

Two brief stops were made here (March 19 and April 26), and on both occasions *An. darlingi* was found in houses. On the latter occasion about two-thirds of the houses were visited; some of these harbored approximately 100 specimens of *darlingi* each. In addition two *An. mattogrossensis* were captured indoors. No anopheline larvae were found during the brief search that was made.

Owing to trade stagnation, and doubtlessly to the malaria which is very evident here, the town appears to be on the verge of collapse. The people are moving elsewhere as opportunity permits.

(*3*) *Boa Esperanza, Amazonas.*—This is a recently built town at the mouth of the Javary, established in an attempt to provide a more healthful town site for the people farther up the river. Although the ground was partly flooded no anophelines were found in the houses; neither were there any observed on board the ship after dark.

(*4*) *Tonantins, Amazonas.*—On March 17, on board ship, while docked at Tonantins, between the hours of 11 p. m. and 2 a. m., two *An. tarsimaculatus* and two *An. mattogrossensis* were captured.

(*5*) *Juhaty, Amazonas.*—On April 28, one *An. darlingi* was found indoors at Jahaty.

(*6*) *Trapiche, Amazonas.*—At Trapiche, on March 13 and April 29, two *An. mattogrossensis* were taken on board ship and one *mattogrossensis* and a male *tarsimaculatus* indoors.

2. Anophelines Found Along the Madeira and Mamoré Rivers.

(*1*) *Porto Velho, Amazonas.*—This is the largest town on the Rio Madeira. It is situated at the head of navigation and is the base for the Madeira-Mamoré railroad. It has a long and bitter malaria history. Two large areas within the town limits as well as several small ones were flooded at the time of my visit (May 10–16). In addition to the town area, a number of flooded areas on both sides of the railroad beyond the town limits were examined. In comparison with the number of anopheline adults that could be captured, larvae appeared to be scarce. The captures made are summarized below.

ANOPHELINE LARVAE AND ADULT CAPTURES AT PORTO VELHO, AMAZONAS.

CONDITIONS	SPECIES	NUMBER OF SPECIMENS
Small flooded area within city limits	*darlingi*	10 larvae, 1 pupa
Large flooded area within city	*tarsimaculatus*	22 larvae
Flooded areas beyond city limits	*darlingi* *tarsimaculatus*	9 larvae 20 larvae
Houses in native quarter	*darlingi*	5 adults
Houses in West Indian (negro) quarter	*darlingi*	154 adults
Scattered houses beyond town limits (see No. 3)	*darlingi*	21 adults
Animal bait near native quarter (No. 4)	*tarsimaculatus* *darlingi* *peryassui*	73 adults 32 adults 1 adult
Animal bait near West Indian quarter (No. 5)	*tarsimaculatus* *darlingi*	106 adults 2 adults

Fifty-six of the *darlingi* collected in houses were dissected; five of them had oöcysts and one of these had sporozoites as well. The rate of infection was 8.9 per cent.

(*2*) *Santo Antonio, Amazonas.* This town is located practically on the fall-line of the Amazon Basin. The S. Antonio Falls of the Madeira River are close by. Very little standing water was seen (extensive drainage was accomplished here during the construction days). Six *An. darlingi* were found in ten houses visited (May 13).

(*3*) *Open Swamp Area near Porto Velho, Matto Grosso.*—During a brief stop at an open swamp area along the railroad about 175 kilometers southwest of Porto Velho, Matto Grosso, on May 18, at dusk a few *An. albitarsis* and *peryassui* attacked us.

(*4*) *Abuna, Matto Grosso.*—On May 19 and 21, ten houses were examined at Abuna, Matto Grosso, but only one *An. darlingi* was found. Several large ground pools had rather numerous *An. tarsimaculatus* larvae. Several *An. strodei* larvae were found in a borrow pit.

(*5*) *Murtinho, Matto Grosso.*—Sixteen *An. darlingi* were found under a mosquito bar in the restaurant-house at Murtinho on May 19.

(6) *Guajara-Mirim, Matto Gross.*—This town is at the railhead, 365 kilometers from Porto Velho. The ground surface is very rocky. The following captures were made with animal bait (May 19): *An. tarsimaculatus* (in part? *strodei*), 160; *darlingi*, 27; *bachmanni*, 24; *albitarsis*, 2; *mediopunctatus*, 2.

(7) *Guayara-Mirim, Bolivia.*—This town is situated across the Rio Mamoré just opposite Guajara-Mirim, Matto Gross. There are large flooded areas along the river. No larvae were found during the short investigation made, and only one house in six was found to harbor adult *darlingi*.

3. Manáos, Amazonas, Rio Negro, June 1–11.

The presence of four igarapes extending through the city of Manáos gives the impression that mosquito breeding should be very prolific. However, as the following records show, collections proved to be much smaller here than in most of the other places visited. Even in the suburbs only small numbers of mosquitoes were captured.

Anophelines Collected at Manáos, Amazonas.

SOURCE	SPECIES	NUMBER OF SPECIMENS
Park Fountains, center of town	*tarsimaculatus*	20 larvae
Igarape Manáos	*tarsimaculatus*	Larvae fairly abundant
Twelve houses along igarape	No anophelines	
Animal bait near igarape	*tarsimaculatus*	54
	bachmanni	1
Igarape São Raymundo	*tarsimaculatus*	Few larvae
Ten houses	*darlingi*	7
Animal bait	*darlingi*	4
	tarsimaculatus	4
	bachmanni	1
	mattogrossensis	1
Outskirts of town, on animal bait	*nimbus*	5
	kompi	2
	tarsimaculatus	14
	bachmanni	3
	shannoni	2
Flores	*albitarsis-brasiliensis*[12]	7
	mediopunctatus	1
	shannoni	5
	peryassui	5

[12] This is the only locality within the basin proper where this form was found. The numerous shallow open marshy areas about Flores represent an unusual type of land for the Amazon Valley.

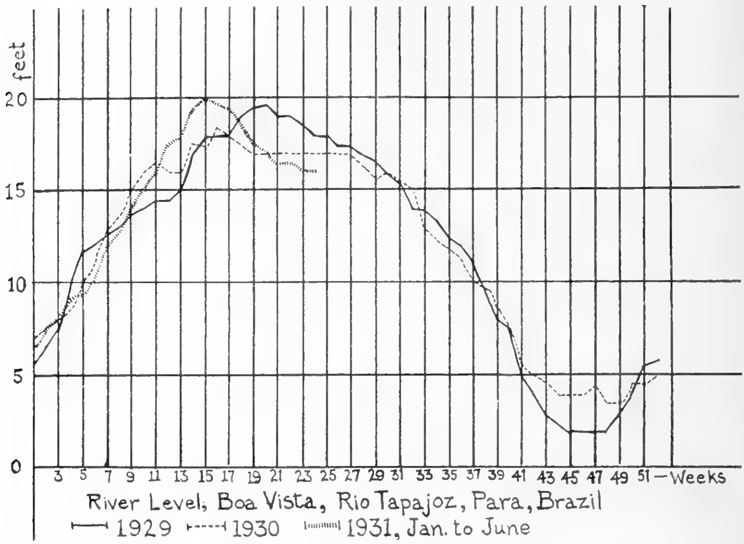

Fig. 2.

4. Boa Vista, Rio Tapajoz, Pará, June 14–19.

Boa Vista, headquarters of the Companhia Ford Industrial of Brazil at Fordlandia, is situated 120 miles up the Rio Tapajos. It lies not far from the fall-line as the San Luis rapids are about 70 miles farther up the river. The general region consists largely of rough hilly country, and streams are fairly numerous. But in spite of its upland features none of the species belonging to the "upland" group of anophelines were found. The fact that the area is in some respects different from the main portion of the basin is indicated by the presence of *An. albitarsis*.

Fordlandia is probably the first extensive section in Amazonia to undergo rapid, large-scale plantation clearings. It will be important to note the effect that this will have upon anopheline breeding, but meanwhile efforts are being made to control the situation in whatever direction it may develop. During the brief investigations made here larvae of both *tarsimaculatus* and *darlingi* were found in situations formerly under forest cover.

Although adult *An. darlingi* were collected in six localities in Fordlandia, the species was not found as abundantly as at Porto Velho and Nazareth. Climatic records supplied by the manager of the plantation shows that in 1931 the river level had reached its maximum height during April and that at the time of my visit (middle of June) the river had fallen approximately four feet. It is probable therefore that the breeding of this species was on the decline. Moreover, the laboratory records furnished me by Dr. Claude Smith show that the peak of malaria infections had been attained during the month of May. Extensive oiling at Boa Vista and nearby towns had checked the breeding at these sites. Elsewhere, however, comparatively few favorable breeding places for *darlingi* were found, although larvae of *tarsimaculatus* and *bachmanni* were fairly abundant. The following captures were made:

1. Boa Vista. In screened houses. Two *An. bachmanni*, biting man.

2. Adults collected on animal bait stationed at a small shallowly flooded grassy field at the river's edge: *An. darlingi*, 1; *albitarsis*, 19; *tarsimaculatus*, 5; *bachmanni*, 248; *mattogrossensis*, 3.

3. A partially flooded ravine, the upper part recently cleared of forest cover, the remainder open marsh land reaching to the river's edge; situated behind the town. Larvae: *An. darlingi*, 2; *tarsimaculatus*, 70; *bachmanni*, 49; *mattogrossensis*, 12.

4. Animal bait capture made near the ravine: *An. albitarsis*, 1; *tarsimaculatus*, 14; *bachmanni*, 68; *mattogrossensis*, 2.

5. Stream at edge of forest cover (near the seed-bed). Ground rather low, partly flooded during the rainy season. On this date (June 15, 1931) parts of the stream had a fairly swift current. Adults captured on animal bait: *An. darlingi*, 9; *tarsimaculatus*, 212; *bachmanni*, 29; *mattogrossensis*, 11.

6. Farm section, about five miles below Boa Vista. Considerable drainage had been effected here, and ditches and standing water were oiled weekly. Only scattered *bachmanni* larvae were found.

7. Native village, about one-half mile below the farm. River bank well flooded but rather heavily shaded by trees. Larvae very scarce, only two *tarsimaculatus;* and one *mattogrossensis* were found. The water at the river's edge was literally swarming with a small species of *Corixidae*, probably a predator on mosquito larvae. In the houses, however, fourteen *An. darlingi* were found.

8. Tabacal, a native town about three miles above Boa Vista. Forty *An. darlingi* were found in houses; twenty were collected in a single house. In addition, two *albitarsis* and one *mattogrossensis* were found indoors. Larvae found in an open, flooded area along the town; *darlingi*, 2; *tarsimaculatus*, 5; *bachmanni*, 3. In the flooded area along the river: *tarsimaculatus*, 3.

9. Sumuhuma, a small town across the river from Boa Vista. A sharp outbreak of malaria occurred here during the preceding months, April and May. At this time a large flooded area existed in the rear of the town, but at the time of my visit drainage operations were about completed, and but little stagnant water could be found. Two *An. darlingi* and eleven *An. tarsimaculatus* larvae were collected, while indoors fourteen *darlingi* adults were found.

VI.

KEY TO THE AMAZON SPECIES OF ANOPHELES.

Adult Females.

1. Integument of the mesonotum with a median longitudinal white line; antennal hairs as long as width of thorax; wing scales and legs entirely dark...Subgenus *Stethomyia*............................2
   Integument of the mesonotum without a median white line; antennal hairs much shorter than width of thorax...3
2. White spot at vertex of head composed of normal scales which do not overhang the basal antennal segments.........................*kompi Edwards*
   This spot composed of silvery-white, scale-like setae which project forward and overhang the basal antennal segments..................................
   nimbus Theobald and *thomasi* Shannon
3. Second, fourth, and sixth veins without white scales; abdomen without scales; hind tarsals black, with two to four white bands or rings............
   Subgenus *Nyssorhychus* (in part) Group *Kerteszia*, *cruzii* Dyar and Knab[13]
   These veins with light colored areas..4
4. Third and fourth hind tarsals white; sixth vein with two dark scaled areas..Subgenus Nyssorhynchus 5
   Third and fourth hind tarsals black, or with black markings; sixth vein with four or more dark spots.....................Subgenus *Anopheles* 10
5. Abdomen without scales save on eighth segment and cerci; third wing nearly all dark. Group *Myzorhychella*, *lutzii* Cruz.[14]
   Abdomen scaled on tergites 2–8, usually with lateral scale tufts.................
   Group *Nyssorhynchus* 6
6. Fifth hind tarsal white...7
   Fifth hind tarsal with black ring..9
7. First abdominal sternite with two longitudinal lines of white scales; first black spot of costa much smaller than succeeding white spot; second hind tarsal one-third to one-half black; eighth abdominal segment distinctly longer than broad and extensively covered with light scales above.
8. First black spot of costa longer than succeeding white spot; second hind tarsal one-third or more black...............................*darlingi* Root
   The size of these spots reversed; second hind tarsal usually less than one-third black...*argyritarsis* Rob. Desv.[15]
9. First black spot on costa equal to or greater than the succeeding white spot; second hind tarsal over one-third black; specimens usually of small size...*bachmanni* Petrocchi
   First black spot on costa smaller than the succeeding white one; second hind tarsal usually not more than one-fourth black; specimens usually of moderate size..............*tarsimaculatus* Goeldi and *strodei* Root

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[13] Recorded but once from Amazonia, Lutz, Pará, 1904.

[14] Recorded but once from Amazonia, Lutz, Manáos, 1904.

[15] Not found but probably occurs in the vicinity of the periphery of the basin.

10. Abdomen without lateral scale tufts; legs without light markings save at articulations of segments....Group *Anopheles*, Series *Cycloleppteron*....11
Abdomen with lateral scale tufts; legs usually with numerous light markings....................................Group *Arribalzagia*[16]....................................12
11. Black and white wing markings strongly contrasted; last abdominal tergite and cerci clothed with scales; thorax bluish gray with three black spots; rather small species........................*peryassui*, Dyar and Knab
Light wing markings brownish yellow; the general effect of the wing as well as the entire insect is dull brown; abdomen with scales only along the middle line of the sternites; mid-mesepimeral setae present; rather large species....................................*mattogrossensis* Lutz and Neiva
12. Wing scales linear, three times as long as broad or longer............................13
Wing scales, particularly on basal portion of wing, broad, the length less than three times the width...14
13. Small species; last four hind tarsals black with small white rings at the apices of segments; haltere small with white scales only on basal portion; without scales on first abdominal sternite; posterior marginal wing scales begin near the wing base............*minor* Costa Lima[17]
Large species; the hind tarsals with additional light markings; haltere well expanded, profusely white scaled; first abdominal sternite with two small patches of scales; posterior marginal wing scales begin well before middle of anal cell................................*maculipes* Theob.[17]
14. Hind tarsals black with small white rings at apices of segments; abdomen with a conspicuous light tip, the cerci usually well extruded, each with the apical half strongly constricted; wing scales predominately black; post-marginal wing scales beginning well before the middle of the anal cell ....*shannoni* Davis
Hind tarsals with additional light markings; tip of abdomen predominantly dark, the cerci normal...15
15. Last hind tarsal entirely light colored; dark spot at tips of second vein about the size of that at tip of first vein; post-marginal wing scales begin at about middle of anal cell...16
Last hind tarsal at least in part black; without scales on mesepimeron; wing scales moderately dilated..18
16. Wing scales moderately dilated; without scales on mesepimeron or first abdominal sternite; mid femur on upper side with a small (less than width of femur) preapical white spot ....
punctimacula Dyar and Knab.
Wing scales markedly dilated, about one-half as broad as long; mespimeron with a small patch of scales on upper portion............................17
17. Fourth hind tarsal with one black ring; mid femur with lateral apical light spots (upper side black); first abdominal sternite with two small

[16] In the course of this study certain characters heretofore unused in the group *Arribalzagia* appeared to offer additional means for classifying this difficult group. I am supplementing the old characters with these, but they should be regarded as tentative until tested by large numbers of specimens. In order to extend their application as much as possible at the present time species of *Arribalzagia* have been included in the table.

[17] Species not found in the Amazon Region.

patches of white scales; lateral scale tufts of the abdomen composed of yellow and black scales .... *mediopunctatus* Theob.

Fourth hind tarsal with two black rings; mid femur, on upper side, with a fairly large white spot (the sides black); first sternite bare; lateral abdominal tufts black, white scales sporadically present............ *fluminensis* Root

18. Post marginal wing scales begin well before the middle of the anal cell; wing scales but little dilated................ *apicimacula* Dyar and Knab[18]

Post-marginal wing scales begin at about the middle of the anal cell; wing scales moderately dilated..19

19. Tips of wing scales rounded; dark spot at the wing apex about the size of the preceding one .... *punctimacula* Dyar and Knab.

Tips of wing scales truncate; dark spot at wing apex decidedly larger than the preceding one.. *intermedius* Chagas

VII.

SYSTEMATIC NOTES ON CERTAIN SPECIES.

1. Larvae of the Species of the Subgenus STETHOMYIA.

Davis (1933) has described and compared the larva of *An. thomasi* with that of *An. kompi*. Important features of the larva of *nimbus* from Iquitos are herein figured. The following key gives the more obvious differences of the three species:

1. Inner hair of the anterior submedian thoracic group with three short apical branches, or simple.. *thomasi*

This hair with six or more branches (about six in *kompi;* fourteen in *nimbus*)..2

2. Antenna with a small two-or-three-branched hair basad of the middle...... *kompi*

Antenna with a four-branched hair at or slightly beyond the middle. Float hairs slightly more apparent than in *kompi* with 8 (1st segment), 12 (2d), 18 (3d) branches .... *nimbus*

Edwards (1930, 1932) in describing the pleural hairs of the larva of *nimbus* states "One of the three long hairs in the prothoracic pleural groups with a series of short spine-like branches along one side." His description was based on specimens from Venezuela. The specimens at hand from Iquitos, however, have this hair developed as described for *kompi* by Root (1932), namely without spines but strongly feathered. The male terminalia of *nimbus* from Iquitos, however, agrees with the figure given by Edwards for this species as based on a specimen from Venezuela.

[18] *Anopheles* (*Anopheles, Arribalzagia*) *neomaculipalpus* recently described by Curry (1931) from Panama is said to differ from *apicimacula* and *punctimacula* by having only two large spots on the costa instead of three, which is characteristic of the other two species.

2. **Anopheles (Cyclolepppteron) mattogrossensis** Lutz and Neiva, 1911.
(= *Anopheles (Anopheles) amazonicus* Christophers, 1923.)

Three specimens of mattogrossensis were compared with the types of *amazonicus* at the Liverpool School of Tropical Medicine by Dr. Alwen Evans, who writes, "The type and paratype of *amazonicus* are by no means in perfect condition, but the only definite difference I can see is the longer forked cell in the former, being about one-third of the wing length in *amazonicus* but not much more than a quarter in *mattogrossensis*." A series of fifty specimens of *mattogrossensis*, however, shows that the length of the upper forked cell varies from 29 to 36 per cent of the wing length, the average being about 32 per cent.

Dyar (1928) suggests that *mattogrossensis* may be a form of *vestitipennis* differing somewhat in color markings. Dr. Alan Stone, however, informs me that the mid-mesepimeral setae which characterize the former are absent in *vestitipennis* (twenty specimens examined). *Mattogrossensis* therefore should be regarded as a distinct species. Apparently it is the only American species possessing mid-mesepimeral setae.

Two pupae were procured, but unfortunately only females emerged. A number of larvae were found. As this stage is as yet undescribed the following is given:

Larva of *An. mattogrossensis*.—Hair at tip of antenna consisting of a single main stem and with small branches uniformly distributed; antennal shaft hair located basad of the middle, very large, the tips extending beyond the apex of the shaft, with about ten branches, outer clypeals thinly branched, each with thirty-five to forty ultimate branches; post clypeals small but with ten to twelve branches; innermost hairs of the anterior submedian thoracic group palmate-like, with ten branches; posterior angle of the thorax with a rudimentary palmate hair; propleural hair group consisting of one short and three long simple hairs; meso- and metapleural groups each with two long simple hairs; abdomen with the full set of palmate hairs, those on segments one and two rather small; segment four with a long lateral two-branched hair, that on segment five two to three branched, the corresponding hair on segment six small, simple; pecten consisting of about sixteen teeth, without marginal hairs.

The double long lateral hairs on segments four and five possibly indicate a relationship with *An. vestitipennis* (Root 1929), but the palmate hairs on the anterior margin of the thorax is an unusual feature for the tropical American species of the subgenus *Anopheles*.

3. **Anopheles (Cyclolepppteron) peryassui** Dyar and Knab 1908.
Anopheles celidopus Dyar and Shannon, 1925.
Anopheles alagoanii Peryassú, 1925.

In the discussion dealing with *peryassui*, *celidopus*, and *alagoanii* by Shannon and Davis (1930), it was pointed out that the last two may be homonyms of the first. Inasmuch as the females and a male of "*celidopus*" (originally described from the Amazon region) collected at Iquitos agree in all essentials with *peryassui* from Bahia, as described by Shannon and Davis, there can no longer be any doubt regarding the homonyms as given above.

4. **Anopheles (Arribalzagia) fluminensis** Root, 1927.

The description of this species was based on two males, reared from larvae found along the edge of a small brook at Itaperuna, Rio de Janeiro. Costa Lima (1929) has recorded two females, one from Goyaz, and the other from São Paulo. In addition to the possession of the white fifth hind tarsal segment, he adds that it may be distinguished from *mediopunctatus* by the color of the scales forming the lateral tufts of the abdomen (see key).

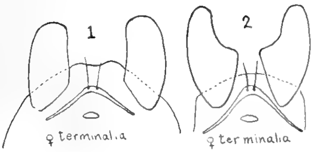
Twelve females which agree with the descriptions of *fluminensis* were collected on animal bait at San Juan, Iquitos. They are quite distinct from other members of *Arribalzagia*, and therefore there should be little doubt regarding the present designation.

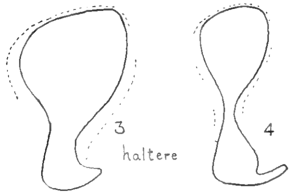
5. **Anopheles (Arribalzagia) Shannoni,** Davis (1931).

Only the female of this species has been described. A single pupa was found in the heart of a forest swamp at San Juan, Iquitos, from which a male was reared. It is therefore possible to add two more stages to the knowledge of this species. In addition, 20 females were collected at various points along the Amazon, but chiefly at Iquitos.

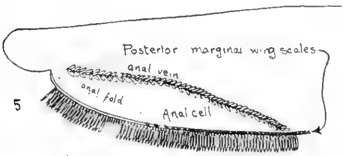
This is the only American anopheline in which the cerci of the female departs strikingly from the palpus-like form common to the genus, a condition possibly correlated with the "flash-color" tip of the abdomen. The abdomen is black except that the eighth tergite and the cerci are conspicuously light-scaled. The cerci are broadened at the middle and taper rather sharply towards the apex (Figure 2, Plate 4).

Terminalia of the male.—Ninth tergite with the usual pair of small, lobe-like processes; inner basal spine with curved tip, the outer straight, rather slender, less than twice the length of the inner (a little longer and heavier than the internal spine); claspette much wider than high, with a median incision, consequently a pair of ventral lobes, each rather uniformly clothed with short hairs and each bearing a single marginal spine and the usual club-like set of three spines which stand on a prominent tubercle; phallosome with a set of seven to eight leaflets on each side at tip, all of similar shape and graduating very uniformly in size from the upper one, which is about two-thirds the length of the phallosome, to the lowermost one which is very minute.

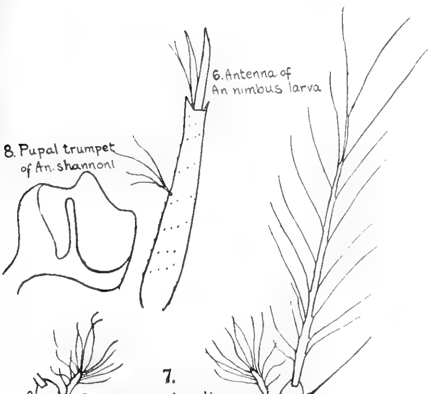




1&3 An mediopunctatus 2 & 4 shannoni



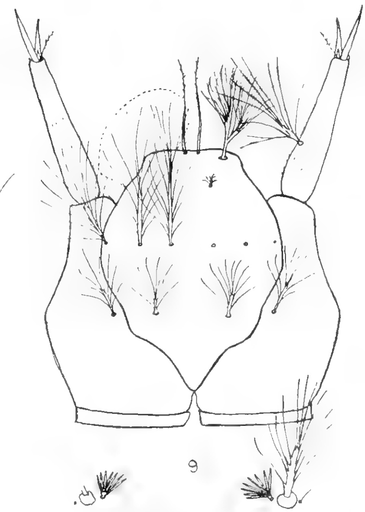
5 Location of the posterior marginal wing scales



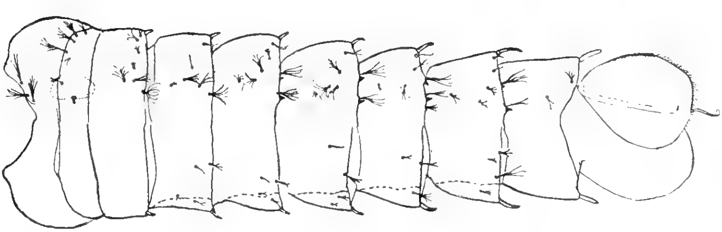
6. Antenna of An nimbus larva

8. Pupal trumpet of An. shannoni

7. Anterior submedian thoracic hair groups An. nimbus



Head and anterior submedian thoracic hair groups of An. mattogrossensis



10. Abdomen of the pupa of Anopheles shannoni. Dorsal and ventral aspects

The short outer basal spine (less than twice the length of the inner), the similarity in form of the leaflets on the phallosome, and the single spine on the claspette shows a similarity to the terminalia of *An. peryassui* (note also that the tarsal markings of these two species are similar); but the presence of the inner spine on the side piece definitely places the species in the *Arribalzagia* group (as also do the inflated wing scales, abdominal scale tufts, and the white scaled upper surface of the halteres).

The pupa.—The salient features of the pupa are: the finger-like process extending across the opening of the pupal trumpet (fig. 8); the short spine-like projections on segments 4–7 (fig. 10); the short hairs on the hind margins of the segments 4-7, equal to but one-half the length of their segments; and the simple condition of the spines on the eighth segment.

VIII.

RAINFALL RECORDS IN THE AMAZON BASIN.

The records for the first five stations were obtained from the Weather Bureau (Washington, D. C.) through the kindness of Mr. W. W. Reed. Those for Boa Vista and Parintins were supplied by the Companhia Ford Industrial do Brazil through the kindness of Mr. C. Rogge.

MEAN MONTHLY AND ANNUAL PRECIPITATION OF CERTAIN STATIONS IN THE AMAZON BASIN.

LOCALITY	YEARS OBS.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JUL.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
Iquitos, Peru	?1	261	250	310	170	254	118	167	117	221	182	213	290	2623
Manáos, Amazonas	15	240	255	235	231	172	111	66	30	50	114	130	210	1819
Porto Velho, Amazonas	6	431	360	455	234	128	40	15	53	80	213	286	406	2682
Belém, Pará	29	294	330	380	310	240	170	157	113	84	70	68	152	2362
Boa Vista, Pará	1 (1929)	385	398	384	373	190	153	45	24	44	8	183	161	2353
Boa Vista, Pará	1 (1930)	165	265	306	236	187	175	61	28	7	20	89	190	1729
Parintins, Amazonas	1 (1930)	208	246	142	182	84	55	46	8	96	2	50	167	1285

SUMMARY.

During a general mosquito survey made in the Amazon Basin, March to June, 1931, fourteen species of *Anopheles* were found, namely *nimbus* Theo., *thomasi* Shannon (*lewisi* Shan.), *kompi* Edwards, *mattogrossensis* Lutz and Neiva (*amazonicus* Christophers), *peryassui* Dyar and Knab (*celidopus* Dyar and Shannon, *alagoani* Pery.), *mediopunctatus* Theo., *fluminensis* Root, *intermedius* Chagas, *shannoni* Davis, *darlingi* Root, *bachmanni* Petrocchi, *tarsimaculatus* Goeldi, *strodei* Root, *albitarsis* L. Arr.

It is shown that the species of anophelini of Brazil, as a whole, can be grouped according to the general type of region they inhabit, as (1) upland species, (2) lowland marsh, swamp, and jungle species, (3) open country, either upland or lowland species, (4) species breeding in bromeliads in forested country. This grouping is in harmony with the systematic group classification of the tribe. All of the species found during the survey belong to groups (2) and (3), which is largely to be expected in view of the nature of the Amazon region. Two species, *strodei* and *albitarsis*, however, were found only at the periphery (fall-line) of the basin, although a variety of the latter, *brasiliensis*, was found at Manáos. The most surprising omission from the list is *argyritarsis*, one of the commonest and most widely distributed of the South American species. One species belonging to group (1), *An. lutzii* Cruz, and one of group (4), *An. cruzii* Dyar and Knab, have been recorded from the region, both by Lutz in 1904. It is believed that the former may have a localized distribution in the valley in the vicinity of hilly sections, where such occur, and that the rarity of the latter may be due to an insufficient development of the bromeliad flora of the region.

An. darlingi appears to be by far the most dangerous malaria vector and was found practically throughout the region, from Belém (near the mouth of the river) to Peru and also on the northern border of Bolivia. It appears to be primarily a floodwater breeding species, and its absence in towns of sufficiently high elevation to be free of flooding (e. g. Iquitos) may thus be accounted for. This, in turn, may account for the comparative lightness of malaria in certain of the Amazonian towns. The presence of *An. albitarsis* along the periphery of the basin may complicate the malaria problem there.

Lists of captures made at each point are given, likewise a key of the species found in the region.

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MEDICAL ENTOMOLOGY—ITS FIELD AND FUNCTION.

By F. C. Bishopp.

Our distinguished associate and friend, the late Dr. W. D. Hunter, in his address as retiring president of this Society in 1915, presented in a most logical way some of the more important facts and principles relating to medical entomology. It is my purpose to present the subject in a somewhat different aspect and to discuss briefly a few of the developments in this field since 1915. I hope to indicate some of the present-day trends, and, as my subject suggests, to analyze the field and point out some of the functions of medical entomology.

It is quite natural that man should have more immediate and direct interest in those insects which annoy him than in those which convey disease to him or those that destroy his crops, stored foods, clothing, habitations, and livestock. Probably one of the chief concerns of Adam and Eve in the Garden of Eden was the mosquito rather than the serpent. It is interesting to speculate on the part which insect annoyance had in stimulating man to develop more adequate body covering than the apron of fig leaves and in impelling him to migrate to other regions.

Since man has found a means of recording his doings, the profound influence which insects have had on him can be determined, at least in part. The destruction of crops by insects obviously influenced very greatly the peoples of southwestern Asia. The rôle played by insect-borne diseases is less apparent in the earlier writings, partly because of the difficulty of identifying such diseases. There is no doubt, however, that insects and insect-borne diseases have played an important part in shaping the destinies of nations and the development of civilization. For example, Sir Ronald Ross, the famed malariologist, has gathered convincing evidence that Greece, once one of the most powerful nations on earth, degenerated partly, if not largely, as a result of the introduction and rather rapid spread of malaria in that country. The industrial and agricultural development of southern Italy has been retarded incalculably and the lives and happiness of the people have been most grievously affected as a result of the prevalence of malignant malaria. Plague, or black death, must have left an ineffaceable imprint on the inhabitants of the countries most frequently stricken. The ravages of this disease were horrible and their economic effects far reaching. Hecker has estimated that in Europe, plague epidemics of the fourteenth century snuffed out the lives of 25,000,000 people, or one-fourth of the population of that continent.

Yellow fever likewise has figured in the political fortunes as well as the economics of nations, particularly in the New

World. As pointed out by Bird,[1] the fact that Porto Rico is American and not British, is practically due to an outbreak of yellow fever. In 1598, when Porto Rico was a Spanish colony, Lord Cumberland attacked San Juan, the capital, and captured it. He held it for five months and was planning to make a British colony of it, when yellow fever broke out among his troops and he was forced to leave. Haiti may credit its independence to an outbreak of yellow fever. The Haitians rose in arms against the French just as Napoleon was preparing to use Haiti as a base for the colonization and fortification of Louisiana. Napoleon sent some of his best troops to subdue the island, but they were stubbornly resisted. A yellow fever epidemic broke out and the troops left. This defeat came when Napoleon was at the height of his glory in Europe. Other insect-borne diseases, such as dysentery, typhoid, and typhus, have had a material influence on the outcome of many wars.

It is not my purpose to do more than touch this interesting historical side of medical entomology. These examples serve to illustrate the importance of the subject in the past. Nor should we conclude that these and many other medical entomological problems are entirely matters of history. They are real, live, vital problems of to-day. While it is true that scientific knowledge of the nature and cause of these diseases has taken much of the terror out of them, especially in this country, where a relatively high plane of living prevails, where an intelligent people live, and where effective machinery for quarantine and other means of combating epidemics is set up, the outlook is not so good among the ignorant, superstitious, and often crowded populations of the Orient and parts of Africa. We must bring ourselves to a realization of the fact that we no longer enjoy the protection that isolation once afforded. The hotbeds of plague, cholera, and sleeping sickness are being brought close to us by fast sea and air navigation. We are now separated from them by days rather than months. Time is an important element in the transfer of disease carriers, whether man or insects. With the development of our present-day system of rapid transportation many of the problems of insect-borne diseases hitherto regarded as more or less localized assume a sinister international aspect.

A very optimistic attitude prevailed in this country and elsewhere with reference to yellow fever when, a few years ago, this disease was wiped out of the United States and epidemics in tropical America were apparently under control. The feeling was freely expressed that this terrible scourge was destined to be banished very promptly from the earth. Recent

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[1] Bird, Jorge, 1930. The Conquest of Yellow Fever. Bol. Asoc. Med. de Puerto Rico, 22: 249–256.

events and discoveries show this hope to be entirely too sanguine. The determination that there exists in West Africa a large endemic area from which several epidemics have arisen, the serious epidemic in Brazil in 1928–29, and the recent occurrence of the disease in the Chaco where Bolivian and Paraguayan troops are battling, cast a deep shadow over the yellow-fever situation. These circumstances make more real the danger that the densely populated Orient, where yellow fever has not yet occurred but where its mosquito vectors abound, may at any time be swept by the disease. Only one unrecognized case entering this region would suffice to set off an epidemic terrible to contemplate.

The ease with which mosquitoes can be carried thousands of miles in a few hours in airplanes used regularly in the now established and rapidly developing intercontinental air service, as shown by recent work by the United States Public Health Service, still further deepens this ominous shadow. Moreover, it has been determined recently that the so-called yellow fever mosquito, *Aedes aegypti* L., is not, as long supposed, the only vector of this dread malady, but that no less than 13 species of *Aedes* are capable of carrying it. This fact, as you can readily see, opens up unexpected possibilities. There is also the disturbing knowledge, recently gained, that in the areas where yellow fever is endemic in Africa there may occur among natives many cases so mild as to pass unnoticed, and also that certain monkeys are susceptible to yellow fever; the difficulties of eliminating the malady from such areas are therefore greatly increased. Here in the United States, in the West Indies, and in other parts of this hemisphere our immune population is dwindling with the lapse of years since yellow fever was eradicated; reintroduction of the disease would consequently give opportunity for more complete devastation of our country.

We probably give too little thought to African insect-borne diseases such as sleeping sickness of man and the deadly nagana of live-stock. A knowledge of the fact that these and other trypanosomiases may be carried by no less than eight different species of tsetse flies (*Glossina* spp.), and that the wild life of Africa harbors the trypanosomes without apparent ill effect, suggests the possibility that wild animals brought into this country may introduce the disease organisms and that these may be carried to man or other susceptible hosts here by the stable fly or some other of our blood-sucking Diptera. Fortunately the quarantine service of the Bureau of Animal Industry guards very closely the introduction into this country of mammals which might be carriers of African trypanosomiasis and other diseases.

The introduction and spread of the flea-borne bubonic plague is a constant threat. With our great population of flea-infested rats and their rather direct contact with other susceptible rodents we have, except for certain climatic conditions, what appears to be an ideal set-up for the introduction and spread of the malady.

This may sound like the preachment of an alarmist. I am not an alarmist but I am convinced that there is need of awakening a more general interest in, and consideration of, some of these dangers. I have confidence in our quarantine agencies. They have a heavy responsibility and one which is shared or should be shared with the general public. There are too many ways of avoiding quarantines and therefore full cooperation of the public is most essential. Moreover, the importance of developing effective methods of combating the many insects which would serve as vectors of these dread diseases, should they gain entrance into this country, can not be too strongly emphasized. In this field especially lies the responsibility of the entomologist.

I have indicated very briefly a few specific problems in the field of medical entomology. There are many others of very diverse character. In its broadest application medical entomology might be defined as the science dealing with insects and related forms which attack vertebrates or which carry disease organisms affecting them. The arthropods concerned may be divided into two main categories: (1) Those which affect vertebrates by their direct attack, contact, or mere presence; (2) those which play a part in carrying disease organisms of vertebrates.

In the first category we find an almost unlimited number of insects involved in a great variety of ways. Certain people and animals show strong reactions to insects. Fear or revulsion may be exhibited upon merely seeing certain insects, or by hearing their buzzing or gnawing. The taste or odor of certain insects in some instances elicits pronounced reactions such as nausea. The pain or worry caused by stings may give even stronger reactions. While perhaps man reacts more strongly than do the lower animals, the effect on lower animals may be very pronounced; consider, for instance, the wild excitement caused among cattle by the oviposition tactics of warble flies, *Hypoderma* spp., and among horses by that of the nose botfly, *Gasterophilus haemorrhoidalis* L. Many different nervous manifestations are caused or intensified by insects. These may take the form of irritability, various skin sensations, insomnia, hallucinations, frenzy, and even insanity. We encounter many interesting instances in man in which it is difficult to differentiate between cases of insect-caused worry and neurosis.

In addition to the pain and discomfort of insect attack there are to be considered the lesions produced from tissue injury and the possible introduction of secondary infection. The forms of mite-produced scabies to which practically all higher animal life is subject are often serious, resulting as they do in great discomfort, loss of weight, and even death. Other species of mites live as endoparasites in various parts of the body, though their economic significance has not been clearly determined. In the numerous cases of myiasis on record we find fly larvae producing various types of injury to tissues; and disturbance to the host may occur even though no direct injury to tissues is apparent, as in certain types of intestinal myiasis.

There is also the important question of the introduction into the host, by the attacking insect, of toxins which may produce purely local symptoms or may cause systemic poisoning. Here again individual idiosyncrasies play a part, as is often observed in connection with the effects of bites of such insects as mosquitoes, sand flies, and fleas, or the stings of ants and bees. More or less generalized symptoms may result from the stings of insects, as in the case of the puss caterpillar, which often causes partial paralysis of parts attacked or even more general paralytic symptoms. Whether tick paralysis in man and animals falls in this category or is the result of the introduction of an organism rather than a toxin is still an unsettled question. Recent work of Drs. Cahn, Wallace, and Thomas of the University of Illinois upon a serious moose disease in which paralysis is manifest leads them to believe that it may be identical with tick paralysis in man and sheep, and that it is caused by a localized infection of a bacillus which they describe as *Klebsiella paralytica*. In cases of tick paralysis the prompt recovery observed upon removal of the ticks causes many to lean toward the toxin theory. The toxic effect of insect bites is well illustrated by the death of mules and other livestock which not infrequently results from the attack of swarms of buffalo gnats (Simuliidae). It is likely that changes in the blood and perhaps other systemic effects may result from the attack on animals of large numbers of blood-sucking parasites such as mosquitoes or ticks. Simple blood loss would hardly account for the profound effects which are sometimes produced by gross infestations.

Now let us return to the second general group mentioned previously, namely, that comprising the forms which carry disease organisms:

There is a great diversity of habit and systematic relationship of both the insect vectors and the organisms carried. Bacteria, fungi, protozoa, helminths, as well as eggs of other disease-producing insects, are transported by insects.

In the transmission of bacterial diseases, insects function mainly in purely mechanical ways but these transmissions are always linked closely with the habits of the insects. Thus we find flies mechanically transferring such bacterial diseases as anthrax, typhoid, and dysentery either from waste products or from diseased individuals to food or wounds, or inoculating healthy individuals by mechanical transfer of the organisms on their beaks as they suck blood. But direct mechanical transference of bacteria is not the only method by which this class of diseases is carried, as Parker has proved that *Bacterium tularense*, the causative organism of tularemia, is capable of inherited transmission in certain ticks, i. e., it passes from one generation to the next through the egg. It is not unlikely that other bacterial diseases may be transmitted similarly from one generation to another.

Protozoan diseases constitute the most important group of insect-borne maladies and in many of them the insect is a necessary intermediate host. A number of them are transmitted through the egg to the next generation, as in splenetic fever of cattle and Rocky Mountain spotted fever of man. Since in most of the protozoan diseases the organisms invade the blood stream, blood-sucking arthropods are most important as carriers. The protozoa transmitted represent many species in several families with a most diversified and intricate relationship to the vectors as well as to the higher animal hosts.

A number of so-called virus diseases, such as yellow fever, fowl pox, and infectious anemia of horses, are carried either exclusively or to a greater or lesser extent by insects. Recent work of Dr. R. A. Kelser of the U. S. Army strongly indicates that encephalomyelitis of horses is transmitted by mosquitoes.

That insects are often infested with larval nematodes and cestodes was one of the first discoveries tending definitely to link insects with the carriage of organisms inimical to higher animals. Entomologists had noted the presence of worms in insects which they had dissected, and Stein, in 1853, suggested that these larval worms may be swallowed with their insect host by some other animal in which the worms complete their development. Not long after, Leuckart made a series of important contributions by showing that a roundworm found in the stomachs of mice passes its earlier stages in the meal worm, and that those of the double-pored tapeworm, which attacks dogs and cats and occasionally man, are passed in the body of the dog louse. In 1878 came Sir Patrick Manson's far-reaching discovery of the relation of mosquitoes to filariasis of man. Since that time our knowledge of the part played by insects and related forms as hosts and carriers of helminths has greatly expanded. In his excellent review of this subject Dr. M. C. Hall[2] has listed the intermediate hosts of helminths. Some 235

[2] Hall, M. C., 1929. Arthropods as intermediate hosts of helminths. Smithsn. Misc. Collect. No. 3024, 77 pp.

species of insects are concerned, representing 14 orders, as follows: Diptera, 110; Coleoptera, 66; Trichoptera, 11; Odonata, 10; Siphonaptera, 7; Lepidoptera, 7; Ephemerida, 7; Orthoptera, 5; Neuroptera, 4; Mallophaga, 2; Isoptera, 2; Anoplura, 2; Plecoptera, 1; and Dermaptera, 1.

The more important orders, with the number of species of each serving as hosts for Cestoda, are: Coleoptera, 8; Siphonaptera, 7; Lepidoptera, 4; for Trematoda are: Diptera, 11; Trichoptera, 11; Odonata, 8; Ephemerida, 5; for Nematoda are: Diptera, 67; Coleoptera, 39; Orthoptera, 5; Siphonaptera, 5; for Acanthocephala are: Coleoptera, 11; Neuroptera, 2; and Orthoptera, 2.

It is not my purpose to enumerate the many diseases, organisms, or insect vectors, but merely to indicate the breadth of the field.

We are given to basing our evaluation of a field of research on purely monetary considerations. It is difficult to put a dollars-and-cents value on a human life and still harder to weigh human suffering in these terms. No one has attempted to estimate the losses caused by all of the insects included in this field of medical entomology. Such estimates are likely to be far from the fact, and hence misleading, but they may serve a useful purpose for comparison and stock taking.

The annual loss in the United States due to malaria has been carefully estimated by Dr. L. O. Howard at $100,000,000. Dr. W. D. Hunter[3] accepted this estimate as conservative and analyzed some of the other losses occasioned by insects as vectors of disease. He lists the following losses chargeable to arthropods:

Malaria	$100,000,000
Splenetic fever of cattle	100,000,000
Spotted fever	100,000
Tuberculosis	50,000,000
Typhoid fever	70,000,000
Enteritis and diarrhea	35,000,000
Dysentery	2,800,000
	$357,900,000

Mr. J. A. Hyslop,[4] in his address as retiring president of this Society a few years ago, in surveying the losses caused by

[3]Hunter, W. D., 1913. American interest in medical entomology. Jour. Econ. Ent. 6: 27–39.

[4]Hyslop, J. A. 1930. An estimate of the damage by some of the more important insect pests in the United States. U. S. Dept. Agr., Bur. Ent. E-286, 21 pp. (Mimeographed circular.)

insects discussed some of the forms which affect man and livestock. His estimates place some of these insects in the forefront as loss producers. He indicates that the annual loss from the cattle grubs (*Hypoderma* spp.) amounts to $35,000,000; from flies on dairy cattle, $60,000,000; from screw worms on livestock, $4,000,000; and from mosquitoes on man, $38,500,000. The last figure, as shown by Hyslop's analysis, includes only time loss caused by morbidity from malaria and among those attending the sick. The death loss and general lowered efficiency from the disease would certainly bring the amount up to Dr. Howard's figure of $100,000,000. Other important sources of loss in connection with mosquitoes, which are not included in this total, are: Depreciated land values, interference with farming and other industries, adverse effect on livestock and wild life, the transmission of filariasis of man and dogs, and transmission of fowl pox and dengue fever. The losses incident to a severe epidemic of dengue such as occurred in the South in 1922 are tremendous. Chandler and Rice estimate the loss in Texas alone during that epidemic at $1,500,000 plus 3,750,000 lost days of labor or other activity. At the extremely low figure of $3 per day this would give a $11,250,000 loss in time, or a total of $12,750,000. The disease was widespread in the South that year and no doubt three times the above number of cases occurred, which would make a probable total loss for the South of $38,250,000. There is also the loss of efficiency of man due to the widespread annoyance of pest mosquitoes, to say nothing of the millions of dollars spent annually on control. The item for screens, which to be sure serve also to protect against flies and other insects, has been estimated by Dr. Howard at $10,000,000 annually. These various losses from mosquitoes would no doubt raise the total for the group to $150,000,000 annually.

Since Dr. Hunter's figure on Rocky Mountain spotted fever was arrived at, the disease has spread to many other parts of the country and the total mortality has increased. Fortunately, however, protection is afforded by the vaccine recently developed by the Public Health Service, and this vaccine is being more widely used each year. Dr. Hunter did not include in his estimate the lowered land values due to the presence of the deadly malady in certain localities, nor the rather considerable expenditures on the prevention of the disease.

Each year there occur in the Rocky Mountain region a considerable number of cases of the so-called Colorado tick fever, a relatively mild disease of man. Time loss from this little-known disease is very difficult to figure, but it is considerable.

Endemic typhus, in the United States, which is apparently carried exclusively by rat fleas and mites, is another important source of loss. There are thousands of cases of this debilitating disease in the United States each year. The eye gnats, which clearly play a part in disseminating pink eye and other more serious eye diseases, materially affect human efficiency and property values in many sections of the South and Southwest. Sand flies are so annoying as to interfere seriously with the resort and tourist business. The failure of resort hotels in some localities has been attributed largely to these insects. Chiggers constitute a troublesome pest over about one-half of the United States, and deter many from living in infested regions. The poultry industry is heavily taxed by infestations of lice, mites, ticks, and sticktight fleas. Some experiments conducted by the Bureau of Entomology at Dallas, Tex., indicated that a 15.8 percent reduction in egg production was chargeable to lice. This loss, if applied to the egg production of the country, would reach a total of approximately $85,000,000 annually.

Biting and sucking lice on livestock clearly cause heavy losses, but it is most difficult to arrive at definite figures. Studies by O. G. Babcock of the damage to mohair from louse infestations indicate that the average annual loss must reach $100,000. The importance of mange and scabies of livestock is attested by the years of effort which have been put forth to eradicate these maladies. Horse botflies are of great importance both as annoyers of their hosts and as internal parasites. The various species of pestiferous ticks affecting all classes of livestock and man also take their toll as parasites.

The ill effects of insects on wild life should not be forgotten. Game birds and animals and other forms of wild life are a great asset, and insects and related forms are coming to be considered as important factors in conservation. For instance, a thorough study of the bob-white by Stoddard has shown that in Southern Georgia the fire ant, *Solenopsis geminata rufa* Jerdon is one of the chief factors in holding down the numbers of this quail. O'Roke has recently shown that from 70 to 100 percent of the domestic and wild ducks in certain areas may be killed by a Leucocytozoon carried by black flies (Simuliidae). Reference has already been made to the moose disease, and many other instances of annoyance or loss chargeable to insects might be cited.

Perhaps we should take some credit on the other side of the ledger for the economic savings effected by the therapeutic use of insects. This does not involve the administration of concoctions containing macerated bedbugs or scorpions, as was done in ancient times, and is even now the practice of certain peoples. I refer to the use of Anopheles mosquitoes in infecting paretics with malaria in the treatment of paresis. The malaria treatment of this disease has given favorable results in many cases and is coming into rather wide use. More tangible results may be presented in connection with the use of fly larvae in the treatment of osteomyelitis. We have the names of 800 hospitals and doctors who have used the maggot treatment for osteomyelitis. Some of these have used the treatment upon 20 to 80 cases. Assuming that each doctor has had 6 to 7 patients, we have a probable total of 5,000 cases treated by this method. Most of the cases heal in a few weeks of treatment. Since many of the patients have been disabled for years, the rapid healing and the discharge of the patient from the hospital mean the saving of hospital expenses either to the patient himself or to the community; and it also means the return of the adult patients to their occupations. A large percentage of the cases are discharged in two months after the treatment is begun, whereas under other methods the hospitalization may last five months. Three months' hospitalization saved for 5,000 patients, at $25 per week, gives a total of $1,500,000. If we assume that one-half of the cases are wage earners, and these are returned to work three months earlier at $100 per month, we have a further saving of $750,000, or a total saving of $2,250,000 as a result of the maggot treatment. This treatment has wider uses which I have not mentioned. There is also the important element of eliminating human suffering.

The function of medical entomology is to control injurious and beneficial insects and related forms in such a way as to prolong life, reduce economic losses, alleviate suffering of both man and his animal friends, and make life more pleasant.

To what extent may we expect these functions to be realized? Perhaps this question may best be answered by the reply to another question, namely: To what extent have these desirable ends been attained already? We must remember that the more important phases of medical entomology are developments of the last 36 years. The fact that 763 papers on medical entomology were abstracted in the Review of Applied Entomology in 1932 is indicative of the activity in this field at the present time. During this brief period discoveries of inestimable value to mankind have followed rapidly one after another. One of the most noteworthy and encouraging things is the readiness with which the fundamental discoveries have been accepted by the people and the rapidity with which they have been applied to the betterment of conditions the world around. The success of the battle against yellow fever has been truly remarkable, the terror of bubonic plague has been largely removed, and malaria is being forced back along the borders of its normal occurrence and its intensity reduced in many of the most malarious regions. Among animals, insect-borne diseases and insect parasites have yielded to a remarkable degree. The results secured in combatting East Coast fever, that dreaded tick-borne scourge of cattle in South Africa, and several other livestock diseases carried by ticks of that region are a great credit to the veterinarians and entomologists of that continent. The eradication of the cattle tick from 88 per cent of the original 728,565 square miles infested in our Southern States is a monumental accomplishment to the credit of the U. S. Bureau of Animal Industry and cooperating State agencies. You will all recall other notable results, and I need not attempt an enumeration of them.

There are almost innumerable problems yet to be solved or which can be more adequately and effectually met. It may be worth while to survey briefly the field with the hope of indicating how science may best function with reference to problems in medical entomology.

In this field there is an unusual opportunity for productive cooperative work. Medical men have contributed the major part of present knowledge on the transmission of disease by insects, but even at the time of the earlier discoveries the work of the entomologist served a most useful purpose. Throughout the planning and execution of the yellow fever-transmission experiments by the Reed Commission Dr. Howard maintained contact with Surgeon General Sternberg and with Major Reed and his associates. Thus his sound advice, as well as his early work and publications[5] on mosquitoes, undoubtedly materially aided the Reed Commission in fixing the responsibility for the transmission of yellow fever on *Aedes aegypti*. The early biological studies of mosquitoes by Dr. Howard and Dr. J. B. Smith and their experience in mosquito control pointed the way to the monumental work of General Gorgas in Cuba and Panama.

The field of medical entomology demands research workers well trained in pathology, physiology, bacteriology, protozoology, helminthology, immunology, epidemiology, engineering, animal husbandry, wild-life conservation, and entomology. Obviously we can not expect expert knowledge in many of these lines in any one man. Cooperation of specialists in these lines would appear to be most necessary. Many excellent and successful cooperative undertakings could be cited.

From the pathological aspect we are concerned with the effects of the insect-borne diseases not only on the higher animal hosts but also on the insects themselves. The lesions caused by direct attack of insects or by their secretions require more complete investigation. Some aspects of the larval therapy for osteomyelitis require expert pathological knowledge, as in

[5] 1892, Life history of and remedies against the mosquito. U. S. Dept. Agr. Div. Ent., Insect Life 4: 329–330; 1900, Notes on the Mosquitoes of the United States: giving some account of their structure and biology, with remarks on remedies. U. S. Dept. Agr. Div. Ent. Bul. 25 (N. S.) 70 pp., illus.

determining the precise effects of maggots on the lesions of the disease and on the patient generally.

Many medical entomological problems require a knowledge of physiology. Questions with reference to the physiology of man or the higher animals are sometimes of importance in this connection but there is an even larger and more important field in the study of the physiology of the insects involved. Altogether too little is known of their tropisms, the functions of their secretions and excretions, their senses, their reactions to all sorts of stimuli, and the factors involved in host choice. Such fundamental physiological information is of the utmost value in insect control.

Naturally the fields of bacteriology and protozoology must be entered to a large extent in studies of insect-borne diseases. There are the questions relating to the development of the disease organisms in the higher animal hosts and in the insect vector, their longevity, their hosts, and other ecological factors concerning these organisms, the answers to all of which are most necessary.

Medical entomology presents some interesting problems in immunology. Of outstanding importance is the production of immunizing sera and vaccines which, as in the case of Rocky Mountain spotted fever vaccine, may be made from the arthropod vector. The subject of immunity to metazoan parasites is relatively new and little understood. The fact that varying degrees of immunity or nonsusceptibility to insect attack exist among higher animals, has long been recognized, but the phenomenon has been little investigated. It is likely that this field offers some opportunity for protection of livestock or man. The recent work of Enderlein[6] in Germany seems to indicate that the injection into livestock of an extract of the bodies or heads of buffalo gnats may prevent the usual death losses from outbreaks of these gnats occurring later in the season. The possibility of desensitizing individuals who are hypersusceptible to insect attack, such as bee stings, mosquito bites, sand fly bites, or chigger attack, is an interesting field for investigation and one which apparently has practical application.

The relationship of insects to helminths naturally extends the reach of medical entomology into helminthology. The extent to which insects are concerned in worm transmission and as obligatory hosts of worms, as well as the effects of the worms on the insects, is a broad and important field. The control of the helminths may be effected by the control of the insect hosts or in other cases the helminths may be a factor in insect control.

[6] 1931. Enderlein, G. Zur Beurteilung und Bekämpfung der Kriebelmücken-Schäden des Leinegebietes. Arch. Wiss. u. Prakt. Tierheilk. 63: 475–528, illus.

Medical entomology has a place in the rather heterogeneous science of epidemiology, because of the fact that arthropods play an important part in the spread of some of the most dangerous epidemic diseases. The suspicion that insects may carry other diseases the means of spread of which is as yet unknown brings entomology strongly into the picture. An intimate knowledge of the distribution of suspected insects, their seasonal abundance, host relationships, and other biological factors is of much value in epidemiological studies of such diseases. These factors often either incriminate or vindicate an insect species. It is recognized of course that purely circumstantial evidence is not sufficient to convict. Only the most careful and extensive transmission experiments can do that.

Engineering fulfills an important function in medical entomology in connection with sewage and other waste disposal and drainage operations, and in other fields where disease organisms are harbored or insects propagate.

Chemistry serves medical entomology in innumerable ways and statistics are a valuable aid.

Quarantine agencies are concerned with medical entomology from the standpoint of the movement of the disease organisms in the higher animal host and of that of the arthropod vector. They are also concerned as to the spread of insect species likely to play a part as pests of man or animals or to become vectors of some disease already established.

Agriculture and animal husbandry are concerned with medical entomology because insects are a serious handicap to animal production, human efficiency, and the conduct of farm operations. The question of farm management is concerned in such matters as the disposal of manure, straw, and wastes, farm-building design and construction, drainage, etc.

As there are many cases in which wild life may serve as intermediate hosts of diseases or the arthropod vectors of such diseases, a knowledge of the biology, habits, and distribution of wild life is of distinct value. In fact, it may be most necessary. This leads us into the field of animal ecology and economic zoology in its restricted sense.

Entomology itself has several important functions to perform with reference to this field of insects and disease. Of fundamental importance is insect taxonomy. This work as it relates to medical entomology is not different from the like service rendered to agricultural entomology. Medical entomology is concerned with taxonomic questions in practically all orders, but especially with certain families of flies, the fleas, the sucking lice, the biting lice, the ticks, and some groups of mites. There is no need of stressing before an entomological audience the value to the field or laboratory worker of early and accurate determinations of insects and of information on the relationships of insect forms which not infrequently indicates their probable biologies, habits, and even distribution.

An intimate knowledge of the biologies not only of known disease vectors but also of those forms which are potential disease carriers is necessary in the furtherance of our knowledge of medical entomology. Such biological information is needed as a foundation for insect control, as has been so often pointed out. Furthermore, it is necessary in the conduct of disease-transmission experiments with insects.

Where insects themselves are the cause of disease, their control solves the disease problem, as in the case of myiasis-producing flies, urticating caterpillars, and other so-called pest forms. In instances in which insects are carriers of disease organisms, the attack has been directed against the disease in the human or animal host, or against the insect vector, or a combination of the two. Probably the latter method has most merit. Treatment of the disease in the man or animal and control of diseased individuals is likely to give disappointing results if the control of the vector is neglected. Dr. C. C. Bass, one of our leading authorities on malaria, who at one time held that quininization of the human malaria carriers would eliminate malaria, seems to have concluded that *Anopheles* mosquito control is also a requisite. Dr. H. R. Carter wrote a few years ago with reference to yellow fever: "Yet Gorgas now believes, and I think all who participated in the work here concur with him unreservedly, that his success in Havana and on the Isthmus was due to the war waged against the *Stegomyia* directly, by the destruction of their breeding places, undertaken as an adjuvant to the isolation of the sick, rather than to that isolation itself; to the control of the insect rather than of the human host."

The logic of attacking the insect vector of a disease is unassailable. In this field, as well as in the biological one, the medical entomologist should have a dominant place.

It is obvious that if the workers in the field of medical entomology are to meet the issues most effectively, close cooperation of a number of groups of scientists and others is necessary. Certain duties and responsibilities rest on each. The line of demarcation between the various fields which contribute to medical entomology in its broadest aspects is by no means well defined.

As entomologists we might do well to ask ourselves how we are functioning with reference to this important field. Are our facilities for training men and our laboratory and field personnel and equipment adequate to meet its demands?

A surprisingly small percentage of the funds appropriated for entomological work are devoted to medical entomology. As an example the appropriations of the Bureau of Entomology may be cited. Of the total appropriations of $2,526,700 for the fiscal year 1933 to the Bureau of Entomology, approximately $169,000, or 6.7 percent, goes to research, taxonomy, and extension work in the field of medical entomology.

The most recent compilation of State experiment station projects is that made by the Office of Experiment Stations for the fiscal year 1930. This list shows that for that year there were 528 entomological projects under way or set up at the various experiment stations. Only 23 of these projects, or 4.3 percent of the whole, were in the field of medical entomology.

Among the 931 extension projects undertaken in the various experiment stations in recent years, 77, or about 8.3 percent, relate to the insect problems under discussion.

Among the medical schools of this country are to be found a few, such as Harvard and Johns Hopkins, which are giving good training in medical entomology. In many of the universities and experiment stations brief courses in medical entomology are given and a few institutions, such as Minnesota and Cornell, give very satisfactory training.

Replies to questionnaires sent out to representative State universities and experiment stations indicate that somewhat less than 5 percent of the time of the entomological staffs of these institutions is devoted to research, service, and extension work in medical entomology and less than 4.5 percent of the time of the entomological staffs is occupied in teaching this subject. Less than 5 percent of the experiment station bulletins and circulars are concerned with this field.

Considering the economic losses in the realm of medical entomology and bearing in mind the expenditures in this field by non-entomological agencies, it is very apparent that the subject is not receiving the attention it merits. It would also appear that the opportunities for training students for this work should be increased.

NOTES ON THE LIFE HISTORY AND MOLTING PROCESS OF SARCOPHAGA SECURIFERA VILLENEUVE.

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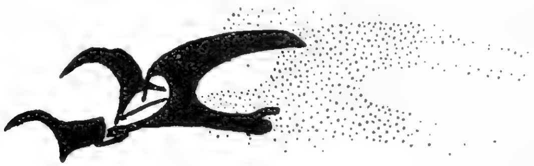
Scientific Aide, Division of Insects Affecting Man and Animals, U. S. Bureau of Entomology.

The mature larva and puparium of *Sarcophaga securifera* Villeneuve are described by Greene (*2*), and Hall (*3*) mentions briefly some observations made by H. E. Ewing. Root (*4*) states that the number of lobes of the anterior spiracle ranges from 10 to 13 with an average of 11.4. Baranoff and Jezic (*1*) report finding the larvae of this species in wounds of domestic animals already occupied by *Wahlfahrtia magnifica* Shin. Identifications of the material used in the work here reported were made by J. M. Aldrich of the U. S. National Museum.

On July 19, 1932, a gravid female was collected from an office window in Washington, D. C., from which numerous larvae were obtained by pressing the abdomen. These were reared on ground lean beef. The larvae were not counted as they were pressed out, but 95 reached maturity and pupated and 91 flies emerged from this one lot. These mated and readily larviposited on fresh beef, making it possible to maintain a permanent stock.

Adults were kept in large cloth-covered cages and given sugar, water, and meat. When meat was omitted, no larvae were developed. After several generations the number of larvae produced began to decline, a condition which was remedied by adding a honey-egg-yeast mixture to the diet of the adults. In most cases the larvae were fully developed but still enclosed in the transparent, membranous eggshell when deposited. In a few minutes the membrane was broken and the larvae crawled out. When light pressure was exerted on the abdomen of a gravid female, the first larvae extruded were not enclosed in this shell, but free and already active. Continued pressure caused these to be followed by others still in the shell, as has also been observed by Ewing (*3*). Although females were frequently watched as they fed on meat, the act of deposition was observed on two occasions only. In each instance about 15 larvae were deposited, all enclosed in the shells. Whenever meat was removed from the cage there could usually be found a few larvae still in the shells and many of the collapsed, empty membranes. Frequently eggs were deposited in which the embryos had not become visible, the membrane being filled with a thick, white liquid. Very often these eggs did not hatch, but in at least one instance they did. About 30 such eggs were deposited between 12:30 and 1:00 A. M., January 19, 1933, and immediately placed in an incubator at 80° F. By 9:00 A. M. the same day all had hatched.

Larvae were reared in a ventilated cabinet which was kept at a constant temperature of 80° F. with the relative humidity variable, but usually ranging from 40 to 50 per cent. Uncovered half-pint paper cups, each containing 100 larvae and fresh beef, were placed on sand in half-gallon waxed cardboard containers covered with cheesecloth. When the larvae were mature they migrated from the beef and buried themselves in the sand to pupate. About 13 hours after deposition, having been kept on beef during the entire time, the larvae began to molt to the second stage. By 16 hours after deposition practically all had molted, although occasional individuals were found in the first stage as late as 29 hours after deposition. The process of molting of the first-instar larvae was observed on several occasions.

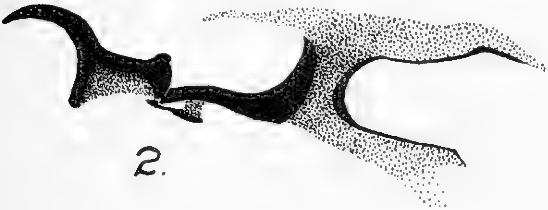


1.

The first change noted as the larvae approach the molt is the appearance of the new lateral hooks directly above the old ones. As early as 8 hours after deposition, 5 hours before the molt, small brown points appear which gradually become darker and longer, until a base is acquired and the entire hook is formed. Just before the molt the new pharyngeal skeleton becomes visible although it is still pale brown (fig. 1). New spiracular plates characteristic of the next instar are formed anterior to those already functioning.

In the instances in which the actual molt was observed, the larva bent the anterior segments ventrally and caught the lateral hooks firmly in the old integument on the ventral surface of the second or third segment. It then twisted and pulled, apparently trying to straighten out. After several efforts the head came up, while the hooks, still caught in the skin, pulled out the old pharyngeal skeleton. The skeleton and hooks were thus left hanging to the ventral surface of the exuvium. The larva now crawled away, the friction against the meat pulling the old skin off toward the posterior end. When larvae were removed from the meat and placed on dry smooth glass after the skeleton had been molted, they were unable to shed the skin. On account of the transparency of the skin, the progress of the molt could be followed only by observing the cast pharyngeal skeleton, which remained hooked to the skin and moved back with it. The last point of attachment of the old skin was at the posterior spiracular plates. When these were pulled loose the lining of the main tracheal trunks was observed to be drawn out attached to them.

The average weight of first-instar larvae just before molting is 2.5 mgm. each. The length at hatching is 2 mm., the width 0.5 mm.; the length at molting is 5 mm., the width 1 mm. The buccopharyngeal apparatus of the first stage is shown in fig. 2. The length of the dorsal cornua is 0.37 mm.; the distance from its posterior extremity to the tip of the hook is 0.62 mm. The larva is metapneustic, each of the posterior spiracles with two slits, connected ventrally (fig. 3). The distance between the two plates is about equal to the width of one.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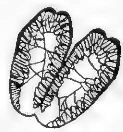
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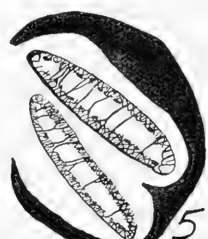
The second molt occurred as early as 23 hours after deposition and as late as 46 hours. Before this molt, as in the previous one, the new lateral hooks can be seen forming above the old ones, and the spiracular plates of the third instar behind those of the second. The actual process of the second molt has also been observed and found to be similar to that of the first. The average weight of second-instar larvae at the time of molting is 20 mgm., single individuals weighing 19 to 22 mgm. The length of second-instar larvae after the first molt is about 5 mm., the width 1 mm.; just before the second molt the length is about 9 mm., the width 2 mm. The dorsal cornua of the pharyngeal skeleton (fig. 4) is 0.55 mm. long; the distance from its posterior tip to the tip of the mouth hooks is 0.82 mm. The second-instar larva is also metapneustic. The anterior spiracles are present under the skin but are not functional. Each posterior spiracle (fig. 5) has two slits. The distance between the two plates is slightly less than one-half the width of one plate.

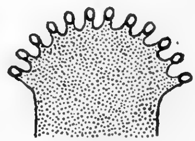

4.


5.

Records of migration were made on 1,435 individuals, of which 585 migrated on the 5th day after deposition, 838 on the 6th day, and 12 later than the 6th day. At the time of migration the larvae become somewhat flattened ventrally and the skin whiter and more opaque. If insufficient meat was provided migration occured earlier and the migrating larvae or prepupae were smaller than normal. When more than sufficient meat was provided a fairly wide range in the weight of the prepupae was noted. The minimum occurred in one lot of 31 individuals which averaged 179 mgm. each, live weight, while the maximum was obtained in a lot of 68 which averaged 235 mgm. each. One lot of 87 individuals reaerd on ground beef heart averaged 251 mgm. The average live weight for 1,549 specimens was 214 mgm. The length of third-instar larvae ranges from 9 mm. after the second molt to 21 mm. at maturity. This instar has been described by Greene[1] (*2*). The length of the dorsal cornua of the pharyngeal skeleton (fig. 6) is 1 mm.; the distance from its posterior extremity to the tip of the mouth hooks is 1.32 mm. The larva is amphipneustic, the posterior spiracles with three slits (fig. 7), the two plates separated by slightly more than one-half the width of one plate. The anterior spiracles are shown in fig. 8.

6.

7.



8.

[1]Owing to a typographical error the number of body segments was given as 10 instead of 11 as the author intended.

TABLE 1.—*Sarcophaga securifera.* Period from deposition of larvae to emergence of adults, and proportion of sexes.

DATE DEPOSITED	DAYS AFTER DEPOSITION.																				TOTAL	
	17		18		19		20		21		22		23		24		25		27			
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
1933																						
Jan. 26					(2)*		7	17	15	12	13	10	1	1							36	40**
do			(14)		(4)		15	17	9	10	3	2	2	1							29	30**
do					(3)		11	9	11	15	14	9	5	3							41	36**
do							1	2	6	6	18	26	7	1	4		2				38	35
do							5	10	11	24	14	14	2	1	1		1				34	49
do								1	5	7	32	27	6	2		1	1		1		45	38
Feb. 4	(57)		14	11																	14	11**
do	(41)		13	22	7	2	4														24	24**
do	(35)		19	22	7	2															26	24**
do	(1)		32	31	13	8	1		1												47	39**
do	(45)		17	15	3																20	15**
do	(71)		6	8																	6	8**
do	(7)		25	28	15	13	1	1													41	42**
do			27	30	13	12		1													40	43

*Numbers in parentheses indicate sexes combined.
**Sex not determined in all the individuals in the lots.

Pupation occurred from the 6th to the 12th day after deposition. Out of 982 individuals, 93 pupated on the 6th day, 564 on the 7th, 269 on the 8th, 36 on the 9th, 12 on the 10th, 5 on the 11th, and 3 on the 12th. The average weight of 1,622 normal pupae was 158 mgm. each. One individual weighed 206 mgm., and one lot of 88 averaged 187 mgm. The smallest pupae from larvae given more than sufficient food were in one lot of 58 averaging 133 mgm. each. The pupa has been described by Greene (*2*).

The pupal period was 10 days in 22 individuals, 11 days in 232 individuals, 12 days in 54 individuals, and 13 days in 1 individual, when kept at 80° F. the entire time.

The total length of the immature stages from deposition of larvae to emergence of adults is shown in table 1. The lots deposited January 26 were kept at 80° F. during the larval period and at room temperature (heated) during the pupal period. The lots deposited February 4 were kept at 80° F. during the entire time.

Oviposition began 8 or 9 days after emergence when the flies were kept at 80° F. with meat present from the first. At room temperature oviposition did not begin until 12 to 14 days after emergence. The flies began to die within a few days after emergence, and the greatest longevity was about a month when the flies were kept at 80° F.

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(4) Root, F. M., 1923. Notes on Larval Characters in the Genus Sarcophaga. Jour. Parasit. 9: 227–229.

MINUTES OF THE SPECIAL MEETING OF THE WASHINGTON ENTOMOLOGICAL SOCIETY, JUNE 15, 1933.

A special meeting of the Washington Entomological Society was held at 8 P. M., Thursday, June 15, 1933, on the campus of the University of Maryland, College Park, Md., under the auspices of the University Department of Entomology, following a basket picnic for members and their families which was held between 6 and 8 P. M. Mr. C. T. Greene, President, presided. There were present about 70 members and visitors. The minutes of the previous meeting were read and approved. There was no preliminary business.

The program consisted of a three-reel motion picture entitled "Parasites of the European Corn Borer," shown by Dr. W. H. Larrimer, which showed many details of life cycles, and artificial rearing methods for several species of parasites.

The President voiced the thanks of the society to Doctor Cory and members of his department for so pleasantly entertaining the society.

Meeting adjourned at 9 P. M.

F. M. Wadley,
Recording Secretary.

Actual date of publication, November 2, 1933.

VOL. 35 NOVEMBER, 1933 No. 8

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OF THE

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OF WASHINGTON

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THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

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The regular meetings of the Society are held in the National Museum on the first Thursday of each month, from October to June, inclusive, at 8 P. M.

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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 35 NOVEMBER, 1933 No. 8

NOTES ON DIPTERA. NO. 6.

By J. M. ALDRICH, *U. S. National Museum.*[1]

The Genus Pedicella or Macrosargus (Stratiomyiidae).—Bigot established the genus *Pedicella* in Annales Soc. ent. France, 1856, pp. 63 and 85, without species, and with a query each time. The slenderness of the abdomen was the only character. In Annales, 1879, p. 187, he proposes to substitute the new generic name *Macrosargus* for *Pedicella*, and places under the new name the following species: *Sargus tenebrifer* Walker, *Sargus natalensis* Macquart, and *Scaeva stamineus* Fabricius, from China, S. Africa, and Mexico, respectively. He also adds with a query two other species.

Brauer, in Zweiflügler des Kais. Mus. Wien (Denkschr. Kais. Akad. Wiss., xliv), pt. 2, 1882, p. 88, designates *Macrosargus tenuiventris* Bigot as type of *Macrosargus*. This is a species which Bigot described among the other new ones much farther along in his 1879 paper (p. 225), but it was not mentioned in the preceding paragraph where he proposed the generic name. In my opinion, supported by high authority in nomenclature, Brauer's designation is not valid, the species not being among those originally included. I therefore designate *Sargus tenebrifer* Walker as type of *Macrosargus*. This Chinese species is easily recognizable and well represented in the U. S. National Museum collection. It belongs to the genus *Ptecticus*, erected in 1855, which therefore takes priority over both *Pedicella* and *Macrosargus*. This does away with much confusion as to the recognition of the very unsatisfactorily defined genus *Pedicella*. Our species of *Sargus* will go in *Geosargus* Bezzi, Wien. Ent. Ztg., xxvi, 1907, p. 53, proposed to replace Sargus preoccupied, and taking the same genotype, *Musca cuprarius* Linnaeus.

Change of name for **Parasetigena segregata** of authors.—Brauer and Bergenstamm proposed Parasetigena (Zweif. Kais. Mus., pt. 5, 1891, p. 339; pt. 6, 1893, p. 120) for *Chaetogena segregata* Rondani (Prod. Dipt. Ital., vol. 3, 1859, p. 7). Mik.

[1]No. 5 of the present series was published in these Proceedings, vol. 33, 1931, pp. 116–121.

(Wien. Ent. Ztg., vol. 11, 1892, p. 117) stated that *Parasetigena* is antedated by *Duponchelia* Robineau-Desvoidy (Dipt. Env. Paris, vol. 1, 1863, p. 531, type species *silvestris*, new), but that the species *segregata* Rondani is prior to Robineau-Desvoidy's specific name in the genus. Bezzi in the Palaearctic Catalogue, vol. 3, did not accept *Duponchelia*, as he showed that it was twice preoccupied. Wainwright (Trans. Ent. Soc. Lond., 1928, p. 195) states that Brauer and Bergenstamm's *segregata* is not the same as Rondani's, but is *Duponchelia silvestris* Robineau-Desvoidy 1863, hence the name *silvestris* takes priority over it; the true *segregata* Rondani he does not know. Villeneuve (Bull. et Ann. Soc. ent. Belg., vol. 59, 1929, p. 105) accepts Wainwright's disposition of the species.

Since *Duponchelia* is preoccupied, *Parasetigena* remains valid if sufficiently distinct from *Phorocera*. Aldrich and Webber (Proc. U. S. Nat. Mus., vol. 63, art. 17, 1924, p. 44), regarded it as a subgenus of *Phorocera*. Wainwright (op. cit., p. 161) says that *Phorocera* has discal abdominal bristles and 3 postsutural dorsocentrals, while *Parasetigena* has no discals and 4 dorsocentrals. European specimens of *segregata* (B. B.'s sense) in the U. S. National Museum, determined by Villeneuve and Coquillett, show bristly discal hairs sometimes approaching the size of bristles. I still think that *Parasetigena* is no more than a subgenus, hence would call the species *Phorocera* (*Parasetigena*) *silvestris* R. D., or for short simply *Phorocera silvestris* R. D.

Pachychaeta jarowchewskyi Portschinsky.

This species was listed by Brauer and Bergenstamm (Zweif. Kais. Mus., v. 1891, p. 403) as from "Russ. Amer.," which naturally appears to mean Alaska. But this was a slip of the pen for "Russ. mer.," or southern Russia. I noted the species as occurring in Alaska in my Catalogue, 1905, p. 421, but at the time could find no reference to the original description. It was published in Horae Soc. Ent. Ross., xvi, 1881, p. 278, where the locality is given as "Ross. merid." It may therefore be dropped from the American list.

The Status of **Oedemagena terrae-novae** Knab.—This species was described by Knab in Proceedings of the Biological Society of Washington, vol. 26, 1914, p. 155. It was based on four females, three, including type, being from Stephenville Bay, St. George, Newfoundland, and one from Deel Lake, Newfoundland, the last bred from the caribou of Newfoundland, *Rangifer terraenovae* (A. Hassall). Knab erroneously states that the first series consists of two specimens, but there are three in the U. S. National Museum, all labeled alike.

The principal character of the species is the uniformly yellow coloration of the abdominal pile, that of *tarandi* being red on the two intermediate segments. Minute differences were alleged in the shape of the eye, width and convexity of frons, and length of abdominal pile. Knab, however, was somewhat doubtful of the distinctness of his form.

In quite recent years a long series of *tarandi* from reindeer in Alaska has been deposited by the Biological Survey in the U. S. National Museum, some 150 specimens in all. While the pile of the intermediate abdominal segments is quite generally red, a few vary in having it more yellow. In three specimens it is entirely yellow, and in several others the red tinge is slight, bridging over the difference completely. The other characters when carefully compared with this series are imperceptible—Knab admitted that they were very slight.

I therefore conclude that *terrae-novae* is a synonym of *tarandi*, although the fact that all the Newfoundland specimens so far known (four) have the yellow abdominal pile may possibly give it the status of a color form for that region.

New Name for **COLLINELLULA** Aldrich.

In August, 1928, the International Entomological Congress met at Ithaca, New York, under the auspices of Cornell University, with a large attendance, including many from abroad. The management arranged a picnic at Taughannock Falls for August 19, which was an immense affair with about 500 in attendance and admirably carried out. On this occasion Mr. J. E. Collin, of Newmarket, England, captured a good series of a remarkable new genus and species of Dolichopodidae, which he left with me for description. After some delay I published this as *Collinellula magistri*, new genus and species, in Proc. U. S. Nat. Mus., vol. 81, art. 9, 1932, p. 4. I intended to signalize Mr. Collin's ability as a collector by both the generic and specific names. But just as I was correcting the page proofs I had a letter from Dr. G. Enderlein, of Berlin, with a sketch of the wing of the male of the same species; he asked its name, remarking that it must be a well-known species, as he had obtained a series at Taughannock Falls on the day of the picnic. I could only add a footnote giving Dr. Enderlein a share in the achievement, which was all the more remarkable since two Europeans had collected the species within a few miles of Cornell University and in the same State with Mr. Van Duzee, whose intensive work on the family is well known.

Unfortunately I overlooked the fact that Duda had proposed the same generic name, *Collinellula*, for a subgenus of Borboridae, in Archiv für Naturgeschichte, 1926 A, p. 48; this was to replace *Collinella* in the same family, a preoccupied name.

I now propose **ENLINIA**, new name, for *Collinellula* Aldrich, in honor of both collectors, and regret that it is too late to change the specific name to the genitive plural.

The Status of **Dimorphomyia calliphoroides** Bigot.—This was described by Bigot in Bull. Soc. ent. France, 1885, p. clxxiii, from Mexico. The describer mentioned that the head appeared to be syrphid in structure, while the wing was muscid. Brauer later examined the type and reported on it in Sitzungsber. Kais. Akad. Wien, cvii, 1898, p. 506. He stated that he could see glue between the head and body, proving that the specimen was composite, or an artifact. This raised a question as to the proper disposal of the name. In my 1905 Catalogue I mentioned it in a note only.

Later I examined the type myself, in the Collin collection. The head is easily recognizable as the common Mexican *Asemosyrphus mexicanus*, in which the ocelli are very far apart, an unusual character. The body is that of a small *Calliphora*, but is a female and unrecognizable without its proper head.

The case is analogous with those in which a type series contains more than one species, and a later reviser is obliged to designate which is to be the true type. I therefore designate the head as the type of *Dimorphomyia calliphoroides;* this makes the genus *Dimorphyomyia* a synonym of *Asemosyrphus* Bigot (genotype *Asemosyrphus oculiferus* Bigot, hereby designated, equals *Helophilus mexicanus* Macquart), and the species *calliphoroides* a synonym of *mexicanus* Macquart.

The Status of the Genus **Spallanzania** Robineau-Desvoidy.—This genus was proposed by Robineau-Desvoidy in Myodaires, 1830, p. 78, with two species, *picea* and *gallica*, both new. Coquillett designated *gallica* as genotype (Proc. U. S. Nat. Mus., 37, 1910, p. 606). Both species were in Robineau's own collection.

Robineau, in Annales Soc. ent. France (II), 9, 1851, p. 317, gives a new definition of the genus and includes *Tachina hebes* Fallen with *gallica* as a synonym; this is repeated in his posthumous Dipteres des Environs de Paris, 1, 1863, p. 749. He places *picea* in *Reaumuria*, 1851, p. 314, but in Env., 1863, p. 747, he again places it in *Spallanzania*, mentioning that the species is in Bigot's collection.

The immediate problem is to ascertain whether *gallica*, the genotype, is really a synonym of *hebes*. If so, *Cnephalia* is a synonym of *Spallanzania;* if not, the identity of *gallica* is obscure and the genus unidentified and probably unidentifiable.

Turning to Robineau's descriptions of *Spallanzania*, his first one reads (translation): "Characters of *Rhedia* and *Reaumuria:* antennae situated in a little deeper groove, second joint longer than in *Rhedia* and shorter than in *Reaumuria;* second joint of arista straight. Facial ridges not ciliate. Color black." Now *Rhedia* and *Reaumuria* are generally accepted as synonyms of *Gonia*, Robineau having placed the males of his species in *Rhedia*, with long third antennal joint, and his females in *Reaumuria*, the third joint being shorter and the second correspondingly lengthened. These characters in this group have slight importance. The main character then is the presence of a deeper antennal groove in *Spallanzania*. This certainly does not occur in *hebes*, where the groove is very shallow in the female, and in the male is less deep than in *Gonia*.

His second description reads (translation):

"Antennae shorter, hardly reaching epistoma; second aristal segment short, straight, not semiarcuate. Bare on the face, the parafacials (optica) without cilia; those of the facial ridges of moderate size, ascending to the middle of the face."

While this description of the antennae fits *hebes* better than *Gonia*, on account of the shorter penultimate segment of the arista, there is an absolute disagreement regarding the parafacials (optica of Robineau) since in *hebes* the presence of numerous bristly and conspicuous hairs on the parafacials is one of the principal characters.

My conclusion is that Robineau did not have the true *hebes*. It may be granted that he did have his own *gallica* before him, although I am not certain even of this much. The types of both original species of *Spallanzania* are lost, and the identification of the genus must rest upon that of the genotype *gallica*. It is practically an unknown genus, but *hebes* does not belong to it, in my opinion.

This outcome is in harmony with European usage, since the genus *Cnephalia* (Rondani, Dipt. Ital. Prod., 1, 1856, p. 62, type des., "*Gonia hebes* Mg.") has been generally accepted there and is the next later generic name. Schiner, Austriaca, 1, 1862, p. 445, states that Rondani's *hebes* is really *Tachina bucephala* Meigen, as Rondani sent him a specimen. This error of Rondani is trivial, since Stein (Archiv f. Naturgeschichte, 91, 1924, p. 120), with the apparent approval of Dr. Villeneuve, makes *bucephala* a variety or perhaps a mere color from of *hebes*.

The American nomenclature has been different since Coquillett, in his Revision of 1897, p. 134, accepted *Spallanzania*, including *Acroglossa hesperidarum* Williston, *hebes* Fallen (as North American), and *antennalis*, new.

Without following the accumulated American literature in detail, I will merely offer the opinion that *hebes* does occur in this country (on the basis of comparison with eight European specimens); that *pansa* Snow (Kans. Univ. Quart., III, 1895, p. 182) is a varietal form of it; that *antennalis* belongs to a distinct genus (*Chaetocrania* Townsend, Proc. Biol. Soc. Wash., 28, 1915, p. 23); and that *Acroglossa* is a valid genus for *hesperidarum* Williston.

TWO REARED SPECIES OF TACHINIDAE FROM SOUTH AMERICA.

By J. M. Aldrich, *U. S. National Museum.*

Specimens of two species of Tachinidae, reared in Brazil and British Guiana by J. G. Myers, were recently received from Sir Guy A. K. Marshall, Director of the Imperial Institute of Entomology, with request for identifications. One of the species had very striking characters and I drew up a description as a new genus and species. The other was not of striking form and I thought it best to send the specimens to Dr. Townsend in Brazil to see if he could connect them with any of his numerous described Brazilian genera and species. I sent along a specimen of my supposed new genus in order that he might record the characters in his index. To my surprise he reported that this had already been described by him, as *Metagonistylum minense;* the other species was not the same as any of his.

The original description of *Metagonistylum minense* is not readily accessible and is written in Portuguese with abbreviations, and moreover gives only a few points of structure; it therefore seems worth while to publish my description of both the genus and the species, especially since the fly now appears to have economic importance.

METAGONISTYLUM Townsend.

Metagonistylum Townsend, Revista Mus. Paulista, vol. 15, 1926, p. 379.

Allied to *Penthosia* Van der Wulp (type *Scopolia satanica* Bigot, from Mexico), but differs in many characters, especially in the great elongation of the first and second antennal joints, greater prominence of the frons, and first posterior cell open. Head as figured (fig. 1), first antennal joint greatly elongated, second also elongated, the third slender, much elongated, concave above, widening at apex; arista with distinctly elongated penultimate joint, the terminal one thickened almost to apex, bare; face very strongly receding; length of head at oral margin hardly one-half of that at antennae; front broad in both sexes, but narrower in male; parafrontals and parafacials wide; ocellar bristles present, proclinate and divergent, uppermost frontal reclinate, the second slightly so; male without orbitals, female with two; lowest frontals diverging below the level of antennal insertion; parafacial bare; facial ridges low and flat with a few hairs below; clypeus with shallow concavity, not at all protruding below; palpi normal, proboscis normal, short; eyes bare; cheek about one-fifth of eye height; hypopleural bristles and postscutellum present; prosternum hairy at sides, propleura bare. Abdomen resembling that of *Cylindromyia*, but the space between its base and the hind coxae distinctly membranous; sternites covered by tergites. Wing with first vein bare, the third with a single large bristle at base, bend of fourth vein a rounded rectangle, thence concave to costa, which it joins well before the apex, the distance to apex being about equal to the costal segment between the second and third veins; hind crossvein joining fourth a little beyond middle between small crossvein and bend.

Genotype.—Metagonistylum minense Townsend.

Metagonistylum minense Townsend.

Metagonistylum minense Townsend, Revista Mus. Paulista, vol. 15, 1926, p. 381.

Black, including antennae and legs; scutellum more or less reddish.

Head.—Male. Vertex 0.31 of head width, the frons widening considerably; parafrontals and parafacials with smooth silvery pollen becoming thin near vertex so that the upper parafrontals appear shining; outer vertical about one-half the inner; a distinct pair of erect parallel post-ocellar bristles; back of head slightly swollen, with broad silvery orbits, a few of the hairs below pale; palpi of ordinary size, blackish except extreme tips, which are distinctly yellow below.

Thorax.—Subshining black with cinereous or rather glaucous pollen, leaving two pairs of shining black stripes, the inner narrow, the outer becoming narrow at the suture and blending behind into a single large subshining area, only visible in posterior view. Chaetotaxy: acrostichal 3, 3 (all rather small); dorsocentral 3, 4 (rather small except hindmost); humeral 4; posthumeral 2; presutural 1; notopleural 2; supraalar 2; intraalar 2 (far back, rather hairlike); postalar 2; scutellum with 3 laterals and an apical depressed pair, not diverging and a small depressed discal pair; sternopleural 1, 1 or 2, 1, sometimes with several other small bristles; ptero-pleural small.

Fig. 1.

Abdomen.—Black, the sides with a more or less reddish tinge, sometimes almost wholly reddish except a median ventral stripe of black; in some angles the tergites are nearly covered with thin grey pollen, but in other lights this is mostly confined to the basal half except on the fourth segment; first segment without median marginals; second with a single pair; third with a marginal row of eight; fourth with a row of erect small discals mixed with bristly hairs and a marginal row of 10 bristles; fifth sternite with a broad excision, the sides short, shining mesially; genital segments small, blackish, inner forceps flat, blunt, tapering, hardly separated to apex; outer forceps shining brownish-black, slender, blunt, a little longer than inner.

Legs.—Claws and pulvilli short, middle tibia with one bristle on outer front side; hind with a few irregular bristles on outer hind side.

Wings.—Of ordinary shape, decidedly brownish, the color more or less confined to wide borders of the veins, but these tend to become confluent; calypters whitish, of ordinary form.

Female.—Frons 0.37 of head width, the parafrontals shining black to a larger extent than in the male; two pairs orbital bristles which are both proclinate in two of the specimens, but in the third the upper one is unmistakably reclinate; abdomen somewhat keeled below and with numerous depressed hairs along the middle; no visible ovipositor.

Redescribed from 3 females and 2 males, reared at Santarem, Amazon, Brazil, by J. G. Myers, a parasite of *Diatraea saccharalis* Fabr.

One male and one female are returned to Imperial Institute of Entomology; one male and two females are retained in the U. S. National Museum.

PROPHRYNO Townsend.

Prophryno Townsend, Revista Mus. Paulista, vol. 15, 1926, p. 262.

Of this genus the designated genotype is *aurulans* Townsend, described on p. 353 of the same work from 7 males taken at Itaquaquecetuba, Sao Paulo, Brazil. One of the males is in the U. S. National Museum, and I add some notes on the generic characters, taken from it.

Eyes densely pilose; facial ridges with strong bristles more than halfway up; third antennal joint decidedly elongate, five or six times the second, with parallel edges; arista with short basal joints, the third joint enlarged on basal two-fifths; ocellar bristles large, proclinate; frontals extending below arista, two uppermost reclinate, of which the second is largest, the decussate frontals below this rather small and sparse on the middle of the front; cheek about one-fourth the eye height; parafacial more than half as wide as third antennal joint. Length of head at vibrissae four-fifths of that at antennae. Dorsocentral 3, 4; acrostichal 3, 3; scutellum with 3 laterals, the middle one small, and a pair of upturned decussate apicals which are less than one-half as long as the next pair of laterals, also with a depressed median pair of discals; sternopleural 2, 2 (both the lower ones small); propleura bare; prosternum with 4 or 5 small hairs on each side. Intermediate abdominal segments without discals, but the second segment has two or three pairs of erect rather bristly hairs in the discal region. Hind tibia subciliate on the outer side. Wing with first vein bare, third with two setules at base, bend of fourth vein rounded and a little oblique, thence concave ending a little before apex and not very far from tip of third; hind cross vein joining fourth a little beyond middle between small and bend.

The new species has all of the above characters with the following differences:—cheek about one-fifth the eye height; face slightly more receding; sternopleurals 2, 1; apical scutellars depressed; no bristly hairs on the middle of the second abdominal segment; the prosternum has one or two pairs of quite strong bristles.

Prophryno myersi, new species.

Male.—Parafrontals and region of ocellar triangle with golden pollen, that of the face and cheek silvery (on the former with a yellowish tinge); basal joints of antennae yellow, third joint black except extreme base, about six times the length of the second; parafacial nearly as wide as third antennal joint; palpi yellow. Thorax black in ground color, tip of scutellum yellowish; mesonotum with two pairs of black stripes bordered by cinereous pollen, the inner pair narrow and rather far apart; pleurae with dense grey pollen; pteropleural minute; calypters white, of ordinary form. Abdomen mostly black in ground color, but the sides rather broadly reddish and the fourth segment entirely red; the pollen is cinereous except on the fourth segment where it is golden; first and second segments without median marginals or the second with a very small depressed pair hardly distinguishable from hairs; third segment with marginal row of about 10, the hairs on its lower side rather dense and small over a considerable area. Venter mostly red; genitalia concealed. Fourth segment with a row of about 10 bristles a little behind the middle, only some bristly hairs at the extreme tip. Legs black, the claws and pulvilli a little elongated, brownish; middle tibia with one bristle on outer front side; hind tibia subciliate with two longer bristles; the coxae are rather strikingly red and subshining when viewed from behind. Wing subhyaline, agreeing with the genotype.

Both specimens are slightly teneral and I do not think the width of the vertex can be determined very exactly; it appears to be about .30 of the head width, but would perhaps be less in more mature specimens. Length 5.6 mm.

Described from two males, reared on Upper Ireng River, Pakeraima Mts., British Guiana, by J. G. Myers, from *Selenis suere* Cramer. The type is returned to the Imperial Institute of Entomology, while the paratype is retained in the U. S. National Museum.

Paratype.—Cat. No. 49789 U. S. N. M.

FOUR NEW SPECIES OF EMPOASCA (HOMOPTERA : CICADELLIDAE).

By F. W. Poos,

Bureau of Entomology, U. S. Department of Agriculture.

This paper contains descriptions of four new species of *Empoasca* from the southeastern part of the United States. Although color and other external characters of these species are described, the writer is of the opinion that the internal male genitalia furnish the only reliably constant characters for specific identification of nearly all of the species belonging to this genus. In many cases the size and shape of the sternal apodemes for muscular attachments at the base of the abdomen are distinct aids in separating species which are otherwise somewhat similar in appearance. The value of these characters was recognized before the writer was aware of their use by Paoli (*4*, *5*)[1] in his descriptions of new species of *Empoasca*. It seems doubtful whether these characters are sufficiently distinctive to make possible the identification of all of the species of this genus by them alone. It is not within the scope of this paper, however, to enter into an extended discussion of the relative value of characters used for specific identification of the species of this genus. For descriptions of other North American species of the genus *Empoasca*, based on characters found in the male genital chamber, the reader is referred to DeLong (*1*, *2*, *3*).

Empoasca sativae, new species.

In general appearance resembling *fabae*. Length of male 3 mm.

Vertex produced about one half its length beyond anterior margins of eyes, a little longer on middle than next eye and about one third wider between eyes than length at middle; pronotum two fifths longer than vertex and with humeral angles prominent.

Color.—Greenish yellow, markings variable; vertex frequently with one pale or dark green spot near anterior margin on each side of median line; pronotum usually with four to six pale spots along anterior margin; scutellum with white line each side of median line to apical half, which has three white spots forming an irregular transverse band just back of middle; elytra greenish yellow, subhyaline.

Male genitalia.—Valve slightly indented on posterior margin (Fig. 1); plates parallel margined for about half their length, then slightly tapered to rounded upturned tips; styles, in ventral view, curved and enlarged between basal third and middle, the apical half narrowed to pointed apices which are somewhat divergent; lateral processes of pygofers in ventral view parallel margined to apical third, where they are somewhat broadened, then concavely rounded to narrow tips, which curve inward and ventrally; spines of tenth segment, in

[1]Reference is made by number (italics) to Literature Cited, p. 178.

ventral view, rather short and inconspicuous, broad at base, extending ventrally to a rather blunt point.

Sternal apodemes for muscular attachments on venter at base of abdomen about three times as long as wide, somewhat narrower than those of *abrupta*, slightly rounded at posterior end.

These characters will distinguish this species from *Empoasca fabae* (Harris) and *Empoasca abrupta* DeLong, the two species which it resembles most closely.

Described from a large series of male specimens collected by the author on alfalfa at Leavenworth, Kans., during August, 1930. Specimens of this species were received from Norman Allen, collected during January, 1932, on alfalfa at Baton Rouge, La. It has also been taken in traplights at Knoxville, Tenn., by W. W. Stanley during 1931 and 1932, and at Arlington Experiment Farm (P. O. Rosslyn, Va.) by the author during 1932. It was also taken by sweeping in an apple orchard at Arlington Experiment Farm by the author in September 1931. Of the collection on alfalfa at Leavenworth, Kans., 82 males were identified and 23, or 28 percent, were *sativae*. Of the collection at Baton Rouge, La., 45 males were identified and 36, or 80 percent, were *sativae*. Of 1,938 specimens identified from collections made in traplights at Knoxville, Tenn., during 1931, 7.3 percent were *sativae*.

Holotype male and paratypes deposited in U. S. National Museum (Cat. No. 49933). Paratypes in the author's collection.

Empoasca delongi, new species.

A pale green, slender species without distinct markings on vertex or pronotum. Length 3 to 3.5 mm.

Vertex produced about one half its length beyond anterior margins of eyes, about one third longer on middle than next the eyes, about one third wider between eyes than length at middle; pronotum twice as long as vertex; elytra long and narrow.

Color.—Pale green marked with white; face tinged with yellow; vertex with a darker green area around each ocellus; pronotum with a rather wide white area bordering anterior margin; scutellum with a pale longitudinal median band to apical third, which is pale green; elytra pale green, subhyaline.

Female genitalia (Figs. 2 and 3).—Last ventral segment more than twice as long as preceding segment and with posterior margin strongly roundedly produced.

Male genitalia.—Valve broad, concavely rounded; plates tapered to rather acute tips and about three times as long as basal width; lateral processes of pygofers, in ventral view, almost straight except near apex, where they curve outwardly to a bluntly pointed apex; styles, in ventral view, curved outward at about half their length and narrowed, with the apices diverging; chitinous spines of tenth segment, in lateral view, rather long and thick, extending to a point which is slightly curved anteriorly.

Sternal apodemes for muscular attachments on venter at base of abdomen not conspicuous but slightly longer than those of *fabae*, slightly longer than width of each at base, somewhat separated from each other, posterior ends distinctly rounded.

Described from a large series of specimens collected as nymphs near Occoquan, Va., during August and September, 1931 and 1932, by the author from horse nettle, *Solanum carolinense* L. Nymphs of this species were also collected by the author, on the same host, at Arlington Experiment Farm on July 12, 1933. This species has also been reared on potato in confinement. The first three specimens of this species were collected near Occoquan, Va., in 1930 by J. G. Conklin. It has never been found abundantly. In one collection of over 40 nymphs, made on August 27, 1932, about 25 percent were attacked by mite larvae determined by Dr. H. E. Ewing of the Division of Taxonomy of Insects, U. S. Bureau of Entomology, as belonging to the family Erythraeidae. The species is named for Dr. D. M. DeLong, who examined three specimens in October, 1930, and recognized that they belonged to an undescribed species.

Holotype male and allotype female in United States National Museum collection (Cat. No. 49934). Male and female paratypes in collections of the author and the U. S. National Museum.

The male genital pieces of this species most resemble those of *Empoasca birdii* Goding as described by DeLong (*1, p. 41–42*) in his revision of this genus, but the genital characters are different and on this basis the two species are easily separated.

Empoasca batatae, new species.

A yellowish green species with a produced vertex which is without distinct markings. Fresh specimens pea green with distinctly yellowish elytra. Length 3.5 mm.

Vertex about one third wider at posterior margin between the eyes than length at middle, produced before anterior margins of eyes about one half its length at middle; pronotum about one half longer than vertex.

Color.—Vertex yellowish with one prominent green spot near apex on each side of median line; pronotum green tinged with yellow; scutellum whitish with posterior tip bluish green; elytra greenish subhyaline tinged with yellow.

Female genitalia (Figs. 4 and 5).—Last ventral segment with posterior margin roundedly produced and entire.

Male genitalia.—Valve concaved on posterior margin between lateral angles; plates more than three times as long as basal width, tapered toward the tip to rounded apices, which are slightly upturned; styles, in ventral view, curved and enlarged at basal third, the apical two thirds more narrowed, almost straight the apices slightly divergent; lateral processes of pygofers parallel margined, rather short and straight, except slightly curved inward at apex, in ventral view; in lateral view apical third curved dorsally to fairly sharp tip; spines of tenth segment, in lateral view, broad and heavy at base, curving anteriorly, then ventrally, and again anteriorly to a sharply pointed apex.

Sternal apodemes for muscular attachments on venter at base of abdomen more than twice as long as wide, rectangular in shape except for slightly rounded corners at posterior end.

Described from a large series of specimens reared on sweet potato in a greenhouse at Arlington Experiment Farm, Rosslyn, Va., and from specimens collected from the same host plant at Fort Myers, Fla., during December, 1931 and 1932, by the author. Specimens were also received from E. J. Hambleton, collected on Leguminosae, June, 1933, at Viçosa, Minas-Gerais, Brazil. The species is named "batatae" for the Latin specific name of the sweet potato. It injures this host plant by feeding on the leaves and producing a distinct and prominent stippling.

Holotype male, allotype female, and paratypes male and female in United States National Museum collection (Cat. No. 49935). Paratypes in author's collection.

Empoasca curvata, new species.

Externally this species is apparently rather closely related to *Empoasca birdii* Goding as described by DeLong. Length 3.5 mm.

Vertex produced about one half its length beyond anterior margins of eyes, about one half longer on middle than next eyes, slightly less than half as wide between eyes (at anterior margin) than length at middle; pronotum less than twice as long as vertex. Elytra rather long and narrow.

Color.—Greenish yellow marked with white and pale brown. Vertex with a pale area anterior to each ocellus and a median longitudinal line; pronotum with three pale spots on anterior margin, a median spot and one behind each eye; scutellum orange with a wide pale longitudinal median band terminating at the apex in a circular spot which is slightly greater in diameter than the width of the median band. Elytra subhyaline with extensive irregular areas brown or smoky.

Male genitalia (Fig. 6).—Posterior margin of valve only slightly concave; plates broad at base and about three times as long as broad, with bluntly pointed apices; styles, in ventral view, curved and slightly enlarged at about the middle, the apical halves gradually narrowed to the apices, which are somewhat divergent; lateral processes of the pygofers long and slender, almost parallel margined, when seen in ventral view extending inward, and crossing near the middle and again near the tips, which are rounded; spines of tenth segment, in lateral view, broad at base, directed ventrally and with apical portion curved rather sharply and tapering almost anteriorly to a pointed apex.

Sternal apodemes for muscular attachments on venter at base of abdomen more than twice as long as width of each at middle; posterior ends rounded and somewhat separated from each other.

The species is named "*curvata*" because of its long curved lateral processes of the pygofers.

Described from one male specimen collected on honeysuckle at Arlington Experiment Farm, Rosslyn, Va., by J. W. Scrivener, March 25, 1932, and from one male specimen taken in traplight October 6, 1931, at Knoxville, Tenn., by W. W. Stanley.

Holotype male, collected March 25, 1932, in the United States National Museum collection (Cat. No. 49936). Paratype male (genitalia only) collected at traplight Oct. 6, 1931, in the author's collection. This specimen was not sufficiently isolated from other material when the abdomen was prepared for study and therefore only the genitalia are available.

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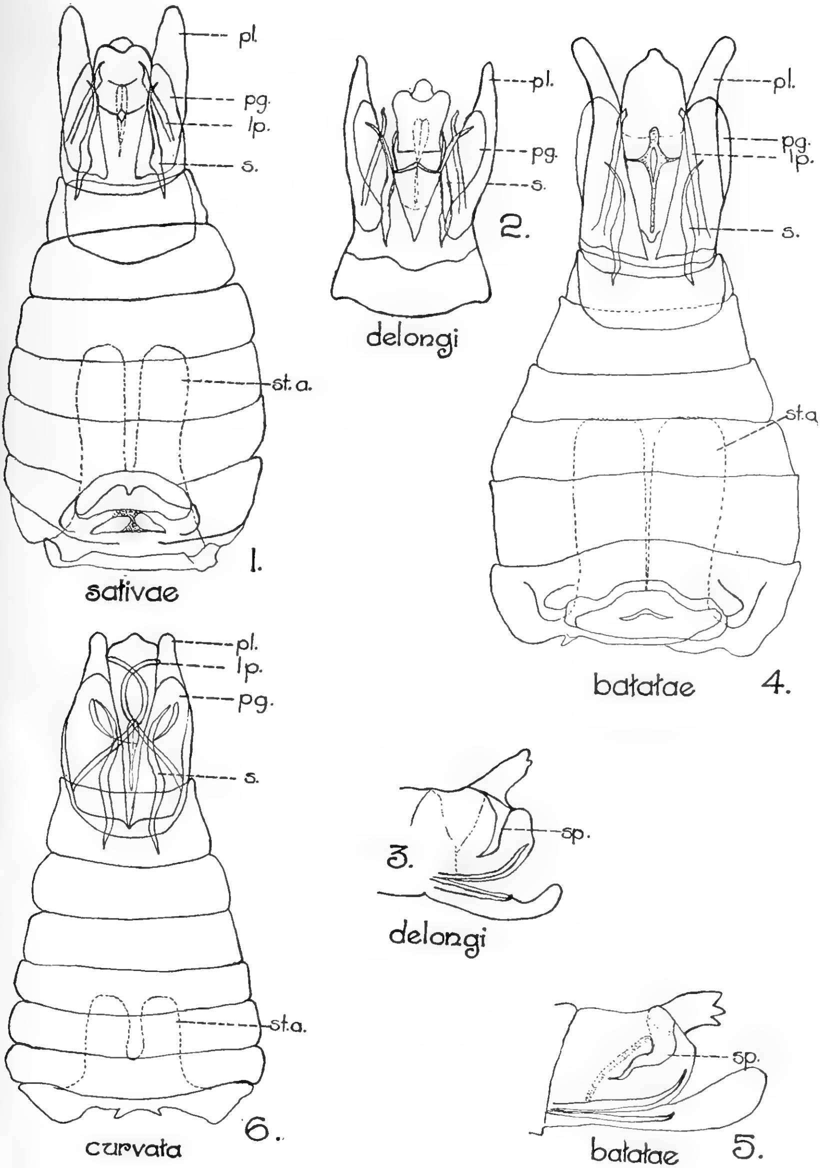
5. Paoli, G. Specie nuove di Empoasca (Hemiptera-omoptera). E Appunti di carologia. (Preprint Nov. 30, 1932.) Mem. Soc. Ent. Ital. 11 : 109–122, illus., published Feb. 28, 1933.

Explanation of Figures.

Internal male genitalia of Empoasca.

Figure 1. *E. sativae*, abdomen, ventral view.
Figure 2. *E. delongi*, ventral view.
Figure 3. *E. delongi*, lateral view.
Figure 4. *E. batatae*, abdomen, ventral view.
Figure 5. *E. batatae*, lateral view.
Figure 6. *E. curvata*, abdomen, ventral view.

l. p...............lateral process of pygofer.
pg....................pygofer.
pl.....................plate.
s.......................style.
sp....................dorsal spine of tenth segment.
st. a...............sternal apodeme for muscular attachment.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TWO NEW SPECIES OF SYSTENA, WITH NOTES ON DIFFERENCES IN SEXUAL COLORATION IN THE GENUS.

By Doris H. Blake,
Bureau of Entomology, United States Department of Agriculture.

The descriptions of two new North American species of *Systena*, well represented in material in the United States National Museum, are here given. One species exhibits sexual differences in coloration, a phenomenon rare in Chrysomelidae, although previously another species of *Systena* has been recognized to be dimorphic in coloration, and a third is noted in this paper.

Systena gracilenta, new species.

Narrowly oblong oval, 3.5 to 5 mm. long, shining, shallowly and finely punctate; pale yellow, with deeper reddish yellow head, and with sides of pronotum and narrow sutural and lateral elytral vittae dark; spot on sides of prosternum, metasternum in part, and tips of tibiae frequently dark; sometimes entire undersurface and legs pale.

Head shining, reddish yellow, with dark mouthparts; very finely and not densely punctate over occiput and front, a larger fovea on each side near eye. Antennae long, slender, and dark, usually each joint paler at the base, third joint considerably shorter than fourth, fifth, or sixth, which are long. *Prothorax* not twice as wide as long, with slightly arcuate sides and more or less distinct basal impression; shining, pale yellow, usually with reddish brown or piceous lateral darkening; finely and not closely punctate. *Scutellum* reddish brown or piceous. *Elytra* long and narrow, shining, very finely and not closely punctate, the humeri not prominent; pale yellow, with narrow dark brown or piceous sutural and lateral vittae, in more heavily marked specimens these joining at apex, in paler specimens the lateral vitta interrupted at apex or evanescent. *Body beneath* shining, with abdomen and legs lightly pubescent; sometimes entirely pale, often with a darker shading on each side of prosternum, and metasternum in part darkened; outer edge or apex of tibiae frequently dark. Length 3.5 to 5 mm., width 1.5 to 2 mm.

Type.—Male, and 4 paratypes (1 male, 3 females), U. S. Nat. Mus. Cat. No. 44746, all collected at Devils River, Texas, in June, 1907, by F. C. Bishopp, F. C. Pratt, and E. A. Schwarz.

Other localities.—Anahuac, Brewster County, Brownsville, Del Rio, Eagle Pass, Edna, Gregory, Laredo, and Victoria, Texas; Tlahualilo, Mexico.

Food plants.—Feeding on *Solidago serotina* Ait. (D. K. McMillan); on *Croton* sp. (J. D. Mitchell); on *Monarda citriodora* (F. C. Bishopp).

This, one of the largest of the vittate species of the genus found north of Mexico, does not appear to have been previously described from Mexico or Central America. It somewhat resembles *S. capitata* Jac., but that species is generally larger, is dark beneath, lacks the dark margin of the pronotum, and has a finely rugose head. *S. gracilenta* is considerably larger and more slender than *S. blanda*, and has longer antennae. Its elytral vittae are narrower, and the punctation finer and not so dense. It most closely resembles the pale southwestern species commonly determined as *S. pallidula* Boh., but that species has a more rectangular prothorax and is generally smaller and paler. The aedeagus of *S. gracilenta* is short and broad, and different from that of either *pallidula* or *blanda*, the two pale vittate species found north of Mexico.

Systena dimorpha, new species.

Oblong oval, 4 to 5 mm. long, somewhat shining, distinctly and densely punctate, prothorax unusually broad; the two sexes differing in coloration.

Male black, often with a lighter, reddish area on vertex, pronotum banded or dark with only the basal margin pale, or rarely entirely black; elytra black with a pale median vitta, rarely entirely black. *Head* with well marked frontal tubercles, usually smooth or only finely punctate in middle of occiput but with a row of coarser punctures near inner margin of eyes and above frontal tubercles, and a larger fovea on each side near eye. Head either entirely dark or with a deep reddish area across vertex. Antennae long and slender, the third joint shorter than the fourth, fifth, or sixth, which are subequal; basal four joints reddish, remainder usually darker. *Prothorax* not twice as broad as long, with arcuate sides and traces of a transverse basal impression, more marked in middle by a depressed spot; surface densely and often coarsely punctate, but in some specimens punctation fine and dense, and in one, somewhat obsolete in middle of disc; black with pale margins, or often only the basal margin pale. *Scutellum* dark. *Elytra* elongate oblong with small humeral prominences; as densely punctate as prothorax and often more coarsely punctate than in *S. elongata;* each elytron usually with a broad, somewhat sinuate pale median vitta not reaching apex. (One specimen from Montana is entirely dark, including the pronotum, with no trace of elytral vittae.) *Body beneath* usually entirely dark, the legs dark, but in paler specimens sometimes a reddish area at base of femora, tarsi reddish brown.

Female usually dark with reddish-yellow area on vertex and about antennal bases; antennae often entirely reddish brown, pronotum either entirely pale or with a dark band; each elytron with a broad pale median vitta and a narrow lateral one, these sometimes uniting at apex. Prosternum pale or at most darkened only in middle. Abdomen sometimes brownish instead of black; femora often with a reddish area at base.

Type.—Male, and 10 paratypes (5 males, 5 females), U. S. Nat. Mus. Cat. No. 44747, all collected at Ordway, Colorado, 26 May, 1913, by H. O. Marsh.

Other localities.—Los Angeles, California; Clemenceau, Arizona; Albuquerque, New Mexico; Ephraim, Utah; Denver, Ft. Collins, and Rocky Ford, Colorado; western Kansas; Montana.

Food plants.—Okra (H. O. Marsh), beets (H. O. Marsh, G. F. Knowlton), *Xanthium* sp. (D. K. McMillan).

This, one of the largest of the vittate species of the genus occurring north of Mexico, resembles *S. elongata* in being rather coarsely and densely punctate, but is larger and shows marked color differences between the sexes. It is quite distinct from *S. taeniata*, which, according to Say's description, is not densely punctate and has pale feet; the elytral vitta of *taeniata*, moreover, is not at all sinuate. Compared with *S. blanda*, to which it is not closely related, it is larger and has a more densely punctate pronotum and a much longer aedeagus. Likewise it is larger than *S. variata* Schaeffer, and is distinguished from that species by its densely and often coarsely punctate pronotum as well as by the coarse punctures about the eyes.

Sexual differences in coloration are found in a few species of *Systena*, but are not frequent in the Chrysomelidae generally. Heikertinger[1] is the only one, as far as is known to me, who has written about sexual bicoloration in Halticinae. He has observed it in the genera *Derocrepis* and *Aeschrocnemis*. He calls attention to the melanistic character of these color differences. In *S. basalis* Jacquel., a West Indian and Central American species, the elytral vitta, which is entire in the male, is present in the female only as a basal and sometimes also an apical pale spot. The undersurface of the male is paler. The existence of color differences between the sexes in this species was first described by Suffrian[2] on the basis of observations by Gundlach. Suffrian noted that the sexes had been separated in the Berlin Museum under two unpublished names, one used for the male and the other for the female.

Another species of *Systena* showing this peculiarity is *S. s-litera* L. Linnaeus[3] described the dark female form. Fabricius[4] noted as a variety a form in which the beetle is paler. Harold[5] also mentioned a pale form. The fact that this "pale form" is the normal male does not appear to have been recognized.

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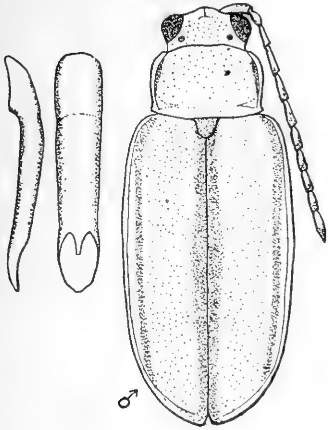
[1]Heikertinger, Ueber Sexualdichroismus bei palaearktischen Halticinen. Zeitschr. f. Wissenschaftliche Insektenbiologie, vol. 8, p. 15, 1912.

[2]Suffrian, Wiegmann's Archiv. f. Naturgesch., vol. 34, Band 1, p. 212, 1868.

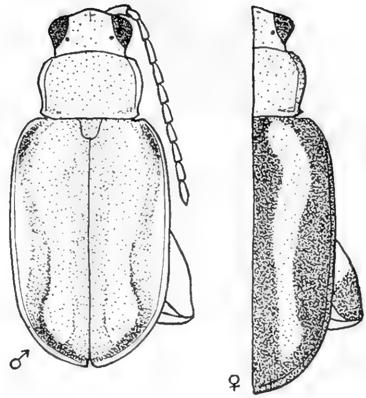
[3]Linnaeus, Syst. Nat., ed. 10, p. 373, 1758.

[4]Fabricius, Syst. El., vol. 1, p. 464, 1801.

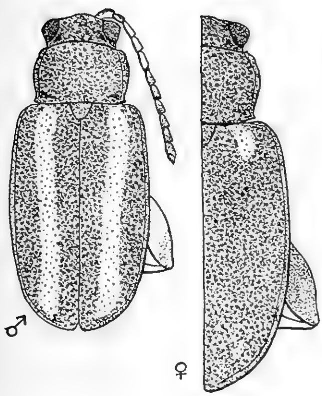
[5]Harold, Col. Heft., vol. 14, p. 30, 1875.



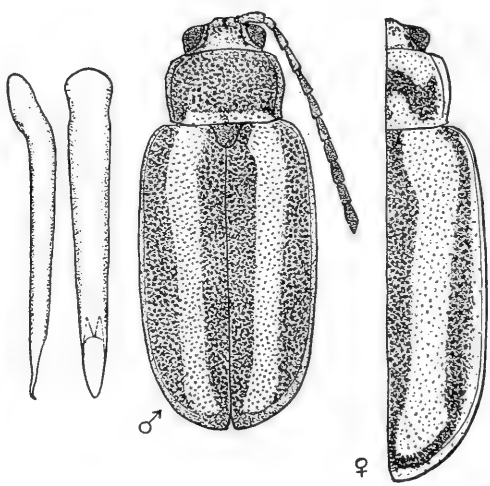
Systena gracilenta n.sp.



Systena s-litera L.



Systena basalis Jacquel.



Systena dimorpha n.sp.

THE EGGS OF FOUR SPECIES OF FRUIT FLIES OF THE GENUS ANASTREPHA.[1]

By Emily Walcott Emmart

Throughout the West Indies and Latin America four species of Anastrepha are of economic importance. These four species *A. ludens*, *A. striata*, *A. fraterculus* and *A. serpentina*, vary widely as to their dominance and distribution. In Mexico all four species are to be found, but *A. ludens* is by far the most prevalent form. With the exception of *A. serpentina* it is not easy to distinguish the adults of these species at sight, unless one is familiar with them at all ages. Both body color and wing pattern vary with age and probably environmental factors. The arrangement of the posterior spiracle and the formation of the mouth hooks of the larva, as well as the arrangement and structure of the spiracular plate of the pupa have been used as a basis of distinguishing the species (C. T. Greene, 1929). The present paper aims to set forth the details of egg structure and pattern so that these four species may be recognized by the eggs alone.

The difficulty in the identification of larva in the field becomes even greater since it is common knowledge that the species at times adopt other than their normal hosts. The preferred host of *A. ludens* in the State of Morelos, Mexico, is the mango (*Mangifera indica*), that of *A. striata* is the guava (*Psidium guayava* L.), of *A. fraterculus*, the hog plum (*Spondias*), and of *A. serpentina*, the zapote mamey (*Calocarpum mammosum* Pierre). Occasionally *A. striata* is reared from mangos and *A. ludens* and *A. fraterculus* are also found in the customary hosts of the other species. This utilizing of different host fruits by the same species makes it impossible to associate definitely, larval forms with specific fruits. As additional evidence for the isolation of species a study of the egg forms was begun. If it were possible to identify the species upon a difference in the eggs, this would have the added value of early identification of species in infested fruit before the larval stage develops.

Using the egg structure as an aid in determination of species is, of course, not new. The structures of the eggs of the Indian Anopheles mosquito have been correlated with the adult characteristics (Christophers and Barraud, 1931), and by studying the marks and structural peculiarities of eggs of *Anopheles maculipennis*, this species has been divided into two

[1]The work on this paper was begun while the author was employed at the laboratory of the Department of Agriculture in Mexico City and was completed in the laboratories of Johns Hopkins University. The author wishes to acknowledge her indebtedness to Prof. H. S. Jennings for reading the manuscript and for his helpful suggestions in the final preparation of the manuscript.

distinct races (Hackett, Martini and Missiroli, 1932). The eggs of different species of *Drosophila* are also known to have distinct characteristics (Sturtevant, 1921).

Method.—A study of the eggs of these four species of *Anastrepha* common in Mexico has been made possible by the rearing in the laboratory of all four species. The adults of these species were reared from larva obtained in fruit collected near Cuernavaca, State of Morelos. Each species was isolated in a separate glass cage and the eggs collected from a number of females in each cage. The eggs which were laid on the glass sides of the cages, were gathered fresh and studied for differences in structure and in size. No difference was noted between these and those which were dissected from beneath the skin of fruit. The following description covers the four species mentioned above.

Appearance.—The eggs of these four species are creamy white in color, elongate in shape and tapering at the ends. In general shape, *A. serpentina* and *A. ludens* most closely resemble each other. The eggs of these two species are slightly wider at the micropylar end, and taper away gradually at the other. *A. fraterculus* and *A. striata* taper at both ends, but can be easily distinguished by the fact that in *A. fraterculus* the micropylar end is twisted (Plate 7).

Sculpturing.—Entirely apart from the difference in general shape, eggs of the four species vary as to the sculpturing on the micropylar end. In *A. fraterculus* and *A. striata* this sculpturing forms a diamond-shaped pattern over the entire end of the egg (Plate 8). This sculpturing is much smaller and more delicate in the eggs of *A. fraterculus* than in those of *A. striata* and can not be seen at all without dark field illumination. The sculpturing seems to be due to an extra deposition of chitin, since the outer egg membrane at this end is thicker than that of the rest of the egg. No sculpturing is present on the eggs of *A. ludens* and *A. serpentina.*

Micropyle.—Both the position and the structure of the micropyle differ in these eggs. In *A. ludens* the micropyle opens at the end of the egg and slightly to one side. The opening is protected by two pairs of minute leaf-like structures or lappets, which protrude farther at some times than at others even in the same egg. They are surrounded by a cluster of fine hairs or bristles, which are numerous and delicate. A few of these appear to be thicker than the others. The micropyle in *A. serpentina* is very similar to that of *A. ludens*, except that the hairs are not so numerous. In *A. striata* the micropyle is in approximately the same position as in *A. ludens* and *A. serpentina*, but the lappets are absent and the hairs are coarser. In *A. fraterculus* the situation is very different. The micropyle is not at the end of the egg, but on one side in the region where the tip of the egg is twisted over. No lappets are present in this egg and the hairs also resemble those of *A. striata* in coarseness.

Hairs.—Besides the hairs or bristles found around the micropyle, there are also tufts of hairs on the smaller end of the eggs of *A. serpentina*, *A. striata* and *A. fraterculus*. None have been observed in this region in the eggs of *A. ludens*. In *A. striata* the whole end of the egg appears to be covered with hairs (Plate 7).

Size.—In size the eggs of *A. serpentina* can easily be recognized as the largest of the four species, but the difference in size of the other three is less obvious. In order to determine their relative differences in size, a straight line between opposite ends of the egg was taken as a measure of the length, and a straight line across the mid-point of the egg as the width. Fifty eggs of *A. ludens*, *A. serpentina* and *A. striata* were measured in this way and thirty-one eggs of *A. fraterculus*. Camera lucida tracings were made of the outlines of these eggs and the distances between the opposite ends of each tracing measured with a centimeter rule. The tracing of a micrometer rule at the same magnification beside these drawings made it possible to calculate the exact size of each egg. *A. fraterculus* eggs are the widest at the midpoint, with a mean width of .242 mm. The mean width of *A. striata* and *A. serpentina* at the midpoint is the same (.207 mm.), while that of *A. ludens* is slightly narrower (200 mm.). An examination of the tracing of the outlines of the eggs (Plate 7) shows that the widest point of the eggs of *A. serpentina* and *A. ludens* falls not at the midpoint but slightly to the left, toward the micropylar end of the egg. The widest point of *A. striata* and *A. fraterculus* eggs falls approximately at the midpoint. These facts, plus the above data of the width at the midpoint, show that it would be impossible to identify the species by the width; however, there are consistently marked differences in the length of these four species. (See Table I.) With regard to length, *A. serpentina* is by far the largest (1.657 mm.), while *A. fraterculus* (1.433 mm.), *A. striata* (1.400 mm.) and *A. ludens* (1.328 mm.) are successively smaller. The standard deviation and the probable errors of both the mean and the standard deviation are given in Table I. The degree of deviation from the mean is due, in part, to the fact that the eggs are curved, and in *A. serpentina* this curvature fluctuates very slightly. Since the distance measured—a straight line between the tips of the egg—would be altered by the degree of curvature, it follows that the standard deviation from the mean length is greater in these eggs with varying curvature than in those which show no variation in curvature. It happens that the largest eggs, those of *A. serpentina*, have the greatest fluctuation in curvature, and therefore the greatest deviation from the mean; *A. fraterculus*, which is next in size, has a slightly higher probable error of the mean, and the standard deviation is almost as high as that of *A. serpentina*. In *A. fraterculus* the micropylar end is bent over and the position of the egg when traced would influence considerably the measurement of the length. This

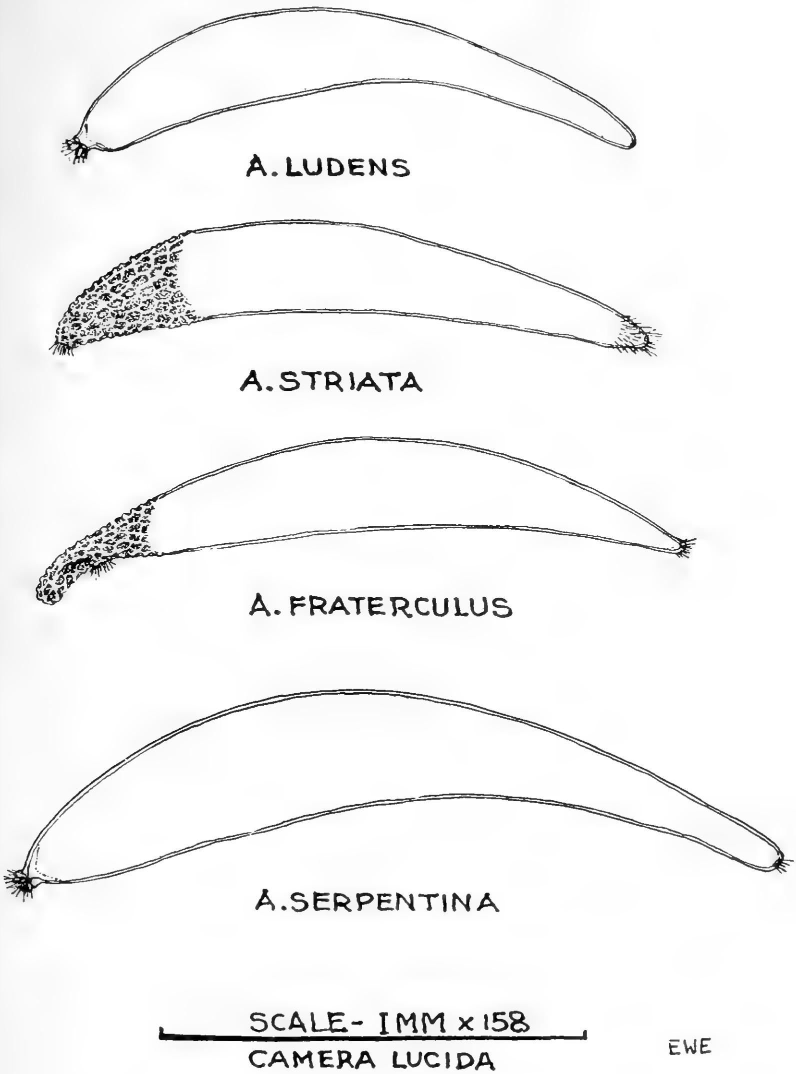


PLATE 7.—EGGS OF FOUR SPECIES OF ANASTREPHA COMMON IN MEXICO.

fact offers an explanation for the higher standard deviation from the mean length in this species. (See Table I.)

TABLE I.

Relative Size of Eggs of Four Species of *Anastrepha*.

SPECIES	NUMBER OF EGGS MEASURED	MEAN LENGTH IN MM.	PROBABLE ERROR	STANDARD DEVIATION IN MM.	PROBABLE ERROR
A. ludens	50	1.328	± .007	.082	± .005
A. striata	50	1.400	± .006	.064	± .004
A. fraterculus	31	1.433	± .012	.102	± .009
A. serpentina	50	1.657	± .011	.116	± .007

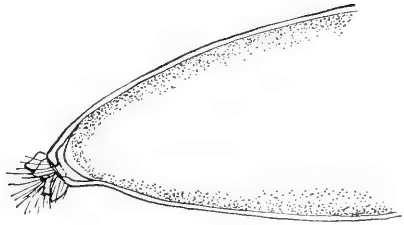
The above data at once raise the question as to whether the difference between the mean lengths is of sufficient significance to serve as a difference between species. The absolute difference is obtained by subtracting successively the means (Table II). If the absolute difference is three times its probable error, it may be stated that the difference is significant and not due to fluctuations of simple sampling. (Pearl, 1930, Page 283.) Using the formula $E_{x-y} = \sqrt{E_x^2 + E_y^2}$ to obtain the probable error of the differences of the mean lengths, the following data are obtained:

TABLE II.

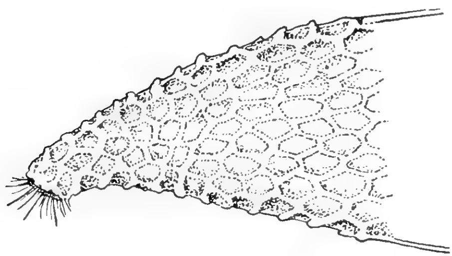
Comparison of the Mean Lengths of Four Species of *Anastrepha*.

SPECIES	NO. OF EGGS MEASURED	MEAN LENGTH IN MM.	*A. ludens*	*A. striata*	*A. fraterculus*
			DIFFERENCES AND PROBABLE ERRORS		
A. ludens	50	1.328±.007			
A. striata	50	1.400±.006	.072±.009		
A. fraterculus	31	1.433±.012	.105±.013	.033±.013	
A. serpentina	50	1.657±.011	.329±.013	.157±.013	.224±.016

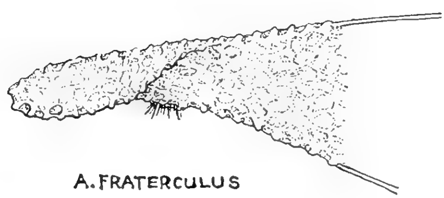
The above Table II, which gives the absolute differences and their probable errors, shows that since the absolute difference between the mean lengths of *A. striata* and *A. fraterculus* is .033 and that the probable error of this is .013, these two species can



A. LUDENS



A. STRIATA



A. FRATERCULUS

A. SERPENTINA

SCALE $\frac{1}{10}$ MM x 720
CAMERA LUCIDA EWE

PLATE 8.—MICROPYLE AND SCULPTURING EGGS OF THE FOUR SPECIES OF ANASTREPHA COMMON IN MEXICO.

not be separated on the basis of the length of the eggs alone. However, in all other comparisons of the egg lengths of these four species, the absolute difference far exceeds three times its probable error and the mean lengths are therefore significantly different.

The striking difference in the size of the eggs of *A. serpentina* and *A. ludens* is not paralleled by the adults—they are almost of the same size. On the other hand, the eggs of *A. striata* and *A. fraterculus* are almost equal in size, as are also the adults.

SUMMARY.

1. Summarizing the various differences in structure found in the eggs of the four species of Anastrepha which are common in Mexico, we find sufficient differences upon which to separate the species (Table III).

TABLE III.

SUMMARY OF EGG VARIATIONS.

SPECIES	SIZE LENGTH IN MM.	POSITION OF MICROPYLE	PRESENCE OF LAPPETS AT MICROPYLE	TWISTING MICRO-PYLAR END	SCULP-TURING	PRESENCE OF HAIRS ON NARROW END
A. ludens	1.328±.007	At end	2 pairs	None	None	None
A. striata	1.400±.006	At end	None	None	Diamond shaped sculpturing around micropylar end	Completely covering narrow end
A. fraterculus	1.433±.012 (Not statistically different from *A. striata*)	Near end in fold of twist	None	Twisted	Same as *A. striata* but much smaller and more delicate	Small tuft at extreme tip.
A. serpentina	1.657±.011	At end	2 pairs	None	None	Small tuft at extreme tip.

2. Using the length as an index to the size of the eggs of the eggs of a species it is possible to separate the species upon this basis, except in the comparison of *A. fraterculus* and *A. striata* which are nearly of the same size. However, the twisted micropylar end of the egg of *A. fraterculus* renders this form easy to identify.

While it has been shown that the identification of these four species is possible on the basis of egg structure, the task of finding the eggs in infested fruit still remains a difficult one. But, when they are obtained, an early identification of the species will be possible.

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MINUTES OF THE 449TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, OCT. 5, 1933.

The 449th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, October 5, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, president, presided. There were present 47 members and 21 visitors. The minutes of the previous meeting were read and approved.

There was no preliminary business.

Dr. Carlos Marelli of La Plata, Argentina; Dr. M. D. Leonard of the Powell Insecticide Co.; and Mr. A. S. Hoyt, Assistant Chief of the Bureau of Plant Quarantine; upon invitation, greeted the society.

Under the heading "Notes and Exhibitions of Specimens" Mr. August Busck showed specimens of *Platynota stultana*, and discussed its recent introduction into the East.

For the last twenty years we have received specimens of *Platynota stultana* Walsingham from California with record of injury to various cultivated plants, from citrus to greenhouse carnations. The species was described by Barnes and Busck as *Platynota chiquitana* and thus determined for California correspondents from 1919 to 1932. In the summer of 1932 I examined the type series of *Platynota stultana* Walsingham in British Museum and secured part of it for our National Museum, enabling me to establish the synonymy of the Barnes and Busck name.

Last summer a considerable infestation of this species on green peppers and tomatoes in Sonora and Sinaloa, Mexico, caused temporary quarantine of these products along our southwest border, and live material was sent to the Department here for rearing and determination. The species has never been known from the East and it was therefore rather startling when Mr. F. F. Smith, of our Department, sent over a specimen of this species, reared from rose in a greenhouse in Alexandria, Va.

The first inference was that the species had escaped from the Mexican material in rearing here; secondly I began to suspect that someone was trying to play a joke on the microlepidopterist to see if he could identify a western species when it was brought in from an eastern locality; but Mr. Smith quickly secured an abundance of living larvae and suggested another and undoubtedly correct explanation of its occurrence here. It appears a common practice that eastern florists send their rose stock to California to have it budded there and then returned to the East. As the *Platynota* is a common greenhouse pest in California it is not surprising that this rose stock should become infested and the insect transported with it to the East, where it can readily establish itself under similar greenhouse conditions and infestations may be expected in other florists' establishments in the eastern States.

Whether the species will establish itself out of doors and be able to survive our winters, time will show; I rather expect it will; closely related species of the genus are common in the eastern States and Canada.

Before critical study had been made of the genus, this species was generally considered equal the Texan *Platynota tinctana* Walker and so determined by me for Woglum, Month. Bull. Calif. Dept. Agr. vol. 9, p. 341, 1920, and for Essig in his Insects Western N. Amer., p. 737, 1926. (Author's Abstract.)

This note was discussed by Rohwer.

Mr. R. A. Cushman exhibited a recently killed specimen of *Megarhyssa lunator*, showing something of the mechanics of its use of its long ovipositor.

The first communication on the regular program was by Dr. J. M. Valentine, National Research Fellow, and was entitled "Environmental Response in Carabidae."

Dr. Valentine's field studies in North America, western Europe and northern Africa under divers ecological and climatic conditions have yielded data of some value in determining the direct or indirect effect of radiant energy (light and heat) upon the coloration of carabid populations.

Deficiency in either heat or light inhibits pigmentation, portions of the body, such as the legs and elytra, where the chitin is weakest, often remaining pale or piceous. Complete depigmentation occurs only in subterranean and cavernicole types.

As available radiant energy is increased, there seems to be a critical point at which full pigmentation is allowed but at which no stimulus is offered for the evolution of a microsculpture capable of diffracting light. Insects subject to these conditions are, for the most part, strictly nocturnal, black species, hiding in dark places by day.

Correlated with a greater exposure to the sun's energy, and with the choice of progressively more open habitats, a long series of corresponding color stages may be assembled, from the dark metallic and dull particolored forms of crepuscular habits, concealed in the forest by day under loose cover, to the brilliantly hued species active in the open sunlight.

A broad consideration of these tendencies has led to the theory that adequate radiant energy above a certain critical point is necessary for the full release of the genetic potential stored within the race. Carrying this idea a little further, it is suggested that the relatively great diversity in form and color characteristic of tropical insects is the result of an actual stimulating effect which mutational forces sustain in environments reached by the equatorial sun.

The release of genetic potential has been found to be by no means a random affair. Wherever an environmental factor, such as a homogeneous substratum, is found to be predominant, it becomes indirectly reflected in the appearance of the carabid population inhabiting that ecological frame. The result is convergent evolution. It is thought that all problems of parallelism including mimicry and insular convergence have, fundamentally, a great deal in common, though no analysis of the factors involved has yet proved satisfactory. (Author's Abstract.)

This paper was discussed by Middleton and Cushman.

The second communication on the regular program was by E. R. Sasscer, and was entitled "Plant Quarantine Activities in Puerto Rico."

Mr. Sasscer briefly outlined the Insular and Federal plant quarantine activities in Puerto Rico, pointing out that the Insular law antedated the Plant Quarantine Act of 1912 by two years. The Federal quarantine work in Puerto Rico was first undertaken in 1925 as a result of the promulgation of Quarantine No. 58—The Fruit and Vegetable Quarantine of Puerto Rico. The talk was illustrated with lantern slides. (Author's Abstract.)

This paper was discussed by McIndoo.

Meeting adjourned at 9.35 P. M.

F. M. WADLEY,
Recording Secretary.

Actual date of publication November 27, 1933.

VOL. 35 DECEMBER, 1933 No. 9

PROCEEDINGS

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ENTOMOLOGICAL SOCIETY

OF WASHINGTON

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PROCEEDINGS OF THE
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VOL. 35 DECEMBER, 1933 No. 9

SEVEN NEW SPECIES OF REARED BRACONIDAE (HYMENOPTERA).

By C. F. W. MUESEBECK,
Bureau of Entomology, United States Department of Agriculture.

The following new species are described at this time in order to make the names available for use in economic entomology.

Apanteles homoeosomae, new species.

Most similar to *cacoeciae* Riley but distinguishable by the smoother face, propodeum, and basal abdominal tergites, the completely yellowish or whitish costa, and the longer ovipositor.

Female.—Length 2.5 mm. Head small, much narrower than the thorax; face smooth, not distinctly wider than distance from bases of antennae to apex of clypeus; antennae shorter than body; ocellocular line not distinctly twice the diameter of an ocellus; eyes twice as long as broad; frons and vertex subopaque, not distinctly punctate.

Thorax not distinctly as high as broad; mesoscutum very finely punctate, the punctures not confluent; disk of scutellum polished, virtually impunctate; polished area on lateral face of scutellum semicircular, not nearly extending to the base; propodeum short and broad, very weakly punctate, with a very shallowly impressed or flattened area medially which is smooth and polished and more or less oval in form but is not defined by carinae; mesopleurum smooth and shining, with only faint punctures anteriorly; metapleurum smooth; stigma about twice as long as broad; first abscissa of radius definitely longer than intercubitus and slightly curved; posterior coxa smooth; calcaria of posterior tibia subequal, less than half as long as metatarsus.

Abdomen fully as long as thorax but much narrower; chitinized plate of first tergite practically parallel-sided, at least no broader at apex than at base, fully one and one half times as long as broad at apex, and with only a few weak punctures toward the sides; plate of second tergite completely polished, very short and broad, longest down the middle, its posterior margin arcuate; remaining tergites polished; ovipositor sheaths a little longer than posterior tarsus and at least as long as abdomen.

Deep black; palpi pale toward apex; wings whitish hyaline; costal margin entirely, and a large conspicuous spot at base of the otherwise blackish stigma, yellowish white; metacarpus blackish; veins mostly hyaline; apex of anterior femur, anterior tibia, and extreme bases of middle and posterior tibiae yellowish brown.

Male.—Essentially like the female except that the propodeum and first abdominal tergite are even less distinctly punctate, and the first tergite narrows gradually from base to apex.

Type locality.—Santiago de las Vegas, Province Havana, Cuba.

Type.—U. S. N. M. No. 50013.

Host.—*Homoeosoma electellum* Hulst in sunflower.

Described from one female and four males (including type and allotype) reared by S. C. Bruner, Sept. 4, 1933; two additional males reared by Mr. Bruner at Central Rosario, Province Havana, Cuba, Jan. 23, 1933; and two females and one male reared from the same host at Matthews, Mo., Aug., 1933, by R. B. Swain.

Apanteles impunctatus, new species.

Owing to the absence of an areola on the propodeum this species will not run to the section of my key[1] which contains *diatraeae* Musebeck, but it is, nevertheless, very closely related to that species. It may be further distinguished, however, by its completely impunctate mesoscutum, smoother first tergite, relatively broader and more convex face, paler legs, and shorter female antennae, which are not longer than head and thorax combined and have the second and following falgellar segments at least as broad as long.

Female.—Length 2 mm. Head slightly broader than thorax, unusually short and broad as viewed from in front; face swollen, twice as broad as long between bases of antennae and clypeus, smooth and shining; frons polished; antennal flagellum tapering apically; first flagellar segment thickening from base to apex, not more than one and one half times as long as thick at apex; temples convex.

Thorax unusually strongly depressed; mesoscutum, scutellum, and the pleura completely polished, impunctate; propodeum flat, scarcely declivous, smooth, with a few weak longitudinal striae on the middle; propodeal spiracles unusually large, separated from base of propodeum by one and one half times their diameter; anterior and middle legs very short; all femora somewhat thickened, the posterior pair about three times as long as broad; posterior tibiae short, strongly thickened apically; first abscissa of radius and the intercubitus subequal; nervellus strongly inclivous.

Abdomen about as long as thorax and somewhat narrower; the chitinized plate of first tergite narrowing slightly toward apex, much more than twice as long as broad at apex, smooth and shining, with only a little indefinite sculpture on basal half; plate of second tergite trapezoidal, about as broad at base as long, nearly twice as broad at apex as at base; following tergites polished; ovipositor sheaths a little shorter than posterior femur.

Black; antennae brownish yellow toward base; tegulae brownish; wings

[1]Proc. U. S. Nat. Mus., vol. 58, 1920, p. 487.

hyaline, stigma yellowish hyaline margined with brown; legs, including coxae, yellow or brownish yellow; posterior tibiae toward apex and their tarsi more or less infuscated.

Male.—Similar to female except for the longer and more slender and entirely testaceous antennae, which are as long as the body and have all the flagellar segments elongate.

Type locality.—Jeanerette, La.

Type.—U. S. N. M. No. 50014.

Host.—*Diatraea saccharalis* Fabricius.

Described from fifteen females and three males reared by Dr. W. E. Hinds, June 14, 1933, from a single host larva. In some of the paratypes the posterior coxae are more or less piceous toward base.

Apanteles sorghiellae, new species.

Closely resembling *flaviconchae* Riley: differing especially, however, in its more opaque and somewhat more punctate scutellum, in its unusually white wings with unpigmented veins, and in the shorter female antennae. From *hyphantriae* Riley, which it also resembles, it differs in the closely punctate scutellum, the narrower and entirely black abdomen, black tegulae, white wings, shorter ovipositor, and shorter antennae of the female.

Female.—Length 2 mm. Head strongly transverse; temples narrow but convex; eyes about twice as long as broad, converging slightly below; malar space inclined inward, about as long as basal width of mandible; face shining, nearly smooth, with only faint punctures; frons smooth; ocellocular line about twice diameter of an ocellus; antennae definitely shorter than the body, the thirteenth to seventeenth segments not distinctly longer than broad, the last segment conical, longer than broad.

Thorax at tegulae distinctly broader than head; mesoscutum and scutellum closely punctate, subopaque; scutellum rather large, only slightly convex; propodeum closely finely rugulose except narrowly across the base, and with a distinct median longitudinal carina; mesopleurum closely punctate anteriorly, polished posteriorly, and with a short, very narrow longitudinal groove in the polished area; mesosternum shallowly but distinctly punctate; metapleurum polished on basal half, rugose beyond; posterior coxae weakly punctate and subopaque outwardly; calcaria of posterior tibia subequal, not distinctly half as long as metatarsus; stigma about as long as metacarpus; radius faintly inclined outwardly, not sharply angled with intercubitus; nervellus strongly inclivous, scarcely curved.

Abdomen not distinctly as long as thorax and much narrower, compressed at apex, even narrower than apical width of propodeum, first tergite broadening gradually behind; the second transverse, more than twice as long as wide, and definitely shorter than the third; first and second closely, finely rugulose, opaque; the third finely roughened at base; remainder of abdomen polished; hypopygium slightly surpassing apex of last dorsal segment; ovipositor subexserted.

Black; antennae entirely black; all coxae and trochanters, bases of anterior and middle femora, more or less of posterior femur, especially toward apex, apex of posterior tibia, and posterior tarsus more or less, blackish; tegulae black; wings strikingly white, stigma and metacarpus brown, veins hyaline except sometimes outer side of first cubital cell; venter of abdomen blackish, even at base.

Male.—Essentially as in the female except for the longer antennae, which are fully as long as the body, with even the apical segments more than twice as long as broad; legs slightly darker than in female.

Cocoons.—Yellowish-white, thin, solitary.

Type-locality.—Columbia, Missouri.

Type.—U. S. N. M. No. 50015.

Host.—*Celama sorghiella* Riley.

Seven females and three males (type, allotype, and eight paratypes) reared by Professor L. Haseman from the host mentioned, in October, 1921; one female reared by F. L. Thomas, in Cherokee County, Texas, from the same host; one female, likewise from *C. sorghiella*, reared by W. A. Baker, May 17, 1923, at San Antonio, Texas; and three females and six males reared by W. A. Baker from "webworm larvae" at Pierce, Texas, Sept. 24, 1923.

Apanteles bushnelli, new species.

Similar to *californicus* Muesebeck but with the posterior femora wholly black, the first tergite broader, and the first and second tergites more coarsely sculptured. From *betheli* Viereck, which it also closely resembles, it differs in having the propodeal areola weakly defined, the propodeum punctate rather than rugulose, and the abdomen less slender.

Female.—Length 3 mm. Head strongly transverse; face scarcely narrowing below, distinctly closely punctate, opaque; malar space distinctly shorter than the basal width of mandible; ocellocular line twice as long as the diameter of an ocellus, slightly longer than postocellar line; frons, vertex, and temples punctate and opaque; antennae about as long as the body, the three apical segments subequal and much shorter than the preceding.

Thorax somewhat depressed, a little broader than the head; mesoscutum entirely closely sharply punctate, opaque; furrow at base of scutellum distinctly foveolate; scutellum shiny, punctate except down the middle; polished area on lateral face of scutellum semicircular, extending only half way to base of scutellum; propodeum mostly punctate and opaque, with a more or less oval polished area at apex on each side of the middle, and with a weakly defined finely rugulose median areola; mesopleurum mostly smooth although definitely punctate anteriorly; posterior coxae only indistinctly punctate, subopaque; hind femora moderately broad; inner calcarium of posterior tibia about half as long as metatarsus; stigma more than twice as long as broad; radius originating slightly beyond middle of stigma and joining intercubitus in an even curve.

Abdomen narrower than thorax and about as long; first tergite nearly parallel-sided, closely irregularly rugulose and opaque; second tergite strongly transverse, more than three times as broad at base as long down the middle, much shorter than third, completely finely rugulose and opaque, its posterior margin curved; third tergite delicately wrinkled at its extreme base; the remainder of dorsum of abdomen smooth; hypopygium attaining apex of last dorsal segment; ovipositor sheath slender, considerably longer than posterior tarsus and at least as long as the abdomen.

Black, palpi pale yellow; tegulae black; wings whitish hyaline; anterior legs yellow, with only the coxae black; middle and hind legs mostly black, the middle femur apically, the middle tibia and tarsus, basal half of posterior tibia, and base of posterior metatarsus, yellow.

Male.—Like female in all essential respects, but with the first tergite about twice as long as broad at apex and the second tergite less than twice as broad at base as long down the middle.

Type-locality.—Halsey, Nebraska.

Type.—U. S. N. M. No. 50016.

Described from two females and one male reared by L. G. Baumhofer from pine tips infested with *Rhyacionia frustrana* var. *bushnelli* Busck, July, 1929 (type and allotype), and August, 1928 (paratype). The paratype is from Nenzel, Nebraska. These specimens were reared in the Bureau of Entomology under Hopkins U. S. Nos. 18569-b (type), 18569-a (allotype), and 18570-b (paratype).

Opius hydrelliae, new species.

Runs to couplet 50 in Gahan's key[2] and is most similar to *americanus* Gahan. It is readily distinguished from that species, however, by having the ventral margin of mandible entire, by the presence of a transverse opening between clypeus and mandibles, and by having the third tergite mostly sculptured. From *suturalis*, which it also closely resembles, it is at once separated by the closely sculptured opaque propodeum.

Female.—Length 1.3 mm. Head transverse, about as wide as thorax; temples and cheeks convex; eyes not prominent; malar space not quite so long as basal width of mandible; face mostly smooth, minutely punctate laterally, very narrowly opaque along inner margins of eyes; antennae slender, a little longer than body, 22-segmented, the first flagellar segment more than three times as long as thick and longer than second.

Thorax compact; mesoscutum and scutellum smooth and polished; notauli represented merely by short impressions anteriorly; no median fovea posteriorly on mesoscutum; propodeum completely finely rugulose and opaque; mesopleurum polished, with a distinct foveolate longitudinal furrow and a little longitudinal roughening immediately below this furrow; legs very slender; stigma narrow, emitting radius well before its middle; first abscissa of radius shorter than petiole of first discoidal cell; second abscissa of radius a little longer than first intercubitus; recurrent vein entering base of second cubital cell;

[2]Proc. U. S. N. M., vol. 49, 1915, p. 72.

first brachial cell not distinctly closed at apex below; posterior wing very narrow; mediella slightly shorter than lower abscissa of basella; postnervellus wanting.

Abdomen about as long as thorax, widest on third tergite, where it is fully as broad as thorax; first tergite narrow at base, broadening strongly behind, scarcely longer than broad at apex, closely granularly roughened and opaque; second tergite more than three times as broad as long and sculptured like the first; third tergite about as long as second and slightly wider, the basal two thirds finely granular; remainder of abdomen smooth and polished; ovipositor sheaths scarcely exserted.

Black; antennal scape, mandibles, lower edge of clypeus, and palpi, yellowish; lower part of face and cheeks dark brown; legs including all coxae yellow, the tarsi more or less infuscated; wings hyaline, stigma and veins dark brown.

Type-locality.—Sacramento, Calif.
Type.—U. S. N. M. No. 50017.
Host.—*Hydrellia scapularis* Loew.

Described from six female specimens reared in the Bureau of Entomology under Sacramento No. 31564 by W. B. Cartwright. The number of segments in the atennae of the paratypes ranges from 21 to 23.

Microbracon phyllocnistidis, new species.

Differs from all other oriental species of *Microbracon* known to me in the delicate posteriorly divergent aciculations of the second abdominal tergite and the unusually short ovipositor.

Female.—Length 1.5 mm. Head about as wide as thorax, entirely polished; face strongly receding, flat, much broader than long; transverse diameter of impression between clypeus and mandibles not greater than distance from impression to eye; eyes broadly oval, prominent; malar space longer than basal width of mandible; ocelli small, the distances between them about equal to diameter of one of them; antennae slender, broken in type, 18 segments remaining, all flagellar segments more than twice as long as thick, the first three nearly three times as long as thick.

Thorax entirely polished; notauli faint; mesonotal lobes not elevated; scutellum nearly flat; propodeum polished, with a short stub of a median carina at apex and a poorly defined narrow longitudinal impression on basal half; legs slender; radius arising from about end of basal third of stigma and going to extreme apex of wing; second abscissa of radius about twice as long as first; first cubital cell much longer than first discoidal; second cubital narrowing apically; recurrent vein about as long as second abscissa of cubitus; length of marginal fringe of posterior wing nearly one third the width of wing; radiella wanting except for a short stub at base.

Abdomen hardly as long as thorax, narrow at base, strongly broadened on second and third segments, where it is a little broader than thorax; chitinous plate of first tergite longer than broad, entirely smooth, the anteriorly convergent grooved lines impunctate, the lateral margins of the plate parallel on apical two thirds, but converging somewhat at base; second tergite strongly transverse, three times as broad as long, the surface feebly longitudinally aciculate, the posterior margin curving forward laterally and conspicuously emarginate at the middle; third tergite slightly longer than second, also weakly aciculate, the median aciculations strongly divergent posteriorly; fourth and following tergites not distinctly sculptured; ovipositor sheaths only slightly longer than first tergite.

Yellow; antenna dark brown, scape, pedicel, and two basal flagellar segments yellowish; legs entirely yellow; wings subhyaline, stigma and veins pale; abdomen weakly infuscated on middle of second tergite.

Male.—Very similar to the female, but with the abdomen much narrower and infuscated at apex, and the posterior margin of second tergite more weakly emarginate at the middle. The antennae are 20-segmented.

Type-locality.—Buitenzorg, Java.
Type.—U. S. N. M. No. 50018.
Host.—*Phyllocnistis citrella* Stainton.

Eight females and nine males reared by A. Voute. The number of antennal segments ranges from 16 to 19 in the female paratypes and from 20 to 21 in the male paratypes.

Chelonus (Chelonella) audeoudiae, new species.

Very similar to *rufiscapus* Cameron but apparently differing in the shorter antennae, in the rugulose punctate face, in the sculpturing of the mesoscutum and propodeum, in the unusually swollen posterior tibiae, and in having the abdomen more extensively pale at base.

Female.—Length 3.5 mm. Head very strongly transverse; temples receding from the eyes; eyes large, thickly covered with short pubescence; malar space shorter than clypeus; clypeus decidedly more than half as long as its apical width, finely punctate; face more than twice as broad as long, rugulose punctate; frons rugulose; vertex and occiput more finely sculptured than face; antennae 16-segmented, not so long as head and thorax combined, segments 10 to 15 not longer than broad; postocellar and ocellocular lines subequal, twice the diameter of an ocellus; occipital carina strong.

Thorax stout, covered with short pubescence; mesoscutum punctate, with a low median longitudinal keel, and on the posterior middle with several short and coarse adjacent striae; notauli poorly defined; disk of scutellum broad, nearly flat, minutely punctate with a few larger punctures along the lateral margins; the short dorsal face of propodeum rugose, with a more or less distinct longitudinal keel each side of the middle, and the posterior lateral angles acute; posterior face of propodeum nearly vertical, irregularly punctate; mesopleurum rugulose punctate, with a few smooth vertical ridges below; stigma more than half as broad as long; basal vein a little sinuate; first abscissa of radius hardly longer than second; third abscissa straight; radial cell shorter than stigma; nervulus postfurcal by slightly less than its length; posterior femur considerably thickened beyond basal third; posterior tibia slender at extreme base, unusually swollen beyond, with numerous minute spines on the outer side; inner calcarium of posterior tibia more than half as long as metatarsus; posterior tarsus slender.

Abdomen hardly as long as thorax and a little narrower, broadly rounded at apex, rugose striate on basal half, rugose beyond, most finely so at apex; two well-developed keels from lateral margins at base, converging strongly for a short distance and then running parallel to beyond basal third of abdomen; ovipositor concealed.

Black; scape red; legs red, the posterior coxae black above; wings hyaline; stigma and veins dark brown; abdomen with more than basal third testaceous, except for a blackish spot at middle of basal margin; remainder of abdomen black.

Type-locality.—Ngerengere, Tanganyika.
Paratype-locality.—Tsumeb, Southwest Africa.
Type.—U. S. N. M. No. 50019.

Described from two female specimens reared from *Audeoudia haltica* Meyrick living in the seed capsules ("jumping beans") of Euphorbiaceae, and communicated by Dr. H. Sachtleben, of the Deutsches Entomologisches Institut, Berlin-Dahlem. The paratype has been deposited in that institution. It differs from the type in having all coxae black.

NOTOTHRIPS FOLSOMI, A NEW GENUS AND SPECIES OF THYSANOPTERA FROM THE UNITED STATES.

By J. Douglas Hood, *University of Rochester.*

Exactly twenty-seven years ago, Dr. Justus W. Folsom, known for his embryological work on the segmentation of the insect head, for his taxonomic studies on Collembola, and as the author of the first modern text-book of entomology, suggested to me that the Thysanoptera might be studied to advantage, and gave me a small collection of thrips which he had accumulated while a graduate student at Harvard University. During the years which followed, he and the late Charles A. Hart, both at Illinois, taught me the fundamentals of entomology, directed me in what was then a little-frequented byway of entomological endeavor, and firmly suppressed all near-attempts at premature publication. A superb artist himself, he stressed the superiority of illustrations over mere words in all morphological papers. In these days, when so many of the new specific names proposed are patronymics, it is perhaps necessary to state the foregoing in detail, the better to emphasize the appreciation felt and the signal compliment intended in dedicating *Notothrips folsomi* to him.

NOTOTHRIPS, gen. nov.

(*νῶτος*, the back—in allusion to the dorsally pigmented and sculptured body; *θρίψ*, a wood worm.)

Dorsal surface of entire body roughly sculptured, excepting in the area of the white stripe on each side of prothorax and abdomen. Head longer than broad, longer than prothorax, with a conspicuous groove extending forward from the anterior ocellus. Cheeks set with a few small setigerous tubercles. Mouth cone nearly pointed, almost attaining posterior margin of prothorax. Prothorax with two major setæ on epimeron. Wings always present, not narrowed at middle. Fore tarsus unarmed in female, armed in male with a distinct tooth. Sternum of eighth and ninth abdominal segments of male longer than tergum, the anterior margin prolonged forward, that of VIII only slightly, that of IX to form a conspicuous, slightly up-turned lobe within the body. (See Plate 9, figures 3 and 4.)

Genotype.—*Phlœthrips vittatus* Hood.

To this genus, in addition to the genotype, is assigned the new species described below; and to it may possibly also belong *Phlœothrips albovittatus* Schille, 1910, described and known from two specimens only, both females, taken in Poland. Closely related though it is to *Phlœothrips* Haliday (= *Phlœothrips*, Uzel, emend.), this new genus must be segregated not so much because of the sculpture and the striking color pattern which have suggested the generic name as because of the two large setæ, instead of one, on the proepimeron and the peculiar modification of the ninth sternal sclerite of the male. In the latter respect it shows a close approximation to Priesner's genus *Odontinothrips* which, however, in common with all its relatives, excepting the African genus *Pselaphothrips* possesses only one major seta on the epimeral plate of the prothorax.

Notothrips folsomi, sp. nov.

(Pl. 9, figs. 3 and 4; Pl. 10, fig. 4.)

Male (macropterous).—Length about 2.0 mm. Dorsal surface closely reticulate, non-shining; ventral surface smooth. General color by *reflected* light, dark mahogany brown, with a narrow, latero-dorsal, white stripe extending along each side of the prothorax and abdominal segments 2–7, terminating in a white spot at the base of segment 8; this white stripe is hardly as wide as the antenna, and is interrupted only on the pterothorax and first abdominal segment, where it is entirely wanting. General color by *transmitted* light yellowish brown, with almost unbroken red subhypodermal pigmentation; legs and tube blackish brown, non-pigmented; antennæ nearly concolorous with legs, segments 3–8 slightly paler, 3 yellow in basal third, 4–6 with yellow pedicels; wings of fore pair clouded with brown in the region of the subbasal setæ.

Head (Pl. 9, fig. 3) about 1.25 times as long as greatest width; dorsal and lateral surfaces closely and distinctly reticulate, and with several moderately prominent setigerous tubercles, of which three or four may be seen in profile on each cheek; postocular setæ minute; cheeks only slightly rounded, converging abruptly to eyes, narrowing to base. Eyes moderately large, finely faceted, contained in length of head about 2.8 times, and very slightly narrower than their interval. Ocelli nearly equidistant, opposite center of eyes. Antennæ seven-fourths the length of head; form of segments and chætotaxy shown in illustration (Pl. 9, fig. 4); sense-cones disposed as in genotype. Mouth cone nearly attaining base of prosternum.

Prothorax (Pl. 9, fig. 3) along median dorsal line about 0.54 as long as head, and (including coxæ) fully twice as wide as long, dorsal surface closely reticulate excepting in the areas occupied by the white stripes; all usual setæ present, dilated apically, two pairs on the epimeron. Wings long and strong, the fore pair somewhat wider distally than at middle and with about 16 accessory hairs on posterior margin; subbasal setæ stout and blunt. Legs normal; fore femora not swollen, fore tarsi armed with a short tooth.

Abdomen normal; segment 9 moderately long and with the anterior margin of its sternum prolonged forward to form a conspicuous, slightly up-turned lobe within the body (Pl. 9, fig. 4). Tube about 0.73 as long as head.

Measurements of holotype (♂): Length 2.04 mm.; head, length 0.286 mm., width behind eyes 0.228 mm., width at base 0.206 mm.; eyes, length 0.100 mm., width 0.068 mm., interval 0.072 mm.; prothorax, median dorsal length 0.164 mm., width across coxæ 0.342 mm.; pterothorax, width 0.388 mm.; abdomen, width across segment 2, 0.402 mm.; tube, length 0.210 mm., width at base 0.091 mm., width at apex 0.040 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	44	64	92	76	72	60	52	39
Width (μ):	40	33	40	38	34	28	24	15

Total length of antenna 0.5 mm.

Described from one male taken by the author at Fraser, Colorado, July 8, 1927, from a dead pine branch infested with scolytid beetles [Hood No. 613].

This is a smaller and much less strongly sculptured species than *N. vittatus*. The pronotum and tube are distinctly shorter in comparison with the head, and the intermediate antennal segments, as may be seen by comparing figures 2 and 4 on Plate 9, are relatively much shorter and stouter.

Notothrips vittatus (Hood).

(Pl. 9, figs. 1, 2; Pl. 10, figs. 1–3.)

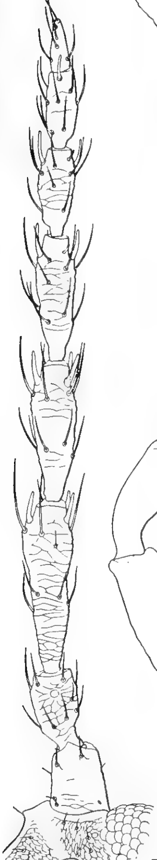
1912. *Phlœothrips vittatus* Hood, Proc. Biol. Soc. Washington, Vol. XXV, p. 11. [2♂, Baldwin, Mich., on poplar.]

1927. *Phlœothrips vittatus*, Hood, Ent. Amer., Vol. VII, p. 229. [1♀, Parkers, Lewis Co., N. Y., on poplar.]

1928. *Phlaeothrips vittatus*, Hood and Herrick, Mem. 101, Cornell Univ. Agr. Exp. Sta., p. 71.

This strikingly colored species, as will be noted from the above citations, is known from three specimens only, two of them males taken in Michigan, one a female from New York. In July and August, 1930, 1931, and 1932, I found it quite commonly at

1



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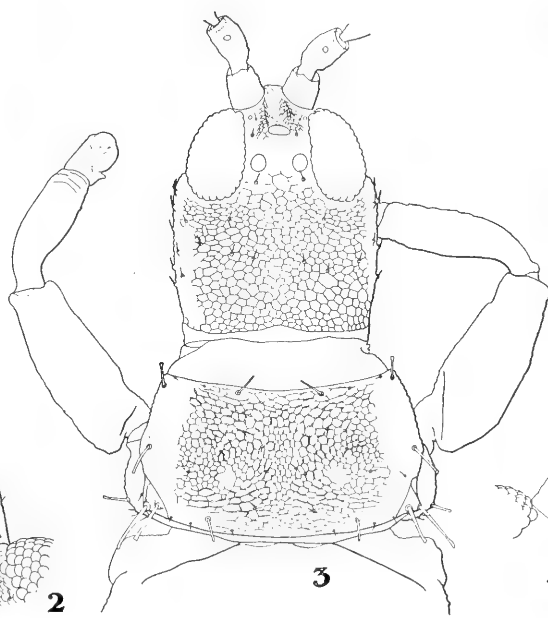

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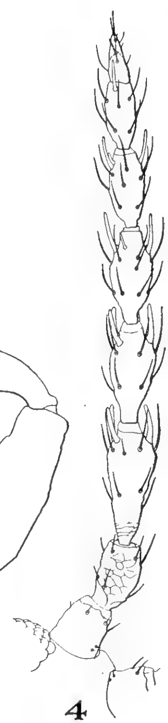

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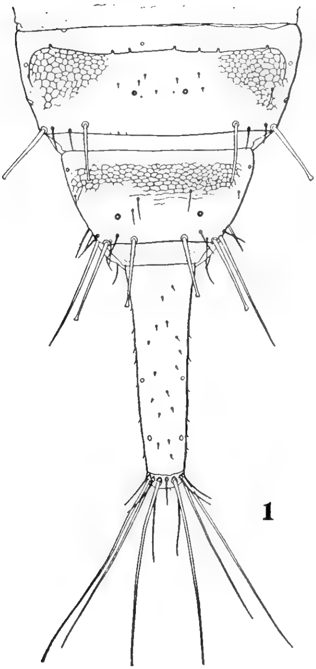

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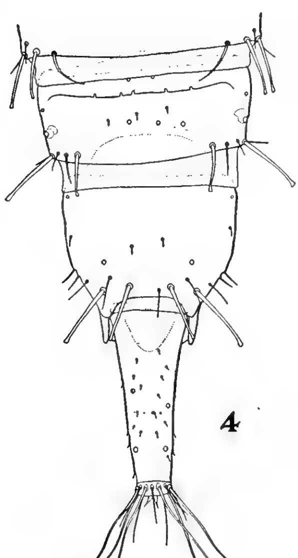

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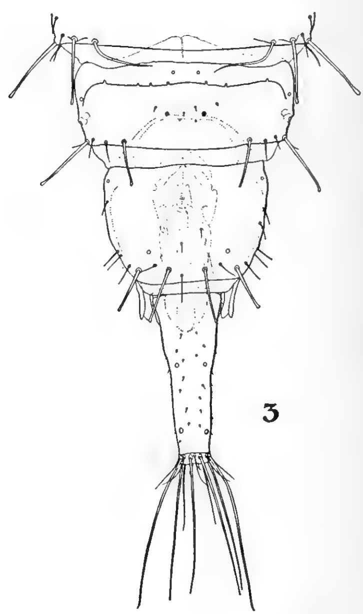

3

Oswegatchie, N. Y., on dying poplar trees (*Populus tremuloides*). On bright warm afternoons individuals could be seen alighting in company with *Acanthothrips nodicornis* (Reuter) on poplars which had been blown down several weeks previously. They were evidently attracted by the noticeable odor of decomposition. Like that species they are very alert and, when approached, are prone to drop to the ground or to fly away if successful in spreading their wings. Though hundreds of adult specimens were seen, nymphs could not be found.

Explanation of Plates.

(The drawings were made with the aid of a camera lucida by Miss Helen E. Rearwin.)

Plate 9.

Fig. 1. *Notothrips vittatus* (Hood), head and prothorax, ♀; setæ omitted from all appendages and from mesothorax.

Fig. 2. *Notothrips vittatus*, right antenna, ♀.

Fig. 3. *Notothrips folsomi* sp. nov., head and prothorax, ♂, holotype; setæ omitted from all appendages and from mesothorax; facets of eyes and some of cephalic structure not shown because of opacity of specimen.

Fig. 4. *Notothrips folsomi*, left antenna, ♂, holotype.

Plate 10.

Fig. 1. *Notothrips vittatus* (Hood), segments 8–10 of abdomen, ♀.

Fig. 2. *Notothrips vittatus*, right fore wing, ♀; stippling indicates color pattern.

Fig. 3. *Notothrips vittatus*, segments 8–10 of abdomen, ♂, showing the prolongation cephalad of sternum IX.

Fig. 4. *Notothrips folsomi* sp. nov., segments 8–10 of abdomen, ♂; certain details shown in Fig. 3 omitted because of opacity of specimen.

PHLEPSIUS ISHIDAE MATSUMURA IN NORTH AMERICA.

By P. W. Oman, *Bureau of Entomology*.

Phlepsius ishidae Matsumura. Monographie der Jassinen Japan. Termesz. Fuz., vol. 25, pp. 382–383, 1902.

Phlepsius tinctorius Sanders and DeLong. Ann. Ent. Soc. Amer., vol. 12, pp. 235–236, 1919.

This interesting leafhopper was described by Matsumura from Japanese specimens in 1902 and was recorded from North America in 1919 by Sanders and DeLong when they described it as *Phlepsius tinctorius*. Since the writer first examined specimens of the species he has considered it exotic, and upon investigation found that it checked well with Matsumura's description and figures of *Phlepsius ishidae* from Japan. Subsequently, Japanese specimens determined by Matsumura as his *P. ishidae* were found in the C. F. Baker Philippine collection. These were identical with specimens at hand, leaving no doubt as to the identity of the North American specimens going under the name of *P. tinctorius*.

Sanders and DeLong described *tinctorius* from specimens collected at Irvington and South Orange, New Jersey, on *Aralia spinosa*, July 23 and August 11. The year in which these specimens were collected was not given. The writer has examined specimens from Annapolis,[1] Md., collected on various dates from July 5 to August 2, 1932; from Crisfield[1], Md., August 6, 1932; and from Bristol, Pa., August 13, 1932, G. B. Sleesman. Its occurrence on *Aralia* suggests its probable introduction in the egg stage on some of the shrubs of that genus, possibly *Aralia chinensis*, which is indigenous to Japan and is reported to be closely related to *A. spinosa*. *Aralia chinensis* is known to occur in the region from which *P. ishidae* is above reported.

EARLIEST GENERA OF MITES AND THEIR TYPES.

By Arthur Paul Jacot, *Cornell University*.

This paper has been prepared because of the large number of errors in citation of genotypes as published in some recent European papers.

Acarus (8, p. 615), Trombidium (1, p. 430), and Hydrachne (9, p. 26) were not typed and are not monotypic. The first monotypic genera of mites date from 1795 (3). **Atomus** is recorded first with *A. phalangii* DeGéer[2] listed under it (3, p. 18). Thus a larva, a six legged animal, parasitic on phalangids, becomes type of the order of mites, which should consequently be known as the **Atomida.** The other genera of mites presented at this time are:

Ixodes, monotype *Acarus reduvius* Lin.
Parasitus, monotype *Acarus coleoptratorum* Lin. (p. 19).
Bdella is not binomially typed.
Argas and *Siro* are still born.

In 1796 (4) the following genera of mites are presented:

Leptus is a synonym of Atomus (same type).
Atomus and *Ixodes* are already typed.
Cheyletus, monotpye: *Acarus eruditus* Schrank (p. 179).

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[1]Taken in a mosquito trap operated by the Division of Insects Affecting Man and Animals, U. S. Bureau of Entomology.

[2]Although DeGéer is only crudely binomial, he does use a species name for his new species, immediately following the generic name. Thus he can be considered binomial.

Bdella, monotype: *Acarus longicornis* Lin. (p. 180).
Smaris, monotype: *Acarus sambuci* Schrank.
Limnochares, monotype: *Acarus aquaticus* Lin. (p. 181).
Eylais, monotype: *Hydrachne extendens* Müller (p. 182).
Carpais is a synonym of Parasitus.
Tyroglyphus, monotype: *Acarus siro* Lin. (p. 185).
Carios, *Argas*, and *Siro* are still born.

In the 1802 (5) treatise the following genera of mites are noteworthy:

Gamasus is a synonym of Parasitus.
Oribata, monotype: *Acarus geniculatus* Lin. (p. 65).
Argas, monotype: *Acarus reflexus* Fab. (p. 66).
Sarcoptes, monotype: *Acarus cabiei* Lin. (p. 67), unquestionably a misprint for *A. scabiei* Lin.
Caris, monotype: *Caris vespertilionis* Latr. (for Carios, p. 67).

In the 1804 volume (vol. 8, p. 55) nothing new is added as far as genotypes is concerned, except that the type of Caris is described. I believe this is another synonym of Nycteribia (Diptera).

In 1806 (6) the following are noteworthy:

Erythraeus, monotype: *E. phalangioides* (DeGéer) (p. 146).
Uropoda, monotype: *U. vegetans* (DeGéer) (p. 157).
Astoma, monotype: *A. parasiticum* (DeGéer) (p. 162).

This generic term is intended by Latreille as a substitute for his Atomus (1804, vol. 8, p. 55, footnote). According to International rules the two genera are distinct, each with its own type.

In 1810 (7, p. 425) "types" are designated for the three old genera as follows:

Trombidium: *Acarus holocericeus* L.
Acarus: *Acarus siro* Fabr.
Hydrachne: *Trombidium geographicum* Fabr.

This is Müller's species as Fabricius was a compiler and refers directly to Müller. The other genera were previously monotyped. Five of them are erroneously presented according to international rules, namely: Gamasus is a synonym of Parasitus, Leptus is a synonym of Atomus, Ixodes was monotyped *A. reduvius* in 1795, Argas was monotyped *A. reflexus* in 1802, Sarcoptes was monotyped *A. scabiei* in 1802.

It should be noted that Acarus here "typed" *A. siro* Fabr. is a synonym of Tyroglyphus, so that Acarus has no further standing in systematic literature. (*A. siro* Fab. is *A. siro* Linné, as Fabricius was a compiler.) In fact Latreille showed this to be his idea in 1802 (p. 64). (See also opinion 113 of the International Commission on Zoölogical Nomenclature.)

As I accept the principle that a genus is not a genus until typed, Tyroglyphus has precedence over Acarus.

The above types give the following classification:

Order ATOMIDA 1795 (Acarina).
Suborder *Ixodina* 1795 (Parasitiformes).
  Superfamily *Parasitoidea* 1795 (Mesostigmata).
  Superfamily *Ixodoidea* 1795 (Ixodides).
Suborder *Atomina* (Trombidiformes).
  Superfamily *Scutacaroidea* 1845 (Tarsonemini).
  Superfamily *Pachygnathoidea* 1834 (Stomatostigmata).
  Superfamily *Atomoidea* (Prostigmata).
Suborder *Tyroglyphina* 1796 (Sarcoptiformes).
  Superfamily *Tyroglyphoidea* 1796.
  Superfamily *Oribatoidea* 1802.
  Superfamily *Sarcoptoidea* 1802.
      etc.

Interim (1804) Hermann (2) established the following genera without types: Scirus (p. 60), Cynorhaestes (p. 63) as Ixodes, Rhynchoprion (p. 69) as Argas, Notaspis (p. 87) as Oribata, Phthiridium (p. 120) as Nycteribia, Limulus (p. 129) a Hydrachnid.

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2. Hermann, Jean-Fréderic, 1804, Mémoire Aptérologique, Publié par Fréderic-Louis Hammer, worked up by Paul Hermann. Strasbourg. 152 pp., 9 pls.
3. Latreille, Pierre-André, 1795, Observations sur la variété des organes de la bouche des Tiques, et distribution méthodique des insectes de cette famille d'après les caractères établis sur la conformation de ces organes, in: *Millin*, Noel et Warens, Magasin Encyclopédique, ou Journal des Sciences, des Lettres et des Arts, vol. 4, pp. 15–20.
4. Same, 1786, Précis des Caractères Génériques des Insectes, disposés dans un ordre naturel. Paris. 201 pp. +
5. Same, 1802, Histoire Naturelle, Générale et Particulière des Crustacés et des Insectes. Paris. vol. 3, pp. 46–68; 1804, vol. 7, pp. 334–400; vol. 8, pp. 5–55.
6. Same, 1806, Genera Crustaceorum et Insectorum. Paris. vol. 1, pp. 144–162.
7. Same, 1810, Considérations générales sur l'ordre naturel des (animaux composant les classes des) crustacés, des arachnides, et des Insectes. Paris. 444 pp.
8. Linné, Charles, 1758, Systema Naturae, ed. 10, reformata, vol. 1.
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REVIEW OF RUSBY'S "JUNGLE MEMORIES."

"Jungle Memories" by Henry H. Rusby, Emeritus Dean and Professor of Materia Medica, College of Pharmacy, Columbia University. 8 vo., 388 pp., illus. N. Y., McGraw-Hill Company, 1933. $3.50.

While this work is primarily a detailed narrative of a botanical expedition of extraordinary interest across the Andes and through the jungles of South America in search of new medicinal plants, yet the volume contains a wealth of data of value to workers in other fields of biology as well, particularly the ornithologist, ichthyologist and entomologist. The scope of this review is limited to consideration of a portion of the information given concerning insects. A résumé of the sections of entomological interest include consideration of such widely varying themes as sufferings from malarial chills contracted from the bites of Anopheles; notes on their habits and ferocity; attacks by swarms of huge hornets and of various species of ferocious tropical flies; ravages, habits and experiments with larvae of a screw worm known as *nigui* and an unidentified insect of extremely minute size locally known as *pium*, both of which cause extreme agony to the victim. There are also numerous general observations on concrete manifestations of insect psychology as well as on the habits and attacks of various species of ants, particularly stinging species, and the *sauba* or leaf-carrying ant with its method of transporting large objects for long distances, as well as discussion of the control on the part of natives of corn-destroying ants by various methods of ditching. Data also are given on the cultivation by ants of various species of fungi for their food purposes, while an extremely vivid description is given of a battle between two species of ants for the possession of a tree. This narration is of such excellence as to remind one of the famous battle of the ants in Thoreau's "Walden." Dr. Rusby has placed on record in Appendix D some 8 pages containing additional detailed observations on various species of tropical ants encountered. The book is an extremely readable one and makes a valuable contribution to the literature on South American exploration. Its reading is commended.

—*J. S. Wade.*

REVIEW OF BAINBRIGGE FLETCHER'S LIFEHISTORIES OF INDIAN MICROLEPIDOPTERA.

During his more than twenty-five years service as Imperial Entomologist of India, concluded last year, T. Bainbrigge Fletcher has many times doubled the knowledge of Indian insects, already most creditably begun by the late Maxwell Lefroy in his "India Insect Life," 1909. Fletcher's well known

"South Indian Insects," 1914, alone would be a worthy monument of his painstaking and diligent work.

Aside from his outstanding work in economic entomology, however, Fletcher is a world authority on the *Microlepidoptera*, especially the *Pterophoridae*, and he has done a remarkable amount of work in the collecting and rearing of these groups in India; more than 3000 species of Microlepidoptera from India have been obtained through his labors and have been described by Edward Meyrick during the last twenty-five years. The Lifehistories of about 650 of these have been worked out by Mr. Fletcher and the two concluding volumes on these "Lifehistories" have just been received, published as Scientific Monographs Nos. 2 and 4 of the Imperial Council of Agricultural Research, Calcutta, December, 1932, and August, 1933. The first volume was published in the Memoirs of the Department of Agriculture in India, vol. 6, nos. 1–9, 1921.

The magnitude of this work by one man in a quarter of a century can best be appreciated when it is realized that it compares favorably with the work accomplished in these groups in North America by numerous workers for more than half a century. Fletcher has collected about as many species of Microlepidoptera in India as are described from North America and the number of known lifehistories of our American species is but slightly larger than that ascertained by him in India. It is a very remarkable record.

These "Lifehistories," handsomely published in quarto volumes, give detailed descriptions of the early stages and are profusely illustrated with excellent plates (many colored) of the moths, their larvae, pupae, and work. These volumes embody our entire knowledge to date of the biology of the Microlepidoptera of India and will be a most valuable source of information not only to Indian students but to all workers in these groups.

Mr. Fletcher has generously donated to the U. S. National Museum fine reared series of a large percentage of the species treated in these volumes. —*August Busck.*

MINUTES OF THE 450TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, NOVEMBER 2, 1933.

The 450th regular meeting of the Entomological Society of Washington was held at 8 p. m., Thursday, November 2, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, president, presided. There were present 43 members and 25 visitors. The minutes of the previous meeting were read and approved.

Mr. F. F. Dicke and Mr. John Scrivener of the cereal and forage insect investigations, U. S. Bureau of Entomology, were unanimously elected to membership on recommendation of the executive committee.

Mr. G. Merino, an entomologist of the Phillipines, upon invitation, greeted the society.

Under the heading "Notes and Exhibition of Specimens," Doctor Howard discussed a letter from Professor Essig, which stated that early-day western pioneers found that infestations of bed-bugs unexpectedly appeared in their isolated cabins. Doctor Howard said that the source of such infestations was an interesting problem, and invited the members to consider it and to comment later.

Dr. J. M. Aldrich spoke of an amusing misinterpretation of an abbreviated locality label. This note was discussed, with mention of similar cases, by Gahan, Clarke, Greene, Cushman, Busck, and Snodgrass.

Mr. August Busck exhibited 3 volumes of a new work by T. B. Fletcher on life-histories of Microlepidoptera of India, containing a remarkable number of life-histories and fine illustrations.

The first communication on the regular program was by P. W. Oman and was entitled "Habitat Associations of Homoptera in the Southwest."

Mr. Oman discussed factors which determine presence or absence of a given species in a given association; typical habitats found in southwestern United States, with type of Homoptera found in each; differences between desert associations and those of more humid regions; and adaptations of Homoptera to their habitats. Lantern slide pictures of some typical habitats illustrated the paper. (Author's abstract.)

This paper was discussed by McIndoo, Poos and Wadley.

The second communication was by Max Kisliuk, and was entitled "Fruit Fly Surveys in the West Indies and South America."

Mr. Kisliuk described a fruit fly field survey made by himself and Mr. C. E. Cooley of the Bureau of Plant Quarantine during the latter part of 1931 and the early part of 1932. This survey included field observations in the Bahamas, Jamaica, Haiti, Santo Domingo, American Virgin Islands, Antigua, Guadeloupe, Martinique, St. Lucia, Trinidad, St. Kitts, Nevis, Dominica, St. Vincent, Barbados, Brazil, Uruguay, Chile, and Peru.

Crops and insect conditions, particularly with relation to fruit flies, were briefly discussed with respect to each country visited. He stated that fruit flies were found in every country visited with the exception of Antigua, St. Johns, St. Vincent, and Barbados. *Anastrepha suspensa* and *A. acidusa* were especially prevalent in the West Indies; *A. serpentina* was taken in Trinidad and Brazil and *A. peruviana* in Peru and Brazil. *Ceratitis capitata* was especially abundant in the vicinity of Rio Janeiro, Brazil.

The talk was illustrated by slides showing the route taken by Messrs. Kisliuk and Cooley.

Because of the lateness of the hour there was no discussion of this paper.

Meeting adjourned at 10:20 p. m.

F. M. WADLEY,
Recording Secretary.

CORRECTION.

In the article "Four New Species of Empoasca," by F. W. Poos, Vol. 35, p. 175 of these Proceedings, species *E. delongi*, Figs. 2 and 3 refer to the male genitalia; p. 176, *E. batatae*, Figs. 4 and 5 refer to the male genitalia. —*Editor.*

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PROCEEDINGS OF THE

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AN EARTH-LINED TRAP FOR ANOPHELINE MOSQUITOES.[1]

By Paul F. Russell and Domingo Santiago.

The difficulties of making day-time catches of adult anophelines in the Philippines have been noted in previous papers (1, 2). In these reports it was shown that the Philippine mosquitoes do not hide in human habitations as do anophelines in other countries. The local houses are light, airy, and dry. The insects prefer to take shelter in places which are dark, quiet, and moist. Such requirements are found in small natural caves where the banks of stream have been undermined, also in crevices of old overgrown stone walls, in wells, and in similar places.

For several years we have been experimenting with traps to catch adult anophelines. Several designs have been used, none successfully, despite such bait as light, sweaty cloth, cut fruit, and carabao dung. Recently we have devised a trap which is more efficient than any heretofore used and of a type which we have not seen reported in the literature available to us. This trap is a simple box-like structure, its main feature being a layer of soil 1 inch thick on the inside walls and roof, held in place by 16-mesh wire screening and kept moist by a drip-can resting on top of the box. The trap has no floor and is placed directly on the ground. One end is not boarded but is kept partly closed at night by means of a black cloth which hangs down to within ½ foot of the ground. Several sizes of traps have been used, the smallest being 2 feet high, 2 feet wide, and 3 feet long. This size is effective but in somewhat larger traps the catches are likely to be greater. (See Figs. 3 to 7.)

Collections were made in the morning by raising the cloth which partly closes the entrance, and removing the mosquitoes one by one in glass vials or any type of mosquito-catching tube.

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[1]The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation.

The senior author is Chief and the junior author a field inspector of Malaria Investigations, jointly supported by the Bureau of Science, Manila, and the International Health Division of the Rockefeller Foundation.

A flash-light is required. The mosquitoes are easily caught; they make no effort to escape if the collector moves quietly and directly.

These traps have been placed in various locations and have been quite successful. Similar box-like traps, without the inner lining of soil, have not given good results, presumably because they do not so closely resemble natural sheltering places. (See Figs. 1 and 2.) The soil-lined traps are inexpensive, and they are portable.

In Tables 1 and 2 are reported the catches from traps placed near the bank of a stream in which *A. minimus* var. *flavirostris* breeds. The traps were unlighted and were about 200 meters from the nearest house. In Table 1, adult catches in the unlined (old-style) trap are recorded and in Table 2 those from the new earth-lined traps are given. It will be seen that in the unlined trap the average catch per trap per night was 4.4 while in the earth-lined traps the average per night per trap was 18.8. More important is the fact that although no *A. minimus* var. *flavirostris* were caught in the unlined trap, an average of 4.1 were taken from earth-lined traps. *A. minimus* var. *flavirostris* is the chief malaria vector of the Philippines. It is this species that we are chiefly interested in trapping. (See also Table 14.)

Tables 3 and 4 report similar catches. In this case the traps were also placed beside the stream bank but were moved to within a few meters of an occupied house. The unlined trap caught an average of 8.3 mosquitoes per trap per night; the earth-lined traps averaged 36.1 mosquitoes per trap per night. No *A. minimus* var. *flavirostris* were caught in the former but an average of 4.8 were taken in the earth-lined traps.

Traps were also placed near a carabao shed about 50 meters from a stream and about the same distance from the nearest house. In this situation the unlined trap averaged 10.4 mosquitoes and the earth-lined traps 46.2 per night per trap, as is shown in Tables 5 and 6. Only 0.3 *A. minimus* var. *flavirostris* were averaged by the unlined and 3.3 by the earth-lined trap.

When the traps situated near the carabao shed were baited with carabao dung the average catches, as shown in Tables 7 and 8, were slightly larger in the unlined trap but were considerably smaller in the earth-lined traps.

When the traps were placed under an occupied house about 100 meters from the nearest stream, as shown in Tables 9 and 10, the catches in the unlined type averaged 12.4, with no *A. minimus* var. *flavirostris*. In the new-style, earth-lined trap the catches averaged 69.5 mosquitoes per trap per night, with an average of 3.6 *A. minimus* var. *flavirostris*.

The effect of light was also tested. Table 11 shows that the average catch per trap per night in the earth-lined box was 137.3. This was the largest catch we made. But the light appears

Table 1.

ANOPHELES ADULTS CAUGHT IN UNLINED TRAPS PLACED NEAR STREAM BANK (UNLIGHTED AND 200 M. FROM HOUSES).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
July															
23	...	...	...	...	...	...	...	...	...	1	...	1	1	...	1
24	...	...	...	1	...	1	...	...	...	1	1	2	2	1	3
25	...	...	...	...	1	1	...	...	...	1	...	1	1	1	2
26	...	...	...	1	...	1	...	...	...	2	1	3	3	1	4
27	...	...	...	...	...	...	...	...	...	1	1	2	1	1	2
28	...	...	...	1	...	1	...	...	...	2	1	3	3	1	4
29	...	...	...	1	...	1	...	...	...	2	3	5	3	3	6
30	...	...	...	...	...	...	...	...	...	2	4	6	2	4	6
31	...	...	...	...	...	...	...	...	...	2	3	5	2	3	5
Aug.															
1	...	...	...	...	...	...	...	...	...	2	3	5	2	3	5
2	...	...	...	...	...	...	...	...	...	1	4	5	1	4	5
3	...	...	...	...	...	...	...	...	...	3	3	6	3	3	6
4	...	...	...	...	...	...	...	...	...	1	5	6	1	5	6
5	...	...	...	1	...	1	...	...	...	2	4	6	3	4	7
Totals	0	0	0	5	1	6	0	0	0	23	23	56	28	34	62
Aver.*	...	...	...	0.3	0.1	0.4	...	...	...	1.5	2.4	4.0	2.0	2.4	4.4

*Per trap per night.

to have repelled the important *A. minimus* var. *flavirostris*, because none were caught in the lighted traps.

Variously colored lights were tested, as is shown in Table 12. No significant variations due to color were noted, but here again no *A. minimus* var. *flavirostris* were taken and no male mosquitoes of any species. It will be noted in Table 11 that in the total catch of 961 mosquitoes there were only 7 males. Apparently light does not attract but probably repels male mosquitoes of these species and repels both male and female *A. minimus* var. *flavirostris*.

When the traps were placed in the middle of a rice field, about 500 meters from houses, very few mosquitoes were caught, as is shown in Table 13. Apparently, since the area

TABLE 2.

ANOPHELES ADULTS CAUGHT IN EARTH-LINED TRAPS PLACED NEAR STREAM BANK (UNLIGHTED AND 200 M. FROM HOUSES).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
July															
11	1	1	2	......	......	......	......	......	......	4	1	5	5	2	7
12	2	3	5	......	2	2	......	......	......	4	4	8	6	9	15
13	1	2	3	1	2	3	1	......	1	2	6	8	5	10	15
14	1	1	2	......	2	2	......	......	......	1	3	4	2	6	8
15	1	2	3	1	2	3	......	......	......	2	7	9	4	11	15
16	......	7	7	1	1	2	......	......	......	15	11	26	16	19	35
17	1	3	4	1	2	3	......	......	......	12	16	28	14	21	35
18	1	2	3	2	3	5	......	......	......	9	6	15	12	11	23
19	1	4	5	1	3	4	......	......	......	4	13	17	6	20	26
20	......	5	5	2	3	5	......	......	......	12	16	28	14	24	38
21	1	2	3	2	6	8	......	......	......	5	12	17	8	20	28
22	2	3	5	1	1	2	......	......	......	9	6	15	12	10	22
23*a*	3	2	5	......	......	......	......	......	......	7	12	19	10	14	24
24*a*	2	6	8	2	3	5	......	......	......	6	17	23	10	26	36
25*a*	3	3	6	1	1	2	......	......	......	8	14	22	12	18	30
26*a*	2	5	7	3	5	8	......	......	......	25	35	60	30	45	75
27*a*	1	5	6	......	......	......	......	......	......	6	21	27	7	26	33
28*a*	3	13	16	1	3	4	......	1	1	29	21	50	33	38	71
29*a*	2	6	8	2	3	5	......	......	......	22	37	59	26	46	72
30*b*	4	9	13	......	......	......	......	......	......	10	17	27	14	26	40
31*b*	5	10	15	......	......	......	......	......	......	10	23	33	15	33	48
Aug.															
1*b*	2	10	12	......	4	4	......	......	......	8	13	21	10	27	37
2*b*	3	7	10	......	......	......	......	......	......	6	19	25	9	26	35
3*b*	2	9	11	......	......	......	......	......	......	10	14	24	12	23	35
4*b*	3	12	15	......	......	......	......	1	1	4	16	20	7	29	36
5*b*	4	11	15	......	3	3	......	1	1	6	17	23	10	32	42
Totals	51	143	194	21	49	70	1	3	4	236	377	613	309	572	881
Aver.*	1.1	3.0	4.1	0.4	1.0	1.5	......	......	......	5.0	8.0	13.0	6.6	12.2	18.8

*Per trap per night.

a. Two traps used.

b. Three traps used.

has no natural shelters in the exposed fields, it is not usual for mosquitoes to seek shelter there.

The catches reported in the tables may seem small but as a matter of fact they are relatively high for individual daytime sheltering places. The traps are so inexpensive that a large number could be used and the total catches made proportionally very much greater.

SUMMARY

This paper reports the development of a new type of trap for catching adult anophelines. This trap is essentially an earth-lined box which imitates the natural day-time sheltering places favored by Philippine *Anopheles* mosquitoes, especially of the important *funestus-minimus* subgroup, which contains the chief local vectors of malaria.

TABLE 3.

ANOPHELES ADULTS CAUGHT IN UNLINED TRAPS PLACED NEAR STREAM BANK BESIDE A HOUSE (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
July															
16	.....	.....	.....	1	2	3	.....	.....	.....	4	14	18	5	16	21
17	.....	.....	.....	1	1	2	.....	.....	.....	2	6	8	3	7	10
18	.....	.....	.....	1	.....	1	.....	.....	.....	3	8	11	4	8	12
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	7	20	27	7	20	27
20	.....	.....	.....	.....	2	2	.....	.....	.....	.....	.....	.....	.....	2	2
21	.....	.....	.....	.....	1	1	.....	.....	.....	1	2	3	1	3	4
22	.....	.....	.....	.....	2	2	.....	.....	.....	.....	.....	.....	.....	2	2
23	.....	.....	.....	1	1	2	.....	.....	.....	1	2	3	2	3	5
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2	4	2	2	4
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2	4	2	2	4
26	.....	.....	.....	.....	2	2	.....	.....	.....	4	9	13	4	11	15
27	.....	.....	.....	.....	1	1	.....	.....	.....	1	1	2	1	2	3
28	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	3	4	1	3	4
29	.....	.....	.....	.....	1	1	.....	.....	.....	1	.....	1	1	1	2
Totals	0	0	0	4	13	17	0	0	0	29	69	98	33	82	115
Aver.*	.....	.....	.....	0.3	0.9	1.2	.....	.....	.....	2.1	4.9	7.0	2.4	5.9	8.3

*Per trap per night.

TABLE 4.

ANOPHELES ADULTS CAUGHT IN EARTH-LINED TRAPS PLACED NEAR STREAM BANK BESIDE A HOUSE (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
July															
16	3	5	8	8	17	25	....	....	....	27	49	76	38	71	109
17	3	9	12	5	13	18	1	1	2	19	60	79	28	83	111
18	3	8	11	2	6	8	....	....	....	20	68	88	25	82	107
19	1	4	5	1	7	8	....	....	....	20	76	96	22	87	109
20	....	13	13	6	8	14	....	....	....	27	44	71	33	65	98
21	5	7	12	2	10	12	....	....	....	11	17	28	18	34	52
22	3	2	5	2	6	8	1	....	1	22	34	56	28	42	70
23	....	5	5	3	6	9	....	....	....	8	21	29	11	32	43
24	....	5	5	....	3	3	....	....	....	5	14	19	5	22	27
25	....	7	7	2	4	6	....	1	1	20	11	31	22	23	45
26	5	7	12	2	6	8	....	....	....	31	54	85	38	67	105
27	3	14	17	....	1	1	....	....	....	7	28	35	10	43	53
28	3	7	10	....	....	....	....	....	....	11	33	44	14	40	54
29	2	10	12	2	3	5	....	1	1	4	7	11	8	21	29
Totals	31	103	134	35	90	125	2	3	5	232	516	748	300	712	1012
Aver.*	1.1	3.7	4.8	1.3	3.2	4.4	0.1	0.1	0.2	8.3	18.4	26.7	10.7	25.4	36.1

*Per trap per night.

Note: Two traps were used each night.

TABLE 5.

ANOPHELES ADULTS CAUGHT IN UNLINED TRAPS PLACED NEAR A CARABAO SHED (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
July															
2	...	...	...	1	4	5	...	1	1	1	5	6	2	10	12
3	1	...	1	1	4	5	1	...	1	...	3	3	3	7	10
4	1	...	1	1	5	6	...	...	...	3	12	15	5	17	22
5	...	...	...	1	2	3	...	...	...	1	6	7	2	8	10
6	...	...	...	2	5	7	...	...	...	3	9	12	5	14	19
7	...	1	1	1	4	5	...	...	...	1	4	5	2	9	11
8	...	...	...	1	3	4	...	...	...	1	4	5	2	7	9
11	...	...	...	...	...	...	...	...	...	...	5	5	...	5	5
12	...	...	...	1	1	2	...	...	...	1	3	4	2	4	6
13	...	...	...	1	4	5	...	...	...	1	2	3	2	6	8
14	...	...	...	1	2	3	...	...	...	1	1	2	2	3	5
15	...	...	...	1	3	4	...	...	...	2	2	4	3	5	8
Totals	2	1	3	12	37	49	1	1	2	15	56	71	30	95	125
Aver.*	0.2	0.1	0.3	1.0	3.1	4.1	0.1	0.1	0.2	1.3	4.6	5.9	2.3	7.9	10.4

*Per trap per night.

Note: Catch also included 2 male *A. kochi* and 1 female *A. barbirostris*.

TABLE 6.

ANOPHELES ADULTS CAUGHT IN EARTH-LINED TRAPS PLACED NEAR A CARABAO SHED (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
June															
19				1	3	4	2	2	4	17	42	59	20	47	67
20	1	5	6	1	5	6	3	6	9	14	33	47	19	49	68
21	3	7	10	5	12	17	5	1	6	11	20	31	24	40	64
22	1	2	3		11	11	2	1	3	5	17	22	8	31	39
23	4	4	8	1	7	8		2	2	3	11	14	8	24	32
24	3	2	5	1	5	6		2	2	5	10	15	9	19	28
July															
2		3	3	1	8	9	1	3	4	2	23	25	4	37	41
3		2	2	1	6	7	1	2	3	3	21	24	5	31	36
4	1	2	3	2	16	18				4	41	45	7	59	66
5		2	2	2	19	21				3	31	34	5	52	57
6	1	1	2	3	20	23				5	42	47	9	63	72
7	1	3	4	3	12	15				2	35	37	6	50	56
8	1	1	2	1	12	13				1	32	33	3	45	48
11	1	1	2		3	3				1	24	25	2	28	30
12	1	1	2	1	7	8				3	19	22	5	27	32
13	1	1	2	1	7	8	1	1	2	2	15	17	5	24	29
14	1	1	2	1	4	5				3	22	25	5	27	32
15	1		1	2	5	7				1	26	27	4	31	35
Totals	21	38	59	27	162	189	15	20	35	85	464	549	148	684	832
Aver.*	1.2	2.1	3.3	1.5	9.01	10.5	0.8	1.1	1.9	4.7	2.6	30.5	8.2	38.0	46.2

*Per trap per night.

Note: The catch also included 1 female *A. barbirostris* and 2 male *A. kochi.*

TABLE 7.

ANOPHELES ADULTS CAUGHT IN UNLINED TRAPS PLACED NEAR CARABAO SHED AND BAITED WITH CARABAO DUNG (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
June															
19	......	......	......	......	2	2	......	......	......	1	10	11	1	12	13
20	......	......	......	......	1	1	......	......	......	1	12	13	1	13	14
21	......	2	2	1	3	4	......	1	1	2	7	9	3	13	16
22	......	3	3	1	......	1	1	1	2	2	10	12	4	14	18
23	......	......	......	......	2	2	......	1	1	......	3	3	......	6	6
24	......	......	......	......	1	1	1	......	1	1	6	7	2	7	9
25	......	2	2	......	1	1	1	......	1	1	3	4	2	6	8
26	......	1	1	......	3	3	......	......	......	......	20	20	......	24	24
27	2	......	2	......	5	5	......	......	......	1	4	5	3	9	12
28	......	......	......	1	2	3	......	......	......	......	6	6	1	8	9
29	......	......	......	......	1	1	......	......	......	......	6	6	......	7	7
30	......	......	......	......	5	5	......	......	......	2	7	9	2	12	14
July															
1	......	......	......	......	1	1	......	......	......	......	2	2	......	3	3
Totals	2	8	10	3	27	30	3	3	6	11	96	107	19	134	153
Aver.*	......	0.6	0.8	......	2.0	2.5	......	......	0.5	1.0	7.3	8.2	1.5	10.3	11.8

*Per trap per night.

Note: The catch also included 1 male *A. fuliginosus*, 1 male and 2 female *A. kochi*.

TABLE 8.

ANOPHELES ADULTS CAUGHT IN EARTH-LINED TRAPS PLACED NEAR CARABAO SHED AND BAITED WITH CARABAO DUNG (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
June															
19	....	....	....	1	3	4	1	1	2	5	18	23	7	22	29
20	....	1	1	....	5	5	1	2	3	3	20	23	4	28	32
21	....	1	1	2	....	2	2	2	4	1	3	4	5	6	11
22	....	1	1	....	2	2	1	4	5	2	9	11	3	16	19
23	....	....	....	....	3	3	1	1	2	1	5	6	2	9	11
24	....	2	2	1	3	4	....	2	2	1	6	7	2	13	15
25	1	3	4	1	2	3	....	....	....	2	13	15	4	18	22
26	....	3	3	1	....	1	....	....	....	1	17	18	2	20	22
27	1	4	5	1	6	7	....	....	....	3	9	12	5	19	24
28	1	4	5	7	16	23	....	1	1	5	15	20	13	36	49
29	1	1	2	1	1	2	....	3	3	3	6	9	5	11	16
30	1	3	4	....	4	4	....	....	....	2	12	14	3	19	22
July															
1	1	3	4	....	3	3	1	1	2	1	2	3	3	9	12
Totals	6	26	32	15	48	63	7	17	24	30	135	165	58	226	284
Aver.*	0.5	2.0	2.5	1.2	3.7	4.9	0.5	1.3	1.7	2.5	10	13	4.5	17.4	21.8

*Per night per trap.

Note: The catch also included 1 female *A. barbirostris*, 2 male *A. kochi* and 2 female *A. fuliginosus*.

TABLE 9.

ANOPHELES ADULTS CAUGHT IN AN UNLINED TRAP PLACED UNDER AN OCCUPIED HOUSE NEAR A STREAM BREEDING-PLACE (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
June															
25	......	......	......	1	2	3	......	......	......	1	4	5	2	6	8
26	......	......	......	1	2	3	......	......	......	1	8	9	2	10	12
27	......	......	......	3	15	18	......	......	......	3	14	17	6	29	35
28	......	......	......	4	14	18	......	......	......	1	7	8	5	21	26
29	......	......	......	......	2	2	......	......	......	3	11	14	3	13	16
30	1	......	1	1	2	3	......	......	......	10	4	14	12	6	18
July															
1	......	......	......	......	1	1	......	......	......	......	......	......	......	1	1
2	......	......	......	1	3	4	......	......	......	1	7	8	2	10	12
3	......	......	......	1	3	4	......	......	......	1	5	6	2	8	10
4	......	......	......	1	2	3	......	......	......	2	3	5	3	5	8
5	......	......	......	2	7	9	......	......	......	1	2	3	3	9	12
6	......	......	......	2	7	9	......	1	1	3	10	13	5	18	23
7	......	......	......	1	3	4	......	......	......	2	7	9	3	10	13
8	......	......	......	1	2	3	......	......	......	1	2	3	2	4	6
9	......	......	......	1	......	1	......	......	......	1	......	1	1	2	2
10	......	......	......	......	2	2	......	......	......	1	3	4	1	5	6
11	......	......	......	......	......	......	......	......	......	1	2	3	1	2	3
Totals	1	......	1	20	67	87	......	1	1	33	89	122	54	157	211
Aver.*	......	......	......	1.2	3.9	5.1	......	......	......	1.9	5.2	7.2	3.2	9.2	12.4

*Per trap per night.

Note: The catches also included 1 male *A. barbirostris*.

For the catches between July 2 and 8 inclusive the trap was covered with bushes.

TABLE 10.

ANOPHELES ADULTS CAUGHT IN EARTH-LINED TRAPS PLACED UNDER AN OCCUPIED HOUSE NEAR A STREAM BREEDING-PLACE (UNLIGHTED).

DATE	SPECIES												TOTALS		
	A. minimus var. *flavirostris*			*A. subpictus* var. *indefinitus*			*A. tessellatus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.	M.	F.	T.
June															
25	7	6	13	7	29	36	2	3	5	15	42	57	31	80	111
26	5	6	11	13	35	48	2	4	6	22	43	65	42	88	130
27	11	5	16	22	43	65	2	1	3	30	49	79	65	98	163
28	3	10	13	24	83	107	....	1	1	32	54	86	59	148	207
29	3	7	10	2	17	19	....	....	....	28	33	61	33	57	90
30	3	3	6	10	15	25	1	1	2	22	28	50	36	47	83
July															
1	1	....	1	1	11	12	....	....	....	9	4	13	11	15	26
2	5	5	10	7	43	50	2	12	14	16	72	88	30	132	162
3	3	4	7	12	36	48	3	10	13	26	65	91	44	115	159
4	3	3	6	32	53	85	....	....	....	31	93	124	66	149	215
5	3	4	7	21	62	83	3	5	8	32	84	116	59	155	214
6	3	6	9	43	69	112	3	4	7	50	101	151	99	180	279
7	3	4	7	44	70	114	3	4	7	30	85	115	80	163	243
8	1	2	3	14	49	63	2	3	5	23	63	86	40	117	157
9	....	1	1	8	9	17	2	1	3	14	13	27	24	24	48
10	....	....	....	2	4	6	....	1	1	6	13	19	8	18	26
11	1	2	1	1	2	....	....	....	....	24	22	46	26	24	50
Totals	55	67	122	263	629	892	25	50	75	410	864	1274	753	1610	2363
Aver.*	1.6	1.9	3.6	7.7	18.5	26.2	0.7	1.5	2.2	12.1	25.4	38.6	22.1	17.9	69.5

*Per trap per night.

Note: Two traps were used. For the catches between July 2 and 8 inclusive the traps were covered with bushes. The catches also included 2 female *A. hyrcanus* var. *sinensis*, 1 male and 1 female *A. barbirostris*, 4 male and 2 female *A. kochi*.

TABLE 11.

ANOPHELES ADULTS CAUGHT IN EARTH-LINED TRAP PLACED NEAR CARABAO SHED. TRAP LIGHTED.

DATE	SPECIES						TOTALS		
	A. subpictus var. *indefinitus*			*A. vagus* var. *limosus*					
	M.	F.	T.	M.	F.	T.	M.	F.	T.
June									
25	1	23	24	6	121	127	7	144	151
26	....	7	7	....	88	88	....	95	95
27	....	54	54	....	138	138	....	192	192
28	....	14	14	....	77	77	....	91	91
29	....	53	53	....	150	150	....	203	203
30	....	29	29	....	126	126	....	155	155
July									
1	....	29	29	....	45	45	....	74	74
Totals	1	209	210	6	745	751	7	954	961
Average*	0.1	29.9	30.0	0.9	106.4	107.3	1.0	136.3	137.3

*Per trap per night.

Note: The catch also included 1 female *A. tessellatus*, and 1 female *A. barbirostris*, but no *A. minimus* var. *flavirostris*.

TABLE 12.

ADULT ANOPHELINES CAUGHT IN EARTH-LINED TRAP HAVING COLORED LIGHT AND PLACED NEAR CARABAO SHED.

DATE	Color of Light	SPECIES						TOTALS		
		A. subpictus var. *indefinitus*			*A. vagus* var. *limosus*					
		M.	F.	T.	M.	F.	T.	M.	F.	T.
July										
2	Red	0	18	18	0	87	87	0	105	105
3	Green	0	21	21	0	62	62	0	83	83
4	Blue	0	26	26	0	78	78	0	104	104
5	Yellow	0	39	39	0	81	81	0	120	120
6	Brown	0	11	11	0	36	36	0	47	47
7	Gray	0	22	22	0	57	57	0	79	79
8	Pink	0	15	15	0	48	48	0	63	63

Note: No adult *A. minimus* var. *flavirostris* were caught and no males of any species. This trap was right beside those used in Tables 5 and 6 from the dates given.

TABLE 13.

ANOPHELES ADULTS CAUGHT IN TRAPS PLACED IN A RICE FIELD (UNLIGHTED AND 500 M. FROM HOUSES).

SPECIES	ONE EARTH-LINED TRAP			ONE UNLINED TRAP		
	M.	F.	T.	M.	F.	T.
A. minimus var. *flavirostris*	0	0	0	0	0	0
A. subpictus var. *indefinitus*	1	0	1	0	0	0
A. vagus var. *limosus*	4	3	7	0	0	0
Totals	5	3	8	0	0	0
Average per night per trap	0.7	0.4	1.0	......	......	......

Note: These traps were in place for one week. Catches were made each morning from July 16 to 22 inclusive.

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1. RUSSELL, P. F. Daytime Resting Places of Anopheles Mosquitoes in the Philippines. First Report. Philip. Jour. Sci. 46 : 639–649, 1931 (Dec.).

2. RUSSELL, P. F. Daytime Resting Places of Anopheles Mosquitoes in the Philippines. (Second Report). Proc. Entomol. Soc. Washington 34 : 129-138, 1932 (Nov.).

Table 14.

COMPARISON BETWEEN UNLINED TRAPS AND DIFFERENT SIZES OF EARTH-LINED TRAPS (UNLIGHTED. NEAR STREAM BANK).

Traps		August 6	August 7	August 8	August 9	August 10	Totals
NEW STYLE							
Large	*A. minimus* var. *flavirostris*	4	6	1	6	1	18
	A. subpictus var. *indefinitus*	3	2	0	0	0	5
	A. tessellatus	0	0	1	0	1	2
	A. vagus var. *limosus*	7	8	3	11	1	30
	Totals	14	16	5	17	3	55
Medium	*A. miniums* var. *flavirostris*	7	10	10	9	11	47
	A. subpictus var. *indefinitus*	2	0	0	0	0	2
	A. tessellatus	0	1	8	4	5	18
	A. vagus var. *limosus*	7	5	16	6	4	38
	Totals	16	16	34	19	20	105
Small	*A. minimus* var. *flavirostris*	4	5	7	16	13	45
	A. subpictus var. *indefinitus*	0	0	0	0	0	0
	A. tessellatus	0	0	2	7	10	19
	A. vagus var. *limosus*	4	5	4	5	3	21
	Totals	8	10	13	28	26	85
EARTH-LINED TRAP TOTALS		38	42	52	64	49	245
Old Style (2 traps)	*A. minimus* var. *flavirostris*	0	0	0	0	0	0
	A. subpictus var. *indefinitus*	0	0	0	0	0	0
	A. tessellatus	0	0	0	0	0	0
	A. vagus var. *limosus*	5	6	3	0	0	14
	Totals	5	6	3	0	0	14

Earth-lined traps—average per trap per night 16.3.

Unlined traps—average per trap per night 1.4.

Of the *A. minimus* var. *flavirostris* caught in earth-lined traps, 23 were males and 87 females.

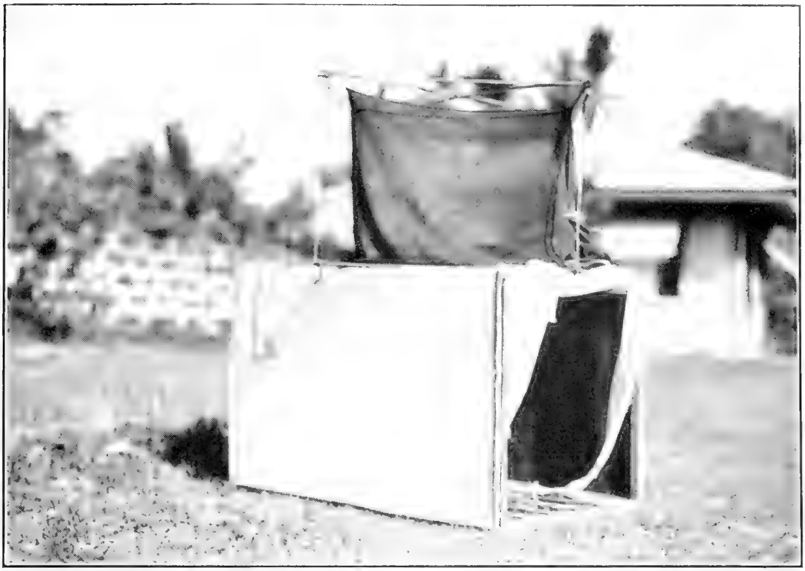

Figure 1.—Unlined (old style) mosquito trap. Showing inside catching chamber removed.

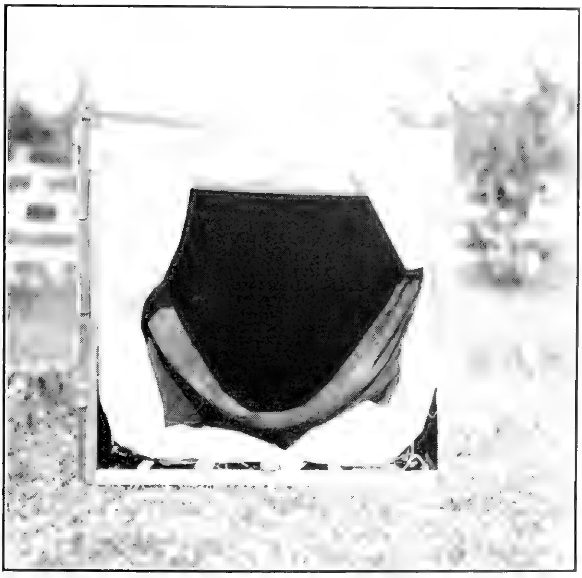

Figure 2.—Unlined (old style) trap ready for use.

Figure 3.—New style trap lined with earth. Front open. Top removed for photograph.

Figure 4.—New style trap lined with earth. View showing interior.

Figure 5. —New style trap lined with earth showing method of removing mosquitoes. Note drip cans on top.

Figure 6. —New style trap lined with earth showing position near a carabao shed.

Figure 7.—New and old style traps side by side for test.

TWO NEW SPECIES OF PLEOCOMA (COLEOPTERA: SCARABAEIDAE).

By A. C. Davis, *Takoma Park, Md.*

Pleocoma remota, n. sp.

Broadly oval, robust, dorsum slightly flattened, fimbriate and clothed beneath with yellow hair. Head very dark brown or blackish, closely punctate above, ocular canthi impunctate; eyes moderately prominent, much flattened, slightly cut into in front by the ocular canthi and rather deeply behind by the lobes of the genae, so that about two thirds of the total area is ventral, set into the head obliquely so that the anterior margins are each about 0.3 mm. nearer the mid-line than the posterior margins, where they disappear under the pronotum; clypeus small, heavy, reflexed, sharply obtusely emarginate at apex, the anterior margins sinuate, apices bluntly rounded and nearly truncate, lateral margins rounded; anterior margins of ocular canthi sinuate, inclined posteriorly from a right angle to the mid-line, apical angles and posterior margins broadly rounded; horn of vertex fairly long, heavy, rounded at apex, quadrate in cross-section, the anterior angles of the horn continued as oblique ridges on the frons, terminating on each side at the junction of the ocular canthus with the clypeus.

Pronotum black, glabrous, less than twice as wide as long, widest at basal two fifths; anterior angles, sides, and basal angles all included in one sweeping curved margin; disc evenly, moderately coarsely, and rather closely punctate, posterior median impression distinct, anterior median impression broad and deep, giving a retuse appearance to the profile of the pronotum.

Scutellum subtriangular, almost covered with tawny hair.

Elytra chestnut brown, wider at the humeri than the base of the pronotum, conjointly nearly as wide as long, widest at about the apical third; costae hardly elevated, smooth, impunctate; geminate striae distinct but not deep, not attaining the apices of the elytra, delimited by large shallow punctures; sutural striae moderately deep; elytral intervals coarsely and sparsely punctate and slightly rugose.

Body beneath castaneous, femora darker, and tibiae nearly black.

Length 22.5 mm., maximum width 14 mm.

Antennae brown, first joint conical; second subglobular, transverse, four fifths as wide as first; third subcylindrical, pentagonal in outline as viewed from above, seven tenths as long as the first joint,[1] widest at apical fifth; joints 2 and 3 together almost or quite equal in length to the first; fourth joint shorter than the third and about equal in width, pentagonal in outline; fifth joint wider than the fourth and about as long, joints 4 and 5 together shorter than the third; sixth joint transverse, angulate, with a short process; seventh joint with a short lamella a little more than one third as long as the joint and lamella of the eighth; joints 8 to 11 forming the club, the ninth joint longest, the tenth nearly

[1]In speaking of the joints composing the antennal club, the terms "length" and "width" are reversed, the length being considered as that of the joint and lamella across the long axis of the antenna.

as long, the eleventh shorter than the tenth, and the eighth shorter than the eleventh.

The thorax in profile is distinctly retuse, although not so pronouncedly so as in *P. staff* Schauf. and *P. edwardsi* Lec. The geminate striae do not reach the apex of the elytra, a peculiarity found also in *staff*. The first geminate stria is interrupted behind the middle by an offset laterally of about its own width, the inner stria of the pair resuming on a line with the outer one, and terminating abruptly a short distance posterior to this point.

Type locality.—Utah.

Type.—Male (Cat. No. 50124) in the collection of the United States National Museum.

The female of this species is not known.

P. remota differs from *P. behrensi* Lec. and *P. fimbriata* Lec., nearest to which it belongs in the genus, in color, in the hairy scutellum (which was probably completely covered with hair when the specimen was first taken), in the different proportions of the antennal joints, in the blunt apical horn, and in the elytral characters. The species resembles *P. staff* Schauf. very closely in all except the number of joints in the antennal club, and might easily be taken for an off-color specimen of that species. Since the unique type is labelled "Utah," and is from the collection of J. B. Smith, there is little doubt that this is the specimen concerning which the note in the Proceedings of the Entomological Society of Washington (vol. I, 1885, p. 33) upon Utah as a new territory for *Pleocoma behrensi* was written.

Pleocoma simi, n. sp.

Broadly oval, robust, dorsum flattened, fimbriate and clothed beneath with yellow hair. Head dark brown, closely but rather lightly punctate, densely clothed with long yellow hair; ocular canthi impunctate; eyes prominent, round; clypeus reflexed, not or very slightly emarginate at center, apices rather sharply rounded, lateral margins rounded, upper surface densely clothed with yellow hair; anterior margins of ocular canthi at right angles to the mid-line, anterior and posterior angles lacking, the outer half being very nearly semicircular in outline as viewed from above; horn of vertex conical, pointed.

Pronotum chestnut brown, less than twice as wide as long (6.5 by 11.8 mm.), of even maximum width from about the middle to the posterior fifth, anterior and posterior angles broadly rounded; disc finely and sparsely punctate at the median base, more coarsely and closely punctate toward the sides, where the punctures tend to confluesce; posterior median impression distinct, anterior median impression long, involving the anterior three fifths of the length of the pronotum, fairly wide and deep, coarsely and extremely closely punctured; anterior margin of pronotum and anterior median impression sparsely clothed with long yellow hair. At each side of the disc, equally distant from the midline and the lateral margin, and at about the basal third, is a large, shallow, circular pit. The pronotum is retuse in profile.

Scutellum transverse, posterior margin rounded, clothed with yellow hair, which, with that of the base of the pronotum, nearly conceals the surface.

Elytra chestnut brown, wider at the humeri than the base of the prothorax, one sixth longer than wide conjointly, widest at apical third; sutural striae moderately deep; costae slightly elevated, smooth, impunctate, not attaining the apices of the elytra; geminate striae faint, consisting of widely separated, small, shallow punctures; elytral intervals finely and sparsely punctate.

Body beneath castaneous, densely clothed with long yellow hair.

Length 24 mm., maximum width 13.6 mm.

Antennae brown, first joint subconical; second joint transverse, wider than long; third joint almost twice as long as wide, subconical, joints 2 and 3 together slightly more than three fourths as long as the first; fourth joint transverse; fifth joint of about the same length, but wider, angulate; sixth joint transverse, longer than the fifth, twice as wide as long; seventh joint as long as the sixth, with a short process; joints 8 to 11 forming the club, the ninth and tenth equal and longest, the eleventh shorter, and the eighth shorter than the eleventh.

Type locality.—Cleveland, Oregon. Collected by W. J. Kocker.

Type.—Male (Cat. No. 50136) in the collection of the United States National Museum.

This species may be distinguished from *P. behrensi* and *P. fimbriata*, to which it seems most closely related morphologically, by the color, the hairy scutellum, and the densely, heavily punctured and hairy anterior median impression of the pronotum. From *P. remota* it differs in the characters of the striae and the shorter third antennal joint.

The unique type was very kindly given me by Mr. R. J. Sim, of Moorestown, N. J., for whom I take pleasure in naming the species.

MINUTES OF THE 451ST REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, DECEMBER 7, 1933.

The 451st regular meeting of the Entomological Society of Washington was held at 8 p. m., Thursday, December 7, 1933, in Room 43 of the new building of the National Museum. Mr. C. T. Greene, president, presided. There were present 39 members and 20 visitors. The minutes of the previous meeting were read and approved.

Under the heading "Election of Officers," the following officers were elected for 1934:

President	J. S. Wade
First Vice-President	B. A. Porter
Second Vice-President	S. B. Fracker
Editor	W. R. Walton
Recording Secretary	F. M. Wadley
Corresponding Secretary-Treasurer	S. A. Rohwer
Additional executive board members	W. H. Larrimer
	H. E. Ewing
	F. L. Campbell
Nominee as Vice-President to Washington Academy of Science	Harold Morrison

Before the election Mr. Rohwer stated that the Society had for years used the principle of a nominating ballot where a contest was involved, but often suspended the rules and did away with the nominating ballot, making elections by acclamation. All the above offices were filled by unanimous ballot except the position of second vice-president, and the position on the executive committee left vacant by Doctor Fracker's election as second vice-president.

A motion was passed that the president appoint committees to draw up suitable resolutions on the recent deaths of C. H. Popenoe and H. F. Wickham.

Dr. C. B. Philip and Dr. Bruce Mayne, of the Public Health Service, "sleeping-sickness" investigations, on invitation, greeted the society.

Under the heading "Notes and Exhibition of Specimens," Dr. S. B. Fracker discussed the present status of the pink bollworm in the United States. He stated that the species had lately been found in a Georgia locality, but that the infested area in Florida had apparently been reduced as compared with last year, and that the species had not been found in the Salt River Valley of Arizona in either 1932 or 1933.

The regular program consisted of a communication by Dr. C. L. Marlatt entitled "Early days in entomology in Washington."

Dr. Marlatt spoke briefly of his first impressions of Washington, and of his early connection with the Society as a member and officer. He then spoke in detail of the Society and its meetings in the nineties and early in the present century, characterizing a number of the members. He also mentioned the social features connected with the meetings in this period, especially when the Society was smaller and could be entertained in the homes of the members.

This talk was discussed by Busck, Aldrich, McIndoo, Greene and Morrison.

The meeting adjourned at 9:50 P. M.

F. M. Wadley,
Recording Secretary.

Actual date of publication, February 2, 1934.

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ENTOMOLOGICAL SOCIETY

OF WASHINGTON

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OF WASHINGTON

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The regular meetings of the Society are held in the National Museum on the first Thursday of each month, from October to June, inclusive, at 8 P. M.

Annual dues for members are $3.00; initiation fee $1.00. Members are entitled to the PROCEEDINGS and any manuscript submitted by them is given precedence over any submitted by non-members.

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PROCEEDINGS OF THE

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TACHINID FLIES WITH AN EVANESCENT FOURTH VEIN, INCLUDING A NEW GENUS AND FIVE NEW SPECIES.

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INTRODUCTION.[1]

The dipterous family Tachinidae contains several genera that have the fourth longitudinal vein evanescent at its tip. Those genera having this unusual character are widely scattered throughout this large family of parasitic flies. The object of this paper is to bring these genera together for convenience in making determinations. While this character is not a natural one it may be used very nicely for grouping these sixteen genera comprising twenty species. *Melanomelia aterrima* Strobl and *Besseria melanura* Meigen, both European species, are not included in my table because I was unable to secure a specimen of either species. All of the species treated in this paper, including the new ones, are in the U. S. National Museum collection.

The head, palpus, and right wing of each species included in this paper are shown for the convenience of persons interested in this group of flies. The palpus is figured principally to show its difference in form and size as among the different species.

Here, I wish to acknowledge my thanks to Dr. J. M. Aldrich for his friendly assistance.

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[1]See Appendix.

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13. Veins one or three bristly 14
    Veins one, three, and five bristly 15
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Bezzimyia busckii Townsend.

Proc. U. S. Nat. Mus. 56, p. 591, 1919.
Figs. 1, 18.

One specimen labeled "Trinidad Rio, Panama, 7, 12, 12. A. Busck collector. *Type*, Cat. No. 22263 U. S. N. M."

Another specimen labeled "Los Borregos, Brownsville, Texas 7. 6, 07. H. S. Barber collector."

Melizoneura albipennis Robineau Desvoidy.

Myod. p. 102, 1830.
Figs. 2, 19.

One specimen labeled "Stadlau, 17, VI, 87, coll. Pok."

Dichaetoneura leucoptera Johnson.

Psyche XIV, p. 9, 1907.
Figs. 3, 21.

One specimen labeled "? Geneva, N. Y., P. J. Parrott, July 15, 12. From Archips cerasivorana."

Another specimen labeled with the same locality and date; also an extra label "fly from cage of Archips cerasivorana."

Another specimen labeled "Kentville, N. S." no date.

Two specimens labeled "Hopkinton, N. H., VII, 21, 24. Ex Archips cerassivorana Fitch, Gip. Moth Lab. 10095 K 5."

Another specimen labeled "Windham, Conn., VII, 8, 21. Ex. A. cerassivorana Fitch. Gip. Moth Lab., 10095 G 3 a."

Another specimen labeled Bangor, Me., VII, 28, 24. Ex. A. cerassivorana Fitch. Gip. Moth Lab. 10095 K 1 C."

Phytomyptera nigrina Meigen.

Europ. Zweifl. 4, p. 355, 1824.

Figs. 4, 22.

Two specimens; one labeled "Portici Napoli, Silvestri." No date. The other specimen without labels.

Roeseliopsis floridensis, new species.

Figs. 17, 29.

Female.—Black species. Antennae, facial ridges, oral margin, femora, and tibiae yellow. Frontal bristles extending slightly below base of second antennal joint; two pairs of orbitals on the right side, one on the left. Sides of face at narrowest part almost one half as wide as facial depression, bare, with three or four hairs extending below frontals; facial ridge very broad, with bristles, diminishing in size, extending slightly above the middle and appearing to form two rows; vibrissae slightly above oral margin; palpi well developed and reddish yellow. Antennae extending slightly below middle of face; third joint nearly five times the length of the second; arista thickened to the middle and the penultimate joint about as long as its diameter. Thorax black with a gray pruinosity forming two narrow central stripes extending almost to the suture; humeri reddish; two presutural and three postsutural dorsocentrals; two presutural and three postsutural acrostichals; three sternopleurals; scutellum with four marginal pairs; one pair of widely separated discals and one large bristle on each side located below the marginals. Abdomen opaque gray pollinose tinged with yellow; segments one and two each with a marginal and a lateral pair; segment three with a marginal row, the middle pair slightly out of line with the others; fourth segment with a row, broken in the middle, located just below the middle of the segment. Middle tibia on the front side bearing four macrochaetae diminishing in size toward base of tibia; all tarsi with a brownish infuscation. Wings hyaline, with a decided depression in tip of apical cell; veins yellowish-brown; hind crossvein straight midway between the small crossvein and the tip of the fourth; two bristles at base of third vein; calypters yellowish white. Length, 8.5 mm.

Type locality.—Palm Beach, Florida, June 15, H. G. Dyar collector.

Type.—Female, Cat. No.   , U. S. N. M.

Differs from *R. americana* Coquillett mainly in the antennae, dorsocentrals, acrostichals, and tip of wing.

Roeseliopsis americana Coquillett.

Proc. Biol. Soc. Wash. XXVIII, p. 23, 1915.
Figs. 6, 24.

One specimen labeled "Tifton, Ga. Oct. 1, 96. *Type* No. 3545 U. S. N. M. Collection Coquillett."

Hemithrixion oestriforme Brauer and Bergenstamm.

Zweifl. Kais. Mus. V, p. 357, 1891.
Figs. 5, 25.

Coquillettina plankii Walton.

One specimen labeled "Pasadena, New Jersey, 8, 13, 14. Bred specimen 8, 25, 14. Quaintance No. 11808. H. K. Plank collector. *Type*, Cat. No. 19599 U. S. N. M."

Another specimen labeled the same except "bred 8, 27, 14."

Another specimen labeled "Colorado." No date.

Racodineura antiqua Meigen.

Syst. Beschr. IV, p. 412, 1824.
Figs. 7, 23.

One specimen labeled "Sardinia, A. H. Krausse." Another specimen labeled "Hunstauton, Norfolk, 24, IX, 00."

Plectops manca, new species.

Figs. 8, 20.

Male.—Front and ocellar triangle subshining, the former with a pale pruinnosity along the edges; frontal bristles extending to apex of second antennal joint; two pairs of orbitals directed forward; ocellars divergent; sides of face very narrow, bare, with a whitish pruinosity; facial ridge not prominent and with small bristles on the basal fourth; vibrissae on a line with the oral margin. Antennae black, reaching to the oral margin; third joint about three times as long as broad; arista thickened on the basal half; penultimate joint a little longer than its diameter. Palpi well developed and black. Thorax with pale grayish pruinosity in front of the suture; two narrow stripes of equal width in the middle extending to the suture; another stripe, on each side of the central pair, is very narrow towards the front and quite broad behind; one large and one small presutural dorsocentral; three postsutural dorsocentrals; two sternopleurals and several hairs present; scutellum concolorous with the thorax, with one large basal macrochaeta and the large apical pair slightly divergent; numerous small bristly hairs on the disk; knobs of halteres pale yellowish brown. Abdomen shining black with a bronze reflection; segments one to four each with a marginal row of macrochaetae (the row on the third segment is slightly more submarginal); segments two to four each with a basal whitish pruinose band interrupted in the middle and widened on the outer ends. Legs black; middle tibia with one bristle on the outer side and one on the flexor side just above the middle. Wings hyaline with the fourth longitudinal vein evanescent at its tip; third vein with four bristles at its base.

Length, 3.5 mm.

Female.—Very much like the male but with the following exceptions: Frontal bristles extending to base of second antennal joint. Abdomen nearly as broad as long; the macrochaetae arranged in submarginal rows, especially on segments three and four. Wing with the third vein having two to four bristles at its base (usually three bristles).

Length, 2.5–3.75 mm.

Described from six males and fourteen females.

Holotype male, Cabin John, Md., May 26, 1916, R. M. Fouts collector, Cat. No. U. S. N. M.

Allotype female, Dead Run, Fairfax County, Va., X, 28, 15, R. C. Shannon collector.

Paratypes.—One female, Livingston Heights, Va., 10, 27, 12; eight females, Dead Run, Va., X, 28, 15; two females, Dead Run, Va, XI, 11, 15, R. C. Shannon collector; one female, Caney Spring, Tenn., April 3, 1918, G. G. Ainslie collector; four males, Falls Church, Va., VIII, 27, Nathan Banks collector; one male, Glen Echo, Md., Aug. 2, 22, and one female, Glen Echo, Md., July 30, 22, J. R. Malloch collector.

APELOGLUTUS, new genus.

Front broad, slightly narrower towards the vertex; frontal stripe broad. Antennae reaching nearly to the oral margin; third joint slightly more than twice as long as wide, lower angle broadly rounded and the upper angle acute; third joint of arista thickened on the basal three fourths; penultimate joint half the length of the third; sides of face very narrow, bare; facial ridge bristly nearly half way. Anterior crossvein located slightly beyond the middle of the discal cell; hind crossvein retracted; the two crossveins separated by a distance slightly greater than the length of the hind one; third longitudinal vein ending near tip of wing; last section of fourth vein evanescent and about four times the length of the preceding section.

Genotype.—*Apheloglutus latifrons*, new species. Related to the genus *Plectops*.

Apheloglutus latifrons, new species.

Figs. 9, 26.

Female.—Small black species, robust, with thorax gray pruinose and abdomen shining.

Front gray pruinose, at the vertex twice as wide as either eye; the sides tapering slightly towards the vertex; frontal stripe broad, dull black; frontals reaching to base of second antennal joint; three pairs of orbitals, with two short bristly hairs below the lower orbital; ocellar pair small, divergent; inner verticals nearly twice as large as the outer pair; sides of face very narrow and bare.

Antennae black. Height of cheeks about two thirds that of the eye; palpi black. Three pairs of presutural acrostichals (postsutural injured by the pin); two presutural and three postsutural dorsocentrals; two large and two small sternopleurals; scutellum with numerous bristly hairs; one large macrochaeta near each basal angle and one large pair at its apex. Abdomen as broad as long; second, third, and fourth segments with a marginal row; third segment with a latero-discal pair; fourth segment with a discal row; segments two, three, and four with a very narrow basal pollinose whitish band interrupted in the middle. Legs black; middle tibia with a single macrochaeta on the outer front side and one on the flexor side just beyond the middle.

Wings hyaline; one small bristle at the base of the third vein. Length, 3.5 mm.

Described from one female.

Type locality.—Tennessee Pass, Colorado, VII, 7., 10240 feet, J. M. Aldrich collector.

Type.—Cat. No. U. S. N. M.

Schizotachina vitinervis Thompson.

Canad. Ent. xliii, p. 268, 1911.
Figs. 10, 10a, 27, 28.

Two specimens labeled, one, "No. 16a" and the other "No. 16aa," and both containing the following labels:

"Par. on Tineid P. australis. Iss. Feb. 20, 80."

Two specimens labeled, "Gipsy Moth Laboratory 2267 T, VI, 2, 10."

One specimen labeled "G. M. L., 2267 T, VI, 6, 10."

Schizotachina ruficornis, new species.

Figs. 11, 34.

Female.—Black with gray pruinosity. Antennae extending almost to oral margin, pale dull reddish yellow; third joint about four times as long as broad and about five times as long as the second; arista yellowish, with brown infuscation extending apically; second joint nearly two thirds the length of the third, the latter thickened nearly to the tip; frontals extending to the insertion of the arista; two pairs of proclinate orbitals and a few very minute frontal hairs; palpi yellow. Thorax pale gray pollinose with three postsutural and three presutural dorsocentrals; three pairs of presutural acrostichals (postsutural acrostichals injured by the pin). Abdomen shining black, nearly as broad as long; segments two and three with a broad pale pollinose basal band interrupted in the middle, wider at the interruption and at the lateral ends; fourth segment entirely thin pollinose. Legs brownish black, the tibiae slightly more yellowish; middle tibiae with one large bristle on the outer front side and one on the flexor side. Wings hyaline, veins yellow; fourth longitudinal vein evaescent; third vein with one large bristle at its base.

Length, 3 mm.

Described from two females.

Type locality.—Titusville, Florida (no date). G. G. Ainslie collector. Ainslie No. 1066.

Type.—Female, Cat. No. U. S. N. M.

Euryceromyia robertsoni Townsend.

Trans. Amer. Ent. Soc. XIX, p. 115, 1892.
Figs. 12, 30.

One specimen labeled "Anacostia, District of Columbia, 29, 9, 14. R. C. Shannon collector."

Actia eucosmae Bezzi.

Anns. & Mag. Nat. Hist. ser. 9, XVII, p. 239, 1926.
Figs. 13, 31.

One specimen labeled "Brisbane, Aust. T. H. Johnston." Another specimen labeled "Richmond, N. S. W., April 29, 1928. T. D. A. Cockerell collector."

Actia lamia Meigen.

Europ. Zweifl. 7, p. 254, 1838.
Figs. 14, 32.

One specimen labeled "Sondrio, 9, V, 98."

Actiopsis autumnalis Townsend.

Ins. Ins. Menst. IV, p. 121, 1916.
Figs. 15, 33.

Two specimens labeled "Rosslyn, Va., IX, 17, 23, J. M. Aldrich collector."

Another specimen "Grove Hill, Md., 7, XI."

Another specimen Bethesda, Md., 23, 9, 14. J. C. Crawford collector, on Aster ericoides."

Another specimen "Pimmit Run, Va., 1, VIII, 08. F. Knab collector, on flowers of Asclepias rubra."

Another specimen labeled the same, but "on flowers of Rhus glabra."

Actiopsis rufescens, new species.

Figs. 16, 35.

Like *Actiopsis autumnalis* Townsend, but differing in the following characters:

Female.—Very much larger, the general color lighter; third antennal joint three times as long as wide, with the yellow at the base more definitely outlined; penultimate joint of the arista three times as long as broad; short bristly hairs on sides of front not arranged in a definite row; palpi broader on apical portion. Thorax with the ground color red covered with a brassy pruinosity; scutellum a little more yellowish than the thorax, with the same pruinosity; one specimen with four long macrochaetae on each side of the scutellum instead of three. Abdomen with the ground color deep yellowish red with a very thin brassy pruinosity which is variable in appearance according to the angle of light; a faint grayish dorsal longitudinal stripe the length of the abdomen; one specimen with one weak discal macrochaeta on one side only of segments two and three. Legs yellowish red, tarsi darker and grayish.

Length 5.5–7 mm.

Described from two females.

Type.—Female, Cat. No.   U. S. N. M.

Type locality.—South Dakota, no date. J. M. Aldrich collector.

APPENDIX.

Apostrophus anthophilus Loew.

Beschr. Eur. Dip't. ii, p. 310, 1871.
Figs. 36, 37.

This species was sent to Mr. J. R. Malloch for determination after my paper was completed. In order to make this paper complete with North American records I have included this European species in this appendix, as it is the first American record of this species.

It belongs in the group having the veins bare. It is easily separated from all the other species herein included in that it is shining black with a large luteous spot on each side of the second abdominal segment and extending backward on to the third segment and narrowly forward on the extreme lateral edges of segment one. Segment two has a narrow vertical black stripe in the middle of the dorsum.

One specimen labeled "Aklavik, N. W. T., June 27, 1931, O. Bryant, Lot 241"; the other, "Cooking Lake, Alberta, VII. 7, 32, O. Bryant collector."

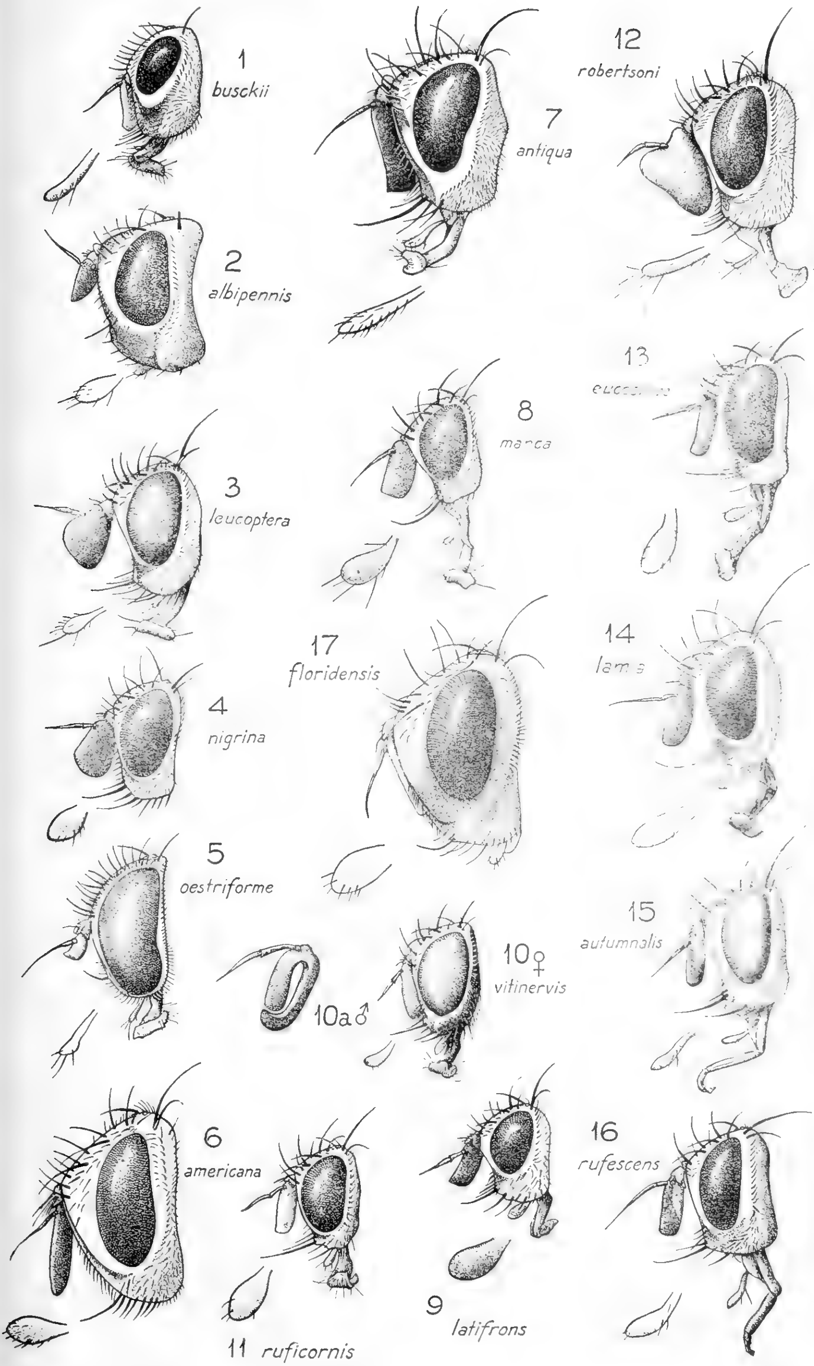
Explanation of Figures.

Drawings by C. T. Greene.

(*Except figs. 10, 15, 26, 27 & 32 by W. R. Walton.*)

Fig. 1. *Bezzimyia busckii* Townsend.
2. *Melizoneura albipennis* Desvoidy.
3. *Dichaetoneura leucoptera* Johnson.
4. *Phytomyptera nigrina* Meigen.
5. *Hemithrixion oestriforme* Brauer & Bergenstamm.
6. *Roeseliopsis americana* Coquillett.
7. *Racodineura antiqua* Meigen.
8. *Plectops manca* Greene.

9. *Apheloglutus latifrons* Greene.
10. *Schizotachina vitinervis* Thompson, female.
10a. *Schizotachina vitinervis* Thompson, 3d antennal joint, male.
11. *Sch'zotachina ruficornis* Greene.
12. *Euryceromyia robertsoni* Townsend.
13. *Actia eucosmae* Bezzi.
14. *Actia lamia* Meigen.
15. *Actiopsis autumnalis* Townsend.
16. *Actiopsis rufescens* Greene.
17. *Roeseliopsis floridensis* Greene.
18. *Bezzimyia busckii* Townsend.
19. *Melizoneura albipennis* Robineau-Desvoidy.
20. *Plectops manca* Greene.
21. *Dichaetoneura leucoptera* Johnson.
22. *Phytomyptera nigrina* Meigen.
23. *Racodineura antiqua* Meigen.
24. *Roeseliopsis americana* Coquillett.
25. *Hemithrixion oestriforme* Brauer & Bergenstamm.
26. *Apheloglutus latifrons* Greene.
27. *Schizotachina vitinervis* Thompson, female.
28. *Schizotachina vitinervis* Thompson, male.
29. *Roeseliopsis floridensis* Greene.
30. *Euryceromyia robertsoni* Townsend.
31. *Actia eucosmae* Bezzi.
32. *Actia lamia* Meigen.
33. *Actiopsis autumnalis* Townsend.
34. *Schizotachina ruficornis* Greene.
35. *Actiopsis rufescens* Greene.
36. *Apostrophus anthophilus* Loew.
37. *Apostrophus anthophilus* Loew.


1
busckii
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albipennis
3
leucoptera
4
nigrina
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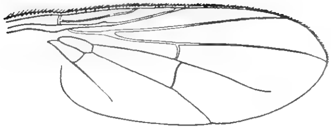
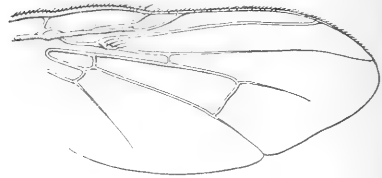
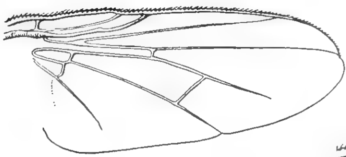
oestriforme
6
americana
7
antiqua
8
9
latifrons
10♀
vitinervis
10a♂
11 ruficornis
12
robertsoni
13
14
15
autumnalis
16
rufescens
17
floridensis



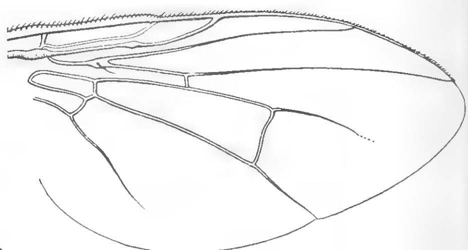
18 *busckii*



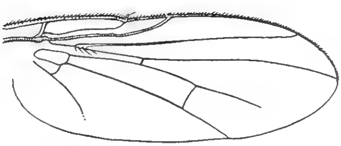
23 *antiqua*



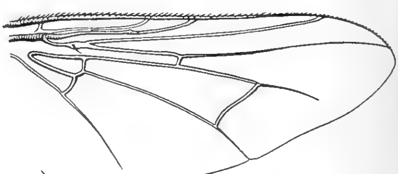
19 *albipennis*



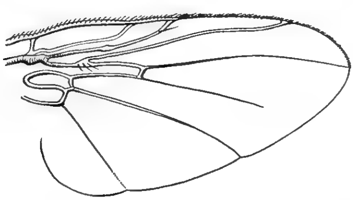
24 *americana*



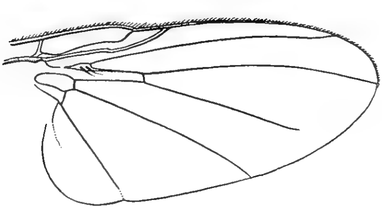
20 *manca*



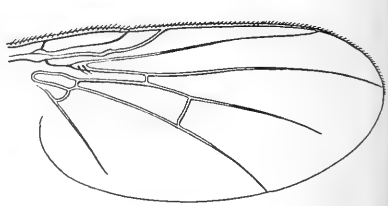
25 *oestriforme*



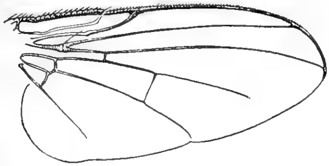
21 *leucoptera*



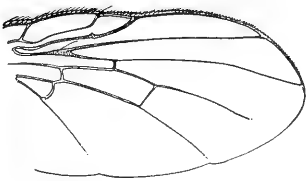
22 *nigrina*



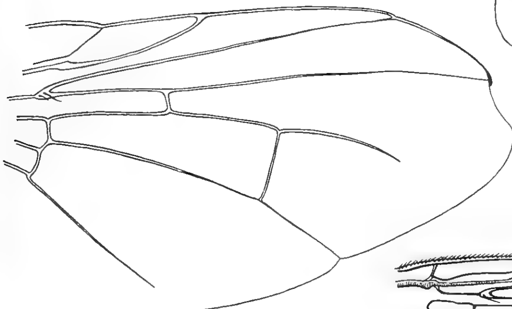
26 *latifrons*



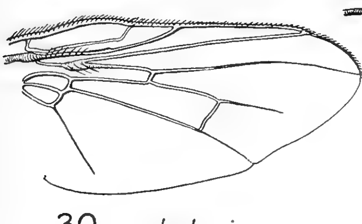
27 *vitinervis* ♀



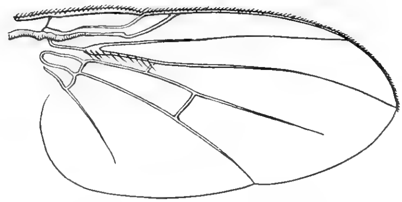
28 *vitinervis* ♂



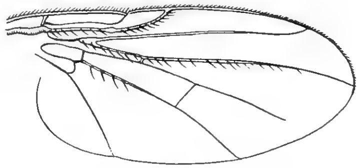
29 *floridensis*



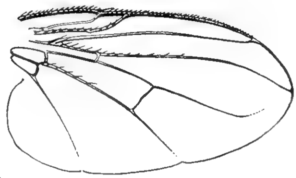
30 *robertsoni*



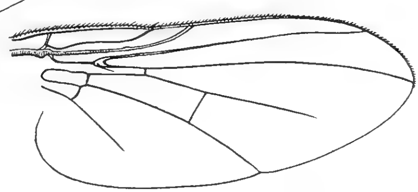
31 *eucosmae*



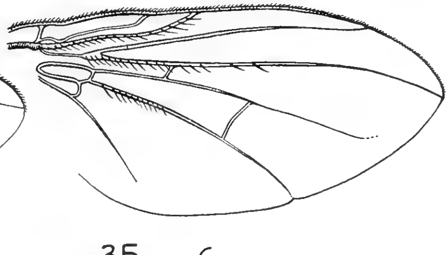
32 *lamia*



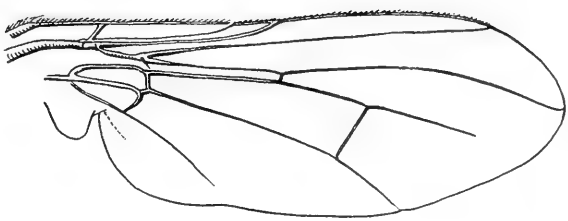
33 *autumnalis*



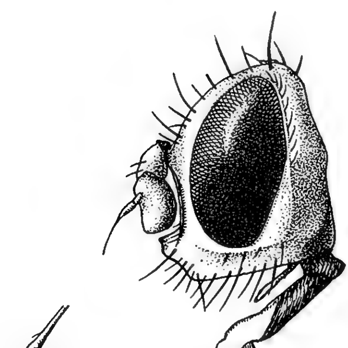
34 *ruficornis*



35 *rufescens*



anthophilus 36



♀ ♂ 37

Apostrophus anthophilus Loew. Wing 36, head and palpus 37.

NOTES ON PSOROPHORA (JANTHINOSOMA) HORRIDUS DYAR AND KNAB.

By Robert Matheson.

Dyar and Knab (1906) described *Janthinosoma champerico* from a single female taken at Champerico, Guatemala. They stated that it was close to *Janthinosoma lutzii* Theobald. The same authors (1908) described *Aedes horridus* from a series of 56 females taken at widely separated points in the southern United States (Texas, Mississippi, Arkansas, Tennessee, Oklahoma, Virginia and Maryland). In their monograph (The Mosquitoes of North and Central America and the West Indies) these species are considered distinct and treated under the names, *Psorophora champerico* and *Psorophora horridus*. Under *P. horridus* they placed as a synonym *Janthinosoma lutzii* Felt (nec Theobald). Felt (1904) had described and figured what he considered was the male of *Janthinosoma lutzii* Theobald. Dyar and Knab assumed that this was the male of their *P. horridus* and described it as such and copied the photograph made by Felt. In the monograph *Psorophora champerico* is described in great detail, the description being based on two females,—one from Guatemala (the type) and another from Tabernilla, Canal Zone. The larva and male were unknown and have not as yet been discovered. The larva of *P. horridus* was also unknown.

Dyar (1922) states that *Psorophora horridus* D. & K. is widely distributed in the southern United States. In describing the species he states that the "thorax is black scaled in the middle." (The original description specifically states that this band consists of deep brown scales; all the female specimens that I have examined have deep bronzy brown scales forming a distinct longitudinal band.) Dyar (1928) places *horridus* as a synonym of *champerico* and assumes that the male of *Janthinosoma lutzii* Felt (nec Theobald) is the male of the species *Psorophora* (*Janthinosoma*) *champerico* D. & K. The drawing illustrating the male genitalia is evidently copied from the photograph published by Felt.

Recently I received a small shipment of mosquitoes from Prof. H. H. Schwardt of the Arkansas State University, Fayetteville, Arkansas. In this collection the genus *Psorophora* is well represented and among them were two males (no females) of *Psorophora horridus* D. & K. (*champerico* according to Dyar). These males were taken at Fayetteville on August 24, 1933. On examining the genitalia I was amazed to find one of the most bizarre types yet recorded for any male of this genus. It is unique and unlike any previously described. The male genitalia figured by Felt (1904) and copied by Dyar and Knab (1917) and by Dyar (1928) as representing the male of *Psorophora horridus* is undoubtedly that of *Psorophora lutzii* Theobald or *Psorophora ferox* Humboldt (*posticata* Wied). This conclusion is in agreement with the descriptions and figures given by Bonne and Bonne-Wepster (1925).

Psorophora horridus D. & K. should remain as a distinct species. *P. champerico* D. & K. is probably identical with *P. lutzii* Theobald but no definite conclusion should be reached until the male has been discovered. Should it prove identical with that of *P. horridus* then *horridus* would become a synonym of *champerico* D. &. K.

Description of the male of **P. horridus,** D. & K.

Coloration of male agrees very closely with the description of the female given by Dyar (1928, p. 119). The proboscis is slender black with bronzy reflections. The palpi are longer than the proboscis, black, with the last two segments slightly enlarged and somewhat upturned. Dyar describes the central broad band of the mesonotum of the female as clothed with "small black scales." In all my specimens of both males and females this central band consists almost entirely of dark bronzy brown scales. (In the original description of *Aedes horridus* Dyar and Knab described this band as consisting of "deep brown scales.")

Hypopygium. (Figures 1 a and b.)—Side-piece cylindrical, short, stout, fully half as wide as long; tip of the lower half terminating in a stout recurved, finger-like process which lies above the clasper (Figure 1 a.); tip and distal margin of the process clothed with numerous yellowish hairs; side-piece with large spines and numerous small setae on distal half; lateral portion with numerous scales. Clasper short, broadly expanded distally, terminating in a short, peg-like spine; on the upper side near the tip is a small triangular expansion bearing 4 to 6 short spines. Claspettes (Fig. 2b) strikingly bizarre in appearance and each fits closely into the large depression on the inner face of each side-piece. The claspettes are united at their bases and each consists of two large branches; the lower branch is short and terminates in two short branches, each of which ends in a stout recurving spine; the upper branch is more than twice the length of the lower branch and it divides into two branches,—the outer long and terminates in a stout spine,—the inner shorter and bears two short, stout, terminal spines. The basal half of the upper branch bears numerous short setae. The phallosome (Fig. 2) presents the appearance of a cone narrowed at the base and open on its ventral face. The tenth sternites (paraprocts) are short and each ends in a short tooth. The ninth segment is prominent with two small detached lobes in front and a most striking structure forms the central portion. This structure projects forward between the lobes and lies below the phallosome. The terminal portion is bulb-like with an invagination which bears a central tooth-like projection. The entire ninth segment is chitinized, strikingly narrowed and is retracted largely within the eighth segment.

Described from two males from Fayetteville, Arkansas, August 24, 1933 (H. H. Schwardt, collector). One male is deposited in the collection of the U. S. National Museum; the other in the collection of Cornell University.

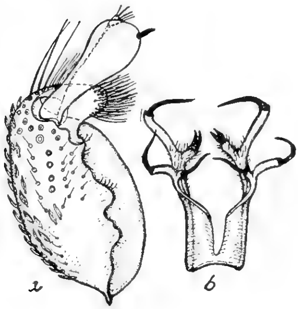


Fig. 1.

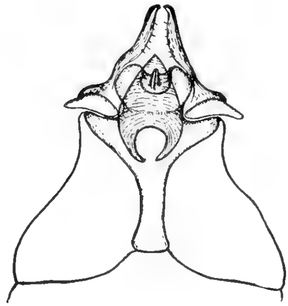


Fig. 2.

Explanation of Figures.

Fig. 1a. Side-piece of hypopygium of *P. horridus*, dorsal view.
b. The claspettes, dorsal view. Both drawn to the same magnification.
Fig. 2. Dorsal (lower) view of the phallosome, tenth sternites and ninth segment of the hypopygium of *P. horridus*.

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Dyar, H. G. and Knab, F. Proc. Biol. Soc. Wash. 19, 134. 1906.
Dyar, H. G., and Knab, F. Proc. U. S. Nat. Mus. 35, 56. 1908.
Dyar, H. G. Proc. U. S. Nat. Mus., 62, 36. 1922.
Dyar, H. G. Carnegie Institution of Washington. Pub. No. 387, 119. 1928.
Felt, E. P. Bull. 97, N. Y. State Museum, 471, Fig. 2, plate V. 1904.

DESCRIPTIONS OF FIVE PARASITIC HYMENOPTERA.

By S. A. Rohwer,
U. S. Department of Agriculture, Bureau of Entomology, Washington, D. C.

The descriptions given below were prepared a number of years ago when the specimens were submitted for identification and are presented at this time in order that the names may be available.

Bruchobius magnus, new species.

Of the described species of *Bruchobius* this new species is more closely allied to *B. colemani* Crawford than to others but it may easily be distinguished from that species by the color of the legs, large size, coppery color, etc. Like *colemani* it differs from the genotype in the better developed knob at the end of the stigmal vein.

Female.—Length, 4 mm. Interocellar line but little shorter than the ocell-ocular line; pedicellum subequal in length with the second joint of funicle, which is distinctly shorter than the first funicle joint; punctation of propodeum somewhat finer than that of the mesoscutum; marginal vein only a little longer than the postmarginal; stigmal club well developed, its greatest width (with the longitudinal axis of wing) half the length of the rest of the stigmal vein. Bright cupreous, abdomen black with a cupreous luster; body with white hairs; legs beyond coxae rufo-ferruginous, bases and apices of tibiae, and most of the tarsi, white. Wings hyaline; venation pale brown, stigmal club dark brown.

Male.—Length, 2.5 mm. Like the female except for the much shortened abdomen, the basal dorsal middle of which is pale. Stigmal knob somewhat more elongate so its greatest length is with the transverse axis of the wing; marginal and postmarginal veins thicker than in female.

Paratypes show that the white markings on the legs, especially the two anterior pairs, may be greatly reduced or wanting.

Type locality.—Uitenhage, Cape Provence, South Africa.

Allotype locality.—Grahamstown, Cape Provence, South Africa.

Hosts.—*Bruchus pisorum* L., *B. rufimanus* Boh., and *B. cicatricosus* Fahr.

Described from three females and one male from the type locality, reared from *Bruchus pisorum* by J. G. Cuyler under Accession Number Department of Agriculture of South Africa 2757. Also three females and one male (allotype) from the allotype locality reared from *B. rufimanus* by B. B. Wright, under number 2761. Also one female and one male from the same locality reared from *Bruchus cicatricosus* by W. R. Goulde. All material received from Dr. L. Peringuey.

Type, allotype, and *paratypes.*—Cat. No. 23112, U. S. N. M.

This species has been intercepted by inspectors of the United States Department of Agriculture engaged in the enforcement of plant quarantines in shipments from Capetown, South Africa, and recorded under number 28362.

Catolaccus fragariae, new species.

This new species runs to the genus *Catolaccus* in Kurdjumov's key[1] and agrees with the characters given. It differs from all the North American species which have been placed in this genus in having a distinct median carina on the base of the propodeum.

Female.—Length 1.5 mm. Head seen from above as wide as the thorax, seen from the side narrowing towards the vertex, longest (antero-posteriorly) at the level of the antennae; face convex; anterior margin of the clypeus rather broadly emarginate; face finely reticulate-punctate dorsally, ventrally with fine striae which converge towards the clypeus; frons and vertex with punctures slightly coarser than those below antennae; vertex narrow; postocellar line distinctly longer than the ocellocular line; antenna with two ring-joints, six funicle joints,

[1]Rev. Russ., 1913, vol. 13, p. 6.

and a three-jointed club which is no wider than the last funicle joint; funicle becoming a little wider apically, the joints all well defined, the first and fourth subequal and a little longer than the fifth and sixth, which are subequal, and a little shorter than the second and third, which are subequal; mesonotum with punctures similar to those on frons and with a few, scattered, fine, white hairs which can only be seen in certain lights; sides of dorsal aspect of propodeum impunctate, median part of propodeum with fine reticulations on a shining surface, lateral sulci distinct, a distinct transverse carina which is angulate medianly and joins with a median longitudinal carina; mesepisternum with umbilicate punctures; apical part of costal cell with scattered hairs; marginal vein somewhat longer than the postmarginal; abdomen shining, slightly longer than the thorax, conic-ovate. Black, sides of propodeum and the abdomen dark metallic green; scape, anterior legs beyond femora, and four posterior legs beyond coxae testaceous with the apices of tibiae whitish; wings hyaline, venation pale brown.

Paratypes indicate that the color of the legs may vary, as in some the anterior femora are testaceous and in others there is a brownish tinge to the posterior femora. The strength of the transverse and longitudinal carinae on the propodeum also varies some but in all specimens they are present.

Male.—Length 1.25 mm. The male agrees well with the above description of the female except that the antennae are more tapering and the club even less differentiated; the abdomen is shorter and black except the first and base of the second tergites, which are yellow.

Type locality.—Knoxville, Tennessee.

Described from five females (one type) and three males (one allotype) reared from *Anthonomus signatus* by S. Marcovitch and sent under his lot number 1.

Type.—Cat No. 24163, U. S. N. M.

Kurdjumov,[2] in his key to the genera of Pteromalidae, states, in reference to the genus Catolaccus, "—none of the American species described under this generic name really belong to it, they are either *Habrocytus* Thoms. or *Zatropis* Crawford." Comparison with specimens of the genotype of *Catolaccus* were not made and there is some uncertainty as to the generic position for this new species. It does not, however, belong to either *Zatropis* or *Habrocytus* as at present understood.

Phanerotoma formosana, new species.

Evidently allied to *Phanerotoma flavida* Enderlein but differing from the description of that species in having the basal part of the abdomen paler, in the third tergite, and in other minor characters.

Male.—Length 4 mm. Head seen from in front about twice as broad as high, eyes prominent; clypeus smooth, convex medianly; malar space somewhat

[2]Rev. Russ., 1913, vol. 13, p. 6.

shorter than width of mandible at base; basal antennal joints lengthened; face transversely striato-reticulate; frons coarsely striato-reticulate dorsad-ventrad; ocelli in an acute triangle, the intraocellar area granular, not surrounded by a well defined furrow; vertex transversely striato-reticulate; posterior orbits slightly receding, but little narrower than width of eyes; occiput deeply, arcuately emarginate posteriorly; scutum punctato-reticulate; notauli poorly defined; suture between scutum and scutellum coarsely foveolate; disk of scutellum punctured, margined laterally, lateral areas of scutellum with strong rugae; propodeum truncate posteriorly, coarsely reticulate and with a few of the lines more prominent; tergites reticulate, more coarsely so basally, the basal carinae strongly converging, extending only to about the middle of the first tergite; first tergal suture straight, foveolate, the second also foveolate but curved anteriorly; third tergite without a median ridge or apical emargination; radius leaving stigma beyond the middle; first abscissa of radius about one third as long as the second. Reddish-yellow; interocellar area and a transverse band behind scutellum brownish; base of abdomen whitish; legs pallid, apex of hind tibia with a brownish spot; wings hyaline; basal venation yellowish, the apical venation darker, stigma dark brown apically, pale basally.

Type locality.—Taihoku, Formosa, Japan.

Type.—Cat. No. 23841, U. S. N. M.

Described from two specimens (one a male and the other without an abdomen) received from T. Shiraki and recorded under his number 152. Material collected by M. Maki and reared from larva of *Glyphodes pyloalis* Walker.

Rhogas narangae, new species.

Differs from *Rhogas japonicus* Ashmead, which it resembles in size and color, in having the first two tergites subequal, in the less prominent ocelli, distinctly receding orbits, etc.

Male.—Length 4.5 mm., length of antennae 5.7 mm. Head seen from the front distinctly converging below; malar space subequal in length with the eye; eyes prominent, oval, their inner margins only slightly emarginate; face punctato-reticulate on a granular surface; front and orbits similarly sculptured; vertex with transverse wrinkles in addition; ocelli not especially prominent, arranged in an acute triangle; occiput completely and strongly margined; orbits strongly receding; antenna longer than body, about 45-jointed, the third and fourth joints subequal; top of pronotum coriaceous and with some transverse raised lines laterally; scutum rather finely reticulate on an opaque surface, the reticulations more distinct posteriorly; scutellum granular, laterally with a few, irregular, longitudinal, raised lines; propodeum granular and with irregular reticulations, the median carina complete for basal half only; mesepisternum irregularly punctato-striate; first three tergites with longitudinal wrinkles on a granular surface, the median carina complete; first two tergites of subequal length; stigma angulate at middle of lower margin; the first and second abscissae of radius subequal; nervulus before middle of cell, but more than four times its length beyond basal. Ferruginous, intraocellar area and irregular stains on mesoscutum brownish; antennae pale brown; palpi pallid; legs testaceous; wings hyaline, venation yellowish, stigma pallid; second intercubitus obsolescent.

The paratypes show that the sculpture of the vertex may almost lack the raised lines, that the reticulations on the scutum may be nearly lost, and that the propodeum and first two tergites may be marked with brown.

Type locality.—Formosa, Japan.
Type.—Cat. No. 23840, U. S. N. M.
Described from three males (one type) received from T. Shiraki, Taihoku, Formosa, and recorded under his number 124 and said to have been reared from the larva of *Naranga aenescens* Moor.

Rhogas metanastriae, new species.

In general appearance like (*Heterogamus*) *Rhogas thoracicus* (Ashmead) but the black legs will readily separate it from that species. *Chelonorhogas rufithorax* Enderlein is similarly colored but differs in size and structure.

Male.—Length 8.5 mm, length of antennae about 8 mm. Head seen from in front broader than high, not much narrowed below; malar space rather short, subequal to the width of the mandibles; face coarsely granular, with a few irregular transverse raised lines and with a median dorsad-ventrad carina which is better defined dorsally; eyes large, reniform, deeply emarginate; front and posterior orbits finely granular; vertex granular but with a few transverse wrinkles in addition; occipital carina interrupted medianly; ocelli large, arranged in nearly an equilateral triangle, postocellar line slightly longer than the ocelloccipital line and a little shorter than the interocellar line; antennae nearly as long as body, flagellum with about 50 joints of nearly equal length; dorsal surface of pronotum coarsely granular, the posterior margin with a tendency toward reticulations; scutum and prescutum granular, the notauli feebly and irregularly foveolate; median area of scutellum granular, margined laterally; propodeum reticulate and with a nearly complete median carina; mesepisternum opaque, granular with a tendency towards aciculations dorsally; tergites longitudinally striato-reticulate, the striations more pronouncd anteriorly, the reticulations posteriorly, the first two, as well as base of third, with a median carina; radius leaving stigma before middle; first abscissa of radius about half as long as second; nervulus in middle of cell. Head and thorax rufous, abdomen black; palpi, intraocellar area, antennae, legs, and dorsal part of propodeum black; body with short silvery hair; wings hyaline; venation dark brown.

Paratype *a* has the propodeum almost entirely rufous, and is so pinned that the posterior part of the prescutum and scutum can be seen to be reticulato-granular. Paratype *b* also has the propodeum mostly rufous.

Type locality.—Taihoku, Formosa, Japan.
Type.—Cat. No. 23839, U. S. N. M.
Described from three specimens received from T. Shiraki of

the Agricultural Experiment Station of Formosa under his number 131 and said to have been reared by M. Maki from the larva of *Metanastria punctata* Walker. The type is in fair condition, paratype *a* lacks the abdomen and some legs, and paratype *b* lacks all of the legs and head.

MINUTES OF THE 452d REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, JANUARY 4, 1934.

The 452d regular meeting of Entomological Society of Washington was held at 8 p. m., Thursday, January 4, 1934, in Room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. There were present 35 members and 17 visitors. The minutes of the previous meeting were read and approved.

Under "Reports of Officers," the Corresponding Secretary-Treasurer submitted his report for the calendar year 1933. The report stated that there were 190 members of the Society and that for the year 1933 there had been 119 subscribers. The receipts during the calendar year 1933 were $1,674.67, total expenditures $1,262.07, cash on hand $207.52. Due to bank failure the Society lost $205.02. It was recommended that the Treasurer be authorized to deduct this from his account, keeping a memorandum for possible future claim. The cost of printing of the volume for 1933 was $1,216.54. The estimated receipts for the coming calendar year are $1,552.27. The amount due from members in arrears was $420. After receipt of the report of the Auditing Committee, the report was accepted and the recommendation approved.

A motion was passed that the report, with its recommendation as to writing off the loss from bank suspension, be accepted.

The President announced the appointment of the several committees; the program committee to include Dr. Muesbeck chairman, Dr. Weigel, and Dr. Cory; the committee for resolutions on the death of C. H. Popenoe, to include Mr. Graf, Mr. White, and Dr. Annand; the committee for resolutions on the death of H. F. Wickham to include Mr. Buchanan with whatever assistance he may request (in this case that of Dr. Alexander Wetmore).

Dr. F. Z. Hartzell of New York Experiment Station, Professor Ruggles of Minnesota University, Dr. C. H. Richardson of Iowa State College, Dr. R. Faxon of Puerto Rico, Dr. Stanley Freeborn of California University, and Mr. Milne of Harvard, upon invitation, greeted the society.

Under "Notes and Exhibition of Specimens," Mr. R. E. Snodgrass reported on the recent scientific meetings.

He stated that the Entomological Society program and the dinner were very good, and that the annual public address, given by Doctor Lutz, was especially worth while.

Doctor Porter discussed the economic meetings, noting especially the symposium on spray residue which favored thorough spraying with later washing.

Dr. C. H. Richardson showed charts illustrating action of some inorganic salts in increasing killing action of nicotine. He also stated that nicotine and other alkaloids may pass direct through insect integument, and discussed technique in such studies.

This note was discussed by McIndoo.

Dr. C. H. Richardson stated that the Mexican mealybug (*Phenacoccus gossypii* T. & Ckll.) is quite widely distributed over the United States, and has become increasingly severe in recent years as a pest of greenhouse plants, particularly Chrysanthemums. A 10% kerosene emulsion was found to be the most effective of 16 different sprays. Overnight fumigation with calcium cyanide (3/8 to 1/2 oz. per 1000 cu. ft.) was the most effective control measure tried, producing a high mortality of all stages except the egg. This mealybug is apparently more susceptible to hydrocyanic acid gas than some of our other greenhouse mealybugs. Chrysanthemums in all stages of bloom were fumigated without injury. (Author's abstract.)

Dr. Freeborn discussed works on fly sprays, stating that oil sprays proved detrimental to dairy cows. This note was discussed by Milne.

Dr. Hartzell discussed work with tar distillate sprays, mentioning questions of definition; of efficiency against aphids, scales, bud-moth and other pests; of concentration and margins of safety; and of combination with petroleum oils.

Mr. L. C. McAlister, Jr., in response to an invitation from the Chair, referred to the occurrence of the West Indian fruit fly, which was discovered infesting hog plums (*Spondias mombin*) at Key West, Fla., in 1930 by inspectors of the Bureau of Plant Quarantine. In 1930 infestations on two properties were found, and in 1931 an infestation on only one property was found. In 1932, however, heavy infestation developed which was general throughout the island of Key West. Investigations to obtain further knowledge concerning the hosts and reaction to poison sprays of the two species of fruit flies, *Anastrepha acidusa* Walk. and *Anastrepha suspensa* Loew, occurring on the island of Key West, were conducted in 1932 and 1933. Results of oviposition experiments indicated that the species *A. acidusa* may successfully attack, under cage conditions, 35 different fruits, including grapefruit, and that the species *A. suspensa* may also attack many of the same fruits. Results of insecticide tests have confirmed the superior merits of tartar emetic as a bait spray for these two species of fruit flies. An active eradication program was started in August, 1933, by the State Plant Board of Florida, and the present indications are that the infestation of the West Indian fruit fly at Key West will be successfully eradicated.

Dr. F. F. Smith discussed life history studies on the Fuller's rose beetle, in which advantage was taken of the insect's habit of ovipositing in crevices by placing a split piece of wood in the cages. The beetles inserted the eggs in this, facilitating egg counts. This weevil reproduces parthenogenetically and no males were found among 2,600 dissected adults. (Author's abstract.)

The first communication on the regular program was by Perez Simmons and was entitled "Remarks on Insects and Diseases of California Figs."

Mr. Simmons stated that great care was used in preparing dried figs in California, and a fine product resulted. The varieties and the uses of the crop, and methods of preparation were discussed. Small mites and also thrips attack the young fruits, and may carry in fungus infection. As the fruit ripens, beetles of the genus Carpophilus attack it and carry infection. During and after drying, the raisin moth attacks the figs. Certain phases of control are difficult.

The second communication was the address of the retiring president, Mr. C. T. Greene, and was entitled "A Brief Outline of the Fruit-Flies."

These fruit-flies belong to the family Trypetidae and are of considerable economic importance because their larvae live within the pulp of commercial fruits. The "Mediterranean fruit-fly" and the "Olive fly" are among the outstanding forms in this group. The scientific and common names and the general distribution of each species was given. Also there were comments on their economic importance following the species.

All the species, except two, are of foreign origin and some of these are occasionally picked up by the quarantine inspectors at the various ports of entry into the United States. The other two species mentioned above are the apple maggot and the cherry maggot which are native to the United States and cause some damage to their respective host fruits. (Author's abstract.)

This paper was discussed by McIndoo, Simmons, Rohwer, Bridwell and Becker.

In discussing Mr. Greene's paper, Mr. Rohwer mentioned a paper published in the issue of The Agricultural Gazette of New South Wales for November, 1933, setting forth the regulations promulgated by responsible agencies regarding the management of orchards to control the Mediterranean fruit fly and the Queensland fruit fly. The fact that the Government of New South Wales found it desirable to promulgate regulations regarding the control of these pests was a clear indication of their economic importance. In discussing the occurrence of the Mediterranean fruit fly in Bermuda he added that when Mr. E. A. McCallan, Agricultural Commissioner of Bermuda, visited Washington, he reported the fruit fly did its greatest damage to green peppers and broad beans.

Mr. Rohwer expressed the thought that the speaker under-rated the importance of out native fruit flies. As an index of their economic importance he referred to regulations establishing a procedure on the handling of orchards so as to prevent infestations by the apple maggot recently promulgated by certain provinces in Canada. The certification of apples to England and other European points was pending on the growers carrying out measures provided in these regulations. A similar procedure was followed in certain states of the United States regarding the cherry maggot fruit fly. In these cases the clean up and control measures required are not based on regulations promulgated by State officials, but perhaps equally effective since they are enforced by the canning companies.

Meeting adjourned at 10:10 p. m.

F. M. Wadley,
Recording Secretary.

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PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF WASHINGTON

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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 36 MARCH, 1934 No. 3

MORE ABOUT THE BEGINNINGS OF THE SOCIETY.

By L. O. HOWARD.

In a way, I have constituted myself the historian of the Society. In 1894 I published a review of the work of the Society during its first ten years. This was read at the one hundredth meeting, January 7, 1894, at Professor Riley's house, and it was published in Volume II of the Proceedings, pages 161 to 167.

In 1909 I read an address written in a somewhat gossipy manner, to help to celebrate the 25th anniversary of the founding of the Society. This was read February 11th, 1909, and was published in the Proceedings, Volume XI, pages 8 to 18. Again in 1924, the first part of my address as retiring president was entitled "On Entomological Societies" and in this I discussed briefly the place of our society among the other publishing entomological societies of the world.

At the semi-centennial meeting, March 1, 1934, as the only resident surviving founder, I gave a brief reminiscential talk, telling, I fear, a number of things I have already put in print before and now I am writing these lines only to place on record some facts about the founding and the founders that will not be discovered in what I have already published.

When I came to Washington in November, 1878, the Potomacside Natural History Society had ceased to exist and the old Philosophical was the only scientific society in existence. Apparently it was not the place for entomologists. In 1880 the Biological Society was founded, but Riley, Schwarz, Comstock and I were the only members interested in insects. It did not fill our wants, while there were not enough of us to start a society of our own. Comstock went back to Cornell in 1881, and Riley, Schwarz and I were left as the only entomologists in the Biological Society. We were lonely, we wanted to talk with people who understood us, and so in January, 1884, when the service had begun to grow, we three issued the call for the preliminary meeting held at Professor Riley's house on February 29.

It is interesting to note that there were only eight entomologists at that time in the Government service. It is also interesting to note that at the meetings of February 29 and March

12 (the constitution was adopted on the latter date), 16 persons were present. The list of charter members published in Volume I has twenty-five names, but nine of these joined the Society later than March 12th (some of them months later), and that there were only sixteen real founders. These sixteen are as follows:

J. G. Morris	C. V. Riley	J. Murdoch
W. S. Barnard	E. A. Schwarz	T. Pergande
A. Koebele	L. O. Howard	J. B. Smith
Lawrence Johnson	L. Bruner	C. J. Schafhirt
B. P. Mann	E. S. Burgess	A. H. Stewart
	George Marx	

All of these men have either died or left Washington, except myself. Lawrence Bruner is still alive and is at Berkeley, California. I have lost track for years of A. H. Stewart. He may possibly be living yet. All of the other men who appear on our list as charter members (that is, who joined later than March 12th), are dead, except possibly T. E. Oertel. He and Stewart were both youngsters of 17 or 18 in those days, and both may be still living, although none of us has heard of them for many years.

In my 1909 address (referred to above), I have mentioned some of the characteristics of some of the founders, and in fact, of a number of them, there have been (about most) good and full published biographies which can readily be consulted, either in our own Proceedings or elsewhere. I may state, incidentally, that there is a good card catalogue of obituary and biographical notes in the library of the Bureau of Entomology, and that this is kept up to date under the eye of the very efficient librarian, Miss Colcord. But you will not be able to find much about some of our founders, so that what follows may be of interest as supplementary to what I said in 1909.

Take the Reverend J. G. Morris, for example. At the time of the founding of the Society he was retired from active life (he had been the clergyman of the German Lutheran church in Baltimore) but came to Washington to see us from time to time and to talk over entomological matters. He was a delightful old fellow, full of reminiscences, and very active and vigorous although more than 80 years of age. Professor Paul Knight of the University of Maryland has called my attention to an article by Dr. Morris on the history of entomology in the United States that was published in Silliman's Journal in 1846. It is a very valuable publication and gives interesting details concerning the history of the Melsheimers and other early American students of insects. In looking through this history the other day I found one especially interesting statement. In speaking of the work of the elder Leconte, Dr. Morris adds (rather patronizingly), "his son, John Leconte, Jr., is an industrious young entomologist who bids fair to become eminent in science." I note by looking up my Hagen that the great coleopterist had at that time published but one paper, but Dr. Morris dimly saw his future fame since he became known, not only to the entomological world, but was one of the original members of the National Academy of Sciences and the first entomologist to become president of the American Association for the Advancement of Science. It might also be stated that he was the first American to be elected to honorary membership in the European societies.

In my 1909 paper, I have mentioned Judge Lawrence Johnson. The Judge lived at Holly Springs, Miss., and happened to be in Washington at that time. He had been a field agent of the U. S. Entomological Commission. I mention him here again for the reason that in those early days he sent a formal communication to the Society, entitled "The Jigger Flea of Florida," that was published on pages 203 to 205 of Volume I of the Proceedings. He suggested for it the name *Pulex pullulorum*. Of course it was afterwards found that the insect had already been named *Sarcopsylla gallinacea* by Westwood, and is now known as the chicken flea.

E. S. Burgess, while interested in insects, was really a botanist and taught natural history at one of the Washington High Schools (I think the Central). He attended the early meetings regularly and finally went to one of the New York City universities as professor of botany. He died there some years ago.

I have mentioned Dr. C. J. Schafhirt, in the 1909 paper, as a druggist who had an excellent store near the Government Printing Office, but I did not tell how he became interested in insects. It was entirely through the work of the cigarette beetle, sometimes known as the "drug store beetle," since *Lasioderma serricorne* became firmly established at his place and I think that it was Dr. Schafhirt himself who first found this malignant little beast feeding on pyrethrum powder! So far as I remember, the doctor's entomological researches did not extend beyond the doors of his shop.

I am inclined to think that Alonzo H. Stewart's interest in entomology was intensified by, if not begun, with the installation of the electric light on the dome of the Capitol, since he was a page in the United States Senate. Insects were attracted by this light in enormous numbers and the white dome of the Capitol was soon covered and disfigured by spiders' webs filled with the remains of insect corpses. It was a great collecting field and it was apparently a race between Stewart and the spiders to see which would make the largest collection.

John Murdoch was not really an entomologist. He was a charming, cultivated fellow, a Harvard graduate, who had spent the winter at Point Barrow, Alaska, under the auspices of the U. S. Signal Service, making scientific observations of diverse character. He also occupied the position of professor of zoology at the University of Wisconsin, while E. A. Birge was absent in Japan. After he finished his Point Barrow report, he became librarian of the Smithsonian and later was an assistant librarian in the Boston Public Library. He died in Boston.

So far as we can be absolutely certain, aside from myself, there is only one person living, either among the real founders or the charter members. He is Professor Lawrence Bruner, for many years connected with the University of Nebraska, but who is now retired and living at Berkeley, California. His presence at the meeting of March 12, 1884, and his signature to the constitution on that date are explained by the fact that he was in Washington on a visit. For a number of years he had been a field agent of the U. S. Entomological Commission, and, if I am not mistaken, his journey to Washington, in 1884, was really his wedding trip. As already indicated, Stewart and Oertel may still be living, but we have not heard about them for very many years.

So far as I know, there has been no real biography of W. S. Barnard. He was a brother-in-law of Dr. Burt G. Wilder of Cornell and had been employed by Professor Riley to work on remedies against the cotton caterpillar. He invented some ingenious machines, which, however could not be adapted to field conditions. He was, however, the inventor of the "cyclone" nozzle, known later in France as the Riley nozzle and still later as the Vermorel nozzle, an excellent device for the under spraying of low growing plants. He also used for the first time as an insecticide, emulsified kerosene, in which he used milk in making his emulsion. Hubbard later substituted soap.

All of the others on the list of true founders have been written up fully since their death. Of those who joined a little later and appear in the list of charter members, all have been well treated in published biographical sketches, many of them in our own Proceedings. The only exception is perhaps Captain R. S. Lacey. As I remember, he was a Washington attorney who had a farm near Washington and who had consulted Professor Riley on some questions of insect damage. Apparently his interest in insects did not continue long and I don't remember to have seen him at subsequent meetings.

Dr. R. W. Shufeldt, U. S. A. retired, appears on this list and died very recently. Undoubtedly his career will be fully described in the scientific papers. He was not an entomologist, although a first-rate general naturalist. I think that his scientific reputation rests largely upon his work on the osteology of birds. The Cosmos Club had been founded only a few years before and I think that Professor Riley had seen both Dr. Shufeldt and Mr. Murdoch there and invited them to these early meetings.

REMARKS ON CHANGES IN THE ENTOMOLOGICAL SOCIETY OF WASHINGTON DURING THE LAST QUARTER OF A CENTURY.

By S. A. Rohwer, *Corresponding Secretary-Treasurer.*

Circumstances and opportunity undoubtedly play important parts in changing procedure and policies of organizations—even in the case of societies like the Entomological Society of Washington. Conditions and customs in the National Capital have changed in many respects during the last twenty-five years, and perhaps more than during the preceding similar period. It is, therefore, not surprising that there have been many changes in the way our Society now conducts its affairs. The changes in customs and national policies which have occurred since 1909 may also account in part for the various modifications, in conducting the affairs of the Society, which have been made during this period. A review of the Society's activities shows rather clearly that more changes, if not more progress, have occurred during the later part of the first half century of the Society's existence.

Most of the meetings during the first twenty-five years were held in the homes of various members. With the increase in attendence this became impracticable and was followed by holding meetings, entertained by individual members, in halls rented for the occasion. It was in such a meeting place that many of us first became associated or acquainted with the Society. Many of these meetings were held in the old Saengerbund Hall at 314 C Street N. W., and these meetings hold many pleasant recollections. The custom of meeting in the homes of members was not put aside all at once, however, and even during the last twenty-five years the Society has been entertained in the home of Dr. C. L. Marlatt. This was in February, 1910, and was the last time a regular meeting was held in a private residence. With the growth of the Society, the entertainment feature became a matter of some little cost and although individual members often continued to meet this expense the habit of "Dutch treat," by contributions, was not uncommon even during the last few years when the meetings were held in the Saengerbund Hall.

The furnishing of refreshments and a meeting place by members developed and permitted the execution of the idea that all funds collected for dues, etc., were to be used solely for necessary operating expenses and particularly the publication of the "Proceedings." This plan had become such a fixed policy that, even when the expenses of holding meetings increased, no change was made. Other ways were devised to meet the expenses incident to holding regular meetings. The plan selected was the establishment of what was known as the "Entertainment Fund." This fund, begun in January, 1918, was maintained by a fixed charge of 25 cents on members attending the meetings and led to the custom, still followed, of having members and guests sign a meeting roster. This method of taxing, however, was not fully satisfactory and often failed to meet the full cost of holding meetings.

After prohibition became effective, in the District of Columbia, it was impracticable to continue to meet in the Saengerbund Hall and the Society moved to the Cosmos Club. This move was not favorably received by some of the members and the cost—even at the reduced rental made by the managers of the Cosmos Club—exceeded the collections. After the meeting of December, 1924, meetings were held in other private halls, such as the one at the corner of 11th and E Streets, belonging to the Perpetual Building Association. These places were even less suitable and were soon given up in favor of the room furnished at only nominal cost in the Natural History Building of the National Museum. Later the Museum removed even the small charge for watch service and have very kindly made room 42–43 available for our regular meetings. Since then the "Entertainment Fund" has been abolished.

Changes in place of meeting have, however, been the less important modification of the meetings. What is more significant has been the increase in attendance and the change in character of the program. During the early part of the last quarter of a century it was unusual when there were more than thirty members and visitors at a meeting. The average attendance in recent years has been more than twice that number. Discussions of papers and the presentation and discussion of notes, were important parts of all the earlier meetings. Even twenty years ago, formal papers were usually only an introduction to a general review of a subject. Frequently it appeared that some of the older members, particularly E. A. Schwarz, F. Knab, N. Banks, T. N. Gill, H. G. Dyar and others, used the notice of papers to be presented only as a suggestion of the topic which they should prepare themselves to discuss. In recent years papers have taken more the form of addresses and discussion is seldom more than answering questions. Whether specialization has brought about this change or whether the size and character of the audience serves to embarrass those who might place other interpretations on the observations reported is not clear. Perhaps it is some of both, mixed with a hesitancy to start an argument. There may even be another reason, as recently, and especially since the World War, there has been a marked increase in the number of ladies present. Their attendance at a meeting was almost unheard of twenty years ago.

In the early days, special summer meetings, more or less in the nature of collecting excursions, were held occasionally. These are now affairs of the past but to an extent have been replaced by holding the June meeting at a nearby laboratory. Twice during the last few years the Society has held the June meeting on the Campus of the Maryland State Agricultural College, College Park, Md., following a picnic supper. Other similar meetings have been held at the Takoma Park laboratory of the Bureau of Entomology and at the Bee Culture laboratory at Somerset, Md.

In the earlier years the members were classed as active or associate. Active members were those residing in Washington and environs. The first list of members, published in 1891, included the names of 26 active and 17 associates. Later the designation for members was changed to active and corresponding and a third group, that of honorary members, added. The list issued in 1902 includes the names of one honorary, 45 active and 81 corresponding members. The next and last change was made since 1912, and we now have only two classes—members and honorary members. Honorary membership is restricted to foreign entomologists who have made outstanding contributions to the science of entomology. They can be elected only after an affirmative mail ballot by members on names unanimously recommended by the Executive Committee. Only two such honorary members have been elected and neither of whom is now living—the last one being David Sharp, who died August 21, 1922.

There has been one other change in the rules affecting membership and it had to do with the increase in the dues for non-resident members. This became effective in 1918, when the dues for all members were fixed at three dollars per year. Previously, corresponding or non-resident members paid only two dollars while active or resident members paid three. This change was accompanied by an increase in the subscription price for the Proceedings from two to four dollars per volume with an added charge of twenty-five cents for postage when the copy was sent to an address outside the United States, Canada or Mexico. Subscribers to the Proceedings were, and for that matter still are, largely institutions and libraries who make no other contribution towards the maintenance of the Society. It seemed logical that they should pay more than those who participate in the meetings and contribute, without cost, the articles which create a demand for the publication. When these changes were made there were many who doubted the wisdom of the move, fearing that it would mean a marked reduction in the number of members and subscribers. Fortunately, these fears were not well founded. The numbers of members and subscribers have rather steadily increased, or at least not markedly declined even in later years during the period of general depression.

Many changes have been made during the last twenty-five years in the style, make up, manner of issuing and editing our Proceedings. The first 15 volumes of the Proceedings were edited and issued under the direction of a Publication Committee of 3 to 7 members. Since then the work has been performed by an editor elected annually, who carries out this task under the general direction of the Executive Committee. The last Committee on Publications was Harrison G. Dyar, A. L. Quaintance and J. C. Crawford. Mr. Crawford was the first elected editor. He was followed by A. C. Baker, Carl Heinrich and the present editor, W. R. Walton. The first nineteen volumes were issued quarterly except in the case of Volume III when five numbers were published. Beginning with Volume 20, for 1918, the volume has consisted of nine numbers each, issued monthly except July, August and September. The special heavy paper cover previously used for each number was eliminated and other changes were made which made it possible to print more words and pages with the same amount of money. Rules concerning publication were issued, requiring among other things that notes or articles be titled so they could be readily indexed. Copies of these rules were sent to and favorably received by other entomological periodicals. For a number of years following these changes the minutes of the meetings were not published in the Proceedings but appeared in the Journal of the Washington Academy of Science. This, however, has been discontinued and the minutes now are included at the end of each number.

The earlier volumes of the Proceedings were printed for the Society by Gibson Brothers, a concern then doing business in the District of Columbia. Later the printing was done by companies whose plants were located elsewhere and included such concerns as Gorman Co., in Pennsylvania, Williams and Wilkins Company of Baltimore, Md., and the Eschenback Printing Co. at Easton, Pa. In 1921 we returned to Washington to have the printing done and since then the firm of H. L. & J. B. McQueen, Inc., has printed our Proceedings and the Maurice Joyce Engraving Co. has made the halftones and line engravings.

At the beginning of this twenty-five year period changes were made in the officers charged with handling the business affairs of the Society. When the Society was founded in 1884 there was created an office of Treasurer and also an office of Corresponding Secretary. These two offices were combined in 1909, and E. F. Phillips was elected as the first Corresponding Secretary-Treasurer. He held this office for the years 1909 and 1910, and was succeeded, in 1911, by the present incumbent, who has held the office since then. Since the founding of the Society only five individuals have been charged with the responsibility of collecting and disbursing money. B. Pickman Mann was Treasurer for the eight years from 1884 to 1891 inclusive; E. A. Schwarz held the office for the nine succeeding years, 1892 to 1900, and J. D. Patten, the last to hold this office, served for the eight years from 1901 to 1908 inclusive. While there were only three who served as Treasurer of the Society, from 1884 to 1908 inclusive, eight individuals held the office of Corresponding Secretary. These were, in the order named: L. O. Howard, J. B. Smith, Otto Lugger, C. H. T. Townsend, E. A. Schwarz, Frank Benton, E. S. G. Titus, and J. G. Sanders. At the annual meeting in 1893, F. H. Chittenden was elected as Corresponding Secretary but he declined to accept.

Effective January 1, 1915, the Society authorized the establishment of a special fund to be known as the "Publication Fund." This fund was to receive the income from the sale of back numbers of the Proceedings, donations or other special contributions, and was to be invested under the direction of the Executive Committee. Unless specifically authorized, the interest only could be used for current operations. Two members, who had always taken much interest in the Society, have made special donations to this fund. These were Frederick Knab and E. A. Schwarz and are listed in order of the receipt of the donation. Prior to the establishment of this fund another member, J. M. Lawford, left the Society a legacy in his will. Mr. Lawford was, at the time of his death in 1913, living in Baltimore, Md. By the terms of his will his insect collection and library were left to the Society. In as much as the Society does not maintain either a collection or a library the books, many of which dealt with natural history and were of considerable value, were sold and the proceeds added to the "Publication Fund." The collection of insects was donated to the National Museum.

CORRECTION.

In the minutes of the 452d meeting of this Society, Vol. 36, p. 49, paragraph 2, read: H. H. Richardson instead of "C. H. Richardson."—*Editor.*

HENRY FREDERICK WICKHAM.

By L. L. Buchanan.

Henry Frederick Wickham, 67, a well known American coleopterist, died at his home in Iowa City, Iowa, Nov. 17, 1933, of a heart attack induced by asthma. Though in failing health for several months, he had remained active in his teaching duties until a few days before his death.

Born at Shrewton, Wiltshire, England, Oct. 26, 1866, he came to Iowa City with his parents in 1871, and lived there since that time. He attended Iowa City high school for three years and the University of Iowa from 1887 to 1891 when he was named to the staff. In 1894 he received an honorary degree of master of science. His 42 years of teaching, the last 30 of these as professor of zoology and entomology, made him one of the oldest University of Iowa professors in point of service.

Professor Wickham was an excellent and a popular teacher, and his courses usually attracted a full quota of students, at times more than could be accommodated. His lectures, which were clearly outlined in advance, combined many original observations derived from his wide experience in the field with the most authentic information available in text books. He used the blackboard freely, illustrating structural points with rapidly but accurately executed free-hand drawings. Endowed with a keen sense of humor, he was not averse to enlivening the class work with occasional witty remarks. Advanced students in entomology highly prized his presence on short collecting trips about Iowa City; and on such occasions he seemed to take pleasure in imparting to the embryonic entomologists bits of his great fund of collecting lore, always in a free and unostentatious manner.

Professor Wickham's interest in entomology, and particularly in beetles, began when he was a young boy and continued unabated through life. He early recognized the handicap of being far separated from the large libraries and collections of the East, and he set about in characteristic manner to provide himself with these essentials. He succeeded notably in both directions, and at the time of his death his beetle collection and entomological library afforded splendid facilities for independent research in the science. It goes without saying that this achievement was beset with difficulties, and he once said that he had kept himself poor for years by buying and binding books. But without the library and collection much of his work, and particularly his fossil investigations, would have been impossible. He was a member of several scientific societies, including American Association for Advancement of Science, Entomological Society of America, Entomological Society of Ontario,

HENRY FREDERICK WICKHAM.

Société Entomologique de Belgique, Iowa Academy of Science, Davenport Academy of Science, Entomological Society of Washington, and Ottawa Field Naturalists' Club.

He ranks high among a small group of this country's most successful collectors, and at one time or another discovered numerous undescribed species of beetles, many of which were made known through the writings of Casey, Fall and others. Beginning in 1885 and continuing through about 30 years he spent most of his summer vacations on privately financed collecting expeditions to various parts of the country, and particularly to what were then the remote and more or less inaccessible regions of the western and southwestern United States. The difficulties of travel in those days, and some of the obstacles overcome, are referred to incidentally in several of his published papers. He collected also in Alaska and northwestern Canada (1889); Bahama Islands (1893); and Mexico (1907, '08, '09). In the summer of 1914 he was appointed field agent for the U. S. Bureau of Entomology on an investigation of the New Mexico range caterpillar, being stationed at Koehler, N. Mex. In 1915 and 1916, with the same service, he worked over a large area in the western United States studying the economic status of the tenebrionid genus *Eleodes*. During the summers of 1917 to 1920, inclusive, he was scientific assistant in the Washington, D. C., laboratories of the Biological Survey, where he classified and arranged parts of the beetle collection, and identified beetle fragments from birds' stomachs. In 1921, with the Bureau of Entomology, he was sent to Mexico to investigate the Mexican bean beetle. After 1921 he spent the summers in the western United States, chiefly at Yellowstone and Glacier parks, but his active collecting days were over, and with the exception of one or two of these trips, he made no serious attempt during this period to enlarge his cabinet.

In his early days Professor Wickham sent many specimens to George H. Horn for identification, and these doubtless formed the nucleus of what subsequently was to become one of the better private collections of the country. In later years, after he had built up a large entomological library, he did much of the identification work himself. In addition to meeting his classes regularly and attending to his expanding library and collection, he carried on extensive correspondence and exchanges with entomologists here and abroad; and it is indicative of his energy and determination that in spite of these time-consuming activities, he found opportunity for preparing the considerable number of entomological papers that came from his pen.

His bibliography includes about 170 titles, and it requires only a casual glance through the list to appreciate his broad interests. Though local lists and accounts of certain of his collecting trips occupy a prominent part in the whole, such subjects as color variation, structural peculiarities, biologies, geographic distribution, monstrosities, etc., received attention at one time or another. He also published several papers on beetle larvae. In later years his writings deal more exclusively with taxonomy, and it was during this period that he described the majority of his 43 new species of Coleoptera. Perhaps his three most important contributions on recent forms are "The Coleoptera of Canada," "The Pselaphidae of North America" (with Brendel), and "List of the Coleoptera of Iowa," the latter enumerating 2,065 species.

In 1912 and 1913 he spent the summers at Florissant, Colorado, collecting fossil insects and plants from the Florissant shales, and later described many new species of beetles, based partly on his own and partly on borrowed specimens. One of his note books at Iowa City lists 352 fossil species as having been described by him up to and including the year 1917; whether or not this is a complete record has not been ascertained, but it probably is. Most of his fossil papers are illustrated with drawings which he prepared with the aid of the camera lucida. In speaking of the dependability of conclusions based on study of fossil species, he maintained that, while mistakes in detail are doubtless more numerous than in the case of studies on recent forms, nevertheless the main deductions drawn from fossil investigation are sound. He compiled the catalogue of North American fossil beetles which was published as a section of the Leng catalogue of North American Coleoptera.

Professor Wickham's collections of beetles and fossils have been presented to the U. S. National Museum by Mrs. Wickham. Besides the types and typical material, the beetle collection contains a good many choice species and much valuable distributional data, particularly for species from the western and southwestern United States. The collection is predominantly North American in character, though the family Cicindelidae, a group in which Professor Wickham was especially interested, includes species from all over the world; in certain other groups also there is a fair amount of exotic material. The fossil collection, including both plants and insects, numbers about 3,000 specimens.

Professor Wickham is survived by his widow, the former Miss Fanny Chastina Thompson of Independence, Iowa, to whom he was married Sept. 10, 1891; and by two brothers, Mr. Bern Wickham, a contractor in South America, and Mr. Edgar F. Wickham of Iowa City.

The accompanying photograph was taken at Washington, D. C., in 1917, by Mr. J. H. Paine.

Charles Holcomb Popenoe.

CHARLES HOLCOMB POPENOE.

By J. E. Graf and W. H. White.

With the passing of Charles Holcomb Popenoe, who died suddenly at his home on November 17, 1933, the Washington Entomological Society has lost one of its veteran members, he having been affiliated with this Society since November 7, 1907.

Mr. Popenoe was born in Manhattan, Kansas, June 7, 1884. Upon graduation from the Kansas Agricultural College in 1905 with the degree of Bachelor of Science, he spent a short time on the farm, and left to accept an appointment as an agent with the Bureau of Entomology, June 14, 1907, with headquarters at the Virginia Truck Experiment Station, Norfolk, Va. He was transferred to Washington in 1909 where he was associated with the late Dr. F. H. Chittenden who was then in charge of Truck Crop and Stored-Product Insect Investigations. By promotion he held the positions of Entomological Assistant from 1913 to 1919 and Entomologist from 1919 until the time of his death. From 1927 he was Associate in Entomology at the George Washington University, Washington, D. C. Mr. Popenoe possessed a very broad knowledge of entomology and its related sciences, and during the earlier years with the Bureau, he specialized in stored product and mushroom insects. He was the author of several publications, his best known, which has gone through several printings, being a Department farmers' bulletin relating to vegetable insects and their control. Mr. Popenoe was a pioneer in work with carbon tetrachloride as a fumigant, and in cooperation with Dr. E. H. Siegler, participated in determining the insecticidal value of fatty acids. Dr. L. O. Howard in his book on the house fly under the discussion of formalin as a fly poison states "So far as we know, the first person in this country to ascertain this (formalin as a poison to fly) was Mr. C. H. Popenoe who at that time was at the Kansas Agricultural College."

His principal hobbies which he followed with a keen interest were botany and aviculture. He was an iris fan and had a large collection of this flower containing many rare varieties. He collected and bred love-birds of which he had a large collection, some of which were new to this country.

At the time of his death he was engaged in a special study on the atomization of oils and their application as truck crop insecticides.

"Pops," as he was familiarly known, was a lovable character, and was extremely popular with his associates both in the Bureau of Entomology and elsewhere. He will be keenly missed by his numerous friends and co-workers.

TORTILIA VIATRIX, new species.

AN AFRICAN MOTH ON SENNA IMPORTED INTO THE UNITED STATES.

By August Busck.

A considerable number of carloads of sacked dry senna leaves (*Cassia* sp.), received from Sudan, Africa, had been stored for 1½ to 3 years in a warehouse in a freight terminal at Hoboken, N. J. In September, 1933, this material was found to be heavily infested by the larvae of a small moth; hundreds of live moths, larvae, and pupae were discovered on or around the sacks; large numbers of dead moths were found on the floor and in corners, indicating that the species had lived and multiplied for several generations in the warehouse.

The infested senna leaves of African origin were packed loosely in burlap sacks; other cargoes of senna received from India were compressed in bales and were apparently not infested. A sample of the leaves and of the burlap covering of the African senna, containing live larvae, was submitted to the writer for identification of the insect. The sample was fairly alive with larvae and about a hundred moths issued during the following week. It was at once realized that the species was not American, and critical examination of its structure proved it to be a new species of the African genus *Tortilia* Chretien (Family Heliodinidae); specimens were sent to the world authority on this group of insects, Edward Meyrick, in England, who promptly confirmed the generic identification and stated that the species was unknown to him.

The genus *Tortilia* was previously known from a single species, *Tortilia flavella* Chretien (Bull. Soc. Ent. France, p. 202, 1908), the larva of which feeds on flowers of *Acacia* in Algiers. *Tortilia flavella* is not known to me except from the description; the present species is clearly very similar not only in structure but also in coloration to the genotype, and their identity is not excluded, but Chretien's careful description differs in several particulars and it would be unwise to assume this identity, notwithstanding the close relationship between the foodplants, *Acacia* and *Cassia*. Chretien reared his species from (presumably fresh) flowers of *Acacia* taken from the tree, while the present species must be considered a stored-product species.

The generic characters of the genus *Tortilia* are as follows: Head smooth; antennae three-fourths the length of fore wing, simple; no ocelli; maxillary palpi absent; labial palpi long, slender, recurved and diverging; second joint slightly thickened, with smooth scales; terminal joint nearly as long as second, smooth, pointed.

Fore wing narrow, elongate, lanceolate, smooth scaled; veins

1*b* stalked at base, 1*c* faint, but present in its entire length, emphasized on margin; 2 nearly obsolescent from before angle of cell; 3 strong; 4 absent; cell open between 3 and 5; 6 and 7 stalked, enclosing apex; 8 out of stalk of 6 and 7; 9 connate with stalk; 10 near to 9; 11 absent; 12 strong, furcate at base.

Hind wing less than half as wide as fore wing, costa rounded to basal third, then straight to apex; apex acute; eight veins; 2, 3, 4, 5, and 6 equidistant; cell open between 5 and 6; 7 to costa, just before apex.

The most striking pterogostic character is the loss of vein 11 in the fore wing. Posterior tibiae clothed with long stiff hairs.

The genus is allied to *Stathmopoda* Stainton and even more so to *Erineda* Busck, from both of which it differs in the venation of the fore wings and in the simple antennae.

Tortilia viatrix, new species.

Labial palpi light ochreous, second joint with a thin fuscous shade on outer side, terminal joint with a similar line and with apex fuscous. Face silvery ochreous; head light ochreous; thorax ochreous, more or less heavily overlaid with blackish fuscous. Fore wings light ochreous with rather undefined blackish fuscous markings as follows: base of costa, dorsum, and a few scattered scales on the fold blackish fuscous; a large transverse, ill-defined, black fascia before the middle of the wing, narrower on costa than on dorsum; an outwardly oblique, blackish streak from outer third of dorsum to costa and apex. Cilia light fuscous. Hind wings light silvery fuscous with light fuscous cilia. Abdomen light ochreous. Legs light ochreous, outer sides shaded with fuscous.

The moths at rest sit with the body nearly horizontal, all legs applied to the surface (*not*, as is common in the family, with hind legs raised above the body); antennae raised in a gentle curve above thorax and wings.

Male genitalia with hooked uncus; tip of gnathos deflected; socii and transtilla absent; harpes elongate ovate, with apex blunt and dorsal edge sinuate; anellus ring-shaped, triangular in front and embracing the very large, stout truncate aedoeagus, which has a lateral hook near apex; no cornuti.

Female genitalia with simple ostium; ductus short; bursa large, double, and heavily armed with spined signa; ductus seminalis from end of bursa, as is the rule in the family Heliodinidae.

Skin of abdomen minutely spined, with a more conspicuous transverse, dorsal line of short spines on the middle of each segment.

Alar expanse, 9–10 mm.

Habitat.—Sudan, Africa (New Jersey).

Foodplant.—*Cassia* sp.

I am informed that the infested bales of senna have since been fumigated with apparent success and the continued survival and spread of this species in America is not probable, though not necessarily excluded. Its ability to maintain itself for several generations in the warehouse indicates that the climatic conditions would not be the determining factor, and the species might accommodate itself to other dry stored vegetable matter, but it is more likely that it is attracted only to its special foodplant, *Cassia*, and though this plant genus is represented in America, the chances for the survival of the *Tortilia* seem remote.

EXPLANATION OF PLATE.

Tortilia viatrix Busck.

Fig. 1 and 2. Moth.

Fig. 3. Wing venation.

Fig. 4. Male genitalia with aedoeagus removed.

Fig. 5. Aedoeagus same enlargement as Fig. 4.

Fig. 6. Female genitalia.

Figures 1, 2, and 3 were drawn by Mr. H. Bradford; figures 4, 5, and 6 by Mrs. Eleanor A. Carlin, both of the Bureau of Entomology, United States Department of Agriculture.

MINUTES OF THE 453d REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, FEBRUARY 1, 1934.

The 453d regular meeting of the Entomological Society of Washington was held at 8 p. m., Thursday, February 1, 1934, in Room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. There were present 8 members and 3 visitors. The minutes of the previous meeting were read and approved as corrected.

Under "Reports of Officers," the Corresponding Secretary-Treasurer reported that approximately one-third of the estimated receipts for 1934 had been received during January. He urged prompt payment of the remaining obligations to the Society.

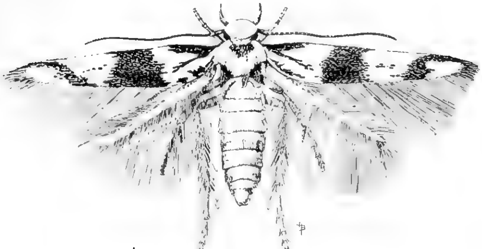
Mr. Rohwer stated that he had recently received a letter from Dr. Walther Horn of the Deutsches Entomologisches Institut, in which Dr. Horn indicated that, beginning in February, the Institut would issue a publication entitled "Arbeiten über morphologische und taxonomische Entomologie aus Berlin-Dahlem," this publication to take the place of "Entomologische Mitteilungen" which was discontinued in 1928.

Mr. Wade noted that the Recording Secretary, Dr. F. M. Wadley, would be absent from the city for an indefinite period and consequently would be unable to function as secretary of the Society. He also stated that Mr. P. W. Oman had consented to substitute for the present.

Mr. A. B. Gahan recommended the appointment of a committee for resolutions on the death of Dr. Robert W. Shufeldt, a charter member of the Society. A motion was passed that such a committee be appointed by the president.

On motion the following statement was ordered spread upon the minutes of this meeting:

"Major Robert W. Shufeldt, Medical Corps, U. S. Army (retired), recently died in Washington. He was an original member of this Society. Although his fame as a naturalist rests principally on his work on the Osteology of Birds, he



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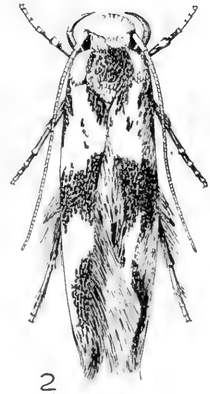

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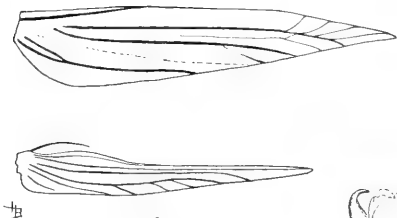

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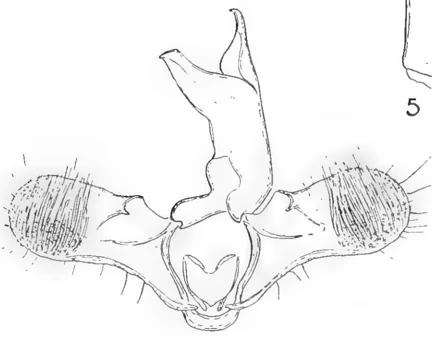

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Tortilia viatrix Busck

was keenly interested in all nature, including insects. It was this breadth of interest that, during his early days in Washington, brought him to the initial meeting of this Society and made him one of our Founders.

"We regret his death, but we have always rejoiced that so broad and sound a naturalist should have assisted at our beginning as a Society."

Under "Notes and Exhibition of Specimens," Mr. L. L. Buchanan discussed the Wickham collection of Coleoptera and fossil insects which was given to the United States National Museum by Mrs. Wickham. Mr. Buchanan exhibited a few boxes of beetles and some fossil insects from the collection, which contains a large amount of material from the western United States and smaller amounts from northwestern Canada, Mexico and the Bahama Islands, collected for the most part by the late Professor H. F. Wickham. It is particularly rich in specimens of the families Cicindellidae, Scarabaeidae, Tenebrionidae and Cleridae. Except in the family Cicindellidae there is little exotic material. The collection consists of between 75 and 80 thousand specimens in double wooden boxes and considerable unmounted duplicate material, as well as about 3000 fossil specimens of various orders. The number of types is comparatively small, but the collection is especially valuable because of several series of rare species.

This note was discussed by Morrison, Rohwer and Wade. Morrison stated that Mr. Buchanan's previous association with Professor Wickham at Iowa University was probably largely responsible for the collection being given to the National Museum.

Mr. S. A. Rohwer mentioned the recent translation from Spanish of an article by Señor Alberto Salmon de los Heros, published in volume 3, numbers 9–10, of the Boletin Agricultura y Ganaderia (Peru), November, 1933, in which the economic importance of *Anastrepha fraterucla* was discussed. This species was reported as being the limiting factor in the production of certain fruits in Peru.

Dr. F. W. Poos, who was to have presented the first communication on the regular program, was unable to be present. His paper was consequently postponed until a later date.

The second communication on the regular program was a paper by Mr. A. B. Gahan entitled "Remarks on parasites of the Hessian Fly." Mr. Gahan discussed briefly, and showed slides of most of the parasites of the fly, which he treated in detail in a recent publication (The Serphoid and Chalcidoid Parasites of the Hessian Fly. United States Department of Agriculture, Misc. Pub. 174, December, 1933.) In view of the recent publication of this paper, no abstract was submitted for publication.

This paper was discussed by Rohwer, Muesebeck, Morrison, Buchanan, and Wade.

The president of the Society called attention to the meeting of March 1, which is to be the 50th anniversary of the Society, and urged that this be made known to members who were not present.

Meeting adjourned at 9.50 p. m.

P. W. Oman,
Acting Recording Secretary.

MINUTES OF THE 454TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, MARCH 1, 1934.

The 454th regular meeting and fiftieth anniversary of the founding of the Society was held at 8 p. m., Thursday, March 1, 1934, in the Assembly Hall of the Cosmos Club at Madison Place and H Street N. W. Mr. J. S. Wade, president, presided. There were present 70 members and 81 visitors. The minutes of the previous meeting were read and approved.

Under "Notes and Exhibition of Specimens," Dr. H. E. Ewing reported the acquisition by the National Museum of specimens of a four-lunged true spider, *Hypochilus thorelli* Marx, which were donated by Mr. Glen Akin of Santa Ana, California. This species is the only American representative of the primitive araneal suborder Hypochilomorphae.

Dr. E. N. McIndoo presented a note and exhibited drawings dealing with the chemoreceptors of blowflies. In order to explain the proboscis response of blowflies, described first by Minnich, it should not be assumed that the tarsi bear taste organs, because a tarsus bears no sense organs, except nine olfactory pores. Observations have shown that it is almost impossible to wet the tarsi with water or sugar water, and when the flies are in the proper nutritive condition they will exhibit the proboscis response when the liquids were about 3 mm. from the tarsi. It was further demonstrated that the tarsi can easily distinguish between chemically pure saccharose water and distilled water. The responses are caused by two stimuli, one mechanical and the other olfactory; the act of touching the feet with a liquid produces the initial stimulus and brings the liquid almost in contact with the olfactory pores in the tarsi. Minnich reports that chemoreceptors on the tarsi of blowflies are 100 to 200 times more sensitive to saccharose water than the human tongue. (Author's abstract.)

Mr. August Busck showed the myrmecophile caterpillars and peculiar flat cases of a new genus and species of Tineidae, received for identification together with the moths from Dr. H. A. Eidmann of the Zoologisches Institute, Hann. Münden, Germany. These caterpillars live in the nests of the large leaf-cutting ant, *Atta sextens*, in Brazil, and, judging from their modified, piercing mandibles, incapable of chewing vegetable food, the caterpillars are undoubtedly predacious on the larvae and pupae of the ants, like the caterpillars of allied genera of Microlepidoptera carefully reared by Roepke in Java and Bainbrigge Fletcher in India. The species is of much interest as the first true myrmecophile Microlepidopteron recorded from America and will be described in the Proceedings of the Society. (Author's abstract.)

Dr. J. M. Aldrich discussed a tachinid fly, *Rynchopeteina stylata*, B. & B., from Greenland, which has as its nearest relative the genus Heteria from New Zealand and is of particular interest because of its occurrence in a locality so far removed from closely related species.

Mr. R. H. Nelson, in discussing the discovery of drosophilid larvae in canned tomatoes, reported that his work on *Drosophila melanogaster* indicates that the flies would not oviposit on tomatoes, even overripe ones, unless the skin was broken, but if either green or ripe tomatoes were smeared with fresh tomato pulp the flies would readily oviposit on those fruits.

Dr. A. G. Böving spoke about a coccinellid larva, *Ortalistes rubidus* Gorham, which is found frequently as a guest in the nests of termites, *Microcerotermes arboreus* Emerson and *M. exiguus* Hagan, in the Canal Zone, Panama. It is strikingly adapted to the extraordinary biological conditions under which it lives and yet possesses all the principal systematic characters of its family. This was illustrated by a plate with several figures. The larval form was first found by Dr. W. M. Wheeler and Mr. Zetek near Summit, C. Z., in 1923, along with pupae and adults. The adults show no particular modifications. Specimens were later found on Barro Colorado Island by Wheeler and Zetek and Dr. T. E. Snyder. According to Dr. Snyder the *Ortalistes* larvae perform the same jerky, convulsive movements as do the termites. These movements are especially noticeable among termites near the queen and are supposed to be means of communication through vibrations. (Author's abstract.)

Mr. R. E. Snodgrass discussed how the female grasshopper succeeded in getting her abdomen so far in the ground during oviposition. Since there are no protractory muscles in the abdomen, some workers have considered that the abdomen was forced into the ground by blood or air pressure, but Mr. Snodgrass stated that there seemed to be no basis for such a belief and that the act was probably actually accomplished by a digging apparatus located at the end of the abdomen. This apparatus consists of the four short prongs of the ovipositor, two curved upward and two downward, and a powerful muscle mechanism designed to push the apparatus out a short distance and open the prongs. Following each thrust, therefore, the earth is apparently pushed aside and the egg burrow is made by repeated actions of this kind. The ovipositor apparatus thus digs automatically into the ground and stretches the abdomen as the insect holds its position with its legs. Contractile movements of the abdomen then eject the eggs and the abdomen is withdrawn by means of its retractor muscles.

This note was discussed by W. B. Wood, who mentioned having seen grasshoppers with their abdomen buried in railroad ties. Mr. Snodgrass confirmed this observation but stated that in such cases the wood was probably considerably decayed.

At the request of the president, the recording secretary read the letter of call of the first meeting of the Society which was held February 29, 1884, and also read the list of charter members.

The first communication on the regular program was by Dr. L. O. Howard, entitled "The Beginning of the Entomological Society of Washington." Dr. Howard gave an interesting picture of the organization and early meetings of the Society and told anecdotes concerning several of the early members. Since Dr. Howard is publishing his reminiscences of the founding of the Society, no abstract was submitted for inclusion in the minutes of the meeting.

The second communication on the regular program was by Mr. S. A. Rohwer, entitled "Some Remarks about the Last Twenty-five Years." Mr. Rohwer presented a summary of the more important events during the quarter century of his association with the Society. Since Mr. Rohwer is publishing a resumé of this period no abstract was submitted for the minutes.

Mr. R. P. Currie recalled entering the Society in the nineties, at which time the meetings were still held at private homes. Mr. Currie stated that he was recording secretary of the Society for several years, the office at that time also including the chairmanship of the publication committee. He remarked on the extremely interesting exhibits and discussions introduced at the meetings by E. A. Schwarz.

Dr. T. S. Palmer gave a brief history of the early scientific societies of Washington, of which the Entomological Society was the sixth to be organized.

In response to a request from the chair, Mr. A. N. Caudell told of his arrival in Washington, in 1898, and of the early meetings of the Society which he attended.

Dr. J. M. Aldrich read an excerpt from his diary of December 4, 1890, giving his impressions of the first meeting of the Society which he attended and from which he departed early because of excessive tobacco smoke.

The president of the Society announced an informal program, with refreshments of beer, cider, pretzels, doughnuts, and sandwiches, immediately to follow adjournment.

Meeting adjourned at 9.55 p. m.

P. W. OMAN,
Acting Recording Secretary.

Actual date of publication, April 20, 1934.

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OF WASHINGTON

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THE

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OF WASHINGTON

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The regular meetings of the Society are held in the National Museum on the first Thursday of each month, from October to June, inclusive, at 8 P. M.

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PROCEEDINGS OF THE

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NEW SPECIES AND A NEW GENUS OF NORTH AMERICAN DELTOCEPHALINE LEAFHOPPERS (HEMIPTERA: HOMOPTERA).

By P. W. OMAN, *U. S. Bureau of Entomology.*

The descriptions which follow are those of apparently new forms which the writer has encountered in the course of his work during the past year and a half. Since representatives of nearly all the species of the genus are available, a key to *Sanctanus* Ball is included.

Sanctanus tectus, n. sp.

(Pl. 13, Figs. A, B, C.)

Similar to *fasciatus* in size but with a more angular vertex and less brown coloration. Color and color pattern resembling those of *Deltocephalus arundineus*. Length 4–4.5 mm.

Color.—Face pale, with three transverse black bands, one across the apex of the clypeus, one below the antennae, and one below the margin of the vertex. Vertex creamy, with a pair of small black spots at the apex and a large irregularly shaped pair on the disk next the ocelli, the latter always connected with the black band on the front, the former usually so. A pair of small dark spots on posterior margin of vertex. Pronotum with a rectangular black spot on the anterior margin medially and an irregular spot behind each eye, disk brownish iridescent, margins irregularly pale. Elytra with basal portions milky, a fuscous spot on disk of each clavus and three fuscous spots on each costal margin, one next the milky area, one before the first nervure to costa, and one in outer apical cell; veins milky to yellowish, bordered with fuscous, cells embrowned except along costal margins. Tips of male plates black.

Structure.—Vertex similar to that of *fusconotatus* but broader and more sharply angled, more produced than that of *sanctus*, margins rounded to front. Elytra broad and flaring, venation typical of the genus.

Genitalia.—Last ventral segment of female with a broad, blunt, median tooth which is attached only basally to remainder of segment. Segment each side of tooth roughly truncate posteriorly. Male plates broad basally, tapering to narrow tips, plates together triangular.

The markings and genital characters will distinguish this species from others in the genus.

Holotype male and allotype female from Deep Creek, Virginia, collected from *Arundinaria tecta* by the writer, Sept. 9, 1933. Paratypes, numerous specimens with the above data and others collected at the same locality by L. D. Anderson on Oct. 8 and Oct. 31, 1933. The writer has also examined specimens from Florence, South Carolina, collected in May, September, and October by O. L. Cartwright and sent to the writer for study by J. O. Pepper of the Pennsylvania Department of Agriculture. Types in collection of United States National Museum (Cat. No. 50369), paratypes in collections of L. D. Anderson and J. O. Pepper.

Key to the North American Species of Sanctanus[1]

1. Ground color pale salmon red with a transverse, black-margined white band at the apex of the clavus and an orbicular black spot in the outer apical cell of each elytron........ *orbiculatus* Ball

   Color not as above........ 2

2. (1) Dorsal color pattern consisting of brown or yellowish brown and ivory. Brownish area on disk of corium not broken by broad white or pale veins........ 5

   Dorsal color pattern lacking in distinct brown and ivory contrasts. Markings on corium consisting mostly of brownish intracellular infuscations which are darker around the margins. Veins on disk of corium broad and pale........ 3

3. (2) Upper one half of face uniformly black, clypeus and portions of adjacent sclerites unmarked........ 4

   Face not as above, black marks consisting of broken transverse bands, one of which crosses the clypeus........ *tectus*, n. sp.

4. (3) Markings on disc of vertex fuscous........ *fusconotatus* Osborn [2]

   Markings on disc of vertex pale orange........ *aestuarium* Del. & S. [2]

5. (2) Face with distinct transverse black bands........ 6

   Face without distinct transverse black bands........ 7

6. (5) Median length of vertex equal to or shorter than one half its width at anterior margin of eyes. Dorsal markings usually dark brown. Length 4.5–5.25 mm........ *cruciatus* Osborn

   Median length of vertex distinctly greater than one half its width at anterior margin of eyes. Dorsal markings usually pale brown. Length 4–4.5 mm........ *fasciatus* Osborn

7. (5) Elytra apically without reticulations, vertex angled........ *sanctus* Say

   Elytra apically with numerous reticulations, vertex bluntly rounded........ *limicolus* Osborn

---

[1] The writer has not examined specimens of *eburneus* DeLong. It appears to be related to *fusconotatus* and *tectus*.

[2] The writer believes that *fusconotatus* and *aestuarium* are extremes of a single species in which the marks on the vertex are variable.

Hebecephalus scriptanus, n. sp.

(Pl. 13, Figs. D, E.)

Related to *labeculus* and *blandus* but differing from both in having the female genital segment produced and unnotched. Length of female 2.75–3 mm.

Color.—Ground color cinereous. Frontal sutures brown to fuscous, frons with broken transverse brown bars basally and an irregular brown spot medially. Vertex with a brown spot next each eye and an elongate brown B or figure 8 mark on each side of median line, this sometimes interrupted along anterior margin of vertex. Pronotum with three pairs of longitudinal brown stripes, these sometimes nearly obsolete. Scutellum with two pairs of narrow longitudinal brown lines. Elytra grayish subhyaline, margins of cells embrowned.

Structure.—Vertex bluntly right angled, broader and shorter than in *bocanus*, about as in *labeculus*, distinctly longer than pronotum. Elytra about equal to abdomen in length, venation typical of the genus.

Genitalia.—Last ventral segment of female with lateral margins short, posterior margin triangularly produced.

Holotype female from Mustang Mt., Ariz., June 12, 1933, collected by the writer. Paratypes, 6 females from the above locality, 3 taken on June 12 and 3 on June 20, by R. H. Beamer and the writer. Type and paratypes in United States National Museum collection (Cat. No. 50370), paratypes in collection of University of Kansas.

Laevicephalus aridus, n. sp.

(Pl. 13, Figs. F, G.)

Similar in size and coloration to *monticolus* (Gillette and Baker), but with the vertex more bluntly angled and the female genital segment without a median tooth on posterior margin. Length 2.75–3 mm.

Color.—Pale greenish white. Front with faint brownish bars; vertex with faint brownish dashes each side of apex, these sometimes extended into narrowing stripes across pronotum. Ocelli black, eyes green.

Structure.—Vertex bluntly angled in female, equalling pronotum in length, more rounded in male and distinctly shorter than pronotum. Elytra extending well beyond tip of abdomen, venation irregular, outer anteapical cell often small or nearly absent.

Genitalia.—Last ventral segment of female comparatively long, lateral margins short, lateral angles rounded, median portion produced and narrowing, with sides of produced portion sinuate, posterior margin truncate or faintly bilobed, often appearing distinctly incised. Male plates broad basally, tapering sharply to acute tips which reach slightly over half way to apex of spiny pygofer.

This species is best separated from all others of the genus except *convergens* by the genital characters, while from that species it may be separated by the smaller size and blunter head.

Holotype female, allotype male, and 1 female paratype from Copper, Ariz., collected by the writer June 30, 1933. Types in collection of the United States National Museum (Cat. No. 50371).

Laevicephalus bocanus, n. sp.

(Pl. 13, Figs. H, I.)

Resembling *labeculus* but smaller, more slender, and with a more produced and angled vertex. Length of female 2.75 mm.

Color.—Ground color pale creamy white to gray. Face slightly embrowned; dorsum with a light brown longitudinal vitta on each side extending from anterior margin of vertex to anterior margin of scutellum, narrowing posteriorly. Pronotum with an additional faint longitudinal vitta behind each eye. Elytra grayish subhyaline, margins of cells embrowned.

Structure.—Vertex produced and pointed, length nearly equal to greatest width and distinctly greater than length of pronotum. Elytra about equalling abdomen in length, venation typical of the genus.

Genitalia.—Last ventral segment of female with lateral margins short, median portion well produced and narrowing posteriorly, apex with a small notch.

Described from 2 females, holotype and paratype, collected at Boca Chica, Texas, May 30, 1933, by the writer and Mrs. Oman. Types in the collection of the United States National Museum (Cat. No. 50372).

Deltocephalus laredanus, n. sp.

(Pl. 13, Figs. J.—K.)

Pale yellowish brown with four fuscous spots on the anterior margin of the vertex and a cream colored stripe dorsally. More closely related to several South American species than to the known North American forms. Length 3 mm.

Color.—General ground color brownish testaceous. Face unmarked except for a small fuscous dot below each ocellus. Dorsum with a cream or ivory colored stripe extending from apex of vertex to apex of scutellum, widening slightly posteriorly, and continued to apex of claval sutures by the cream colored commissural margins of the elytra. Vertex with a triangular fuscous spot on the anterior margin each side of the apex next the median stripe and another irregular and often indistinct one next ocellus. Pronotum with lateral margins narrowly creamy and traces of two creamy longitudinal stripes each side of the median stripe. Median stripe usually margined with fuscous on scutellum. Elytra subhyaline, veins whitish, often faintly margined with fuscous.

Structure.—Vertex well produced and bluntly angled, slightly shorter than pronotum in length. Elytra extending well beyond tip of abdomen, venation typical deltocephaloid.

Genitalia.—Last ventral segment of female narrowed posteriorly, exposing underlying membranes, posterior margin broadly and shallowly excavated, with a small median tooth. Male plates small, together roughly triangular, with lateral margins concave and tips blunt.

Holotype male, allotype female, and numerous paratypes of both sexes collected by the writer near Laredo, Texas, June 3,

1933. Also 1 male paratype labeled Austin, Texas, May, 1905, in collection of E. D. Ball. Types in the collection of the United States National Museum (Cat. No. 50373), paratypes in collection of E. D. Ball.

Genus **BALDULUS**, new genus.

Small, elongate leafhoppers, related to *Cicadula* in the characters of the venation of the elytra and wings, but with the elytra long and slender as in *Balclutha*, the head narrow and produced and angled as in *Deltocephalus*. Also resembling *Cicadulina* but with a more produced vertex and with one more apical cell in both elytra and wings.

Face elongate, triangular, margin of genae slightly sinuate below the eyes. Vertex triangularly produced and rounding to the front, median length slightly less than length of pronotum. Head, including eyes, equal to pronotum in width. Elytra elongate and slender, with two anteapical and four apical cells and distinct appendices. Wings with three apical cells.

In the species known to the writer the color is pale yellowish with a black spot on the margin of vertex, above or sometimes slightly anterior to each ocellus. Markings of pronotum and scutellum consisting of more or less distinct longitudinal vittae of pale yellowish brown to brown.

Type of the genus, *Baldulus montanus*, n. sp.

This genus will also include *Deltocephalus elimatus* Ball [3] from Mexico, which the writer believes to be congeneric with *B. montanus* in spite of its peculiar, elongate genitalia in both sexes (Pl. 13, Figs. N, O,) and slightly shorter vertex.

Baldulus montanus, n. sp.

(Pl. 13, Figs. L, M.)

Smaller than *elimatus*, with a more angled vertex and darker markings on vertex and pronotum. Length 3.25–3.5 mm.

Color.—General ground color pale yellow. Face unmarked except for a small fuscous dot below each ocellus, these sometimes obsolete. Vertex with a small fuscous spot at apex, a larger, black, triangular pair above and a little anterior to the ocelli, a fuscous quadrangular pair on the posterior margin next the eyes, and a faint brown pair between these. In pale specimens the spot at the apex and the inner basal pair may be obsolete. Pronotum and scutellum with a longitudinal brownish-fuscous vitta each side of the median line, emphasizing a broad creamy median stripe. Traces of two additional brownish vittae laterally on pronotum. Elytra with veins and commissural line to apices of clavi white, cells embrowned except along costa and sometimes apically.

Structure.—Vertex nearly twice as long medially as next the eyes, median length slightly less than length of pronotum. Pronotum truncate posteriorly, median length about one half the width.

Genitalia.—Last ventral segment of female about one and one half times as

[3] Can. Ent., vol. 32, p. 345, 1900.

long as preceding segment, posterior margin truncate or slightly sinuate. Male valve broad, bluntly angled posteriorly. Male plates together triangular, apices terminating in divergent ligulate processes about one half as long as the rest of the plates. Apex of aedeagus usually visible between tips of plates. Aedeagus with shaft long and nearly straight, extending posteriorly; apex curved upward and with two pairs of processes at tip, one pair long and slender and extending anteriorly along the shaft, the other pair curved first upward and then anteriorly, forked near base, the upper fork crooked and shorter than the lower fork.

Holotype male, allotype female, and numerous paratypes of both sexes from the Santa Rita Mts., Ariz., collected June 27, 1933, by the writer. Other paratypes from the same locality; 20 specimens collected June 26, 1933, by R. H. Beamer, and 20 specimens collected July 6, 1933, by E. D. Ball. Holotype, allotype, and paratypes in the United States National Musem collection (Cat. No. 50374), paratypes in the collection of E. D. Ball and the University of Kansas.

EXPLANATION OF PLATE.

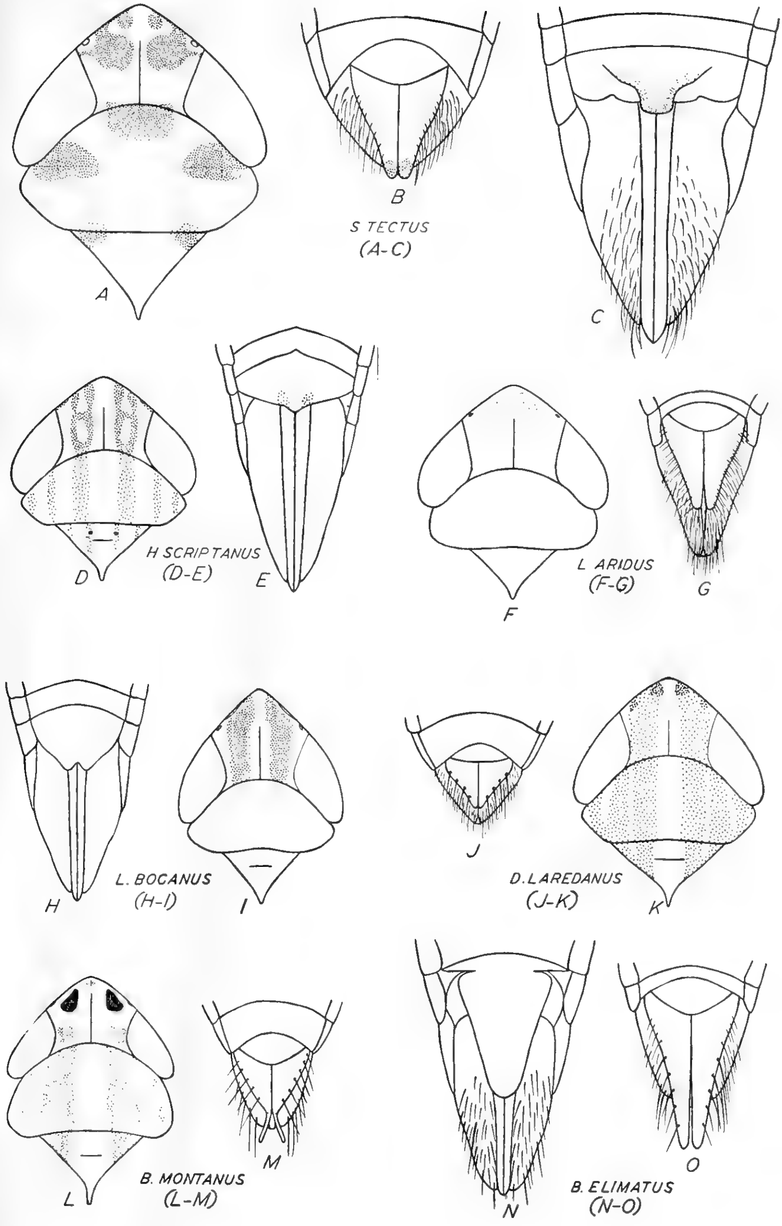
A, head and thorax, B, male genitalia, and C, female genitalia of *Sanctanus tectus;* D, head and thorax, and E, female genitalia of *Hebecephalus scriptanus;* F, head and thorax, and G, male genitalia of *Laevicephalus aridus;* H, female genitalia, and I, head and thorax of *L. bocanus;* J, male genitalia, and K, head and thorax of *Deltocephalus laredanus;* L, head and thorax, and M, male genitalia of *Baldulus montanus;* N, female genitalia, and O, male genitalia of *B. elimatus* Ball. All drawings show an enlargement of approximately 30 diameters.

A NOTE ON THE DISTRIBUTION OF EUMERUS NARCISSI SMITH (DIPTERA : SYRPHIDAE)

By RANDALL LATTA,

Bureau of Entomology, U. S. Department of Agriculture, Sumner, Wash.

In a previous publication (A Comparative Study of the Species of *Eumerus* known as the Lesser Bulb Flies. Monthly Bul. Calif. Dept. Agr. Vol. XXII, Nos. 2–3, Feb.–March, 1933, p. 147) the distribution of *Eumerus narcissi* Smith in the United States was mentioned as being confined to California and Oregon. The species is quite common in bulb districts in California, but only one specimen had been found in Oregon, that near Portland at a large bulb ranch. In 1931 one pair were collected in a greenhouse on Long Island, New York, by Blanton and Spruijt (The Species of *Eumerus* on Long Island. Jour. Econ. Ent. Vol. 26, No. 2, Apr. 1933, p. 515). During the past summer a single male was collected at Morning Sun, Iowa, by Helen Latta, from flowers near a bed of naturalized daffodils. Future collections in the eastern and southern bulb growing sections will probably reveal more occurrences of this species.


A
B
S TECTUS
(A-C)
C
D
H SCRIPTANUS
(D-E)
E
F
L ARIDUS
(F-G)
G
H
L. BOCANUS
(H-I)
I
J
D. LAREDANUS
(J-K)
K
L
B. MONTANUS
(L-M)
M
N
B. ELIMATUS
(N-O)
O

A NEW GENUS AND SPECIES OF THE FAMILY GELECHIIDAE (LEPIDOPTERA).

By August Busck,

Bureau of Entomology, U. S. Department of Agriculture.

CREMONA, new genus.

(Plate 10, Figs. 1–5.)

Labial palpi long, recurved; second joint somewhat thickened with rough scaling, slightly furrowed in front; terminal joint shorter than the second, also somewhat thickened with scales and rough on frontal edge; apex pointed. Maxillary palpi minute. Tongue short, spiralled. Antennae simple, shorter than fore wing, slightly serrate towards the tip in the males. Face, head, and thorax smooth.

Fore wing smooth, costal and dorsal edges nearly straight and parallel; termen evenly rounded; apex bluntly pointed; 12 veins, 7 and 8 stalked to costa; 6 out of stalk of 7 and 8 to termen; 2, 3, 4, and 5 nearly equidistant; 2 and 3 from before end of cell; 9, 10, and 11 nearly equidistant; 11 from middle of cell; 9 somewhat variable, more or less approximate to stalk of 7 and 8; 1*b* furcate at base; 1*c* faint at base, outer half obsolete.

Hind wings as wide as fore wings; costa nearly straight, slightly bulging before middle; dorsum nearly straight; termen rounded, sinuate before apex; apex produced, pointed; 8 veins, 8 straight to apical third of costa; 6 and 7 long-stalked, enclosing apex; 5 much nearer to 4 than to 6, but distant from both and nearly parallel to 4; 3 and 4 variable, separate or approximate or sometimes connate; 2 parallel to 3. Posterior tibia heavily clothed with long hairs.

Male genitalia (pl. 10, fig. 5) with uncus weakly developed, short, blunt, thumb-like, with a few stiff hairs; socii undeveloped; gnathos very long, abruptly curved, with pointed apex. Harpes divided; upper arms long, slender, pointed, heavily haired on outer half; lower arms short, stout, pointed; anellus two small, triangular plates. Aedoeagus short, stout, curved, with pointed apex and with rounded base; no cornuti. Vinculum large, rounded.

Female genitalia (pl. 10, fig. 4) with short, protruding, chitinized lips to the ostium; ductus bursa rather short, chitinized in posterior end and twisted once upon itself; bursa globular, with a small, inverted, pointed signum.

Type: *C. cotoneastri.*

The genus is allied to *Gelechia* of authors, but differs in the venation, having vein 6 of fore wing out of stalk of 7 plus 8 and veins 3 and 4 of hind wing normally separate as in *Telphusa*, from which genus it differs in the smooth fore wings. The genitalia are typical of the family, but easily differentiated generically.

The genus *Gelechia*, as at present used, comprises a heterogeneous aggregation and the name must eventually be restricted to the forms agreeing with the genotype, the European *Gelechia rhombella* Schiffermüller, which has veins 3 and 4 of fore wings stalked (a character which may not prove dependable) but which has very characteristic genitalia, differing essentially from those of the bulk of the species at present included in the genus, which represent several good generic groups.

Cremona cotoneastri, new species.

Labial palpi dark fuscous, flecked with ochreous, especially on inner surfaces and on terminal joint. Antennae blackish fuscous with narrow light ochreous annulations. Face light fuscous mixed with ochreous. Head and thorax dark fuscous with each scale narrowly tipped with ochreous. Fore wings uniformly dark fuscous, mixed with silvery white; each scale dark with base and extreme tip silvery; no other markings; cilia concolorous. Hind wings dark fuscous, a shade lighter than the fore wings; cilia gray. Abdomen blackish fuscous with the tips of the long protruding harpes light gray. Legs dark fuscous, tarsi with narrow ochreous annulations.

Alar expanse 12–14 mm.

Habitat, Portland, Oregon.

U. S. National Museum Type No. 50252.

Foodplant, *Cotoneaster horizontalis*.

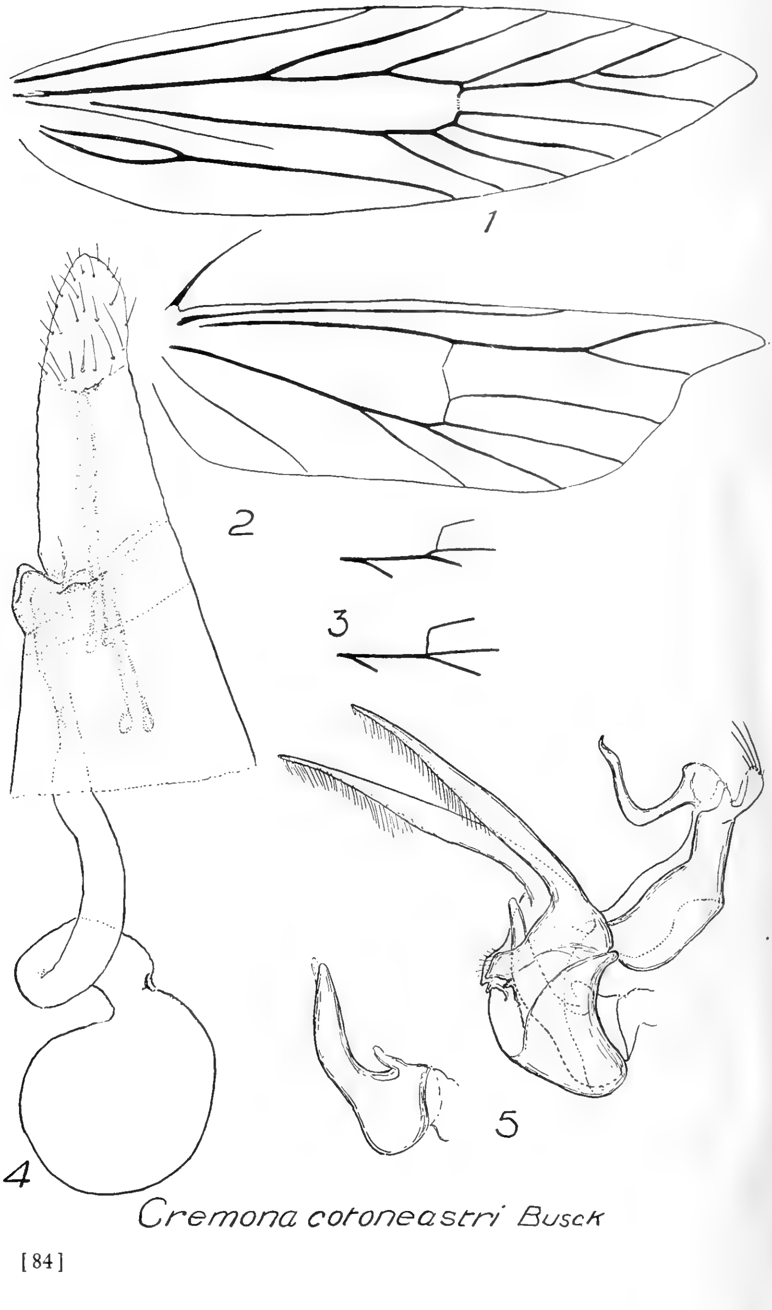
Reared in good series by Mr. J. R. Roaf and submitted for identification by Dr. Don C. Mote, Entomologist, Oregon State Agricultural College.

The moth appeared during June and July.

The foodplant belongs to a northern temperate Old World genus of ornamental shrubs of the family Rosaceae, which in late years has been introduced into various parts of the world for horticultural purposes. The home of *Cotoneaster horizontalis* is China and it seems probable that the insect is also of Chinese origin. For this reason I sent specimens to Edward Meyrick in England, who is well acquainted with the Chinese microlepidoptera and he has kindly advised me that he agrees with me, that "the insect is quite new and undoubtedly a new genus allied to *Gelechia*," and he is also disposed to believe it of Chinese origin, though "I have been studying a considerable number of Chinese forms lately and have not so far come across anything like it" (Meyrick).

I take the occasion again to express my thanks to the venerable dean of microlepidopterists for much professional help through nearly forty years. The workers in this field, in all parts of the world, are fortunate in being able to consult his extensive knowledge, which he so liberally shares.

If we are correct in this suspected origin and recent introduction of *Cremona cotoneastri*, this species should be watched as a potential danger to American fruit; it is quite possible that the species may find other rosaceous plants more to its liking than the original hostplant, as did another Asiatic introduced microlepidopteron (*Laspeyresia*) *Grapholitha molesta* Busck, the well known oriental fruit moth.



Cremona cotoneastri Busck

EXPLANATION OF PLATE.

Cremona cotoneastri Busck.

Fig. 1. Venation of fore wing.
Fig. 2. Venation of hind wing.
Fig. 3. Details showing variations of veins 4 of hind wing.
Fig. 4. Genitalia of female.
Fig. 5. Genitalia of male.

Figures drawn under author's supervision by Mrs. Eleanor A. Carlin of the Bureau of Entomology, U. S. Department of Agriculture.

A NEW NORTH AMERICAN MAGDALIS FROM BLUE SPRUCE (COLEOPTERA : CURCULIONIDAE)

By L. L. BUCHANAN, *U. S. Bureau of Entomology.*

The species described below was received from O. W. Collins, of the Gipsy Moth Laboratory of the Bureau of Entomology, U. S. Department of Agriculture, Melrose Highlands, Mass., who states that the specimens were reared in Massachusetts from Colorado blue spruce, *Picea pungens* Engelmann var. *glauca*. The figures were drawn by Mrs. E. A. Carlin. Measurements to determine length of rostrum and location of antennal socket were made along dotted lines "a" and "b" respectively, as shown in figure 3.

Magdalis piceae, new species.

Length, 3.8–4.3 mm. A rather slender species of the *gentilis* group. Moderately shining, glabrous above, black, antennal scape generally rufescent apically; pronotum with a narrow, polished, impunctate, median line which is abbreviated before and behind; femoral tooth unusually small, sometimes subobsolete on hind legs; tarsal claws simple.

Rostrum as long as, or slightly longer than, prothorax, more slender and rising more abruptly from head in female; surface shining except at base, finely and closely punctate; antennal socket slightly in front of middle (male) and at or slightly behind middle (female). Scape passing anterior eye margin in both sexes, first funicular segment a little longer and much stouter than second, which is not more, and generally less, than twice as long as wide and usually a little shorter than third and fourth together; club longer in male than in female. Head feebly alutaceous, with closely set punctures that are larger but apparently shallower than those on rostrum, interocular puncture small, eyes in male a little larger, more convex, and closer together above than in female. (In male, distance between eyes above is to width of rostrum at base as 3½ is to 6, approximately.) Prothorax about as long as wide at middle, sides broadly and feebly rounded, divergent at hind angles, apical constriction not deep; pronotal punctures dense and scabrous at margins, becoming less dense on disk, where they are often separated by narrow but flat and shiny intervals, the

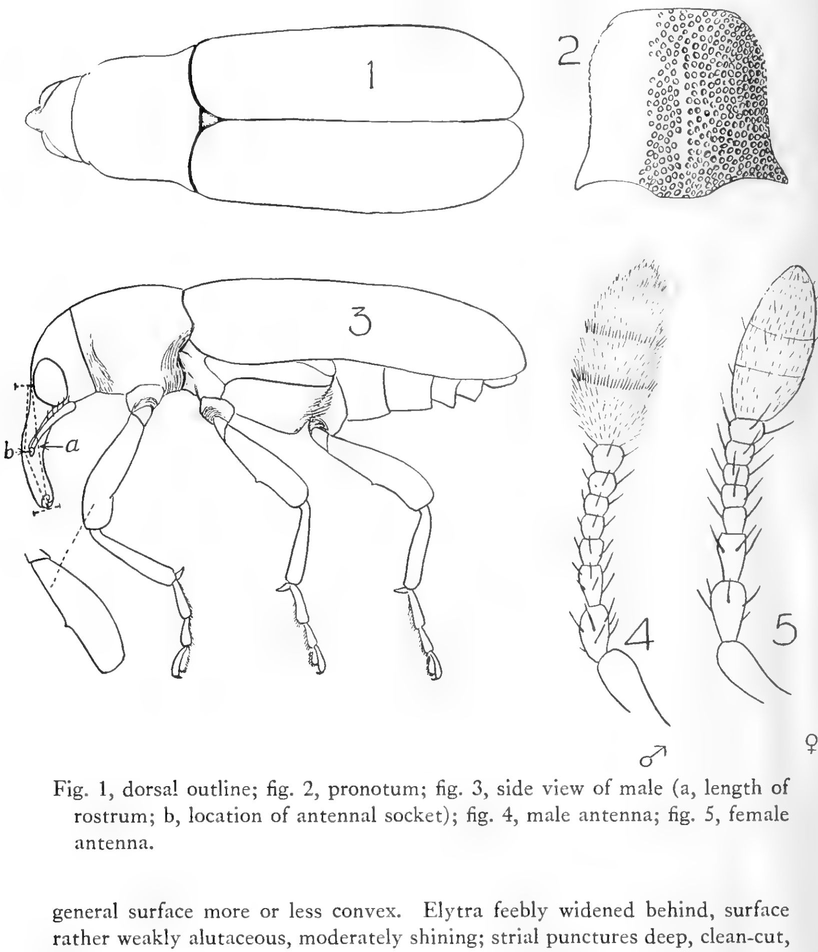


Fig. 1, dorsal outline; fig. 2, pronotum; fig. 3, side view of male (a, length of rostrum; b, location of antennal socket); fig. 4, male antenna; fig. 5, female antenna.

general surface more or less convex. Elytra feebly widened behind, surface rather weakly alutaceous, moderately shining; strial punctures deep, clean-cut, closely set; on disk, the intervals nearly flat, each with a fairly regular single row of generally distinct punctures which may be here and there, and especially toward sides, somewhat confused or in a partly double row. Thoracic sternites densely punctate, side pieces of mesosternum and metasternum clothed with pale, plumose scales; abdominal sternites a little less densely punctate, first sternite of male feebly impressed; first tarsal segment of hind leg elongated, rather more so in male than in female.

Type locality.—Dover, Mass., 6/3/33; Ex. Blue Spruce; Gip. Moth Lab. 12164 U 108.

Other locality.—White Mts., N. H., Peabody River, VII–15–1925, A. Nicolay.

Type (male), allotype, and 8 paratypes.—Cat. No. 50284, U. S. N. M.

Described from 10 specimens, 9 from type locality, 1 from New Hampshire.

The black color, slender form, moderately shining surface, comparatively narrow prothorax with its polished median line, small femoral tooth, and slightly enlarged antennal club of male, form a combination of characters unknown to me in any other species.

By the small femoral tooth *piceae* is most closely related to *vitiosa* Fall but that Californian species is considerably smaller (3.1–3.3 mm.), more densely punctate, duller in luster, and with the median pronotal line not polished.

RECORDS OF HYMENOPTEROUS PARASITES OF TICKS IN THE UNITED STATES.

By F. C. Bishopp,

Principal Entomologist, Bureau of Entomology, U. S. Department of Agriculture.

The widespread occurrence of Rocky Mountain spotted fever in the United States as reported in recent years has stimulated interest in the several species of ticks concerned in the transmission of this malady and in their natural enemies.

Exact information on the distribution and abundance of the two known hymenopterous parasites of ticks which occur in this country is meager. These parasites, *Ixodiphagus texanus* and *Hunterellus hookeri*, were both described by Dr. L. O. Howard.[1] The type specimens of the former were reared from nymphs of the rabbit tick, *Haemaphysalis leporis-palustris*, collected by J. D. Mitchell on a cotton-tail rabbit in Jackson County, Texas, May 8, 1907. Although many collections of nymphs of this tick have been made in various parts of Texas and in other States only one other parasitized lot has been collected by workers in the Bureau of Entomology. This was a collection of *Haemaphysalis leporis-palustris* nymphs taken from the road-runner or chaparral cock (*Geococcyx californianus*) at Reagan Wells, Tex., on April 28, 1914, by D. C. Parman. This lot consisted of 17 nymphs, two-thirds to fully engorged. Four of these proved to be parasitized. From 3 of these 11 parasites emerged. These were identified by the writer as *Ixodiphagus texanus* Howard. This is the only record of the collection of this parasite since the type material was reared.

Hunterellus hookeri appears to have much wider distribution as reported by H. P. Wood.[2] This parasite occurs in Texas,

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[1] L. O. Howard, 1907. A Chalcidid parasite of a tick. Ent. News, Vol. 18, pp. 375–378. 1908. Another chalcidoid parasite of a tick. Can. Ent. Vol. 40, pp. 239–241.

[2] H. P. Wood, 1911. Notes on the life history of the tick parasite, *Hunterellus Hookeri* Howard. Journ. Econ. Ent. Vol. 4, pp. 425–431.

California, Mexico, and Portuguese East Africa. Our work since 1911 has not added greatly to the known distribution except for the collection of 4 lots of parasitized nymphs of *Rhipicephalus sanguineus* Latr. in South Miami, Florida, in 1931 by Mrs. S. G. Martin. These ticks were all taken on dogs. The first lot, collected September 6th, consisted of 127 well engorged nymphs, 7 of which were parasitized. The second lot consisted of 35 nymphs, a few of which were parasitized. These were collected September 14th. The third collection, October 9, consisted of 15 nymphs, 13 of which were parasitized. The fourth consisted of 45 nymphs collected October 24. Among these 15 were parasitized, 14 of which produced a total of 85 parasites.

This species was also reared from a single nymph of *Dermacentor variabilis* Say which was collected, together with several engorged nymphs of *Amblyomma americanum* L., on a cow October 15, 1931, on Capers Island, S. C., by E. K. Moore. The nymphs of *A. americanum* were not parasitized. The parasites from South Miami and Capers Island were identified by A. B. Gahan. In 1929 a number of nymphs of *Dermacentor* parasitized by the French species *Ixodiphagus caucurtei* Buysson were released on Capers Island by Dr. Joseph Bequaert of Harvard University.

H. O. Schroeder of the Bureau of Entomology has found this parasite to be more or less common in the vicinity of Brownsville, Tex., in the past two years, but has not found parasitized ticks in other parts of the State.

A NEW VARIETY OF PLEOCOMA.[1]

By A. C. DAVIS, *Takoma Park, Md.*

Pleocoma conjungens Horn Variety **hirsutus,** n. var.

General appearance as in *Pleocoma conjungens.* Elytra shining black, margins with a brownish tinge, pronotum piceous, brown at sides.

Head above, including ocular canthi, closely punctate and thickly covered with long yellow-brown hair; ocular canthi with the anterior margins curving forward of a right angle with the long axis of the body, apices acute, rounded, lateral margins nearly straight, posterior angles obtuse but distinct.

Pronotum slightly less than twice as wide as long (6 by 11.8 mm.), black, brown at sides, with an occasional hair upon its surface; posterior median impression nearly lacking; lateral pits lacking; transverse ridge lacking, the basal part of the pronotum being smoothly and evenly convex to the declivity; anterior median impression distinct and moderately deep, very heavily and coarsely punctate, and rather densely clothed with long yellow-brown hair.

Scutellum sparsely, finely punctate, and sparsely clothed with short hair.

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[1] Order Coleoptera; family Scarabaeidae.

Legs and body beneath brown, very densely clothed with long yellow-brown hair.

Antennae almost exactly as in the specimen of *P. conjungens* labeled as the type in the collection of the Academy of Natural Sciences of Philadelphia, except in the proportions of antennal joints 1 to 3, which are 1.2, 0.3, and 1.0 mm. in length, respectively, as compared with 0.7, 0.25, and 0.8 mm. in the type.

Type locality.—Between Lebec and Saugus, in Los Angeles County, Calif., in the Sierra Madre Mountains. Collected by R. D. Lusk.

Type.—Male in the collection of the Los Angeles Museum. This specimen was lent to me for study by L. J. Muchmore.

Among Mr. Lusk's effects the following data, attached to a letter of inquiry from Mr. Muchmore, were found by Earl Hakes: "Found on the 22d day of January, 1933, about 7 miles this side of the summit on the Ridge Route. There were hundreds of these bugs flying through the air just below the snow line about 5 P. M."

This variety, while close to *P. conjungens* in most respects, seems to differ from the typical form enough to justify at least a varietal name. It may be separated from *conjungens* by the color, different shape of the ocular canthi, the more parallel sides of the horn of the vertex, the extreme hairiness of the head and anterior part of the pronotum, the heavily punctate anterior median impression, and the slightly different proportions of the first 3 antennal joints.

ON THE IDENTITIES OF CHALCIDOID TICK PARASITES (HYMENOPTERA).

By A. B. GAHAN,
Senior Entomologist, Bureau of Entomology,
United States Department of Agriculture.

The discovery that Rocky Mountain spotted fever, a tick-borne disease, has become established in several widely separated sections of the United States and is becoming an increasingly important problem, has stimulated a keen interest in the natural enemies of ticks.

So far as known the only important insect enemies of ticks are minute chalcidoids belonging to the family Encyrtidae. The first record of one of these parasitic insects attacking a tick was published by L. O. Howard (*1*) in 1907 when he described *Ixodiphagus texanus*. The following year Howard (*2*) described a second genus and species from Texas which he called *Hunterellus hookeri* and in 1912 *Ixodiphagus caucurtei* was named and described by R. du Buysson (*5*) from France. A paper by R. A.

Cooley (*19*) published in 1929 apparently implies (*p. 267*) that all three of these names refer to the same insect. As will be shown later, however, *Ixodiphagus texanus* and *Hunterellus hookeri* are quite distinct species while *I. caucurtei* is identical with *Hunterellus hookeri*.

In another article by Prof. Cooley (*20*) published in 1930 and giving an account of his trip to Africa for the purpose of investigating tick parasites, it is stated that G. A. H. Bedford of the Veterinary Research Laboratory at Onsderpoort, Transvaal, had discovered a chalcid that attacked adult ticks. It is also related that Dr. L. E. Robinson, parasitologist of the Cooper Technical Bureau, some years previously had received a box of adult *Amblyomma hebraeum* Koch from Cape Province and that upon being opened later in England the box was found to contain adult chalcids that had emerged in transit and which were different from the species discovered by Bedford. The conclusion is drawn that it is reasonably certain that there exist in Africa two new chalcidoid parasites of ticks. A review of tick parasite work published by Prof. Cooley (*21*) later in the same year, however, stated that the alleged tick parasite discovered by Bedford had been identified by the present writer as *Mormoniella vitripennis* (Walker), a common parasite of blowflies, and was probably not a parasite of ticks at all. The same review indicated that attempts to obtain examples of the supposed tick parasite taken by Robinson had failed and the identity of the species could not be established.

At present therefore only two species of tick parasites are definitely known to exist, viz, *Ixodiphagus texanus* Howard and *Hunterellus hookeri* Howard. These two species bear a close resemblance to each other and may easily be confused if examined only superficially. Both are small, robust, black species, with the antennae 11-jointed and clavate in the female, 10-jointed and nearly filiform or weakly clavate in the male; head as broad as thorax, broadly but not deeply concave behind; eyes distinctly hairy; mesoscutum weakly shagreened and uniformly clothed with rather coarse hairs; wings normal in size, the marginal vein about as broad as long, stigmal about as long as marginal and post-marginal combined, oblique hairless streak from stigmal vein distinct; propodeum medially very short; abdomen broader than long, shorter than the thorax, the ovipositor concealed.

Despite the resemblance, however, they are distinct enough to be maintained as separate genera. The following dichotomy, together with the accompanying figures, should make it possible to distinguish the two species without much difficulty.

DICHOTOMY FOR SEPARATION OF *Ixodiphagus texanus* AND *Hunterellus hookeri*.

Head, viewed dorsally, very nearly or quite three times as broad as long; fronto-vertex nearly twice as broad as long and not flattened; ocellar triangle distinctly obtuse, the postocellar line much longer than a line from the anterior ocellus to a posterior ocellus; ocelli rather large, the ocellocular line about equal to the diameter of an ocellus; *antennae inserted distinctly below middle of head and distinctly below a line connecting lower extremities of eyes*, the distance from antennal socket to anterior margin of clypeus equal to about half the distance between antennal sockets; *scape four or five times as long as thick, not expanded beneath;* antennal club of female obliquely truncate from base of second segment, subacute at apex; funicle joints of male antenna not longer than broad, the club 2-jointed and a little broader than the funicle joints; *labial palpi 3-jointed*, the second joint very short; maxillary palpi 4-jointed, the second and third joints each broader than long and shorter than either the first or last joint; mesoscutum and scutellum moderately convex, the scutellum polished except for very weak reticulation on the basal one third; angle between stigmal and postmarginal veins distinctly less than 45°; antennae fusco-testaceous; tibiae and tarsi nearly uniformly testaceous, as are also the trochanters and apices of femora; wing subhyaline.

Ixodiphagus texanus Howard.

Head viewed dorsally, about twice as broad as long; fronto-vertex in the female not twice as broad as long, flattened and more or less horizontal, in the male more transverse than in the female but usually not so short as in *I. texanus;* ocellar triangle large, the postocellar line only a little longer than a line from the anterior to a posterior ocellus; ocelli not large and the lateral ones separated from the eye margin by a distance greater than the diameter of an ocellus; *antennae inserted at about the middle of head, slightly above the lower extremities of eyes*, the distance from antennal socket to anterior margin of clypeus approximately equal to the distance between antennal sockets; *scape not over three times as long as broad, with a distinct flange-like expansion on the inner side beneath:* club not strongly obliquely truncate, more rounded at apex; funicle joints in the male all distinctly longer than broad; *labial palpi 2-jointed;* maxillary palpi either 3- or 4-jointed (the third and fourth joints most often distinctly separated but frequently completely joined together), when 4-jointed the second and third joints subequal and always distinctly longer than broad; mesoscutum and scutellum flattened, the scutellum weakly reticulated or shagreened on at least the basal two thirds; angle formed by stigmal and postmarginal veins approximately 45°; antennae dark brown to blackish, the scape usually fusco-testaceous; legs brownish black with the trochanters, knees, apices of tibiae and the tarsi reddish testaceous, the middle and hind tibiae always dark brownish or blackish except at base and apex; forewing subhyaline but usually with the area embracing the oblique hairless streak more or less distinctly stained with fuscous.

Hunterellus hookeri Howard.

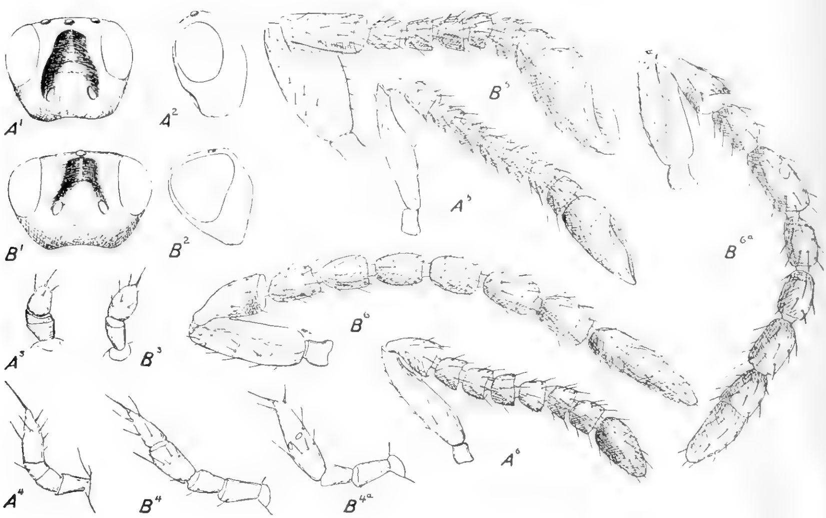

Fig. 1.—A. *Ixodiphagus texanus* Howard. 1, Front view of head; 2, side view of head; 3, labial palpus; 4, maxillary palpus; 5, antenna of female; 6, antenna of male.

B. *Hunterellus hookeri* Howard. 1, Front view of head; 2, side view of head; 3, labial palpus; 4, maxillary palpus, normal; 4a, maxillary palpus (third and fourth joints connate); 5, antenna of female; antenna of male, normal; 6a, other antenna from same individual as 6, abnormal.

Ixodiphagus texanus Howard.

This species was originally described in 1907 (*1*) from several females reared from nymphs of *Haemaphysalis leporis-palustris* (Packard) taken on wild rabbits in Jackson County, Tex. Although the species has been mentioned frequently in literature there is to date no published record of its again having been reared or collected.

The original type material of *I. texanus* in the U. S. National Museum is in poor condition and as a consequence the identity of the species was in some doubt until recently. In April, 1933, a consignment of twenty specimens was received for identification from R. A. Cooley through F. C. Bishopp, the labelling of which was as follows: "Parasite on *Ixodes hexagonus* var. *cookei* Packard on woodchuck, Mayfield, Idaho, June 28, 1932. Reared through fourth generation from the original. Bishopp No. 20657." All of the specimens were labeled alike. Eleven specimens of this lot were identified by the writer as *Hunterellus hookeri* and the other nine specimens as *Ixodiphagus texanus*.

The material was also examined by C. F. W. Muesebeck, who concurred in the identifications.

In the absence of a complete history of the specimens involved, it is impossible to explain the obvious contradiction between these identifications and the above indicated labeling. The two species of parasites are distinguished by good structural characters and can not be progeny of the same parents. Unless some mistake was made in labeling a part of the specimens, it appears certain either that the original stock of parasites comprised two species which were carried along together through the fourth generation or else that there was some contamination introduced in the course of the breeding work. Following the discovery that two species were involved, Dr. Bishopp obtained from Prof. Cooley and submitted to the writer for examination several specimens said to be the original stock from which the experiment was started. Whether or not this material included the actual parents used in starting the experiment, or constituted merely a part of the original rearing from a tick on a woodchuck taken at Mayfield, Idaho, from which the original parents were selected, the writer was not informed, but since the specimens submitted apparently emerged from the same individual tick nymph as did the parent stock, it appears practically certain that the specimens used as parents were of the same species. All of the specimens submitted proved to be *Hunterellus hookeri*. It therefore appears certain that the experiment was started with this species alone and that *Ixodiphagus texanus* was introduced later by accident, perhaps upon some animal used as host to the ticks. According to Fred A. Morton (*18*) rabbits were used for quantity production of ticks in the laboratory, and since the original host of *I. texanus* was *Haemaphysalis leporis-palustris*, the rabbit tick, it is possible that a parasitized tick of this species may have been inadvertently introduced on one of these animals. Whatever the explanation, it is to be questioned whether the specimens of *I. texanus* actually had as their original host *Ixodes hexagonus* var. *cookei* as indicated by the labeling. Likewise the locality from which the specimens came can not be stated definitely.

Hunterellus hookeri Howard.

Syn. *Ixidophagus caucurtei* Buysson.

Hunterellus hookeri was described in 1908 (*2*) from four females and six males reared from nymphs of *Rhipicephalus texanus* Banks (now recognized as a synonym of *R. sanguineus* Latreille) collected on a dog at Corpus Christi, Tex. *Ixodiphagus caucurtei* was proposed in 1912 (*5*), being based upon specimens reared by E. Brumpt from nymphs of *Ixodes ricinus* Linnaeus taken on deer at Chantilly and at Fontainebleau, France.

As already stated, *H. hookeri* and *I. caucurtei* are believed to be identical. This opinion is based upon a comparative study of authentic material in the U. S. National Museum. Included in this material are the types and many other undoubted specimens of *H. hookeri* from Texas and other parts of the United States as well as the following representatives of *I. caucurtei:* A series of 21 specimens reared from *Ixodes ricinus* by E. Brumpt at Paris, France; a large series received from S. B. Wolbach, reared from *Rhipicephalus sanguineus* collected in the Forest of Fontainebleau, France; and a third large series received through J. Bequaert and representative of the French stock which was first introduced on Naushon Island, Mass., and later into Montana and Dewees Island, S. C. The types of *I. caucurtei* in the Museum of Natural History in Paris were also examined by the writer in 1927, but these were not before him when the comparative study was made. The *caucurtei* material mentioned differs in no discernible way from typical *Hunterellus hookeri.* The development and habits as recorded by H. P. Wood for *hookeri* (*4*) and by Brumpt (*6*), Cooley (*17*), and others for *caucurtei* seem to agree. Both have been shown freely to attack closely related and in some instances the same species of ticks. There is no apparent reason to doubt, therefore, that the two names represent the same widely distributed species.

Hunterellus hookeri together with its synonym has received frequent mention in literature. According to C. P. Lounsbury (*3*) an unsuccessful attempt was made to introduce it into South Africa in 1908. In 1911 H. P. Wood (*4*) gave an account of its life history as a parasite of *Rhipicephalus sanguineus* Latreille in Texas and recorded it also as having been reared from *Dermacentor parumapertus marginatus* Banks collected at Green Valley, Calif.; from *R. sanguineus* at Monterey, Mexico; and from the same host taken at Lourenço Marques, Portuguese East Africa. E. Brumpt (*6*), in 1913, gave details of its life history in France as a parasite of *Ixodes ricinus* Linnaeus, stated that it also attacked *Haemaphysalis concinna* Koch in nature, and reared it experimentally through *Dermacentor reticulatus* Fabricius, *D. venustus* Banks (=*andersoni* Stiles), and *R. sanguineus.* A paper by A. E. Shipley (*7*) in 1914, entitled "Insects and War," mentioned *Ixodiphagus caucurtei* as a ubiquitous enemy of all kinds of ticks. In 1915 A. da Costa Lima (*8*) recorded the taking of *Hunterellus hookeri* at Rio de Janeiro, Brazil, as a parasite of ticks on a dog. Nuttall, Warburton, and Cooper (*9*) in their monograph of ticks mention the parasite records by Howard and Brumpt. In 1922 P. H. Timberlake (*10*) exhibited before the Hawaiian Entomological Society specimens of *hookeri* said to have been taken on a dog at Coimbatore, South India, and in 1923 G. N. Wolcott (*11*) recorded the species infesting *Dermacentor nitens* Neumann in Porto Rico.

R. A. Cooley (*12*), in 1927, gave an account of the introduction of *I. caucurtei* into the United States at Naushon Island, Mass., for the purpose of combating the dog tick, *Dermacentor variabilis* Say, and outlined plans for its introduction into Montana to combat the Rocky Mountain spotted fever tick, *D. andersoni* Stiles. A very similar paper, published the same year by Cooley (*12a*), further discussed the same subjects and gave a brief review of literature together with a summary of the life history of the French parasite. The following year F. Larrouse, A. G. King, and W. B. Wolbach (*13*) contributed a short account of the Naushon Island experiment in which the introduced parasite was shown to have survived the New England winter, field collections of both *D. variabilis* and *Ixodes scapularis* Say having yielded the parasite. The same year Cooley (*14*) stated that under certain circumstances this parasite would oviposit in fed larvae of *D. andersoni*, but that when eggs were deposited in a larva development was delayed until the tick reached the nymphal stage. A series of articles published in 1929 in the Seventh Biennial Report of the Montana State Board of Entomology by R. A. Cooley (*15, 16*), Fred A. Morton (*17*), and J. R. Parker and W. J. Butler (*18*) discussed various phases of the tick-parasite work at the Hamilton laboratory and reviewed the previous work of others. The previous record by Wood of *Rhipicephalus sanguineus* as host to *Hunterellus hookeri* at Lourenço Marques, Portuguese East Africa, was stated by Cooley (*16, p. 17*) to refer to *R. evertsi* Neumann instead of *sanguineus* and two new distribution records based upon material in the United States National Museum were cited, viz.: Indo-China, bred from dog tick by E. Roubaud; and Havana, Cuba, from unidentified nymphal ticks collected by Dr. Etchegoyhen. Later in the same year Cooley (*19*) gave a short summary of tick parasite studies and recorded the rearing of what was probably *H. hookeri* from *Haemaphysalis leachi* (Audouin) collected at Durban, Natal, and from *Hyalomma aegyptium impressum* Koch taken in the Pretoria district of South Africa. The article already referred to as having been published in 1930 by Cooley (*20*) states that a parasite closely related to and possibly identical with *caucurtei* had been discovered in the Transvaal preying on *Hyalomma aegyptium* Linnaeus. In 1931, C. B. Philip (*22, 23*) announced the rearing of *H. hookeri* from nymphs of *R. sanguineus* taken on dogs at Apapa, near Lagos, Nigeria, in West Africa. A paper by J. MacLeod (*24, p. 398*) in 1932 on the bionomics of the sheep tick, *Ixodes ricinus*, stated that over a thousand nymphs of this tick taken in England showed no parasitization by *I. caucurtei* or any other species. In 1933 Cooley (*25*) again discussed briefly the work with *I. caucurtei* in Montana.

From this brief review of the literature it will be seen that *Hunterellus hookeri* is known to attack a large number of species of ticks and that it has been recorded from Texas, California, Massachusetts, Montana, Cuba, Puerto Rico, Mexico, Brazil, France, Portuguese East Africa, Natal, the Transvaal, Nigeria, Indo-China, and India. Specimens representative of all of these locality records except the ones from Mexico, Brazil, Natal, Transvaal, and Nigeria are now in the National Museum collection and have been reviewed in the preparation of these remarks. The same collection contains specimens representing the following as yet unpublished records: A large series of specimens from South Miami, Fla., reared from *Rhipicephalus sanguineus* in 1931, under Bishopp Nos. 18033, 18184, 18187 and 16097; two specimens from Charleston, S. C., reared from *Dermacentor variabilis*, Oct. 15, 1931, under Bishopp No. 18183; and one specimen from Ravalli County, Mont., said to have been reared from the nest of a magpie by W. L. Jellison, June 3, 1932. To these may be added the record already referred to in the discussion of *Ixodiphagus texanus*, of *Hunterellus hookeri* reared from *Ixodes hexagonus* var. *cookei* taken at Mayfield, Idaho, on a woodchuck.

The wide distribution of this species may be accounted for by its propensity for attacking the ticks of domesticated animals, especially dog ticks. In view of this well authenticated habit, it seems reasonable to suspect that its distribution may be even more general than indicated by the foregoing records, and the suggestion is offered that before further attempts to introduce the species into other regions or areas are undertaken, careful investigation should first be made to determine whether or not the species is already present in the area under consideration.

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A REVIEW OF JAEGER'S "THE CALIFORNIA DESERTS."

"The California Deserts," by Edmund C. Jaeger, 12 mo. cloth, 207 pp., illus., maps, bibliog. Stanford California University Press, 1934. $2.00.

While the greater portion of the subject-matter of this volume is not primarily of entomological interest, it is given notice here because it contains not only an exceedingly interesting discussion of the outstanding desert insects and their near relatives, (chapter 5, pp. 45–66 inc., 10 illus.) but also records considerable ecological and other information concerning arid region insects. Among the principal insects considered are specialized desert forms of grasshoppers, (*Bootettix argentatus* and *Anconia integra*); crickets (*Nemobius mexicanus*); termites (*Amitermes arizonensis* and *Reticulotermes tibialis*); scales (*Tachardiella larreae* and *Cerococcus quercus*); leafhoppers (*Oncometopius lateralis*); cicadas (*Diceroprocta apache*); robber flies (*Rhapionidas xanthos*); black flies (*Leptonops kerteszi* var. *americanus*); salute flies (*Hippaletes flaviceps*); horse flies (*Tabanus punctifer*); mosquitoes (*Culex quinquefasciatus*, *Anopheles pseudopunctipennis*, *Theobaldia inornata*, and *Psorophora* spp.); darkling beetles (*Eleodes* spp.); inflated beetle (*Cysteodemus armatus*); ants (*Messor pergandei*, *M. andrei*, *Pogonomyrmex barbatus*, *P. occidentalis* and *Myrmecocystus mexicanus*); mutillids (*Dasymutilla satanus*, *D. arenivaga* and *D. gloriosa*); butterflies (*Papilio multicaudata*, *Pieris beckeri*, *P. sisymbrii*, *Euchloe creusa lotta*, and others); and moths (*Eucaterva variaria*). Related forms under consideration include scorpions, pseudoscorpions, spiders, mites, millipeds and the like. There are also included discussion of effects of prolonged heat and extreme droughts on various insects and on their eggs, the curious summer sleep called aestivation, and related themes. Rich in information about deserts and desert life, and written in a sympathetic vein by one who gives abundant evidence of possession of an ample fund of experience pertaining to his subject, the book will prove to be a useful one to all desert habitues. —*J. S. Wade.*

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PROCEEDINGS OF THE

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THE GENUS MANSONIA (CULICIDAE) IN THE AMAZON VALLEY.[1]

By RAYMOND C. SHANNON.

The present communication is based on material collected during a general mosquito survey in the Amazon region from the latter part of March to the end of June, 1931.

The species of *Mansonia* of the Amazon are of particular interest; they are the most troublesome of the wild mosquitoes of the region and doubtlessly are to be included among the outstanding pests of the country, so frequently alluded to by travellers. One species in particular, *M. indubitans*, is very troublesome at times, and at Iquitos, Peru, it invades houses to such an extent as to be as annoying as both *Stegomyia* and *Culex fatigans* combined. On the whole, however, mosquito pests were not found to be as troublesome along the Amazon as they are in certain other parts of the world, but this may have been due to the season.

All but two of the known Brazilian species of *Mansonia* were collected during the course of the survey; in addition, two species (*flaveolus* and *nigricans*), which were hitherto known only from the northern part of the continent and from the West Indies, were obtained. The commonest and most widely spread species of the genus (*titillans*) was not found, although it has previously been reported from the Amazon. The other species not found (*chrysonotum*, Peryassú) is known, to date, only from the coastal States of Brazil.

SYSTEMATIC NOTES ON THE SPECIES OF THE SUBGENUS MANSONIA.

The male terminalia of the species.—These organs are very distinctive in *M. amazonensis* and are fairly so in *M. humeralis*. Among the other species which form the *titillans* complex,

[1] The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation. The writer wishes further to acknowledge the opportunity granted him by the officials of the U. S. National Museum and the U. S. Bureau of Entomology, to study the Culicidae in the U. S. National Collection.

however, they are very uniform. The style appears to be the only structure showing distinctive differences. Unfortunately, the differences are small and it is necessary to place the organs consistently in the same position in order to avoid misinterpretations.

Howard, Dyar, and Knab (1912) have figured the terminalia of *M. titillans* Wlk.) and *M. flaveolus* (Coq.); the distinguishing features, however, are poorly indicated. Later, Dyar (1918) reexamined those of *M. flaveolus* and concluded that the species was a homonym of *M. titillans*. In 1928 he stated that it was merely an aberration of *M. titillans*. Bonne & Bonne-Wepster (1925) give an accurate illustration of *titillans*. These authors were also the first to describe the terminalia of *amazonensis* (Theo.).

Costa Lima (1929) gives the first illustrations for *M. pseudotitillans* (Theo.) and in addition gives photographic reproductions of the terminalia of *M. amazonensis* and *M. humeralis*, although the latter is stated to be *M. titillans*.

Dyar (1928) gives a figure of what he considered to be the terminalia of *M. humeralis*, Dyar & Knab. An examination of the specimen from which the illustration was made, however, discloses the fact that what he had was a typical specimen of *M. titillans*. This specimen was one of a series collected at Barranquilla, Colombia, which included a number of female *M. humeralis*, *M. titillans*, and what appears to be a new species closely related to *M. titillans*. Dyar made two slide mounts from this material, one of which he labeled *M. titillans*. The style of this specimen is much broader than in the true *M. titillans* (See Chart I, Fig. 4) and may prove to be an undescribed species. Because the second specimen differed from the first he evidently considered it to be the male of *M. humeralis*, which at that time was unknown. The only figure extant for the terminalia of *M. humeralis* is, therefore, that given by Costa Lima (1929), which, as stated above, he presented under the name of *M. titillans*.

Key to the Species of the Subgenus *Mansonia*.

Adult Females.

1. Hind tibia rather strongly ciliate, at least on basal half, the girth appearing a little larger than that of the femur; anterior corners of the mesonotum with reddish brown areas clothed with golden scales........*humeralis* Dyar & Knab

   Hind tibia not distinctly ciliate, the tibia appearing more slender than the femur........2

2. Abdomen covered entirely with bright golden scales; mesonotum generally yellowish brown, clothed with golden scales and isolated

patches of dark scales; palpi of the female exceeding one-half the length of the proboscis .... *flaveolus Coquillett*

Abdomen mostly dark scaled; palpi of female less than one-half the length of the proboscis 3

3. Anterior portion of mesonotum reddish brown, clothed with small golden scales .... *amazonensis* Th.

Mesonotum entirely reddish or dark brown, with sparse golden scales 4

4. Antenna a little longer than the proboscis; palpi more than one-third the length of the proboscis. A rather large species .... *pseudotitillans* Theo.

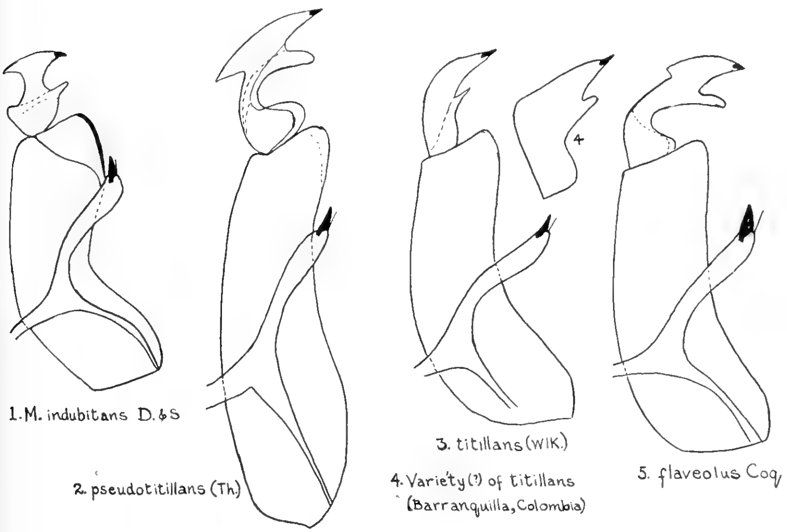
Antenna a little shorter than the proboscis 5

5. Palpi about one-third the length of the proboscis. Small to moderate in size .... *titillans* Walker

Palpi about one-fourth the length of the proboscis. Uniformly small species .... *indubitans* Dyar & Shannon

M. titillans and *indubitans* are difficult to distinguish one from the other. In addition to the characters given in the key it may be noted that the last palpal segment (a minute organ) is more conspicuous in *pseudotitillans*, intermediate in *titillans* and very small in *indubitans*.

CHART.



Inside view of the right side-piece and appendages of the terminalia of the species of the Subgenus *Mansonia*. All drawn to the same scale.

Mansonia (M.) titillans (Walker) 1848.

This species was not found by the writer in the Amazon region. It has been reported from there on several occasions but the records, in at least some of the cases, appear to be erroneous.

(1) Goeldi (1905) gives descriptions and colored illustrations. These appear to be based on specimens of *M. humeralis*. He also reproduces photographs of "*titillans*" in the act of ovipositing. Quite obviously the specimen shown belongs either to *Psorophora confinnis* (L. A.) or *P. cingulata* (Fabr.), both of which closely resemble species of *Mansonia*.

(2) Converse (1914) states that larvae of *M. titillans* are found in millions in the pools along the open ditches of Iquitos. Most probably the larvae referred to belong to *Psorophora confinnis* or *P. cingulata*. The writer found great numbers of these larvae in roadside ditches, etc., about Iquitos.

(3) Bequaert (1926) records *M. titillans* from Manáos. It is probable that they belong to *indubitans*.

(4) The *M. titillans* reported by Costa Lima from Obidos and Santarem, belong, at least in part, to *humeralis*.

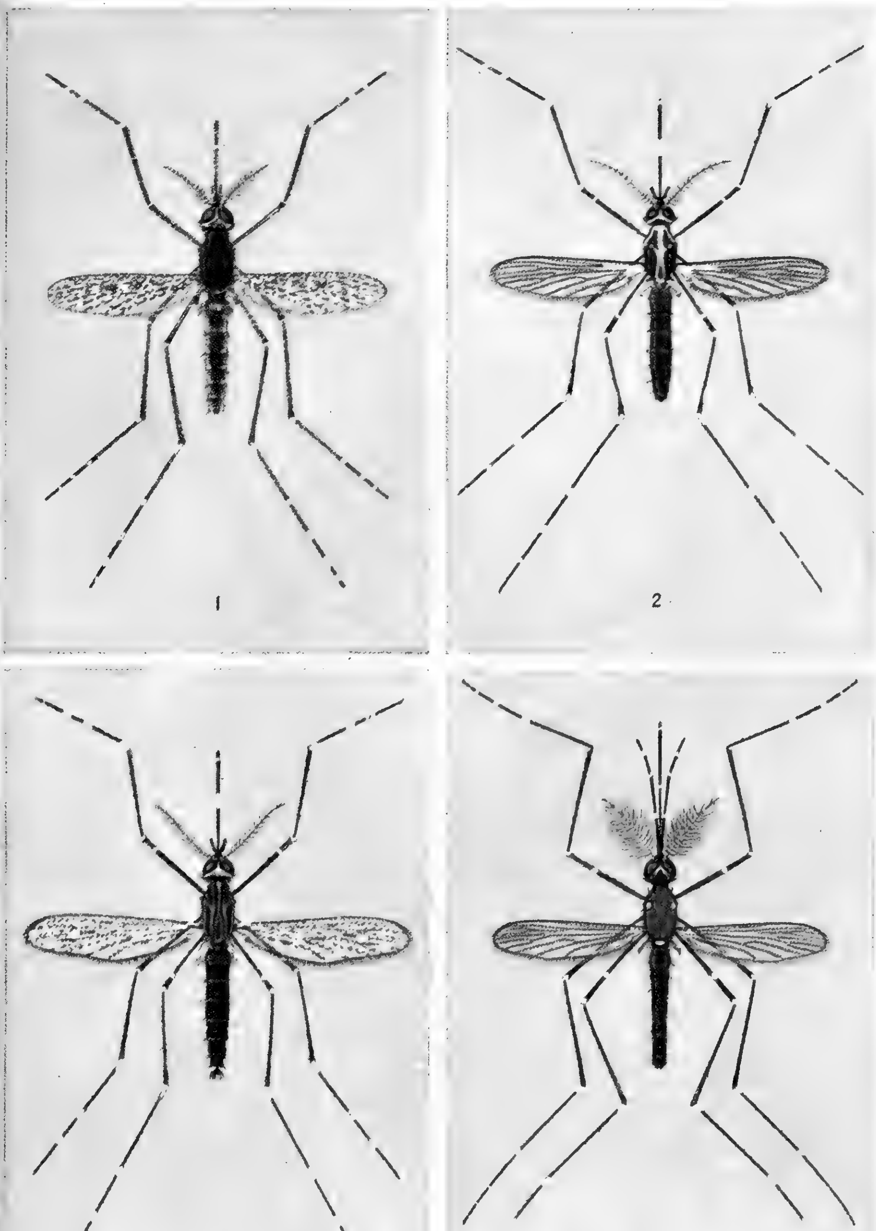
(5) Newstead & Thomas (1910) and Gordon & Evans (1922) also record *M. titillans* from the Amazon.

No doubt the species does occur in at least some part of the valley.

Mansonia (M.) indubitans Dyar & Shannon, 1925.

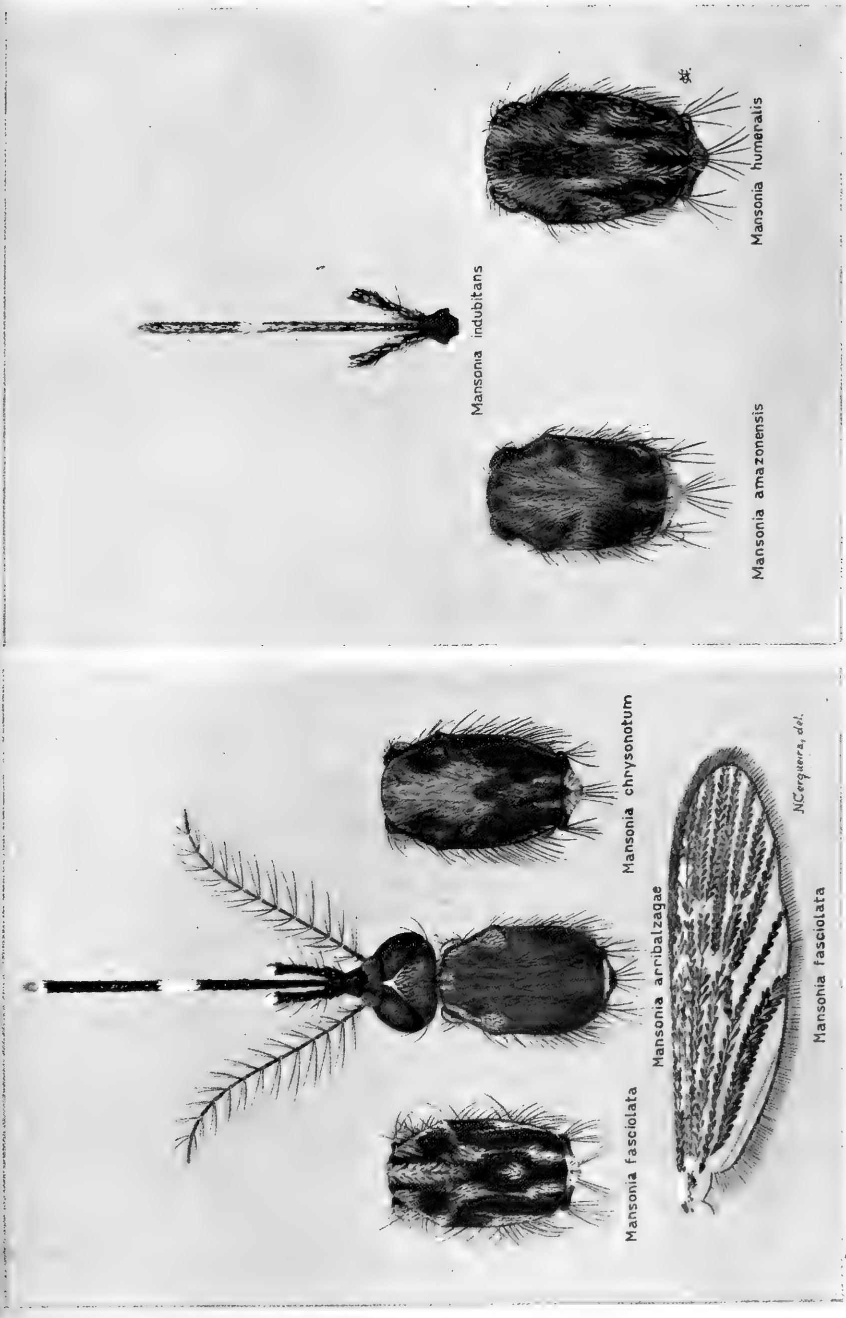
M. indubitans has been described from females collected by Bequaert on the Amazon at Belém, Santarem, and Itacoatiará, and at Carmo, Rio Branco. Several specimens, including three males, were collected at Tonantins. In April, 1931, it was extremely abundant at Iquitos where it invaded the houses along the river front in large numbers. Owing to its numbers, its fearlessness in attack, and its activity at all hours of the day and night, it appears to be fully as troublesome indoors as both *stegomyia* and *Culex fatigans* combined. Very probably it has a seasonal abundance and therefore may not be so annoying at other seasons of the year. In fact, the mosquitoes were most in evidence several days after a heavy rain, following which they diminished rather rapidly in numbers. Usually, *M. indubitans* was the most abundant species collected on animal bait and on such occasions many individuals were observed to attack other mosquitoes and from them suck out the blood which had already been imbibed from the horse; the victimized mosquito meanwhile continued to feed until it had acquired another meal.

No *Pistia* was found growing about Iquitos; in fact this plant was not observed on the Amazon above the mouth of the Rio Javary. The roots of other aquatic plants were searched for larvae but without success.



Drawings by Nelson Cerqueira.

1. MANSONIA (MANSONIA) TITILLANS.
2. MANSONIA (RHYNCHOTAENIA) ALBICOSTA.
3. MANSONIA (RHYNCHOTAENIA) JUSTAMANSONIA.
4. MANSONIA (RHYNCHOTAENIA) LYNCHI.


Mansonia humeralis
Mansonia indubitans
Mansonia amazonensis
Mansonia chrysonotum
Mansonia arribalzagae
Mansonia fasciolata
N.Cerqueira, del.
Mansonia fasciolata

The species was also found at Manáos, Guajara-Mirim, Porto Velho, and Fordlandia, and in the coastal state of Bahia.

Mansonia (M.) pseudotitillans (Theo.) 1901.

This species was found only at Teffé and at Tonantins. Several males were collected at night on board a boat at the latter locality. It has been recorded by Costa Lima from Santarem and Obidos, and is known to occur in Surinam.

Mansonia (M.) flaveolus (Coquillett) 1906.

This species has been known to date only from a few specimens collected in widely separate regions. A single male was collected in St. Thomas, W. I., in 1906 (A. Busck) and a single female was found in Panama, 1912 (A. Busck). It was subsequently placed by Dyar (1918) as a homonym of *M. titillans* and in 1928, Dyar adds: "A light yellow form occurs rarely, aberration *flaveolus* Coquillett." In addition, Bonne and Bonne-Wepster (1925) record two males and one female of *M. flaveolus* (as a variety of *titillans*) from Paramaribo, Dutch Guiana.

In view of the history of this species and the great distances between its known points of distribution, the discovery of *M. flaveolus* in the Amazon Basin is of unusual interest. A series of thirty specimens, including three males, was collected at Teffé and at Tonantins, all on board ship, in company with *M. pseudotitillans*, *indubitans*, and *amazonensis*. In addition to the slight differences in the male terminalia as compared with the other species, there is a striking difference in coloration and in the length of the female palpi. These characters are listed in the key to species.

Mansonia (M.) amazonensis (Theobald) 1901.

As far as is known, the present species has not been found outside the Amazon Valley. The specimens collected were one male and one female from Tonantins, and one female from Manáos. They were recorded by Bequaert from Belém, and Gordon & Evans from Macopa. Costa Lima states that he found the species to be very abundant at Obidos and at Santarem. A series of specimens was collected by N. C. Davis at Belém.

Mansonia (M.) humeralis Dyar & Knab, 1916.

Next to *M. titillans* this species has the greatest known range of any of the subgenus. It has been recorded by Dyar (1928) from Colombia, Venezuela, British Guiana, and the Amazon region. It also occurs in the middle coast states of Brazil. New Amazon records are: Iquitos, Peru (April); Guajara-Mirim, Matto Grosso (May); Manáos, Amazonas (June). Only females were captured.

Species of the Subgenus **RHYNCHOTAENIA.**

Six of the eight known species of this subgenus were found. These are all included in the key to the species given by Shannon (1931).

Mansonia (R.) nigricans (Coquillett) 1904.

Hitherto recorded only from Cuba, Panama, Colombia, and Venezuela. Three females were collected at Iquitos, Peru (April).

Mansonia (R.) albicosta (Peryassú) 1908.

Two females from Iquitos, Peru, and two from the Rio Madeira, Guajara-Mirim. Also from Xerem and Belém, Pará (Bequaert, 1926). It occurs likewise in the coastal states of Brazil, but has not been reported outside the country.

Mansonia (R.) justamansonia (Chagas) 1907.

Four females from Iquitos, Peru, and one from Guajara-Mirim, Matto Grosso. It is also found in the coastal States but has not been recorded outside Brazil.

Mansonia (R.) fasciolata (Lynch Arribalzaga) 1891.

=*Mansonia venezuelensis* (Theobald) 1912.

This species appears to be the dominant one of the subgenus, occurring from Central America to Argentina; it frequently outnumbers, in point of individuals, all the others combined. It was common at Iquitos, nine males as well as a large series of females being captured. A few specimens were taken at Manáos. Bequaert and Davis have also collected it at Belém, Pará.

Dyar (1928) states that *M. venezuelensis* differs from *M. fasciolata* in the possession of light scales on the anterior margin of the wing. However, this is a common characteristic of both species. A comparison of material in the U. S. National collection of both species disclosed no essential difference.

Mansonia (R.) arribalzagae (Theobald) 1903.

Although this species has a wide distribution, Panama and Surinam, as well as the Amazon region, it is regarded as a rare species. It was fairly abundant in heavily forested areas about Iquitos, fifty-four specimens being collected. Males were found rather commonly flying about the jungle, and seventeen of them were net-captured. The species occurs in Panama and is also recorded by Gordon & Evans from the vicinity of Manáos, Amazonas.

Mansonia (R.) lynchi Shannon, 1931.

This species has previously been known only from the type specimens, two males and two females from Belém, Pará (N. C. Davis). They were collected with larger numbers of *M. arribalzagae*. The two species, which closely resemble one another, differ markedly in adult coloration from the other species of the subgenus. Two males and two females of *M. lynchi* were found in the same forested areas about Iquitos in which *arribalzagae* occurred. Both species appear to be primarily day fliers.

SUMMARY.

Eleven species of the genus *Mansonia* were collected in the Amazon region (April, May, and June, 1931); five belong to the subgenus *Mansonia: indubitans*, D. & S., *pseudotitillans* (Th.), *flaveolus* (Coq.), *humeralis* D. & K., *amazonensis* (Th.); and six to the subgenus *Rhynchotaenia: nigricans* (Coq.), *albicosta* (Pery.), *justamansonia* (Chagas), *fasciolata* (L. A.), *lynchi* (Shan.), and *arribalzagae* (Th.). *M. flaveolus* (here removed from *titillans* as a homonym) and *nigricans* were previously unrecorded from Brazil. Two Brazilian species, *titillans* (the commonest and most widespread species of the genus) and *chrysonotum*, were not found, although the former has been recorded a number of times from the Amazon. All of the records for *titillans*, however, are possibly erroneous, although in all probability the species is to be found somewhere in the valley.

M. indubitans is the commonest and most annoying species occurring in the region. In Iquitos, Peru, it invades the houses in such large numbers that it is frequently as troublesome as the two domestic species (*Stegomyia* and *C. fatigans*) combined. Doubtlessly this species is to be classed as one of the outstanding pests of the region so frequently alluded to by travelers; but its annoyance probably is not so great as that caused by mosquitoes in many other parts of the world.

A new key is given for the American species of the subgenus *Mansonia* and the characters of the male terminalia are discussed.

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TWO NEW GENERA AND SPECIES OF PHLÆOTHRIPIDÆ (THYSANOPTERA).

By J. Douglas Hood, *University of Rochester.*

The two new genera described below are unusual in that they are heavily sculptured and have seven-segmented antennæ. The types are in the author's collection.

Genus STEGOTHRIPS nov.

(*στέγος*, a roof; Θρίψ, a wood-worm—in allusion to the form of the dorsum of the head.)

Body reticulate and tuberculate dorsally, non-shining. Head much longer than wide, very deeply reticulated above; *dorsum strongly elevated and arched* as seen from the side (Pl. 17, fig. 4), *angulate and roof-like when observed from the front; ventral surface concave;* vertex rounded, slightly produced and overhanging, bearing the forwardly-directed median ocellus at its extremity, *without strong setæ; eyes normal in position*, small, rounded, finely-facetted, larger on ventral surface of head, and *strongly protruding;* postocular setæ moderately long and stout, expanded at tip, arising from low tubercles; *antennæ 7-segmented but with a distinct suture on ventral surface* between morphological seventh and eighth segments, intermediate segments short, subglobose, pedicellate, with long sense-cones; mouth-cone heavy but acute, surpassing base of prosternum. *Prothorax short and broad* (*in the genotype much less than half as long as head*) with a deep transverse groove across middle, this groove with a fovea at either end; pronotum minutely tuberculate, anterior margin curved, *posterior margin straight; epimeron largely fused with pronotum;* all major setæ present, stout, expanded distally, and arising from slight eminences; legs tuberculate, short; female with fore tarsus unarmed on inner surface but *with a strong downwardly-directed claw on outec surface at apex of first segment* (much as in many Urothripidæ); *wings abruptly bent outward at middle* but not narrowed beyond, *fore pair with the basal portion tuberculate*, no accessory setæ. Abdomen with its segments short and transverse, in long-winged forms with a shallow longitudinal groove for the reception of the wings, the major setæ on terga II–VIII (excepting the wing-retaining ones) short, stout, and apically dilated, those on IX much longer; tube long (in the genotype more than three times the length of tergum IX), *thickened at sides*, and constricted at apex, with short terminal setæ.

Genotype.—Stegothrips barronis sp. nov.

Stegothrips would appear at first glance to take its proper place in the Tribe Docessissophothripini, instead of in the Phlæothripini where I have assigned it. The type-genus of the former tribe has the occipital region of the head elevated much as in the present genus; in fact, the similarity in this respect between *Docessissophothrips titschacki* Priesner and *Stegothrips barronis* is so close that the conclusion that they are related is almost inescapable.

However, similarly elevated heads are found in such widely different genera as *Megalothrips*, *Phlœobiothrips*, and *Trichothrips;* but in the last genus they occur *only in those species whose heads and mouth-spines have become elongated.* The long, crested head has apparently been derived independently in several different portions of the Tubuliferous series as the result of mechanical necessity, so to speak, *this being the only practicable method for increasing the length of the mouth-spines without decreasing the angle of their penetration.* The character seems to be purely an adaptive one and of no phylogenetic significance whatever.

This genus is related to *Strepterothrips* Hood and to the new genus described below, both of which it resembles in such structural features as wing-form, the number of antennal segments, the general build of the abdomen (with its dorsal furrow, in long-winged forms, for the reception of the wings), the long tube, dilated setæ, and dorsal sculpture. The italicized portions of the diagnosis given above should serve, however, to distinguish it readily.

Stegothrips barronis sp. nov.

(Plate 17, Figs. 1–5.)

Female (macropterous).—Length about 1.5 mm. (distended, 1.8 mm.). Color, by *reflected* light, blackish brown in head (black under low magnifications), with median line of head brown behind eyes and about concolorous with remainder of body; pterothorax paler at sides of notal plates, abdomen irregularly paler along sides of terga II–VIII and in segment I, tube brownish orange and tipped with black; subhypodermal pigmentation of two colors, white and red, the former producing a conspicuous white spot where it shows through the membrane between head and pronotum, a small white spot at anterior margin of mesonotum, and a whitish spot, more or less variegated with the red pigmentation and interrupted by tergum I of abdomen, along sides and posterior margin of metanotum; antennæ brown in segment I (apex slightly paler), clear lemon-yellow in II and III, blackish brown in IV–VII; legs blackish brown, paler than head, with distal ends of all femora and proximal ends of all tibiæ yellow, tarsi brownish yellow, with darker brown cups. By *transmitted* light the white markings are not visible; wings pale brown, the fore pair darker in distal half and in anal area ("scale"), with two narrow pale streaks in the bend of the wing, one near each margin; hind wings with a pale median line extending to near tip, in bend margined narrowly with nearly black and with a minute clear spot near posterior margin.

Head (Pl. 17. fig. 1) about 1.77 times as long as greatest width, as broad at basal third as across basal collar and 0.93 as wide at narrowest place between, the cheeks nearly straight and converging to eyes, where they are rather abruptly narrowed and only 0.8 as broad as at widest part; dorsum of head roof-like, very strongly elevated along median line, where it is nearly carinate, much arched as seen from the side (Pl. 17, fig. 4), angulate and almost roof-like when observed from the front, heavily polygonally reticulate (excepting along the nearly smooth median line) with raised dark lines which in profile (as on the cheeks) appear as tubercles, and with a number of distinct setigerous tubercles which are more numerous and best seen along the cheeks, the smooth median area narrow and bordered on either side with a very regular row of 8–10 slender pointed setæ; postocular setæ strong, dilated at apex, 54 μ long, arising slightly in advance of posterior margin of eyes, and 1.44 times as far apart as the latter, the measured interval between their bases 101 μ; vertex at a much lower level than highest part of occiput, evenly rounded and slightly overhanging, bearing the forwardly-directed anterior ocellus at its extremity, without strong setæ, but with four pairs of short setæ, one of these directly between posterior ocelli, one almost directly beneath them at sides of vertex close to eyes, one laterad of median ocellus, and one about midway between this last pair and the first mentioned; ocelli about 17 μ in diameter, the posterior pair 45 μ apart, the median one 15 μ in advance of front margin of eyes. *Eyes* normal in position, strongly protruding, but small, little more than one-fifth as long as head, about 1.5 times as long as wide, and nearly two-thirds as wide as their interval. *Antennæ* (Pl. 17, fig. 2) hardly 1.1 times as long as head, segment VIII fused with VII to form a large lanceolate and pedicellate segment which is the longest in the entire antenna and has an incomplete transverse suture on ventral surface; most of the segments roughened by distinct raised lines of sculpture; sense-cones moderately long and slender, segments III, V, and VI each with one on either side of apex, IV with two on either side, morphological seventh segment with the usual dorsal one.

Prothorax (Pl. 17, fig. 1) along median dorsal line of pronotum only 0.33 (!) as long as head and (inclusive of coxæ) three times as broad as long, without median thickening, but with a deep transverse groove across middle, this groove with a large irregular fovea at each end; anterior margin of pronotum emarginate, elevated at median line, posterior margin straight; surface of pronotum and epimeron with numerous small tubercles, the latter sclerite almost completely fused with pronotum; all major setæ present, stout, expanded distally, and arising from distinct eminences, the anterior marginals 30 μ, anterior laterals 36 μ, midlaterals 27 μ, epimerals 54 μ, posterior marginals 37 μ, coxals 30 μ; mesonotum tuberculate like prothorax, metanotum with the tubercles larger and more rounded. *Legs* short and stout, roughened by numerous low anastomosing rugæ and many setigerous tubercles; fore tarsus without tooth or claw on inner surface but with a strong downwardly-directed claw on outer surface at apex of first segment. *Wings* bent abruptly outward at middle (where they are slightly narrower than elsewhere), but not widened distally, the fore pair without vestige of longitudinal vein; basal portion of fore wing tuberculate in the region of the three subbasal setæ, these equal in length (27 μ long), stout, flaring outward from base, and arising from low tubercles; distal two-thirds of fore wing roughened; no accessory setæ.

Abdomen broadest at segment II, equal in width to pterothorax, with a longitudinal furrow for the reception of the wings, this furrow at sides in each of terga II–VII with two pairs of brown wing-retaining setæ, of which the posterior pair is in every case longer, broader, flatter, and less abruptly curved at extreme base; posterior margins of these same terga each with two pairs only of major setæ, both of them stout, dilated and divided at apex, arising from tubercles, and pale in color, the inner pair longer and stouter than the outer, on tergum V thei nner pair 65 μ and the outer pair 42 μ; tergum VIII (Pl. 17, fig. 3) with the outer pair 75 μ, stigmata borne on low tubercles; IX (Pl. 17, fig. 3) with the dorsal pair of setæ 135 μ and knobbed at tip, the upper lateral pair 240 μ and pointed; tergum I with the middle portion subrectangular and much longer than wide; tube large, two-thirds as long as head, formed and sculptured as shown in Pl. 17, fig. 3, about 2.7 times as long as greatest subbasal width and 2.5 times as broad near base as at apex, its longest terminal setæ 100 μ, its sides thickened; entire dorsum of abdomen in segments II–VIII and basal portion of IX lightly sculptured with anastomosing lines which are weaker in the distal half of the dorsal furrow in each of segments II–V and also in the lateral portions of III–VII at base, prolonged into dark asperæ at sides of segments and also across base of segment II, some of the dark points projecting beyond posterior margins of sides of segments II–VIII and of middle of IX.

Measurements of holotype (♀): Length about 1.51 mm. (distended, 1.82 mm.); head, length 0.307 mm., greatest width (near base) 0.173 mm., width at basal constriction 0.161 mm., least width (at posterior margin of eyes) 0.137 mm., width across eyes 0.158 mm.; eyes, length 0.067 mm., width 0.045 mm., interval 0.070 mm.; prothorax, median length of pronotum 0.103 mm., width (inclusive of coxæ) 0.308 mm.; pterothorax, greatest width 0.313 mm.; abdomen, greatest width 0.312 mm.; tube (length of segment X only) 0.207 mm., width near base 0.077 mm., width at apex 0.031 mm.

Antennal segments:	1	2	3	4	5	6	7
Length (μ):	35	53	53	51	44	42	58
Width (μ):	32	33	31	33	29	25	23

Total length of antenna, 0.336 mm.

Described from one female taken on Barro Colorado Island, Canal Zone, Panama, 1933 (probably in October), by Silvestre Aviles, from a branch of sour orange [Hood No. 1075]. The specimen was transmitted by Mr. James Zetek.

Genus **ARCYOTHRIPS** nov.

(ἄρκυς, a net; θρίψ, a wood-worm—in allusion to the net-like reticulation of the head and pronotum.)

Body reticulate dorsally, non-shining. Head longer than wide, deeply reticulated above; dorsum somewhat elevated and arched as seen from the side; vertex rounded and slightly overhanging, bearing the forwardly-directed median ocellus at its extremity, *without strong setæ;* eyes relatively small, extending onto ventral surface in a forward direction and not at all involving sides of head; *postocular setæ very short;* antennæ 7-segmented, without trace of suture on ventral surface between morphological seventh and eighth segments, intermediate segments short, globose, pedicellate, II particularly large, III much shorter and narrower than either II or IV; mouth-cone acute, attaining base of mesosternum. Prothorax of normal form, reticulated above, with a shallow curved impression across middle and a shallow fovea on each side between mid-lateral seta and the curved anterior margin, posterior margin curved; epimeron not fused with pronotum; all major setæ present, very short, broadly expanded from base and hence somewhat fan-shaped, all arising from slight eminences; legs short, with minute tubercles, all of which are setose, and anastomosing rugæ; female with fore tarsus unarmed and without a downwardly-directed claw on outer surface at apex of first segment; wings bent abruptly outward at middle, where they are narrowest, and slightly expanded apically, fore pair with the basal portion tuberculate, no accessory setæ. Abdomen with its segments short and transverse, in long-winged forms with a distinct longitudinal groove for the reception of the wings, the major setæ on terga II–VIII (excepting the wing-retaining ones) short, stout, and dilated; tube long (in the genotype more than twice the length of tergum IX), not thickened at sides, narrowed rather than constricted at apex, with terminal setæ about half its length.

Genotype.—*Arcyothrips africanus* sp. nov.

From *Strepterothrips* this genus differs principally in lacking the two pairs of strong and very prominent expanded setæ on the vertex and occiput, and in having the postocular setæ minute.

Arcyothrips africanus sp. nov.

(Plate 18, figs. 1–4.)

Female (macropterous).—Length about 1.3 mm. (distended, 1.6 mm.). Color dark brown with head and tube blackish brown, pterothorax paler along anterior and posterior margins,[1] abdomen slightly paler along median line and distinctly so at base of segment I and in segment IX; head, thorax, and sides of abdomen with bright red subhypodermal pigmentation; legs concolorous with body, slightly paler at bases of femora, apices of tibiæ, and in tarsi; wings pale brown, the fore pair darker at tip and along anterior margin at base, with a short black median vein in bend, beyond the vein with an indistinct pale streak paralleling both margins of wing, pale in about posterior half of basal fourth; hind wings with dark median vein extending to near tip, this vein nearly black just before middle, the membrane of the wing nearly white behind it in about basal fifth and again briefly just before middle where the vein is nearly black, the wing darkest in its full width between these white areas and in distal portion; antennæ nearly blackish brown, segments IV–VII and sides of II darkest, III yellow in pedicel and pale yellowish brown beyond.

Head (Pl., 18 fig. 1) about 1.18 times as long as greatest width, broadest at posterior margin of eyes, the cheeks perfectly straight and converging between

[1] I suspect that in life this species, like all of its close relatives, is marked with white. Such markings are due to the presence in the fat body of an opaque, light-reflecting substance which disappears after a short time in alcohol or other preservatives. If this suspicion is correct, the white will certainly show through the integument along the posterior margin of the metathorax and in the first abdominal segment, and possibly also along the front margin of the mesothorax and in the membrane between the head and prothorax.

this point and one just in front of the slight basal collar, this least width 0.9 the greatest width; dorsum of head somewhat elevated and arched as seen from the side, with heavy dark lines of reticulation which give the cheeks a tuberculated appearance, and with a number of short, stout, pale setæ (many, perhaps all, of them rounded at tip) which arise from tubercles situated frequently in the middle of reticles, the reticles themselves often more or less subdivided by dark incomplete rugæ and decidedly smaller along median line of head; postocular setæ very short (about 13 μ) and stout, curved and broadened distally; vertex rounded and slightly overhanging, bearing the forwardly-directed median ocellus at its extremity, without strong setæ but with a number of short curved ones; ocelli about 13 μ in diameter, the posterior pair 43 μ apart, the median one with its posterior margin on a line with anterior margin of eyes. Eyes small, just one-fourth the length of head, a little longer than wide, and about two-thirds as wide as their interval, composed of relatively few facets, extending onto ventral surface of head in a forward, rather than lateral, direction and thus occupying the front, instead of the sides, of head. *Antennæ* (Pl. 18, fig. 2) about 1.33 times as long as head, segment VIII completely fused with VII to form a large lanceolate and pedicellate segment which is the longest in the entire antenna, no trace of a transverse suture even on ventral surface; segment III particularly small and weak; II especially large, roughened, and with subcircular sensorium elevated; III–VI with prominent transverse lines of sculpture on dorsal surface; sense-cones absent (!) from III, IV with a large one arising on outer surface of apex and extending beneath the succeeding segment and a smaller one arising ventrally on inner surface, V and VI each with a much slenderer cone on each surface and an additional minute one on outer surface, morphological seventh segment with the usual dorsal one.

Prothorax (Pl. 18, fig. 1) along median line of pronotum nearly 0.6 as long as head and (inclusive of coxæ) about 2.3 times as wide as long, without median thickening, but with a shallow curved impression across middle and a shallow fovea on each side between midlateral seta and the roundly emarginate anterior margin, the posterior margin curved; epimeron distinct; surface reticulated like that of head, with numerous short curved pale setæ arising from tubercles, posterior margin with numerous minute non-setigerous tubercles; major setæ all present, very short (13–20 μ), broadly expanded from base and hence somewhat fan-shaped, all arising from slight eminences, epimerals longest (20 μ); metanotum and posterior part of mesonotum heavily reticulated like pronotum, the anterior part of mesonotum with asperate anastomosing lines. *Legs* short and stout, roughened by numerous low anastomosing rugæ and setigerous tubercles; fore tarsus unarmed and without a downwardly-directed claw on outer surface at apex of first segment. *Wings* curving posteriorly in basal third, then recurving and continuing in the original direction, this distal portion of wing somewhat more than half the total length of wing and slightly widening to apex; basal third of fore wing closely tuberculate along anterior margin and with four or five widely separated setæ which are similar to anterior marginals, equal to them in length, and which arise from tubercles; recurved portion of wing with a median vein-like thickening, distal portion roughened but scarcely reticulated; no accessory setæ.

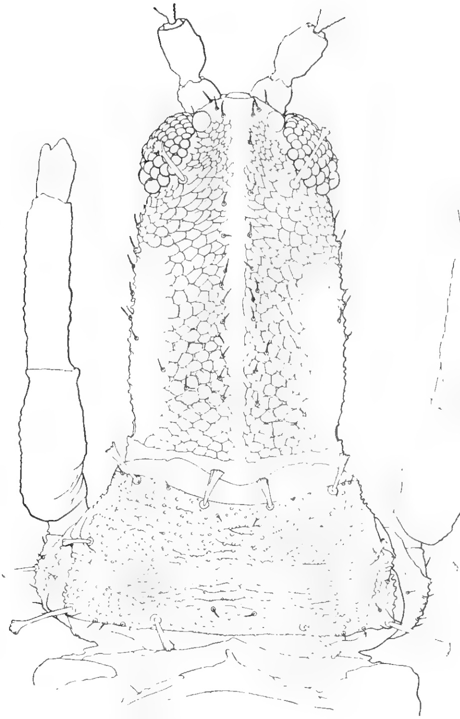
Abdomen broadest at segment III, distinctly wider than either the pterothorax or prothorax, with a longitudinal furrow for the reception of the wings, this furrow at sides in each of terga II–VII with two pairs of conspicuous dark brown wing-retaining setæ, of which the posterior pair is in every case longer, broader, flatter, and more recurved at base; posterior margins of these same terga each with three pairs of major setæ, all of which arise from tubercles and are stout, pale yellow, and divided at apex, the inner pair longest, the middle pair much the shortest and fan-shaped, the outer pair similar to the inner but smaller (on tergum V these setæ measure respectively 50 μ, 20 μ, and 32 μ); tergum VIII (Pl. 18, fig. 3) with these setæ more slender than on VII, the outer pair longer than its homologue on VII, the inner pair shorter than its, the middle pair pointed and with a companion midway between it and outer seta, one pair only of wing-retaining setæ, two pores and five (six normally?) smaller setæ between them (these forming a broad arc), and four pairs of setæ in lateral portions of tergum, the stigmata borne on low tubercles; tergum IX (Pl. 18, fig. 3) with the dorsal pair of major setæ stout and 40 μ long, the others slender and pointed; tergum I much broader than long, trapezoidal, and distinctly polygonally reticulate with dark lines; tube three-fourths as long as head, slender, formed as shown in Pl. 18, fig. 3, and three times as long as greatest subbasal width, its longest terminal setæ 133 μ; entire dorsum of abdomen in segments I–VIII and in basal portion of IX sculptured with anastomosing lines which are much weaker than those on head and prothorax, but thoroughly distinct even in the dorsal furrow, heavier, more raised and prolonged into dark asperæ at sides of segments, some of these sharp points projecting beyond posterior margins of terga II–VII.

Measurements of holotype (♀): Length about 1.3 mm. (distended, 1.62 mm.); head, length 0.212 mm., greatest width (across eyes) 0.180, least width (near base) 0.163 mm.; eyes, length 0.053 mm., width 0.046 mm., interval 0.071 mm.; prothorax, median length of pronotum 0.126 mm., width (inclusive of coxæ) 0.293 mm.; pterothorax, greatest width 0.307 mm.; abdomen, greatest width 0.323 mm.; tube (length of segment X only) 0.157, width near base 0.053 mm., width at apex 0.025 mm.

Antennal segments:	1	2	3	4	5	6	7
Length (μ):	28?	50	33	40	35	38	57
Width (μ):	25	36	27	33	32	28	23

Total length of antenna, 0.281 mm.

Described from one female taken at Amani, Tanganyika Territory (East Africa), January 27, 1928, by Dr. C. B. Williams, from a dead branch [Hood No. 460].



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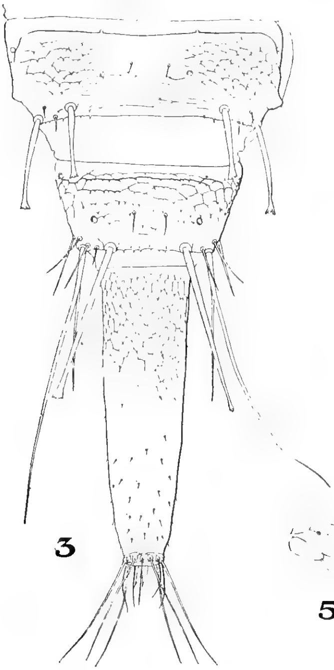

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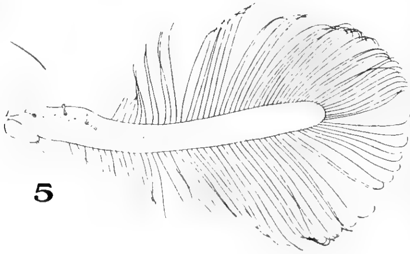

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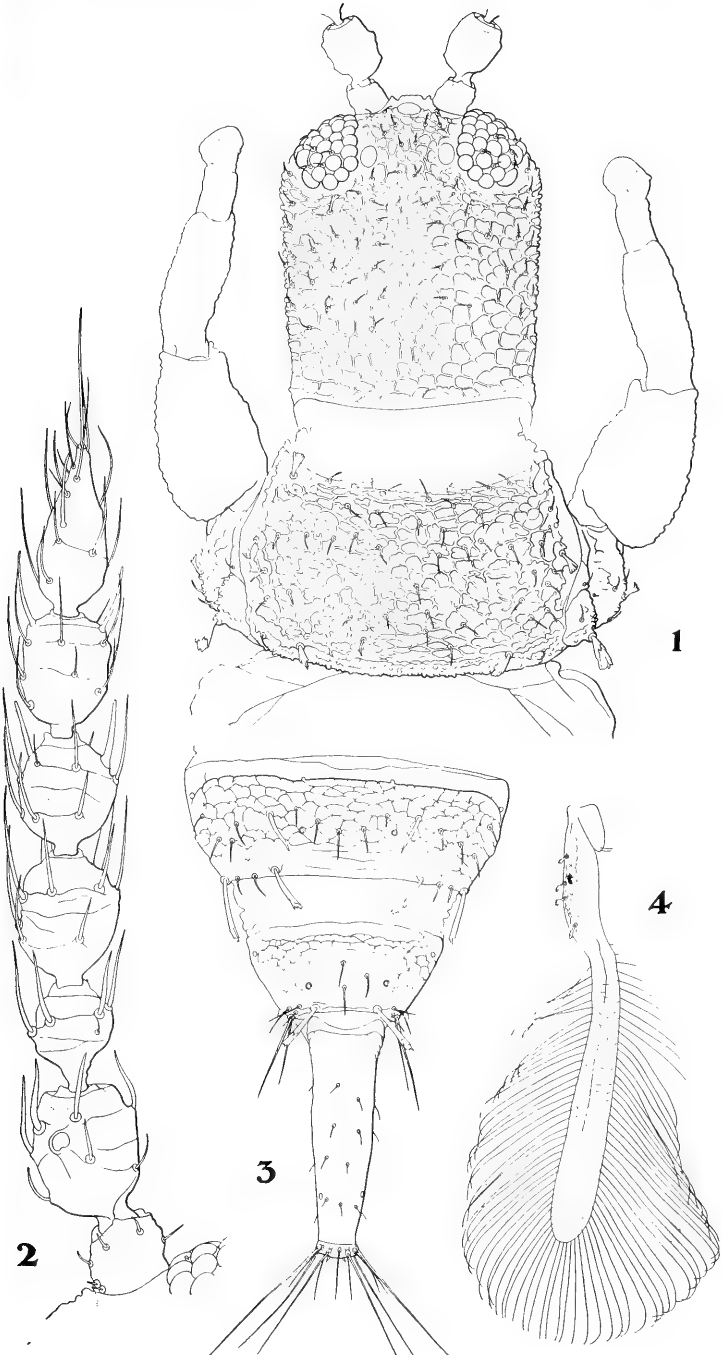
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EXPLANATION OF PLATES.

(Drawn by Miss Helen E. Rearwin; camera lucida.)

PLATE 17.

Stegothrips barronis gen. et sp. nov.; holotype, ♀.

Fig. 1. Head and prothorax; all setæ omitted from legs and antennæ; sculpture of posterior part of cheeks not shown.

Fig. 2. Right antenna.

Fig. 3. Abdominal segments VIII–XI.

Fig. 4. Head and prothorax; perspective view (*freehand drawing*).

Fig. 5. Right fore wing.

PLATE 18.

Arcyothrips africanus gen. et sp. nov.; holotype, ♀.

Fig. 1. Head and prothorax; all setæ omitted from legs and antennæ.

Fig. 2. Right antenna.

Fig. 3. Abdominal segments VIII–XI.

Fig. 4. Left fore wing.

NOTES ON MOSQUITOES FROM SOUTH AMERICA, WITH A DESCRIPTION OF A NEW SPECIES (DIPTERA, CULICIDAE).

By ROBERT MATHESON.

In several small collections of mosquitoes made by Dr. J. C. Bradley, Dr. Babiy and Dr. Forbes in various parts of South America I find some interesting records of distribution. In addition I find one quite distinct form not hitherto described.

Aedes albifasciatus Macquart.

Two males fron Ancud, Chiloe Island, Chile. One female from Butalcura, Chiloe Island, Chile. April 2–7, 1920.

Aedes fulvus Wied.

One female from El Encanto, Putumayo River, near Peru, Aug. 21, 1920; one female from Iquitos, Peru, Aug. 1, 1920.

Aedeomyia squamipennis L. Arrib.

Putumayo River, Peru, Aug. 7, 1920; Amazon River, near Peru, Aug. 9, 1920.

Culex taeniopus Dyar & Knab.

Two females, Amazon River, near Peru, Aug. 9, 1920; one male, Putumayo River, Peru, Aug. 14, 1920.

Culex putumayensis, new species.

Male.—Proboscis slender, black; palpi slender, black, the last two segments upturned, longer than the proboscis by the last two segments; last two segments not enlarged and clothed with sparse, fine, blackish hairs. Antennae almost black, each segment except the last two clothed with dense whorls of black hairs; last two segments elongate with numerous short hairs. Occiput brownish with numerous narrow, curved, yellowish scales and erect, forked, yellowish scales; sides with broad, flat, whitish scales. Prothoracic lobes widely separated with a few scales and hairs. Mesonotum brownish-yellow, clothed with very small hair-like, golden yellowish scales with bronzy reflections and scattered black setae. Scutellum trilobed with long, black hairs and golden yellow scales on the lobes. Postnotum nude, dark brown. Abdomen densely clothed with black scales which give a bluish reflection in certain lights; basal white bands distinct and prominent except on the first and second and the last two segments; last two segments with prominent white lateral spots; venter brownish scaled with distinct basal whitish bands on the last four segments. Legs entirely black, the scales giving a metallic bluish reflection in certain lights. Wings with broadly ovate and narrow, brownish scales. Halteres with dark brown knobs, yellowish on basal part.

Hypopygium (Figure 1).—Side-piece somewhat longer than wide, stout, clothed with scales and long spines; shorter spines on the lower surface. Apical lobe divided; base of inner lobe columnar, not divided and bears two elongate, parallel distorted filaments,—one hooked and the other sharply pointed; outer division columnar and bears a broad, angularly hooked filament, a stout spine, two peculiar spatulate structures supported on their outer sides by thickened borders, and a single short spine. Clasper a little more than one-half as long as

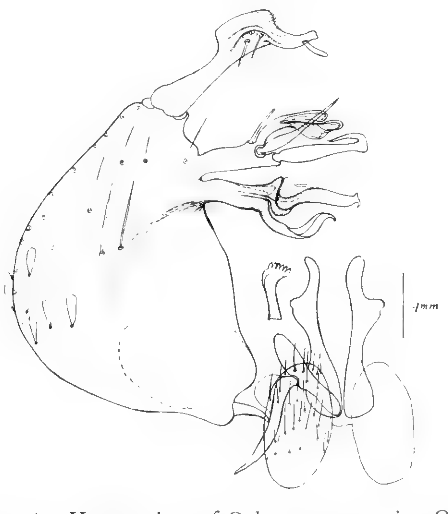

Figure 1. Hypopygium of *Culex putumayensis*. Only the apical portion of the 10th sternite is shown.

the side-piece, thickly snout-shaped, the snout strongly crested, two setae below the groove, terminal horn and stout appendiculate spine. Tenth sternites slender, comb-shaped, each with about seven teeth. Mesosome consists of two narrow, elongate plates, expanded laterally near the middle but without teeth. Ninth tergites large, broadly elliptical, approximate, slightly oblique, and clothed with fine setae on their posterior half.

Female and larva unknown.

Type.—One male from the Amazon River, collected by Dr. J. C. Bradley, Aug. 7, 1920. Hypopygium mounted on a slide. U. S. National Museum No. 50353.

Paratypes.—Two males, Putumayo River, Peru, Aug. 10, 1920. Hypopygia mounted on slides; five males taken on the Amazon River, near Peru, Aug. 7, 1920. Two paratypes in the collection of the U. S. National Museum; the others in the collection of Cornell University.

Mansonia amazonensis Theo.

One male from Bella Horizonte, Minas Gerais, Brazil, Nov., 1919; one female from Porto America, Putumayo River, Brazil, Sept., 1920.

Mansonia humeralis Dyar & Knab.

Ucayali River, Peru, July, 1925; Sint Barbara Plantation, Surinam River, Surinam, Apr. 15, 1927; Kwakoegron and Ongelijk, Surinam, June 1 and May 1, 1927. Dyar (1928) records this species from Colombia, Venezuela, British Guiana and Brazil. Bonne and Bonne-Wepster (1925) record taking only a single specimen in Surinam.

Trichoprosopon (Joblotia) splendens Lutz.

One female from McKenzie River, British Guiana, June 23, 1927. This species has hitherto been recorded only from Brazil.

A NEW SPECIES OF CIRROSPILUS WESTWOOD (CHALCIDOIDEA).

By A. B. Gahan,

Bureau of Entomology, U. S. Department of Agriculture.

The following description is published at this time in order to make the name available for use by Mr. Frank L. Marsh, to whom the writer is indebted for the material.

Cirrospilus inimicus, new species.

This species can be distinguished from others of the genus only by differences in the details of coloration.

Female.—Length 2.4 mm. Head, except occiput, pale yellow, occiput black; mandibles reddish at apex; palpi and rest of mouthparts yellow; antennal scape yellow with a broad black longitudinal stripe on inner side; pedicel and flagellum black above, more or less yellowish beneath; prothorax black above and below, the prosternum narrowly bordered with yellow, and the pronotum with a broad oblong yellow spot at each lateral posterior angle, these spots broadly separated; mesoscutum yellow except for a large, irregularly semicircular area at the anterior margin of the median lobe; axillae yellow; scutellum and postscutellum bronzy black, propodeum entirely black; dorsum of metathorax black but with two transversely elongate yellow spots which are separated by the postscutellum; meso- and metathorax entirely black laterally and beneath; anterior coxae yellow, median and posterior pairs yellow at apex; all trochanters, all femora and the posterior tibiae yellow; anterior tibiae yellow but with a blackish posterior margin; median tibiae yellow with a broad, usually incomplete, black band near the middle; anterior tarsi fuscous, the median and posterior pairs, except apical joint, yellow; tegulae yellow; wings hyaline, the venation yellowish; abdomen black above and below, but with the apical half or more of first tergite and the lateral margins of tergites 2 to 5 yellow, the black area at base of first tergite triangularly produced caudad at the middle; ovipositor sheaths black.

Both funicle joints longer than broad, subequal; head without distinct sculpture; thorax dorsally and ventrally with distinct shallow reticulate punctate sculpture, the axillae smooth and scapulae less distinctly sculptured than median lobe of mesoscutum; propodeum weakly reticulated, shining, with a distinct median carina but without lateral folds; abdomen about as long as head and thorax, with weak reticulate sculpture, the first tergite and yellow portions of following tergites apparently smooth.

Male.—Length 1.75 mm. Color variable. The allotype specimen largely yellow with the following black markings. Antennal pedicel above, a large, semicircular area at base of prescutum, scutellum on apical two-thirds, propodeum except for a small spot near each lateral posterior angle and one in the middle, sutures between mesopleura and metapleura, a moderately broad submedian band on each middle tibia, a broad apical band on dorsum of third tergite, all of fourth tergite dorsally and all of fifth tergite dorsally except for a large rounded spot at each anterior lateral angle. Wings hyaline; venation pale yellow. Eyes slightly reddish.

The color in both sexes is variable but distinctly more so in the male than in the female. Some female paratypes have the head mostly black with only the frons and face yellow. The prothorax is sometimes entirely black, the coxae of at least one female are all blackish, and in several specimens the yellow area on abdomen is greatly reduced. The great majority of the females, however, agree with the type. Males may have the head entirely yellow or yellow with a narrow transverse streak of blackish on the occiput, the prothorax mostly yellow with the anterior margin black, the scutellum entirely yellow to entirely black, the propodeum mostly yellow to entirely black, and the black area on abdomen slightly variable in extent. Among the females examined length varied from 1.5 to 2.5 mm. and among the males from 1.4 to 1.9 mm.

Type locality.—Hinsdale, Ill.

Type.—Cat. No. 50149 U. S. N. M.

Described from 23 females and 6 males said to have been reared from *Spilocryptus extrematis* (Cresson) infesting *Cecropia* at Hinsdale, Ill., August 30, 1933, by Frank L. Marsh.

MINUTES OF THE 455TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, APRIL 5, 1934.

The 455th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, April 5, 1934, in Room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. There were present 38 members and 37 visitors.

Under notes and exhibition of specimens, Mr. John Smith of New Jersey discussed the mouthparts of the dragon fly and exhibited a mechanical model to show how they functioned.

H. H. Richardson discussed briefly some phases of his work on the Phlox plant bug, *Lopidea davisi* Knight, and showed lantern slides of nymphs hatching.

Among those present were Dr. J. Chester Bradley, Dr. V. S. L. Pate, and Major J. A. LePrince. Dr. Bradley, upon invitation, greeted the Society.

Mr. A. B. Gahan presented a note on the identity of two Chalcidoid tick parasites of the family Encyrtidae, *Ixodiphagus texanus* Howard and *Hunterellus hookeri* Howard, stating that at present these were the only known parasites of the tick.

Dr. S. B. Fracker discussed the influence of the weather during the past winter on entomological work in various portions of the United States.

The first communication on the regular program was by W. D. Reed of the Tobacco Insect Laboratory, Richmond, Virginia, and entitled "Infestation of Turkish Type Tobaccos." Before proceeding with his discussion, Mr. Reed conveyed to the society the greetings of the following European entomologists: Dr. C. A. Isaakides, Director of the Benaki Institute, and Technical Advisor of the Minister of Agriculture of Greece; Nesip Bey, Director of the Scientific Section, Turkish Tobacco Monopoly, Instabul; Prof. F. Silvestri, Portici, Italy; Dr. Paul Marchal, Paris, France; and Prof. J. W. Munro and Mr. G. V. B. Hereford, Imperial College of Science and Technology, London.

During the period July 29 to October 16, 1933, Mr. Reed made a survey of tobacco districts in Greece and Turkey. This survey was made in order to determine the distribution and abundance of cured tobacco insects in the Near East and to cooperate with the importers of Turkish tobacco in working out satisfactory control measures. The principal insects attacking cured tobacco are the cigarette beetle (*Lasioderma serricorne* Fab.) and the moth (*Ephestia elutella* Hbn.).

A short account was given of visits made to various tobacco districts in Greece and Turkey and lantern slides of the cultivating, curing, and storing of Turkish tobacco were shown.

A total of 68 tobacco warehouses were inspected for insect infestation. The warehouses were the property of American tobacco companies, Greek tobacco merchants, and the Turkish Monopoly.

Infestation was found to be most severe where large stocks of old tobaccos were stored or where accumulations of scrap tobacco were allowed to remain in the building. This scrap is a by-product of the manipulation of Turkish tobacco into the various grades which meet trade requirements.

The warehouses visited were divided into Groups A and B on the basis of the amount of old-crop tobacco and scrap in the building. Those in Group A, 30 in number, contained none or very small amounts of old tobacco and scrap, while the 38 in Group B contained large quantities of these tobaccos. In Group A 235 bales of tobacco were examined and in Group B 188 bales. The data obtained from these inspections showed the following per cent of the bales infested:

	Group A.	Group B.
Ephestia elutella Hon.	59.2	90.4
Lasioderma serricorne Fab.	26.4	35.6
Microbracon hebetor (Say)	28.1	61.2
Aplastomorpha calendrae (How.)	.4	5.8
Nemeritis canescens (Grav.)	0	5.8
Tenebroides mauritanicus L.	0	8.0
Pediculoides ventricosus Newp.	0	2.0

The old tobacco and scrap stored in the warehouses support heavy infestations of insects and it is likely that this factor is responsible for the heavier infestation in the storage of Group A.

Microbracon hebetor (Say) and *Nemeritis canescens* (Grav.) were parasitizing the larvae of *Ephestia*, and *Aplastomorpha calendrae* (How.), the larvae of the cigarette beetle. *Tenebroides mauritanicus* L. and the mite, *Pediculoides ventricosus* Newp., were preying on the larvae of the cigarette beetle. (Author's abstract.)

This paper was discussed by Dr. McIndoo.

The second communication on the regular program was by Dr. F. C. Bishopp, entitled "Combating Mosquitoes with an Army of 25,000 Unemployed Workers." Dr. Bishopp showed numerous lantern slides illustrating the type of work being done and told some of the difficulties encountered in its execution.

An interesting discussion of this paper was given by Major J. A. LePrince.

Meeting adjourned at 10.25 P. M.

P. W. OMAN,
Acting Recording Secretary.

Actual date of publication, May 25, 1934.

VOL. 36 JUNE, 1934 No. 6

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OF THE

ENTOMOLOGICAL SOCIETY

OF WASHINGTON

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THE

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PROCEEDINGS OF THE

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A REVISION OF THE GENUS ANASTREPHA BASED ON A STUDY OF THE WINGS AND ON THE LENGTH OF THE OVIPOSITOR SHEATH (DIPTERA: TRYPETIDAE).

By Charles T. Greene.[1]

The two-winged flies of the dipterous genus *Anastrepha*, belonging to the family Trypetidae, are usually referred to as fruit flies because their larvae live in the pulp of fresh fruits. Many of them, such as the Mexican fruit fly (*A. ludens* Loew) and the West Indian fruit fly (*A. acidusa* Walker), infest fruits of commercial value and cause considerable damage. In order to prevent the introduction of such injurious forms into the country, the United States Government has established certain quarantines against fruit flies and the proper recognition of the different species of the genus *Anastrepha* has in consequence become increasingly important. It is hoped that this paper will prove useful in the identification of the species belonging to this genus.

Prof. M. Bezzi, who revised this genus in 1909 (*3*), included only 20 species; while Dr. Friedrich Hendel, in his revision published in 1914 (*14*), treated 32 species. The present paper includes 54 species, of which 16 are new to science. Representatives of 45 of these species, including the types of all of the new species described herein, are contained in the collection of

[1] The writer wishes to thank the following persons for their assistance in helping to make this revision much more complete than it would otherwise have been: Dr. Friedrich Hendel, for his generous loan of types and type material for study; Dr. H. Zerny, of the Vienna Museum, through Dr. J. M. Aldrich, for the loan of the type of *Anastrepha fraterculus* Wied.; the British Museum, through Dr. F. W. Edwards and Miss Daphne Aubertin, for photographs of Walker's types and notes on them; the Museum of Comparative Zoology, Cambridge, Mass., through Mr. Marston Bates, for the privilege of examining several types of Loew's species; Mr. E. E. Blanchard, Department of Agriculture, Buenos Aires, Argentina, for supplying a copy of an obscure description; and Dr. J. M. Aldrich, for assistance in translations and for helpful suggestions.

Nearly all of the material used in this revision was furnished by the Bureau of Entomology and the Bureau of Plant Quarantine of the United States Department of Agriculture. Messrs. Max Kisliuk, Jr., and C. E. Cooley furnished many specimens which they collected on their fruit fly survey during 1931 and 1932, through the West Indies and South American countries. Several of the species captured by them were new to the U. S. National Collection and some proved to be new to science.

With certain exceptions noted, the photographs of the wings included in this paper are by J. G. Pratt, photographer of the Bureau of Entomology. The pen drawings are by the author.

the United States National Museum, which served as the basis for this revision.

As the writer had an opportunity to examine the types of a great many species of this genus he has been able to record some good characters which were omitted in the original descriptions. These additions are mentioned in separate paragraphs under certain species.

DEFINITION OF TERMS.

The terms used for some of the principal characters in the accompanying descriptions may be defined as follows: (See drawing of wing, fig. 1.)

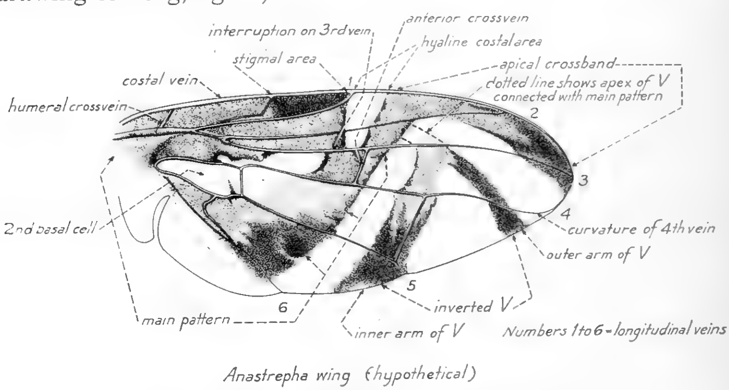

Fig. 1.—Wing of an *Anastrepha*, showing characters.

Main pattern: Includes all the color pattern on the basal two thirds of the wing. There is usually a definite line marking the outer limits of this pattern, extending diagonally across the wing just beyond the anterior crossvein.

Stigmal area: This is the space along the costal or anterior margin of the wing extending from the tip of the auxiliary vein to the tip of the first longitudinal vein and limited posteriorly by this latter vein.

Hyaline costal area: This space begins at the tip of the first longitudinal vein and extends posteriorly across the wing at least to the second and usually to the third longitudinal vein. In some species this area continues beyond the third vein and is continuous with the hyaline area which includes the second basal cell. It is absent in a few species.

Interruption on third vein: This term means that the hyaline costal area is not continuous to the base of the wing to include the second basal cell. The yellow or brown pattern extends across the third longitudinal vein, causing an interruption of the hyaline space at this vein. When the hyaline costal area extends posteriorly from the costal margin to include the second basal cell it is then called "continuous."

Anterior crossvein: A small crossvein near the middle of the wing, on the upper side of the discal cell, connecting the third and fourth longitudinal veins.

Apical crossband: The narrow portion of the color pattern along the apical costal portion of the wing. It is really a continuation of the main pattern and terminates at the margin of the wing between the apices of the third and fourth longitudinal veins.

Curvature of the fourth vein: The apical tip of the fourth longitudinal vein curves upward to the margin of the wing and unites with the tip of the costal vein.

Inverted V: This portion of the pattern is shaped like the letter V inverted. The tips of the arms reach the posterior margin of the wing. The point at which the two arms join is called the apex and is usually at the third longitudinal vein or slightly anterior to this vein. The narrow arm, nearer the tip of the wing, is called the "outer arm"; the broad arm is called the "inner arm."

When the apex of the V is prolonged beyond the third longitudinal vein and connects with the main pattern it is termed "connected" (dotted lines in figure 1 show it connected). When the apex of the V stops at the third longitudinal vein it is termed "disconnected" because a broad hyaline area separates it from the main pattern.

For additional information on characters used in this paper see text figures 1 to 4, inclusive.

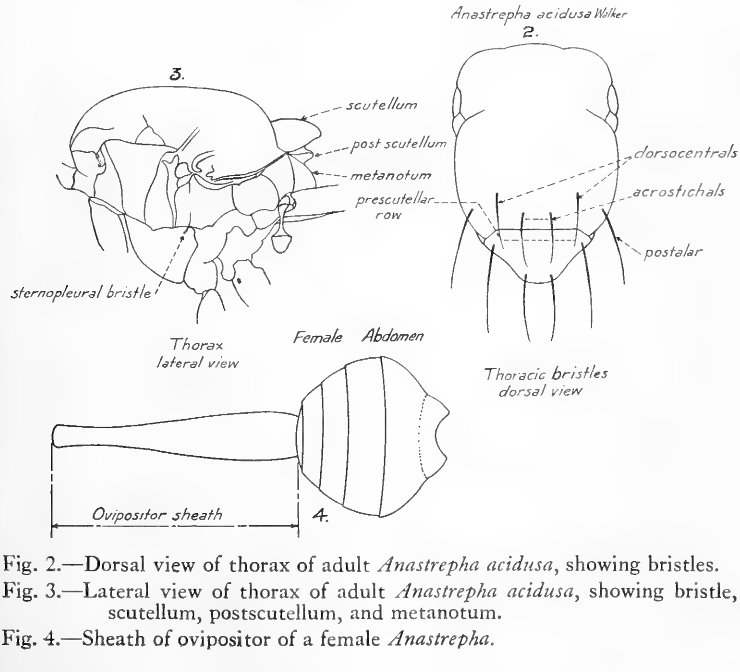

Fig. 2.—Dorsal view of thorax of adult *Anastrepha acidusa*, showing bristles.

Fig. 3.—Lateral view of thorax of adult *Anastrepha acidusa*, showing bristle, scutellum, postscutellum, and metanotum.

Fig. 4.—Sheath of ovipositor of a female *Anastrepha*.

Genus ANASTREPHA Schiner.

Anastrepha was described by Schiner in 1868 (*28, p. 263*) in his Reise Novara, page 263. The genotype is *Dacus serpentina* Wied.

Head hemispherical; eyes bare; front broad, slightly longer than wide; surface of front with numerous very short black setae; a vertical row of large bristles on each side; face vertically impressed on each side beneath the antenna; epistoma somewhat prominent, no vibrissae, mouth opening large; proboscis with large labellae; palpi rather broad; antenna with basal joints short, third joint slender, a little longer than first two together; arista long and slender, microscopically pubescent. Mesonotum slightly convex, with large bristles at the sides and a transverse row anterior to the scutellum; scutellum with four large bristles. Abdomen not much longer than thorax, with five segments; male genitalia somewhat prominent; abdomen of female projecting style-like; this projection or ovipositor ranges in length from two-thirds the length of the abdomen to a length slightly longer than head, thorax, and abdomen together. Legs rather long; front femora bristled below; middle tibiae with apical bristles; metatarsi not shortened. Wings large as a rule, with brown bands; apical portion of auxiliary vein bent forward almost at a right angle, into the costal vein; first and third longitudinal veins setulose; apical portion of fourth longitudinal vein curved up toward the third and joining with the tip of the costal vein; small crossvein beyond the middle of the discal cell; anal cell drawn out to a point on the posterior edge.

This genus is most closely related to *Acidia* and *Hexachaeta*. The scutellum has four large macrochaetae like the former, whereas the latter has six macrochaetae. It differs from both genera in having the apical portion of the fourth longitudinal vein curved forward to unite with the tip of the costal vein. This genus is found only in the western hemisphere and occupies the same position there as the genus *Dacus* occupies in the eastern hemisphere.

For students interested in the genus *Anastrepha* papers by Crawford (*7*), Dampf (*8, 9*), Darby and Kapp (*10*), Greene (*13*), Isaac (*15*), Lima (*18*), Mackie (*22*), McPhail and Bliss (*27*), Silvestri (*30*), and Wille (*35*) are included in the literature list, although having more of a biological or economic than a taxonomic bearing.

The Aldrich Catalog (*1*) is listed because the genus *Anastrepha* is mentioned, although at the time this catalog was published there were no species known from the United States.

The article by Bezzi (*4*) was included but the writer was unable definitely to place the species mentioned.

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Females.

1. Dark brown to nearly black species.......... 2
   Yellow species.......... 5
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3. Hyaline costal area interrupted just before the third vein; only the inner arm of the V present, beginning near apex of sixth vein, extending upward along the posterior crossvein and ending at the third vein. Ovipositor sheath 3 mm. long. (West Indies, Trinidad, Mexico, Central America, Peru, Brazil, Ecuador).......... *serpentina* Wied., p. 142
   Hyaline costal area continuous to the base of the second basal cell; only the inner arm of the V present, connected with the main pattern along the posterior margin of the wing and extending upward along, and ending just beyond the tip of, the posterior crossvein. Ovipositor sheath 3 mm. long. (Ecuador).......... *ornata* Aldrich, p. 143
4. Wing mostly hyaline; a dark brown band along the costa to the tip of the fourth longitudinal vein; a dark brown band from the posterior border following the posterior crossvein to slightly beyond its tip; a dark band from the base of the wing extending to the tip of the sixth vein. Ovipositor sheath 2 mm. long. (Brazil, Paraguay).......... *daciformis* Bezzi, p. 143
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   With vertical dark brown stripes.......... 8
8. Four vertical black stripes, the outer ones interrupted at the transverse suture and connected transversely on posterior edge of thorax. Abdomen with three transverse dark brown bands; last segment with two large brown spots. Inner arm of V very conspicuously large and dark brown; outer arm very narrow, pale yellow. Ovipositor sheath as long as thorax and abdomen together (British Honduras)..........*cordata* Aldrich, p. 144
   Two vertical black stripes interrupted at transverse suture.......... 9

9. Wing pattern dark yellow; inverted V with only the inner arm present, located on posterior crossvein, extending from the fourth longitudinal vein to the posterior margin. Ovipositor sheath robust, one and one-fourth times as long as the abdomen. (Brazil, Peru, Paraguay) .... *grandis*, Macq., p. 145
   Wing pattern yellow with some brown near base of wing; inverted V with both arms present, mostly brown, disconnected from main pattern. Ovipositor sheath robust, almost as long as the abdomen. (Mexico, Central America, Trinidad, West Indies, Bolivia) .... *striata* Schiner, p. 145
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11. Hyaline costal area absent; inner arm of V connected at its apex and on the fourth longitudinal vein with the main pattern; outer arm absent. Ovipositor slightly longer than the abdomen. (Surinam, Brazil) .... *atrigona* Hend., p. 146
   Hyaline costal area present 12
12. Hyaline area interrupted on third longitudinal vein 13
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13. Abdominal segments 2, 3, and 4 each with a transverse black band. Inner arm of V usually extending to third vein; outer arm short, extending slightly beyond fourth vein. Ovipositor sheath half as long as head, thorax, and abdomen together. (Cuba, Isle of Pines) *tricincta* Loew, p. 146
   Abdominal segments without black markings 14
14. Costa with a broad, very dark brown band from base of wing to tip of first vein. Ovipositor sheath as long as last three abdominal segments combined. (Jamaica) .... *longimacula*, n. sp., p. 146
   Costa not as above 15
15. Ovipositor sheath shorter than the abdomen 16
   Ovipositor sheath as long as or longer than the abdomen 18
16. V connected with main pattern; species of a more golden brown color; hyaline costal area usually interrupted on third vein. Ovipositor sheath as long as last three abdominal segments combined. (Puerto Rico, Cuba, Florida) .... *suspensa* Loew, p. 147
   V not connected with main pattern; species paler yellow 17
17. Black spot on dorsum of thorax always present. Hyaline costal area interrupted on third vein; width of apical crossband never more than half the length of anterior crossvein; stigmal area with a brownish tinge. Ovipositor sheath as long as last three abdominal segments combined. (Peru, Chili) .... *peruviana* Towns, p. 148
   Black spot on dorsum of thorax usually absent. Hyaline costal area interrupted on third vein; width of apical crossband about three-fourths the length of anterior crossvein; stigmal area dark brown and a little longer than in *peruviana*. Ovipositor sheath as long as last three abdominal segments combined. (Brazil, Uruguay, Peru) .... *distans* Hend., p. 149

18. Ovipositor sheath not longer than the abdomen. Interruption on third vein not more than one half the length of anterior crossvein; V not connected with the main pattern. Metanotum with a black stripe on each side. (Peru) .... *distincta*, n. sp., p. 149
    Ovipositor sheath longer than the abdomen 19
19. Ovipositor sheath only a little longer than the abdomen 20
    Ovipositor sheath at least as long as thorax and abdomen 21
20. Ovipositor sheath only slightly longer than abdomen. V not connected with the main pattern; interruption on third vein as long as anterior crossvein. Metanotum entirely yellow. (Panama) .... *panamensis*, n. sp., p. 150
    Ovipositor sheath one and one third times as long as the abdomen. V not connected with the main pattern; interruption on third vein not more than half as long as anterior crossvein. Metanotum with a black mark on each side. (Mexico, Texas) .... *ludens*, Loew, p. 151
21. Ovipositor sheath slender, about as long as the thorax and abdomen together. Interruption on third vein about as long as anterior crossvein; V usually connected with the main pattern; inner arm of V mostly dark brown. (Canal Zone) .... *passiflorae*, n. sp., p. 151
    Ovipositor sheath very slender, slightly longer than head, thorax, and abdomen together. Interruption on third vein nearly equal in length to anterior crossvein; V not connected with the main pattern. (Canal Zone) .... *zeteki*, n. sp., p. 152
22. Inverted V incomplete; inner arm dark brown, not connected with main pattern; outer arm absent or at most represented by only a brown spot on or near fourth vein. Ovipositor sheath almost as long as the abdomen. (Guatemala, Honduras, Trinidad) .... *leptozona* Hend., p. 153
    Inverted V complete, both arms complete, not connected with main pattern. Ovipositor sheath very slightly longer than the abdomen. (Brazil, Panama) .... *similis*, n. sp., p. 153
23. With two black spots on posterior edge of thorax 24
    With three (rarely two) somewhat elongated black spots on posterior edge; scutellum with a black latero-basal spot on each side; basal third of scutellum reddish brown, apical portion pale yellow. Wing pattern pale yellow; hyaline costal area continuous to include second basal cell; inner arm of V broadly connected at its apex with the main pattern; outer arm absent. Ovipositor sheath slender, half as long as head, thorax, and abdomen together. (Texas, Honduras) .... *pallens* Coq., p. 154
24. Bristles of thorax reddish; thoracic spots large, rounded 25
    Bristles of thorax black; thoracic spots small, not definitely rounded. Wing pattern mostly dark brown, sharply defined; hyaline costal area continuous; V dark brown, arms narrow, usually not connected. Ovipositor sheath slightly longer than last three abdominal segments. (Brazil) .... *braziliensis*, n. sp., p. 154
25. Abdominal segments 3 to 5 each with two dorsal brown spots. Hyaline costal area continuous to second basal cell; inverted V

with both arms complete, narrow, reaching to the third vein but not connected together. Ovipositor sheath slender, almost as long as abdomen. (Brazil, Paraguay) .... *punctata* Hend., p. 155

Abdominal segments without spots. Otherwise like *punctata*. (Brazil) .... *hendeli*, n. sp., p. 155

26. Palpi broadly black along apical edge. Ovipositor half as long as head, thorax, and abdomen together. (Bolivia) .... *nigripalpis* Hend., p. 156

Palpi entirely yellow 27

27. Inverted V absent; hyaline costal area not quite reaching the third vein; a semihyaline area at tip of first posterior cell; a semihyaline triangular area on posterior border of second posterior cell; another such area just beyond the middle of the third posterior cell extending backward to base of wing. Ovipositor sheath almost as long as thorax and abdomen together. (Trinidad) .... *obscura*, Ald., p. 157

Inverted V present, complete or incomplete 28

28. Inverted V incomplete (outer arm absent or only part of it present) 29

Inverted V complete (both arms present) 32

29. Outer arm of V absent; inner arm of nearly uniform width, paler at apex, which touches the third vein, not connected with the main pattern; basal half of wing entirely dark yellow. Ovipositor sheath almost as long as abdomen. (Para, Brazil ?) .... *bivittata* Macq., p. 157

Outer arm of V usually present in part 30

30. Hyaline costal area broadly continuous to include second basal cell; inner arm of V pointed at apex and barely reaching third vein; outer arm sometimes absent but usually there is an elongated brown spot on or near the fourth vein. Ovipositor sheath robust, hardly longer than last three abdominal segments. (Guatemala, Honduras, Trinidad) .... *leptozona* Hend., p. 153

Hyaline costal area extending to third vein 31

31. Inner arm of V of nearly uniform width, its apex broadly connected with main pattern; outer arm extending from margin of the wing to or slightly beyond fourth vein. Ovipositor sheath slightly longer than thorax and abdomen together. (Brazil) .... *hamata* Loew, p. 157

Inner arm of V wide at the base, tapering to apex, where it is paler, touching third vein and narrowly disconnected from main pattern; outer arm narrow, extending from margin of wing to slightly beyond fourth vein. Ovipositor sheath half as long as head, thorax, and abdomen together. (Jamaica) .... *ocresia* Walker, p. 158

32. V connected with main pattern 33

V not connected with main pattern 42

33. Hyaline costal area interrupted near the second or on the third vein 34

Hyaline costal area continuous to include second basal cell 41

34. Hyaline costal area interrupted just before the second vein 35

Hyaline costal area interrupted on the third vein 36

35. Scutellum with a black spot at the apex. Wing pattern normal at the stigmal area; apex of V broadly connected with main pattern. Length of ovipositor sheath not given in description. (Mexico).... *tripunctata* v. d. Wulp, p. 158

Scutellum entirely yellow. Wing with a large rectangular brownish-black spot which includes the stigmal area; apex of V broadly connected with main pattern; inner arm of V connected with main pattern along posterior margin of wing. Ovipositor sheath one and one third times as long as the abdomen. Species 7.5 mm. (without ovipositor sheath). (Peru)............*cryptostrepha* Hend., p. 158

A species very similar but much larger (13 mm. without ovipositor sheath). (Bolivia)............*conjuncta* Hend., p. 159

36. Ovipositor sheath as long as or longer than the abdomen............37

Ovipositor sheath shorter than the abdomen............38

37. Ovipositor sheath as long as the abdomen. Hyaline costal area narrowly interrupted on third vein; arms of V slender, pale; apex of V very narrowly connected or disconnected with the main pattern; wing color pale. (Trinidad)............*sylvicola* Knab, p. 159

Ovipositor sheath one and one fourth times as long as the abdomen, much enlarged on basal two thirds. Hyaline costal area very broadly interrupted on third vein; inner arm of V very broad; apex of V very broadly connected with main pattern at third vein and inner arm narrowly on fourth vein; wing color dark golden brown. (Trinidad) ....*urichi*, n. sp., p. 159

38. Ovipositor sheath more than half length of abdomen............39

Ovipositor sheath half or less than half length of abdomen............40

39. Ovipositor sheath three fourths as long as abdomen. Apex of V broadly connected with main pattern; outer edge of outer arm continuing in a straight line a little anterior to the second vein; stigmal area deep yellow, a little shorter than the preceding costal section. (Brazil, Panama)............*flavipennis*, n. sp., p. 160

Ovipositor sheath three fourths as long as abdomen. Apex of V narrowly connected with main pattern; outer edge of outer arm arcuated at third vein; stigmal area dark brown, as long as the preceding costal section. (Trinidad)............*trinidadensis*, n. sp., p. 161

40. Ovipositor sheath half as long as abdomen. Wing more brown than yellow; hyaline costal area interrupted on the third vein and constricted on the second vein; apex of V narrowly connected with the main pattern. (Brazil, Trinidad)............*ethalea* Walker, p. 161

Ovipositor sheath as long as the last three abdominal segments combined. Hyaline costal area usually broadly interrupted on third vein, not constricted on second vein; apex of V broadly connected with main pattern. (West Indies, Panama)............ *acidusa* Walker, p. 162

41. Bristles of head and thorax black. Stigmal area grayish; dark color of outer arm of V forms a definite black line between the third and fourth veins. Ovipositor sheath about two thirds as long as abdomen. (Cuba, Canal Zone, Honduras)............*obliqua* Macq., p. 163

Bristles of head and thorax reddish yellow. Stigmal area yellowish-brown; wing otherwise like that of *obliqua*. Ovipositor sheath about two thirds as long as abdomen. (Brazil) .... *xanthochaeta* Hend., p. 163

42. Hyaline costal area interrupted on third vein 43

Hyaline costal area continuous to include second basal cell 51

43. Inner arm of V connected with main pattern on posterior margin of wing. Ovipositor sheath as long as last three abdominal segments. (Peru) .... *lambda*, Hend., p. 164

Inner arm of V not connected with the main pattern 44

44. Ovipositor sheath shorter than the abdomen 45

Ovipositor sheath as long or longer than abdomen 48

45. Ovipositor sheath three fourths as long as abdomen 46

Ovipositor sheath not more than two thirds as long as abdomen 47

46. Bristles of thorax black. Apex of V narrowly disconnected from main pattern; stigmal area dark brown, as long as the preceding costal section. Species 6 mm. long. (Trinidad) .... *trinidadensis*, n. sp., p. 161

Bristles of thorax red. Apex of V broadly disconnected from main pattern; stigmal area deep yellow, as long as the preceding costal section; wing color mostly light yellow. Species 8 to 9 mm. long. (Trinidad, Brazil) .... *pseudoparallela* Loew, p. 164

47. Ovipositor sheath two thirds as long as the abdomen. Stigmal area brownish, three fourths as long as preceding costal area; apex of V not connected with main pattern; arms moderately broad. (Brazil, Trinidad, Costa Rica, Guatemala) (see *peruviana*) .... *fraterculus* Wied., p. 164

Ovipositor sheath as long as last three abdominal segments combined. Stigmal area dark brown, almost as long as preceding costal area; apex of V not connected with main pattern; arms narrow. (Brazil, Uruguay, Peru.) Species slightly larger than *fraterculus* .... *distans* Hend., p. 149

48. Ovipositor sheath as long as abdomen 49

Ovipositor sheath longer than abdomen 50

49. Bristles of thorax reddish-yellow. Arms of V slender, pale colored; apex of V very narrowly disconnected or connected with main pattern; stigmal area as long as the preceding costal area; wing color pale. (Trinidad) .... *sylvicola* Knab., p. 159

Bristles of thorax black. Arms of V very slender, not connected at apex of V; apex of V not connected with main pattern. Species smaller than *sylvicola*. (Peru) .... *distincta*, n. sp., p. 149

50. Ovipositor sheath robust, one and one half times as long as abdomen. Wing broad, deep yellow; anterior and posterior margins not parallel; V well marked, its apex not connected with main pattern; outer arm broad. Species robust. (Brazil) .... *townsendi*, n. sp., p. 165

Ovipositor sheath very slender, as long as the thorax and abdomen together. Wing narrow, pale yellow, anterior and posterior margins parallel; apex of V not connected with main pattern; outer arm narrow. Species slender. (Colombia)........ *pallidipennis*, n. sp., p. 166

51. Ovipositor sheath shorter than abdomen........52
    Ovipositor sheath as long as or longer than abdomen........53
52. Ovipositor sheath as long as last three abdominal segments combined. Arms of V always connected at apex. Species more robust than *braziliensis*. (Brazil)........*soluta* Bezzi, p. 166
    Ovipositor sheath a little longer than last three abdominal segments combined. Arms of V seldom connected at apex. Species more slender than *soluta*. Pattern darker brown, more sharply defined. Usually with posterior dorsal angles of thorax brown. (Brazil).... *braziliensis*, n. sp., p. 154
53. Ovipositor sheath at least as long as head, thorax, and abdomen together........54
    Ovipositor sheath shorter than thorax and abdomen together........55
54. Ovipositor sheath slender, much longer than head, thorax, and abdomen together. Apex of first posterior cell much narrowed on apical margin of wing. (Guatemala)........*barnesi* Ald., p. 166
    Ovipositor sheath robust, as long as head, thorax, and abdomen together. Apex of first posterior cell normal, not narrowed in apical margin of wing. (Brazil)........*consobrina* Loew, p. 167
55. Ovipositor sheath as long as abdomen........56
    Ovipositor sheath longer than abdomen........57
56. Ovipositor sheath very slender; abdomen a little longer than broad. Stigmal area three times as long as broad. Bristles of thorax black. Species paler yellow and slender. (Peru)........ *chiclayae*, n. sp., p. 167
    Ovipositor sheath more robust; abdomen as broad as long. Stigmal area four times as long as broad. Bristles of thorax slightly reddish. Species brownish yellow and more robust than *chiclayae*. (Brazil, Panama)........*similis*, n. sp., p. 153
57. Ovipositor sheath slender, about as long as thorax and abdomen together. Stigmal area seven times as long as broad. (Brazil, Paraguay)........*parallela* Wied., p. 168
    Ovipositor sheath a little longer than the abdomen, very much enlarged at base, tapering to middle, thence very slender to tip. Stigmal area five times as long as broad. (Trinidad, Dominican Republic)........*integra* Loew, p. 168

Table of Species.

Males.

1. Dark brown to nearly black species........2
   Yellow species........4
2. Hyaline costal area absent; wing mostly hyaline; a dark brown band along costa to tip of fourth longitudinal vein; a dark brown band from posterior border following posterior crossvein to slightly

beyond its tip; a dark band from base of wing extending to tip of sixth vein. (Brazil, Paraguay)........*daciformis* Bezzi, p. 143

Hyaline costal area present........ 3

3. Hyaline costal area interrupted just before third vein; only inner arm of V present, beginning near apex of sixth vein, extending upward along posterior crossvein and ending at third vein. (West Indies, Trinidad, Mexico, Central America, Peru, Brazil, Ecuador) *serpentina* Wied., p. 142

Hyaline costal area continuous to base of second basal cell; only inner arm of V present, connected with main pattern along posterior margin of wing and extending upward along, and ending just beyond tip of, posterior crossvein. (Ecuador)..*ornata* Ald., p. 143

4. Dorsum of thorax with one or more black markings........ 5

Dorsum of thorax without any black marking........23

5. Dorsal markings in the form of a band or stripes........ 6

Dorsal markings in the form of a spot or spots........ 8

6. With a broad, transverse, dark brown band on posterior margin of thorax. Hyaline costal area broadly interrupted on third vein; V complete, its apex connected with main pattern. (Mexico, Guatemala, Venezuela)........*robusta*, n. sp., p. 144

With two vertical brownish black stripes interrupted at transverse suture.. 7

7. Wing pattern dark yellow; inverted V with only inner arm present, located on posterior crossvein, extending from the fourth longitudinal vein to the posterior margin. (Brazil, Peru, Paraguay).... *grandis* Macq., p. 145

Wing pattern yellow with some brown near base of wing; inverted V with both arms present, mostly brown, disconnected from main pattern. (Mexico, Central America, Trinidad, West Indies, Bolivia)........*striata* Schiner, p. 145

8. With one spot at the middle of posterior edge of thorax........ 9

With two or three spots on posterior edge of thorax........20

9. Hyaline costal area absent (pattern may be paler at apex of first longitudinal vein). Inner arm of V broad, connected at its apex and on fourth longitudinal vein with main pattern; outer arm absent. (Surinam, Brazil)........*atrigona* Hend., p. 146

Hyaline costal area present........10

10. Inverted V incomplete (only a portion of outer arm present)........11

Inverted V complete (both arms present)........12

11. Hyaline costal area continuous to include second basal cell; inner arm of V complete to third vein; outer arm incomplete, straight, extending slightly beyond fourth longitudinal vein. Abdomen entirely yelow. (Guatemala, Honduras, Trinidad)........ *leptozona* Hend., p. 153

Hyaline costal area interrupted on third vein; inner arm of V complete to third vein; outer arm incomplete, curved, extending slightly beyond fourth longitudinal vein. Abdominal segments 2, 3, and 4 with a transverse black band. (Cuba, Isle of Pines)...... *tricincta* Loew, p. 146

12. Inverted V connected with main pattern 13
 Inverted V not connected with main pattern 15
13. Base of wing with a broad blackish area extending to tip of first longitudinal vein; hyaline area narrowly interrupted on third vein. (Jamaica) .... *longimacula*, n. sp., p. 146
 Base of wing without large black area 14
14. Hyaline costal area usually narrowly interrupted on third vein; small species, golden brown in color. (Puerto Rico, Cuba, Florida) *suspensa* Loew, p. 147
 Hyaline costal area very broadly interrupted on third vein; large pale yellow species. (Canal Zone) .... *passiflorae*, n. sp., p. 151
15. Bristles of thorax and abdomen deep reddish; hyaline costal area interrupted on third vein; V indistinctly marked; wing pattern very pale yellow. (Panama) .... *zeteki*, n. sp., p. 152
 Bristles of thorax and abdomen black 16
16. Hyaline costal area very narrowly continuous to include second basal cell; V well marked to third vein; stigmal area almost as long as preceding section. (Mexico, Texas) .... *ludens* Loew, p. 151
 Hyáline costal area narrowly to broadly interrupted on third vein 17
17. Stigmal area about one half as long as preceding costal area; interruption on third vein slightly longer than anterior crossvein; V well marked, of nearly uniform color to the apex. (Panama) .... *panamensis*, n. sp., p. 150
 Stigmal area at least two thirds as long as preceding costal area 18
18. Stigmal area dark brown, almost as long as the preceding costal area; apex of V pale yellow; arms connected at third vein; width of apical crossband about three fourths the length of anterior crossvein. (Brazil, Uruguay, Peru) .... *distans* Hend., p. 149
 Stigmal area with a brownish tinge; about two thirds as long as preceding costal area 19
19. Inverted V pale yellow at apex; outer arm very narrow; width of apical crossband never more than half the length of anterior crossvein. Paler yellow species than *distincta*. (Peru, Chili) .... *peruviana* Towns., p. 148
 Inverted V mostly brown, paler at apex; outer arm about three fourths as wide as inner arm; width of apical crossband two thirds to three fourths as long as anterior crossvein. Dark tawny species, a little larger than *peruviana*. (Peru) .... *distincta*, n. sp., p. 149
20. Usually with three pointed spots on postero-dorsal margin of thorax (middle spot sometimes absent). Wing pattern pale yellow; hyaline costal area continuous to include second basal cell; inner arm of V connected with main pattern; outer arm absent. Scutellum broadly brown on basal third, apical portion pale yellow; a black spot on the latero-basal angle. (Texas, Honduras) .... *pallens* Coq., p. 154
 With two spots on postero-dorsal margin of thorax 21
21. Thoracic spots small, not definitely outlined. Hyaline costal area

continuous to include second basal cell; arms of V narrow, mostly brown, narrowly disconnected at apex. (Brazil) *braziliensis*, n. sp., p. 154

Thoracic spots large, rounded. Hyaline costal area continuous to include second basal cell 22

22. Abdominal segments three to five each with two dorsal brown spots. Inverted V with both arms complete, reaching to third vein but not connected together. (Brazil, Paraguay) ..... *punctata* Hend., p. 155

Abdominal segments without spots. Otherwise like *punctata*. (Brazil) ..... *hendeli*, n. sp., p. 155

23. Hyaline costal area present, ending between second and third longitudinal veins; V entirely absent; wing pattern mostly brownish yellow; a large triangular hyaline area on posterior margin of wing; a second large hyaline area on posterior margin of wing from middle of third posterior cell to base of wing. Species dull brown in color. (Trinidad) ..... *obscura* Ald., p. 157

Hyaline costal area present, extending to or beyond the third vein. Inverted V present 24

24. Hyaline costal area continuous to include second basal cell 25

Hyaline costal area interrupted near second or at third longitudinal vein 32

25. Inverted V incomplete; inner arm tapering to third vein, not connected with main pattern; outer arm short, extending from margin of wing to a little beyond fourth vein. (Guatemala, Honduras, Trinidad) ..... *leptozona* Hend., p. 153

Inverted V complete, both arms complete 26

26. Apex of V connected with main pattern; dark color on outer side of outer arm forming a rather definite black line to third vein; bright yellow species. (Cuba, Canal Zone, Honduras) ..... *obliqua* Macq., p. 163

Apex of V not connected with main pattern 27

27. Mouth with a broadly flattened margin of shining black edged with white; third joint of antenna yellow with a black apex. Inner arm of V dark brown extending along margin of wing almost to sixth vein. (Costa Rica) ..... *schausi* Ald., p. 168

Mouth and antenna entirely yellow 28

28. Inner arm of V broad, touching posterior margin of wing only at fifth vein; outer arm of V narrow, not quite touching posterior margin. Metanotum deep yellow. (Brazil) ..... *consobrina* Loew, p. 167

Both arms of V touching posterior margin of wing 29

29. Stigmal area golden yellow, normal in size; a conspicuous small black spot at juncture of second and third veins and another elongated dark brown spot on third vein just beyond this juncture. Metanotum entirely yellow. Species medium sized. (Peru) ..... *chiclayae*, n. sp., p. 167

Stigmal area not as above 30

30. Stigmal area unusually long and narrow, golden brown in color; a black spot at anterior apex of humeral crossvein and auxiliary

vein. Metanotum deep yellow. (Large species, 9 to 10 mm. long) (Brazil, Paraguay)........*parallela* Wied., p. 168
Not as above. (Smaller species, 5.5 to 6 mm. long)........31

31. Stigmal area normal in size, brownish black; apical crossband wider at third vein where width is equal to three fourths length of anterior crossvein; arms of V slightly separated at apex. Metanotum and postscutellum black on sides. (Brazil)........ *braziliensis*, n. sp., p. 154
Stigmal area yellow with a faint brown tinge; apical crossband narrow, of equal width throughout, its width equal to about half length of anterior crossvein. Metanotum and postscutellum with black on each side. (General color pale yellow). (Brazil)........ *soluta* Bezzi, p. 166

32. Hyaline costal area not reaching second vein........33
Hyaline costal area interrupted at third vein........34

33. Arms of V broad, their sides nearly parallel; inner arm extending along posterior margin of wing about three fourths distance to sixth vein; width of apical crossband uniform, equal to length of anterior crossvein. Metanotum and postscutellum deep tawny. Scutellum yellow. (Dominican Republic)........*integra* Loew, p. 168
Arms of V narrow, their sides sinuous; inner arm only slightly widened on posterior margin of wing at tip of fifth vein; width of anterior crossband much greater than length of anterior crossvein, its greatest width on third vein. Scutellum with a black spot at apex. Metanotum with a black spot on each side. (Mexico) *tripunctata* v. d. Wulp, p. 158

34. Wing with costal vein slightly concave near apex of second vein; wing pattern mostly deep brown; inverted V broadly connected with main pattern; outer arm slightly curved. (Canal Zone)........ *concava* n. sp., p. 169
Wing normal in outline........35

35. Inverted V connected with the main pattern........36
Inverted V not connected with the main pattern........39

36. Hyaline costal area slightly constricted at second vein........37
Hyaline costal area not constricted, sides of area straight........38

37. Wing pattern more brownish along basal portion of costa; apical crossband of uniform width. (Slightly larger species than following one.) (Brazil, Trinidad)........*ethalea* Walker, p. 161
Wing pattern lighter along basal portion of costa; apical crossband slightly wider at third vein. (Slightly smaller species than the former.) (Trinidad)........*trinidadensis*, n. sp., p. 161

38. Wing pattern mostly yellow; V broadly connected with the main pattern; outer side of outer arm almost straight, outer arm broad; inner edge of apical crossband almost straight, band broad; stigmal area uniformly broad. Metanotum light reddish-yellow. (Large species.) (Brazil, Panama)........*flavipennis*, n. sp., p. 160
Wing pattern with considerable blackish brown color; V narrowly to broadly connected with the main pattern; outer arm not as in

above species, narrow; inner edge of apical crossband curved, not perfectly even; stigmal area narrow, tapering sharply to apex. Metanotum usually with a black marking on each side. (Small species.) (West Indies, Panama)........................*acidusa* Walker, p. 162

39. Rather large species (8 to 10 mm.); stigmal area long and narrow............40
    Smaller species; stigmal area not so long..41
40. Stigmal area as long as preceding costal section, very narrow, tapering from base to apex; apical crossband very dark toward its apex. (Trinidad)..*sylvicola* Knab, p. 159
    Stigmal area a little shorter than preceding costal area, narrow, tapering from about basal fourth to apex; apical crossband of a nearly uniform yellow. (Species slightly more robust than the above.) (Trinidad, Brazil)........................*pseudoparallela* Loew, p. 164
41. Arms of V narrow, narrowly separated at third vein; interruption on third vein not more than one half length of anterior crossvein. (Peru)..*distincta*, n. sp., p. 149
    Arms of V connected at the third vein 42
42. Stigmal area three fourths as long as preceding costal section; first posterior cell as wide on margin of wing as it is opposite posterior crossvein. (Brazil, Trinidad, Costa Rica, Guatemala).................. *fraterculus* Wied., p. 164
    Stigmal area almost as long as preceding costal area; first posterior cell much narrowed on margin of wing. (Brazil, Uruguay, Peru) (Slightly larger species than *fraterculus*)................*distans* Hend., p. 149

Anastrepha serpentina Wiedemann.

(Plate 19, fig. 1.)

This species was originally described by Wiedemann (*34, p. 521*) in 1830 in the genus *Dacus*. Macquart (*24, p. 373* (*216*)) in 1843 placed the species in the genus *Leptoxys*. Macquart (*26, p. 259* (*286*)) in 1851 described *Urophora vittithorax*, which is a synonym. Schiner (*28, p. 263*) in 1868 erected the new genus *Anastrepha* with *serpentina* Wied. as genotype. Loew (*20, p. 227*) in 1873 erected the genus *Acrotoxa*. Bezzi (*3, p. 284*) in 1909 placed the species again in *Anastrepha*. Hendel (*14, p. 14–16*) in 1914 used this latter name also. This species is distinguished from all the other species of the genus by the wing pattern, thoracic markings, and general dark color.

Described from Brazil, no date. Specimens in the U. S. National Collection are from the following localities: Bahia, Brazil, March, 1905; Lima, Peru, Aug. and Sept., 1930, W. M. Mann collector; Huerta Palmarei Malamba, Peru, March 15–31, 1932, M. Kisliuk and C. E. Cooley collectors; Ecuador, no date, F. Campos R. collector; La Ceiba, Honduras, January 4, 1926, E. Kostal collector; Ancon, Canal Zone; La Sabanas, Panama and Panama City, Panama, March, April, May, 1926, I. Molino and C. T. Greene collectors; San Pedro de Montes de

Oca, Costa Rica, Feb. 28, 1933, C. H. Ballou collector; Guatemala City, Guat., July 23, 1923, E. G. Smyth collector; Trinidad, B. W. I., Nov. 1913, F. W. Urich collector; Cuernavaca, Mexico, no date, A. L. Herrera collector; and Weslaco, Tex., July 3, 1933, G. V. Harren collector.

Reared from the following fruits: *Mammea americana*, *Chrysophyllum panamense* (common name, caimito), adults emerged March 27, 1933, Nispero, *Achras zapota* (cultivated sapodilla), star apple, and guava.

The type is in the Vienna Museum.

Anastrepha ornata Aldrich.

(Plate 19, fig. 2.)

This species was originally described by Aldrich (*2, p. 6*) in 1925 and is distinguished by the wing pattern.

Described from Banos, Oriente, Ecuador, October 30, 1922, and January 19, 1923, F. X. Williams collector.

Host unknown.

Both types are in the U. S. National Collection. One specimen was captured on the "luma tree."

Length 6 mm. without the ovipositor sheath, which is 3 mm. long.

Anastrepha daciformis Bezzi.

(Plate 19, fig. 3.)

This species was originally described by Bezzi (*3, p. 282*) in 1909. In his revision of this genus published in 1914 Hendel (*14, p. 13*) erected the new subgenus *Pseudodacus* for this beautiful species, which is separated from all other species of the genus by the wing pattern and general form of the body.

Described from Sao Paulo, Brazil. Specimens in the National Collection are from Sao Paulo, Brazil, December 26, 1931, and were taken by Max Kisliuk and C. E. Cooley on leaves and fruit of persimmon.

Host unknown.

The types are in the collection of the late Prof. M. Bezzi at Milan and in the collection of the Hungarian Museum at Budapest.

Anastrepha macrura Hendel.

(Plate 19, fig. 4.)

This species was originally described by Hendel (*14, p. 16*) in 1914. It is distinguished from all other species by the following characters: Three pairs of frontal bristles, all bristles of a deep reddish-yellow color; metanotum and postscutellum black, and the unusual wing pattern. Length of body, 8 mm., ovipositor sheath 5.5 mm.

Described from Paraguay, no date.

Host unknown.

The type is in the Hungarian National Museum and was examined by the writer.

Anastrepha robusta, n. sp.

(Plate 19, fig. 5.)

Male and female.—Dull luteous with the surface of the thorax and abdomen covered with short, dense, yellow hairs; the hairs along the sides of the abdomen longer and brownish in color; all macrochaetae black. Thorax with a broad, dark brown, transverse band on the posterior edge as long as the scutellum, humeri, a stripe on each side, extending from scutellum to the transverse suture; and a large indefinite area in front of the dark brown band, pale yellow; prescutellar row with the dorsocentrals very slightly forward; sternopleura present but weak (hairlike), yellow in color; scutellum pale yellow with four macrochaetae; metanotum and postscutellum reddish yellow without black markings. Abdomen only slightly longer than broad.

Male: Last abdominal segment about one and one half times as long as the preceding segment; two middle segments of equal width.

Female: Last segment very narrow; three preceding segments of nearly equal length; ovipositor short, robust, slightly darkened at apex.

Wing pattern golden yellow partly edged with pale brown: costal hyaline area broadly touching the third longitudinal vein and narrowly interrupted from the hyaline area involving the second basal cell; inverted V complete and definitely connected with the main pattern; a large hyaline spot involving the second basal cell, base of discal and extending into the first basal cell. Pattern of the wing of one female the same but much darker in color.

Length 8 mm. without ovipositor; length of ovipositor 2.25 mm.; wing 8 mm. Male of same size except wing, which is 8.5 mm.

Described from three specimens.

Type, female, allotype, male, Cat. No. 50508, U. S. N. M.

Type from Cayuga, Guatemala, VIII–15, W. Schaus collector; allotype from Cordoba, Mex., XI.6, F. Knab collector. One paratype female from C. Bolivar, Venez. V. 14.98, from the collection of C. W. Johnson now in the Museum of Comparative Zoology. This paratype is slightly paler in color than the type; it appears to have been in liquid.

Anastrepha cordata Aldrich.

(Plate 19, fig. 6.)

This species was originally described by Aldrich (*2, p. 4*) in 1925. This unique looking specimen can be distinguished from all other species by the unusual wing pattern and the ovipositor sheath.

Described from Belize, British Honduras, no date.

Host unknown.

The type is in the U. S. National Collection and was examined by the writer.

Anastrepha grandis Macquart.

(Plate 19, fig. 7.)

This species was originally described by Macquart (*25, p. 340* (*212*)) in 1846 in the genus *Tephritis*. Loew (*20, p. 231*) in 1873 referred the species to *Acrotoxa*. Bezzi (*3, p. 284*) in 1909 referred the species to the genus *Anastrepha*. Hendel (*14, p. 14–15*) in 1914 placed it in the latter genus also. Fischer (*11, p. 303*) in 1932 made *schineri* Hendel a synonym of *grandis*. Dr. Hendel loaned the writer two specimens of *schineri* and the synonymy is correct. *A. grandis* is distinguished from all the other species of the genus by the wing pattern and the ovipositor sheath.

Described from New Grenada, no date. Specimens in the National Collection are from Rio Grande do Sul, Brazil, Nilopolis, Brazil, Nov. 16–18, 1931, Vicosa Minas Geraes, Brazil, Nov. 1928 (through Dr. R. H. Rolfe), Sao Paulo, Brazil, Dec. 26, 1931, Rio de Janeiro, Brazil, Dec. 11, 1931, all collected by M. Kisliuk and C. E. Cooley; S. Bernardino, Paraguay, K. Fiebrig collector; Chimbotes, Amazon, Peru, March 20, 1931, R. C. Shannon collector. The above specimens were captured on the foliage of Valencia orange, guava, and magnolia.

Reared from squash Nov. 1928, and from watermelon Dec. 11, 1931. Reared from oranges from the State of Rio Grande do Sul.

The type is in the collection of M. Bigot.

Anastrepha striata Schiner.

(Plate 19, fig. 8.)

This species was originally described by Schiner (*28, p. 264*) in 1868. Bezzi (*3, p. 283–285*) in 1909 and Hendel (*14, p. 15–16*) in 1914 mentioned the species in their revisions. The species may be distinguished from all others by the wing pattern and thoracic markings.

Described from females from South America. Specimens in the U. S. National Collection are from Port of Spain, Trinidad, January, 1914, and Arima, Trinidad, no date, F. W. Urich collector; near Juan Diaz, Panama, Ancon, Canal Zone, Oct. 1923, James Zetek collector; La Sabanas, Panama, April 5 to May 9, 1926, and Frijoles, Canal Zone, April 12, 1926, C. T. Greene collector; Cuernavaca, Mexico, Sept. 1923, E. G. Smyth collector; La Ceiba, Honduras, no date, E. Kostal collector; Cavinas Beni, Bolivia, 1921–22, W. M. Mann collector; San Pedro de Montes de Oca, Costa Rica, November 4, 1932, C. H. Ballou collector; and San Jose, Costa Rica, no date, A. T.

Tonduz collector. Some specimens were captured on *Inga ingoides*.

Reared from fruit of *Calyptranthes tondusii* and from guava.

The type is in the Vienna Museum.

Anastrepha atrigona Hendel.

(Plate 19, fig. 9.)

This species was originally described by Hendel (*14, p. 20*) in 1914 and is distinguished from all other species by the wing pattern.

Described from Surinam, May Sept. Also a female specimen in the collection of Dr. Hendel labeled "Amazonas, Dampfer, Prainha, Monte Alegre, May 30, 1927, H. Zerny collector." A female specimen in the National Collection from Amazon River, Aiary to Manaos, Brazil, Sept. 20–21, 1930, Holt, Blake, and Agostini collectors.

Host unknown.

Type, male, in the collection of Dr. F. Hendel. The type was examined by the writer.

Anastrepha tricincta Loew.

(Plate 19, fig. 10.)

Length 7 mm. without ovipositor sheath, which is 3.5 mm.

This species was originally described by Loew (*20, p. 225*) in 1873 in the genus *Trypeta* and later (*20, p. 227*) he erected the new genus *Acrotoxa*. Prof. M. Bezzi (*3, p. 284*) in 1909 placed the species in the genus *Anastrepha*. Dr. Hendel (*14, p. 14–16*) in 1914 followed Bezzi. This species is distinguished from all others by its wing pattern and the dorsal black markings.

Described from Haiti, no date. Specimens in the U. S. National Collection are from Bolondron, P. de Gruanaha, Cabibres, Cuba, March 11 and April 11, 1924, S. C. Bruner collector, and Baracao de Banta, Cuba, June 19, 1930, E. Kostal collector; Isle of Pines, June, 1924, G. Moznette collector. Specimens were captured on mango, orange, and grapefruit.

Host unknown.

Type in the Museum of Comparative Zoology, Cambridge, Mass. Type examined by the writer.

Anastrepha longimacula, n. sp.

(Plate 19, fig. 11.)

Male and female.—Deep yellowish amber in color, subshining, with the humeri, a narrow area along the pleural suture, and the scutellum pale yellow. All bristles black; the short fine hair covering the dorsum of the thorax and abdomen yellow, in certain lights this hair appearing darker on the abdomen. Antennae reaching three fourths the distance to the oral margin; third joint twice as long as wide in the male and two and one half times as long as in the female; arista long, slender, dark, with short pubescence and with the base yellow and swollen; palpus broad with the bristles pale, darker at the apex; four or five pairs of frontals; a reclinate pair on each side above the frontals; ocellar triangle small, black, with a small pair of ocellars. Prescutellar row with the dorsocentrals set well forward; one sternopleural bristle; metanotum concolorous with the thorax and without markings. Wing with the hyaline costal area slightly open or just barely closed on the third longitudinal vein; wing pattern mostly brown with a little yellow through the central area; inverted V complete, narrowly connected with the main pattern; a large dark brown to nearly black area of equal width on the costa extending from the base of the wing to the tip of the first longitudinal vein.

Male abdomen about as broad as long, last segment one and one half times as long as the preceding. Female abdomen about as broad as long; posterior segments of about equal length; ovipositor sheath slightly shorter than the abdomen, more reddish, robust, with the apex darkened.

Length of female 5.5 mm. without ovipositor sheath, which is 1.75 mm.; wing 7 mm.

Length of male 5.5 mm.; wing 6 mm.

Described from 9 specimens: Hope, Jamaica, VI 16–17, 1931, Kisliuk and Cooley collectors; Jamaica, intercepted at Boston, Sept. 8, 1925, C. A. Davis collector; Mandeville, Jamaica, no date, T. D. A. Cockerell collector; and Kingston, Jamaica, Sept. 9, 1917, Harold Morrison collector.

Type, female, allotype, male, Cat. No. 50514 U. S. N. M. Both from Hope, Jamaica.

Paratypes, 3 males, 4 females.

Host unknown.

Adults collected on leaf of cocoa tree and on leaf of mango.

Note. Two of the specimens show a dark, faintly infuscated spot on the posterior edge of the thorax in front of the scutellum.

The wing of this species shows a slight resemblance to that of *A. cryptostrepha*, but on examination the pattern is entirely different and there is a difference in the character of the bend of the fourth longitudinal vein.

Anastrepha suspensa Loew.

(Plate 19, fig. 12.)

This species was originally described by Loew (*19, p. 69*) in 1862 in the genus *Trypeta*. Schiner (*28, p. 263*) in 1868 erected the genus *Anastrepha*. Loew (*20, p. 222 and 227*) in 1873 erected the genus *Acrotoxa*. Bezzi (*3, p. 284*) in 1909 placed this species in *Anastrepha*. Hendel (*14, p. 16*) in 1914 also referred this species to *Anastrepha*. Sein (*29, p. 190–191*) in 1933 described a new species, *unipuncta*, which is really a synonym of *suspensa*. This species is distinguished from all the other species of the genus by the deep golden brown color, the wing pattern, and the dorsal black spot on the posterior edge of the thorax.

Described from Cuba, no date, Poey collector. Specimens in the U. S. National Collection are from Arecibo, P. R., July 27, 1931, to April 2, 1932, Anderson, Berry, Faxon, Mills and Oakley collectors; Villalba, P. R., Oct. 27, 1931, Anderson and Oakley collectors; Fajardo, P. R., Sept. 1, 1931, Martinez collector; Baraguá, Cuba, no date, L. C. Scaramuzza collector; Rio Piedras, P. R., February 5, 1932, Anderson and Mills collectors; and Bayamon, P. R., June 6, 1932, Oct. 28, 1932, Kisliuk and Ludlam collectors. Specimens were captured on guava, star apple, pomarrosa fruit, grapefruit, and sour orange, and adults taken at light.

Reared from the following fruits: guava (*Psidium guajava*), bitter almond (*Terminalia catappa*), plum (*Spondias lutea*), and *Chrysobalanus icaco*, rose apple or pomarrosa (*Eugenia jambos*), nispero (*Achras zapota*), grapefruit (*Citrus maxima*), sour orange (*Citrus aurantium*), Valencia orange (*Citrus aurantium*), Valencia orange (*Citrus sinensis*), kumquat (*Fortunella margarita*).

The type is in the Museum of Comparative Zoology and was examined by the writer.

The type has one very good character which Loew did not mention in the original description. On the dorsum of the thorax, at the middle of the posterior edge, is a black spot which sometimes extends onto the scutellum. This species is more of a deep golden brown color than a clay-yellow as stated by Loew. The wing pattern is mostly of a rich golden brown, the apex of the inverted V is definitely connected with the main pattern.

Anastrepha peruviana Townsend.

(Plate 20, fig. 1.)

This species was originally described by Townsend (*31, p. 345–346*) in 1913. Hendel (*14, p. 13–15*) in 1914 referred to the species in a footnote and in his table of species. It has been considered a synonym of *fraterculus* Wied. by some workers but the writer examined the types and is convinced that it is a good species which may be distinguished from all the other species of this genus by the black thoracic marking, the wing pattern, and the general pale color.

Described from Chosica, Peru, no date, and Sullana, Peru, issued March 5, 1912, from peaches, C. H. T. Townsend collector. Other specimens in the U. S. National Collection are from Trujillo, Peru, May 26, 1932, Malamba, Peru, March 31, 1932, Asenda Caballera, Peru, March 31, 1932, Est. Inf. Sugarcia, 13 km. north of Lima, Peru (no date), Arica, Chile, February, 1929, La Maita, Arica, Chile, February 7–8, 1932,

M. Kisliuk and C. E. Cooley collectors; and Boa Vista, Brazil, February 5, C. H. T. Townsend collector.

Reared from peaches and *Annona cherimola*.

Additional specimens in the U. S. National Collection were collected on the fruit of pomegranate, fig, peach, orange, mango, and grape. Some specimens were captured on the leaves of loquat, avocado, and guava.

Anastrepha distans Hendel.

(Plate 20, fig. 7.)

This species was originally described by Hendel (*14, p. 17*) in 1914. It is separated from all the other species of the genus by the wing pattern. A specimen was loaned to the writer for study by Dr. Hendel.

Described from Peru, Meshagua, October. Specimens in the U. S. National Collection are from Casa Sr. Perez, 2 km. west of Santa Eulalia, Peru, no date; near Sao Paulo, Brazil, Dec. 27, 1931; Piracicaba, Sao Paulo, Brazil, Dec. 29, 1931; Campinas and Louviera, Sao Paulo, Brazil, Dec. 28, 1931; Matula Salvador and Cabulla, Bahia, Brazil, Dec. 11, 1931; M. Kisliuk and C. E. Cooley collectors.

Host unknown. Specimens have been collected on pomegranate, peach, Valencia orange, sour orange, guava, apple, plum, grape, sapodilla, persimmon, *Citrus medica*, and *Eugenia* sp.

Anastrepha distincta, n. sp.

(Plate 20, fig. 2.)

Male and female.—Entire insect deep luteous yellow, subshining; the face, front, occiput, humeri, sides of the dorsum of the thorax with a narrow stripe from the suture to the posterior corner, a narrow central stripe broadening on the posterior end, and the scutellum lemon-yellow; all bristles black; the short hairs covering the dorsum of the thorax and abdomen pale yellow. Antenna reaching three fourths distance to oral margin; third joint two and one half times as long as broad and rounded at the apex; arista dark, almost bare, with the base thickened and yellow. Palpus with yellow hairs, those at the apex faintly infuscated. Four pairs of frontal bristles in male and five in female; a reclinate pair above the frontals in each sex; ocellar triangle small, black. Prescutellar row present with the dorsocentrals set well forward; one sternopleural bristle, yellow and hairlike; metanotum of deep amber color with the sides broadly blackened. Wing: Hyaline costal area to the third vein, where it is interrupted; inverted V complete, disconnected, apical portion pale yellow, remainder brownish.

Male: Abdomen slightly longer than broad; second and third segments about equal in length; fourth segment twice as long as third.

Female: Abdomen about as long as broad; ovipositor sheath robust, deep reddish-yellow.

Length 7.5 mm. without ovipositor sheath, which is 3 mm.; wing 7.5 mm.

Male 7 mm.; wing 7 mm.

This species resembles *peruviana.*

Described from 65 specimens from estate of M. Carmona Ferranefe, Huerta Palmarei Malambo, Peru, March 31, 1932; estate of I. Gonzales, 2.5 km. north of Ferranefe, Peru, March 20, 1932; Hacienda Higuirilla Surco, Peru, March 17, 1932; Hacienda Ouefe, J. R. Ugaz, Chiclaya, March 21, 1932, Huerta Santa Rosa, H. Gonzalez, Lambeyeque, Peru, March 21, 1932; Casa Sr. Perez, 2 km. west Santa Eulalia, Peru, no date; Kisliuk and Cooley collectors.

Type, female, allotype, male, Cat. No. 50513, U. S. N. M.

Host unknown.

Adults collected on leaf and fruit of mango, pomarosa, orange, quince, guava, *Annona cheromola,* leaf of *Inga feuillei.*

Anastrepha panamensis, n. sp.

(Plate 20, fig. 8.)

Male and female.—Deep golden yellow, translucent. All bristles black; the fine short hair on the thorax and abdomen pale yellow. Antenna reaching about three fourths the distance to the oral margin; third joint slightly deeper yellow, about two and one half to three times as long as broad, rounded at the apex; arista dark, with short pubescence, the base slightly swollen and yellow. Palpus broad, yellow, with yellowish bristles. Frontal bristles varying from three to five pairs; a reclinate pair on each side above the frontals, the upper bristle slightly smaller, ocellar triangle small, black, ocellar bristles quite small. Prescutellar row in a straight line; no sternopleural; metanotum deep reddish-brown without black markings. Abdomen of the male slightly longer than broad; last segment about one and one half times as long as the preceding; in the female the abdomen is about as broad as long with the segments of nearly equal length. Wing pattern alike in both sexes; hyaline costal area reaching the third vein, where it is broadly interrupted; inverted V decidedly disconnected, complete, but the color weaker at the apex where the two arms meet at the third vein.

Length of female 7 mm. without ovipositor sheath, which is 3 mm.; wing 7.5 mm.

Male 6 mm.; wing 6 mm.

Described from two males and two females, Barro Colorado, Island, Canal Zone.

Type, female, allotype, male; Cat. No. 50510, U. S. N. M.; paratypes, male and female (ovipositor sheath broken).

Reared from fruit of wild cainito (*Chrysophyllum cainito*). Flies emerged March 21–24, 1930.

Anastrepha ludens Loew.

(Plate 20, fig. 3.)

This species was originally described by Loew (*20, p. 223*) in 1873 in the genus *Trypeta;* then Loew (*20, p. 227*) placed the species in the genus *Acrotoxa*. Johnson (*16, p. 53–57*) described the female in 1898. Bezzi (*3, p. 284*) in 1909 referred the species to *Anastrepha*. Hendel (*14, p. 14–15*) in 1914 referred the species to this latter genus also. It is distinguished from all the other species in the genus by the wing pattern and the ovipositor sheath. Some good characters not mentioned in the original description are as follows: In both sexes the dorsum of the thorax with a blackish spot at middle of posterior edge; metanotum with or without a black spot on each side; postscutellum with a black spot on each side.

Described from Mexico, no date. Specimens in the U. S. National Collection are from Guanajuato, Mexico, A. Duges collector; Morelos, Mex., no date, A. Koebele collector; Mexico City, January and February 3, 1898, Cordoba, Mex., March 2, 1908, F. Knab collector; Tampico, Mex., January and March 3, 1913, T. E. Holloway collector; Los Condes, Mex., February 3, 1898, A. Koebele collector; Matamoros, Mex., Oct. 15–Nov. 12, 1929, A. V. Smith collector; Laredo, Tex., May 8, 1924 (material from Mex.), A. A. Stalmach collector; Mission, Tex., no date, and Weslaco, Tex., February 10, 1932, G. M. Douglas collector.

Reared from grapefruit, January, 1913, and April 2, 1913. Also reared from orange and mango.

The type (male) is supposed to be in the Museum of Comparative Zoology but only the pin remains.

Anastrepha passiflorae, n. sp.

(Plate 20, fig. 9.)

Male and female.—Very much like *A. zeteki*, n. sp., but differs in the following characters: Entire insect deeper yellow and subshining. Thoracic stripes indistinct. Antenna reaching nearly to oral margin; third joint about two and one half times as long as wide. Three or four frontal bristles on each side; ocellar pair usually small. Two acrostichal bristles just before the scutellum and slightly behind the dorsocentrals; one dorsocentral on each side located definitely anteriorly to the acrostichal pair; no sternopleural bristle. Wing pattern mostly clay-yellow with a slight infuscation of brown in the third posterior cell, along the tip of the apical crossband and the greater portion of both arms of the inverted V; hyaline costal area reaching the third longitudinal vein, and very broadly interrupted on this vein; inverted V complete, broadly connected at its apex with the main pattern; inner arm of V broadly and outer arm narrowly deep brown; width of apical crossband almost equal to length of apical crossband.

Female: Abdomen twice as long as wide; fifth abdominal segment not much wider than the fourth; ovipositor a little shorter than the thorax and abdomen together, only slightly enlarged on the basal half.

Length of female 8–8.5 mm. without ovipositor sheath, which is 5.6–6 mm. long; wing 9 mm. long.

Male: Fifth abdominal segment twice as wide as the fourth; fifth with a marginal row of black bristles.

Length of male 8 to 9 mm.; wing 8–9 mm. long.

Described from 44 specimens from Barro Colorado Island, Canal Zone, June 7–22, 1927, I. Molino collector, Z–2744 and Z–3042, and one specimen from Barro Colorado Island, C. Z., April 21, 1929, on passion flower, S. W. Frost collector.

Type, female, allotype, male, Cat. No. 50506 U. S. N. M.; paratypes, males and females.

Reared from fruit of *Passiflora vitifolia* by James Zetek.

Anastrepha zeteki, n. sp.

(Plate 20, fig. 4.)

Male and female.—Entire insect pale yellow, subshining, with a faint, brownish stripe on each side of the dorsum of the thorax extending forward and fading before reaching the suture. All bristles brown to nearly black; the short fine hair covering the thorax and abdomen pale yellow. Antenna reaching three fourths the distance to the oral margin; third joint twice as long as broad, with the apical end slightly narrower and rounded at apex; arista long, slender, faintly pubescent, dark brown with the basal fourth yellow. Palpus strongly curved on the basal side, with the bristles yellow. Four to six frontal bristles on each side; two pairs of large, reclinate bristles on upper side of front; inner and outer verticals large; ocellar bristles small, ocellar triangle deep brown with yellow ocelli. Prescutellar row of four bristles in a straight line; two postalar bristles in the same line with the prescutellar; one sternopleural bristle; a small black spot below postalar callosity; metathorax without black marking. Abdomen about twice as long as wide.

In the female the fifth abdominal segment about equal in length to the fourth; ovipositor sheath cylindrical, enlarged at the base, with the tip dark brown; length slightly greater than head, thorax, and abdomen combined. Wing pattern pale honey yellow; hyaline costal area extending to the third longitudinal vein; entire second basal cell, basal fourth of discal cell, and a large spot the width of the first basal cell hyaline; this spot is broadly separated from the costal hyaline area on the third vein by the yellow pattern; the inverted V rather faint, mostly gray except the apical portion of the inner arm, which is faintly yellowish; the V reaching the third vein and broadly disconnected from the diagonal yellow band.

Length of female 7.5 mm. without ovipositor sheath, which is 8 mm.; wing 8 mm.

Male: Fifth abdominal segment twice as long as fourth, three large bristles at each apical angle.

Length of male 8 mm.; wing 8 mm.

Described from 3 specimens, Barro Colorado Island, Canal Zone, James Zetek collector, No. Z-3279.

Type, female, allotype, male, Cat. No. 50511, U. S. N. M.; paratype, female.

Reared from *Chrysophyllum panamense* Pittier (a small star-apple native to Panama).

Related to *parallela* Wied.

Anastrepha leptozona Hendel.

(Plate 20, fig. 10.)

This species was originally described by Hendel (*14, p. 19*) in 1914. It is distinguished from all the other species of the genus by the wing pattern.

Described from Bolivia, Mapiri, February. Specimens in the U. S. National Collection are from Puerto Barrios, Guatemala, April 20, 1923, E. G. Smyth collector; Cayuga, Guat., Aug. 1915, W. Schaus collector; Barrios, Guat., Jan. 28, 1912, Mrs. W. P. Cockerell collector; Antigua, Guat., June 23, 1923, E. G. Smyth collector; La Ceiba, Honduras, no date, E. Kostal collector; Salvador, Bahia, Brazil, Dec. 11, 1931, M. Kisliuk and C. E. Cooley collectors; and Las Cuevas Road, Trinidad, February, 1932, F. W. Urich collector. Specimens were collected on *Eugenia sp.* and *Rheedia sp.*

Host unknown.

The type is in the Dresden Museum.

Anastrepha similis, n. sp.

(Plate 20, fig. 5.)

Female.—Dull, translucent, luteous yellow. All bristles black; the fine short hair on the surface of the thorax and abdomen pale yellow. Antenna reaching three fourths the distance to the oral margin; third joint about two and one half times as long as broad, rounded at apex; arista long, slender, pubescent, brown above with basal portion thicker and yellow. Palpus broad, bristles yellow, those at apex longer and black. Three pairs of frontal bristles; an upcurved pair of bristles on each side above frontals. Prescutellar row present, with the outer bristle slightly forward; no sternopleural bristle. Metanotum without black markings. Abdomen about as broad as long; second segment slightly longer than the third; third and fourth segments of equal length; ovipositor sheath slightly longer than abdomen. Wing pattern golden-yellow edged with deep brown; hyaline costal area continuous to and including the second basal cell; inverted V complete, disconnected, arms brown, pale yellow at apex, where they join.

Length 7 mm. without ovipositor sheath, which is 2.5 mm.; wing 7 mm.

Described from two females.

Type, Cat. No. 50516, U. S. N. M., Cabima, Panama, May

17, 1911, August Busck collector. Paratype, Bonito Prov., Pernambuco, Brazil, I.2.83.

Host unknown.

Adult collected on cotton.

Anastrepha pallens Coquillett.

(Plate 20, fig. 11.)

This species was originally described by Coquillett (*6, p. 35*) in 1904. Hendel (*14, p. 14–15*) mentioned it in his revision. It is distinguished from all the other species of the genus by the wing pattern, thoracic markings, and tri-colored scutellum.

Described from a male, Brownsville, Tex., June. Other specimens in the U. S. National Collection are from Brownsville, Tex., Aug. 8, 1931; Mission, Tex., no date, C. J. Volz collector; Mission, Tex., Aug. 11, 1931; Weslaco, Tex., Feb. 10, 1932, G. V. Harren collector; Donna, Tex., reared May 16, 1932, J. W. Monk collector; and Tegucigalpa, Honduras, no date, F. J. Dyer collector.

Reared from berries of *Bumelia angustifolia.* Some specimens were captured in traps in trees of grapefruit and orange.

Female.—Very much like the male except in the following characters: Near the posterior margin on the dorsum of the thorax there are usually three blackish spots but sometimes the middle one is missing. Each abdominal segment is paler yellow along the apical edge. Ovipositor sheath slightly enlarged on the basal half, cylindrical, slender on apical half, blackish at the tip.

Length 6 mm. without ovipositor sheath, which is 3 mm.; wing 7 mm. long.

Anastrepha braziliensis, n. sp.

(Plate 20, fig. 6.)

Male and female.—Deep golden yellow, subshining, with a faint infuscation at each posterior angle of the thorax, where the scutellum joins; humeri, pleural suture, a narrow line on each side of the dorsum from the suture to the posterior edge, a narrow, indefinite central stripe which is broader posteriorly, and the scutellum all lemon-yellow. All bristles black; the fine short hairs on dorsum of thorax and abdomen pale yellow. Antennae reaching about three fourths the distance to the oral margin; third joint about two and one half times as long as wide; arista long, blackish, faintly pubescent, base yellow and slightly thickened; frontal bristles varying from three to five pairs; two reclinate bristles on each side above the frontals, the upper bristle smaller; ocellar triangle black with two very small ocellar bristles; palpus fairly broad with yellow hairs, the apical ones sometimes black. Prescutellar row with the dorsocentral directed forward; metanotum and postscutellum slightly darker yellow, with a broad black stripe on each side. Abdomen of male not much longer than broad; the last segment about one third longer than the preceding. In the female the abdomen about as broad as long and segments subequal. Wing pattern more brown than yellow; hyaline costal area continuous and including the second basal cell; the inverted V decidedly disconnected, complete with the arms faintly connected and reaching the third vein; the V dark brown with a faint tinge of yellow at the apex.

Length of female 5–6 mm. without ovipositor sheath, which is 1.75–2 mm.; wing 6–7 mm.

Male 5.5–6 mm.; wing 5–6 mm.

Described from 83 specimens. Minas Geraes, Brazil, Dec., 1931. Kisliuk and Cooley collectors, and Vicosa, Minas Geraes, Brazil, E. J. Hambleton collector, reared from grapefruit 1930.

Type, female, allotype, male, Cat. No. 50518, U. S. N. M.

Reared from grapefruit 1930; also on plum, Minas Geraes, Brazil, Dec. 19, 1931, Kisliuk and Cooley collectors.

Anastrepha punctata Hendel.

(Plate 20, fig. 12.)

This was originally described by Hendel (*14, p. 19*) in 1914 in his revision. C. R. Fischer (*12, p. 83*) in 1933 gave a redescription. The species is distinguished from all the other species of the genus by the wing pattern and the spots on the dorsum.

Described from S. Bernardino, Paraguay, March. Specimens in the U. S. National Collection are from Sao Paulo, Brazil, December 27–28, 1931, M. Kisliuk and C. E. Cooley collectors. The latter specimens were captured on plum and the leaf of Solanum.

Host unknown.

The types are in the Hungarian National Museum.

Anastrepha hendeli, n. sp.

(Plate 21, fig. 1.)

Male and female.—Entire insect honey yellow, translucent, with a black spot near each posterior angle of the thorax where the scutellum joins. All bristles yellow with their apices brownish; the short fine hair covering the dorsal surface of the thorax and abdomen yellow. Antenna reaching three fourths distance to oral margin; third joint twice as long as wide with the apical end slightly narrower and rounded at apex; arista long, slender, faintly pubescent, brownish; basal portion yellow and slightly swollen. Palpus strongly curved on basal side, with the bristles brownish. Usually three pairs of frontal bristles (sometimes two or four bristles on one side), a reclinate pair on each side of the upper part of the front; inner verticals large; the outer verticals somewhat shorter; postvertical pair present; ocellar triangle small, black, with three yellow ocelli. Prescutellar row of four bristles, outer ones slightly forward;

other bristles normal; central thoracic stripe yellowish white, bifid at base and reaching almost to apical edge of thorax; each lateral stripe pale, reaching forward to transverse suture; humerus pale yellow with the color extending backward but not reaching the transverse suture; one sternopleural bristle; scutellum with four large bristles; metanotum deep yellow but without black markings. Abdomen about as broad as long.

In the female the ovipositor sheath is about as long as the abdomen, with the apex narrowly infuscated; fifth abdominal segment narrower than the fourth. Wing pattern honey-yellow with some gray along outer edge of the diagonal band just beyond tip of anal cell, at apex of second longitudinal vein, at tip of third vein, and end of each arm of the inverted V; the hyaline costal area extending diagonally across the wing including the entire second basal cell; inverted V decidedly disconnected from the diagonal yellow band and the two arms feebly connected at the third longitudinal vein; a black spot at the costal end of the humeral crossvein, one at costal end of auxiliary vein, one at base of fourth vein, and another at bifurcation of second and third veins; third longitudinal vein arcuate opposite the posterior crossvein. In the male the fifth abdominal segment nearly twice as wide as the fourth; four marginal macrochaetae on each side.

Length of female 5 mm. without ovipositor sheath, which is 1.9 mm.; wing 6 mm.

Male 5 mm.; wing 5.9 mm.

Described from 8 specimens. Sao Paulo, Brazil, December 26–28, 1931, Max Kisliuk, Jr., and C. E. Cooley collectors.

Holotype, female, allotype, male, Cat. No. 50517, U. S. N. M. Paratypes 1 male and 5 females.

Related to *punctata* Hendel.

Host unknown.

Adults collected on leaf of plum and leaf of persimmon.

Anastrepha nigripalpis Hendel.

(Plate 21, fig. 6.)

This beautiful large species was originally described by Hendel (*14, p. 18*) in 1914. It is distinguished from all other species of the genus by the wing pattern and the black marking on the palpi.

Described from (female), Bolivia-Mapiri, S. Antonio, February, 1,000 m; (male) Peru, Meshagua, Urubambafluss, October.

Host unknown.

The female type is in the collection of Dr. F. Hendel and was examined by the writer. The male is in the Dresden Museum.

Anastrepha obscura Aldrich.

(Plate 21, fig. 2.)

This species was originally described by Aldrich (*2, p. 5*) in 1925 and is distinguished from all other species by the wing pattern and the large size.

Described from Maraval, Trinidad, W. Büthn collector. There are also additional specimens from Trinidad, F. W. Urich collector, in the U. S. National Collection.

Reared in February and March, 1918, from larvae in *Lucuma multiflora* by W. Büthn.

Types are in the U. S. National Collection and were examined by the author.

Anastrepha bivittata Macquart.

(Plate 21, fig. 7.)

This species was originally described by Macquart (*24, p. 379* (*222*)) in 1843 as a species of *Urophora*. Loew (*20, p. 231*) in 1873 placed the species in *Acrotoxa*. Prof. Bezzi (*3, p. 284*) in 1909 placed the species in *Anastrepha*; then Hendel (*14, p. 16*) in 1914, in his revision, used the same generic name as Bezzi. The species is distinguished from all the other species of this genus by the unusual wing pattern.

Described from a single specimen from an unknown locality. The species is not represented in the U. S. National Collection. I know this species only from the description and the picture of the wing by Macquart. It is a very distinct species.

Host unknown.

The type is in the Museum at Para, Brazil, according to Prof. M. Bezzi.

Anastrepha hamata Loew.

(Plate 21, fig. 3.)

This species was originally described by Loew (*20, p. 229*) in 1873 in the genus *Trypeta*. Bezzi (*3, p. 284*) in 1909 placed it in the genus *Anastrepha*. In his revision of this group in 1914 Hendel (*14, p. 14–15*) retained it in this latter genus. Distinguished from the other species by the wing pattern.

Described from Brazil (no date). Specimens in the U. S. National Collection are from Brazil, A. Compere collector, and a specimen from the Amazon River, Aiary to Manaos, Brazil. Sept. 20–21, 1930, Holt, Blake, and Agostini collectors.

Host unknown.

The location of the type is unknown.

Anastrepha ocresia Walker.

(Plate 21, fig. 8.)

This species was originally described by Walker (*32, p. 1016*) in 1849 in the genus *Trypeta*. Loew (*20, p. 337*) in 1873 refers the species to his genus *Acrotoxa*. Bezzi (*3, p. 283–285*) in 1909 placed it in the genus *Anastrepha*. Hendel (*14, p. 14, 15*) in 1914 placed this species in the same genus as Bezzi. The species is distinguished from all the other species of the genus by the wing pattern.

Described from Jamaica. Not represented in the U. S. National Collection.

Host unknown.

Type, female in the British Museum.

The writer had some difficulty in distinguishing this species from the description. Walker (*32, p. 1016*) states that the "sucker" (proboscis) and the palpi are pitchy. Miss D. Aubertin, of the British Museum, furnished a photograph of the wing and in a note stated that the "proboscis and palpi are tawny." Apparently Walker's statement is incorrect.

Anastrepha tripunctata van der Wulp.

(Plate 21, fig. 4.)

This species was originally described by van der Wulp (*36, p. 405*) in 1899. Bezzi (*3, p. 284–286*) in 1909 redescribed the species in his revision. Hendel (*14, p. 14–16*) in 1914 also mentioned the species in his revision. This species is distinguished from all the other species in the genus by the black spot at the apex of the scutellum, and the wing pattern.

Described from Mexico.

Host unknown.

Types in the British Museum.

Anastrepha cryptostrepha Hendel.

(Plate 21, fig. 9.)

This species was originally described by Hendel (*14, p. 14, 17*) in 1914. It is distinguished from all the other species in the genus by the combination of unusual wing pattern and the ovipositor sheath, which is 4 mm. long. (See *conjuncta*, a much larger species.)

Described from Meshagua, Urubamba River, Peru, October.

Host unknown.

The type male is in the Dresden Museum and the type female in the collection of Dr. Hendel. The female was examined by the writer.

Anastrepha conjuncta Hendel.

This species which was originally described by Hendel (*14, p. 14, 17*) in 1914, is distinguished from all the other species by the wing pattern. (See *cryptostrepha*, a much smaller species.)

Described from Mapiri, Sarampioni, Bolivia; January, 700 m.

Host unknown.

Type in the Dresden Museum.

I did not see the type of this species but according to Dr. Hendel it is larger (13 mm.) than *cryptostrepha*. The wing pattern is quite similar but the curve of the fourth longitudinal vein is much broader in *conjuncta*.

Anastrepha sylvicola Knab.

(Plate 21, fig. 5.)

This species was originally described by Knab (*17, p. 146*) in 1915 and is distinguished from all other species by the wing pattern and the red bristles on head and thorax.

Described from Trinidad, West Indies, June, 1914, F. W. Urich collector. There are other specimens in the U. S. National Collection from Port of Spain, Trinidad, October 29, 1931, "resting on guava," Kisliuk and Cooley collectors.

Reared from unknown fruit in forest.

Types in the U. S. National Collection were examined by the writer.

Anastrepha urichi, n. sp.

(Plate 22, fig. 1.)

Female.—Deep luteous, subshining, with the surface of the thorax and abdomen covered with short golden-yellow hair; thorax and abdomen of uniform color. All bristles reddish yellow with their tips darkened. Antenna reaching three fourths the distance to the oral margin; third joint two and one half times as long as wide, with the apex rounded; arista very long, slender, faintly pubescent, brownish; basal portion yellow and slightly swollen. Palpus dull luteous, broadly infuscated along the apical edge; proboscis badly stained; bristles yellow. Four pairs of frontal bristles; a large reclinate bristle on each side of the upper part of the front; ocellar triangle very small, black, with three yellow ocelli. Thorax with prescutellar row with the outer or dorsocentrals slightly forward; no sternopleural bristle; scutellum with four bristles; metanotum and postscutellum reddish yellow without black markings. Abdomen about as broad as long; last two segments of equal width and each segment about three fourths the width of the preceding segment; ovipositor sheath deep reddish brown, slightly darkened at tip, about one and one half times as long as the abdomen; basal two thirds much thicker than the remaining portion, tapering very slightly toward apical portion; apical third quite slender and of equal diameter to the tip. Wing pattern deep yellowish brown edged with a much darker brown; hyaline costal area quite pointed and not quite reaching the third vein; inverted V quite broad, mostly dark brown and broadly connected at apex with main pattern; broad inner arm of V connected, along fourth vein, with main pattern; an elongated hyaline spot in middle of first basal cell; second basal cell brownish yellow.

Length 8 mm. without ovipositor sheath, which is 4.5 mm. long. Wing 9 mm. long.

Described from one specimen labeled "Trinidad, F. W. Urich, v.v. 14/6/19."

Host unknown.

Type, female, Cat. No. 50507, U. S. N. M.

Anastrepha flavipennis, n. sp.

(Plate 22, fig. 6.)

Male and female.—Entire insect honey yellow, translucent. All bristles reddish yellow; the fine short hair covering dorsal surface of thorax and abdomen golden yellow. Antenna reaching almost to oral margin; third joint slightly narrowed and rounded at apex; two and one half times as long as the second; arista slender, dark brown and short pubescent; base yellow and slightly swollen. Palpus and all its bristles yellowish. Three pairs of frontal bristles in the male, four pairs in the female. Each with two pairs of ocellar bristles, reclinate. Prescutellar row of four bristles almost in a straight line; sternopleural absent. Metathorax pale yellow.

In the female the abdomen is about as long as wide; ovipositor almost as long as abdomen. Wing with the hyaline costal area interrupted on third vein, interruption about one half length of anterior crossvein; an elongated hyaline spot in first basal cell just before base of discal; second basal cell deep yellow like main pattern; width of apical crossband about equal to length of anterior crossvein; inverted V complete, broadly connected at its apex with main pattern; stigmal area deep golden brown.

In the male the wing is the same except that it is slightly narrower and the stigmal area is only slightly infuscated with brown. Abdomen a little longer than broad; last segment twice as wide as preceding.

Length of female 7 mm., without ovipositor sheath; ovipositor 2.5 mm.; wing 8 mm. Male 7.8 mm; wing 6–7 mm.

Described from two specimens, male and female, from Boa Vista, Brazil, ♂–20, Jan. ♀–5 Feb., C. H. T. Townsend collector; one male from Corozal, Canal Zone, Panama, at light, C. P. Crafts collector; one male from Cãno Saddle, Gatun Lake, Panama, August, 1923, R. C. Shannon collector.

Host unknown.

Type, female, allotype, male, Cat. No. 50509, U. S. N. M.

Anastrepha trinidadensis, n. sp.
(Plate 22, fig. 2.)

Male and female.—Entire insect honey yellow, translucent. All bristles black; the short fine hair covering the dorsal surface of the thorax and abdomen yellow; the longer hairs on the sides of the abdomen blackish. Antenna reaching three fourths distance to oral margin; third joint slightly narrower and rounded at apex, two and one fourth times as long as second joint; arista long, slender, faintly pubescent, brown; basal portion yellow and slightly swollen. Palpus broad, bristles at apex black. Frontal bristles varying from three to five pairs. Prescutellar row with the dorsocentrals a little before the row; sternopleural bristle yellow, hair-like; metathorax deep yellow, with two black stripes. In the female the abdomen is about as long as broad; ovipositor robust, cylindrical, as long as last three abdominal segments. Wing with an interruption on the third vein equal to half the length of anterior crossvein; hyaline costal area reaching the third vein, with a slight trace of a constriction on the second vein; inverted V mostly brown, yellowish at its apex, where it is narrowly connected with the main pattern; width of apical crossband almost equal to length of anterior crossvein; stigmal area dark brown, the brown extending slightly behind the first vein.

In the male the abdomen is slightly longer than broad; the last segment about one and one half times as wide as preceding; wing like that of the female.

Length of female 6 mm., without ovipositor sheath; ovipositor 1.8 mm.; wing 7 mm. Male 6.5 mm.; wing 7 mm.

Described from 52 specimens.

Type, female, allotype, male, Cat. No. 50505, U. S. N. M.

Localities: Union Hall, St. Madeleine, Trinidad, B. W. I., October 13, 1931; Cedar Hill, St. Madeleine, Trinidad, B. W. I., October 15, 1931; Princes Town, Trinidad, B. W. I., October 25, 1931; St. Mary, Trinidad, B. W. I., October 24, 1931; Tabaquite, Trinidad, October 20, 1931; Carnage, Trinidad, October 13, 1931; Kisliuk and Cooley collectors.

Host unknown.

Adults collected on guava, sapodilla, *Cordia cylindrostachta*, and *Spondias ciruella*.

This species is very close to *ethalea* except in size and may ultimately prove the latter to be a variable species in size.

Anastrepha ethalea Walker.
(Plate 22, fig. 7.)

This species was originally described by Walker (*32, p. 1015*) in 1849 in the genus *Trypeta*. Loew (*20, p. 335*) in 1873 referred it to *Acrotoxa*. Bezzi (*3, p. 283*) in 1909 referred it to the genus *Anastrepha*. Hendel (*14, p. 14*) in 1914 referred the species to this latter genus. The species may be distinguished by the wing pattern.

Described from Para, no date. Specimens in the U. S. National

Collection are from Cedar Hill, St. Madeleine, Trinidad, B. W. I., October 15, 1931, M. Kisliuk and C. E. Cooley collectors. Specimens were collected on guava and sapodilla.

Host unknown.

Type in the British Museum.

Francis Walker (*32, p. 1015*) in 1849 states that the "sucker (proboscis) is pitchy." Miss D. Aubertin of the British Museum furnished the writer with a photograph of the wing of the type and stated that "the proboscis in *ethalea* appears to be brown, but it is rather overgrown with fungus." The specimens mentioned above have the proboscis deep yellow.

The type is 10 mm. long without the ovipositor sheath, which is 3 mm.

Anastrepha acidusa Walker.

(Plate 22, fig. 3.)

This species was originally described by Walker (*32, p. 1014*) in 1849 in the genus *Trypeta*. Loew (*20, p. 231*) in 1873 erected the genus *Acrotoxa*. Bezzi (*3, p. 284*) in 1909 placed the species in the genus *Anastrepha*. Hendel (*14, p. 15*) in 1914 also referred it to the latter genus. Sein (*29, p. 187*) in 1933 described the new var. *mombinpraeoptans*, which is a synonym. This species may be distinguished from all the other species of the genus by the wing pattern and the ovipositor sheath.

Described from Jamaica, no date. Specimens in the U. S. National Collection are from Tapia, Panama, June 15, 1922, James Zetek collector; Ancon, Canal Zone, and Panama City, April 11 and May 2–3, 1926, C. T. Greene collector; Costa Rica, no date, Boston No. 404; Damien, Haiti, July 30, 1930, E. Ducasse collector; Pétionville, Haiti, July 2, 1931, M. Kisliuk and C. E. Cooley collectors; Hope Gardens, Jamaica, June 16, 1931, Kisliuk and Cooley collectors; Rio Piedras, P. R., July 11, 1931, Oakley, Berry, and Anderson collectors; near Castria, St. Lucia, B. W. I., Sept. 12, 1931, Micaud, St. Lucia, B. W. I., Sept. 10, 1931, Stapleton, St. Kitts, B. W. I., Aug. 10, 1931, Gingerland, Nevis, B. W. I., Dominica, B. W. I., Sept. 19–21, 1931, Clark Hall, near Layon, Dom. Rep., near Trinite, Martinique, F. W. I., Lamentin, Martinique, F. W. I., all Sept. 3, 1931, Kisliuk and Cooley collectors; Loiza, P. R., July 18, 1931, Oakley and Anderson collectors; Bayamon, P. R., Aug. 5, 1931, R. G. Oakley collector; Ponce, P. R. May 10, 1932, R. G. Oakley, collector; Aibonito, P. R., Sept. 5, 1931, Oakley and Mills collectors; Mayaguez, P. R., Sept. 4, 1931, Oakley and Mills collectors; San Turce, P. R., Aug. 3, 1932, Kisliuk and Cooley collectors; Weslaco, Tex., January 4, 1933, G. V. Harren collector; and Key West, Fla., Oct., 1932, R. Hart collector. The above specimens were captured on the leaves of cocoa, cotton, cacao, guava, and almond, and on the fruit of guava, manjack (*Cordia sp.*), and pomarosa.

Reared from the following fruits: plum (*Spondias mombin* and *S. lutea.*), rose apple or pomarosa (*Eugenia jambos*), mango (*Mangifera indica*), and guava (*Psidium guajava*).

Type in the British Museum.

The writer had for study specimens compared with the type, also a photograph of the wing and critical notes on the type which were kindly furnished by Miss D. Aubertin of the British Museum. This species appears to be the common form in the West Indies. For a long time it was considered a synonym of *fraterculus*. After a careful study of the type of *A. fraterculus* Wied. and the above photograph and notes on *acidusa* Walker, I am convinced that it is a distinct species.

Anastrepha obliqua Macquart.

(Plate 22, fig. 8.)

This species was originally described by Macquart (*23, p. 464*) in 1835 in the genus *Tephritis* and in 1843 (*24, p. 382*) he described the male in the same genus. Loew (*20, p. 231*) referred the species to *Acrotoxa.* Bezzi (*3, p. 283*) in 1909 referred the species to *Anastrepha.* Hendel (*14, p. 13–15*) in 1914 used the same genus as Bezzi. This species is distinguished from all other species of this genus by the wing pattern.

Described from Cuba, no date. Specimens in the U. S. National Collection are from Cãno Saddle, Canal Zone, May 2, 1923, R. C. Shannon collector; La Ceiba, Honduras, no date, E. Kostal collector; and Barro Colorado Island, Canal Zone, Sept. 1930 and 1933, James Zetek collector.

Reared from fruit of *Quararibea asterolepis* Pittier by J. Zetek.

The location of the type is unknown.

The black markings on the metanotum are variable. In some specimens the metanotum is entirely yellow.

Anastrepha xanthochaeta Hendel.

This species was originally described by Hendel (*14, p. 18*) in 1914. It is distinguished from all other species of the genus by the wing pattern and the large bristles of the head, thorax, and legs, which are reddish yellow.

Described from Rio Grande do Sul, Brazil.

Host unknown.

The type is in the Wiener Hof-Museum. This species was not seen by the writer.

Anastrepha lambda Hendel.

(Plate 22, fig. 4.)

This species was originally described by Hendel (*14, p. 17*) in 1914 and is distinguished from all other species by the wing pattern and by its large size. Length 9 mm. without ovipositor sheath, which is 2.5 mm.

Described from Peru, Pini-Pini.

Host unknown.

Type in the Dresden Museum.

Anastrepha pseudoparallela Loew.

(Plate 22, fig. 9.)

This species was originally described by Loew (*20, p. 230*) in 1873 in the genus *Trypeta* but in the same paper (*20, p. 227*) he had erected the genus *Acrotoxa*. Bezzi (*3, p. 283–285*) in 1909 placed this species in *Anastrepha* and Hendel (*14, p. 14, 15*) in 1914 used this latter genus. The species is distinguished from all other species by the wing pattern and the ovipositor sheath.

Described from Brazil, no date. Specimens in the U. S. National Collection are from Sao Paulo, Brazil, no date; Trinidad, June 18, 1917, F. W. Urich collector; and Rurrenabaque Beni, Bolivia, October, 1921, W. M. Mann collector.

Host unknown.

Location of type unknown.

The metanotum is entirely yellow.

Anastrepha fraterculus Wiedemann.

(Plate 22, fig. 5.)

This species was originally described by Wiedemann (*34, p. 524–525*) in 1830 in the genus *Dacus*. Loew (*19, p. 70*) in 1862 described *Trypeta unicolor*, which is a synonym. Schiner (*28, p. 264*) in 1868 described *Anastrepha munda*, which is also a synonym of *fraterculus*. Loew (*20, p. 222*) in 1873 redescribed *fraterculus* and makes his *unicolor* a synonym. Loew (*20, p. 227*) placed the above species in his new genus *Acrotoxa*. Weyenbergh (*33, p. 165*) in 1874 described *frutalis*. Van der Wulp (*36, p. 404–405*) in 1899 referred *fraterculus* to *Anastrepha*. Bezzi (*3, p. 283*) in 1909 also used this latter genus. Hendel (*14, p. 18*) in 1914 also used *Anastrepha*. Brèthes (*5, p. 59*) in 1914 made *frutalis* Weyenb. a synonym. This species may be distinguished from all the other species of the genus by the wing pattern and the ovipositor sheath. The female is exactly like the male except in the sexual characters. The apex of the inverted V is broadly disconnected from the main pattern. The ovipositor sheath is about two thirds as long as the abdomen, or about 2 mm. long.

Described from Sao Paulo, Brazil, no date. Specimens in the U. S. National Collection are from Vicosa, Minas Geraes, Brazil, 1930, E. J. Hambleton collector; Sao Goncalo, Brazil, Nov. 23, 1931, near Tabera, Pernambuco, Brazil, Dec. 4, 1931, St. Mary, Trinidad, B. W. I., Oct. 24, 1931, Hermitage, St. Madeleine, Trinidad, Oct. 15, 1931, San Fernando, Trinidad, Oct. 24, 1931, Port of Spain, Trinidad, Oct. 29, 1931, all collected by M. Kisliuk and C. E. Cooley; Higuito, Costa Rica, no date, Pablo Schild collector; and Guatemala, March 22, 1931, D. M. Bates collector. Specimens collected on *Spondias ciruella*, sapodilla, guava, and Natal orange.

Reared from *Inga*, and grapefruit.

The type is in the Vienna Museum and was examined by the writer. Dr. H. Zerny of that museum loaned this type to Dr. Aldrich in order that the writer might make a careful examination of it. (The specimen was in remarkable condition considering that it was described in 1830.) *A. fraterculus* of authors included four species.

The type of *unicolor* Loew is in the Museum of Comparative Zoology, Cambridge, Mass., and was examined by the writer.

Anastrepha townsendi, n. sp.

(Plate 22, fig. 10.)

Female.—Dull, luteous yellow. Bristles black, except one large one on the cheek and sternopleural; the short hair covering dorsal surface of thorax and abdomen yellow. Antenna reaching almost to oral margin; third joint slightly narrower at apex, rounded, and three times as long as second segment; arista long and slender, dark brown, faintly pubescent; basal portion slightly thicker and yellow. Palpus yellow, bristles yellowish red. Three pairs of frontal bristles; two pairs of orbitals, upper pair about half the size of lower pair. Prescutellar row with the outer bristle slightly forward of the row; one sternopleural, small, reddish-yellow, hair-like. Metathorax deep reddish yellow, without black markings. Abdomen slightly longer than broad, last segment slightly wider than preceding. Ovipositor sheath almost as long as head and thorax together, enlarged on basal half, then cylindrical for a short distance and slightly widened at the apex. Wing pattern mostly deep golden yellow; hyaline costal area interrupted on the third vein for a distance equal to one half the length of anterior crossvein; width of apical crossband almost equal to length of anterior crossvein; inverted V complete, broadly disconnected from the main pattern; stigmal area long, narrow, deep brown, this color extending a little behind the first vein.

Length of female 10 mm. without ovipositor sheath, which is 5.4 mm. long; wing 10 mm.

Described from one specimen, Boa Vista, Brazil, X 8, C. H. T. Townsend collector.

Type, female, Cat. No. 50504, U. S. N. M.

Host unknown.

Anastrepha pallidipennis, n. sp.

(Plate 23, fig. 1.)

Female.—Very much like *A. zeteki*, n. sp., but differing in the following characters. Entire insect slightly darker. Dorsum of thorax with a broad, pale, central stripe extending from front edge to a short distance before scutellum; posterior end wider and bifid; a narrow, pale yellowish lateral stripe extending from posterior angle to transverse suture; all bristles black; the postalar bristle in the same line with the two acrostichals; a single dorsocentral bristle on each side decidedly forward of the acrostichals; no sternopleural bristle. Three frontal bristles on one side, four on the other. Third abdominal segment wider than fourth. Ovipositor sheath very slender, cylindrical, a little enlarged at the base and slightly shorter than the remainder of the insect. Wing pattern pale yellow; hyaline costal area broadly separated on the third vein from the rest of the first basal cell, the basal fourth of the discal, and the entire second basal cell; the inverted V mostly yellow, reaching the third vein and broadly separated from the diagonal yellow band.

Length 6 mm. without ovipositor sheath, which is 6 mm.; wing 11 mm.

Described from one specimen from Medellin, Colombia, Aug. 28, 1930, C. H. Ballou collector. Captured on *Passiflora quadrangularis* Col. 83.

Type, female, Cat. No. 50512, U. S. N. M.

Host unknown.

Anastrepha soluta Bezzi.

(Plate 23, fig. 6.)

This species was originally described by Bezzi (*3, p. 284*) in 1909 as a new variety but the present writer considers it a good species. It is distinguished from all other species by the wing pattern.

Described originally from Sao Paulo, Brazil, no date. Specimens in the U. S. National Collection are from the same locality and were determined by Prof. Bezzi.

Reared from pitanga (*Eugenia uniflora*) and from Ameixa do Para.

Types in the collection of the late Prof. M. Bezzi in Milan.

Anastrepha barnesi Aldrich.

(Plate 23, fig. 2.)

This species was originally described by Aldrich (*2, p. 3*) in 1925. It can be distinguished from all other species by the wing pattern and the very long ovipositor sheath, which is 9.5 mm.

Described from Cayuga, Guatemala, Feb. and March, W. Schaus and J. Barnes collectors.

Host unknown.

The types are in the U. S. National Collection and were examined by the writer.

Anastrepha consobrina Loew.

(Plate 23, fig. 7.)

This species was originally described by Loew (*20, p. 230*) in 1873 in the genus *Acrotoxa*. Bezzi (*3, p. 283*) in 1909 referred the species to the genus *Anastrepha*. Hendel (*14, p. 14, 15*) in 1914 referred it to the same genus. This species can be distinguished from all the other species of this genus by the wing pattern and the ovipositor sheath.

Described from Brazil, no date. Specimens in the U. S. National Collection are from Estado de Rio, Brazil, Dr. C. Lima collector (through M. Kisliuk and C. E. Cooley).

Reared from *Passiflora edulis*, January, 1930.

Location of type unknown.

Anastrepha chiclayae, n. sp.

(Plate 23, fig. 3.)

Male and female.—Deep golden-yellow, with the head, humeri, narrow band along pleural suture, and scutellum pale lemon yellow. All bristles black; short fine hairs on dorsal surface of the thorax and abdomen pale yellow. Antenna reaching, in the male one-half, and the female two thirds, the distance to the oral margin; third joint (male and female) slightly more than twice as long as wide; arista slender, dark, with short pubescence, the base yellow and slightly swollen; palpus broad with pale hairs which are darker at the apex; three pairs of frontal bristles; a reclinate pair on each side of the upper part of the front (in the male there are two additional large black bristles on the left side of the front just below this reclinate pair); ocellar triangle small, black (in the female there is one large bristle to the right of the triangle), ocellar bristles small. Prescutellar row with the dorsocentrals set forward (in the female the acrostichal pair entirely wanting), no sternopleural bristle; metanotum golden yellow without black markings. Wing pattern mostly yellow; hyaline costal area continuous to and including the second basal cell; inverted V complete, narrowly disconnected from the main pattern (in one male the V narrowly connected).

Male abdomen about twice as long as broad; last segment one and one fourth times as long as the preceding. Female abdomen nearly as broad as long, the last three segments of nearly equal length; ovipositor sheath about as long as abdomen, without black at tip.

Length of female 6.5 mm. without ovipositor sheath, which is 2.25 mm.; wing 7 mm.

Length of male 6 mm.; wing 6 mm.

Described from 4 specimens: Hac. Ouefe, J. R. Ugaz, Chiclaya, Peru, March 21, 1932, Kisliuk and Cooley collectors.

Type, female, allotype, male, Cat. No. 50515, U. S. N. M.

Host unknown.

Adults collected on leaf of caracucho.

Anastrepha parallela Wiedemann.

(Plate 23, fig. 8.)

This species was originally described by Wiedemann (*34, p. 515*) in 1830 in the genus *Dacus*. Loew (*20, p. 229*) in 1873 placed it in the genus *Acrotoxa*. Bezzi (*3, p. 283*) in 1909 and Hendel (*14, p. 13, 15*) in 1914 both placed the species in *Anastrepha*. It is distinguished by the wing pattern.

Described from Brazil. Specimens in the U. S. National Collection are from S. Bernardino, Paraguay, no date, K. Fiebrig collector; and Sao Paulo, Brazil, Dec. 28, 1931, on sapodilla, Kisliuk and Cooley.

Host unknown.

The types are in the Vienna Museum and the Frankfort Museum.

Anastrepha integra Loew.

(Plate 23, fig. 4.)

This species was originally described by Loew (*20, p. 230*) in 1873 in the genus *Acrotoxa*. Bezzi (*3, p. 283*) in 1909 referred it to *Anastrepha*, and Hendel (*14, p. 13–15*) 1914 does likewise. The species is distinguished from all others by the wing pattern and the size of the ovipositor sheath.

Described from Brazil, no date. Specimens in the National Collection are from Verdant Vale, Ariam, Trinidad, B. W. I., April, 1912, F. W. Urich collector. One specimen captured 3 miles south of La Vega, Dominican Republic, July 20, 1931, Kisliuk and Cooley collectors. A specimen was collected on the leaf of rose apple.

Host unknown.

Types are in the Berlin Museum.

Anastrepha schausi Aldrich.

(Plate 23, fig. 9.)

This species was originally described by Aldrich (*2, p. 3*) in 1925. This male can be distinguished from that of all other species known to the writer by the conspicuous black and white border around the expanded edge of the mouth. The female is unknown.

Described from Juan Vinas, Costa Rica, Jan. 11, W. Schaus and J. Barnes collectors.

Host unknown.

The type is in the National Collection and was examined by the writer.

Anastrepha concava, n. sp.

(Plate 23, fig. 5.)

This specimen is so damaged, abdomen missing, that I can not tell the sex. Its wing pattern is so entirely different from that of any known species that I think it worth while to describe the fragment. Perhaps later on a good specimen may be captured.

Head and thorax luteous, subshining; all short hair pale yellow; all bristles black. Five pairs of frontals; one pair of orbitals. Antenna reaching three fourths the distance to oral margin; third joint tapering slightly toward apex, where it is rounded; third joint about twice as long as second, with a yellow bristly hair on under side near apex; arista long, brown with yellow enlargement at base. Palpus broad, with very faint infuscation on apical half (this infuscation may be only a stain); proboscis luteous.

Wing pattern almost entirely dark brown; small amount of yellow at bases of marginal and first basal and entire anal cells. Inverted V very broadly connected at apex with main pattern. Hyaline costal area broadly interrupted on third vein, interruption about as long as anterior crossvein. The species would be from 10 to 12 mm. long without the ovipositor sheath. Wing 11 mm. long. Length of head, thorax, and scutellum 6.5 mm. Abdomen missing.

Locality.—Close's, Cãno Saddle, C. Z., Sept. 1923, M. F. Close, collector.

Type, Cat. No. 50520, U. S. N. M. Host unknown.

Anastrepha munda Schiner.

This species was originally described by Schiner (*28, p. 264*) in 1868 in the above genus. Bezzi (*3, p. 283*) in 1909 considered this species a synonym of *fraterculus* Wied. Schiner compared his specimen with *unicolor* Loew, which Loew (*20, p. 223*) admitted to be a synonym of *fraterculus* Wied. The writer examined the types of *fraterculus* and *unicolor* and found that they are identical. Hendel (*14, p. 18*) in 1914 and Carlos R. Fischer (*11, p. 309*) in 1932 both considered the species to be a synonym of *obliqua* Macq. I can not give a definite opinion as I have not seen a specimen of *munda.*

Described from South America. The type is in the Vienna Museum. Host unknown.

Anastrepha fenestrata Lutz and Costa Lima.

This species was originally described by Lutz and Costa Lima (*21, p. 8*) in 1918. From the description I am unable definitely to place the species.

Described from Amazonia, no date. Host unknown.

Type in the Museum of Instituto Oswaldo Cruz. at Rio de Janeiro. Not seen by the writer.

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EXPLANATION OF PLATES.

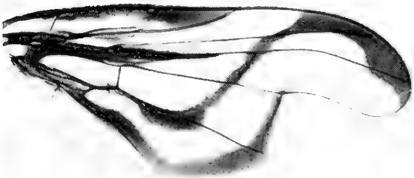
Plate 19.

1. *Anastrepha serpentina* Wiedemann, female (Peru).
2. " *ornata* Aldrich, female (type) (Banos, Or. Ecuador).
3. " *daciformis* Bezzi, female (Sao Paulo, Brazil).
4. " *macrura* Hendel, female (type) (Paraguay).
5. " *robusta* Greene, male (type) (Cordoba, Mexico).
6. " *cordata* Aldrich, female (type) (British Honduras).
7. " *grandis* Macquart, male (Brazil).
8. " *striata* Schiner, female (Ancon, C. Z.).
9. " *atrigona* Hendel, female (Brazil).
10. " *tricincta* Loew, female (Cuba).
11. " *longimacula* Greene, female (type) (Hope, Jamaica).
12. " *suspensa* Loew, female (Mayaguez, P. R.).

Plate 20.

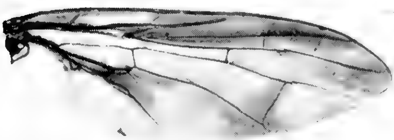
1. *Anastrepha peruviana* Townsend, female (type) (Chosica, Peru).
2. " *distincta* Greene, male (type) (Chiclaya, Peru).
3. " *ludens* Loew, male (Matamoros, Mex.).
4. " *zeteki* Greene, female (type) (Barro Colorado Isl., C. Z.).
5. " *similis* Greene, female (type) (Cabima, Panama).
6. " *braziliensis* Greene, male (type) (Brazil).
7. " *distans* Hendel, female (Sao Paulo, Brazil).
8. " *panamensis* Greene, male (paratype) (Barro Colorado Isl., C. Z.).
9. " *passiflorae* Greene, female (type) (Barro Colorado Isl., C. Z.).
10. " *leptozona* Hendel, female (Bahia, Brazil).
11. " *pallens* Coquillett, female (Mission, Texas).
12. " *punctata* Hendel, female (Sao Paulo, Brazil).

1 SERPENTINA ♀



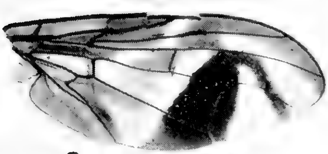
2 ORNATA ♀

3 DACIFORMIS ♀

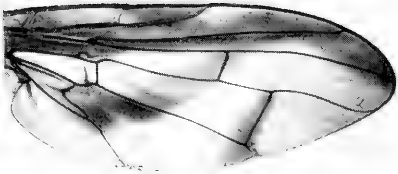


4 MACRURA ♀

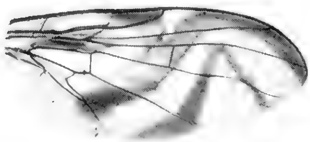
5 ROBUSTA ♂



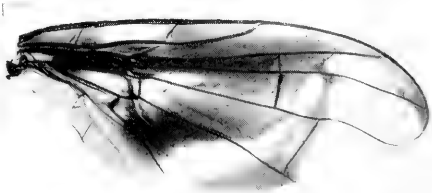
6 CORDATA ♀



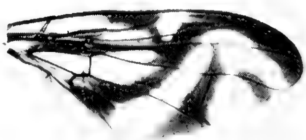
7 GRANDIS ♂



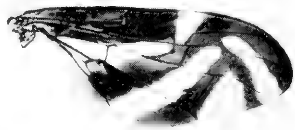
8 STRIATA ♀



9 ATRIGONA ♀

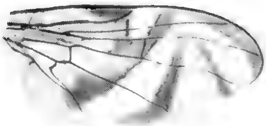


10 TRICINCTA ♀



11 LONGIMACULA ♀

12 SUSPENSA ♀



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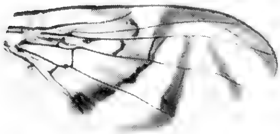
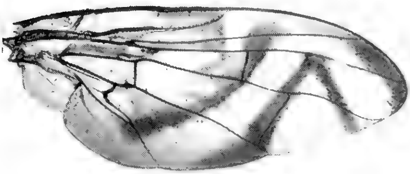
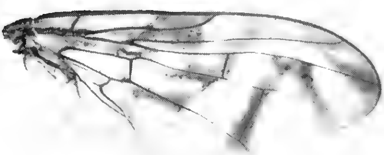


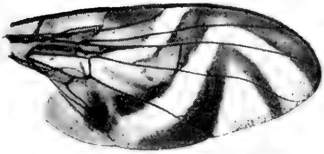
2 DISTINCTA ♂



3 LUDENS ♂

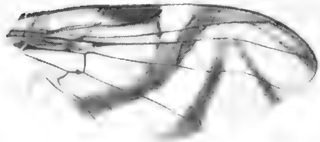


4 ZETEKI ♀

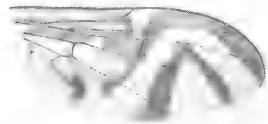


5 SIMILIS ♀

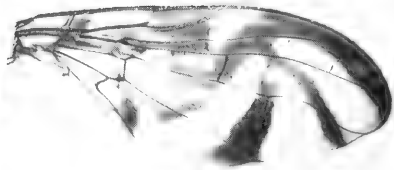
6 BRAZILIENSIS ♂



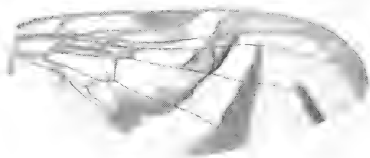
7 DISTANS ♀



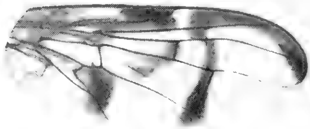
8 PANAMENSIS ♂



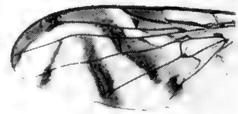
9 PASSIFLORAE ♀



10 LEPTOZONA ♀



11 PALLENS ♀



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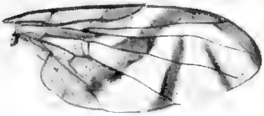

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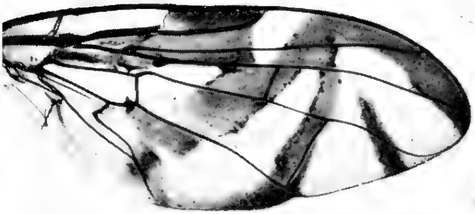
2 OBSCURA ♂



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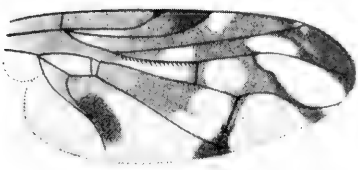

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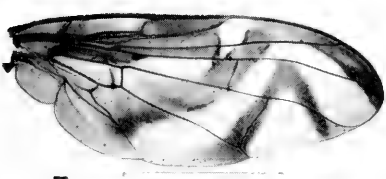

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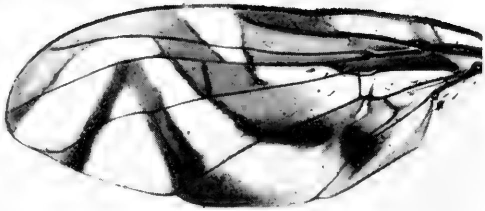

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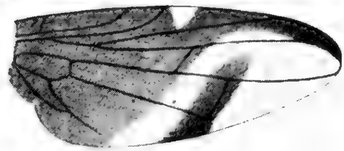

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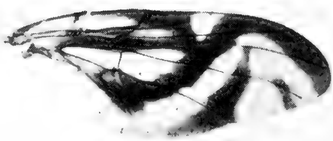

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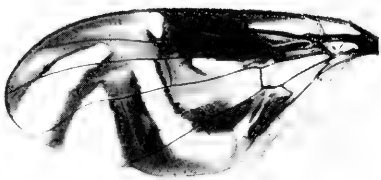

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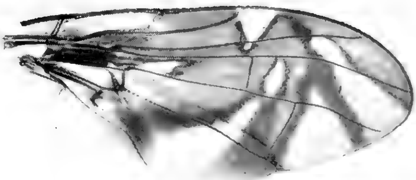

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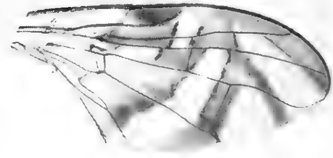

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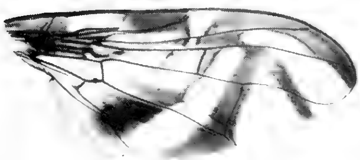

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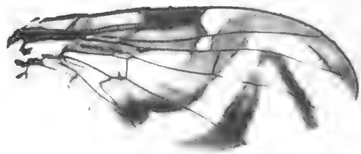

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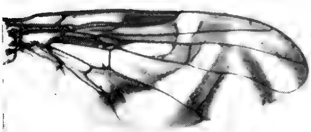

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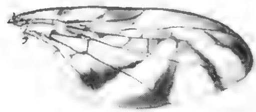

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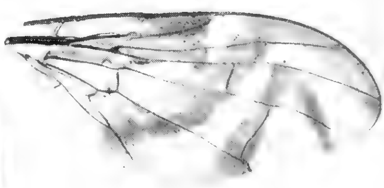

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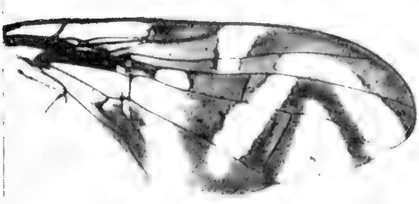
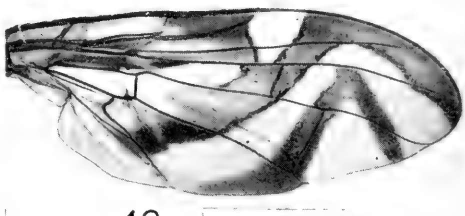


4 LAMBDA ♀

5 FRATERCULUS ♂



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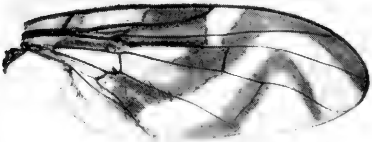
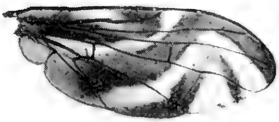


1 PALLIDIPENNIS ♀

2 BARNESI ♀



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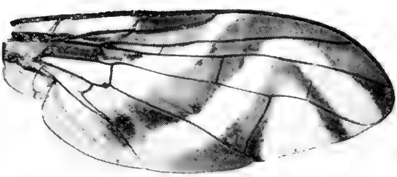

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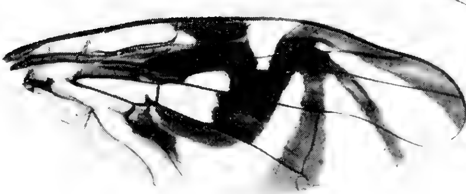

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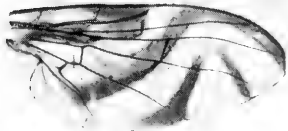

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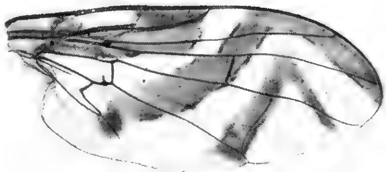

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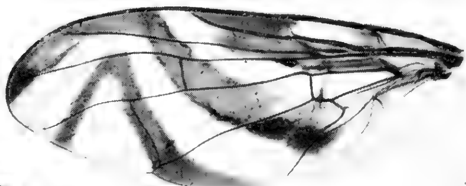

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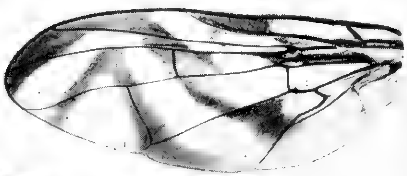

9 SCHAUSI ♂

Plate 21.

1. *Anastrepha hendeli* Greene, female (type) (Sao Paulo, Brazil).
2. " *obscura* Aldrich, male (paratype) (Trinidad).
3. " *hamata* Loew, male (Brazil).
4. " *tripunctata* Van der Wulp, female (type) (Mexico).
5. " *sylvicola* Knab, female (paratype) (Trinidad).
6. " *nigripalpis* Hendel, female (type) (Bolivia).
7. " *bivittata* Macquart, female (locality unknown).
8. " *ocresia* Walker, female (type) (Jamaica).
9. " *cryptostrepha* Hendel, female (type) (Peru).

Plate 22.

1. *Anastrepha urichi* Greene, female (type) (Trinidad).
2. " *trinidadensis* Greene, female (type) (Tabaquite, Trinidad).
3. " *acidusa* Walker, female (type) (Castries, St. Lucia, B. W. I.).
4. " *lambda* Hendel, female (type) (Peru).
5. " *fraterculus* Wiedemann, male (type) (Sao Paulo, Brazil).
6. " *flavipennis* Greene, female (type) (Boa Vista, Brazil).
7. " *ethalea* Walker, female (type) (Hermitage, Trinidad).
8. " *obliqua* Macquart, female (Barro Colorado Isl., C. Z.).
9. " *pseudoparallela* Loew, female (Trinidad).
10. " *townsendi* Greene, female (type) (Boa Vista, Brazil).

Plate 23

1. *Anastrepha pallidipennis* Greene, female (type) (Medellin, Colombia).
2. " *barnesi* Aldrich, female (type) (Cayuga, Guatemala).
3. " *chiclayae* Greene, male (type) (Chiclaya, Peru).
4. " *integra* Loew, female (Trinidad).
5. " *concava* Greene, male (type) (Cano Saddle, Canal Zone).
6. " *soluta* Bezzi, male (Sao Paulo, Brazil).
7. " *consobrina* Loew, female (Brazil).
8. " *parallela* Loew, male (Sao Paulo, Brazil).
9. " *schausi* Aldrich, male (type) (Juan Vinas, Costa Rica).

JOHN MERTON ALDRICH, PH. D.

At the 457th meeting of the Entomological Society of Washington, June 7, 1934, the following announcement was made by W. R. Walton:

"*Mr. President, fellow members, ladies and gentlemen:*

It becomes my sad duty to announce to the Entomological Society of Washington the death of one of its most valued and beloved members, Dr. John Merton Aldrich, who passed away on May 27th, at Georgetown Hospital, Washington, D. C., after an illness of about three weeks, at the age of 68 years and 4 months.

I shall omit for the present the details regarding his early life which I feel sure will be carefully collated and recorded by the Society subsequently, and speak now of Dr. Aldrich principally as a member of the Federal Bureau of Entomology and of the Entomological Society of Washington as we knew him.

In 1913, immediately following his separation from the University of Idaho, Dr. Aldrich accepted appointment as Entomological Assistant in the Division of Cereal and Forage Insect Investigations of the Federal Bureau of Entomology under the immediate leadership of the late F. M. Webster. He was assigned to a field station at West Lafayette, Indiana, where, at the request of Webster, he began in December of that year, a revision of the North American Sarcophagidae. This work finally culminated in 1916, in the publication, under the auspices of the Thomas Say Foundation, of the well-known volume entitled 'Sarcophaga and Allies in North America.' At the inception of this task Aldrich states in his Introduction to the book: 'In the United States since the beginning of any indigenous dipterology, about 1880, there has been a virtual blockade in this group, due to the vast number of old unrecognizable descriptions, of which the types were scattered in European museums or lost.'

When Aldrich's 'Catalog of the North American Diptera' was published in 1905, 'it included 106 nominal species of Sarcophaga of which hardly more than half a dozen were ever recognizably described.' In the absence of any clear understanding of the specific characters in this group, Aldrich truly says that 'this looked like the most hopeless field imaginable.' However, the completion of his work saw the intricacies of the complex resolved most satisfactorily into 145 species and varieties, belonging to 16 genera, in a volume containing some 300 pages and 170 figures, which undoubtedly will stand as a model of taxonomic excellence for all time to come.

During his service at Lafayette, Aldrich also conducted a series of biological experiments with several nominal species of Oscinis affecting small grains which resulted in the revelation of the presence in America of the European fruit fly *Oscinis frit* (Fab.) which had been masquerading under various specific names for many years although, curiously enough, it has never become of more than occasional economic importance here.

It was during this period that I first became well acquainted with Dr. Aldrich although, in common with all students of the American Diptera, I had known him through his writings and especially through his monumental and indispensable catalog of the order. Upon the death of Webster in 1916, when the administration of the Division passed into my hands, I had frequent contact with Aldrich, both personally and through correspondence, as he was then making all routine identifications of the Diptera for us. In these circumstances, it was not only astonishing to observe the celerity with which Dr. Aldrich determined practically all of this material, but I was deeply impressed by his ever-present desire to furnish his correspondents, many of them personally unknown to him, with all information that could possibly prove pertinent to their work. No pains were too great, or no research of the literature so tedious, as to prevent the transmittal of whatever information Aldrich considered appropriate to the needs of the case. This admirable trait of the man persisted with the passage of the years, as I have within the last few months had occasion to remark its exercise in the case of a peculiarly involved taxonomic tangle in the tachinid parasites of the European corn borer. In this case Aldrich had not only resolved the snarl to its last convolution but, in the written discussion of it, he had even sent to our field men copies of his correspondence with European authorities in the group in order that no vestige of doubt should remain regarding the matter.

I well remember my feeling of extreme gratification when, in the early months of 1919, Dr. L. O. Howard told me in private that he was seriously considering the nomination of Dr. Aldrich for the position of Associate Curator of Insects in the U. S. National Museum and I then expressed the opinion that none could fill the position with greater ability and honor than he.

Shortly after his arrival in Washington that year, Aldrich began to interest himself in the affairs of our Society and very soon to publish in our Proceedings. His longer papers were, of course, included in the regular series issued by the Museum but those of lesser length usually came to us. Thus no less than 25 such articles have been contributed to the Society during the past 14 years. In addition to these generous contributions, Dr. Aldrich served the Society as its First Vice President in 1925, and in 1926 was elected President, filling the office with his usual efficiency and kindliness. He was a constant and most welcome contributor to the informal discussion of many papers presented before the Society as well as to our program; in point of fact, he was to have had a place on it this very evening.

As a taxonomist in the American Diptera Dr. Aldrich was the peer of any who had preceded him, and I feel confident in saying that none survives who possesses his breadth of knowledge of this complex. In his work he had accepted Osten Sacken and Williston as his models and in this choice he could not have done better. His descriptive work possesses a quality that is exceptional and his command of good English was indeed remarkable. All who knew him well will remember with wonder his amazing ability to converse on his beloved order almost 'ad infinitum' and at great speed, without faltering an instant for a shade of expression or a technical name. Dr. Aldrich, to the end, maintained his boyish enthusiasm and I can not refrain from quoting as an illustration of this a note received from him in 1931 which then impressed me as so characteristic that it was preserved. It was as follows:

> 'Dear Walton: I seized the opportunity to send over a page of manuscript by Joe [Wade] yesterday, but it was a little premature, as, in the first draft, I found I had not covered the ground properly. So now I shall have to ask you to substitute the two pages enclosed for the one page sent yesterday. *I feel quite jubilant to have at last found out what Eurycephalomyia is, it having been an enigma since 1881!*' (The italics are mine.)

Although he was then 65, and had been working continuously with the Diptera for at least 40 years, he still found delight in adding another morsel of knowledge to his already plethoric store. What further proof is wanting that Aldrich had indeed found his exact vocation in life?

The sound quality of Dr. Aldrich's work is universally acknowledged and, although always in a conservative vein, it is never reactionary. He kept abreast of the times in taxonomic advance, and, especially in recent years, when he devoted a large part of his attention to the taxonomy of the muscoidean flies, he provided a stabilizing influence which not only was greatly needed in this field but which will now be sorely missed. In addition to a vast store of knowledge of the Diptera and their literature, Dr. Aldrich possessed that rare and most desirable quality in taxonomic work, the judicial mind. This enabled him to view his problems uncolored by personal feeling, and in a detached and dispassionate manner that was ever admirable. Thus, even in the heat of argument, so inseparable from this type of research, we find him scrupulously courteous and polite toward his opponents.

Although we, who mourn his loss, can not refrain from feeling that his end was both premature and untimely, John Merton Aldrich bequeathed to us a great work well done, and a scientific heritage of which entomology may well feel proud."

A more extended biography, together with a portrait of the late Dr. Aldrich, will appear in a subsequent issue of these Proceedings.

MINUTES OF THE 456th REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, MAY 3, 1934.

The 456th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, May 3, 1934, in room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. There were present 28 members and 10 visitors. The minutes of the previous meeting were read and approved.

Under "Notes," Dr. J. M. Aldrich read a letter from E. P. Van Duzee, of the California Academy of Science, calling attention to the recent death of M. C. Van Duzee, one of the leading authorities on Dolochopodidae. Van Duzee's collection of flies of that family has been purchased by the California Academy of Science.

Dr. Aldrich also called attention to the report of the committee on graduate instruction of the American Council on Education, and read the list of institutions considered by the council as being qualified to give doctorate degrees in Entomology.

This note was discussed by Ewing.

The first communication on the regular program was by Dr. F. W. Poos, and entitled "Notes on the genus *Empoasca*." Dr. Poos gave a brief review of the more common species of the genus and the plants which they affect. He also showed slides with drawings illustrating the structures by which the species are separated taxonomically, charts giving a comparison of the life histories of some of the species, and pictures of the disease-like injury to legumes that is caused by *Empoasca fabae*.

This paper was discussed by Cushman and McIndoo.

The second communication on the regular program was by W. B. Wood, entitled "Plant Inspection." Mr. Wood limited his remarks to the inspection of introduced plants, most of which come into the country for propagation in nurseries or for experimental work by the Department of Agriculture. Most of the stock for propagation comes from European nurseries and because of the money invested it must be handled with extreme care during inspection and treatment. Treatment most frequently consists of fumigation with cyanide gas or carbondisulphide, often in connection with vacuum. Heat, hot water, and moist air are also used, depending upon the nature of the infestation or disease and the plants involved.

This paper was discussed by Cushman.

The third communication on the regular program was a paper by N. E. Good, entitled "Biology of the flour beetles of the genus Tribolium." Mr. Good gave a comprehensive discussion of the seven species of this interesting genus, three of which occur in the United States and two of which are almost cosmopolitan. The most widely distributed species are practically omnivorous, living on all kinds of seeds if the hull is broken. The genus is of particular importance as a pest of stored grains.

This paper was discussed by Hyslop.

Meeting adjourned at 10:05 P. M.

P. W. OMAN,
Recording Secretary.

Actual date of publication, July 9, 1934.

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OF THE

ENTOMOLOGICAL SOCIETY

OF WASHINGTON

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OF WASHINGTON

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The regular meetings of the Society are held in the National Museum on the first Thursday of each month, from October to June, inclusive, at 8 P. M.

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OFFICERS FOR THE YEAR 1933.

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PROCEEDINGS OF THE

ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 36 OCTOBER, 1934 No. 7

THE BIOLOGY OF STEGOMYIA UNDER LABORATORY CONDITIONS.[1]

By RAYMOND C. SHANNON AND PERSIS PUTNAM.

I. THE ANALYSIS OF FACTORS WHICH INFLUENCE LARVAL DEVELOPMENT.

The main features relating to the life history of *Aedes* (*Stegomyia*) *aegypti* are well known. When we attempt to define conditions of nurture, however, we find that a state of confusion exists. Buxton and Hopkins (1927) have said: "One frequently wants a number of larvae for experimental purposes, all of precisely the same age. In our present state of ignorance one can only secure these accidentally by putting a lot of eggs into suitable water; three-quarters may hatch in an hour, or none may hatch in the first week."

The contradictions in the results of laboratory work may have resulted from different environmental conditions or from the fact that the cultural methods practiced did not give uniform and favorable results. Some of the difficulties may have arisen from the use of different strains. The material, for example, that Roubaud (1927–29) used in his experiments may belong to a different strain than the Brazilian material used by us, which may account for the different rate of hatching he obtained. Preliminary experiments (R. C. S.) which are being made on the Greek strain indicate that its incubation requirements differ from those of the Brazilian strain.

In the course of two years in the Yellow Fever Laboratory in Bahia, Brazil, some of the causes of variation have been determined, and through their elimination a standard method of breeding has been devised, especially adapted to the normal conditions prevailing in tropical laboratories. This method must of necessity differ from those in practice in temperate climates, e. g., at the Wellcome Entomological Field Laboratory (MacGregor, 1931) and at the London School of Tropical Medicine (Lesson, 1932).

The method devised has been thoroughly tested through two

[1]The studies and observations on which this paper is based were conducted at the Yellow Fever Laboratory, Bahia, Brazil, with the support and under the auspices of the International Health Division of The Rockefeller Foundation.

years of daily routine breeding during which several hundred thousand mosquitoes have been reared, constituting the type of material referred to as "standard stock" in various papers published from this laboratory. The individuals reared by this formula maintained a uniform rate of development in all stages. Mortality was low, and the adults attained what appeared to be maximum size and vigor for the species. Excellent material of known age in desired quantity was thus easily available.

The detailed observations of large numbers of specimens made routinely throughout the period of development furnished excellent data for statistical analysis. We are able, consequently, not only to discuss the basis and technic of the method and its application, but also to describe the results biometrically and to evaluate some of the factors which influence them.

The literature dealing with the biology of stegomyia is very extensive and scattered. Reference here will be limited to a few of the earlier and a few of the later papers. It may be stated, however, that most of the experiments to be described have been covered by others in the papers cited.

The essential phases of the biology were worked out by the American Yellow Fever Commission in Cuba (Reed and Carroll, 1911). The minimum duration of the early stages of development, as indicated by Reed and Carroll, was nine and one-half days: incubation, two days; larval stage, six days; pupal, 36 hours. Goeldi (1905) obtained a minimum of four days for the larval stage, with males emerging on the fifth day. The duration of egg and pupal stages as given by Reed and Carroll, and of the larval stage as given by Goeldi represent the minimum obtained by us.

MacGregor (1931) states that the strain of *aegypti* used at the Wellcome Entomological Field Laboratory, when kept at 30° C. produces successive generations on the average of every 10 to 15 days throughout the year. He does not mention egg-production, larval mortality, or size and longevity of adults. Martini (1924) observed that mosquito larvae when subjected to warm temperatures produced smaller sized adults than those kept at cooler temperatures. It is probable, therefore, that MacGregor's strain was rather dwarfed.

The development and behavior of stegomyia under laboratory conditions will be discussed from two points of view: as observed under normal or standard conditions, and when subjected to special influences which may materially retard or alter their course. A third point to be mentioned will be the appearance of a natural phenomenon of unknown origin adversely affecting development.

Standard Development.

Equipment.

All equipment is of a very simple nature and was originally installed by Bauer and Davis in August, 1928.

1. *Breeding cages.*—Screened cages of about one-half cubic meter capacity will readily accommodate from 100 to 250 female mosquitoes and an equal number of males. This number of females will supply from 500 to 1,000 eggs daily. Fresh adults are added once a month. An immobilized guinea pig is supplied every third or fourth day, and a dish with raisins is kept in the cage continuously. Receptacles for the eggs consist of flat pans containing a layer about one inch thick of wet cotton covered with filter paper.
2. *Larval rearing jars.*—Any type of uncovered dish or jar with a capacity of one liter suffices.
3. *Pupal tubes.*—Wassermann tubes are used to isolate the pupae. These are plugged with cotton and stored in wire racks.
4. *Experimental cages for adult females.*—These are 12 by 12 by 16 inches, with screened sides and an attached cloth sleeve.

Procedure.

Conditioning of the eggs.—At the time of oviposition the embryo has not as yet begun to form. The eggs are, therefore, kept *in situ* on the egg pans and placed in the open air to dry slowly. It requires from two to three days at temperatures from 25° to 27° C. for the embryo to form and to reach a state for immediate hatching. Below 25° the time is longer, and at 23.5° the eggs should be allowed to stand for at least four or five days. After eggs have been kept on moist filter paper for several days they may be dried and, if used within a month, serve as well as freshly conditioned eggs for routine rearing.

For hatching the eggs.—Properly conditioned moist eggs, when submerged in water with food, will hatch within 10 minutes' time. If floated, eclosion is irregular, requiring one to five days or more.

Rearing of the larvae.—It was found that minimal larval development and mortality were obtained when lots were limited to 150 eggs or less. Consequently, our practice is to use 100 eggs per jar although the number may be increased to 150 or 200 without adverse results.

Ordinary tap water and about 2 cc. of dried bread may be used exclusively. Dried blood serum in place of bread or a combination of both will also serve. Bacteria quickly develop in the water, and the larvae appear to be fully nourished.

Care of the pupae.—Each morning the pupae are removed by means of a large-bore pipette and isolated in individual Wassermann tubes.

Care of the adults.—The tubes are examined daily for adults. The males are discarded and the females placed in the experimental cages. These are provided with two petri dishes, one containing wet cotton, the other honey overlaid with filter paper.

Laboratory labor required.—One well-trained laboratory assistant can perform all the routine work, handling as many as 200 pupae and an equal number of adults in four to five hours. Occasionally the assistant has handled fully a thousand of each in a day.

Two experiments will now be described and their results analyzed to illustrate what may be expected through the application of the standard method. The first was carried out under routine laboratory conditions, and the second under what might be considered optimum conditions.

Development of Stegomyia Larvae under Routine Laboratory Conditions.

In this experiment a lot of 100 properly conditioned eggs in a rearing jar was set aside each day for 61 consecutive days. Daily records of pupation and emergence were kept for each jar. Temperature was recorded at 8:00 A. M. and 4:30 P. M., and a mean was computed for each day. No record was made of eggs that did not hatch, so that larval mortality as recorded includes that for both eggs and larvae. Time was counted from the day on which the eggs were placed in the jar. Table 1 contains the daily pupation records for each jar and the mean pupation day for each lot. It also contains a seven-day average temperature, which will be described here.

TABLE 1.

DEVELOPMENT OF STEGOMYIA LARVAE UNDER ROUTINE LABORATORY CONDITIONS. DAILY PUPATION RECORDS OF LOTS OF 100 OVA.

DATE OF 1ST DAY	NUMBER OF PUPAE ON SUBSEQUENT DAYS									TOTAL	MEAN PUPATION DAY OF LOT	MEAN TEMPERATURE (C) FOR 7-DAY PERIOD
	5	6	7	8	9	10	11	12	13			
1930												
Sept. 13			1	25	40	17	5	2		90	9.57	23.8
14			4	9	25	23	13	7	2	83	10.23	23.6
15		2	61	28	1					92	7.80	23.6
16		1	17	23	30	14	2	2		89	9.10	23.6
17		8	52	16						76	7.61	23.4
18		14	66	9	2					91	7.49	23.3
19		39	49	1						89	7.07	23.4
20		12	38	33						83	7.75	23.5
21		12	53	21	5					91	7.71	23.7
22			9	38	20	12	11	2		92	9.33	23.7
23		48	15	5						68	6.87	23.9
24		1	20	45	27	4	1			98	8.66	23.9
25			30	55	8	4	1			98	8.39	23.8
26		56	33	5		1				95	6.99	23.7
27		65	32	1						98	6.85	23.7
28		17	59	16		1	1			94	7.56	23.6
29		10	40	28	4	2				84	7.88	23.6
30		52	39	3	1					95	7.01	23.6

[TABLE 1 *continued on next page.*]

TABLE 1—*continued.*

DEVELOPMENT OF STEGOMYIA LARVAE UNDER ROUTINE LABORATORY CONDITIONS. DAILY PUPATION RECORDS OF LOTS OF 100 OVA.

DATE OF 1ST DAY	NUMBER OF PUPAE ON SUBSEQUENT DAYS									TOTAL	MEAN PUPATION DAY OF LOT	MEAN TEMPERATURE (C) FOR 7-DAY PERIOD
	5	6	7	8	9	10	11	12	13			
Oct. 1		57	19	1						77	6.77	24.0
2		22	61	12	1					96	7.42	24.3
3		36	50	7		3				96	7.29	24.5
4		41	41	9	3					94	7.22	24.6
5	1	51	34	4	1					91	6.98	24.7
6	1	57	32	2		1				93	6.92	24.7
7	3	66	20							89	6.69	24.8
8	2	25	24	4	2					57	7.13	24.8
9		53	31	3						87	6.93	24.8
10		53	35	2						90	6.93	24.9
11				18	37	33	12			100	9.89	25.1
12		10	50	6	1		1			68	7.53	25.2
13		70	12	1	1		1			85	6.76	25.3
14	32	48	3							83	6.15	25.5
15	27	69	3							99	6.26	25.6
16	37	35	7							79	6.12	25.8
17	3	56	29	4		1				93	6.91	25.8
18	21	62	11							94	6.39	25.7
19	22	51	13							86	6.40	25.7
20	2	69	24		2					97	6.79	25.7
21		8	44	29	12					93	7.98	25.7
22		62	32	3	2					99	6.94	25.6
23	40	10	1							51	5.74	25.6
24	53	34								87	5.89	25.7
25		40	42	10	3					95	7.25	25.8
26		6	39	24	10	2	1	1		83	8.14	25.8
27	2	49	22	8	2	1				84	7.05	25.8
28	14	67	6							87	6.41	25.9
29	11	67	4							82	6.41	25.9
30	19	47	11	1						78	6.42	25.9
31	3	38	43	7						91	7.09	25.9
Nov. 1	1	31	45	13		1				91	7.31	25.9
2	13	57	15	3	1					89	6.62	25.9
3	37	48	6	1						92	6.18	25.9
4	26	46								72	6.14	26.1
5	37	42	3							82	6.09	26.2
6	21	66	7	1						95	6.37	26.5
7	56	16	14							86	6.01	26.6
8	63	27	5	1						96	5.92	26.5
9	11	59	22	2	1					95	6.69	26.6
10	33	47	9	1						90	6.26	26.7
11	11	50	13	2						76	6.58	26.5
12	27	52	8	2						89	6.33	26.4
Total	629	2237	1508	542	242	120	49	14	2	5343	7.16	25.0

The mean pupation period or duration of larval stage, for all individuals in the 61 lots was 7.16 ± .01 days. It seems desirable, therefore, to convert the daily temperature averages into a mean for a period that would approximate the interval required for the pupation of the individual lots. The seven-day moving average computed for any date in the table is the mean of the temperatures on seven days beginning with the date indicated.

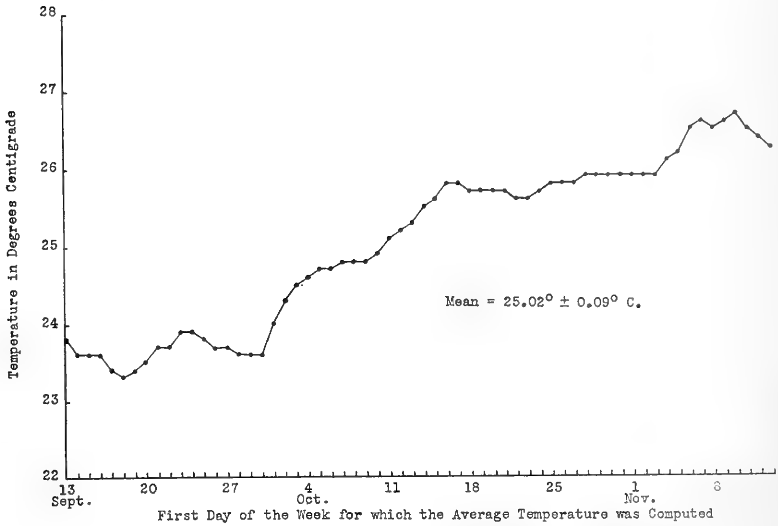

Figure 1.—Development of Stegomyia Larvae under Routine Laboratory Conditions. Seven-day Average Temperature, September 13–November 13, 1930.

Figure 1 shows the time trend of these moving averages. It is evident that there was a steady rise in temperature during the period of the experiment, with relatively slight deviation from a straight line course. We may now compare the mean pupation period, or duration of larval stage, for each lot with its corresponding temperature average. This has been done in Figure 2.

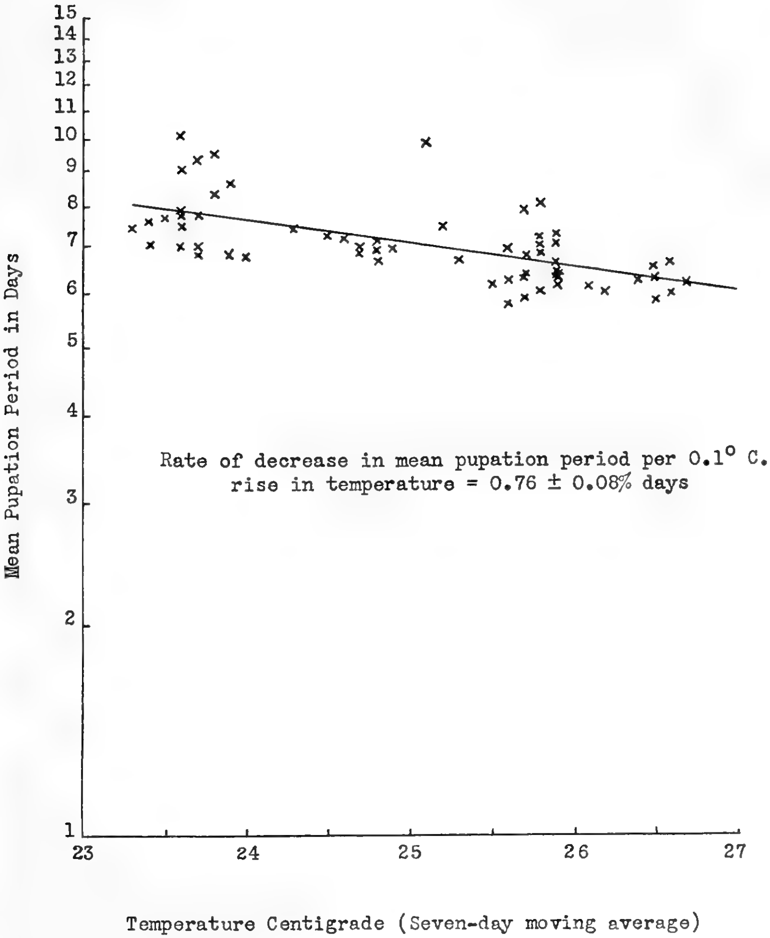

Figure 2.—Decrease in Pupation Period with Rise in Temperature in Routine Laboratory Studies of Stegomyia Development.
(Each symbol represents the pupation period for a lot of 100 stegomyia ova.)

It was found that if the mean pupation periods were plotted on a logarithmic scale against the temperature on an arithmetic scale, a definite decrease in larval stage with rise in temperature appeared. Figure 2 shows the character of the relationship with the aid of the fitted regression line.[2] From the equation

[2] The equation for the line was:
Log (mean pupation period in days) = log 8.1247 + log 0.9924 . temperature. (Temperature was expressed in units of one for each 0.1° from 23.2° C. as origin.)

for the line we obtain the mean rate of decrease in pupation period per rise of 0.1° in seven-day temperature average. The rate was 0.76 ± 0.08 per cent days which, though slight, was nearly ten times its probable error and hence statistically significant.

By means of the equation for the line it is possible to compute an expected mean pupation period for a given seven-day temperature average. For example, at 27° C., when temperature is considered more favorable for rearing, the computed duration of larval life would be 6.08 ± 0.07 days. We shall see presently how well this period compares with actual results of rearing at this temperature.

Table 2 contains the mean number of days to emergence of adult stegomyia males and females from these 61 lots. The decrease in these averages with rise in temperature is shown in Figures 3 and 4. The rate of decrease was the same in each case: 0.74 ± 0.07 per cent days per 0.1° rise in average temperature.[3] The important difference here was the higher level of the emergence periods for females. Means for all individuals were as follows:

Mean Emergence Periods.

Females	9.64 ± 0.02 days
Males	9.05 ± 0.02 days
Difference	0.59 ± 0.03 days

The emergence period of females was approximately 14 hours longer than that for males.

[3] Regression equations:
Log (male emergence period in days) = log 10.2412 + log 0.9926 . temperature
Log (female emergence period in days) = log 10.8176 + log 0.9926 . temperature
(Temperature was expressed in units of one for each 0.1° C. from 23.2° C. as origin.)

TABLE 2.

DEVELOPMENT OF STEGOMYIA LARVAE UNDER ROUTINE LABORATORY CONDITIONS. MEAN DAY OF EMERGENCE OF MALES AND FEMALES.

DATE OF 1ST DAY	MEAN DAY OF EMERGENCE		MEAN TEMPERATURE (C) FOR SEVEN-DAY PERIOD	DATE OF 1ST DAY	MEAN DAY OF EMERGENCE		MEAN TEMPERATURE (C) FOR SEVEN-DAY PERIOD
	MALES	FEMALES			MALES	FEMALES	
1930				1930			
Sept. 13	11.68	12.46	23.8	Oct. 15	8.38	8.67	25.6
14	12.03	13.48	23.6	16	7.78	8.50	25.8
15	10.07	10.33	23.6	17	8.57	9.48	25.8
16	11.03	12.13	23.6	18	8.37	8.84	25.7
17	9.76	10.09	23.4	19	8.31	8.59	25.7
18	9.84	9.98	23.3	20	8.57	9.17	25.7
19	9.31	9.53	23.4	21	10.04	10.14	25.7
20	9.63	10.19	23.5	22	8.87	8.99	25.6
21	9.78	10.46	23.7	23	7.50	8.50	25.6
22	11.56	12.45	23.7	24	7.59	8.29	25.7
23	9.07	9.17	23.9	25	9.05	9.70	25.8
24	10.72	11.44	23.9	26	9.98	10.32	25.8
25	10.55	11.04	23.8	27	8.81	9.30	25.8
26	9.13	9.68	23.7	28	8.01	8.52	25.9
27	8.85	9.46	23.7	29	8.27	8.61	25.9
28	9.48	10.32	23.6	30	8.37	8.61	25.9
29	9.63	10.69	23.6	31	8.84	9.13	25.9
30	8.76	9.32	23.6	Nov. 1	9.06	9.65	25.9
Oct. 1	8.71	9.09	24.0	2	8.22	9.03	25.9
2	9.23	9.63	24.3	3	7.96	8.55	25.9
3	8.99	9.76	24.5	4	7.67	8.08	26.1
4	9.20	9.87	24.6	5	7.67	8.01	26.2
5	9.01	9.39	24.7	6	7.88	8.50	26.5
6	8.74	9.38	24.7	7	8.15	8.77	26.6
7	8.79	9.15	24.8	8	7.60	8.26	26.5
8	9.08	9.37	24.8	9	8.40	9.01	26.6
9	8.70	9.39	24.8	10	7.77	8.57	26.7
10	8.74	9.26	24.9	11	8.18	8.76	26.5
11	11.58	12.53	25.1	12	7.97	8.78	26.4
12	9.24	9.81	25.2				
13	8.40	9.01	25.3	Total	9.05	9.64	25.0
14	7.79	8.67	25.5				

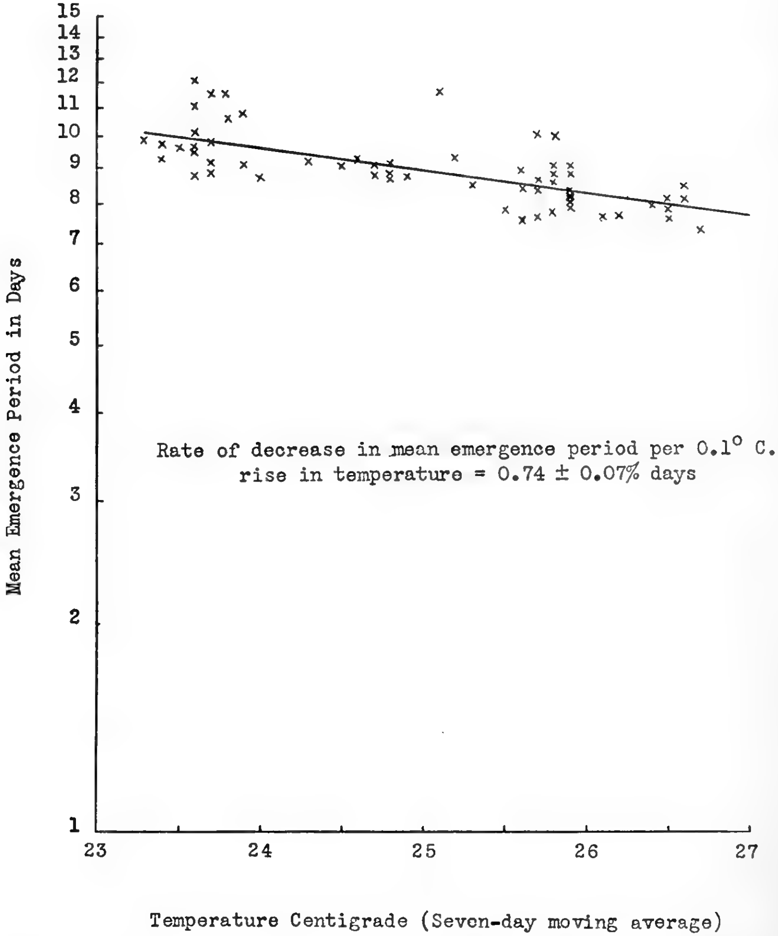

Figure 3.—Decrease in Emergence Period for Males with Rise in Temperature in Routine Laboratory Studies of Stegomyia Development.
(Each symbol represents the emergence period for a lot of 100 stegomyia ova.)

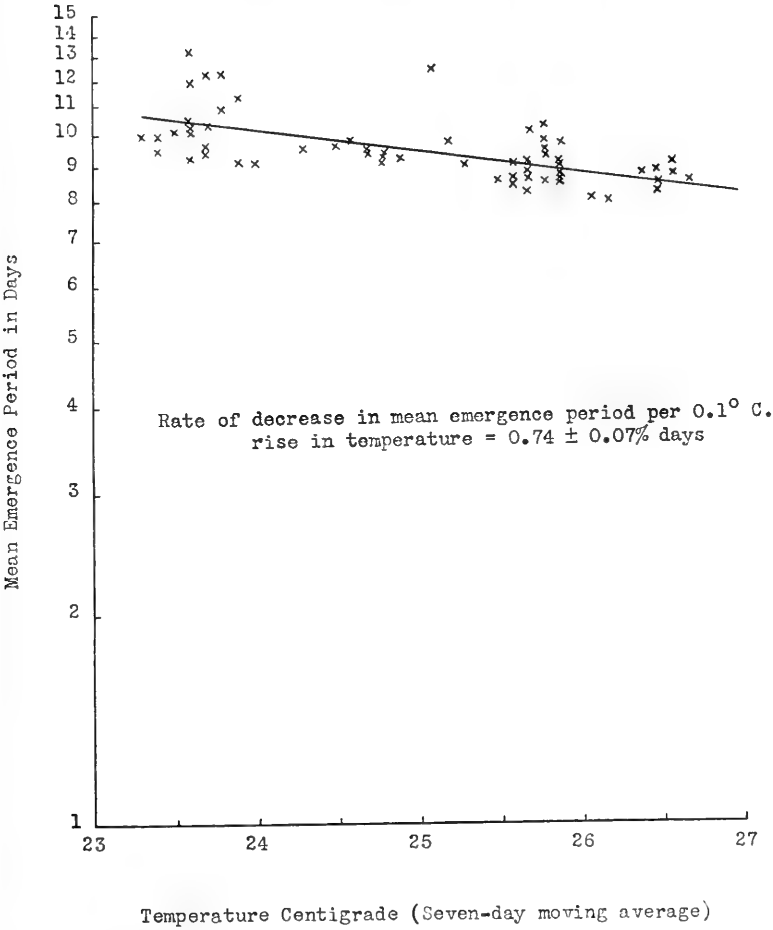

Figure 4.—Decrease in Emergence Period for Females with Rise in Temperature in Routine Laboratory Studies of Stegomyia Development.
(Each symbol represents the emergence period for a lot of 100 stegomyia ova.)

The interval between mean pupation and emergence periods for males and females was as follows:

Males.		*Females.*	
Emergence	9.05 ± 0.02 days	Emergence	9.64 ± 0.02 days
Pupation	7.16 ± 0.01 days	Pupation	7.16 ± 0.01 days
Difference	1.89 ± 0.02 days	Difference	2.48 ± 0.02 days

Under routine conditions, therefore, the interval from pupation to emergence of males was approximately 45 hours and for females 60 hours.

The frequency distributions of individuals in all lots according to day of pupation and of emergence are shown in Figures 5 and 6. These figures show more scattering of the observations to the right of the means than to the left.

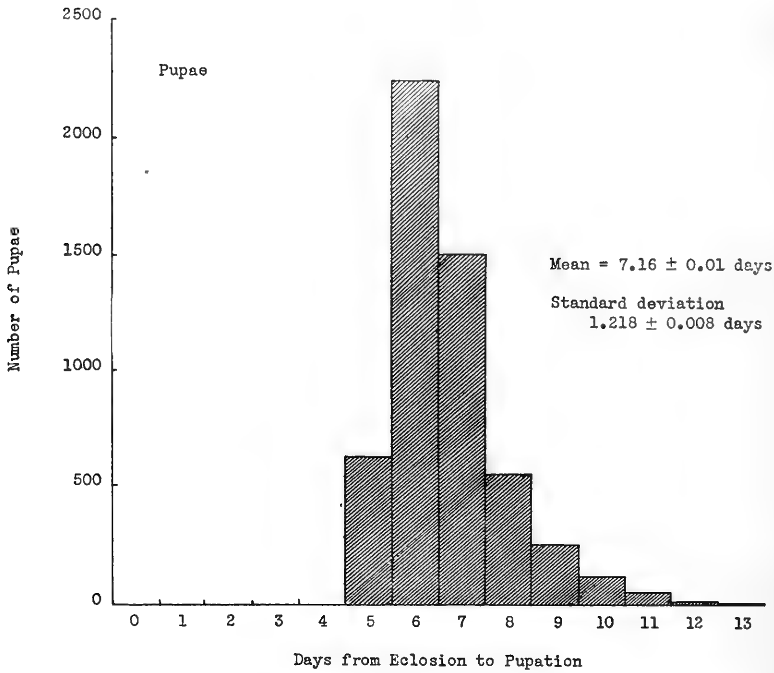

Figure 5.—Development of Stegomyia Larvae under Routine Laboratory Conditions. Period from Eclosion to Pupation.

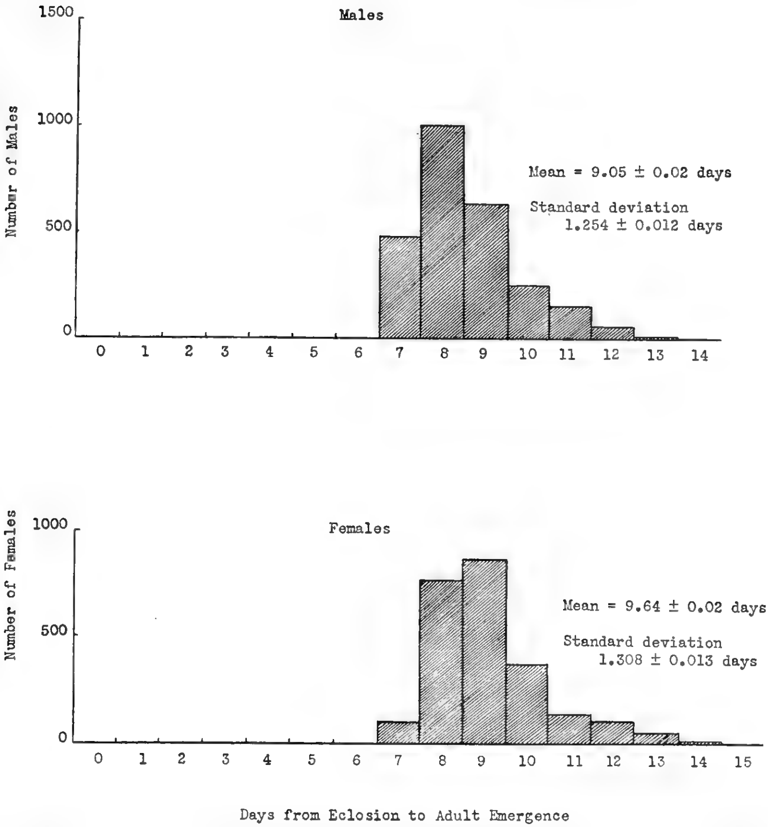

Figure 6.—Development of Stegomyia Larvae under Routine Laboratory Conditions. Period from Eclosion to Emergence.

Egg and larval mortality in the 61 lots was 12.41 ± 0.29 per cent, since 757 individuals failed to pupate from the 6100 eggs set aside. Among pupae 364, or 6.81 ± 0.23 per cent, died before emerging.

The mean temperature for the entire period computed from the seven-day averages was 25.02 ± 0.09° C.

Development of Stegomyia Larvae under Optimum Laboratory Conditions.

In this experiment five lots of 100 eggs each were bred under optimum laboratory conditions. These were the most favorable conditions existing in the Bahia laboratory and were doubtless as favorable as any occurring in nature in Brazil. The eggs had been kept eight days on damp filter paper, and eclosion was effected in from 10 seconds to 10 minutes. All but about five per cent hatched. This experiment was carried out at midsummer temperatures averaging 27° C.

Table 3 contains the pupation and emergence records for this experiment, and Figures 6 and 7 show the frequency polygons. The mean period of pupation for these lots was 6.40 ± 0.02 days, which was 18 hours less time than that required for the 61 lots reared under routine conditions. Furthermore, pupation was completed on the ninth day, and was limited almost wholly to the fifth to seventh days.

TABLE 3.

DEVELOPMENT OF STEGOMYIA LARVAE UNDER OPTIMUM LABORATORY CONDITIONS.

LOTS OF 100 OVA AT 27° C.

LOT	DAYS SINCE ECLOSION									MEAN INTERVAL IN DAYS
	4	5	6	7	8	9	10	11	TOTAL	
DAILY PUPATION RECORDS (NUMBER OF PUPAE)										
1	2	61	27	5	1				96	
2		11	59	22	2	1			95	
3		33	47	9	1				90	
4		2	69	24		2			97	
5		27	52	8	2				89	
Total	2	134	254	68	6	3			467	6.40 ±0.02
MALE EMERGENCE RECORDS.										
1			2	44	5	1			52	
2				12	41	4	1		58	
3				34	8	2			44	
4				3	48	7			58	
5				25	22				47	
Total			2	118	124	14	1		259	8.09 ±0.03
FEMALE EMERGENCE RECORDS.										
1				15	22	5			42	
2					21	14	1	1	37	
3				4	33	7			44	
4					16	20			36	
5				5	24	7	3	1	40	
Total				24	116	53	4	2	199	8.72 ±0.03

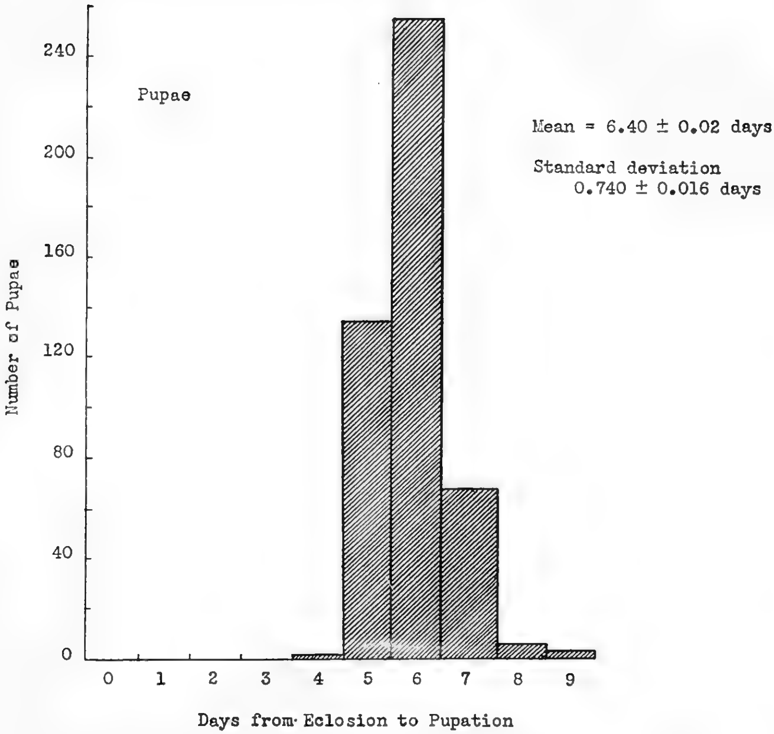

Figure 7.—Development of Stegomyia Larvae under Optimum Laboratory Conditions. Period from Eclosion to Pupation.

Emergence of adults was also highly concentrated, particularly among males. The mean interval for males was 8.09 ± 0.03 days and for females 8.72 ± 0.03 days. This was a reduction from the time required in the first experiment of 23 hours for males and 22 for females. The observations were again more concentrated than they were in the previous experiment. These differences are all significant.

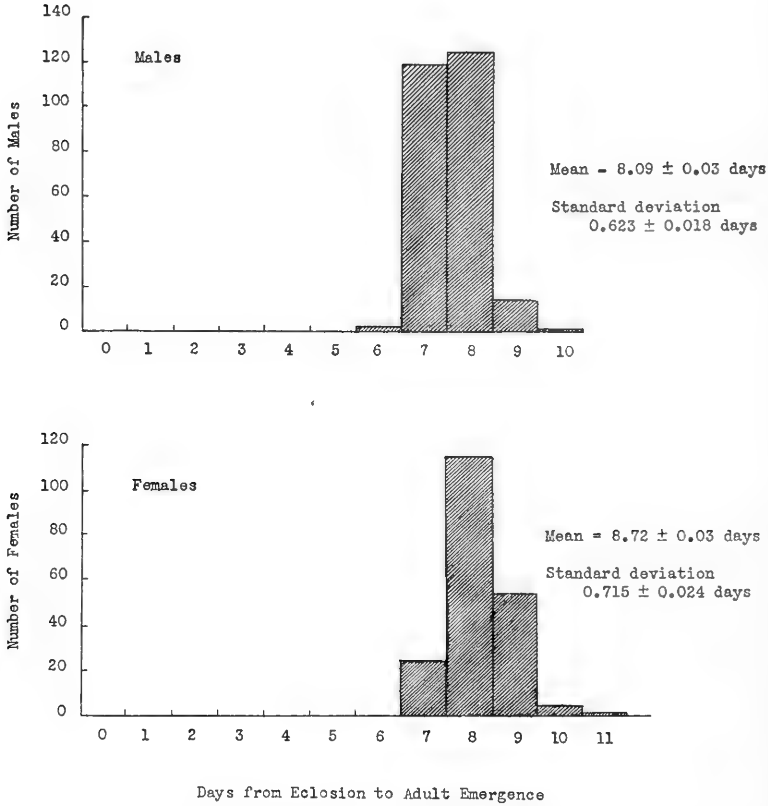

Figure 8.—Development of Stegomyia Larvae Under Optimum Laboratory Conditions Period from Eclosion to Emergence.

The interval between pupation and emergence was shorter in the experiment under optimum temperature conditions. For males it was reduced from 45 to 40 hours, and for females from 60 to 56. The emergence of females still required 15 more hours than that of males.

Mortality was less for individuals in this experiment than for those in the previous one. For eggs and larvae it was 6.67 ± 0.75 per cent and for pupae it was 1.93 ± 0.43 per cent.

The developmental process was accelerated in this experiment, and the hazards to survival were fewer. The question arises, to what extent was the difference in the mean temperature of the two experiments responsible. The regression equations, expressing the relation between pupation period and temperature and emergence period and temperature, enable us to compute expected pupation and emergence intervals for a seven-day average temperature of 27° C. These expected intervals are in the form of geometric means since the regression was based on the logarithms of the original means. Consequently, they must be compared with geometric means of observations in the second experiment, although the arithmetic means that we have been discussing are not significantly higher. The following comparisons may be made:

Comparison of Expected with Observed Results.

Geometric mean period in days	Observed at 27° C.	Computed for 27° C.	Difference
Pupation period	6.35 ± .02	6.08 ± .07	.33 ± .07
Emergence period			
Males	8.07 ± .03	7.71 ± .08	.36 ± .08
Females	8.69 ± 03	8.27 ± .08	.42 ± .08

The results of this comparison are most interesting. The means computed on the basis of the experience with the 61 lots were significantly lower in every case than those actually observed under similar temperatures. That is to say, if the routine experiments had been continued until midsummer the results might have been as good as or better than those attained in this special experiment.

Obviously, we cannot assume that the relationship between pupation and emergence periods and rise in temperature from 23.3° to 26.7° C. would necessarily continue for all higher temperatures. The justification for making the assumption in this case was the fact that the observed averages in the earlier experiment extended to within 0.3° of the desired point. In this connection MacGregor's (1931) statement that at 30° C. only 10 to 15 days are required from egg stage to egg stage is of interest.

In each of these experiments a larger number of males than of females was obtained. The proportion was 56.55 ± 1.56 per cent males in the experiment under optimum temperature. In the routine experiment the proportion of males was 52.10 ± 0.48 per cent. In each case the difference was significant. Owing to the fact that a significantly larger proportion of males was obtained under optimum conditions, the possibility of a correlation with temperature was investigated, but none that was significant was found.

Development Under Adverse Conditions.

In nature the development of the stegomyia is subjected to many influences favorable and unfavorable to its progress. In the experiments just described optimum conditions were provided, the only variant being the temperature. Before the standard method was adopted, certain experiments were performed under adverse or suboptimum conditions of known character in order to measure their effect upon development. Many of these adverse factors are present in nature and affect development. The adaptablity of the species enables it to survive often in spite of most unfavorable conditions, as the following experiments will show:

Egg Stage.

The egg stage is the most resistant of the four major stages of stegomyia. The small size and black color of the eggs prevent detection—except where ants are concerned—and their ability to withstand desiccation after the full development of the enclosed larvae for from six to twelve months renders this stage the strongest link in the life of the species. In the egg stage the species are transported great distances (in water jars, etc.) and no doubt this is one of the chief means of distribution. Reed and Carroll (1911) called attention to the fact that the eggs of stegomyia were remarkably resistant to drying, and that even though the adults could not survive a winter lasting three months, it would be entirely possible for the eggs to do so, especially since they are also resistant to freezing.

Reports of investigators on nurture for this stage give varying results. Bacot (1916), Young (1922–23), Buxton and Hopkins (1927), and Roubaud (1927–29), although fully aware that some time was required for incubation before the eggs woud hatch, state that frequently numbers of matured eggs would resist hatching indefinitely. These investigators are all agreed that the presence of organic matter, especially bacteria or yeast, stimulates hatching. Buxton and Hopkins and Roubaud have also shown that a variety of chemicals will produce a similar result although some of the substances used are lethal for the larvae. Preliminary experiments on the Greek strain (R. C. S.) suggest that this resistance may be peculiar to certain strains of stegomyia.

Four classes of eggs will now be discussed, divided according to initial treatment:

Class I.—Properly conditioned eggs are those that have been kept in the open air on moist filter paper until the enclosed larvae are fully developed and then placed in water containing food. The process was discussed under "Standard Development." Approximately 95 per cent of the moist eggs properly conditioned will hatch within 10 minutes when submerged in water with food.

Class II. These consist of freshly oviposited eggs less than twelve hours old. If placed immediately into water containing food, these eggs do not undergo as rapid or uniform a period of development as the eggs that are air conditioned according to the method followed in Class I. The rate of hatching at 24° C. of six lots of 100 eggs each according to the period of air conditioning given them is shown in Table 4.

TABLE 4.

ECLOSION PERIOD OF SIX LOTS OF 100 EGGS EACH ACCORDING TO PERIOD OF AIR CONDITIONING (ALL EGGS OVIPOSITED LESS THAN 24 HOURS BEFORE THE BEGINNING OF THE EXPERIMENT). TEMPERATURE 24° C.

LOT	HOURS AIR CONDITIONED		HOURS REQUIRED FOR FIRST HATCHING		HOURS REQUIRED FOR FINAL HATCH	TOTAL PERIOD IN HOURS
	RANGE	MEAN	ADDITIONAL HOURS	CUMULATED HOURS		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	0–24	12	144	156	216	372
2	12–36	24	52	76	72	148
3	33–57	45	31	76	54	130
4	40–64	52	18	70	48	118
5	60–81	70	8 min.	70	24	94
6	87–111	99	2 min.	99	10 min.	99

There are several points of interest in this table. The interval, following that of air conditioning, which elapsed before hatching began was less for each lot given a longer period of conditioning. Hatching time was also less, decreasing from nine days for the first lot to 10 minutes for lot 6.

From the biological point of view, there is another aspect of this table to be considered, and that is the variation in the complete interval from the time the lots were started (1) to the beginning of hatching, and (2) to the completion of hatching. These intervals are given in columns 5 and 7 of Table 5. Here we find that the interval to the beginning of hatching was approximately the same for lots 2 to 5. It was slightly longer for lot 6 and very much longer for lot 1. The time required for complete hatching was also much longer for lot 1 than for any of the others. The interval decreased with the longer period of conditioning for lots 2 to 5, and rose slightly for lot 6.

What apparently happened was this: the eggs in lot 1 were not fully mature when they were placed in water, and their subsequent development was retarded. In lots 2 to 5 the increased interval of air conditioning did not affect the time required for the beginning of hatching, but the lots with the longer preliminary treatment completed the process somewhat earlier. Lot 5 completed the entire process in the minimum time of 94 hours, conditioned for 70 hours and hatching in 24 hours. The entire interval required by lot 6 was covered by the conditioning process of 99 hours, since hatching was completed in 10 minutes.

Class III.—Eggs in this class were air dried while less than 24 hours old and kept in this state a week or longer. When placed in water these eggs exhibited a high mortality. Many of our early routine breeding records for the summer of 1928–1929 show a mortality of 50 to 80 per cent, which we attribute to the fact that the eggs were dried before they were fully mature. Table 5 shows the results of experiments at 24° C. in which the eggs were dried shortly after oviposition and kept in this state for varying lengths of time.

TABLE 5.

MORTALITY DUE TO DRYING FRESHLY OVIPOSITED EGGS, 100 EGGS PER LOT, AT 24° C.

LOT	DATE OF OVIPOSITION	DAYS KEPT DRIED	DATE SUBMERGED IN WATER WITH FOOD	INTERVAL TO FIRST HATCHING	INTERVAL TO FINAL HATCHING	PER CENT MORTALITY
1	July 14	1	July 16	3 days	4 days	8
2	July 14	7	July 22	½ hour	1 hour	20
3	July 14	17	Aug. 1	1 hour	8–16 hours	38

Although humid atmospheric conditions prevailed when these experiments were made, mortality was fairly high, particularly when we consider that lot 6 in Table 4 of eggs air conditioned for 99 hours at the same temperature before being submerged had a mortality of only 3 per cent.

Class IV.—These are eggs ripened on moist filter paper and then dried. Treated in this way the eggs may be stored for a period of six months without showing a high mortality. About 5 per cent will survive a year or more.

Our experience with thousands of eggs which were dried within four weeks and then used in routine rearings gave such uniform results that it is possible to formulate the following rule for our Brazilian strain:

Conditioned eggs, air dried from one to four weeks, begin to hatch within 30 minutes when submerged in water to which food has been freshly added; and when placed in water which has contained food 12 hours or more, they begin to hatch in about seven minutes.

A large proportion will even hatch in distilled water. Better results in general may be obtained by using eggs less than 10 days old, or by moistening the older eggs several hours before submerging them in water.

A small percentage of eggs which have been dried a month or more may resist hatching. If these are removed and re-dried, additional ones will hatch when again placed in water. If this process is repeated several times, all viable eggs will eventually hatch. We have not observed such striking cases of resistance to hatching as recorded by Roubaud (1927–29), Buxton (1927), and others.

Only one experiment with 5,000 eggs, which had been kept dry five to six weeks, is given below, but others also numbering thousands of eggs have given similar results.

TABLE 6.

EFFECT UPON ECLOSION OF IMMERSING AND RE-DRYING EGGS PREVIOUSLY CONDITIONED AND DRIED FOR A PERIOD OF 5 TO 6 WEEKS; 5,000 EGGS USED.

DATE IMMERSED IN WATER WITH FOOD	NUMBER LARVAE HATCHED	DATE UNHATCHED EGGS REMOVED FOR FURTHER DRYING
March 2	4,500 ±	March 6
March 18	170	March 19
March 28	19	March 29
April 4	0	April 10
Total hatch	4,689 ±	

These methods of treating newly oviposited eggs of stegomyia were designed to reproduce various events that may occur in nature so that their results might be evaluated. The wild female stegomyia lays her eggs preferably on the side of the water jar just above the water line, where the film ordinarily keeps the eggs moist until the enclosed larvae are mature. Some of the eggs may be laid on the surface of the water and maturation in this case must take place there. The laboratory experiments indicate that the moist side of the jar is more favorable to rapid development of the eggs than the water surface, but that sufficient water must be added to cover the eggs before they will hatch. The speed of hatching when water is added depends on the length of time the eggs had remained on the moist side of the jar. Eggs laid on the surface of the water develop more slowly, and the hatching process is longer than those ripened on the side of the jar. If water is removed and the eggs dry before they are ripe, mortality is doubtless high, but if they remain moist until thoroughly mature, they can withstand drying for some time. When water is added to the jar, they will begin to hatch, and repeated drying and submergence will facilitate almost a complete hatch.

Larval and Pupal Stages.

These are the most critical stages in the life cycle of the stegomyia. Inasmuch as the female stegomyia prefers the domestic water container for oviposition, there is always the danger that the water may evaporate or be drawn off before the larvae have completed their development. Experiments in this laboratory show that larvae can survive at least 18 hours on the damp sides of the container. Half-developed pupae when placed on a damp surface are still capable of producing adults. Young (1922) states that pupae kept dry 24 hours were able to produce adults.

The strictly domestic habitats of stegomyia larvae are practically free from predatory enemies, and it may be for this reason that these larvae are more susceptible to predators added to their breeding jars than are the larvae of other species. This was discussed in detail in a former paper (Shannon, 1931).

The following experiments describe the effect upon stegomyia larvae of (1) starvation, and (2) overcrowding.

Starvation.—In the first experiment 20 larvae were allowed to hatch in distilled water and were then transferred to isolation tubes containing distilled water. Another 20 larvae were given plenty of food until the third stage was attained. They were then thoroughly washed in distilled water and placed in isolation tubes with distilled water. Mean temperature during this period was 23.5° C. Table 7 shows the number of days survived by the individuals in each group.

TABLE 7.

RESISTANCE OF LARVAE TO COMPLETE STARVATION AT 23.5° C.

	DAYS SURVIVED IN DISTILLED WATER																		TOTAL
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
1st stage larvae of eggs hatched in distilled water......	—	—	—	1	2	—	—	6	5	1	1	1	1	—	—	1	—	1	20
3d stage larvae with plenty of food until this stage was reached	1	—	1	1	4	1	—	2	—	3	1	3	2	—	—	1	—	—	20

	Mean days Survived	Standard Deviation
1st stage larvae	14.35 ± 0.50	3.32 ± 0.35
3d stage larvae	13.45 ± 0.59	3.93 ± 0.42
Difference	0.90 ± 0.77	0.61 ± 0.55

It is of interest to note that the survival period was no longer for larvae fed up to the time of reaching the third stage than for those starved from the time of hatching. Three weeks was the survival period for at least one individual in each group.

Table 8 shows the effect upon survival when only a very small amount of food was present. The small pinch of dried beef serum was sufficient to stimulate hatching but not enough to enable the larvae to complete development. In this experiment the feeding jar was kept covered.

TABLE 8.

RESISTANCE OF 50 LARVAE TO ALMOST COMPLETE STARVATION. TEMPERATURE APPROXIMATELY 27° C.

DATE OF OBSERVATION	LARVAE SURVIVING	DAYS SURVIVED	REMARKS
Dec. 1	50		Number eggs hatched
Jan. 6	15	36	About one-third grown
Jan. 11	11	41	About one-half grown
March 25	1	114	Very small, died pupating

Although the survivors fed upon those which died, none of the 50 larvae in this experiment lived to complete pupation in spite of the fact that approximately one-third lived 36 days. This experiment was run during the summer, and experience with normal rearings at midsummer temperature under standard development gave a mean pupation period of 6.40 ± 0.02 days and a maximum interval of nine days. The effect of lack of food is therefore apparent. The maximum survival period in this experiment was 114 days.

The ability of stegomyia larvae to withstand semistarvation and even to develop when there is but a minimum of food present is well shown in the following experiment in which *Culex quinquefasciatus* was included. In this experiment 100 stegomyia eggs and an equal number of culex eggs were put in a large pan of tap water, which was placed in a fairly dusty room. The only food available consisted of the dust and small insects settling on the water, any microorganisms which may have been in the water originally, and the larvae which died during the experiment. The results are given in Table 9.

TABLE 9.

EFFECT OF SEMISTARVATION ON 100 STEGOMYIA AND 100 *Culex quinquefasciatus* LARVAE (EGGS PLACED IN A LARGE OPEN PAN OF TAP WATER JUNE 19 IN A FAIRLY DUSTY ROOM. NO FOOD ADDED).

SPECIES	PUPATION				EMERGENCE		MORTALITY	
	FIRST		LAST		MALES	FEMALES	EGGS AND LARVAE	PUPAE
	DATE	INTERVAL IN DAYS	DATE	INTERVAL IN DAYS				
Stegomyia	July 18	29	Sept. 24	97	43	28	17	12
Culex	Aug. 11	53	Aug. 23	65	2	1	94	3

The differences are striking. Mortality was 29 per cent for stegomyia and 97 per cent for culex. Adult emergence for stegomyia was 71 per cent and for culex 3 per cent. Actually very few of the culex larvae had advanced beyond the second stage at the time of death, and one of the striking results of this experiment was that within four days the stegomyia larvae could be instantly distinguished from those of culex by their noticeably larger size.

It is well known that stegomyia breeds preferably in fresh water supplies while *Culex quinquefasciatus* shows an equal preference for waste waters. The reason why stegomyia larvae can develop in a medium with but a small amount of surface food while nearly all of the culex larvae die in such a medium, apparently lies in the differences in behavior of the two species.

The chief characteristic of stegomyia larvae, aside from their negative phototropic tendencies, is their extreme restlessness and their ability to feed from all parts of the body of water. They feed chiefly around the sides and bottom of the container, but are able to feed on suspended particles and from the surface of the water as well. The larva possesses two methods of feeding at the surface film. By means of the first, the body is raised and twisted so that the mouth parts are brought into contact with the surface. By retaining hold on the surface film with its respiratory tube, the larva is able to propel itself about in a circle by the movement of its mouth brushes, feeding as it goes. By the second method, the larva may feed on the lower side of the surface film by turning its body completely over, with the respiratory tube pointed downward, and by gliding along with the aid of the mouth brush movements.

Culex larvae are also able to feed from the sides and bottom of the container and to pivot in a circle at the surface film, but they prefer to hang suspended from the surface film, feeding upon the suspended particles within their reach. It may well be that culex larvae require a richer type of food than stegomyia. Certainly the experiment indicated that the stegomyia larvae were better able to find and utilize what food was present than were the culex larvae.

This difference in the behavior of the two species suggests that in experiments dealing with the food of mosquito larvae, behavior as well as type of food should be studied. Christophers and Puri (1929) have shown the importance of this for anopheline larvae. They speak of the tendency for particles of living and dead matter to accumulate just under the surface of the water without coming into contact with the surface film, and suggest that the horizontal position of anopheline larvae enable them to tap this special food supply.

MacGregor (1929) has noted a phase of suspended development among tree-hold breeding species which he attributes to the temporary or complete disappearance of microorganisms from their breeding sources. He suggests that these microorganisms help to convert organic particles in the water into suitable form for larval food.

Hinman (1930) met with a type of development similar to that in the experiment described above when he attempted to rear stegomyia in water obtained from tubs previously used for breeding larvae in large numbers and which had been passed through a Berkefeld filter. All solid material and organisms were thus removed and only the organic and inorganic substances in solution and colloids in suspension remained. He was successful, however, in rearing a few adults in from 9 to 17 days, while similar experiments with culex and anopheles were unsuccessful. His experiments also indicate a greater efficiency in searching for food on the part of the stegomyia larvae as compared with those of culex.

Overcrowding.—Table 10 gives mortality and the time required for pupation at 27° C. of lots of stegomyia larvae according to their density in the rearing jar.

TABLE 10.

EFFECT OF OVERCROWDING ON PUPATION PERIOD AND MORTALITY OF STEGOMYIA LARVAE AT 27° C.

NUMBER OF EGGS PER LOT	DAYS TO FIRST PUPATION	DAYS TO FINAL PUPATION	NUMBER OF PUPAE	PER CENT EGG AND LARVAE MORTALITY
100	5	7	95	5.00 ± 1.47
400	5	10	10	15.50 ± 1.22
1000	7	16	790	21.00 ± 0.87
4000	10	60	2096	47.60 ± 0.53

These results should be compared with those obtained at 27° C. under standard development. There we found a pupation period extending from the fourth through the ninth day and an egg and larval mortality of 6.67 ± 0.75 per cent. These are virtually the same as the results in Table 10 for the lot of 100 larvae. Although the pupation interval for the lot of 400 larvae was not appreciably longer, mortality was nearly three times as high, 15.50 ± 1.22 per cent. In lots of 1,000 eggs and more, both pupation interval and mortality were increased.

One might be inclined to attribute the slow development and high mortality in the overcrowded jars to toxic action exerted by waste products in the water. It was found, however, that 25 larvae when placed in water that had been fouled by 2,000 larvae during two weeks' time—the pH had dropped from 8.0 to less than 5.2—developed normally, completing pupation on the fifth day and producing large sized adults.

The behavior of the stegomyia larvae may offer an explanation for this. Their sensitiveness to light and vibration is well known. Owing to their negative phototaxis, the larvae seek the darker side of the container. Their massing together and extreme restlessness may prevent them from feeding normally even when an abundance of food is present. De Buck, Schoute, and Swellengrebel (1932) claim that it is necessary for anopheline larvae to maintain a constant stream of food passing through the body in order to develop normally, and that when they live in overcrowded conditions food may remain undigested in the alimentary tract from 12 to 24 hours.

Apparently, too, when once growth has been arrested it is likely to continue so. The larvae remaining in a jar that was formerly overcrowded continued to develop slowly. Figure 9 shows the relative difference in size of the cephalothorax of a female stegomyia pupa developed under uncrowded conditions and that of one from an overcrowded jar.

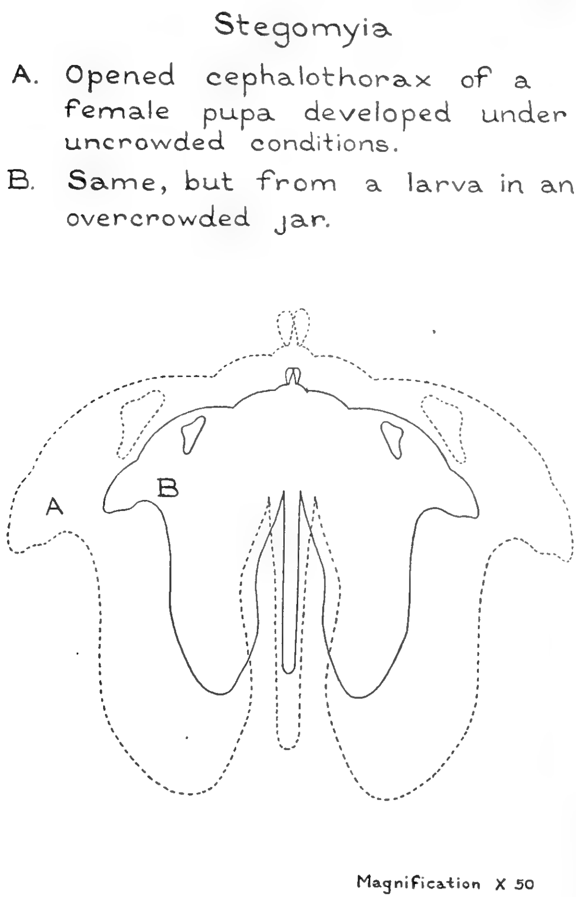

Figure 9.

AN ADVERSE PHENOMENON OF UNKNOWN ORIGIN.

In routine laboratory procedure an average of five larval jars were started daily. It was observed that once or twice a month from 50 to 75 per cent of the adults, usually from one jar, died shortly after emerging. Equal numbers of males and females were usually affected. Similarly full grown larvae in a single jar would die just before pupating. Instances of this may be found in Table 1. It is highly probable that a disease is the cause of this remarkable phenomenon, although as yet the laboratory staff has been unable to discover the cause. Neither has it been possible to propagate the cause in fresh jars.

The fact is of interest in that it suggests the existence of a disease which attacks stegomyia larvae, which may kill them while they are still in the larval stage or which may not become effective until the adults have emerged.

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The authors are indebted to Drs. J. H. Bauer and N. C. Davis, who installed the equipment for rearing stegomyia in the laboratory at Bahia and who began the routine breeding. Dr. Davis in his capacity as director of the laboratory contributed materially in practical and advisory ways. Dr. Hugo Muench in the New York Office assisted with the statistical analysis.

SUMMARY.

In this paper a technic for rearing stegomyia larvae has been described which was evolved in the Yellow Fever Laboratory, Bahia, Brazil. The method was found to give highly uniform results, with a minimum mortality and maximum development for the species, indicating most favorable conditions of nurture. A statistical analysis of records of two series of observations defined relationships and set up norms for comparison with results of subsequent experiments under similarly favorable or unfavorable conditions. Since stegomyia is essentially a domestic species, the laboratory affords an environment not unlike that encountered in nature.

The standard method adopted was based on results obtained in experiments similar to those described under "Development under Adverse Conditions." In summarizing, therefore, these results will be discussed in their relation to the technic adopted.

This paper is concerned with egg and larval stages of stegomyia development. Egg laying capacity and longevity of adults will be discussed later.

Egg stage.—The most rapid and complete hatching of stegomyia eggs was secured when they were allowed to ripen on moist filter paper from two to five days before being submerged in water. The time required depended upon the temperature. Although the total number of hours in the egg stage did not decrease materially for eggs conditioned more than 24 hours, the hatching process was accelerated by a longer period. In the experiment reported, eggs conditioned four days completed hatching in ten minutes when submerged in water containing food.

Freshly oviposited eggs if placed immediately in water require a much longer interval for complete eclosion, possibly because the eggs are not ripe when placed in water. On the other hand, eggs that are dried before they mature show a high mortality. If conditioned first, they may be dried and kept six months without losing their viability. Some may survive for more than a year.

The egg stage of the stegomyia is doubtless the most resistant period in the life cycle of the species owing to the ability of the egg to withstand drying and adverse temperature.

Larval stage.—The most favorable conditions for rearing larvae require an adequate food supply consisting of 2 to 3 cc. of dry bread, temperature ranging

from 23° to 27° C., and a maximum of 100 larvae per jar. In such an environment pupation will occur in an average of 6 to 7 days, mortality will be low, and the size of the individuals will be large.

It was found that stegomyia larvae were able to complete development on an amount of food wholly inadequate for *Culex quinquefasciatus* larvae. Mortality was 29 per cent among stegomyia and 97 per cent among culex larvae in this experiment. Difference in larval behavior and feeding habits may account for this. Although stegomyia may survive for a considerable period on a minute quantity of food, pupation does not necessarily occur.

Experiments in overcrowding indicated that mortality was significantly higher when 400 or more larvae were placed in the same jar. With 1000 or more larvae, the pupation period was also increased and the ultimate size of the individual larva was smaller. Improper nourishment due to massing habits of the larvae may account for this rather than an excess of toxic substances, since it was found that small numbers of larvae passed through a normal cycle when placed in water previously fouled by the presence of large numbers of larvae.

An apparently natural phenomenon of unknown origin was also observed in the course of routine rearings which caused severe mortality among full-grown larvae and newly emerged adults.

To illustrate the type of results attained in rearing stegomyia larvae according to the standard method, two series of observations were analyzed. The first applied to pupation and emergence periods for 61 lots of 100 eggs each, one started on each of 61 succeeding days. Daily mean temperature records were available for this series. The second series of observations were from five lots of 100 eggs each reared at an average temperature of 27° C. The results were analyzed statistically, and the findings will now be summarized:

1. A definite relationship was found to exist between the mean pupation periods of the 61 individual lots and rise in temperature. The decrease in mean pupation period was 0.76 ± 0.08 per cent days per 0.1° C. rise in temperature. In computing this relationship the temperature records were converted into seven-day averages to correspond to the mean pupation period for all individuals in the 61 lots found to be 7.16 ± 0.01 days.

2. A similar relationship was found between rise in temperature and emergence periods.

3. The average emergence period of females in the 61 lots was 14 hours longer than that of males.

4. Mean temperature for the entire rearing period of the 61 lots was 25° C.

5. Rearing at 27° C. was more rapid and the process more concentrated.

6. By means of the regression equations expressing the relation between pupation and temperature, and emergence and temperature, it was possible to estimate the mean pupation and emergence periods at an average temperature of 27° C. for comparison with the observed results at this temperature. This was done and the results agreed very well.

7. Mortality was less for lots raised under optimum temperature conditions.

8. In each series a larger number of adult males than females emerged.

9. The important statistical measures of larval development given by the two series of observations follow:

	61 lots at 25° C.	5 lots at 27° C.
Egg and larval mortality	12.41 ± .29%	6.67 ± .75%
Pupal mortality	6.81 ± .23%	1.93 ± .43%
Mean pupation period	7.16 ± .01 days	6.40 ± .02 days
Mean emergence period		
Males	9.05 ± .02 days	8.09 ± .03 days
Females	9.74 ± .02 days	8.72 ± .03 days
Males per 100 pupae	52.10 ± .48	56.55 ± 1.56

10. In a later paper it will be shown that at 27° C. the female can not produce eggs until six to seven days after emergence. Therefore, at this temperature and with the foregoing data at hand it can be stated that the interval from egg stage to egg stage averaged about 15 days.

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THE BIOLOGY OF STEGOMYIA UNDER LABORATORY CONDITIONS.[1]

By PERSIS PUTNAM AND RAYMOND C. SHANNON.

II. EGG-LAYING CAPACITY AND LONGEVITY OF ADULTS.

The preceding paper contains an experimental and statistical analysis of various factors which influence the development of stegomyia eggs and larvae under laboratory conditions. A standard technic for rearing larvae is described which was evolved in the Yellow Fever Laboratory in Bahia, Brazil. It is shown that this technic gives highly uniform results under the ordinary laboratory conditions in the tropics, with minimum mortality and maximum development for the species. The statistical analysis brings out a negative correlation between pupation and emergence intervals and temperature. Means and standard deviations for lots of larvae reared under routine and optimum conditions are discussed. The experimental work forming the basis of the standard technic is described.

In the present paper various factors which influence egg-laying capacity and longevity of stegomyia females will be considered. The experiments were performed in the Yellow Fever Laboratory in Bahia, and because of the excellent quality of the data statistical methods have been used in their analysis. The results will be discussed from the statistical point of view.

Three series of observations form the basis for this study. The first includes records of frequency of feeding, amount of blood consumed, frequency of oviposition, number of eggs deposited, and total length of life, for each of twenty isolated females. The second series includes frequency of feeding, weekly egg components, and total duration of life for ten lots of females. These data apply to lots except in the case of length of life for which individual records are available. The third series comprises longevity records for a group of females which was never offered a blood meal.

Two preliminary sets of observations will be discussed which concern the intervals beween emergence and the first blood meal, and between the first blood meal and the first oviposition period.

The object of this study is to describe statistically the relationships between the attributes of the biologic functions as found in the laboratory records. The regression equation will be the usual form since it gives a mathematical basis for estimating results to be expected of similar stock reared under

[1] The studies and observations on which this paper is based were conducted at the Yellow Fever Laboratory, Bahia, Brazil, with the support and under the auspices of the International Health Division of The Rockefeller Foundation.

like conditions. The specific form of equation used will be described when it is applied.

Conditions of the Experiments.

Stock.—The stock used in the experiments was reared in accordance with the methods described in detail in the preceding paper.

Temperature.—Controlled temperature experiments were not made for these studies. At the time observations were being made the temperature approximated 27° C. For the development of the larval stages this was found to be highly favorable.

Nutrition.—Dishes containing raisins or honey and water were kept continuously in the experimental cages. It is a well known fact that although adults can survive for their full life time on honey or fruit juices and water, blood is absolutely required for the development of the ova. Bacot (1916) claims that he obtained single eggs from females which had been fed on a mixture of blood and honey and blood and syrup respectively. In our laboratory several specimens which had been fed on honey and water only for several weeks were dissected, and in all cases the eggs were still in the primary stages, i. e., the first and second stages as described by Christophers (1911).

The Preoviposition Stage.

Before the female can produce fertile eggs she must pass through a preliminary period which will be called the preoviposition stage and is defined as the interval from emergence to the deposition of the first eggs.

The adult is ready for flight almost immediately after emerging from the pupal cast. Both sexes readily mate within a few hours after emergence. It should be noted, however, that ovulation does not require fertilization.

A certain time must elapse before the sclerotin of the proboscis is sufficiently hard to penetrate ordinary skin. Table 1 shows the age at time of first blood meal of 29 females at an average temperature of 27° C. These individuals emerged between 10 A. M. and 4 P. M. and were given an opportunity to feed on the following day at 9 A. M. No notice was taken at this time of the operator's hand or of the guinea pig when placed in the cage. At 4 P. M. of the same day, however, three individuals fed. The mean age of the group at this time was 27 hours.

TABLE 1.
AGE OF STEGOMYIA FEMALES AT FIRST BLOOD MEAL.

DATE ON WHICH BLOOD MEAL WAS OFFERED		NUMBER FED	AGE IN HOURS AT TIME OF FEEDING
Nov. 4	9 a.m.	0	—
	4 p.m.	3	27
Nov. 5	9 a.m.	8	44
	4 p.m.	5	51
Nov. 6	9 a.m.	4	68
	4 p.m.	4	75
Nov. 7	4 p.m.	0	—
Nov. 8	9 a.m.	0	—
Nov. 9	9 a.m.	5	140

Mean age at time of first feeding 67.6 ± 4.5 hours.

The mean age at first blood meal of these 29 specimens was 67.6 ± 4.5 hours, or 2.8 days, but half the specimens had fed at the age of 51 hours. The mean was higher because five females did not feed until they were more than five and a half days old.

The ovulation period is defined as the time elapsing between the blood meal and oviposition. Such an interval must follow each blood meal, but the number of eggs matured each time can not be determined since they are not necessarily all deposited at once. The ovulation period and ovulation rate following the first blood meal can be determined, however, and this was done for eight lots of females with the results given in Table 2.

TABLE 2.
REGRESSION OF OVULATION ON TEMPERATURE FROM DAY OF INITIAL BLOOD MEAL THROUGH SECOND OVIPOSITION DAY.

Eight Lots of Stegomyia Females.

LOT	1	2	3	4	5	6	7	8
Date fed	July 11	July 9	July 9	Nov. 8	Sept. 22	Jan. 19*	Oct. 15*	Oct. 9*
Temperature (C.)	23.6	24.0	24.0	25.6	26.0	27.0	27.2	27.7
Number of females	180	180	180	180	250	118	10	10
Days between 1st meal and 1st oviposition	4	4	4	2	3	3	4	3
Eggs 1st day	15	62	92	6	21	290	117	4
Eggs 2d day	130	250	300	115	610	287	66	376
Total eggs	145	312	392	121	631	577	183	380
Eggs per female per day								
Observed	.13	.29	.36	.17	.50	.98	3.05	7.60
Computed	.14	.19	.19	.62	.83	1.75	2.03	2.94

*These lots are analyzed in detail later.

The rate of ovulation should take into account the length of the ovulation period and the number of eggs deposited at its close. In the analysis of the data in Table 2 it was arbitrarily assumed that the eggs matured by the first meal were laid on the first and second oviposition days, and the ovulation period was increased by two days to cover them. From the data given the number of eggs per female per day was computed for each lot, and is given in the table.[2]

If we compare the ovulation rates with the temperature given for each lot, we notice that those for higher temperatures were larger. This suggests that temperature may have affected the speed of ovulation as it did that of pupation and emergence of larvae.

Figure 1 shows the form of this relationship. The observed eggs per female per day were plotted on a logarithmic scale against temperature on an arithmetic scale, and a straight line was fitted to the observed rates.

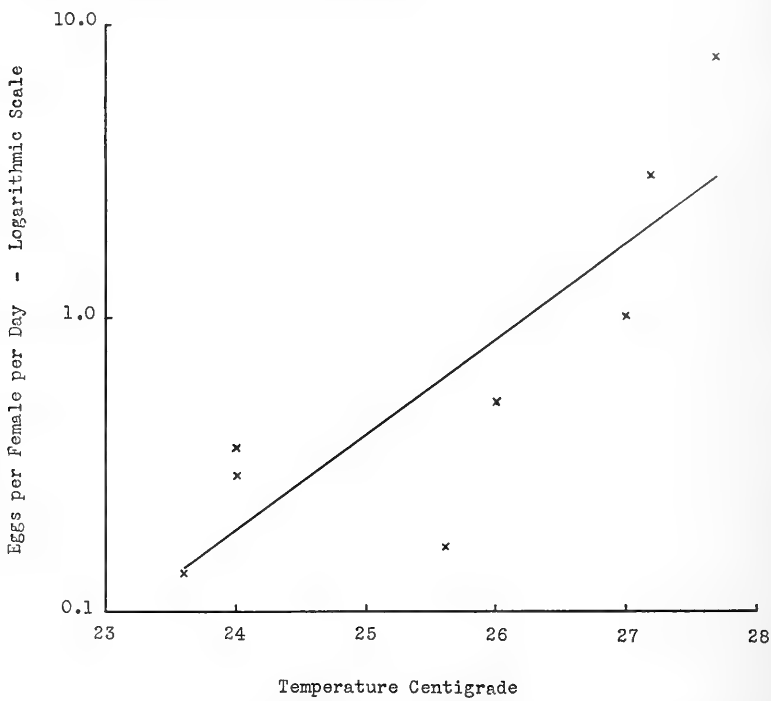

Figure 1.—The Regression of Ovulation on Temperature from the Day of the Initial Blood Meal through the Second Oviposition Day for Eight Lots of Stegomyia Females.

[2] It should be noted that individuals in some of the lots were fed a second time before oviposition occurred, the second meal three days after the first. It is possible that oviposition of eggs matured by the first meal may have been hastened by the ingestion of the second.

The straight line indicates that the ovulation rate increased 7.70 ± 1.38 per cent for each successive rise of 0.1° C. By substituting specific temperatures in the equation,[3] we may compute theoretical ovulation rates. Those for the eight lots in Table 2 were computed and are given in the table. They lie on the fitted line opposite the corresponding observed rates.

We find then that ovulation was distinctly more rapid for lots started at temperatures of 27° C. and above than for those started at lower ones; and for the eight lots observed we have given this relationship definite mathematical expression.

This ovulation rate was determined not only by the number of eggs deposited but also by the interval required. Table 2 indicates the time elapsing between the blood meal and the day on which the first eggs were deposited. This is a minimal period for the lot, not the average for the individuals included. The table shows that there was a decrease in interval with increase in temperature, with a mean for the eight lots of 3.4 days.

Egg-laying Capacity with Respect to Length of Life, Blood Consumption, and Oviposition.

The following analysis is based on the complete lifetime records of twenty females included in Lots 7 and 8 of Table 2. These individuals were three days old at the time of their first blood meal and were divided into three groups. Group I contained four specimens allowed but one blood meal; Group II, consisting of eight specimens, was offered a blood meal once a week; and the eight specimens in Group III were offered a blood meal once every three days.

A rough estimate was made of the amount of blood consumed at each feeding. A full engorgement was rated as three units, a moderate one as two, and a small one as one unit.

Egg-laying usually occurred some time between the hours of 5 P. M. and 8 A. M. In the present study the eggs found each morning constitute those laid in a single oviposition period.

Table 3 contains the final record for each of the twenty females according to the frequency with which blood meals were offered. Since individual performance was greater for those offered a blood meal once a week and every three days, the first step in the analysis was to see whether these differences were statistically significant.

[3] The equation for the line was:
Log (mean eggs per female per day) = log 0.13049 + log 1.0770. temperature.
(Temperature was expressed in units of 0.1° C. from 23.5° C. as origin.)

TABLE 3.

EGG-LAYING CAPACITY OF TWENTY STEGOMYIA FEMALES ACCORDING TO FREQUENCY OF FEEDING, DAYS LIVED, BLOOD UNITS CONSUMED, AND NUMBER OF OVIPOSITION PERIODS.

SPECIMEN	BLOOD MEALS OFFERED	DAYS LIVED	BLOOD UNITS CONSUMED	OVIPOSITION PERIODS	EGGS DEPOSITED
A	Twice	67	5	4	169
B	Once	75	2	1	35
C	"	73	3	1	91
D	"	36	2	4	81
Total		251	12	10	376
E	Weekly	100	38	20	571
F	"	87	38	18	488
G	"	99	32	22	590
H	"	108	21	8	285
I	"	60	18	11	376
J	"	124	48	24	645
K	"	5	3	0	0
L	"	10	3	0	0
Total		593	201	103	2,955
M	Every 3 days	77	33	15	302
N	" "	64	37	24	473
O	" "	103	29	5	279
P	" "	75	6	4	75
Q	" "	90	20	8	184
R	" "	58	6	0	0
S	" "	96	54	21	501
T	" "	17	8	0	0
Total		580	193	77	1,814
Total all specimens		1,424	406	190	5,145

Means were computed from the data for all twenty specimens and are given in Table 4. They indicate that the 20 specimens in this group lived 71 days on the average, consumed 20 units of blood, and oviposited approximately nine times with a total component of 257 eggs.

TABLE 4.

MEANS AND STANDARD DEVIATIONS OF OBSERVATIONS ON EGG LAYING CAPACITY OF TWENTY STEGOMYIA FEMALES ACCORDING TO FREQUENCY OF FEEDING.*

ATTRIBUTE OBSERVED	ALL SPECIMENS		BLOOD MEALS OFFERED		
	MEAN	STANDARD DEVIATION	ONCE	WEEKLY	EVERY THREE DAYS
			MEAN		
Days lived	71.20 ± 5.12	32.21 ± 3.62	62.75 ± 15.36	74.12 ± 7.68	72.50 ± 7.68
Blood units consumed	20.30 ± 2.65	16.66 ± 1.87	3.00 ± 7.95	25.12 ± 4.59	24.12 ± 4.59
Oviposition periods	9.50 ± 1.40	8.79 ± .99	2.50 ± 4.19	12.88 ± 2.42	9.62 ± 2.42
Eggs deposited	257.25 ± 34.74	218.55 ± 24.57	94.00 ± 104.23	369.38 ± 60.18	226.75 ± 60.18

*N–2 used in computing probable errors.

The standard deviations shown in Table 4 indicate statistical variability. They are better measures of range than maximum and minimum values since they give average rather than extreme variability.

The size of the standard deviation depends upon that of the corresponding mean. In Table 4, for example, the largest standard deviation is that for eggs deposited, but this does not signify that the individuals actually varied more with respect to egg production than they did with respect to oviposition.

Before actual variability can be compared, the standard deviations must be reduced to a comparable base, and this may be done by computing coefficients of variation from the formula:

$$\text{Coefficient of variation} = \frac{100\ (\text{Standard deviation})}{\text{Mean}}$$

These are given below:

Attribute observed.	*Coefficient of variations.*
Days lived	45.21 ± 6.03
Blood units consumed	82.07 ± 14.13
Oviposition periods	92.53 ± 17.13
Eggs deposited	84.96 ± 14.93

These coefficients indicate that the females varied most with respect to the number of oviposition periods and least with respect to the number of days lived. The differences between the coefficients were none of them as much as three times their probable errors, and so were not significant. They are given to show how the relative variability in performance of the individuals in the group may be found.

The purpose of varying the frequency of feeding was to see what the effect would be on blood consumption, oviposition, and the number of eggs deposited. Table 4 contains the means of the observations for each of the three groups.[4] Although these means differed considerably, none of the differences was statistically significant. It was possible, therefore, to proceed to the analysis of the data for all the specimens as a single group.

The question next to be considered was what effect length of life, amount of blood consumed, and the number of oviposition periods had, severally and collectively, upon the egg-laying capacity. The correlation method was used for this analysis. In its simplest form this is illustrated in Figure 2 in which each individual was plotted according to the number of days lived and the number of eggs deposited in the course of its life. Each of the scales is arithmetic, and the straight line was fitted to the observations. This line shows graphically what the average increase in egg component was per unit increase in days lived. It was plotted from the equation:

$$\text{Mean eggs deposited during lifetime} = 4.88\ (\text{days lived}) - 90.19.$$

[4] In computing probable errors the standard deviations applying to all twenty specimens were used, on the assumption that variability of the means of the subdivisions would be similar to that of the whole group.

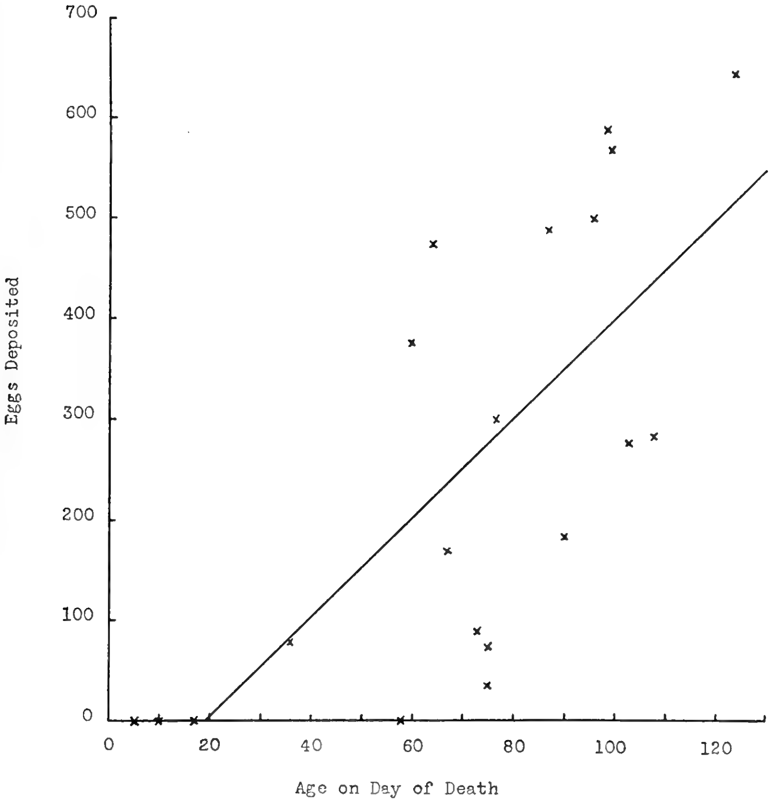

Figure 2.—The Regression of Eggs Deposited on the Number of Days Lived for Twenty Stegomyia Females.

From this equation we may estimate the average egg component of individual specimens living a specified number of days, but we also want to know how blood consumption and frequency of oviposition affected egg production. Table 5 contains the correlation coefficients giving the amount of association between attributes of various pairs of biologic functions and between pairs of functions with the effect of a third or a third and fourth held constant.

TABLE 5.

EGG-LAYING CAPACITY OF TWENTY STEGOMYIA FEMALES. CORRELATION BETWEEN (z) EGGS DEPOSITED, (x) AGE IN DAYS, (y) BLOOD UNITS CONSUMED, AND (u) OVIPOSITION PERIODS.

*Coefficients of Correlation.**

ZERO ORDER		FIRST ORDER		SECOND ORDER	
SUBSCRIPT	r	SUBSCRIPT	r	SUBSCRIPT	r
zx	+ .719 ± .077	$zy.x$	+ .832 ± .050	$zx.uy$	+ .507 ± .125
xy	+ .682 ± .085	$zu.x$	+ .943 ± .018	$zu.xy$	+ .803 ± .060
xu	+ .623 ± .097	$yu.x$	+ .862 ± .042	$xu.zy$	— .414 ± .140
zy	+ .913 ± .026	$zx.y$	+ .323 ± .147	$zy.xu$	+ .112 ± .167
zu	+ .960 ± .012	$xu.y$	+ .011 ± .164	$yu.zx$	+ .421 ± .139
yu	+ .918 ± .025	$zu.y$	+ .756 ± .070		
		$zx.u$	+ .555 ± .113		
		$zy.u$	+ .284 ± .150		
		$xu.z$	+ .351 ± .143		
		$xy.z$	+ .090 ± .162		
		$yu.z$	+ .361 ± .142		

**N*–2 was used to compute probable errors of zero order coefficients;
N–3 for probable errors of first order coefficients; and
N–4 for probable errors of second order coefficients.

It may be well to state briefly how these coefficients should be interpreted. If for every increase of one unit in either of the two attributes compared there is a definite and proportional rise in the other, the correlation coefficient will be + 1. If the attribute of either function decreases while the other rises in a definite manner, the correlation coefficient will be — 1. In either case the correlation is said to be perfect. Consequently, coefficients in the neighborhood of + 1 or — 1 indicate a high degree of association. If the attributes are unrelated the correlation coefficient will be in the neighborhood of zero.

If we examine the zero order coefficients in Table 5, we find good positive correlation between the attributes compared. This means that as one of the attributes increased the other rose in a definite fashion. The two most closely associated were the number of eggs deposited and oviposition periods, $r_{zu} = + 0.960 \pm 0.012$. Egg components and blood units were also highly correlated, $r_{zy} = + 0.913 \pm 0.026$, and so were oviposition periods and blood units, $r_{yu} = 0.918 \pm 0.025$. Actual length of life apparently affected the number of eggs deposited less than either of the other two functions.

From these zero order coefficients it is possible to set up regression equations from which mean egg-laying capacity may be computed in terms of each of the other attributes. This was done in Figure 2 for eggs deposited and length of life.

To determine the effect upon egg components of two of the other functions, partial correlation coefficients of the first order were computed. These indicate the association between the attributes of two of the functions for a constant value of a third. For example, the correlation between eggs deposited and oviposition periods with blood units constant, $r_{zu.y} = +0.756 \pm 0.070$, represents the amount of correlation we should find if we compared the egg production and oviposition periods of those individuals only whose total blood consumption was the same.

Actually, we are dealing with attributes of four interdependent biologic functions, and holding one or another constant would necessarily decrease the amount of correlation between the two compared. Table 5 shows that the least reduction between zero order and first order coefficients occurred when length of life was held constant, $r_{zu.x} = +0.943 \pm 0.018$. When either oviposition periods or blood units were held constant the correlation was considerably less.

To express the association between egg-laying capacity and all three other functions the second order correlation coefficients in Table 5 were computed. These indicate the relation between attributes of two functions with the other two held constant. This step reduced the coefficients still further. The largest one remaining was that between eggs deposited and oviposition periods with length of life and blood units held constant, $y_{zu.xy} = +0.803 \pm 0.060$.

We find from this analysis that the number of eggs deposited was most closely associated with oviposition periods. Blood units were highly correlated with oviposition periods also, and when they were held constant the correlation between eggs deposited and oviposition periods were considerably reduced. It still persisted, however, even to the second order coefficient when length of life and blood units were both held constant.

Regression equations from which egg-laying capacity may be computed from attributes of two and finally of three other functions have been set up and are given in Table 6. Since the correlation between eggs deposited and oviposition periods was highest, the equations in terms of oviposition periods give the best estimates.

TABLE 6.

EQUATIONS FOR THE REGRESSION OF EGGS DEPOSITED ON AGE IN DAYS, BLOOD UNITS CONSUMED, AND OVIPOSITION PERIODS, IN STUDIES OF EGG-LAYING CAPACITY OF TWENTY STEGOMYIA FEMALES.

z = Eggs deposited
x = Age in days
y = Blood units consumed
u = Oviposition periods

Regression of eggs deposited on:	Equation
Age and blood units	$z = 1.22x + 10.33y - 39.49$
Blood units and oviposition periods	$z = 19.32u + 2.62y + 20.58$
Age and oviposition periods	$z = 1.34x + 20.82u - 36.02$
Age, blood units, and oviposition periods	$z = 1.26x + .92y + 15.42u + 2.81$

The significance of these equations may be clearer if we examine them graphically. The straight line in Figure 2 represents the regression of egg production on days lived. Points on the line indicate the average egg component for a given number of days lived, based on the experience of these twenty females.

When the regression of egg-laying capacity is expressed in attributes of two other functions, the theoretical egg components computed from the equation lie in a plane, not on a straight line, and the graph showing the three variables is in three dimensions. This is illustrated in Figure 3. Here each of the twenty females is represented by a black-headed pin, its height determined by the total number of eggs deposited during life. The position of the pin on the rectangular base of the drawing is determined by the observed number of blood units consumed and the number of oviposition periods for that individual. The equation for the regression plane indicated is as follows·

$$\text{Mean egg component} = 19.32\ (\text{oviposition periods}) + 2.62\ (\text{blood units}) + 20.58$$

The little ellipses indicate the points where the pins pierce the plane or where they would pierce the plane if they were tall enough to do so. The slope of the edge of the plane above the y axis shows how egg-laying capacity increases with rise in blood consumption when oviposition periods are held constant. The slope of the plane above the u axis indicates the rise in eggs deposited with increasing frequency of oviposition when blood units are held constant. The steeper slope of this line indicates a greater correlation between these attributes. The maximum effect of both functions on egg production is indicated by the height of the plane with respect to the base of the figure at the back of the drawing. The diagonal trend and increasing height of the pins toward the far corner of the picture indicates how well the slope of the plane follows that of the observations.

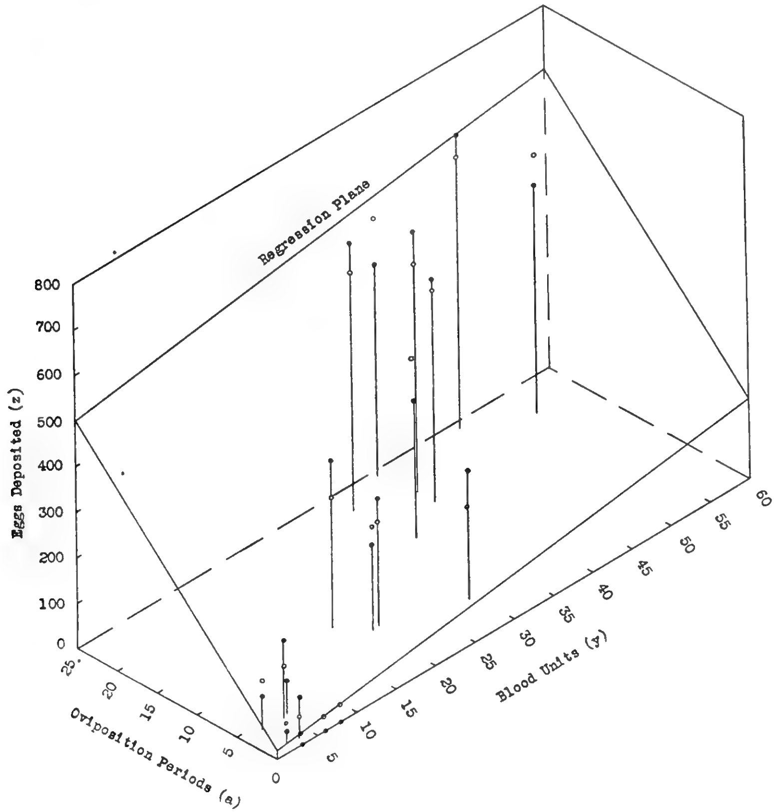

Figure 3.—The Regression of Eggs Deposited on Oviposition Periods and Blood Units Consumed for Twenty Stegomyia Females.

It is possible to illustrate in this way the relationship between egg-laying capacity and two other functions, but the final equation in Table 6 can not be graphed since it adds a third variable to the regression and calls for a figure in four dimensions.

This completes the analysis of the total performance of the twenty isolated females. The results are highly gratifying.

We have shown that specimens living longer and consuming more blood will, on the average, have more oviposition periods and a larger total egg component. Furthermore, we have expressed this fact mathematically so that we may estimate the egg component for other specimens reared under similar conditions.

When we consider that there were only twenty individuals, that the frequency of feeding was predetermined, and that the terms blood unit and oviposition period were arbitrarily defined, it is surprising that the correlations should be so definite and that the regressions should fit the observations so well. One of the requirements of a good fitting regression equation is that the standard deviation of the observations about the fitted plane should be appreciably less than that of the observations about the mean. Table 4 gave the standard deviation of egg components about the mean as 218.55 ± 24.57. That for egg components about the regression plane shown in Figure 3 was 63.35 ± 7.55, or less than one-third. It is true that we are considering functions obviously highly correlated, but it is gratifying to be able to give such a satisfactory mathematical expression to their interrelations.

These regressions are based on completed performance only. We now come to the question of the activity of these individuals at stated intervals during their lives.

Table 7 contains the weekly record of survivors, blood units consumed, oviposition periods, and eggs deposited for sixteen of these isolated females. The four specimens fed only once were excluded, since this fact obviously affected their subsequent activity. From the data in this table weekly rates per survivor were computed and are included.

TABLE 7.

WEEKLY RECORD OF SURVIVORS, BLOOD UNITS CONSUMED, OVIPOSITION PERIODS, AND EGGS DEPOSITED FOR SIXTEEN STEGOMYIA FEMALES.

WEEK FOLLOWING EMERGENCE	SURVIVORS AT BEGINNING OF WEEK	BLOOD UNITS CONSUMED DURING WEEK	OVIPOSITION PERIODS DURING WEEK	EGGS DEPOSITED DURING WEEK	BLOOD UNITS PER SURVIVOR	OVIPOSITION PERIODS PER SURVIVOR	EGGS DEPOSITED PER SURVIVOR	EGGS DEPOSITED PER OVIPOSITION PERIOD
0	16	54	1	4	3.4	—	—	—
1	15	21	21	869	1.4	1.4	57.9	41.4
2	14	34	16	707	2.4	1.1	50.5	44.2
3	13	29	20	688	2.2	1.5	52.9	34.4
4	13	28	17	566	2.2	1.3	43.5	33.3
5	13	33	9	279	2.5	.7	21.5	31.0
6	13	33	13	221	2.5	1.0	17.0	17.0
7	13	29	13	412	2.2	1.0	31.7	31.7
8	13	33	11	171	2.5	.8	13.2	15.5
9	11	18	11	233	1.6	1.0	21.2	21.2
10	10	23	8	35	2.3	.8	3.5	4.4
11	8	26	14	167	3.2	1.8	20.9	11.9
12	8	12	12	144	1.5	1.5	18.0	12.0
13	6	15	9	202	2.5	1.5	33.7	22.4
14	5	3	2	29	.6	.4	5.8	14.5
15	2	3	3	42	1.5	1.5	21.0	14.0
16	1	0	0	0	0	0	0	0
17	1	0	0	0	0	0	0	0
Total		394	180	4,769				

The number of individuals was obviously too small to justify any detailed analysis of these weekly rates. We shall examine them merely to see whether there were any definite time trends in activity. Apparently, weekly blood consumption did not vary to any extent. The same was true of oviposition periods. Weekly egg components per individual, however, decreased with age. Although rates for later weeks varied greatly, there was a definite downward trend during the first six weeks when they were more stable. The same was true of eggs deposited in terms of oviposition periods. For these few specimens we may say, therefore, that egg-laying activity was greater early in life, whereas blood consumption and frequency of oviposition continued in much the same way until the end. The question of trend of egg-laying rate with increasing age will now be analyzed from observations on a larger group of individuals.

The Trend of Egg-laying Capacity with Age.

Egg-laying capacity and longevity were studied from records of 118 females subdivided into ten lots, half of which were offered blood meals once a week and the other half every three days. Daily records were kept of deaths and of the number of eggs deposited. All 118 individuals emerged on the same day and comprise Lot 6 of Table 2. Temperature at the beginning of the experiment was 27° C.

The first question to be investigated was whether the frequency of feeding affected the longevity or total egg production of these specimens. Consequently, the mean age at day of death and the eggs deposited per female were computed from the original data. These are given below:

118 Females.

Frequency of blood meal	Mean age on day of death	Egg component per individual
Once a week	64.7 ± 2.2	206.4
Every 3 days	59.7 ± 2.3	190.2
Total	62.2 ± 1.6	198.3

The difference in length of life between the two groups was insignificant. Probable errors for the mean egg components could not be computed since the records applied to lots, not to individuals, but the two means are so similar that this omission is unimportant. The two groups may be combined for further analysis.

The records of eggs deposited by these 118 females were placed on a weekly basis and rates per survivor at the beginning of the week were computed and are given in Table 8. They are plotted in Figure 4.

TABLE 8.

OBSERVED AND EXPECTED EGG-LAYING RATES OF CONGREGATED STEGOMYIA FEMALES OFFERED A BLOOD MEAL ONCE A WEEK OR EVERY THREE DAYS.

WEEK FOLLOWING EMERGENCE	SURVIVORS AT BEGINNING OF WEEK	EGGS DEPOSITED DURING WEEK	EGGS PER SURVIVOR AT BEGINNING OF WEEK	EXPECTED EGGS PER SURVIVOR AT BEGINNING OF WEEK
(1)	(2)	(3)	(4)	(5)
0	118	0	0	0
1	118	5,306	44.97	41.13
2	115	3,605	31.35	35.44
3	109	3,509	32.19	30.54
4	108	2,757	25.53	26.31
5	98	2,567	26.19	22.67
6	88	1,726	19.61	19.53
7	79	1,220	15.44	16.83
8	67	925	13.81	14.50
9	59	472	8.00	12.50
10	51	458	8.98	10.77
11	39	466	11.95	9.28
12	29	184	6.35	7.99
13	16	91	5.69	6.89
14	9	65	7.22	5.94
15	4	51	12.75	5.12
16	1	0	0	4.41

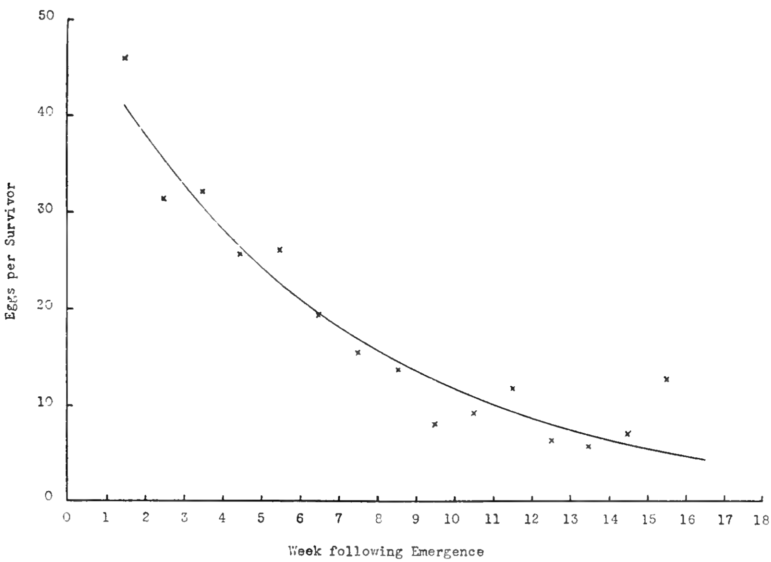

Figure 4.—Observed and Expected Egg-laying Rates per Survivor at the Beginning of the Week.

It is apparent that the first weekly egg-laying rate was the highest and that later rates decreased more or less continuously. The actual amount of decrease was greater in earlier weeks, so we could not use a straight regression line here as we did in describing the relationship between total egg component and days lived shown in Figure 2. To obtain a mathematical expression of this relationship, it was necessary to use an exponential equation. The one plotted in Figure 4 was:

$$\text{Mean weekly egg component per survivor} = 51.42_e \; {}^{-\,0.1489\,(\text{age in weeks})}$$

This equation gives an average weekly rate of decrease in egg production of 15 per cent, and from it theoretical egg-laying rates were computed. These are given in Table 8. They lie on the fitted curve in Figure 4. With the exception of the last two observed rates, the curve fits remarkably well, and may be considered a very satisfactory expression of the trend of these observations.

From this equation we may also compute the maximum number of eggs per female by summating the weekly egg components throughout life and assuming that life continues until the ultimate egg-laying capacity is reached. For the group we are considering this would average 350 eggs per female.

Longevity of Stegomyia Females.

Two series of records formed the basis for the analysis of longevity, one obtained from the blood-fed lots of 118 specimens just discussed, and the other obtained from 190 specimens that were fed throughout life on honey and water only. The blood-fed lots were started in January, 1930, the non-blood-fed lots in October and December, 1930.

The mortality records for these two series of observations were placed on a weekly basis and the number of survivors at the beginning of each week was determined. The results are given in columns (2) and (3) of Tables 9 and 10. From these populations and deaths mortality rates were computed and are given in column (4).

TABLE 9.

LONGEVITY OF CONGREGATED STEGOMYIA FEMALES OFFERED A BLOOD MEAL ONCE A WEEK OR EVERY THREE DAYS.

WEEK FOLLOWING EMERGENCE	SURVIVORS AT BEGINNING OF WEEK	DEATHS DURING WEEK	DEATHS PER 1,000 SURVIVORS $1{,}000q_x$	OF 1,000 FEMALES EMERGING		AVERAGE LENGTH OF LIFE REMAINING TO EACH ONE ALIVE AT BEGINNING OF WEEK $\mathring{e}_x$	
				NUMBER ALIVE AT BEGINNING OF WEEK l_x	NUMBER DYING DURING WEEK d_x	*Weeks*	*Days*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	118	0	0	1,000	0	8.89	62.2
1	118	3	25.4	1,000	25	7.89	55.2
2	115	6	52.2	975	51	7.08	49.6
3	109	1	9.2	924	9	6.44	45.1
4	108	10	92.6	915	85	5.50	38.5
5	98	10	102.0	830	85	5.01	35.1
6	88	9	102.3	745	76	4.52	31.6
7	79	12	151.9	669	102	4.00	28.0
8	67	8	119.4	567	68	3.60	25.2
9	59	8	135.6	499	68	3.03	21.2
10	51	12	235.3	431	101	2.42	16.9
11	39	10	256.4	330	85	2.01	14.1
12	29	13	448.3	245	110	1.53	10.7
13	16	7	437.5	135	59	1.38	9.7
14	9	5	555.6	76	42	1.05	7.4
15	4	3	750.0	34	26	.74	5.2
16	1	1	1,000.0	8	8	.50	3.5

TABLE 10.

LONGEVITY OF CONGREGATED STEGOMYIA FEMALES NEVER OFFERED A BLOOD MEAL.

WEEK FOLLOWING EMERGENCE	SURVIVORS AT BEGINNING OF WEEK	DEATHS DURING WEEK	DEATHS PER 1,000 SURVIVORS $1{,}000q_x$	OF 1,000 FEMALES EMERGING		AVERAGE LENGTH OF LIFE REMAINING TO EACH ONE ALIVE AT BEGINNING OF WEEK $\overset{\circ}{e}_x$	
				NUMBER ALIVE AT BEGINNING OF WEEK l_x	NUMBER DYING DURING WEEK d_x	*Weeks*	*Days*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	190	0	0	1,000	0	11.75	82.2
1	190	1	5.3	1,000	5	10.75	75.2
2	189	0	0	995	0	9.80	68.6
3	189	0	0	995	0	8.80	61.6
4	189	1	5.3	995	5	7.80	54.6
5	188	0	0	990	0	6.83	47.8
6	188	3	16.0	990	16	5.83	40.8
7	185	0	0	974	0	4.92	34.4
8	185	1	5.4	974	5	3.92	27.4
9	184	37	201.1	969	195	2.94	20.6
10	147	41	278.9	774	216	2.55	17.8
11	106	20	188.7	558	105	2.35	16.4
12	86	32	372.1	453	169	1.77	12.4
13	54	12	222.2	284	63	1.53	10.7
14	42	31	738.1	221	163	.82	5.7
15	11	10	909.1	58	52	.71	5.0
16	1	0	0	6	0	1.50	10.5
17	1	1	1,000.0	6	6	.50	3.5

To compare longevity in these two groups the distributions of survivors had to be put on a comparable basis. This was done by starting each with 1,000 individuals and computing the number of survivors at the beginning of each successive week by applying the death rates in column (4) and deducting the computed deaths. In this way columns (5) and (6) were obtained for each table. Column (5), indicating the number of survivors at the beginning of each week out of 1,000 emerging on the same day, gives the familiar l_x curve of the life table which is plotted for each distribution in Figure 5.

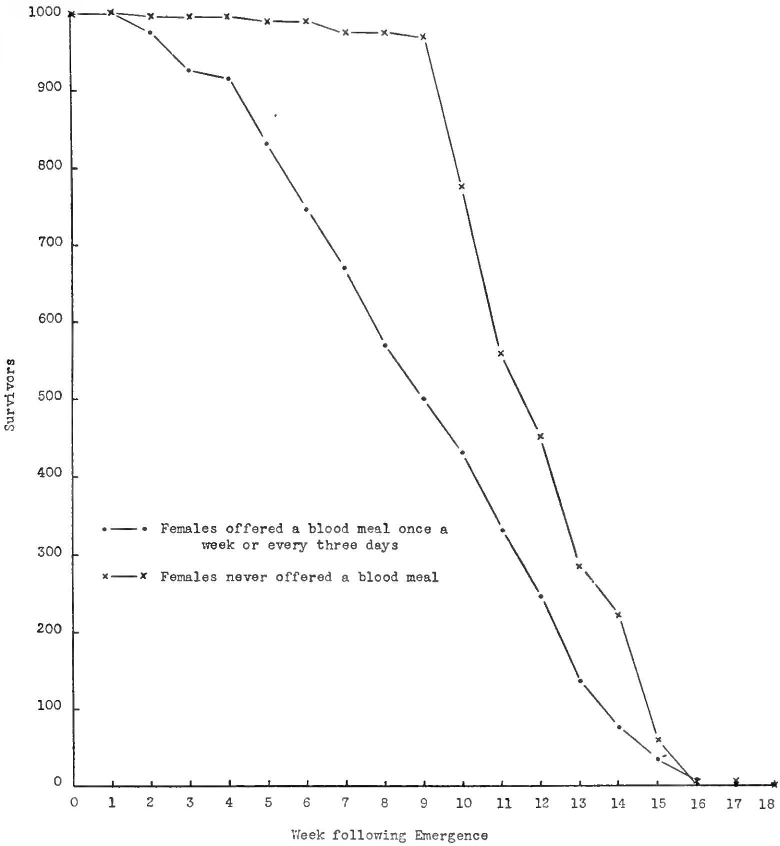

Figure 5.—Survivors at the Beginning of Each Week of Two Groups of 1,000 Stegomyia Females Emerging.

The mean age at death of individuals in the non-blood-fed group was 82.2 ± 0.77, which was twenty days later than that for the blood-fed group. We must compare columns (3) and (4) of Tables 9 and 10 and the two curves in Figure 5 to see what this difference means.

Table 10 indicates that practically no deaths occurred in the honey-and-water-fed group until the tenth week of life. During this week 37 specimens died, and mortality continued very high until all individuals were dead. Deaths among the individuals in the blood-fed group were scattered throughout life. Figure 5 shows the difference in the form of the curves very clearly. Survivors in the blood-fed group began to decrease in number after the first week, while the honey-and-water-fed group remained close to the upper limit until the tenth week and then dropped precipitously.

The last two columns in Tables 9 and 10 give the average expectation of life in weeks and in days for survivors at the beginning of the week. The blood-fed group started at emergence with a mean expectation of 62.2 days or nine weeks, the non-blood-fed group with 82.2 days or nearly twelve weeks. Beginning with the tenth week the mean expectation of life was the same in both groups.

The difference in longevity between these two groups is clear-cut and unmistakable. The survivorship curve of the non-blood-fed specimens approaches in form that of the theoretical rectangular curve described by Pearl and Doering (1923) as approached in *Proales decipiens* and by Pearl (1928) in the wild type of *Drosophila melanogaster*. Individuals in this type of population nearly all survive to a given age and then die almost simultaneously.

It is believed that this difference in longevity was probably due to diet. Howard (1925) pointed out the effect of blood consumption on the life of the female when he said: "Blood food, however, in hastening the development of the eggs shortens the life of the mosquito. A diet of honey, on the other hand, prevents the development of the eggs and prolongs life."

There was an interval of nine months between the experiment with the blood-fed specimens and the other, but both series were run during summer months when atmospheric conditions were presumably similar. Beeuwkes *et al.* (1933), found that humidity had a noticeable effect on the longevity of stegomyia females. Experiments were run in Yaba (Southern Nigeria) and Gadau (Northern Nigeria) and from the data given the following means were computed:

Laboratory	Mean temperature, C.	Mean relative humidity, (per cent)	Mean days lived
Yaba (S. Nigeria)	26.2	86.9	96.5
Gadau (N. Nigeria)	26.8	49.7	41.7

Temperature conditions were identical in these two experiments, yet the average length of life was less than one-half as great in the area with the lower relative humidity. The mean duration of life among the Brazilian specimens was lower than that for Yaba, but higher than that found in Gadau. Temperature conditions were similar.

There are no records of relative humidity for January and February, 1930, during the Brazilian experiment with blood-fed specimens. The average was approximately 75 per cent for the interval covered by the non-blood-fed specimens. It is believed that the average for the earlier period was similar and that humidity does not account for the difference in longevity.

One lot of Yaba females was given no blood meals. Its mean duration of life was 98 days, which was not significantly higher than that of the blood-fed specimens. The shape of the curve of survivors could not be determined from the data given.

The Laboratory versus Nature.

The female stegomyia once infected with yellow fever may transmit the disease at any time during the remainder of her life. She may continue to imbibe blood in approximately the same amounts while she lives. She may also continue to lay eggs, but the actual number deposited toward the end of her life will be few. These are important facts from the point of view of yellow fever control.

The average length of life of the blood-fed laboratory female was nine weeks, but half the average maximum egg component of 350 eggs was deposited by the end of the sixth week. Under similar conditions in nature a thoroughgoing antilarval service would definitely limit propagation before the adult population had been seriously reduced. But do we know that similar conditions exist in nature?

Actually the environment of adults in captivity differs in important respects from that in nature. While in captivity they are not exposed to natural enemies. Their longevity may, therefore, be greater than that of females in nature and their total egg components consequently larger.

Stegomyia adults reared in the laboratory were found to be larger than those frequently found in nature. The regressions computed from laboratory data would lead one to expect larger egg components from females with a greater capacity for engorgement. It is also possible that the follicles per ovary may be fewer in the smaller females.

Because of these facts we are inclined to assume that conditions in the laboratory are more favorable to longevity and egg-laying capacity than those in nature. On the other hand we do not know the effect of arbitrarily limiting blood meals to certain definite intervals. The very stealthy attack of the stegomyia in nature is well known. She frequently takes alarm upon the slightest provocation but usually returns quickly to her attack. It is possible, therefore, that complete engorgement is not usual in nature, that most females are content with small amounts of blood taken at intervals during most of the days of their lives. The total blood consumption may not thereby be increased, nor the total number of eggs laid, but this manner of feeding would probably increase the number of oviposition periods and so decrease the number of eggs per period.

The type of regression found between egg-laying capacity and the attributes of the various other biologic functions of laboratory females is doubtless similar to that existing among females in nature. The specific equations, however, based on laboratory records may not be directly applicable to females in nature. They should not be used to estimate performance outside the laboratory.

The opinion prevails among field workers in yellow fever control that a rigid antilarval service for a period of six weeks will virtually stop transmission of the disease (Connor, 1924). This, however, may not signify that longevity of females in nature is only six weeks. It simply means that the original stegomyia population has been reduced to the point where the probability of transmission is very small. But we do not know the probability of transmission. It may not be necessary for one-half or even one-third of the population to die to render it negligible. We can not use this empirical observation as a basis for estimating longevity of females in nature.

Conclusions.

In an earlier paper the method of rearing stegomyia larvae in the Yellow Fever Laboratory in Bahia, Brazil, was described, and results of rearing under routine and under optimum laboratory conditions were given statistical analysis. In the present paper statistical methods have been applied to data for adult stegomyia females reared in the laboratory at an average summer temperature of 27° C. The findings were as follows:

1. The mean age at time of first blood meal for 29 specimens was 67.6 ± 4.5 hours or 2.8 days.

2. The minimum period between the first blood meal and the first oviposition for eight lots of females was 3.4 days.

3. The ovulation rate computed for the same eight lots or the number of eggs per female per day, from the first blood meal through the second oviposition day increased at a rate of 7.70 ± 1.38 per cent per unit rise of 0.1° C.

4. The number of eggs deposited during the lifetime of the female increased

with the number of days lived, the number of blood units consumed, and the number of oviposition periods. Coefficients of correlation computed from observations of twenty isolated specimens from emergence until death were high in each case.

5. The egg-laying function was most closely associated with oviposition. This was shown by the high positive correlation remaining between their attributes when age and blood units consumed were held constant, $r_{zu.xy} = + 0.803 \pm 0.060$.

6. The combined effect upon egg-laying capacity of any two other functions was expressed in the form of regression equations. From these equations the average egg-laying capacity may be computed from given attributes of any two other functions.

7. The effect of all three functions, length of life, blood consumption, and oviposition, upon egg laying capacity was given final mathematical expression.

8. Weekly egg-laying rates for a group of 118 females dropped at a rate of 15 per cent per week. An equation was set up whereby weekly performance at specific ages in the lifetime of a similar group may be estimated.

9. A mean maximum of 350 eggs per female living until ultimate egg-laying capacity has been reached was computed from this equation.

10. Longevity of two groups was compared, one of 118 blood-fed females, and one of 190 specimens fed on honey and water only. Comparison of the survivorship curves showed that practically none of the honey-and-water-fed group died until the tenth week while deaths among blood-fed specimens were well distributed throughout life.

11. The mean age at death of the blood-fed group was 62.2 ± 1.6 days, that of the non-blood-fed group was 82.2 ± 0.77 days.

12. Inasmuch as longevity, feeding habits, and egg-laying capacity of females in nature are very imperfectly known, it is impossible to apply the findings in this analysis, based wholly on laboratory observations, to the problems facing the yellow fever control officer in the field.

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PROCEEDINGS OF THE

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A NEW MYRMECOPHILE TINEID FROM BRAZIL.

By AUGUST BUSCK,

Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Professor H. A. Eidmann of the Zoologisches Institut, Hann. Münden, Germany, has asked me to describe the following species, collected and reared by him from nests of *Atta sexdens* at Mendes, Brazil.

Mr. Carl Heinrich has kindly supplied the descriptions of the larva and pupa.

The plates were drawn by Mrs. Eleanor A. Carlin.

ATTICONVIVA, new genus (Fam. Tineidae).

Labial palpi (pl. 24, fig. 1) heavily scaled, laterally compressed, porrected, diverging; second joint with rough, heavy scaling above and beneath; terminal joint slightly deflected, shorter than second, fringed with heavy scaling, apex blunt. Maxillary palpi and tongue rudimentary. Antennae as long as fore wings, simple in both sexes, basal joint somewhat enlarged. Face and head rounded, smoothly scaled, face not retreating. No ocelli. Thorax smooth. Fore wings elongate ovate, costa and dorsum gently and evenly curved, apex blunt. Female (pl. 24, fig. 3) with 12 veins in fore wings, 7 and 8 longstalked to costa; 9 free; 2 from before angle of cell; 3, 4, 5, and 6 nearly equidistant; 1*b* basally forked; 1*c* present in its entire length. In the male (pl. 24, fig. 2) vein 9 is variable, sometimes out of stalk of 7 and 8, and 3 and 4 are sometimes short-stalked. Hind wings nearly as broad as fore wings, ovate, apex blunt. Female with 8 veins in hind wings, 2, 3, and 4 widely separate; 5 and 6 short-stalked; 7 parallel to 6; 8 free; a short, oblique cross vein in cell between 7 and the internal vein. In the male this cross vein is not present and veins 5 and 6 are sometimes united, making only 7 veins in the hind wings of this sex. Legs short, heavily scaled; posterior tibiae with thick scale tuft on upper side; tarsi thickened with scales.

Type: *Atticonviva eidmannella.*

The genus is typical of the family Tineidae in all stages except for the modified mandibles of the larva, described below. It is related to *Tiquadra* Walker, which it resembles in general habitus, though it has not the receding flattened face of that genus; it differs from *Tiquadra* in the stalked veins 7 and 8 of the fore wing and the stalked or united veins 5 and 6 of hind wing, as well as in genitalia. *Atticonviva* is also comparable with and probably closer to *Setomorpha* Zeller, which has a similar though more pronounced sexual dimorphism of the venation and quite similar type of genitalia.

Atticonviva eidmannella, new species.

Labial palpi, face, and head light ochreous brown. Thorax and fore wings slightly darker, dull ochreous brown; a few scattered bluish black scales on apical part of fore wing and along costal and dorsal edge; cilia concolorous. Hind wings lighter than fore wings, light iridescent ochreous with light ochreous fuscous edges and cilia. Abdomen light ochreous fuscous. Legs ochreous brown.

Male genitalia (pl. 24, fig. 4) with the large alimentary canal supported ventrally by a weakly chitinized, elongate ventral plate and surrounded by the tegumen, which ends in an unspecialized, triangular uncus. Soci and gnathos absent; harpes lyre shaped, broad and thick at base, attenuated toward tip, which is armed with a few short, heavy spines; anellus ring shaped, strongly developed with thorns and spined extensions through which the long, slender undulating aedoeagus penetrates; the tip of the aedoeagus is pointed and there are three short spines below the tip; vinculum broad basally and with a long, strongly chitinized prolongation, which fits in between two strongly tufted soft lobes on the eighth abdominal joint, supported by two curved, chitinous rods.

Female genitalia (pl. 24, fig. 6) with slender, elongate ovipositor lobes, ostium simple, ductus bursae short, strongly chitinized and abruptly bent near ostium, rest of ductus and bursa unchitinized; bursa small, elongate, without signum.

Alar expanse: Male 16–18 mm., female 24–28 mm.

Habitat.—Mendes, Brazil (H. A. Eidmann coll.).

U. S. National Museum type No. 50459.

Paratypes in collection Eidmann.

Named in honor of the collector, Prof. H. A. Eidmann of the Zoologisches Institut, Hann. Münden, Germany, who has liberally presented the type material to the U. S. National Museum and who has supplied the biological notes on the species.

Larva (pl. 25, figs. 9–19).—Body elongate, subcylindrical, very slightly flattened, anal end bluntly rounded; sordid ochreous-whitish with areas about tubercles strongly sclerotized and pale amber yellow. Skin smooth. Prothoracic shield very broad, covering the entire dorsal area of the segment and the sclerotization extending forward into the intersegmental area; faintly divided by a fine median line; amber yellow with a narrow, irregular, brownish line on each side near posterior margin, otherwise without reticulations or color markings. A smaller, paler dorsal shield on mesothorax formed by the fused sclerotizations about paired setae groups Ia – Ib. A similar, still smaller shield on metathorax. Anal shield pale, unmarked. Prespiracular shield narrowly elongate, extended backward to include the spiracle. Spiracles dark-rimmed; thoracic and eighth abdominal spiracles oval, much larger than other abdominal spiracles; the latter round and quite small. Legs (pl. 25, fig. 12) short, the prothoracic pair much reduced and only half the size of those on meso- and metathorax; sclerotization of coxal lobes extended and fused on prothorax to form a ventral shield; on meso- and metathorax these sclerotizations are similarly extended. Abdominal prolegs normal; crochets (pl. 25, fig. 17) uniordinal, arranged in a narrow ellipse, 40 to 44. Body setae (pl. 25, fig. 13) short to moderately long, shorter on dorsum and venter than on sides, pale; three setae (III, IV, V) on prespiracular shield of prothorax; group VI unisetose on meso- and metathorax; IV and V below the spiracle and well separated on abdominal segments 1 to 8, with III and IIIa arranged about spiracle in the form of a trapezium (almost square); III on 8th abdominal slightly nearer spiracle and slightly lower than on other abdominal segments; group VII trisetose on abdominal segments 1–7, bisetose on abdominal 8, unisetose on abdominal 9; on proleg-bearing abdominal segments one seta of the VII group upon a separate sclerotization from the other two; abdominal segment 9 with II and I upon a single enlarged sclerotization, III remote from I, IV on separate sclerotization from V and VI, all setae in a line. No secondary hair. Anal fork absent.

Head (pl. 25, figs. 9, 10) brown; slightly flattened; nearly square in outline viewed from above; with a deep, rather large concavity between juncture of adfrontal suture (ADFS) and occipital foramen and with a rather long blackish dash from incision of lateral hind margin. Frons (FR) irregularly triangular, about as broad as long, not quite reaching middle of head; frontal punctures (F^a) close together, slightly behind a line connecting frontal setae (F^1); division between frons and epistoma not distinguishable; epistomal setae in a line on anterior margin of epistoma. Adfrontal areas broad. Epicranium with the anterior, ocellar, and lateral setae and posterior seta (P^1) crowded well forward showing a great reduction in the anterior and a corresponding enlargement of the posterior areas of the head; setae A^1 and A^2 approximate, with puncture A^a somewhat closer to A^1 than to A^2; A^3, approximate to 0^2 and L^1; A^2 on the level of F^1; L^1, P^1 and Adf^1 on a line; P^1, A^3, and 0^2 on a line; posterior setae (P^1, P^2) and puncture P^a) lying forward of middle of head with puncture (P^a) approximate to seta P^2; setae of ocellar group (0^1, 0^2, 0^3) lying in a slightly curved line with 0^1 close to anterior margin of epicranium and both 0^1 and 0^2 showing upon dorsal surface of epicranium, ocellar puncture 0^a lying between 0^3 and 0^2; subocellar setae (SO^1, SO^2, SO^3) triangularly placed with SO^1 on a projection from anterior ventral margin of epicranium (the most anteriorly placed seta on the epicranium).

Ocelli absent.

Labrum (pl. 25, fig. 11) with setae crowded forward toward anterior margin and with a *single* central puncture (Lp); epipharyngeal setae (ET) small, triangular, rather close together and triangularly grouped near anterior margin of epipharynx.

Mandible (pl. 25, fig. 18) with a single, greatly produced, sharply pointed, ventral tooth; cutting edge otherwise toothless, incurved and slanting sharply backward.

Antenna (pl. 25, figs. 14, 16) long, slender; joint II twice as long as I; joints III and IV fused and greatly reduced.

Submentum (SM, pl. 25, fig. 19) yellowish and covered with minute granulations except for two elongate, narrow, pale translucent areas (X) near anterior margin.

Length of full grown larva 17–20 mm.

This larva is at once distinguished from tineid larvae of other genera by the following combination of characters: Its reduced prothoracic legs, the extended sclerotization of the coxal lobes of all thoracic legs, the absence of ocelli, its lack of division between frons and epistoma, the extreme forward position of setae SO^1 and the epistomal group E^1, E^2, the strongly pointed, single-toothed mandible, and the pair of pale, elongate spots on the submentum.

Pupa (pl. 25, figs. 20, 21, 21*a*) moderately stout, abruptly tapering at caudal end. Maxillary palpi present, rather large, irregularly triangular. Prothoracic and mesothoracic legs not extending cephalad between sculptured eyepiece and antenna. Sculptured and glazed eyes, labrum, mandibles, fronto-clypeal suture, and invaginations for anterior arms of tentorium clearly indicated. Front evenly rounded, smooth. Vertex shorter than prothorax on the median line; as long on the lateral margins. Labial palpi stout, less than one fourth length of the wing. Maxillae but little longer than labial palpi. Pro-, meso-, and metathoracic coxae exposed. Prothoracic legs rather broad, not reaching middle of wing. Mesothoracic legs very broad, not extending to end of wings. Wings extending to cephalic margin of fifth abdominal segment. Metathoracic legs and antennae extending beyond tips of wings to middle of fifth abdominal segment. Dorsum of abdomen with two rows of heavy elongate spines (pl. 25, figs. 21, 21*a*) on segments 2 to 6 inclusive and a single row of similar spines on abdominal sements 7, 8, and 9. Tenth abdominal segment with a pair of sharp, triangular, lateral projections on each side and a similar dorsal pair. Abdominal setae minute. Genital opening an inverted Y. Anal opening slit-like, situated at end of abdomen. Cremaster absent. Abdominal segments 3 to 7 free.

Color whitish yellow to pale amber; darkest on wings, trophi, thorax, and dorsum of abdomen.

Length 10.5–11 mm., width 4 mm.

The literature on myrmecophile Tineidae is not extensive. The European *Myrmecozela ochraceella* Tengström has long been known to be associated with ants, its larvae making long silken tubes in refuse galleries of *Formica rufa;* the larvae feed on dry vegetable matter.

Meyrick (Proc. Linn. Soc. N. S. W., vol. 32, p. 72, 1907) described the genus *Cyclotorna* (type *monocentra* Meyr.) on which he quotes from F. P. Dodd: "The larva has two stages, one bug-like, the other rayed; in the latter stage it lives in the nest of ants." Mr. Dodd afterwards (Trans. Ent. Soc. London, pp. 577–589, pl. 48, 1911), gave an interesting account of the life history and excellent figures of this insect. The eggs are laid singly on the bark of trees harboring Jassidae; the young larvae are parasitic on these Jassidae and when they leave these hosts, they are taken by ants (*Iridomyrmex purpureus*) into the ant nest for the sake of a secretion, agreeable to the ants. In the ant hill the caterpillars assume a very different flat and laterally fringed form and feed solely on the early stages of the ants. Meyrick originally described *Cyclotorna* in the family Plutellidae, but later considered it an early form of *Tineina* and erected a new family for it, Cyclotornidae. Judging from the genitalia of authentic, reared specimens, kindly given me by Mr. Meyrick, as well as from Dodd's figures of the larvae, we believe this family closely allied to the Epipyropidae, the larvae of which are parasitic on Homoptera. At least it has no close relation to *Atticonviva* or other Tineidae.

Dr. A. Reichesperger (Zool. Jahrb. Jena, vol. 35, p. 201–211, 1913) described four lepidopterous larvae and their cases found in various ants' nests in Africa, which he believed predacious on the ants and their brood. He did not succeed in rearing adults, but his so-called "Sandgehäuse-raupe" from Abyssinia proves from his excellent figures of the head capsule and mandible (figs. F and G *b*) to be a tineid and apparently closely allied to *Atticonviva*, with very similar grouping of setae and a similar one-toothed mandible, but with six ocelli (none in *Atticonviva*. The flattened cases, open in both ends, are very similar to the Indian and Javan forms, subsequently figured by Bainbrigge Fletcher and Roepke (see *post*) as well as to the specialized case described in this paper (pl. 24, fig. 8).

Bainbrigge Fletcher discovered in Ceylon tineid caterpillars living in peculiar flat cases in the nests of *Crematogaster*, and the adults bred from these larvae were described by Meyrick as *Hypophrictis inceptrix*, n. gen., n. sp. (Exot. Micr., vol. 1, p. 604, 1916). Meyrick subsequently (Exot. Micr., vol. 2, p. 85, 1917) described the larval cases found by Fletcher and described three additional species of the genus, collected in the same region, but without biological notes. Fletcher gave a very good plate of *Hypophrictis inceptrix* and another unnamed species of the genus (Mem. Dept. Agr. India, Entom. Ser., vol. 6, pl. 55, 1920), showing the larvae and the characteristic flat cases.

The most important contribution on the subject is Dr. W. Roepke's paper (Tidschrift voor Entomologie, vol. 68, 1925) in which he described a new allied genus and species, *Hypophrictoides dolichoderella*, associated with and predacious on ants in Java, and gives good figures of all stages and most interesting notes on the manner in which the larvae secure and prey on the ant pupae. Dr. Roepke was able under glass to observe how the caterpillars were afraid of the adult ants and quickly withdrew to safety in their flat eight-shaped cases when unloaded ants came near; but when an ant came within reach, carrying in its jaws an ant pupa, the caterpillar would strike out and grasp the pupa from the surprised ant and quickly withdraw into its case to devour the pupa at leisure. Dr.

Roepke found that one larva sometimes stored up several ant pupae inside its case and then did not appear outside for a long time, while it devoured its stored-up supply.

Both of these genera, *Hypophrictis* Meyrick and *Hypophrictoides* Roepke, are closely related to the present genus, *Atticonviva*, but differ structurally in venation, having veins 2 and 3 in fore wing stalked and 7 to termen, and having veins 5 and 6 of hind wing closely approximate, not stalked or coincident as in *Atticonviva*. A reared female and its case of *Hypophrictis*, kindly sent me by Mr. Fletcher, shows great similarity in genitalia to those of *Atticonviva* and has, like this genus, narrow ovipositor lobes and a weak elongate bursa without signum.

Silvestri has described (Cont. d. Termitidi e. Termitofili, part 2, p. 297–302, Portici, 1920) from the caterpillars a new genus and species of a highly modified termitophile lepidopteron from Africa, which he tentatively placed in the family Tineidae; similar larvae found in termite nests in Africa were described and figured by I. Trägaarth (Ark. f. Zoologi, vol. 3, no. 22, p. 1–7, pl. 1, 1907). From Silvestri's figures 19–20 it appears very improbable that his species is a tineid, at least it has no relationship to the other genera here discussed.

According to Hagen (Linn. Entom., vol. 10, p. 320, 1855) Burmeister found a tineid in a termite nest in Brazil.

The larvae of the present species were found commonly by Dr. Eidmann in the abandoned mushroom beds of *Atta sexdens* where they construct flattened cases and galleries. The cases are light brown in color and are composed of small grains of sand, particles of compost, and excrement, roughly spun together with silk; there are also occasionally unmistakable fragments of insect chitin, apparently parts of ants, but these are so few and scattered that they are hardly significant and certainly not conclusive support of the suspected animal food. They are more probaly skeletal remains of dead ants accidentally encountered in the compost and accidentally woven into the larval cases. The cases are open in both ends in a large horizontal slit and the inside is sparsely lined with silk; they are from 5 to 7 mm. wide and vary in length from 15 to 25 mm. The females find their way into the ant nest and lay their eggs in the discarded mushroom beds. Dr. Eidmann took only females in these nests and suggests that pairing takes place in the open and that the males die while the females seek entrance into the ant nests; he fortunately reared both sexes from the larvae collected.

From the form of the larval mandibles, which do not appear suited to chew vegetable matter, I had surmised that the larvae were predacious on the early stages of the ants, but Dr. Eidmann informs me that the larvae and their cases were found in the abandoned chambers of the ants in which the discarded old leaf fragments were accumulated, and in which no ants of any stage were found. He has, moreover, examined the food content of the larval digestive tract and found only vegetable material.

It would be easy for these larvae to feed without much chewing on the fine particles of compost in which they live, but the specialized piercing mandibles suggest an animal food of which possibly only the juices are swallowed, and such juices might not be apparent in the alcoholic larval stomachs studied by Dr. Eidmann. That their food does not consist of ant larvae or pupae is apparent, however, because such are not found in the discarded compost, but these large accumulations of decomposed leaves teem with other insect larvae of many kinds, which could easily fall prey to the tunnelling lepidopterous caterpillars.

Dr. Eidmann collected in the same locality in Brazil very similar caterpillars in the nests of the other large leaf-cutting ant, *Acromyrmex;* these caterpillars make larger and more specialized flat cases (pl. 1, fig. 8) more smoothly spun than those of *eidmannella*, shaped like an hourglass, constricted in the middle, and the upper and lower walls are connected only in the middle of the case, leaving them free, but elastically closed together on the major part of the edge, thus permitting very free motion of the larva at both ends of the case. These caterpillars are nearly identical in structure and are undoubtedly congeneric with *eidmannella;* they differ only in having posterior seta P^1 much farther forward upon the epicranium, almost on the level of frontal punctures (F^a); fused joints III and IV of antenna longer (comp. pl. 25, figs. 14, 15), as long as the long seta of joint II, this seta also much shorter than in *eidmannella*.

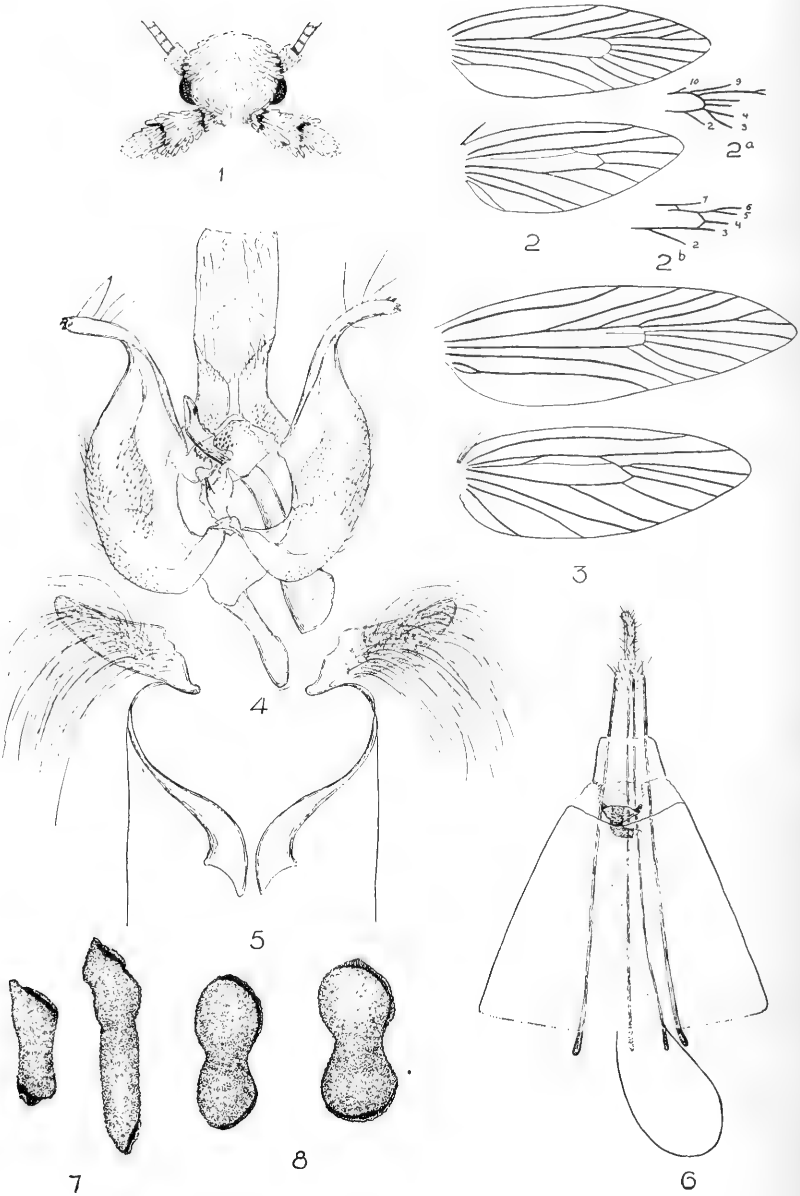
They were found in the living mushroom beds of the ants and while there has been no actual observation of their food habits, they were at least in position to obtain larvae and pupae and they may represent a further step toward true myrmecophagous forms.

Explanation of Plates.

Atticonviva eidmannella Busck.

Plate 24.

Fig. 1. Head and labial palpi.
Fig. 2. Wing venation of male.
Fig. 2 *a* and *b*. Variations of venation of male.
Fig. 3. Wing venation of female.
Fig. 4. Male genitalia.
Fig. 5. Supporting structure of eirhth segment.
Fig. 6. Female genitalia.
Fig. 7. Larval cases.
Fig. 8. Larval cases of allied *Atticonviva* species.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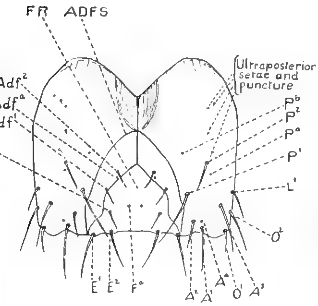

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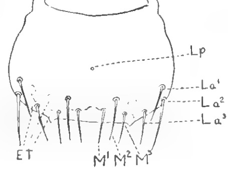

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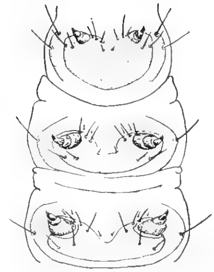

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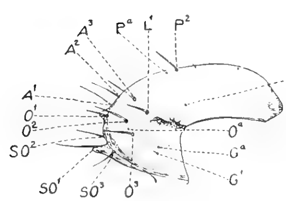

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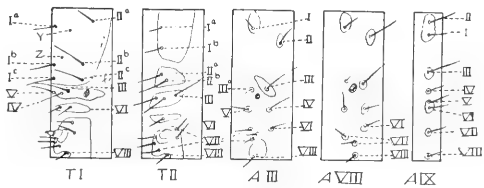

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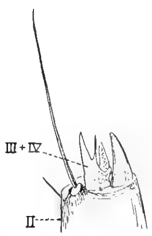

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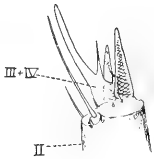

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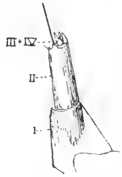

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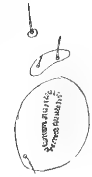

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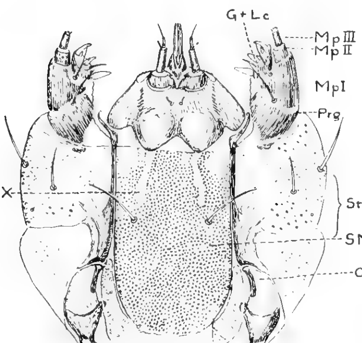

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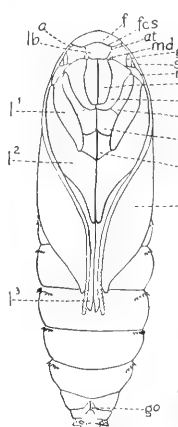

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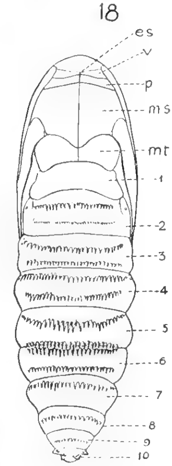

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Plate 25.

Fig. 9. Dorsal view of head capsule of larva showing setal arrangement.
Fig. 10. Lateral view of head capsule.
Fig. 11. Labrum of larva.
Fig. 12. Thoracic segments of larva, ventral view; leg setae, except for those on coxa, omitted.
Fig. 13. Setal map of first and second thoracic and third, eighth, and ninth abdominal segments of larva.
Fig. 14. Terminal joints of larval antenna, greatly enlarged.
Fig. 15. Terminal joints of larval antenna of allied *Atticonviva* sp., same enlargement as fig. 14.
Fig. 16. Antenna of larva.
Fig. 17. Proleg of larva showing arrangement of crochets.
Fig. 18. Mandible of larva.
Fig. 19. Labium and maxillae of larva.
Fig. 20. Pupa, ventral view.
Fig. 21. Pupa, dorsal view.
Fig. 21 *a*. Sample of dorsal spines, greatly enlarged, on abdomen of pupa.

AN APPARENTLY NEW SPECIES OF NORTH AMERICAN HYLOBIUS, WITH SYNOPTIC KEY (COLEOPTERA: CURCULIONIDAE).

By L. L. Buchanan,

Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Recent field work in New York and Minnesota has brought to light a species of *Hylobius* that attacks the root crown of living Scotch pine (*Pinus sylvestris*). This weevil is closely related to *Hylobius pales* Herbst, but differs in certain adult structures as well as in some details of its life history. The writer is indebted to Dr. F. C. Craighead for first pointing out the probable significance of the different habits of the root-crown species, and also for aid in obtaining a good set of specimens for study.

Hylobius radicis, new species.

Length 9.6 to 12.5 mm. Similar to *pales* in shape but with elytra a little less flattened on disk and slightly longer compared with prothorax. Rostrum feebly arcuate, as long as or a little longer than prothorax; punctation dense but rather more regular than in *pales*, and generally not leaving a smooth median line or carina, as is commonly the case in *pales;* vestiture finer than in *pales*, and upper edge of scrobe not so prominent; head densely, finely punctate, the punctures behind interocular fovea, though often larger than adjacent punctures, not or only slightly coalescent; vestiture fine, not condensed in a spot or line of coarser scales on forehead. Pronotum with strigose sculpture not quite so strongly developed as in *pales*. Elytra with irregularly placed spots of whitish or pale yellowish-brown, prostrate, seta-like scales, the spots better developed on even intervals and rarely forming evident submedian and subapical bars, the general effect being distinctly more tessellated than in *pales;* elytral striae with punctures rather more elongate than in *pales*, the ninth and tenth striae at base more deeply impressed so that the humeral callus somewhat overhangs the surface directly beneath it. Venter similar to that of *pales* but with the abdominal, and especially the metasternal, punctures less dense, and the lateral abdominal spots more diffuse. As in *pales*, the male has the first, or first and second, abdominal sternites concave, and the fifth sternite with a broad and distinct impression occupying middle third.

Hind tibial uncus of male rather narrow and generally with its sides converging toward apex, which is subacute as a rule (fig. 7); median lobe of male genitalia relatively broader, with longer struts, and with apex more nearly truncate than in *pales* (figs. 1–3).

Female pygidium with a feeble, median, longitudinal impression in about apical third, and a more or less evident impunctate median line in basal fourth, these features wanting or less developed in the female *pales* examined.

Described from the following specimens: 21 from Ballston Spa, Saratoga County, N. Y., July 8, 1933, O. S. Thompson and H. G. Harris; 11 from Cass Lake, Minn., August 8 and 18, September 6 and 8, L. W. Orr; two from Cass Lake, Minn., August 9, 1933, attacking live Scotch pine, S. A. Graham; one from Albany, N. Y., May, 1932, injuring Scotch pine, H. L. McIntyre.

Type locality.—Ballston Spa, Saratoga County, N. Y.

Type (*male*), *allotype, and paratypes.*—Cat. No. 50354, U. S. N. M.

Paratypes returned to H. L. McIntyre, N. Y. Conservation Department, Albany, N. Y., and to C. E. Mickel, University of Minnesota.

Closely related to *pales* Hbst., but in that species the vestiture is a little coarser and of a darker hue, and is quite often arranged to form two fairly well defined bars on elytra, one beginning at lateral spot opposite metasternum and extending inward and backward to about middle of elytra near suture, the other a broad, indefinite bar or group of spots across top of declivity; also, in *pales* the rostral vestiture is generally coarser, the head punctation more or less confluent or rugose behind interocular puncture, and the male uncus broader, its sides subparallel, and its apex very broadly rounded.

The male uncus of *radicis* varies in shape, and in two specimens has sides only feebly converging and apex quite broadly rounded; but in most males it is distinctly narrower and more nearly acute at apex than in *pales*. The Minnesota specimens of *radicis* have the vestiture somewhat more abundant, especially on elytra, and a few of the head punctures in vicinity of interocular puncture more often confluent than in the New York specimens. One New York specimen has a small spot of narrow scales on forehead.

Aside from the narrower male uncus, the characters of *radicis* that appear to be distinctive, in comparison with *pales*, are the larger size, the lack of scaly spot on forehead, and the spotted, rather than barred, elytra.

The three North American species of *Hylobius*, as interpreted chiefly from specimens in the U. S. National Museum collection, are distinguished as follows:

1. Scutellum virtually glabrous, or with a few fine hairs or, rarely, seta-like scales which leave most of surface exposed; anterior face of at least the hind femur almost always with a narrow, shallow, median groove in about basal third; inner edge of fore tibia of male with a fringe of white hair, the length of some of the longer hairs equal to width of tibia; vestiture finer, the elytral spots white; sculpture above finer, the pronotum rugose rather than strigose and the elytral intervals not so rough. Length 5.8 to 9 mm. New Jersey, New York, and New England States west to Minnesota and north to Alaska ....
congener Dalla Torre, Schenkling, and Marshall
(*confusus* Kirby, nec Payk.)

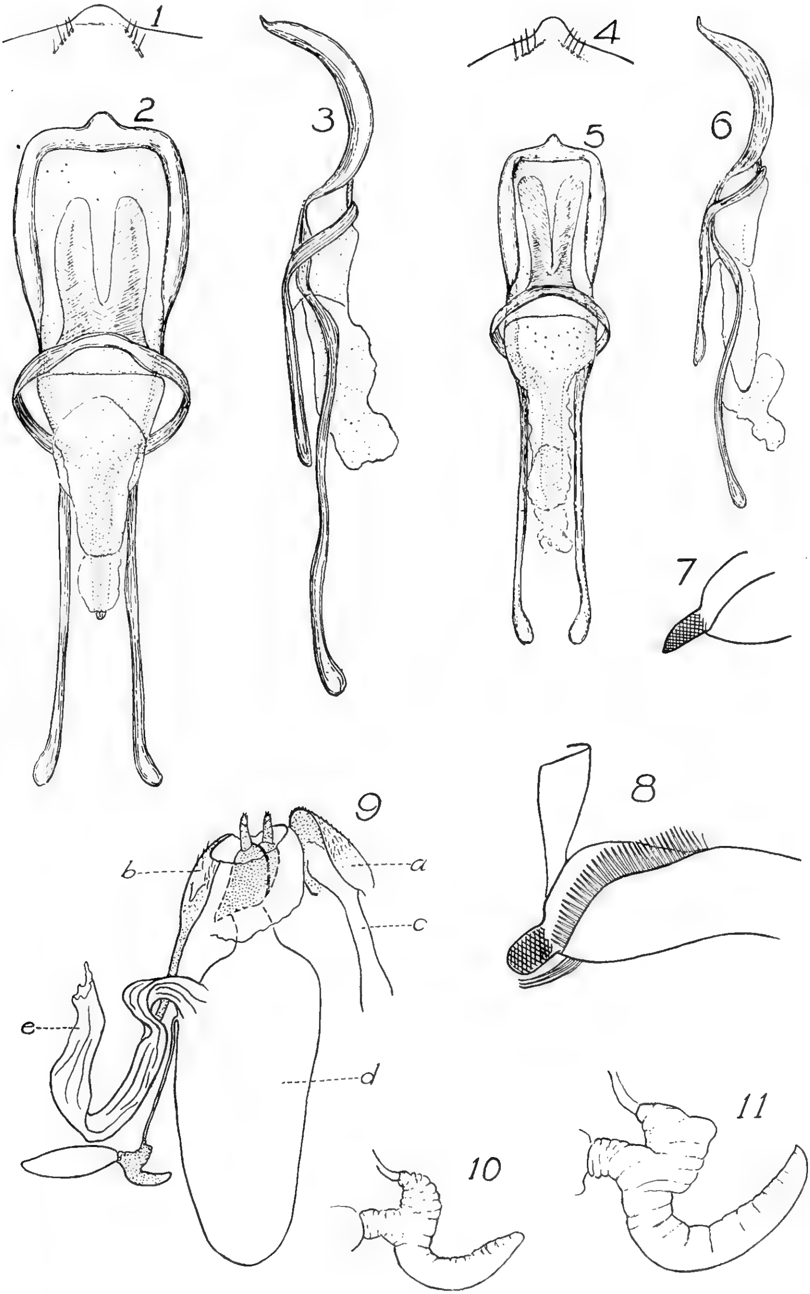
Scutellum normally covered by a dense coating of seta-like scales; hind femur rarely with even a trace of groove; male without tibial fringe as above; pronotum strigose 2

2. Size smaller, 5.8 to 11.3 mm. (most specimens being between 8 and 10 mm.); head normally with a spot or line of coarser seta-like scales on vertex or on front; punctures immediately behind interocular puncture more or less strongly coalescent to form short, irregular rugae; hind tibial uncus of male broad, parallel-sided, very broadly rounded at apex; "Canada" and Maine south to Florida, and west to Texas and Minnesota.................. *pales* Herbst

Size larger, 9.6 to 12.5 mm. (most specimens being between 10 and 11 mm.); head without a line or spot of scales on front or vertex; punctures behind interocular puncture generally separated by narrow intervals, or at most only feebly coalescent; hind tibial uncus of male narrow, sides generally convergent to the subacute apex. New York and Minnesota.................. *radicis*, n. sp.

About 98 per cent of the specimens studied have been segregated by the above key, but there are 11 examples (Maryland, South Carolina, Florida, and Texas) whose exact status has not been determined; they may represent one or two additional races or species. *Hypomolyx piceus* Deg. is placed in *Hylobius* in the Junk catalog; it differs from the above 3 species in its untoothed femora.

Judging from an examination of several dissections each of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pales and *radicis*, the female genitalia are subject to considerable individual variation, besides being warped and shrunken in many cabinet specimens; the drawings of these parts, therefore (fig. 9), have been made somewhat diagrammatic. The spermatheca may perhaps have taxonomic value, as this structure shows a slight average difference in the two species, being a little longer, more slender, and more sharply bent in *radicis* (figs. 10 and 11). The bursa copulatrix of *pales* is relatively longer, of *radicis* shorter and constricted about the middle, but these apparent differences are quite likely the result of greater shrinkage of the sack in the specimens of *radicis* examined.

The drawings were made by Mrs. E. A. Carlin.

Explanation of Plate 26.

Fig. 1. *Hylobius radicis*, tip of male median lobe.
Fig. 2. *Hylobius radicis*, male median lobe in dorsal view.
Fig. 3. *Hylobius radicis*, male median lobe in side view.
Fig. 4. *Hylobius pales*, tip of male median lobe.
Fig. 5. *Hylobius pales*, male median lobe in dorsal view.
Fig. 6. *Hylobius pales*, male median lobe in side view.
Fig. 7. *Hylobius radicis*, hind tibial uncus of male.
Fig. 8. *Hylobius pales*, hind tibial uncus of male.
Fig. 9. Female genitalia drawn from specimens of *pales: a*, 8th tergite; *b*, 8th sternite; *c*, intestine; *d*, bursa copulatrix; *e*, section of oviduct.
Fig. 10. *Hylobius pales*, spermatheca of female.
Fig. 11. *Hylobius radicis*, spermatheca of female.

A NEW SPINNING MITE ON CITRUS AT YUMA, ARIZONA.

By E. A. McGregor,

Bureau of Entomology and Plant Quarantine,
United States Department of Agriculture.

From time to time, during the past few years, the writer has received specimens of a mite attacking citrus trees, especially grapefruit and lemons, in the Yuma Valley of Arizona. Since satisfactory male material was lacking in these consignments, it was impossible to be certain of the specific identity of this mite. On the occasion of a recent trip to the Yuma Valley, the writer was able to obtain a series of males of this mite, and recent studies have revealed that the "red spider" at Yuma is an undescribed species, and it is herewith described:

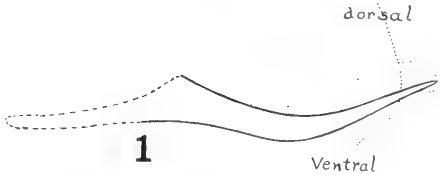
Tetranychus yumensis, sp. nov.

Female.—General body color rusty red or ferruginous, usually with a few small dark spots; legs paler. A single pale eye cornea on each side. Body oval, in length averaging 0.32 mm.; width, averaging 0.18 mm. (in preserved material). Dorsal setae pale, not arising from tubercles. Mandibular plate rounded anteriorly, with no emargination. "Thumb" of palpus fully as wide as long, bearing at its tip a strong, slightly spatulate "finger" whose thickness is almost equal to its length; on its upper distal corner are two pin-shaped pseudo-fingers; on upper side hardly half way to base is a sensilla much slenderer than terminal "finger," and between this and base are two setae somewhat exceeding the sub-basal "finger"; a strong seta arises latero-ventrally about half way from tip to base of "thumb." Claw on the penultimate joint of palpus about reaching sub-basal sensilla. Foreleg fully equaling body length (posterior margin to tip of mandibular plate), relative lengths of joints as follows: Trochanter, 13; femur, 27; patella, 17; tibia, 18; tarsus, 25. Tip of tarsus bearing a claw which is bent sharply downward at a point rather near its base; portion of claw distad of point of bending is split into six component, subequal spurs. The usual series of four tenent hairs arise in pairs by the side of the claw base. The collar trachea departs radically from the orthodox U-shaped structure typical of *Tetranychus*, consisting of a narrow straightish tube which is abruptly deflected downward and as abruptly deflected upward as a somewhat swollen chamber, the whole structure being rather pipe-shaped. Egg nearly spherical but very slightly compressed, with a weak dorsal axial stalk which in length is about half the vertical thickness of the egg; a few fibrils often extending from tip of stalk to supporting substratum.

Male.—Abdomen less oval and more wedge-shaped than female, body length much shorter; legs proportionately longer. Penis with inner lobe seemingly rodlike (difficult to observe); basilar lobe consisting merely of an obtuse prominence; shaft proper about 2.5 times as long as its basal thickness, distally bent upward about 34° from axis of main shaft, the deflected distal ("hook") portion being slightly longer than the shaft proper and with acuminate point.

Type slide.—Cat. No. 1111, U. S. N. M.

The type material is from Yuma, Ariz., Feb. 20, 1934, from lemon foliage. Specimens of the present species were first received from J. L. E. Lauderdale, district inspector, Yuma, Ariz. Material was also supplied by R. S. Woglum and H. C. Lewis, entomologists for the California Fruit Growers Exchange. Mr. Lauderdale writes that usually the mites are most abundant in March and April, and that they become scarce when the daily maximum temperatures reach 100° F. or over. The mite feeds chiefly on the ventral side of the leaves, spinning considerable webbing, and imparting a blotchy appearance to the foliage. Severe infestations may cause some shedding of foliage. Grapefruit and lemons are much preferred to oranges. Lauderdale states: "I am sure that the puncture vine is a host plant." He adds that the mite was first observed about 1928;



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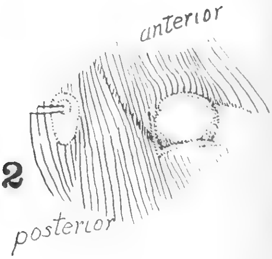

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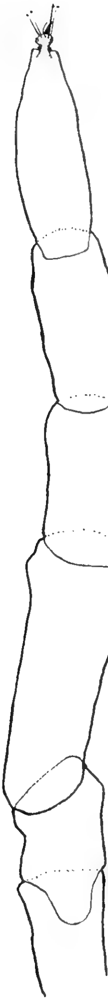

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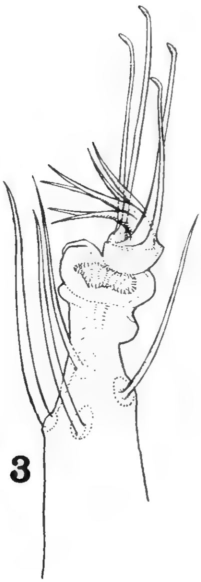

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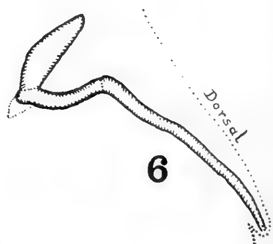

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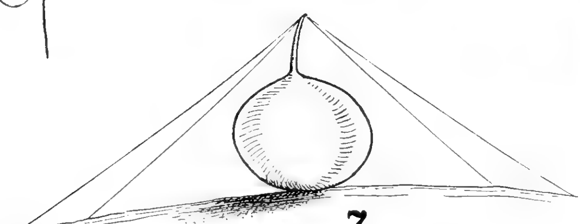

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that it has never been reported outside the Yuma Valley; that complete control may be had through applications of sulfur flour.

The present species is possibly closest to *T. sexmaculatus* Riley, from which it may be distinguished as follows:

T. sexmaculatus. Female: Body color usually lemon-yellow with six blackish blotches on abdomen; forelegs not equalling body length; thickness of palpal "thumb" at base about equalling its length; terminal palpal "finger" considerably longer than thick, not spatulate in profile; collar trachea pipe-shaped, with straightish anterior tube. Egg globular, without apical stalk. Male: Penis with distal ("hook") portion of shaft bent downward, tip obliquely truncate and produced ventrally into a very inconspicuous spur.

T. yumensis. Female: Body color ferruginous; forelegs fully equalling body length; thickness of palpal "thumb" at base exceeding its length; terminal palpal "finger" about as thick as long, somewhat spatulate in profile; collar trachea also pipe-shaped, but with anterior tube deflected sharply downward to join proximal point of swollen posterior chamber. Egg slightly depressed, with dorsal axial stalk whose length is about half the axial thickness of egg. Male: Penis with distal portion of shaft bent upward, tip acuminate, with no trace of a spur.

EXPLANATION OF PLATE 27.

Tetranychus yumensis.

Fig. 1. Penis (viewed laterally).
Fig. 2. Right eye cornea (viewed from above).
Fig. 3. Tarsal appendages of leg III (viewed laterally).
Fig. 4. Distal portion of right palpus with terminal appendages (viewed from outside.
Fig. 5. Left leg I (viewed dorsally); bristles not shown.
Fig. 6. Collar trachea (viewed laterally).
Fig. 7. Egg on supporting leaf (viewed laterally).

TWO UNRECORDED SUBSPECIES OF MOSSMITES (ORIBATOIDEA-ACARINA) FROM THE NORTHEASTERN UNITED STATES.

By ARTHUR PAUL JACOT, *Monroe, Connecticut.*

An intensive study of the Galumninae of the United States (in press) has brought out the important fact that indigenous species with a wide range break up into subspecies, as in Florida, California, Washington, while species recently introduced from Europe (usually found about our cities) are of the same subspecies whether at New Haven (Conn.), Gainesville (Fla.), or San Francisco. This subspecific differentiation therefore furnishes an excellent criterion for determining whether a species is holarctic or recently introduced. On this basis the following subspecies were resident in the United States before the advent of the Mayflower.

Ceratoppia bipilis brevicuspis, subsp. nov.

In European individuals the free end of the lamellae extends to beyond rostrum and the lamellar bristles are much shorter than this free end, while in the American specimens the free end of the lamellae barely reaches base of rostrum (that is, region of insertion of rostral bristles) and the lamellar bristles are as long as this free end. Moreover in the species, the cusp extending laterad of the base of the lamellar bristles is nearly half the *length* of the bristle while in the present subspecies this cusp is as long to twice as long as the *diameter* of its bristle.

Material examined: *New York:* Two specimens from under face of stones and boards or bark of fallen twigs, Six Mile Creek, east of Ithaca; taken April 14, 1917, slide 176n1 (*cotypes*). One specimen from Six Mile Creek; taken May 19th by Nathan Banks, slide 26B118 (*cotypes*). Nineteen specimens from fallen twigs, bark and stones between Danby and West Danby; taken May 13, 1917, slide 179n1 (*cotypes*). Two specimens from under bark and stones, Gloversville; taken April 17, 1917 by Axel Olson, slide 177n1. Two specimens from moss, upland swamp, one mile west of East Village, Monroe, *Conn.;* taken March 23, 1919, slide 1913n1. One specimen from tree on woodland slope, same locality; taken August 22, 1925, slide 2526n1. One specimen from Falls Church, *Virginia;* taken bv Banks, slide 26B70f. One specimen from Aurora, West Virginia; taken August 7, by O. Heid, slide 26B119.

Habitat: These few records seem insufficient for definite data. The specimen from the tree seems to make it out as a tree climber. In Europe it is reported from Birches. It is of the forest floor but can not be regarded as common.

Hypochthonius rufulus paucipectinatus, subsp. nov.

One of the subspecific characters is the number of pectinations of the pseudostigmatic organs. In Regensburg specimens, the number varies between five and ten while in Connecticut individuals, the number ranges between three and four. I have no idea what the degree of variability is in other parts of Europe. Another character is the position of dorsal bristles c1 which are on transverse plane passing slightly anteriad of bristles c2 in Regensburg individuals (c being the first transverse row behind the transverse fold), while in most of the American specimens bristles c1 are inserted on the same plane as c2 or posterior to them. Again I have no idea how constant this character is in Europe as a whole.

Material examined: *Connecticut:* One specimen from *Carex stricta* clump, upland swamp, one mile west of East Village, Monroe; taken August 7, 1925, slide 2512n1. One specimen as previous, taken August 10, 1925, slide 2514n5. Four specimens from emergent sphagnum clump, near previous; taken August 18, 1925, slides 2520n1, 2521n1 (*cotypes*). Four specimens from *Carex stricta* clump, open marsh, stream valley, East Village, Monroe; taken August 29, 1925, slides 2533n1, –n3c, –n4. Three specimens from *C. stricta* clump of old meadow with much fern, three miles west of East Village; taken September 5, 1925, slides 2537i, –n1, –h2. Four specimens from sphagnum of Cranberry bog, Cliff Island, Casco Bay, *Maine;* taken September 17, 1925, slides 2543n2, 2544n4.

The following are the species, evidently introduced near New York City. One specimen from burnt leaf humus, Cypress Hills Cemetery, Brooklyn; taken March 2, 1919, slide 195n. Two specimens from rotten wood or under bark slabs, Glen Cove, Long Island; taken May 8, 1920, slides 208n1 and 209n1.

Lots without collector were not taken by others. Type material deposited in Museum of Comparative Zoology, Cambridge, Mass.

MINUTES OF THE 457TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, JUNE 7, 1934.

The 457th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, June 7, 1934, in room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. There were present 34 members and 19 visitors. The minutes of the previous meeting were read and approved.

Mr. W. R. Walton read the report of a committee appointed by the chair to draw up resolutions on the death of Dr. J. M. Aldrich. It was voted that the report be extended and published at an early date in the proceedings of the Society.

Mr. C. N. Ainslie, of Sioux City, Iowa, upon invitation from the chair greeted the society.

The first communication on the regular program was by Mr. J. Zetek and entitled "Some Problems of an Entomologist in the American Tropics." Mr. Zetek presented many interesting pictures of the tropics and charts illustrating the unpleasant climatic conditions under which all their work is done. He discussed and showed pictures of the red-ring disease of coconut palms, caused by a nematode, *Aphelenchoides cacophilus* Cobb, which is apparently spread from tree to tree primarily by the ovipositing females of a large weevil, *Rhynchophorus palmarum* L. The disease is a real menace to the American coconut industry. Another severe pest of the coconut palm is the scale insect, *Aspidiotus destructor*, commonly known as San Andres blight, which may become very severe under favorable climatic conditions and freedom from natural predators.

The second communication on the regular program was by H. S. McConnell and entitled "Notes on two parasites of Tomostethus."

During investigations on the biology of *Tomostethus multicinctus* Rohwer, two parasites were encountered that are apparently new. The first species encountered was a Tryphonine which apparently hibernates as a full grown larva in the *Tomostethus* cells and emerges about the same time that the host does. This parasite oviposits in the eggs of *Tomostethus*, and completes its development shortly after the host enters the ground.

The second species, *Pezoporus* sp. emerges about the time that the host larvae are full grown. *Pezoporus* apparently will not attack the host until it has entered the ground, and transformed into a prepupa. Under laboratory conditions additional evidence was secured that this species is fossorial. (Author's abstract.)

The third communication was by Mr. J. C. Bridwell, entitled "Remarks on Xyela and Cimberis, two insects nourished by pollen of pines." Mr. Bridwell has found that the local species of the primitive sawfly genus *Xyela* feed as adults on the pollen of alder, hazel, and willow and as larvae on the developing pollen in the staminate cones of *Pinus virginiana*. The larvae drop to the ground as the pollen ripens. It was also found that the primitive curculionid genus *Cimberis* (better known by the twice preoccupied name *Rhinomace*) feeds as adult and larva on the ripe pollen of the same tree, the larvae dropping to the ground for pupation. More complete notes, including material from subsequent investigations, will be published in the Proceedings at a later date. (Author's abstract.)

The final communication was by Mr. R. A. Cushman and entitled "Preliminary note on the parasites of Xyela of Pinus virginiana." Mr. Cushman stated that four unidentified species of the Ichneumonid tribe Porizonini, three species of the anomalous genus *Lysiognatha* and one undescribed species of *Microbracon* had been found by Mr. Bridwell and himself to be associated with *Xyela*. At this time the new generation of these parasites were still in the egg stage and three types of eggs were found in or on the *Xyela* larvae. The one external egg was identified by dissection of adult females as that of *Lysiognatha*. This egg is of the tryphonine type, having a stalk by which it is fastened to the skin of the host. Of the internal eggs a small grayish elongate oval egg was tentatively identified as that of one of the Porizonini while a larger black spindle-shaped egg was not identified. Mr. Cushman also discussed another structure found immediately below the skin of the *Xyela* larva and attached to it. He had been unable to get from any source any suggestion as to the possible nature of this structure. He illustrated his remarks by blackboard sketches. (Author's abstract.)

Meeting adjourned at 9.55 P. M.

P. W. OMAN,
Recording Secretary.

MINUTES OF THE 458TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, OCT. 4, 1934.

The 458th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, October 4, 1934, in room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. There were present 32 members and 18 visitors. The minutes of the previous meeting were read and approved.

Under the head of business, the corresponding secretary-treasurer urged that members who were in debt to the society pay their bills.

Under "Notes and Exhibition of Specimens" Mr. Austin H. Clark noted the following recent additions to the butterflies known from the District of Columbia and vicinity: *Chrysophanus thoë*, one unusually large female from the Soldiers' Home grounds taken June 25, 1934, and a male from the Beltsville bog taken July 22, 1934, both by Mr. W. Herbert Wagner; *Papilio philenor acauda*, one female from the open fields near the Powder Mill bogs in the Paint Branch valley, May 7, 1932; *Atrytome bimacula*, one female taken at Cabin John, Md., June 25, 1932. He called attention to the fact that *Thorybes confusis* Bell was inadvertently omitted from his list of the butterflies of this region, although it has been recorded from Washington, Takoma Park, Md., and from along the canal in Maryland (Ent. News, vol. 34, 1923, p. 154).

Dr. F. C. Bishopp reported a record of *Ixodiphagus texanus* from the common tick at Laurel, Md. This record indicates a wider distribution for the species than was previously thought.

Mr. S. A. Rohwer mentioned an infestation of the black fly of citrus, *Aleurocanthus woglumi* Ashby at Key West, Florida, also stating that the species has caused considerable damage in Cuba in the past.

Mr. J. C. Bridwell presented notes and exhibited specimens relevant to his investigations of the life histories of *Xyela* and *Cimberis* on pine. He mentioned finding larvae and pupae of both and discussed the probable significance of certain sclerotized structures in the pupae of *Xyela*.

The first communication on the regular program was by Miss Mabel Colcord, entitled "Book Notes." Miss Colcord called attention to the recent books, obtained by the library of the Bureau of Entomology and Plant Quarantine, stating briefly the subject-matter of each.

This communication was discussed by Webb, Rohwer, and Snodgrass. Rohwer called attention to the desirability of increasing the collection of pictures of bureau workers and requested additions be made by members. Snodgrass mentioned a recent book by Woodworth on Insect Physiology, the first to be published on that subject.

The second communication on the regular program was by Dr. P. N. Annand, entitled "The grasshopper control campaign of 1934." Doctor Annand gave a comprehensive discussion of the work carried on against grasshopper outbreaks, particularly in Minnesota, Iowa, the Dakotas, and Montana. Details of administrative problems in connection with the work were emphasized and an outline of the most successful baits and methods was given.

This paper was discussed by Fracker, McIndoo and Wood.

Meeting adjourned at 10.10 P. M.

P. W. OMAN,
Recording Secretary.

MINUTES OF THE 459TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, NOV. 1, 1934.

The 459th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, November 1, 1934, in room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. Those in attendance who registered comprised 44 members and 12 visitors. The minutes of the previous meeting were read and approved.

Upon recommendation of the Executive Committee, W. K. Lawler of the Public Health Service was admitted to membership by vote of the Society.

Under "Notes and Exhibition of Specimens" Dr. A. G. Böving reported on his trip to Europe during August and September of the past summer. The trip was made in response to invitations from the University of Copenhagen and from the Royal Agricultural College in Copenhagen to deliver two lectures and conduct a course of study on the classification and determination of Coleopterous larvae. Dr. Böving was also invited to speak on the history and activities for the control of injurious insects in the United States. For the latter lectures, four in number, a summary was printed, outlining the various topics to be discussed. The lectures were well attended and received favorable mention in the newspapers, including pictures and interviews.

In addition to giving the lectures, Dr. Böving made taxonomic studies on beetle larvae with Mr. H. C. T. Newton in Rothamsted, with Mr. Rymer Roberts at Cambridge and at the British Museum and the Museum at Copenhagen.

Mr. A. B. Gahan stated that a record of *Hunterellus hookeri* How. from magpie nests from Ravalli Co., Montana, was probably erroneous since it is now known that the magpie nests were examined in the same room in which parasites were being reared.

Mr. J. C. Bridwell exhibited an excellent example of a trap-door spider's nest. He also spoke of finding in the phylloxera galls on hickory a species of *Phylloxeroxenes*, the larvae of which are predaceous on the aphids. *Phylloxeroxenus* belongs in the Family Eurytomidae, most of which are true parasites.

This note was discussed by Cushman.

Dr. N. E. McIndoo gave a physiological explanation of why people like to smoke.

On the regular program the first communication was by R. E. Snodgrass on "The Feeding Mechanism of Sucking Insects." Mr. Snodgrass gave an interesting and comprehensive discussion of the morphology of the mouthparts of sucking insects and the apparent functions of the various structures. The talk was well illustrated with numerous lantern slides.

This paper was followed by a lengthy discussion, participated in by Rohwer, Ewing, Campbell, Stone, Cushman, Morrison, Middleton, Bridwell, and Cory.

The second scheduled communication was by Wm. Middleton, entitled "The Dutch Elm Disease and its Transmission by an Insect." Mr. Middleton reviewed briefly the known history of the disease in this country and in Europe. In North America the work done thus far, aside from control measures to prevent the spread from infested areas in New England, has been concerned primarily with experiments to learn the actual and potential carriers of the disease. Two species of beetles, *Scolytus multistriatus* Marsh in North America and *Scolytus scolytus* Fabr. in Europe appear to be the principal offenders.

Because the hour of adjournment was past the discussion of this interesting paper was omitted.

Meeting adjourned at 10.15 P. M.

P. W. OMAN,
Recording Secretary.

MINUTES OF THE 460TH REGULAR MEETING OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON, DECEMBER 6, 1934.

The 460th regular meeting of the Entomological Society of Washington was held at 8 P. M., Thursday, December 6, 1934, in room 43 of the new building of the National Museum. Mr. J. S. Wade, president, presided. There were present 41 members and 20 visitors. The minutes of the previous meeting were read and approved as corrected.

Upon recommendation of the Executive Committee, Mr. L. A. Strong and

Mr. D. J. Caffrey, of the Bureau of Entomology and Plant Quarantine, and Mr. W. H. W. Comp, of the U. S. Public Health Service, Ancon, Canal Zone, were elected to membership by vote of the Society.

The Corresponding Secretary announced that members of the Society were invited to attend exhibits and lectures to be held during December under the auspices of the Carnegie Institution of Washington.

Prior to the annual election of officers, Mr. S. A. Rohwer reviewed the custom of the Society as to procedure in elections, and suggested that to save time the nominating ballots be dispensed with and that nominations be made from the floor. This was placed in the form of a motion and seconded, then amended to exclude the office of second vice-president, for which a nominating ballot was to be cast. The Society voted to follow this procedure and the following officers were elected for the year 1935. For each of these the Recording Secretary was instructed to cast the unanimous ballot of the Society.

Honorary President . . . . L. O. HOWARD
President . . . . B. A. PORTER
First Vice-President . . . . S. B. FRACKER
Second Vice-President . . . . N. E. McINDOO
Recording Secretary . . . . P. W. OMAN
Corresponding Secretary-Treasurer . . . . J. E. GRAF
Editor . . . . W. R. WALTON
Members of the Executive Committee
S. A. ROHWER, J. S. WADE, H. E. EWING
Representing the Society as Vice-President
of the Washington Academy of Sciences . . . . H. MORRISON

Under "Notes and Exhibition of Specimens" Mr. J. C. Bridwell reported the discovery of a bruchid affecting the seeds of Umbelliferae. The seeds concerned belong to an undetermined species of the umbelliferous genus *Prangos*, and were collected in western central Asia by Messrs. Westover and Enlow of the Bureau of Plant Industry. Upon examination of this material, Mr. Spessard, of the Bureau of Entomology and Plant Quarantine, found a living bruchid larva loose among the seeds. Subsequent examination resulted in the finding of another larva and the head capsules of several more. Some of the seeds showed evidence of insect injury, and although this was hardly suggestive of bruchid work, the occurrence of the larval head capsules in these cavities makes it appear certain that the seeds of *Prangos* are attacked by a bruchid.

In addition to the larvae, there was found separately upon the seeds three eggs which resemble those of *Chrysopa* in being ellipsoidal and mounted on a stalk that is as long as the egg itself and appears to be composed of cement. Two of these are blackened and discolored and in that respect similar to bruchid eggs affected by *Uscana semifumipennis*. One egg has a circular emergence hole near the base, this opening resembling that made by bruchid larvae and being quite different from the irregular larval emergence hole at the apex of the egg of *Chrysopa*. Although these eggs are different from known bruchid eggs, it seems probable that they belong to that family. In the Bruchidae the cement used to attach the eggs to the host pod or seed often assumes very curious forms.

The above appears to be the first authentic record of a bruchid infesting the seeds of an Umbellifer, although Perris (1833, Ann. Ent. Soc. France (5); 87) found *Bruchus* [now *Bruchidius*] *cinerescens* on the flowers of *Eryngium campestre* and asserted that he would find the larvae a month later in the fruit. As Peyerimhoff has bred this bruchid from the stems of *Eryngium*, Perris appears to have been mistaken in assuming that it uses the seeds. In Motschulsky's posthumous paper of 1874 (Bul. Soc. Nat. Moscou 46^2; 231) *Bruchus* [now *Bruchidius*] *holosericeus* Schoenherr is described and the habitat listed as "Conf. Perse sur le Bangos phoeniculacea." When consulted in regard to the identity of the plant indicated, Dr. S. F. Blake interpreted this to mean *Prangos foeniculacea*. Whether *B. holosericeus* Schoenherr is the insect found in the present material is of course uncertain, but the distribution of the 36 species of *Prangos* n the Mediterranean region and Central Asia agrees very well with the geographical distribution given for *Bruchidius holosericeus* (Schoenherr) (=*Bruchus Steveni* Gyllenhal=*Bruchus canaliculatus* Mulsant and Rey), which is listed from southern France, Spain, Portugal, Calabria, Krain, Dalmatia, Greece, Turkey, southern Russia, Syria, and Persia. (Author's abstract.)

The first paper on the regular program, by Dr. H. H. Richardson, was entitled "The Mexican Mealybug, *Phenacoccus gossypii*, T. & Ckll., an important pest of greenhouse chrysanthemums." The Mexican mealybug, which was originally found in Mexico in 1898, was first reported from the United States in 1918, when it was found in California. It is now known to occur throughout most of the southern states and as far north as New York in the east and Nebraska and Michigan in the middle west. It is spread commercially chiefly in rooted cuttings from infested propagating houses. Dr. Richardson illustrated his talk with lantern slides showing pictures of the mealybugs and with charts indicating the comparative effectiveness of various sprays and fumigants tested in connection with the control of this and other species of the family.

This paper was discussed by Rohwer, Cory, Middleton, Bishopp, Graf and Bridwell.

The second communication was by Dr. E. A. Chapin and entitled "Spiracles in Scarabaeidae, with reference to taxonomy."

Since about 1840 the classification of the Scarabaeidae has been predicated upon the assumption that in the family there are two distinct types of spiracular arrangement. It was not until quite recently that attention of workers has been called to the fact that in reality there are not two but several distinct types. Certain facts have been overlooked and certain have been misinterpreted.

The usual number of spiracles in the abdomen of a scarabaeid is eight pairs, of which one pair (the last) may or may not be functional. The usual count has been given as six pairs, in which case the first pair has been erroneously assigned to the thorax and the last pair overlooked. The spiracles in the Glaphyrinae are not extraordinary.

The genus *Oncerus* Lec., type genus of the tribe or subtribe Oncerini, has been considered as pleurostict but upon examination proves to be definitely laparostict. Its other characters are all in accord with *Aclopus* Er. and there seems to be no reason for not associating the two genera. *Chnaunanthus* Burm. and *Chasmatopterus* Latr. are true Melolonthinae and have nothing to do with *Oncerus* Lec.

Because the pigmentation of the sclerites of the abdomen of *Pachypus* is incomplete, the spiracles in this genus appear to be the membranes. By staining in acid fuschsin, the limits of the membranes can be determined and it is evident that the spiracles are in the sclerotized portion. Further, the seventh spiracle is very large in comparison with the fifth, a condition that obtains in all Melolonthinae examined. It is therefore suggested that the Pachypodinae be dropped as a separate subfamily and the species be returned to the Melolonthinae to find a place near *Sparmannia* Cast. (Author's abstract.)

Cushman, Ewing, and Rohwer discussed this paper.

The final communication, "Remarks on the Scarabaeid Genus *Pleocoma*," was by Mr. A. C. Davis. The genus *Pleocoma*, which is restricted in distribution to western North America, is of no economic importance so far as known. The sexes are dimorphic, and during the mating season the males, which live but a short time in the adult stage, search out the females in their burrows in the ground. Oviposition apparently takes place at some depth underground. Very little is known of the life history, and very few larvae have ever been collected, but indications are that the life of the insect may extend over 3 to 5 years.

This paper was discussed by Chapin and Bridwell.

Meeting adjourned at 10 P. M.

P. W. OMAN,
Recording Secretary.

THE EUROPEAN TARSONEMID STRAWBERRY MITE IDENTICAL WITH THE AMERICAN CYCLAMEN MITE.

By H. E. Ewing, *Entomologist*, and Floyd F. Smith, *Entomologist*,
Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Strawberry plants in both Europe and North America have suffered in recent years from the attacks of tarsonemid mites. The species chiefly involved in North America is the so-called cyclamen mite, *Tarsonemus pallidus* Banks, which was described in 1899 (Ent. Soc. Wash. Proc. 4 : 295) from specimens taken from leaves of chrysanthemums. The European strawberry tarsonemid mite was described in 1905 by Zimmerman (Ztschr. mäkr. Landemus. Brunn 5 : 91–103) under the name of *Tarsonemus fragariae*. It was recognized at that time as a pest of strawberries. This European species has been regarded by specialists in the past as different from our American one. Even after comparisons were made between specimens sent from America and those occurring in England it was claimed that the tarsal setae of leg IV of the male of *pallidus* were much weaker than the corresponding setae in *fragariae*. Also it was held that the basal femoral seta of leg IV of the male was very different in the two species.

Recently the writers have received from England, through the courtesy of Mr. A. M. Massee, specimens of *Tarsonemus fragariae* Zimm., for comparison with those of our *Tarsonemus pallidus* Banks. A direct comparison between the two, character for character, has failed to reveal any significant differences. It has been noted, however, that there is an important individual variation in the size of the tarsal setae of leg IV of the male. Also, there is an individual variation of considerable proportions in the shape of the hyaline inner lobe of femur IV of the male. These individual variations, of which there are others not here mentioned, appear greater than they really are when specimens of the mites are observed in different positions under the microscope. Thus it is easily understood why *fragariae* could have been considered distinct from *pallidus*.

A further study of the specimens of these two supposedly distinct species also showed that they both fit very nicely the original description of *fragariae* by Zimmerman, but are somewhat different from copies of Zimmerman's figures which have not been reproduced accurately.

For many years *T. fragariae* in Europe was supposed to attack mainly the strawberry, although occasionally pelargonium and begonia were reported to have been injured. However, in recent years cyclamen has been reported as being attacked in Europe. The symptoms developing on plants that have been injured by *T. fragariae* in Europe are similar to those produced by *T. pallidus* when feeding on the same hosts in America and the habits of the mites in the two hemispheres are similar. The differences in the cultural practices of florists, nurserymen, and strawberry growers in Europe and America may account for the absence of this tarsonemid mite on certain crops in Europe that are damaged in America.

Because they failed successfully to establish mites from strawberry on cyclamen, entomologists concluded that the strawberry-attacking tarsonemid mites in Europe and in California belonged to the same species and that this species was distinct from *pallidus*. In the writers' experiments, cyclamen appears to be one of the favorite hosts of *T. pallidus* and mites persist on it satisfactorily after having once become established, although they are often established on it with great difficulty. The cyclamen mite is most successfully transferred to any of its hosts and thrives best under low greenhouse temperatures and at high humidities. The host plants should be in a growing condition and have tender young leaf or flower parts present among which the mites can seclude themselves, feed, and inaugurate the deformities, and within which they can persist, even under rather adverse conditions. Best results are obtained with cyclamen if the flower buds are present at the time of transfer. By making transfers under these favorable conditions the mites from strawberries in California, which Dr. L. M. Smith of the California Experiment Station sent to Washington, D. C., for experiment, were successfully established on cyclamens, delphiniums, *Saintpaulia*, and *Achyranthes*. Injury on each host was typical for *pallidus*. According to recent correspondence, Dr. L. M. Smith confirmed these results by making transfers to cyclamens under similar conditions. Previous to these transfers C. F. Doucette successfully established on cyclamen the mites occurring on strawberry in Washington State and his results were confirmed with mites that he recently sent to the writers.

Based on the present biological and morphological studies, it appears that those tarsonemid mites occurring on strawberries and other hosts in America and having *pallidus*-like characters are *T. pallidus*. A study of the morphological characters of *fragariae* from Europe and of *pallidus* from America has revealed no differences. Therefore, it appears that the name *pallidus* should be applied to the European form on strawberry and other hosts, the later name *fragariae* being a synonym of *pallidus*, as indicated below:

Tarsonemus pallidus Banks, 1899, Ent. Soc. Wash. Proc. 4 : 295. *Tarsonemus fragariae* Zimmerman, 1905, Ztschr. mäkr. Landemus. Brunn 5 : 91–103.

NOTE UPON INSECTS FOUND IN MUSHROOM HOUSES.

By A. C. Davis,

Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Of the following insects found in mushroom houses, some have not heretofore been recorded as pests of mushrooms, others are little known as such, while still others are predators upon the pests.

(MITES (ACARINA).

Pigmeophorus americanus Banks. Attacking spawn in cultures.

Eupodes (?). Extremely numerous in gills of mushrooms at Pomeroy, Pa.

SPRINGTAILS (COLLEMBOLA).

Proisotoma minuta Tull. Doing some damage to spawn, Arlington Farm, Va.

Proisotoma simplex Fols. Attacking spawn, Capitol Heights, Md.

Sinella höfti Schäf. Damaging mushrooms, Leeds, Mo.

Achorutes maturus Fols. Damaging mushrooms, Leeds, Mo.

Lepidocyrtus albicans Reut. West Chester, Pa., attacking spawn.

Lepidocyrtus cyaneus Tull. and var. *cinereus* Fols. West Chester, Pa., attacking spawn.

Lepidocyrtus lanuginosus (Gmel.). Attacking and damaging mushrooms and spawn, Barberton, Ohio. Present but not numerous at Avondale, Pa.

Xenylla humicola Tull. Kennett Square, Pa.

Xenylla welchi Fols. Attacking mushrooms at Redwood City, Calif.

BEETLES (COLEOPTERA).

Corticaria serrata (Payk.). Common on and about beds at Arlington Farm, Va. May feed upon spawn.

Acritus sp. Predacious upon springtails and mites (?), Arlington Farm, Va.

Atheta virginica Bernh. Extremely common in mushroom houses, Arlington Farm, Va., and throughout mushroom-growing district of Pennsylvania, Delaware, and New Jersey. Predacious, attacking larvae of the mushroom flies (*Sciara* sp.) in the beds.

Nephanes sp. Feeding in spawn, Kennett Square, Pa.

Ptilium sp. Reared from spawn from a house at West Chester, Pa.

MOTHS (LEPIDOPTERA).

Pyralis farinalis L. Several generations reared from compost from mushroom beds at Arlington Farm, Va. Numerous in the mushroom house.

"A GENERAL TEXTBOOK OF ENTOMOLOGY INCLUDING THE ANATOMY, PHYSIOLOGY DEVELOPMENT AND CLASSIFICATION OF INSECTS." By A. D. Imms, pp. I–XII and 1–727 with 624 text figures. Published by E. P. Dutton and Company, Inc., New York, price $10.80.

This is the third edition of Imms' well known "General Textbook" which has undergone important revision in the present issue. Considerable matter has been added in several orders, notably the Orthoptera, Ephemeroptera, Lepidoptera and Diptera. This volume is particularly valuable for its modern treatment of the anatomy and physiology of insects to which the first 233 pages are exclusively devoted. In the chapters following this section, which are arranged in ordinal sequence, much excellent information is included dealing with the anatomy and biology peculiar to the various orders and families. Rather copious bibliographies pertinent to the subjects are provided in convenient places throughout the volume, but in these the page references are generally omitted. The illustrative matter is plentiful, good and well chosen. Indices, both author's and subject, are provided and in the latter reference to illustrations is indicated by bold-face type.

The book is excellently printed, and should prove of real value in the library of any serious student of entomology. — W. R. WALTON.

REVIEW OF FOURTH EDITION (1934) OF FOLSOM'S "ENTOMOLOGY WITH REFERENCE TO ITS ECOLOGICAL ASPECTS."

"Entomology with Reference to its Ecological Aspects," by J. W. Folsom, 4th edition, revised by R. A. Wardle, 8 vo. cloth, 605 pp., 5 plates, 308 text figures. Philadelphia, P. Blakiston's Son & Co., Inc., 1934. $4.00.

Excellent criteria of the practical value of a standard textbook on entomology and of the growth of that science are indicated by necessity for revision of the subject-matter of the work at fairly frequent intervals. In the case of this book, it is of especial interest to compare the newly issued fourth edition of 1934 with the 1st edition of 1906, the 2d of 1913 and the 3d of 1922 in order that there may be noted the progress which has been made in entomology during that period. This volume is particularly appropriate for such purpose because of its wide scope and its honored history as a much used and highly valued tool in a large number of entomological workshops throughout the world.

In this latest edition no noteworthy changes have been made in the basic structure of the book, and all those features included in previous editions which have appealed to teacher and research worker have been retained. A considerable amount of additional matter has been interpolated, and several chapters have been entirely rewritten, notably those dealing with insects and disease and insects and man. The selection of new material has required thorough resumé of a large number of books and periodicals published in recent years, and this survey appears to have been very carefully made, particularly in insect ecology and related branches. As would be expected, the section on insect ecology (pp. 444–511) provides subject-matter of probably the most outstanding usefulness because of the succinctness and the general excellence of its resumés of such existence factors, as soil, atmosphere, water, temperature, light, pressure, metabolism, acclimatization, adaptation, biotic potential, environments, and communities. Only those who have had experience in assembling and compiling a vast array of material of this character can adequately appreciate the magnitude and the difficulties of such a task. It is believed that the new revision will be found to be reasonably up to date, due largely, according to the preface, to the labor and enthusiasm of the junior author. It is with a feeling of gratitude that the reviewer must acknowledge his personal indebtedness to the previous editions of this work for the reason that the information presented therein was in such compact and accessible form as to render it suitable not only for office correspondence and laboratory use but also was readily portable, this making it available even while in travel status. The new edition will be heartily welcomed, and it is believed that it will fully attain the great usefulness of its predecessors. — J. S. WADE.

Actual date of publication, February 18, 1935.

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